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TASK 5
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TABLE OF CONTENTS

Section		Page
	Executive Summary	i-xiii
1.0	Introduction	1-1
1.1	Task 5 - Objectives	1-2
1.2	Task 5 - Scope of Work	1-2
1.3	Task 5 - Report Structure and Organization	1-3
2.0	Description of Testing Units	2-1
2.1	Batch Scale Testing	2-1
2.1.1	"ARC" 1-Liter Agglomeration Vessel	2-2
2.1.2	"ARC" 1-Liter Agglomeration Vessel with Cover	2-2
2.1.3	Waring Blender	2-3
2.1.4	3-Liter Separatory Funnel	2-3
2.1.5	3-Liter Separatory Vessel with Screen	2-3
2.1.6	Denver D-12 Flotation Machine	2-4
2.1.7	Standard 8" Sieves	2-4
2.1.8	Ultrasonic Mixer	2-4
2.1.9	Pressure Filter	2-4
2.1.10	Grinding Equipment	2-4
2.1.11	Pelletizer	2-5
2.1.12	Extruder	2-5
2.1.13	Drying Oven	2-5
2.2	Bench Scale Diesel Continuous Testing (CPRU)	2-5
2.2.1	Coal Grinding and Slurry Holding Tank	2-6
2.2.2	Conditioning Vessel	2-7
2.2.3	High-Shear Mixers	2-7
2.2.4	Flotation Cell	2-7
2.2.5	Pyrite Separator	2-8
2.3	Bench Scale Heptane Continuous Testing Unit	2-8
2.3.1	Grinding and Coal Slurry Feed System	2-9
2.3.2	High-Shear Mixing System	2-10
2.3.3	Separation System	2-11
2.3.4	Tailings Handling System	2-11
2.4	20 kg/hr Continuous Low-Shear Operation	2-12
2.5	Integrated Agglomeration Testing Facility (IATF)	2-13
2.5.1	Coal Slurry Preparation	2-13

2.5.2 Microagglomeration or High-Shear Mixing 2-15
2.5.3 Microagglomerate Separation by Flotation 2-15
2.5.4 Macroagglomeration or Low-Shear Mixing 2-16
2.5.5 Dewatering and Tailings Handling 2-17

3.0 Experimental Procedures for Batch and Continuous Testing Process 3-1

3.1 Batch Scale Testing 3-1

3.1.1 Sample Preparation 3-1
3.1.2 Microagglomerates and Reject Samples 3-2
3.1.3 Agglomeration Procedures 3-3
3.1.4 Procedures used for Microaaglomerate Recovery 3-4

3.1.4.1 Flotation for Heavy and Light Agglomerants 3-4
3.1.4.2 Multiple Screens for Heavy Agglomerants 3-5
3.1.4.3 Single Screens for Heavy Agglomerants 3-6
3.1.4.4 Phase Separation for Light Agglomerants 3-7
3.1.4.5 Screening for Light Agglomerants 3-8

3.1.5 Pelletizing 3-8
3.1.6 Agglomerant Emulsification 3-9
3.1.7 Grinding Calibration 3-9

3.2 Bench Scale Diesel Continuous Testing (5 kg/hr) 3-10

3.2.1 System Operation 3-10
3.2.2 Operating Conditions and Sequence of Operation 3-11
3.2.3 Sampling 3-11

3.3 Heptane Bench Scale Experimental Procedure 3-13

3.3.1 Start-up Procedures 3-13
3.3.2 System Operation 3-15
3.3.3 Product and Tailings Sampling 3-16
3.3.4 Sample Preparation Procedure 3-16

3.4 Continuous Low-Shear Testing 3-17

3.4.1 Preparation 3-17
3.4.2 Binder Preparation 3-17
3.4.3 Test Procedure 3-18
3.4.4 Product Analysis 3-18

3.5 Integrated Agglomeration Test Facility (IATF) - Experimental Procedure 3-19

3.5.1 Pre-Test Activities 3-19
3.5.2 System Operation 3-19

3.5.2.1 Sample Locations 3-19
3.5.2.2 Sampling Program 3-20

4.0 Analytical Procedures 4-1

4.1 Size Analysis 4-1
4.2 Analysis of Feed Coals, Clean Coals and Reject 4-2
4.3 Analysis of Agglomerants 4-3

4.4 Determination of Bridging Liquid Content of Agglomerates and Rejects 4-3
4.5 Determination of Moisture Content of Agglomerates by Azeotropic Distillation 4-4
4.6 Determination of Heptane Content in Agglomerates and Tailing Streams 4-5

4.6.1 Agglomerates 4-5
4.6.2 Tailings 4-6

4.7 Physical Characterization Tests 4-8

4.7.1 Compressive Strength Test 4-8
4.7.2 Abrasion Resistance Test 4-9
4.7.3 Water Resistance Test 4-9
4.7.4 Weatherability Test 4-10

5.0 Criteria for Process Performance Evaluation 5-1

5.1 BTU Recovery or Coal Matter Recovery (CMR) 5-1
5.2 Pyritic Sulfur Rejection (PSR) 5-2
5.3 Total Sulfur Rejection (TSR) 5-2
5.4 Ash Rejection (AR) 5-2

6.0 Project Feedstocks Characterization 6-1

6.1 Coal Analysis 6-1
6.2 Grind Size Data 6-2
6.3 Washability Analysis 6-3

6.3.1 Illinois No. 6 6-9
6.3.2 Pittsburgh No. 8 6-10
6.3.3 Upper Freeport 6-10
6.3.4 Kentucky No. 9 6-10

6.4 Pyrite Characterization and Distribution by Petrographic Analysis 6-11

6.5 Agglomerant Characterization 6-13

7.0 Batch Scale Test Program 7-1

7.1	Summary of Test Plan	7-1
7.2	Selection of Agglomerants	7-3
7.3	Microagglomerate Recovery Methods	7-14
7.4	Single-Stage High-Shear Operation	7-23
7.4.1	Grinding Methods	7-23
7.4.2	Confirmatory Tests	7-24
7.4.3	Optimization Tests	7-27
7.4.3.1	Agglomerant Concentration and High-Shear Concentration	7-28
7.4.3.2	High-Shear Agitation and Residence Time	7-33
7.4.3.3	Flotation Solids Contents	7-36
7.4.3.4	Flotation Residence Time	7-38
7.4.3.5	Incremental Flotation	7-43
7.4.3.6	Screen Loading Effect	7-44
7.4.4	Other Process Parameters	7-45
7.4.4.1	Pyrite Depressants	7-45
7.4.4.2	Emulsification	7-49
7.4.4.3	Oxidation Effect	7-52
7.4.4.4	Storage Effect	7-55
7.4.4.5	pH Effect	7-56
7.4.5	Pyrite Distribution Analysis	7-58
7.4.6	Agglomeration using Precleaned Coals	7-62
7.5	Two-Stage High-Shear Testing	7-67
7.5.1	Product Regrinding	7-67
7.5.2	Tailings Reprocessing	7-69
7.6	Low-Shear Operation	7-71
7.7	Support Tests	7-74
7.7.1	Drying Tests for Heptane Agglomerates	7-74
7.7.2	Tests for Heptane Balance	7-75
7.7.3	Particle Size of Heptane Agglomerates	7-77
7.7.4	Alternative Size Enlargement Methods for Diesel High-Shear	7-78
7.7.5	Drying Tests of Diesel Agglomerates	7-79
7.7.6	Preliminary Handleability Tests	7-80
7.8	Comparison Tests with Other Laboratories	7-83
7.9	Light and Heavy Agglomerants - Summary	7-88
7.10	Conclusions of Batch Scale Testing	7-91
8.0	Bench Scale Diesel Continuous Testing (CPRU)	8-1
8.1	Summary of Test Plan	8-1
8.2	Coal Slurry Feed Characterization	8-2

8.2.1 Slurry Density 8-2
8.2.2 Particle Size Distribution 8-2
8.2.3 Size Degradation 8-3

8.3 Commissioning Tests 8-3

8.3.1 Feed Consistency 8-4
8.3.2 Steady State and Sampling Protocol 8-5
8.3.3 Mass Balance of CPRU-1 8-7

8.4 Confirmatory Tests 8-8

8.4.1 Upper Freeport Coal 8-8

8.4.1.1 Effect of Diesel Dosage Rate 8-12
8.4.1.2 Effect of Frother Concentration 8-13
8.4.1.3 Effect of Grind Size 8-14
8.4.1.4 Effect of Flotation Solids Concentration 8-15
8.4.1.5 Effect of High-Shear Configuration 8-16
8.4.1.6 Comparative Evaluation of High-Shear Configuration 8-19
8.4.1.7 Mass Balance Analysis 8-20

8.4.2 Kentucky No. 9 Coal 8-20

8.4.2.1 Effect of Diesel Dosage Rate 8-25
8.4.2.2 Effect of Frother Concentration 8-26
8.4.2.3 Effect of Grind Size 8-28
8.4.2.4 Effect of Residence Time 8-28
8.4.2.5 Mass Balance Analysis 8-29

8.4.3 Pittsburgh No. 8 Coal 8-30

8.4.3.1 Effect of Diesel Dosage 8-32
8.4.3.2 Effect of Frother 8-33
8.4.3.3 Effect of Grind Size 8-33
8.4.3.4 Mass Balance Analysis 8-34

8.5 Conclusions 8-35

9.0 Heptane Test Program 9-1

9.1 Summary of Test Plan 9-1
9.2 Grind Size Distributions 9-2
9.3 Commissioning Test 9-4

9.3.1 Operational Debugging 9-4
9.3.2 Performance Observations 9-6
9.3.3 Test Repeatability 9-8
9.3.4 Mass Balance Test Intervals 9-11
9.3.5 Heptane Content in Tailings Solids 9-13

9.4 Heptane Continuous Testing 9-14

9.4.1 Test Matrix 9-14
9.4.2 Results from Continuous Heptane Testing 9-17
9.4.3 Discussion of Heptane Continuous Testing 9-20

9.4.3.1 Process Performance vs Washability Data 9-20
9.4.3.2 Main Factor Effects 9-21

9.5 Conclusions 9-24

10.0 Continuous Low-Shear Testing Program 10-1

10.1 Summary of Test Plan 10-1
10.2 Feedstocks for Low-Shear Tests 10-2
10.3 Effect of Operating Variables 10-2

10.3.1 Effect of Binder Type 10-4
10.3.2 Effect of Binder Content 10-4
10.3.3 Effect of Coal Particle Size 10-5
10.3.4 Effect of Low-Shear Residence Time 10-6
10.3.5 Other Variables 10-6
10.3.6 Preliminary Comparison with Batch Low-Shear Data 10-7

10.4 Conclusion for Continuous Operation Low-Shear Tests 10-8

11.0 IATF Continuous Testing 11-1

11.1 Summary of Test Plan 11-1
11.2 IATF Test Results 11-5

11.2.1 Mass Balance Calculations 11-5
11.2.2 Process Performance 11-12

11.3 Conclusions 11-15

12.0 Quality Assurance/Quality Control (QA/QC) and Statistical Analysis of Data 12-1

12.1 Quality Assurance/Quality Control 12-1

12.1.1 Procedures 12-1
12.1.2 Analytical Quality 12-2
12.1.3 Experimental Repeatability 12-3

12.1.3.1 Pyrite Rejection by Calculation and Measurement 12-3
12.1.3.2 Test Repeatability 12-4

12.2 Statistical Analysis of Data 12-4

12.2.1 Method 12-5
12.2.2 Analysis of Batch Process 12-6
12.2.3 Analysis of Bench Scale Continuous Process with Diesel 12-9

13.0 Task 5 - Final Conclusions 13-1

LIST OF TABLES

Table		Page
1	Summary of Bench Scale Testing, Overall Performance of Precleaning and Agglomeration	ii
2	Summary of Bench Scale Testing, Performance of Agglomeration Process	iv
3	Heavy Oil Process Optimization	vii
4	Light Oil Process Optimization	vii
5	Summary of Bench Scale Diesel Continuous Testing	x
6	Performance of Three Project Coals, Bench Scale Heptane Continuous Testing	xi
2-1	Stream and Vessel Specifications for Heptane Process Schematic	2-8
3-1	General Operating Conditions of CPRU	3-12
3-2	Run 1, Sampling Program	3-25
3-3	Run 2, Sampling Program	3-26
3-4	Run 3, Sampling Program	3-27
5-1	Experimental Data Used for Calculation of Process Performance Indices	5-3
6-1	Analytical Data for Project Coals used in Subtask 5.1	6-1
6-2	Analytical Properties of Project Coals (Dry Basis)	6-2
6-3	Coal Grinding Data	6-3
6-4	Illinois No. 6	6-4
6-5	Pittsburgh No. 8	6-5
6-6	Upper Freeport	6-7
6-7	Kentucky No. 9 Washability Results	6-8
6-8	Detailed Characterization of Three Project Coals	6-12

6-9 Summary of Pyrite Distribution 6-12

6-10 Analysis of Agglomerants 6-13

7-1 Summary of Test Plan for Batch Scale Test Program 7-2

7-2 Test Conditions 7-4

7-3 Upper Freeport - 28 Mesh 7-6

7-4 Pittsburgh No. 8 - 28 Mesh 7-7

7-5 Illinois No. 6 - 28 Mesh 7-8

7-6 Upper Freeport - 200 Mesh 7-9

7-7 Pittsburgh No. 8 - 200 Mesh 7-10

7-8 Illinois No. 6 - 200 Mesh 7-11

7-9 ISR vs Agglomerant Concentration for: Upper Freeport Coal - Pittsburgh No. 8 Coal - Illinois No. 6 Coal 7-12

7-10 Process Performance for Different Agglomerants 7-13

7-11 Process Performance for Different Agglomerants 7-13

7-12 Comparison of Phase Separation and Screen Recovery 7-17

7-13 Waring Blender Results with and without Low-Shear 7-18

7-14 ARC Vessel Results with and without Low-Shear 7-18

7-15 Effect of Low-Shear with No Microagglomerate Recovery 7-19

7-16 Multiple Screen Test 7-21

7-17 Effect of Low-Shear on Maya-Diesel Agglomeration Tests 7-22

7-18 Effect of Agglomerate Recovery in Staged Addition Tests 7-23

7-19 Test Conditions 7-23

7-20 Dry vs Wet Grinding 7-24

7-21 Test Conditions 7-25

7-22 Characterization Tests - Illinois No. 6 7-25

7-23 Characterization Tests - Upper Freeport 7-25

7-24 Characterization Tests - Pittsburgh No. 8 7-26

7-25 Characterization Tests - Kentucky No. 9 7-26

7-26 Evaluation of High-Shear Agglomeration Testing Conditions 7-27

7-27 Effect of Agglomerant Addition and Solids Concentration - Illinois No. 6 7-28

7-28 Effect of Agglomerant Addition and Solids Concentration - Pittsburgh No. 8 7-29

7-29 Effect of Agglomerant Addition and Solids Concentration - Upper Freeport 7-30

7-30 Effect of Agglomerant Addition and Solids Concentration - Kentucky No. 9 7-31

7-31 High-Shear Operating Conditions 7-32

7-32 Effect of High-Shear Conditions - Pittsburgh No. 8 Coal 7-33

7-33 Effect of High-Shear Conditions - Upper Freeport Coal 7-34

7-34 Effect of High-Shear Conditions - Kentucky No. 9 Coal 7-35

7-35 Test Conditions 7-37

7-36 Influence of Solids Concentration on Flotation Performance 7-38

7-37 Effect of High-Shear Conditions - Illinois No. 6 7-39

7-38 Effect of High-Shear Conditions - Pittsburgh No. 8 7-40

7-39 Effect of High-Shear Conditions - Upper Freeport 7-41

7-40 Effect of High-Shear Conditions - Kentucky No. 9 7-42

7-41 Test Conditions 7-44

7-42 Screen Loading Tests 7-45

7-43 Test Conditions 7-46

7-44 Pyrite Depressant Tests with Pittsburgh No. 8 Coal 7-46

7-45 Pyrite Depressant Tests with Upper Freeport Coal 7-47

7-46 Pyrite Depressant Tests with Kentucky No. 9 Coal 7-48

7-47 Test Conditions 7-50

7-48 Effect of Emulsification - Upper Freeport 7-50

7-49 Effect of Emulsification - Pittsburgh No. 8 7-51

7-50 Effect of Emulsification - Kentucky No. 9 7-51

7-51 Test Conditions 7-53

7-52 Effect of Oxidation - Pittsburgh No. 8 Coal 7-53

7-53 Effect of Oxidation - Kentucky No. 9 Coal 7-54

7-54 Test Conditions 7-55

7-55 Effect of Slurry Storage Time 7-56

7-56 Test Conditions 7-57

7-57 Effect of Slurry pH 7-57

7-58 Pyrite Distribution and Association Pittsburgh No. 8 - 200 Mesh 7-59

7-59 Pyrite Distribution and Association Upper Freeport - 200 Mesh 7-60

7-60 Pyrite Distribution and Association - Kentucky No. 9 - 200 Mesh 7-61

7-61 Test Conditions 7-63

7-62 Properties of Raw and Precleaned Coal 7-63

7-63 Kentucky No. 9 Precleaning Test Results 7-64

7-64 Upper Freeport Precleaning Test Results 7-65

7-65 Pittsburgh No. 8 Precleaning Test Results 7-65

7-66 Test Conditions 7-67

7-67 Two-Stage Tests 7-68

7-68 Test Conditions 7-70

7-69 Effect of Tailings Reprocessing - Upper Freeport Coal 7-70

7-70 Test Conditions for Low-Shear Experiments 7-71

7-71 Low Shear Testing - Effect of Binder Addition on Agglomerate Size 7-72

7-72 Low-Shear Testing - Effect of Type of Binder on Agglomerate Size 7-73

7-73 Low-Shear Testing - Effect of Solids Concentration on Agglomerate Size 7-73

7-74 Low-Shear Testing - Effect of Surfactant on Agglomerate Size 7-74

7-75 Thermal Drying of Agglomerates - Heptane Base Case 7-75

7-76 Heptane Distribution in Various Streams 7-76

7-77 Test Conditions 7-77

7-78 Heptane Agglomerates Quality and Size Distribution - Pittsburgh No. 8 Coal 7-78

7-79 Test Conditions 7-78

7-80 Particle Size Distribution of Drum Pellets 7-79

7-81 Size Enlargement of Diesel High-Shear Products - Methods and Conditions 7-80

7-82 Selected Indices for Product Handleability Evaluation 7-81

7-83 Influence of Additives on Quality of Extrusion Products - Diesel Base Case - Alternative Methods for Size Enlargement 7-82

7-84 Selected Physical Properties of Heptane and Diesel Final Products 7-83

7-85 Test Conditions 7-84

7-86 Heptane Tests with Pittsburgh No. 8 Coal - Comparison of Arcanum and Alberta Research Council Results 7-85

7-87 Heptane Tests with Illinois No. 6 Coal - Comparison of Arcanum and Alberta Research Council Results 7-86

7-88 Heptane Test with Upper Freeport Coal - Comparison of Arcanum and Alberta Research Council Results 7-87

7-89 Comparison of Agglomeration Performances for Heavy Oil and Heptane Cases 7-88

7-90 Comparison of Agglomeration Performances for Diesel and Heptane Cases - New Project Coals 7-90

7-91 Comparison of Agglomeration Performances for Diesel and Heptane Cases with Precleaned Coals 7-91

7-92 Single-Stage High-Shear Operation Optimized Conditions 7-92

8-1 Determination of Size Distribution of Upper Freeport Coal Slurry Feed for CPRU-7 8-2

8-2 Evaluation of Size Degradation in Slurry Holding Tank 8-3

8-3 Upper Freeport Coal - Diesel Commissioning Test CPRU-1: Test Conditions 8-4

8-4 Upper Freeport Coal - CPRU-1 Feed Rates to Conditioning Vessel 8-5

8-5 Upper Freeport Coal - Steady State Analysis: CPRU-1 8-6

8-6 Upper Freeport Coal - Mass Balance of CPRU-1 8-7

8-7 Upper Freeport - CPRU Diesel Case Summary of Test Results 8-10

8-8 Upper Freeport Coal - Effect of Diesel Concentration 8-12

8-9 Upper Freeport Coal - Effect of Frother Concentration 8-14

8-10 Upper Freeport Coal - Effect of Grind Size 8-15

8-11 Upper Freeport Coal - Effect of Flotation Solids Concentration 8-16

8-12 Upper Freeport Coal - Effect of Residence Time - 5 kg/hr Bench Continuous Diesel Runs - 28 Mesh Tests 8-17

8-13 Upper Freeport Coal - Effect of Frother and Different Residence Time 8-18

8-14 Comparative Evaluation of High-Shear Configuration 8-19

8-15 Upper Freeport Coal - Mass Balance of CPRU-30 Set Point 2A 8-20

8-16 Kentucky No. 9 - CPRU Diesel Case Summary of Test Results (CPRU 13-29 Inclusive) 8-22

8-17 CPRU Test Runs with Kentucky No. 9 Coal - Effect of Diesel Concentration 8-25

8-18 CPRU Test Runs with Kentucky No. 9 Coal - Effect of Frother Concentration 8-27

8-19 CPRU Test Runs with Kentucky No. 9 Coal - Effect of Grind Size 8-28

8-20 CPRU Test Runs with Kentucky No. 9 Coal - Effect of Residence Time 8-29

8-21 Kentucky No. 9 Coal - Mass Balance of CPRU-28 Set Point 2A 8-30

8-22 Pittsburgh No. 8 Coal - CPRU Diesel Case Summary of Test Results (CPRU 26-27 Inclusive) 8-31

8-23 CPRU Test Runs with Pittsburgh No. 8 Coal - Effect of Diesel Concentration 8-32

8-24 CPRU Test Runs with Pittsburgh No. 8 Coal - Effect of Frother Concentration 8-33

8-25 CPRU Test Runs with Pittsburgh No. 8 Coal - Effect of Grind Size 8-34

8-26 Pittsburgh No. 8 Coal - Mass Balance of CPRU-26 Set Point 2A 8-34

8-27 Promising Operating Conditions and Results 8-35

9-1 Upper Freeport Grind Test - Particle Size Distribution by Laser Granulometry 9-2

9-2 Kentucky No. 9 Grind Test - Particle Size Distribution by Laser Granulometry 9-3

9-3 Pittsburgh No. 8 Grind Test - Particle Size Distribution by Laser Granulometry 9-3

9-4 Target Test Conditions for Heptane Commissioning Test 9-6

9-5 Summary of Heptane Commissioning Test Conditions Summary of Heptane Commissioning Test Results 9-7

9-6 Test Repeatability 9-10

9-7 Statistical Indicators of Repeatability 9-11

9-8 Detailed Mass Balances 9-12

9-9 Test Plan for Upper Freeport 9-15

9-10 Test Plan for Kentucky No. 9 9-15

9-11 Test Plan for Pittsburgh No. 9 9-15

9-12 Test Conditions for Upper Freeport 9-15

9-13 Test Conditions for Kentucky No. 9 9-17

9-14 Test Conditions for Pittsburgh No. 8 9-17

9-15 Performance Summary for Upper Freeport 9-19

9-16 Performance Summary for Kentucky No. 9 9-19

9-17 Performance Summary for Pittsburgh No. 8 9-19

10-1 Results of Continuous Low-Shear Tests 10-3

10-2 Continuous Low-Shear Test Results - Binder Type vs Agglomerate Size 10-4

10-3 Continuous Low-Shear Test Results - Binder Content vs Agglomerate Size 10-5

10-4 Continuous Low-Shear Test Results - Initial Coal Size vs Agglomerate Size 10-5

10-5 Continuous Low-Shear Test Results - Low-Shear Residence Time vs Agglomerate Size 10-6

10-6 Comparison of Batch and Continuous Low-Shear Test Results 10-7

11-1 Run 1 - Summary of Process Conditions 11-2

11-2 Run 2 - Summary of Process Conditions 11-3

11-3 Run 3 - Summary of Process Conditions 11-4

11-4 Error Estimations for Mass Balance Calculations 11-6

11-5 Calculated Material Balances Final Results After 7 Iterations 11-7

11-6 Calculated Material Balances Final Results After 6 Iterations 11-8

11-7 Calculated Material Balances Final Results After 6 Iterations 11-9

11-8 Calculated Material Balances Final Results After 7 Iterations 11-10

11-9 Calculated Material Balances Final Results After 7 Iterations 11-11

11-10 Performance Calculations 11-14

12-1 Pyritic Sulfur Rejections for Calculated vs Measured Pyritic Sulfur Contents 12-3

12-2 Repeatability of Test Results 12-4

12-3 Relative Density Values for Agglomerants 12-7

12-4 Coefficients in Regression Equations with Standardized Variables 12-8

12-5 Independent Variables in Descending Order of Influence on CMR 12-10

12-6 Independent Variables in Descending Order of Influence on TSR 12-11

12-7 Independent Variables in Descending Order of Influence on ISR 12-12

LIST OF FIGURES

Figure		Page
2-1	Agglomeration Vessel	2-18
2-2	Baffle Assembly for ARC 1-Liter Agglomeration Vessel	2-19
2-3	ARC 1-Liter Agglomeration Vessel for Heptane	2-20
2-4	3-Liter Modified Separatory Vessel with Retaining Screen	2-21
2-5	Denver Laboratory Flotation Machine	2-22
2-6	Continuous Pyrite Removal Unit, Process Flow Diagram	2-23
2-7	Coal Slurry Preparation System for Continuous Oil Agglomeration Unit	2-24
2-8	Heptane Process Schematic	2-25
2-9	Continuous Low-Shear Test Apparatus	2-26
2-10	Integrated Agglomeration Test Facility, 1/4 TPH	2-27
4-1	Soxhlet Extractor	4-11
4-2	Apparatus for Azeotropic Distillation of Water	4-12
4-3	Strength of the Bed of Agglomerates as a Function of Contraction	4-13
4-4	Apparatus for Mass Strength Determination	4-13
7-1	Illinois ISR for Different Agglomerants and Agglomerant Concentrations, 28 Mesh	7-94
7-2	Illinois ISR for Different Agglomerants and Agglomerant Concentrations, 200 Mesh	7-94
7-3	Pittsburgh ISR for Different Agglomerants and Agglomerant Concentrations, 28 Mesh	7-95
7-4	Pittsburgh ISR for Different Agglomerants and Agglomerant Concentrations, 200 Mesh	7-95
7-5	Upper Freeport ISR for Different Agglomerants and Agglomerant Concentrations, 28 Mesh	7-96

7-6 Upper Freeport ISR for Different Agglomerants and Agglomerant Concentrations, 200 Mesh 7-96

7-7 Microagglomerate Recovery by Screening and Phase Separation (Light Oil) 7-97

7-8 Microagglomerate Recovery by Screening and Flotation (Heavy Oil) 7-98

7-9 Incremental Flotation Illinois No. 6 7-99

7-10 Incremental Flotation Upper Freeport 7-100

7-11 Incremental Flotation Pittsburgh No. 8 7-101

7-12 Incremental Flotation Confirmatory Tests with New Project Coals 7-102

7-13 Incremental Flotation Kentucky No. 9 7-103

7-14 Tailings Reprocessing Schemes 7-104

7-15 Low Shear Testing - Effect of Binder Addition on Agglomerate Size 7-105

7-16 Low Shear Testing - Effect of Type of Binder on Agglomerate Size 7-106

7-17 Low Shear Testing - Effect of Solids Concentration on Agglomerate Size 7-107

7-18 Low Shear Testing - Effect of Surfactant on Agglomerate Size 7-108

7-19 Heptane Balance - Pittsburgh No. 8 7-109

7-20 Product Size Distribution - Heptane Process 7-110

7-21 Thermal Drying at 40°C - Diesel Product 7-111

8-1 Size Distribution Curve of Upper Freeport Feed Coal Slurry 8-38

8-2 Steady State Analysis for Second Stage Flotation Solids Streams 8-39

8-3 Steady State Analysis for Second Stage Flotation Ash Streams 8-40

8-4 Steady State Analysis for Second Stage Flotation Sulfur Streams 8-41

8-5 Mass Balance of CPRU 8-42

8-6 CPRU Test Runs with Upper Freeport Coal 8-43

8-7 CPRU Test Runs with Upper Freeport Coal 8-44

8-8 CPRU Test Runs with Upper Freeport Coal (Effect of Grind Size) 8-45

8-9 CPRU Test Runs with Upper Freeport Coal (Effect of Flotation Solids Concentration) 8-46

8-10 CPRU Test Runs with Upper Freeport Coal (Effect of Residence Time) 8-47

8-11 CPRU Test Runs with Upper Freeport Coal (Effect of Frother and Different Residence Time) 8-48

8-12 CPRU Test Runs with Kentucky No. 9 Coal 8-49

8-13 CPRU Test Runs with Kentucky No. 9 Coal 8-50

8-14 CPRU Test Runs with Kentucky No. 9 Coal 8-51

8-15 CPRU Test Runs wtih Kentucky No. 9 Coal 8-52

8-16 CPRU Test Runs with Pittsburgh No. 8 Coal 8-53

8-17 CPRU Test Runs with Pittsburgh No. 8 Coal 8-54

8-18 CPRU Test Runs with Pittsburgh No. 8 Coal (Effect of Grind Size) 8-55

9-1 Size Distribution - Upper Freeport 9-26

9-2 Size Distribution - Kentucky No. 9 9-26

9-3 Size Distribution - Pittsburgh No. 8 9-26

9-4 CMR and PSR vs Heptane Concentration 9-27

9-5 CMR and AR vs Heptane Concentration 9-28

9-6 % Combustible Matter Recovery vs Pyritic Sulphur Rejection for Upper Freeport Coal 9-29

9-7 % Combustible Matter Recovery vs % Ash Rejection for Upper Freeport Coal 9-29

9-8 % Combustible Matter Recovery vs Pyritic Sulphur Rejection for West Kentucky No. 9 9-30

9-9 % Combustible Matter Recovery vs % Ash Rejection for West Kentucky No. 9 Coal 9-30

9-10 % Combustible Matter Recovery vs Pyritic Sulfur Rejection for Pittsburgh No. 8 Coal 9-31

9-11 % Combustible Matter Recovery vs Pyritic Sulphur Rejection for Pittsburgh No. 8 Coal 9-31

9-12 % Combustible Matter Recovery vs % Heptane Concentration in the High Shear Mixer for Upper Freeport Coal 9-32

9-13 % Pyritic Sulphur Rejection vs % Heptane Concentration in the High Shear Mixer for Upper Freeport Coal 9-32

9-14 % Ash Rejection vs % Heptane Concentration in the High Shear Mixer for Upper Freeport Coal 9-33

9-15 % Combustible Matter Recovery vs % Solids in the High Shear Mixer for Upper Freeport Coal 9-33

9-16 % Pyritic Sulphur Rejection vs % Solids in the High Shear Mixer for Upper Freeport Coal 9-34

9-17 Ash Rejection vs % Solids in the High Shear Mixer for Upper Freeport Coal 9-34

9-18 Combustible Matter Recovery vs Sieve Bend Water Loading Rate for Upper Freeport Coal 9-35

9-19 % Pyritic Sulphur Rejection vs Sieve Bend Water Loading Rate for Upper Freeport Coal 9-35

9-20 % Ash Rejection vs Sieve Bend Water Loading for Upper Freeport Coal 9-36

9-21 % Combustible Matter Recovery vs % Heptane Concentration in the High Shear Mixer for West Kentucky No. 9 Coal 9-36

9-22 % Pyritic Sulphur Rejection vs % Heptane Concentration in the High Shear Mixer for West Kentucky No. 9 Coal 9-37

9-23 % Ash Rejection vs % Heptane Concentration in the High Shear Mixer for West Kentucky No. 9 9-37

9-24 % Combustible Matter Recovery vs % Solids in the High Shear Mixer for West Kentucky No. 9 Coal 9-38

9-25 % Pyritic Sulphur Rejection vs % Solids in the High Shear Mixer for West Kentucky No. 9 Coal 9-38

9-26 % Ash Rejection vs % Solids in the High Shear Mixer for West Kentucky No. 9 Coal 9-39

9-27 Combustible Matter Recovery vs Sieve Bend Water Loading Rate for West Kentucky No. 9 Coal 9-39

9-28 % Pyritic Sulphur Rejection vs Sieve Bend Water Loading Rate for West Kentucky No. 9 Coal 9-40

9-29 % Ash Rejection vs Sieve Bend Water Loading Rate for West Kentucky No. 9 Coal 9-40

9-30 % Combustible Matter Recovery vs % Heptane Concentration in the High Shear Mixer for Pittsburgh No. 8 Coal 9-41

9-31 % Pyritic Sulphur Rejection vs % Heptane Concentration in the High Shear Mixer for Pittsburgh No. 8 Coal 9-41

9-32 % Ash Rejection vs % Heptane Concentration in the High Shear Mixer for Pittsburgh No. 8 Coal 9-42

9-33 % Combustible Matter Recovery vs % Solids in the High Shear Mixer for Pittsburgh No. 8 Coal 9-42

9-34 % Pyritic Sulphur Rejection vs % Solids in the High Shear Mixer for Pittsburgh No. 8 Coal 9-43

9-35 Ash Rejection vs % Solids in the High Shear Mixer for Pittsburgh No. 8 Coal 9-43

9-36 Combustible Matter Recovery vs Sieve Bend Water Loading Rate for Pittsburgh No. 8 9-44

9-37 % Pyritic Sulphur Rejection vs Sieve Bend Water Loading Rate for Pittsburgh No. 8 9-44

9-38 % Ash Rejection vs Sieve Bend Water Loading for Pittsburgh No. 8 Coal 9-45

10-1 Effect of Binder Type on Agglomerate Size (30 Minute Low-Shear Residence Time) 10-10

10-2 Effect of Binder Type on Agglomerate Size (1:1 Binder Blends, 30 Minute Low-Shear Residence Time) 10-11

10-3 Effect of Initial Coal Size on Agglomerate Size (CLB 1:1, 10% Addition) 10-12

10-4 Effect of Low-Shear Residence Time on Agglomerate Size (Cold Lake Bitumen 1:1) 10-13

10-5 Effect of Low-Shear Mixer Power Input on Agglomerate Size (12% CLB 3:1, 100 Mesh Coal) 10-14

10-6 Comparison of Agglomerate Size Produced from Batch and Continuous Low-Shear Operation (1:1 Binder Blends, 28 Mesh Coal) 10-15

11-1 Nodal Diagram for Mass Balance Analysis of IATF Experiments 11-16

EXECUTIVE SUMMARY

This report summarizes the results of batch and continuous process testings in Task 5 of DOE contract DE-AC22-89PC88879, "Engineering Development of Selective Agglomeration". The work was performed by the Alberta Research Council in Devon, Alberta, Canada, from September, 1989 to July, 1991.

The prime objective of Task 5 was to demonstrate the capability of selective agglomeration to produce a clean coal with maximum pyritic sulfur rejection and BTU recovery, for the utility markets. Both heavy agglomerant and light hydrocarbon were studied for the development of a generic agglomeration process most suitable for engineering development. Diesel was selected as the heavy agglomerant based on selectivity and availability; heptane was used as the light hydrocarbon because of its superior physical properties in contrast to pentane and hexane. The three project coals used in this program were Pittsburgh No. 8 (Belmont County, Ohio), Upper Freeport (Jefferson County, Pennsylvania), and Kentucky No. 9 (Webster County, Kentucky). The Pittsburgh coal was precleaned coal whereas the other two feedstocks were run-of-mine.

Over 1000 batch experiments were performed in order to critically evaluate the agglomeration process for both heavy and light agglomerants. Continuous tests were conducted to verify the batch data. Comparisons of batch and continuous processing data are summarized in the Process recommendation report in Task 7. The existing bench scale diesel continuous unit, referred to as CPRU (Continuous Pyrite Removal Unit) was modified to include wet grinding capability, and a new bench scale heptane continuous unit was designed, constructed, and operated. In addition, the ARC's 1/4 TPH IATF (Integrated Agglomeration Testing Facility) was utilized to establish sampling methodology and mass balance for large scale operation. Confirmatory tests were performed in the Wilsonville laboratory and by Arcanum Corporation. QA/QC guidelines were followed and statistical analysis was used as an aid for data evaluation.

Supporting experiments were carried out to generate data which were essential for engineering assessment. During the evaluation of low-shear operation, pelletization was proposed by the Alberta Research Council as an alternative method for fine coal reconstitution. Pellets of up to 6 mm diameter with good handleability were successfully produced in the laboratory at 2% binder.

This was verified by vendor testing on a large scale operation. The combination of high-shear agglomeration for pyrite removal and pelletization for size reconstitution was subsequently ranked as the first option for engineering development.

Precleaning of raw coals followed by selective agglomeration was found to offer the best chance for commercialization in the near term. The overall process performance data obtained on precleaned Upper Freeport, Pittsburgh No. 8 and Kentucky No. 9 coals, using diesel and heptane are presented in Table 1. This table also shows the qualities of the agglomerated products, the precleaned coals, and the raw coals before precleaning. For both the Upper Freeport and Kentucky No. 9 coals, pyritic sulfur rejection of 80% was achieved at a BTU recovery of 90%. The pyritic sulfur rejection was lower for Pittsburgh No. 8 coal (about 70%) at the same BTU recovery level. While the ash content for the Upper Freeport coal was 8%, the ash contents for Pittsburgh 8 and Kentucky No. 9 are in the range of 5% to 6%.

Table 1

SUMMARY OF BENCH SCALE TESTING
Overall Performance of Precleaning and Agglomeration*

		Upper Freeport	Pittsburgh No. 8	Kentucky No. 9
ROM coal	Ash %	16.2	24.3	21.7
	TS%	2.28	4.95	4.59
	PS%	1.65	3.04	3.29
Precleaned coal	Ash %	11.8	11.3	9.5
	TS%	1.38	4.21	2.93
	PS%	0.79	2.19	1.26
	BTU Recovery %	96.2	96.9	92.3
	PSR %	54.7	40.9	65.0
Agglomeration Clean Coal	28 Mesh (Diesel)			
	Ash %	8.3	5.7	6.5
	TS %	0.98	3.55	2.64
	PS %	0.43	1.23	0.98

Table 1 (Continued)

SUMMARY OF BENCH SCALE TESTING
Overall Performance of Precleaning and Agglomeration*

		Upper Freeport	Pittsburgh No. 8	Kentucky No. 9
	100 Mesh (Diesel)			
	Ash %	7.9	5.8	6.1
	TS %	0.94	3.46	2.59
	PS %	0.39	1.14	0.92
	200 Mesh (Heptane)			
	Ash %	8.2	5.0	6.1
	TS %	0.92	3.30	2.72
	PS %	0.37	1.17	1.05
Overall Performance	28 Mesh (Diesel)			
	BTU %	89.2	88.7	88.1
	PSR %	77.9	67.2	78.7
	100 Mesh (Diesel)			
	BTU %	91.3	93.7	88.4
	PSR%	79.7	67.8	79.9
	200 Mesh (Heptane)			
	BTU %	92.9	90.3	90.8
	PSR %	80.4	71.2	76.6

*All values presented on dry basis.

To illustrate the effectiveness of agglomeration process, the performance data for Upper Freeport and Kentucky No. 9 raw coals, along with the Pittsburgh No. 8 precleaned coal, is summarized in Table 2. These results show that for Upper Freeport coal, a BTU recovery greater than 90% is achieved at a pyritic sulfur rejection of 70%, for both the diesel and heptane processes. About 90% of BTU recovery is also achieved for Kentucky No. 9 coal, with 65% pyritic sulfur rejection for the diesel case but 45% pyritic sulfur rejection for the heptane option. For Pittsburgh No. 8 coal, pyritic sulfur rejection is at the level of 45-51%, at a BTU recovery range between 91 to 96%. As expected, this precleaned coal was more difficult to clean than the other two raw coals. The ash contents of the agglomeration products are slightly higher than those obtained by using both precleaning and agglomeration.

Table 2

SUMMARY OF BENCH SCALE TESTING
Performance of Agglomeration Process*

		Upper Freeport	Pittsburgh No. 8	Kentucky No. 9
Feed Coal	Ash %	16.2	11.3	21.7
	TS %	2.28	4.21	4.59
	PS %	1.65	2.19	3.29
Agglomeration Product	28 Mesh (Diesel)			
	Ash %	8.7	5.7	7.6
	TS %	1.16	3.55	2.87
	PS %	0.58	1.23	1.47
	100 Mesh (Diesel)			
	Ash %	8.6	5.8	7.4
	TS %	1.25	3.46	2.93
	PS %	0.66	1.14	1.53
	200 Mesh (Heptane)			
	Ash %	8.9	5.0	13.0
	TS %	1.15	3.30	3.47
	PS %	0.56	1.17	2.15
Agglomeration Performance	28 Mesh (Diesel)			
	BTU %	90.6	91.4	92.1
	PSR %	71.1	44.5	65.5
	100 Mesh (Diesel)			
	BTU %	94.1	96.6	91.5
	PSR %	65.9	45.5	64.4
	200 Mesh (Heptane)			
	BTU %	94.3	93.1	94.4
	PSR %	70.6	51.3	45.0

*All values presented on dry basis

The performances of the diesel and heptane agglomeration processes are highly comparable. The grind sizes for the diesel process, between 28 and 100 mesh, show minimal effect on process performance. A 200 mesh grind, however, is necessary for the heptane process to achieve the same level of performance as the diesel process using coarser grinds. The operating conditions for the diesel process and the heptane process are also quite different. The diesel process operates at 1% agglomerant and 20% solids contents in the high-shear; the heptane process shows a comparable performance at 20% agglomerant and 5% solids contents in the high-shear.

Work performed in the various testing units at the Alberta Research Council is described in the following sections.

BATCH SCALE TESTING

Bench scale testing in Task 5 was performed to investigate the effect of process parameters/configurations, and methods for enhancing process performance or product handleability. The most important findings are as follows:

- Agglomeration of precleaned coals gives the best overall performance
- Performance of diesel and heptane processes are comparable but operating conditions are different
- Pelletization produces handleable products at low binder contents

The development of the batch scale programs for agglomerant selection, microagglomerate recovery, high-shear optimization, effect of secondary variables, two-stage high-shear operations, and product characterization are described below.

Five potential agglomerants were evaluated in the batch program: diesel, diesel/Maya crude mixture, Maya crude, diesel/Fuel Oil No. 6 mixture, and hexane. Coal samples used in this series were referred to as old project coals which were later replaced in the main test program. During this study, it was found that hexane was evaporated during the high-shear step and in the microagglomerate recovery step using flotation. As a result, new experimental procedures were subsequently developed to handle light hydrocarbon. Based on the pyritic sulfur rejection and BTU recovery as the main performance criteria, diesel and diesel/Maya crude mixture provided better results than Maya crude and diesel/Fuel Oil No. 6 mixture. As the availability of Maya crude was questionable, diesel was selected as the "heavy" agglomerant for the remaining test program. In order to evaluate the light hydrocarbon option, heptane was used after an assessment of the properties of three light hydrocarbons: pentane, hexane and heptane.

Three methods for microagglomerate recovery were critically evaluated for the agglomeration processes based on diesel and heptane. Screening and flotation were examined for diesel

agglomeration, and screening as well as phase separation were evaluated for the agglomeration process using heptane. The study of various microagglomerate separation methods necessitated the use of a wide range of operating conditions. In the heavy agglomerant case, it was found that high concentrations of agglomerant were required for successful recovery of microagglomerates by screening, but the selectivity suffered from large dosages of agglomerants. Process selectivity was improved at low concentrations of agglomerants, with satisfactory BTU recovery, using flotation as the microagglomerate recovery method. Test results also showed that pyrite rejection was poor when there was no separation step prior to low-shear processing, and low-shear processing had little effect on the quality of the final product. In the light agglomerant case, screening consistently yielded better process performance than phase separation.

The parallel development of the diesel and heptane processes required an optimization of the high-shear operations. An extensive study was performed and a number of variables were critically evaluated. The variables tested, the conditions used, and the levels selected for the process parameters are summarized in Table 3 and Table 4 for the diesel process and the heptane process, respectively. In essence, the diesel process required low agglomerant concentration, coarser grinds, and could be operated at high solids loading. In contrast, the heptane process demanded high agglomerant concentration, fine grind, and low solids content. Confirmatory tests carried out in the Wilsonville laboratory and by Arcanum Corporation showed consistent behaviours in the heptane process.

Table 3

HEAVY OIL PROCESS OPTIMIZATION

Variables Tested	Conditions Tested	Selected Levels
Agglomerating Liquid	Diesel, Maya, M/D, FO/D	Diesel
Agglomerant Dosage	0.5, 3, 6, 10%	1%
Particle Size	28M, 100M, 200M	28M/100M
High-shear Solids	5, 10, 20%	20%
HS Residence Time	0.5, 1, 2, 4 minutes	1 minute
HS Mixing Intensity	1600, 2000, 2400 rpm	1600/2000 rpm
Microagglomerate Recovery	Screening, Flotation	Flotation
Flotation Solids	1.5, 3, 6%	6%
Flotation Stages	1-stage and 2-stages	2-stage

M/D - Maya/Diesel mixture
FO/D - Fuel Oil No. 6/Diesel mixture

Table 4

LIGHT OIL PROCESS OPTIMIZATION

Variables Tested	Conditions Tested	Selected Levels
Agglomerating Liquid	Hexane and Heptane	Heptane
Agglomerant Dosage	10, 20, 30, 50, 100, 150%	10 - 30%
Particle Size	28M, 100M, 200M	200M
High-shear Solids	5, 10, 20%	5%
HS Residence Time	0.5, 1, 2, 4 minutes	1 minute
HS Mixing Intensity	1600, 2000, 2400 rpm	1600/2000 rpm
Microagglomerate Recovery	Screening, Flotation	Screening

A number of secondary variables was also investigated to enhance the process performance. These included the application of pyrite depressants, the use of emulsified agglomerants in the high-shear operation, and the use of elevated pH in both the high-shear and in flotation steps. Both depressants tested, namely oxone and potassium ferrocyanide showed some improvement in pyrite rejection when they were added into the grinding step of the agglomeration process. The improvement was definitely not observed for the majority of the tests. Overall, the depressants used did not show any significant improvement. There was no improvement in process performance by using emulsified agglomerants, although some potential in the reduction of mixing intensity for a longer residence time was noticed. When the high-shear operation was conducted at pH 11, different responses were observed for the project coals. Some improvement was observed for the Upper Freeport coal, while there was no change in process performance for Kentucky No. 9 and lower BTU recovery was observed for Pittsburgh No. 8. A substantial loss of BTU, however, was observed for all the project coals when the pH was raised to 11 in the flotation cell.

Two-stage processing schemes were also investigated in the Task 5 batch scale test program. These included product regrinding for all project coals and reprocessing of tailings for Upper Freeport coal. In the investigation of product regrinding, the agglomerates produced from the 28 mesh grind were ground to a finer size and reagglomerated using small amounts of agglomerant. For this scheme, an increase in pyrite rejection was accompanied by a decrease in BTU recovery. Reprocessing the tailings of Upper Freeport coal, which was slightly oxidized, increased the BTU recovery but decreased pyrite rejection. The results of these two options of two-stage processing were not considered significant to warrant further study for other project coals.

Various supporting tests were performed during Task 5 program to generate data for engineering and environmental assessments. For the light agglomerant process, the distribution of heptane into the product streams from high- and low-shear operations was quantified. Dried agglomerates (100°C for 60 min) contained about 0.2% of heptane. Up to 1% of the heptane input to the high-shear mixer was found in the tailings stream (0.9% and 0.1% solid and liquid phases, respectively). Additional amounts of heptane were detected in the low-shear tailings. The solid phase contained 0.8% of the initial heptane input, whereas 0.1% was determined in the

water phase. The size analyses of the heptane agglomerates after drying indicated that roughly 30% of the product was below 28 mesh.

Preliminary evaluation of product handleability was also initiated at the Alberta Research Council to provide a first-level assessment, using small quantities of samples. Selected samples were evaluated for Abrasion Resistance Index (ARI), Strength Index (SI), Water Resistance Index (WRI), and Weatherability Index (WI). These tests are recommended for further testing using large quantity of samples.

BENCH SCALE DIESEL CONTINUOUS TESTING

ARC's Continuous Pyrite Removal Unit (CPRU) was modified according to the requirements of this research contract. Two high-shear vessels were installed to allow the investigation of various residence times in the high-shear operation. Microagglomerates were first recovered by a flotation cell followed by a hydraulic separator, which was used as a substitute for a second stage flotation cell. Sampling procedures were developed and the time required to reach steady state operation was determined. Mass balances of about 96-100% for coal, ash and sulfur were achieved for all the three project coals.

The results of the bench scale diesel testing showed that an increase in diesel concentration improved BTU recovery but decreased pyrite rejection, in the absence of frother or at lower frother concentrations. At higher frother concentrations, the effect of diesel concentration was masked by the effect of frother which increased BTU recovery and reduced process selectivity. Similarly, the effect of frother at higher diesel concentrations was affected by the presence of large dosages of the brighing liquid. The effect of solids contents in the flotation cell also showed that higher solids concentration gave better BTU recovery however pyrite rejection was deteriorated. This observation became unclear as the frother concentration was increased. In general, it was observed that shorter residence times in high-shear gave better process selectivity at the expense of BTU recovery, but a definative conclusion could not be made due to the complex interactions between many variables in the continuous system.

Only new project coals were studied in the bench scale diesel continuous tests. The performances of these coals at 1% diesel, in the absence of frother (except for the Upper Freeport coal) are summarized in Table 5. Data presented for Pittsburgh No. 8 coal is on a clean coal basis as this was a precleaned coal.

Table 5

SUMMARY OF BENCH SCALE DIESEL CONTINUOUS TESTING

			Product Quality		Process Performance	
Coal	Grind Size	Frother	Ash %	TS%	BTU %	PSR%
Upper Freeport	28 mesh	0.01%	8.4-9.1	1.28-1.46	85-90	69-77
	100 mesh	0.005%	9.5	1.34	92	56
Pittsburgh No. 8	28 mesh	----	6.3	3.48	94	31
	100 mesh	----	6.3	3.39	90	47
Kentucky No. 9	28 mesh	----	8.2	2.98	81	66
	100 mesh	----	8.2	3.06	92	64

BENCH SCALE HEPTANE CONTINUOUS TESTING

A new bench scale heptane continuous testing unit was designed, built and operated at the Alberta Research Council. All the equipment and wirings were explosion proof rated. The unit was located inside an isolated test cell equipped with detectors for hydrocarbons. The unit consisted of a high shear mixing system, a vibrating sieve bend for microagglomerate recovery, and a tailings handling system which permitted tailings disposal in compliance with regulations for hazardous material. A separate sample preparation room was also specially equipped with a high rate exhaust system and activated carbon filter. Safety operating procedures were also developed. The heptane unit was operated for 8-10 hour periods without noticeable levels of heptane emission.

Results of the heptane continuous testing showed that all the controlling components were functioning properly, resulting in good correlation between actual conditions and set points. These included the coal feed rates, heptane concentrations, solids contents and residence time in the high-shear vessel. Good repeatability in mass flow and product qualities were also

demonstrated for tests conducted under the same operating conditions. Mass balance data gathered from three short test periods were satisfactory except for the lower balance of sulfur and combustible materials, which required further calculations from mass flows and analytical data.

Continuous testing of Upper Freeport, Pittsburgh No. 8 and Kentucky No. 9 project coals showed that high heptane concentrations increased BTU recovery but reduced pyrite rejection. Heptane concentrations in the range of 10-30% appeared to give the best combination of BTU recovery and pyrite rejection. Solids content in the high-shear exhibited similar effects on process performance. However, due to the interaction of solids contents and residence times in the high-shear, it was not possible to evaluate these two parameters independently based on the experimental data. Solids contents in the range of 5-10% with a corresponding retention time of 1-2 minutes, appeared to be the best conditions found in the testing program. It was not possible to arrive at a definite conclusion on the effect of the sieve bend water loading; it was speculated that there was a combined effect of retention time on the sieve bend and the velocity of the microagglomerates when passing through this separation device.

Despite the fact that there were intrinsic differences in the batch and continuous operations, and the variations in processing conditions, the results obtained from the continuous heptane testing unit were in agreement with those observed in the batch operation. The performances of the three project coals from these limited tests are summarized in Table 6.

Table 6

PERFORMANCE OF THREE PROJECT COALS
Bench Scale Heptane Continuous Testing

	Product Quality		Process Performance	
Coal	Ash %	TS %	BTU %	PSR%
Upper Freeport	8.5-9.3	1.18-1.33	93-96	59-67
Pittsburgh No. 8	6.5	3.2	84	52
Kentucky No. 9	7.5-8.4	2.93-3.07	88-89	55-61

new sampling equipment, establish a procedure to minimize sampling for large scale operation, and determine the operating time required for achieving steady state of the system. Test results were analyzed by a computerized minimum variance balance program (MATBAL II).

The results of these limited runs demonstrated a high level of process repeatability. New sampling equipment performed satisfactory, and the procedure of composite sampling was acceptable for the evaluation of component and plant performance. Steady state conditions in all process streams was achieved after operating for a period of three hours. Good mass balances were obtained for all of the test runs.

While these tests were not conducted to optimize process performance, general trends of the effect of variables on process responses were revealed. The effects of the key parameters were consistent with those observed in batch scale testing. The IATF data indicated that pyrite rejection was increased at lower diesel addition rates, and BTU recovery was influenced by frother addition. Agglomerates with a d_{50} of 800 um were produced from a feedstock with a d_{50} of 128 um at a binder dosage of 8%.

1.0 INTRODUCTION

This report describes the work performed and summarizes the results obtained under Task 5, "Bench and Continuous Process Testing", in DOE Contract DE-AC22-89PC88879, "Engineering Development of Selective Agglomeration". The work in Task 5 was carried out at the Alberta Research with constant interactions with all project participants. The results of this task provide the majority of data for both technical assessment and economic evaluation of the selective agglomeration processes.

Task 5 was a systematic experimental program for development of generic selective agglomeration technologies, based on both heavy agglomerant and light hydrocarbon. The framework of the process development program was first outlined in Task 2, "Design of a 20 TPH Semi-works Plant", and from this design all the process uncertainties and deficiencies were critically defined in Task 3, "Determination of Critical Areas". A comprehensive test plan to address and resolve all of these critical areas was developed in Task 4, "Test Plan Formulation and Coal Procurement". The Task 5 test plan was designed to be evolutionary, systematic, and covered both batch and continuous operations.

The work in Task 5 was carried out parallel with Task 6, "Component Development in Selective Agglomeration". These two tasks had different objectives: Task 5 placed emphasis on process performance (i.e. high-shear operation) while Task 6 concentrated on product dewatering (low-shear operation). With the process performance data generated in Task 5 and product dewatering characteristics defined in Task 6, a sound basis could be established for the proper design of the proof-of-concept (POC) module for the engineering development of selective agglomeration. Task 7, the final task of Phase 1 of this project, summarized all data gathered from Task 5 and Task 6 for a recommendation of process for further development in Phase 2 of this DOE contract.

1.1 Task 5 - Objectives

Under the overall objectives of DOE Contract "Engineering Development of Selective Agglomeration", there were a number of specific objectives in the Task 5 program. The prime objectives of Task 5 are highlighted below:

- Maximize process performance in pyritic sulfur rejection and BTU recovery
- Produce a low ash product
- Compare the performance of the heavy agglomerant process based on diesel and the light agglomerant process using heptane
- Define optimum processing conditions for engineering design
- Provide first-level evaluation of product handleability
- Explore and investigate process options/ideas which may enhance process performance and/or product handleability

1.2 Task 5 - Scope of Work

Process development work under Task 5 consisted of experimental programs in the batch level and continuous operations. The continuous operations were carried out largely on a capacity scale of 5 kg/hr for both the heavy agglomerant process (diesel) and the light hydrocarbon process (heptane). A limited number of test runs for the heavy agglomerant process were also conducted at the 1/4 TPH scale IATF (Integrated Agglomeration Testing Facility) at the Alberta Research Council.

The scope of work under this task was substantial and extensive. The Task 5 work program began with the selection of agglomerants most suitable for pyritic sulfur rejection for the project coals. An extensive program was performed to optimize the heavy agglomerant process and the light hydrocarbon process. A detailed study of a large number of process variables was performed. Following these, various processing schemes for the "Diesel" and "Heptane" processes were evaluated along with studies of other process parameters for the engineering

development of the selective agglomeration technologies. Outside laboratories and the support laboratory in Wilsonville were also used to provide data for confirmation and verification.

Using the batch experimental program to screen the effect of major process parameters permitted a more efficient and effective selection of operations in the continuous processing experiments. The existing Continuous Pyrite Removal Unit (CPRU) at the Alberta Research Council was modified for the heavy agglomerant process; and a new continuous unit for the light hydrocarbon process was designed, constructed and operated for the project. Test runs were conducted in the continuous operations to confirm the effects of major process variables on process performance, and extended runs were performed for each project coal to generate mass balance data.

While the emphasis of the Task 5 program was placed on the high-shear operation, the low-shear operation was also investigated in the batch scale and a continuous operation of 20 kg/hr capacity. Laboratory scale pelletizing was investigated as an alternative method for size enlargement and as a process substitute for low-shear. First level evaluation of product handleability characteristics was also performed on selected samples.

In addition, a number of supporting tests were carried out during the Task 5 program to provide additional information and data which were required for engineering, economic and environmental assessments of the selective agglomeration processes. These tests included the determination of drying kinetics of clean products from both heavy and light hydrocarbon processes, light hydrocarbon distribution in process streams and also size degradation of product from the light hydrocarbon process as a result of thermal drying.

1.3 Task 5 - Report Structure and Organization

The Task 5 report is structured in such a manner to allow the logical presentation of the data gathered from the batch and continuous operations. As such, the sequence of data presented in this report does not necessarily follow the chronological order.

The data used for discussions in each section are also selected, regrouped, or subdivided from the huge data base to illustrate the significance of the observations. The complete data base is provided in the appendix for reference. Following the discussions of batch, small continuous operation (5 kg/hr), and pilot scale operation (1/4 TPH), the data from the batch and continuous operations are compared and a statistical analysis of the data is also provided. A separate chapter is used to discuss the subject of Quality Assurance and Quality Control (QA/QC) of the Task 5 program.

2.0 DESCRIPTION OF TESTING UNITS AND OPERATIONS

Five different testing units and operations were used in the Task 5 program:

- Batch scale testing
- Bench scale diesel continuous testing (5 Kg/hr)
- Bench scale heptane continuous testing (5 Kg/hr)
- Continuous low-shear testing (20 Kg/hr)
- Pilot scale diesel continuous testing (1/4 TPH IATF)

These testing units and operations are described below.

2.1 Batch Scale Testing

Major experimental equipment used for batch scale testing consisted of the following:

- "ARC" 1-liter agglomeration vessel
- "ARC" 1-liter agglomeration vessel with cover
- Waring Blender, 1-liter vessels (glass and stainless steel)
- 3-liter standard separatory funnel
- 3-liter modified separatory vessel with screen
- Denver D-12 flotation machine
- Standard 8" diameter sieves
- Ultrasonic mixer
- Pressure filter
- Grinding equipment (dry and wet)
- Disk/drum pelletizer
- Extruder

- Drying oven

This equipment is briefly described below.

2.1.1 "ARC" 1-Liter Agglomeration Vessel

This vessel, shown in Figures 2-1 and 2-2 (pp. 2-18 and 2-19) is a standard batch vessel used at the Alberta Research Council. It was used for all the heavy agglomerant tests for high- and low-shear agglomeration. Shear is provided by the 4-blade impeller that rotates at various speeds (up to 2,400 rpm) for high-shear and at 1,800 rpm for low-shear. The four baffles inside the vessel intensify the mixing action in the vessel. During testing the vessel remains open to the atmosphere.

The dimensions of the high-shear mixing vessel are as follows:

Volume	1 liter
Ratio of impeller diameter to vessel diameter	0.44
Ratio of baffle width to vessel diameter	1:10

2.1.2 "ARC" 1-Liter Agglomeration Vessel with Cover

This vessel, shown in Figure 2-3, is the same as the vessel described in Section 2.1.1. A cover was constructed to prevent the evaporation of the light agglomerant. The cover was positioned immediately above the water level, thereby minimizing head space and potential agglomerant evaporation. The valves in the cover allowed the addition of agglomerant by means of a syringe.

This vessel was used for all light agglomerant tests using various rpm (1,000-2,000) of high-shear and for all light agglomerant low-shear steps.

2.1.3 Waring Blender

A standard 2-speed Waring blender, Model 31BL92, was used for high-shear for all light agglomerant tests at 14,000 rpm. Two vessels were used, one of clear glass and the other of stainless steel, each of 1-liter nominal capacity. The glass vessel was used during procedure development and for observation of agglomeration progress (kinetics). The majority of the tests were completed with the stainless steel vessel in which a small 1-mm diameter hole was drilled in the cover to allow the addition of the agglomerant by means of a syringe.

2.1.4 3-Liter Separatory Funnel

This was a standard 3-liter teardrop-shaped separatory funnel with a sealable narrow opening at the top and stopcock at the bottom. This vessel was used for all light agglomerant tests utilizing phase separation as the agglomerate recovery method. The contents of the high-shear vessel were transferred to the separatory funnel via a standard funnel.

2.1.5 3-Liter Separatory Vessel with Screen

This vessel is shown in Figure 2-4. The vessel was constructed specifically for this test program. This vessel was used for all light agglomerant tests utilizing screening as the agglomerate recovery method. The separatory vessel consisted of two sections. The bottom section was made of glass and had a cylindrical shape tapering to a narrow tube equipped with a drain valve. This was used to remove the tailings and water from microagglomerates. The top removable section was made of glass and had the shape of a cylinder equipped with the small valve to release a possible light hydrocarbon pressure build-up, and a stopper to prevent a major loss of the agglomerant. Steel cloth screens of various sizes were used to separate microagglomerates from the tailings. Rubber gaskets and clamps provided the necessary seal between two sections of the vessel.

2.1.6 Denver D-12 Flotation Machine

This is a standard laboratory flotation unit with a 3-liter cell. This machine was used for all light and heavy agglomerant tests utilizing flotation as the microagglomerate recovery method. A schematic diagram of D-12 Flotation Machine is shown in Figure 2-5.

2.1.7 Standard 8" Sieves

Standard Tyler series 8" full height (2") sieves were used for all heavy agglomerant tests utilizing screening as the microagglomerate recovery method. These sieves were also used for recovering all low-shear products, regardless of whether they were from light or heavy agglomerant tests.

2.1.8 Ultrasonic Mixer

Ultrasonic mixer, Type PT10/35 - Kinematica GmbH, was used for emulsification of heavy and light agglomerants.

2.1.9 Pressure Filter

Dewatering of microagglomerates was carried out in a "BOOT" pressure filter - Model PF-2, The Booth Company, Salt Lake City, Utah, U.S.A.; "Whatman" filter paper - Cat. No. 1114270, was used as filtration medium.

2.1.10 Grinding Equipment

Dry Grinding Equipment

- Hammer mill: Holmes Pulverizer Model 501-XL Single Phase 220V/1 HP Motor
- Disc grinder: Quaker City Mill Model 4-E with 110V/ 1/3 HP Motor Single Phase

Wet Grinding Equipment

- U.S. Stoneware 784-VM Jar Mill (variable speed)
- U.S. Stoneware Ceramic Jars - 1.1 L Internal Capacity
- Zirconium Grinding Media 1/2" x 1/2" cubes, 1,775 gm/per jar

2.1.11 Pelletizer

Convertible disk/drum pelletizer MMC, Model DP-14 with Dayton motor, SCP control, Model 5X412 was used in pelletizing experiments with clean coal generated by high-shear process utilizing heavy agglomerant.

2.1.12 Extruder

Laboratory type extruder, Model No. 387475, Cranfordsville, Ind., was used to produce extrusion rods from heavy agglomrant high-shear product.

2.1.13 Drying Oven

"Fisher" isotemp oven, Model 655G was used for drying of clean coal product and reject samples.

2.2 Bench Scale Diesel Continuous Testing Unit (CPRU)

The existing bench scale continuous testing unit, known as continuous pyrite removal unit (CPRU) was modified to equip with wet grinding capability for this contract. The testing unit had the following major components.

- Coal grinding and slurry holding tank
- Conditioning vessel
- High-shear agglomeration vessels
- Flotation cell for microagglomerate separation

- Second stage flotation unit

A flow diagram of the CPRU is presented in Figure 2-6. The components are described in the following sections.

2.2.1 Coal Grinding and Slurry Holding Tank

Coal grinding for tests in the CPRU was conducted using either the rod mill in the Integrated Agglomeration Testing Facility (IATF) or a ball mill purchased for this project. Coal grinding by rod mill is described in Section 2-3, "Bench Scale Heptane Continuous Testing Unit". This section concentrates on coal grinding using the ball mill, slurry holding tank and delivery system.

A Denver ball mill 813 mm L x 406 mm D (32" L x 16" D) was used for coal grinding to produce the 28 mesh and 100 mesh grinds for testing. Stainless steel balls of 25.4 mm (1") diameter were used as a grinding medium. The coal was fed to the mill by a variable speed screw feeder and close-loop grinding mode was employed for preparing a slurry feedstock of required size distribution.

A custom designed mobile coal slurry holding tank was manufactured to store and transport the slurry. The slurry tank was made of stainless steel 864 mm H x 457 mm I.D (34" H x 18" I.D). An inverted cone was installed at the bottom to facilitate intensive mixing which prevented settling of the solids. Mixing was achieved by using the Lightnin Model XD-43 agitator with two impellers. The agitated slurry was pumped to the CPRU slurry delivery system by a Mayno pump, Model 354, manufactured by Robinson and Mayers, Inc. of Ohio.

The holding tank, agitator and slurry pump were mounted on a steel plate with heavy duty castors which allowed easy mobility from the grinding set-up to the testing unit. Figure 2-7 illustrates the coal slurry preparation system for the CPRU.

2.2.2 Conditioning Vessel

The function of the conditioning vessel was to adjust the slurry concentration for the process. The conditioning vessel was 203 mm H x 127 mm I.D (8" H x 5" I.D), fitted with four baffles. It had 900 ml working volume and 2.2 minute residence time while operating at 5 Kg/hr dry coal basis (20% solids). The vessel agitator had 93 Watts (1/8 HP) motor, 4-paddle stirrer, and a speed controller to maximum of 1800 rpm. The dilution water was regulated using a Matheson Model 605 rotameter.

2.2.3 High-Shear Mixers

The CPRU could accommodate one mixer with single discharge point or two mixers each with 3-discharge levels, 145 ml, 345 ml, 815 ml which could be connected in series in any combination for the required residence time. The agitator manufactured by G.K. Heller Corp., Floral Park, N.Y., had 93 Watts (1/8 HP) motor, and a digital controller Model HST 20N were used to adjust rpm or torque.

Diesel injection pump, manufactured by the Nichols Zeniths, Waltham, Massachusetts, was driven by 1 HP motor, and had a capacity to deliver 0.05 to 25 gm per minute of agglomerant with $\pm$ 1% accuracy.

2.2.4 Flotation Cell

The microagglomerates formed in the high-shear mixer/mixers were recovered by flotation. The flotation cell had a capacity of 3.2 liters with working capacity of 2830 ml of water. A standard Denver Model D-12 flotation machine was used. The flow of air could be regulated by adjusting the rotation of the impeller.

Frother pump manufactured by Pulsofeeders, Rochester, N.Y., Model L30-SE was equipped with vernier type precision regulator. It could deliver from 0.03 gm/min of 1% methyl isobutyl carbinol solution with $\pm$ 1% accuracy.

2.2.5 Second Stage Flotation Unit

The second stage flotation was carried out with the unit which was referred to as a hydraulic separator. This unit comprised of (a) washing zone (1.1 l capacity), where the feed entering the unit was diluted, (b) settling zone 152 mm H x 140 mm I.D (6" H x 5 1/2" I.D) and (c) flotation zone of the dimensions similar to settling zone. The settling zone had four baffles.

The Denver flotation machine Model D12 with an induced air impeller was used to supply the regulated volume of air.

2.3 Bench Scale Heptane Continuous Testing Unit

The bench scale heptane continuous testing unit consists of four systems:

- Coal grinding and slurry feeding system
- High-shear mixing system
- Microagglomerate separation system
- Tailings handling system

The heptane process flow diagram (Figure 2-8) and Table 2-1 are presented to facilitate the description of the continuous unit.

Table 2-1

STREAM AND VESSEL SPECIFICATIONS FOR HEPTANE PROCESS SCHEMATIC

Stream Designation	Description
1	Coal slurry line
2	Coal slurry sampling location
3	High-shear H_2O addition line
4	Slurry feed line to high-shear
5	Heptane line to high-shear
6	Sieve bend feed line
7	Sieve bend product line
8	Tailings to hazardous containment
9	Tailings decant line
10	Discharge line
11	Sieve bend vent line
12	Recycled coal slurry line

Table 2-1 (Continued)

STREAM AND VESSEL SPECIFICATIONS FOR HEPTANE PROCESS SCHEMATIC

Vessel Designation	Description
A	Rod mill
B	Slurry holding tank
C	Mobile slurry tank
D	Slurry pump (TEFC - 3 phase)
E	Peristaltic pump
F	Impeller motor speed controller
G	Impeller motor (TEFC)
H	High-shear vessel
I	Heptane pump
J	Heptane vessel
K	Emergency reservoir
L	Sieve bend
M	Valve
N	Product collection system
O	Tailings sampling system
P	Valves
Q	Tailings settling vessel
R	Pressure control switch
S	Pump
T	Tailings decant effluent vessel

TEFC - Totally Enclosed Fan Cooled

2.3.1 Grinding and Coal Slurry Feed System

The grinding operation was performed in the Integrated Agglomeration Testing Facility (IATF) rod mill (A) at a slurry concentration of 50% and a rod charge of 500 Kg. The raw coal feed rate was 1 to 2.5 Kg/hr, dependent upon the coal type.

The grind product was diluted to 20% solids and pumped to the IATF coal slurry holding tank (Vessel B) where it was thoroughly mixed. This feed slurry was then pumped to the portable 120 liter stainless steel slurry holding tank (Vessel C). The portable tank was constructed on a mobile trolley was equipped with a mixing and slurry feeding system. The mixing system consisted of a 373 Watts (1/2 HP) motor equipped with twin turbine impellers at a 30° pitch. The slurry feed pump (Pump D) was a positive displacement pump which delivered 20 liters/min at atmospheric pressure, and was capable of providing both the feed slurry flow and constant recycle (Stream 12) for the portable slurry tank. A peristaltic pump (Pump E) located adjacent to the high-shear

vessel was used downstream of the main slurry feed pump to provide for a steady coal slurry feed rate (Stream 4). The remaining stream of coal slurry was recycled past the high-shear vessel back to the slurry holding tank (Stream 12) to help ensure constant mixing.

2.3.2 High-Shear Mixing System

The high-shear mixing system (Vessel H) consisted of three components:

- High-shear vessel
- Mixer
- Heptane pump

The high-shear mixing vessel was fabricated from 6.3 mm (1/4 in) cast acrylic pipe, and was equipped with a sealed top flange, and a mechanical seal for the mixing shaft. The vessel was 127 mm (5 in) in diameter, and 350 mm (14 in) in height, and had a 30° conically shaped bottom. The discharge from the high-shear vessel was located at 250 mm (10 in) from the bottom, and had an operating volume of 1000 ml at 2000 rpm's.

The mixer had a 373 Watt (1/2 HP) totally enclosed, fan cooled (TEFC) three phase motor (Motor G) and was equipped with a twin turbine impeller mixing shaft. The impellers were 90 mm (3.5 in) in total width, and 13 mm (1/2 in) in total depth. The bottom impeller was located approximately 25 mm (1 in) from the bottom of the vessel, and the top impeller was located approximately 13 mm (1/2 in) from the bottom of the discharge. The motor was connected to an explosion proof main power switch and variable speed controller, both of which were located inside the operating cell. All wiring was rated explosion proof.

The heptane pump (Pump I) was a positive displacement piston pump with variable speed and stroke length control. The pump was a TEFC three phase pump and was equipped with an explosion proof power switch and speed controller. Heptane was added to the bottom of the high-shear mixing (Stream 5) vessel nearest to the action of the bottom impeller as practically possible. The heptane pump was equipped with a pressure relief valve and was connected to

a sealed emergency reservoir (Vessel K). The heptane feed source was contained in a sealed pyrex reservoir (Vessel J) with a constant mass read out load cell to monitor heptane addition.

2.3.3 Separation System

The separation component consisted of a vibrating sieve bend (Item L). The sieve bend had a total available surface area of 0.0504 m^2, and an operating surface area of 0.0336 m^2. The total sieve bend width was 0.18 m, and the length, (accounting for curvature) was 0.28 m. The operating width, however, was 0.12 m as flow restricters were installed on the sieve bend to study the flow characteristics of the heptane agglomerates. The sieve bend openings were 125 microns. The vibration source was supplied by standard air pressure of 45 psi, and was controlled by a pressure regulator to about 25 psi. The placement of the vibration source directly onto the sieve bend resulted in a proper operation of the sieve bend, as the heptane agglomerates tended to bounce on the sieve bend, which discouraged plugging of the openings. Hence, the sieve bend could be operated for extended hours (8 to 30 hours) without any concern of the openings blinding with agglomerate product. The sieve bend was vented to building exhaust (Stream 11).

The sieve bend was completely enclosed, with a stainless steel bottom support, and a clear cast acrylic plate assembly over the top of the unit. All the seams of the enclosure were sealed with neoprene gaskets and silicon sealant. The sieve bend enclosure was vented to allow for the vibration air source to release into the research cell exhaust system. The product collection system consisted of a 100 mm ball valve (Item M) to isolate the sieve bend during the changing of the collection containers, and a 100 mm Can Lock valve system to facilitate the rapid interchange of product collection containers (Vessel N). The product collection system and sieve bend enclosure proved to be very effective, as the heptane unit was operated for extended hours without any noticeable levels of heptane vapors.

2.3.4 Tailings Handling System

The tailings handling system consisted of two settling chambers (Vessels Q and T), fabricated from two 45 gallon sealed plastic barrels, and a tailings pump (Pump S) equipped with a pressure

control switch (Item R). The tailings stream (Stream 8) reported by gravity via a three-way valve into the first settling barrel. In this barrel the tailings solids were permitted to settle from the stream. The pressure switch activated the tailings pump when about 50% to 60% of the barrel volume became full. The secondary tailings stream (Stream 9), now substantially reduced in solids content, was pumped to the second settling chamber (Vessel T). The water phase was then disposed to the municipal sewer system in Devon after further sedimentation in a three chamber solids settling system available at Alberta Research Council. The tailings solids, settled in both barrel settling chambers from the bench scale system, contained high levels of heptane and required hazardous waste disposal procedures.

The tailings sample collection system consisted of a three-way valve connection to a 4-liter sample collection container (Vessel O) and the primary tailings barrel. This valve was normally closed to the sample collection container, and the tailings (Stream 8) reported by gravity to the primary tailings barrel. When a testing period began, the tailings stream was immediately diverted to a 4-liter sample collection container for the 10 minute interval. Once the time had elapsed, the stream was immediately diverted to the primary settling barrel, and the sample container was covered and sealed immediately thereafter.

2.4 20 kg/hr Continuous Low-Shear Operation

A 20 kg/hr capacity continuous low-shear testing unit was assembled to carry out small scale low-shear agglomeration tests in a continuous mode of operation. A schematic flow diagram of the continuous unit is shown in Figure 2-9.

Main equipment of the continuous low-shear unit is a high-shear mixer and a low-shear mixer. The high-shear mixer has a volume of 15 liters with a variable speed Lightnin mixer driving two impellers. The low-shear mixer has a volume of 65 liters and has a single 4-blade paddle type impeller driven by a Lightnin variable speed mixer. Both mixing vessels are equipped with 4 vertical baffles.

Other equipment of the continuous low-shear unit include a coal slurry metering pump, a diesel oil metering pump and a binder metering pump. The coal slurry metering pump is a 9.5 mm

(3/8") diameter Jabsco flexible impeller centrifugal pump. The pump is driven with a variable speed motor for flowrate adjustment. The diesel oil metering pump is a Marlow-Watson peristaltic pump with adjustable speed for flow control. The binder metering pump is a Bran & Luebbe positive displacement pump coupled with a variable speed drive.

Under continuous operation of the unit, coal slurry from the slurry tank is pumped to the high-shear mixer at a controlled rate using the coal slurry metering pump. Using the diesel metering pump, diesel oil is added to the stream of coal slurry entering the high-shear mixer. Slurry from the high-shear mixer discharges directly into the low-shear mixer. Binder is added to the low-shear mixer using the binder metering pump. Product from the low-shear mixer is screened and discharged into 200 liter barrels.

2.5 Integrated Agglomeration Testing Facility (IATF)

The IATF was utilized to perform 250 kg/hour testing with Upper Freeport coal. The IATF is divided into five major circuits. These circuits are categorized below, and their process arrangement is provided in Figure 2-10, the Process Schematic for the IATF.

- Coal Slurry Preparation
- Microagglomeration or High-Shear Mixing
- Microagglomeration Separation by Flotation
- Macroagglomeration or Low-Shear Agglomeration
- Dewatering and Tailings Handling

2.5.1 Coal Slurry Preparation

The coal slurry preparation circuit consists of coal grinding, coal classification, and coal slurry equalization. The grinding consists of an Allis Chalmers Rod Mill, 610 mm in diameter, 1120 mm in overall length. The mill is enclosed and insulated for noise reduction and safety requirements. The Rod Mill has a 7.5 kW (10 HP), 575 V drive system, and operates at 38 rpm delivering 250 kg/hour. Grinding is performed at 50% solids concentration. The rod charge is varied depending

on the coal and desired grind size and distribution, and can be varied up to a 500 kg rod charge mass. The rod diameter distribution can also be varied to affect the size distribution. The residence time is estimated to be about 10 minutes, and the power requirements were measured to be 6.5 kW under normal operating conditions. The IATF is also equipped with a ball mill for extra fine grinding, however, this unit operation is not a circuit component. The rod mill feed weigh belt conveyor is equipped with dual load cells. Feedback process control is used to ensures the coal feed rate is accurate. The weight belt is 150 mm in width, and uses a 0.25 kW (1/3 HP) AC drive. The coal hopper is 1 cubic meter (35 cu ft) in capacity and is equipped with a 115 V vibrator. The coal hopper is equipped with a 89 mm screw feeder to deliver coal to the weigh belt and requires a 0.75 kW (1 HP) variable DC drive motor.

The coal classification equipment consists of vibrating inclined screen which cuts the rod mill discharge at 0.6 mm. The screen is 305 mm in width by 760 mm in length. The screen overflow reports to a coarse recycle screw auger which delivers the oversize coal back into the rod mill which produces a closed loop grinding circuit. The mill discharge is delivered to the classifying screen by a Minpro vertical sump pump, which has a 1800 kg/hr capacity and is equipped with a 2.25 kW (3 HP), 575 V drive system.

The classifying screen underflow is delivered to a 700 liter coal slurry equalization tank via a Minpro vertical sump pump, which has a 1800 kg/hr capacity and is equipped with a 2.25 kW (3 HP) and 575 V drive system. The underflow is diluted to 20% solids prior to delivery to the equalization tank. The equalization tank is equipped with a 1.12 kW (1.5 HP) single impeller Grey Lightnin agitator, which is operated at 350 rpm. The tank is also equipped with a 2.25 kW (3 HP) 575 V Galigher circulation pump. The slurry delivery pump, which feeds the high-shear and flotation systems, is a 1.5 kW (2 HP), 208 V, Sala variable speed horizontal pump. All coal slurry lines throughout the plant are 19 mm in diameter, and the estimated velocity is about 0.7 meters per second. The slurry deliver system is equipped with a feed back process control circuit consisting of a slurry flowrate and nuclear density meter to measure volumetric flowrate and slurry solids concentration. The flow rate signal reports to a computer controller which regulates the delivery pump speed, while solids concentration adjustments are manually controlled by operator.

2.5.2 Microagglomeration or High-Shear Mixing

The microagglomeration system consists of two high-shear mixers, each with 58 liter capacity, 316 mm in diameter. The mixers are top fed and bottom discharged, and are equipped with 3.75 kW (5 HP) 208 V, mechanically sealed variable speed Grey Lightnin drives. Each mixer is equipped with two impellers, impeller, Impeller 1 having a 114 mm diameter axial design, and Impeller 2 possessing a 102 mm diameter radial design. The typical residence time is about 4 minutes per stage, and the operation rpm is 1750. The power requirements are 3.5 kW under operating conditions and 0.8 kW when the mixer is empty. The mixing power delivered to the slurry is estimated to be 45 Watts per liter.

The agglomerant feeding system supplies binder for both the high- and low-shear mixers. Agglomerant is added using two Bran & Luebbe positive displacement piston pumps, rated with 0.37 kW (0.5 HP), 208 V drive systems, and a maximum capacity of 830 grams per minute each. The agglomerant pumps are controlled using adjustable AC speed controllers. Flowrates into both the high- and low-shear mixers are measured for mass flowrate and logged to the computer control and data acquisition system. The agglomerant reservoir has a 200 liter capacity, and is equipped with a 0.25 kW (0.33 HP) air powered agitator. The reservoir is heat traced for temperature control. The normal operating temperature is about 2°C, unless higher viscous oils are being used.

2.5.3 Microagglomerate Separation by Flotation

The separation stage consists of a bank of flotation cells and the second stage flotation unit. The flotation bank consists of six Denver cells, with a total volumetric capacity of 500 liters, and adjustable froth skim paddles. The agitation system consists of three 2.25 kW (3 HP) 575 V drives operating at 800 rpm, with one drive per two agitators. The power consumption of the agitation system is about 12 Watts per liter during normal operating conditions. The flotation machine can be operated with six or three cells, and the flotation cell slurry concentration can be varied. The hydraulic retention time will vary from about 7 to 15 minutes, depending upon the slurry concentration. The product phase reports by gravity flow to the second stage flotation, and

the middlings also report to the tailings treatment circuit via gravity. Frother addition is achieved using an adjustable peristaltic feed pump system.

The second stage flotation unit consists of three zones, the washing zone, the flotation zone, and the settling zone. In the washing zone, the froth from the Denver flotation cells reports directly to the surface of the washing zone, where the froth is washed with high penetration washing sprays. The spray action serves to reliberate any attached pyrite particles, and causes them to report to the settling zone. The settling zone is equipped with a vortex stabilizer and baffle system which serves to promote the downward migration of the heavier ash and pyrite rich particles. The flotation zone serves to recover the combustible matter and is equipped with a Denver type air induced flotation agitator system. The mechanism is equipped with a 1.5 kW (2 HP) 208 V variable speed controller and height adjustment. The product phase is removed with a variable speed froth paddle, which reports to the product pump. The product pump delivers the slurry to the low-shear mixer via a Minpro 2.25 Kw (3 HP) 575 V vertical sump pump. The tailings stream discharge from the second stage flotlation is controlled by using a Jabsco centrifugal pump with an operating capacity of 15 kg/hr at nominal pressure. The settling stream report to an accumulation system by gravity flow through a 50 mm settling line (see Figure 2-11). All tailings lines throughout the plant are 25 mm in diameter.

2.5.4 Macroagglomeration or Low-Shear Mixing

The macroagglomeration system consists of two low-shear mixers. The first low-shear mixer has a 360 liter operating capacity and is equipped with top discharge to the second mixer. The mixer is a 15 kW (20 HP) 575 V drive, and operates at 575 rpm with a nominal residence time of 26 minutes. The impeller is a four bladed radial system, 330 mm in diameter. Additional binder is added to low-shear mixer 1. The power requirements were measured to be about 13.5 kW during operating conditions, and 4.5 kW when empty. The power delivered to the slurry was estimated to be about 25 Watts per liter. Mixer 2 has a volume of 725 liter and a nominal residence time of 52 minutes. Total residence time for two mixers is about 78 minutes. Mixer 2 is also equipped with a top discharge and delivers the macroagglomerates to a dewatering screen located directly below. Mixer two is equipped with a 15 kW (20 HP) 575 V drive system, and a 425 mm diameter four bladed radial impeller, which operates at 370 rpm. The power requirements were measured

to be about 16.1 kW during operating conditions, and 4.5 kW when empty. The power delivered to the slurry was estimated to be about 11 Watts per liter.

2.5.5 Dewatering and Tailings Handling

The dewatering system consists of a 122 cm diameter vibrating double deck Sweco drain and rinse screen. The top screen cuts at 0.7 mm and the second at .35 mm. The water and ash phase report the tailings treatment circuit and the product reports to 200 liter product collection barrels. The tailings streams are collected in a six compartment, 7000 liter capacity sedimentation tank system. The plant is also equipped with a Lancy sludge thickener and Lancy corrugated plate separator for operation under closed circuit water.

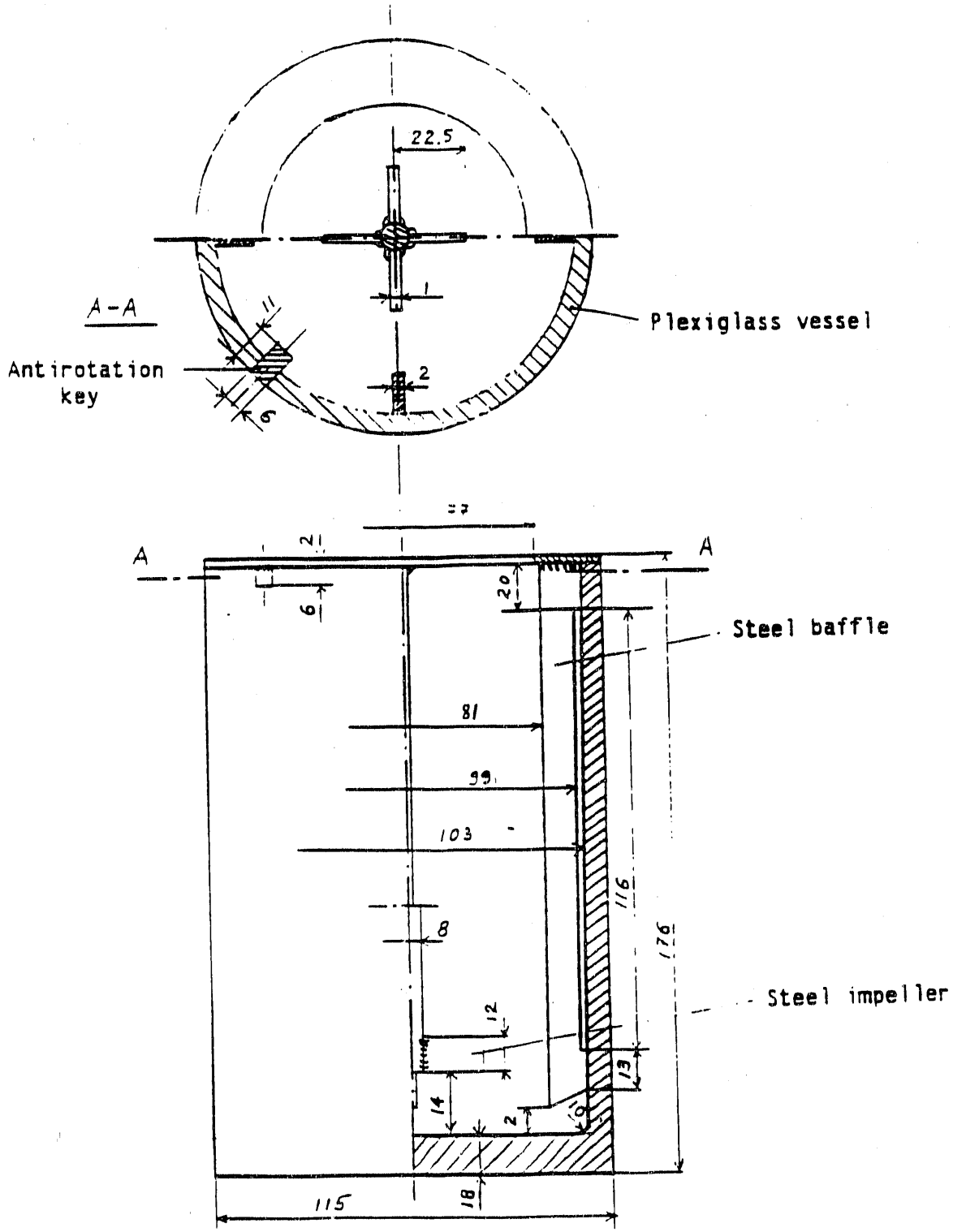


Figure 2-1 Agglomeration Vessel

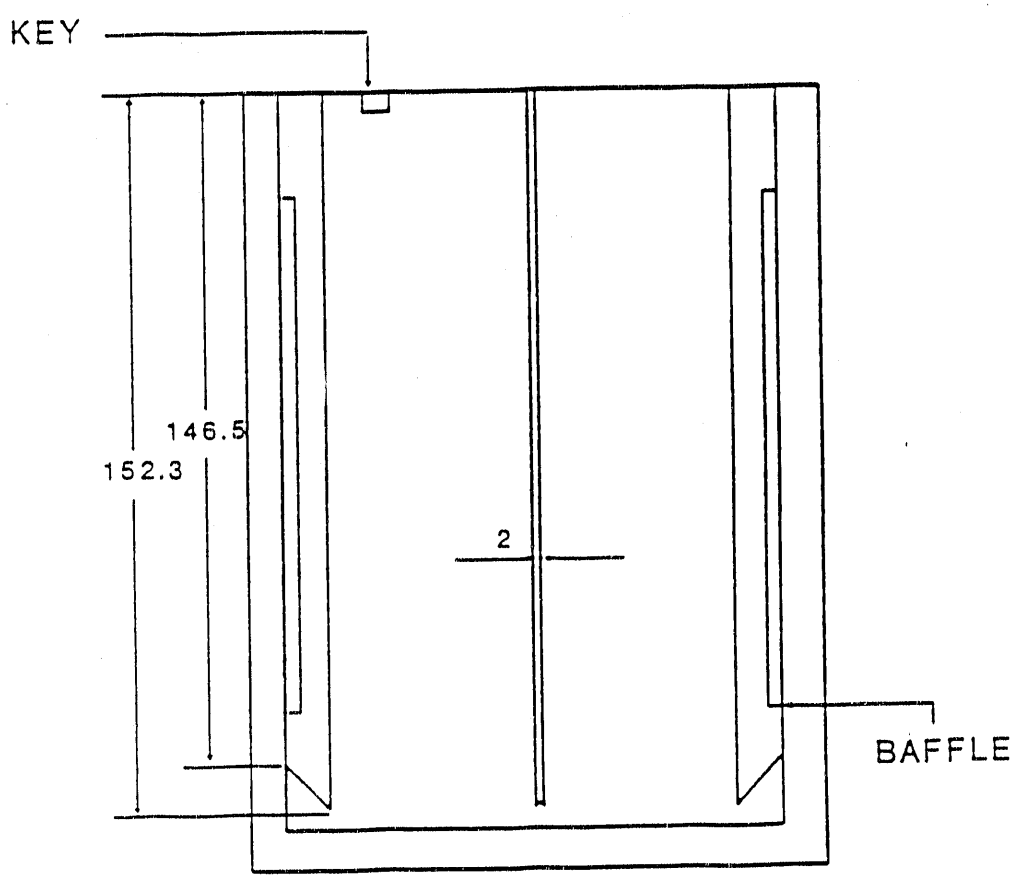


Figure 2-2 Baffle Assembly for ARC 1-liter Agglomeration Vessel

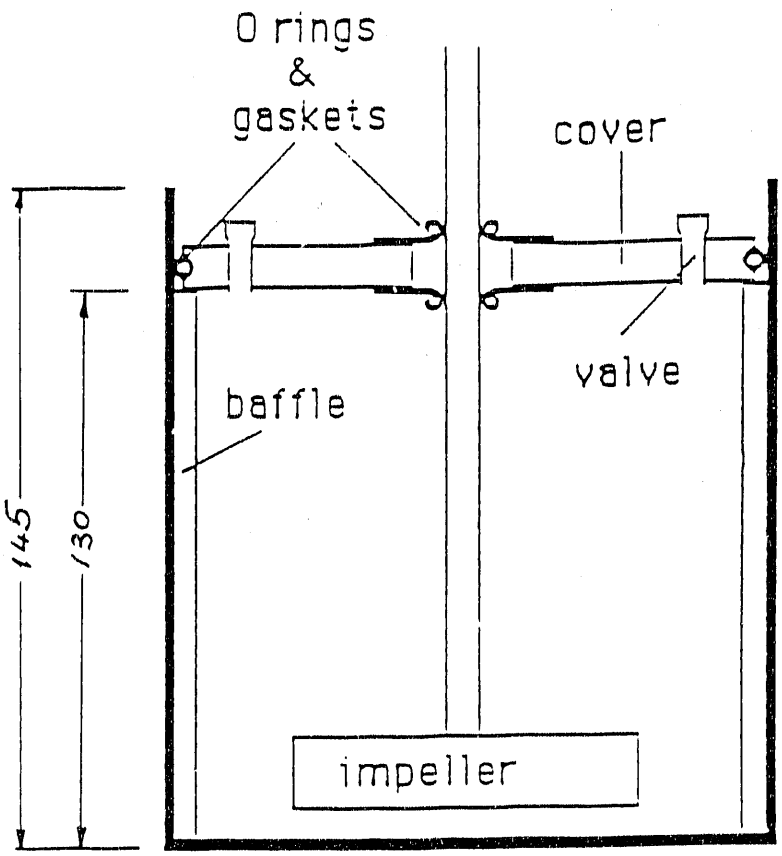


Figure 2-3 ARC 1-liter Agglomeration Vessel for Heptane

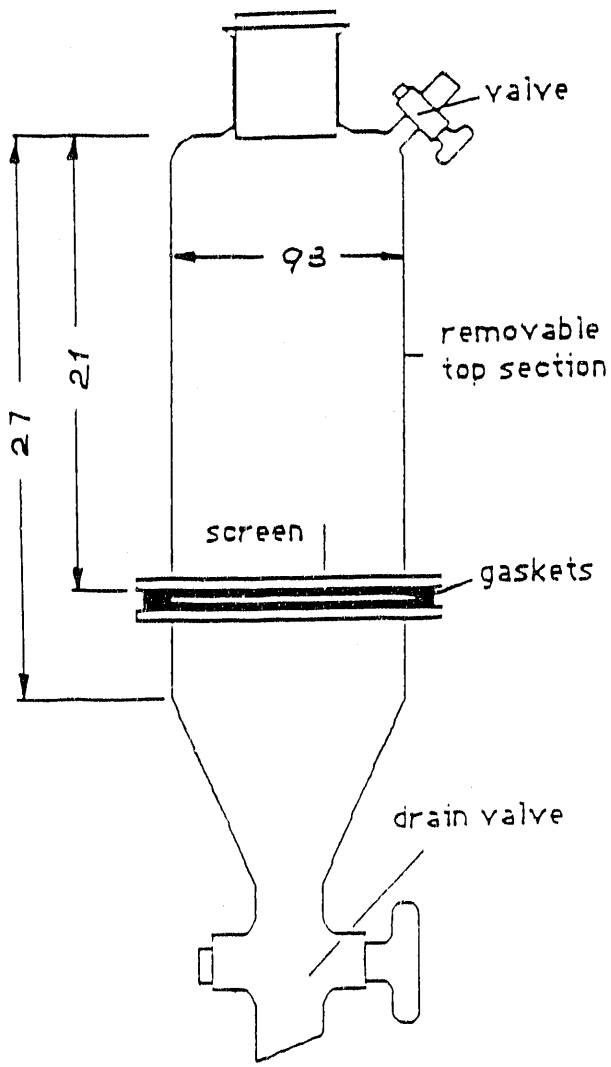


Figure 2-4 3-liter Modified Separatory Vessel with Retaining Screen

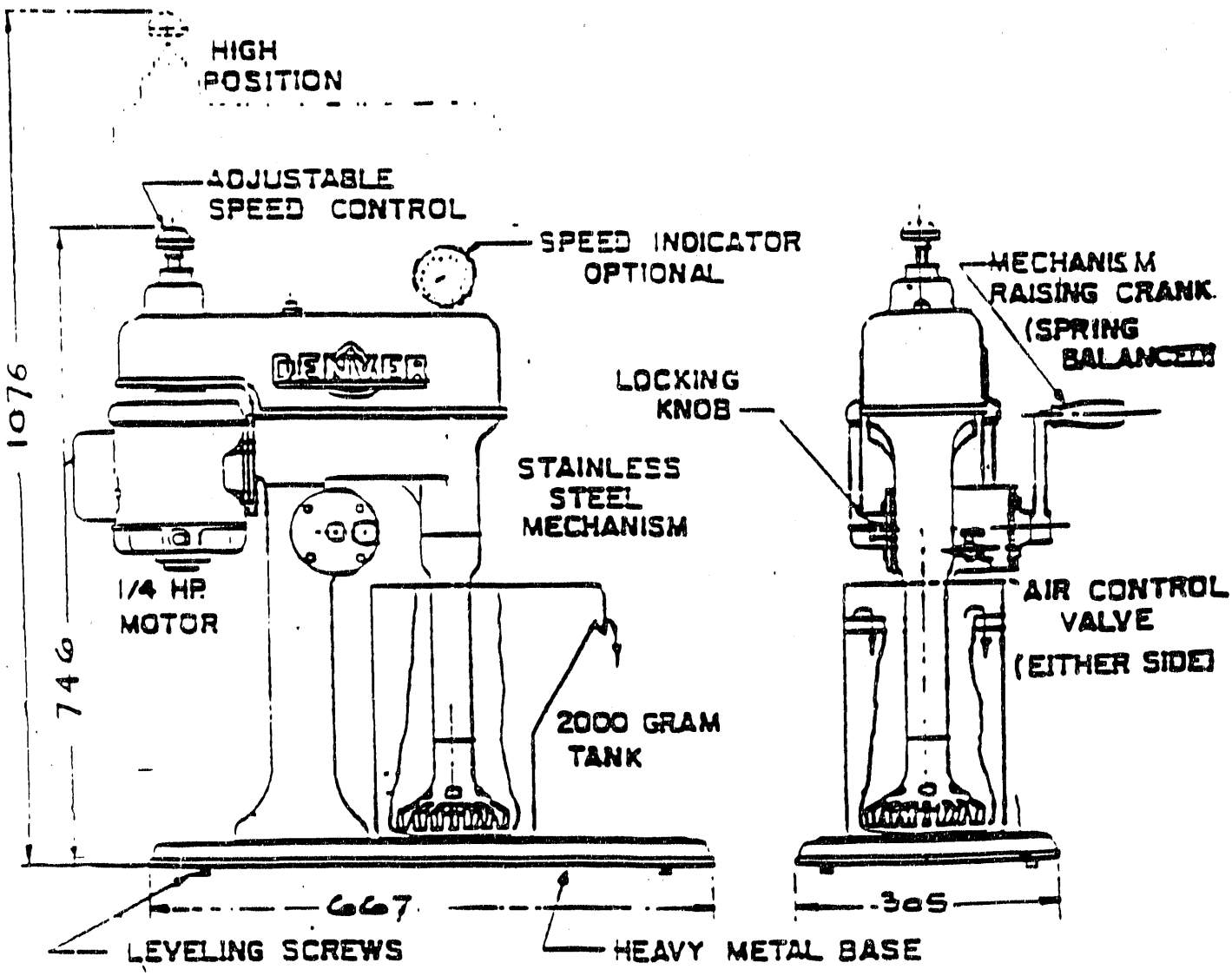
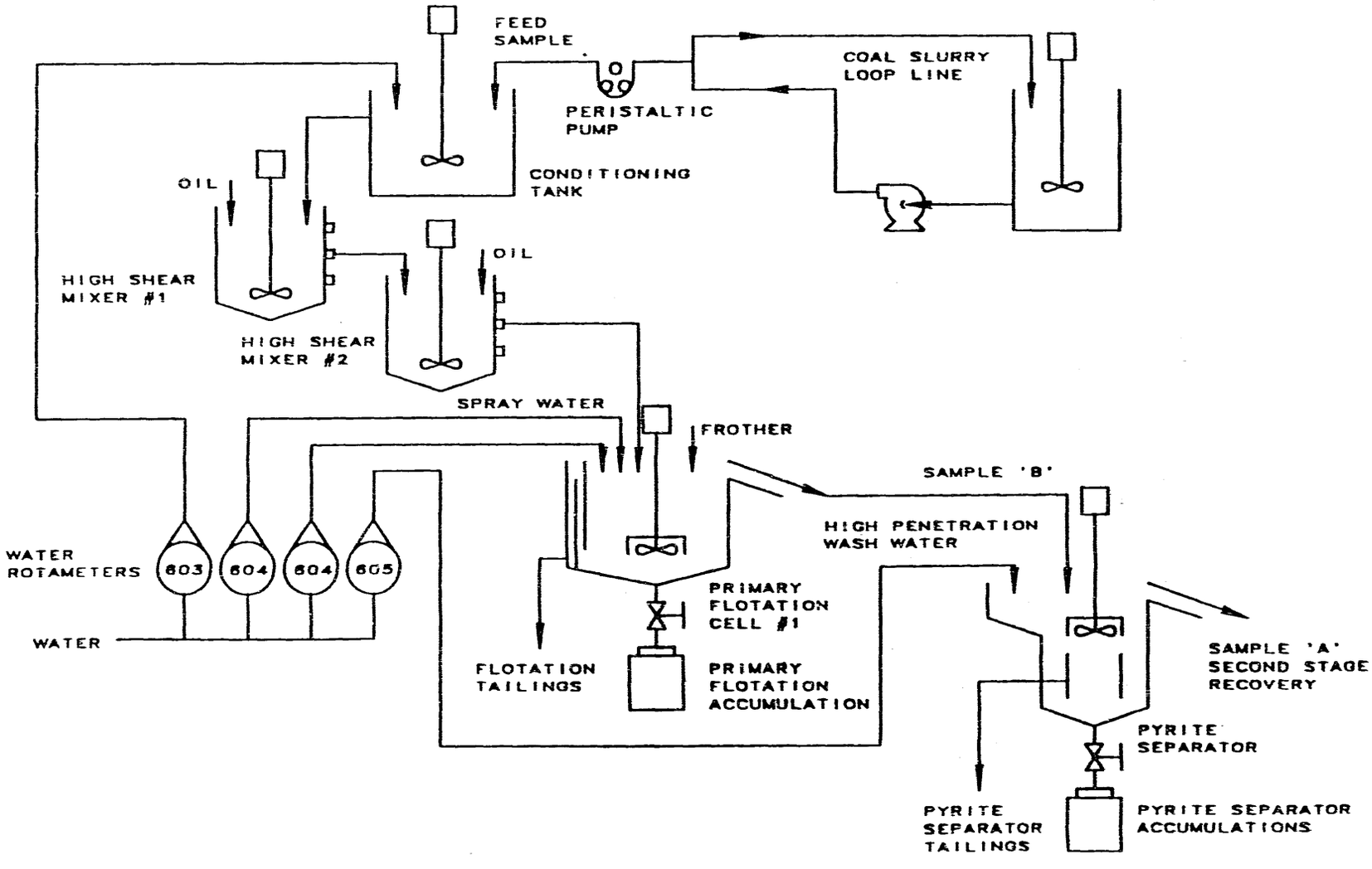


Figure 2-5 Denver Laboratory Flotation Machine

FIGURE 2-6 CONTINUOUS PYRITE REMOVAL UNIT PROCESS FLOW DIAGRAM



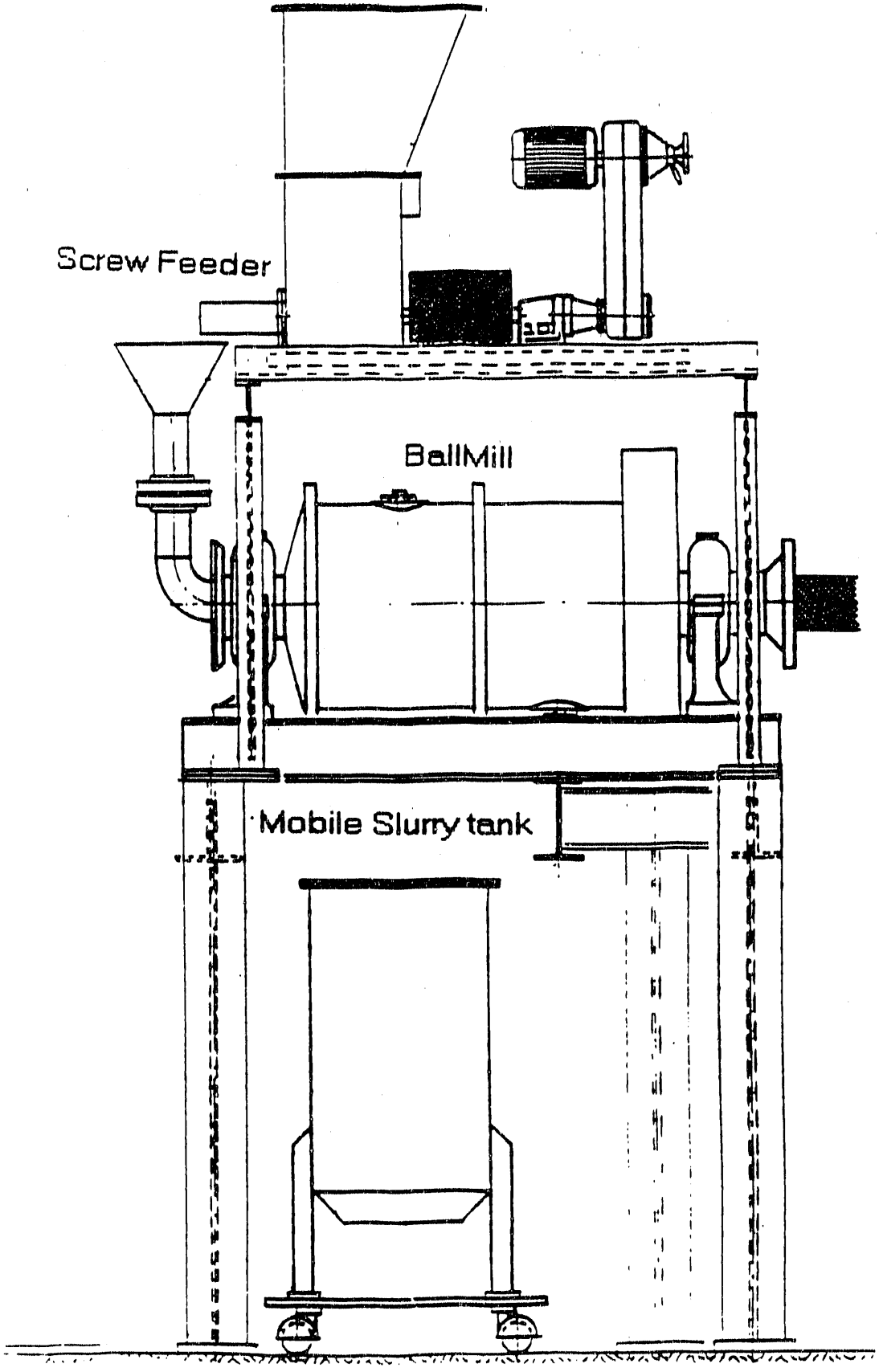
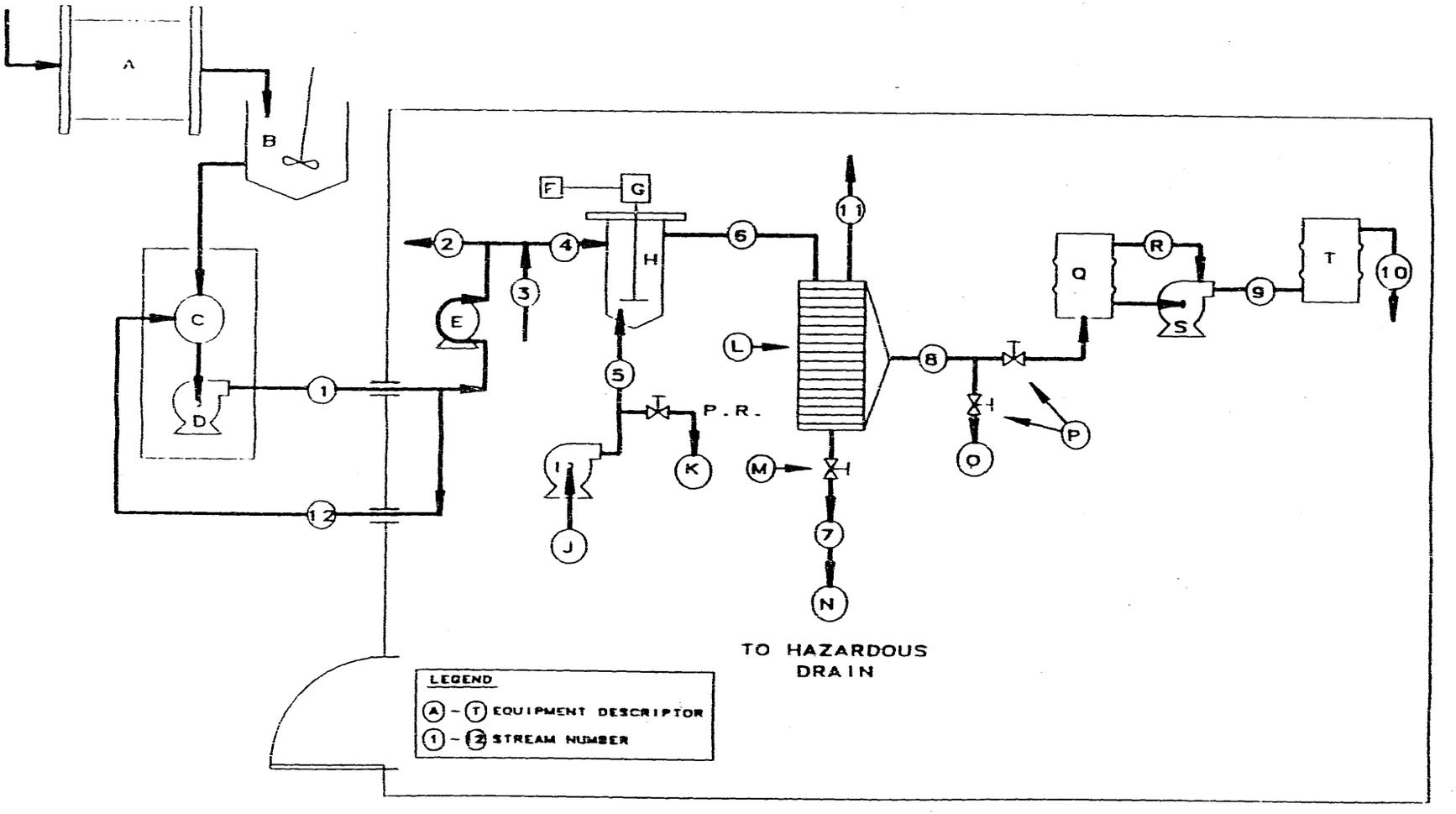


Figure 2-7 Coal Slurry Preparation System for Continuous Oil Agglomeration Unit

Figure 2-8 Heptane Process Schematic



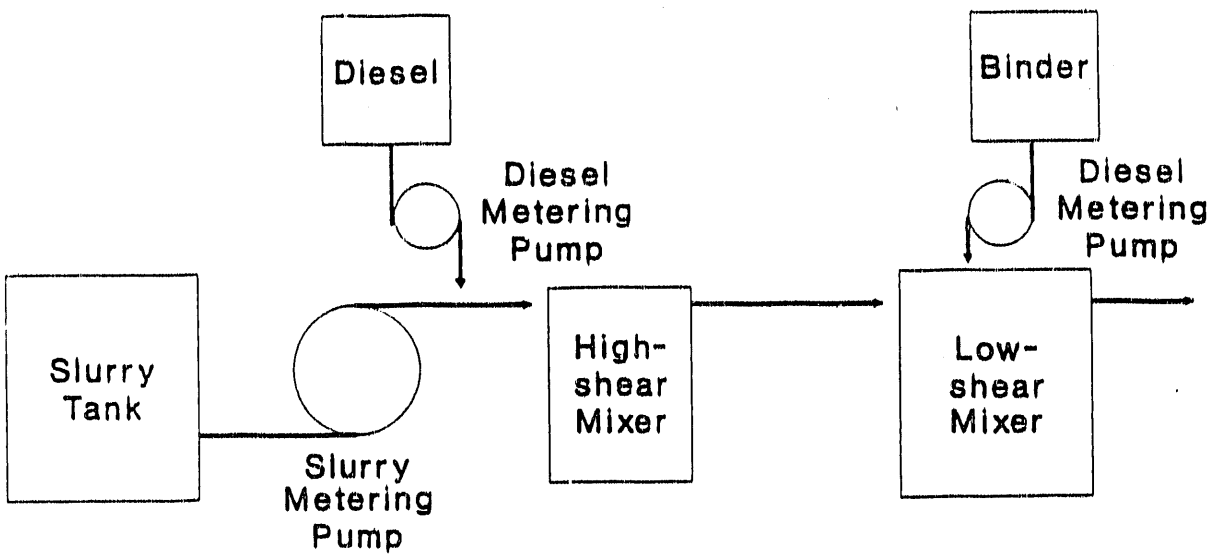
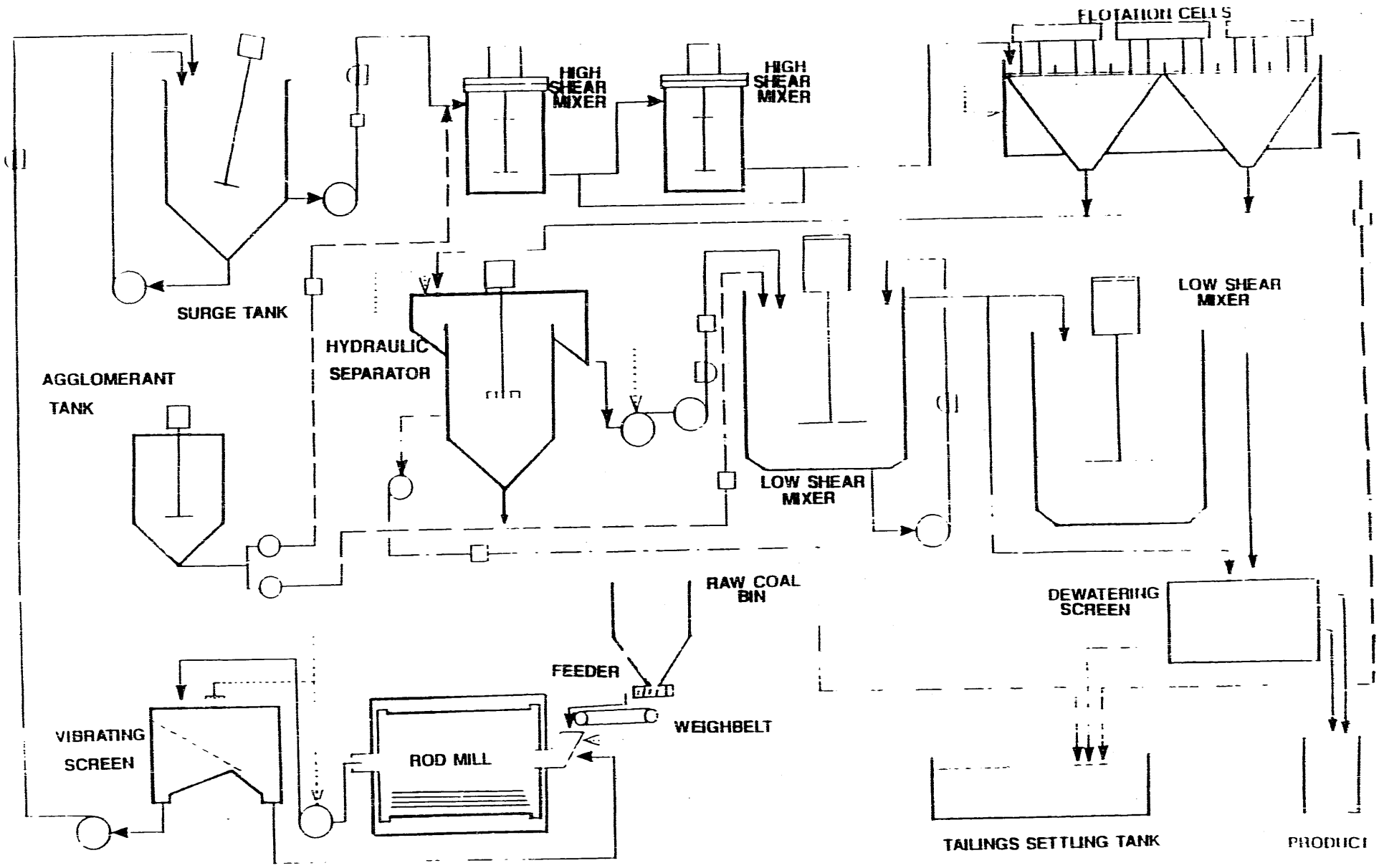


Figure 2-9 Continuous Low-Shear Test Apparatus

Figure 2-10 Integrated Agglomeration Test Facility 1/4 TPH



3.0 EXPERIMENTAL PROCEDURES FOR BATCH AND CONTINUOUS PROCESS TESTINGS

The operational procedures used for batch and continuous testings are described in this section.

3.1 Batch Scale Testing

Batch scale testing in Task 5 examined agglomeration process performance using both diesel and heptane as agglomerants. Due to the different nature of these agglomerants and various methods used for microagglomerate separation, distinct procedures were developed and examined in the Task 5 test program.

In addition, the procedures used for pelletization, agglomerant emulsification in high-shear, and wet grinding of samples for agglomeration are also summarized.

3.1.1 Sample Preparation

In the batch testing program there were essentially three categories of samples:

(a) The dry crushed sample of nominal 1 mm top size and approximately 10 kg quantity.
Preparation of this sample was done by crushing the original 19 mm x 0 bulk sample, weighing approximately 12 kg, to a nominal 1 mm top size using a jaw crusher and disk pulverizer in a multi-stage process. This sample formed the batch sample from which the individual agglomeration test samples were taken.

(b) Individual Test Samples
The entire 10 kg sample was mixed by rotating the plastic pail end-over-end several times. The pail was then opened and manually stirred. A scoop was then used to take the required sample amount, typically as one increment. Actual sample weight was determined beforehand and moisture had to be accounted for in order to obtain the weight on a dry basis. Excess of sample

in the scoop was returned to the sample pail which was immediately sealed. This procedure was repeated each time a fresh sample was required.

Revised Procedure for Obtaining Samples for Batch Agglomeration Tests

Commencing with Batch 6 of the Task 5.1 coals, the procedure for obtaining the individual samples for wet grinding was changed.

The nominal minus 1 mm batch sample was obtained in the same manner: crushing of the nominal minus 19 mm material, screening at 1.18 mm, recrushing the oversize, etc. The entire crushed sample was then homogenized by rolling on a large plastic sheet. The homogenized sample was then riffled into 16 samples of approximately 800 grams each. The 800 gram samples were sealed in plastic jars and stored at 4°C. Every fourth jar was subsampled and analyzed for comparison with the composite head sample.

For agglomeration test a fresh sample was obtained by selecting a jar at random. Each jar contained sufficient amount of coal sample for a certain number of tests (i.e., enough sample for four tests of 20% solids concentration). The coal remaining in the jar was discarded once there was less than the amount required for the test with the lowest solids concentration.

(c) Microagglomerates and Rejects Samples

Typically, these samples were filtered, dried at 40°C, and then weighed. The quantity of rejects was usually too small for subsampling so the entire reject sample was sealed in a small sample container and sent for analysis. The dried microagglomerates were usually subsampled by taking 10 to 20 small increments from a homogenized sample. All samples were sealed to prevent changes in moisture content.

3.1.2 Sample Grinding for Agglomeration Tests

The feed for wet grinding consists of the nominal minus 1 mm dry crushed coal. The wet grinding procedure is as follows:

- Place 1.8 kg of grinding medium, typically 1.3 cm x 1.3 cm zirconia cubes, in porcelain ball mill of 1.1 liter capacity.
- Add water to the mill in the amount equal to the weight of coal on an as-received basis.
- Place mill on rollers and begin milling at 97 rpm.
- Select the milling time based on grinding calibration data for a particular coal size and solids concentration.
- Open mill and pour entire contents onto screen with openings of sufficient size to allow coal to pass while retaining grinding medium (i.e., 6 mm openings).
- With wash bottle, wash coal from inside of mill, from lid, and from each grinding cube. Similarly, wash screen surface.
- Transfer coal slurry into agglomerating vessel.
- Use as little amount of wash water as possible in order to ensure that the final solids concentration in the agglomerating vessel is not less than that predetermined for the agglomeration test.

The amount of the sample required for an individual wet grinding test was predetermined on the basis of total coal/water slurry weight in agglomeration vessel and working solids concentration. They were as follows:

Total coal/water slurry	800 g
Feed for wet grinding at solids concentration:	
20%	160 g (db)
15%	120 g (db)
10%	80 g (db)
5%	40 g (db)

3.1.3 Agglomeration Procedures

Agglomeration was done in either the ARC 1-liter vessel or the Waring Blender, depending on the test conditions. The procedure was essentially the same for each vessel.

High-shear:

- Dilute wet ground slurry to desired solids concentration, i.e., 5% or 20%.
- Weigh out appropriate quantity of agglomerant based on dry solids.
- Set impeller rpm, at 1000 - 2400 (ARC vessel), or 14000 (Waring Blender).
- Add agglomerant and agitate for 0.5 - 4 min, as predetermined for the particular test.
- Empty contents of agglomeration vessel into appropriate agglomerate recovery vessel or screens.

Low-shear:

- Add recovered agglomerates to ARC agglomeration vessel and dilute to desired solids concentration.
- Weigh out appropriate quantity of binder based on initial dry solids used in high-shear step.
- Set impeller at 2000 rpm.
- Add agglomerant and agitate for 1 minute.
- Set impeller at 1800 rpm and agitate for 16 min or longer as required for low-shear kinetics study.
- Pour contents of vessel onto screen.

3.1.4 Procedures Used for Microagglomerate Recovery

3.1.4.1 Flotation for Heavy and Light Agglomerants

Flotation was used as a means of agglomerate recovery. The procedure was as follows:

- Transfer the contents of agglomeration vessel to a 3-liter cell of the Denver D-12 flotation machine.
- Dilute to approximately 10% solids concentration.
- Set impeller at 1100 rpm and open air valve.

- Manually remove froth until barren.
- If another stage of agglomeration (low-shear) is required, return froth to agglomeration vessel, agglomerate, transfer the agglomerates back to flotation cell, and repeat flotation procedure.
- Combine tailings from both flotation stages.
- Filter the clean coal and tailings, dry at 40°C, weigh and send for analysis.

In this project, most of the tests were carried out using two-stages of flotation subsequent to a high-shear stage. For these tests, the froth product from the first flotation was repulped for the second flotation step. The second-stage flotation product and the combined tailings from both steps were then prepared for analysis.

3.1.4.2 Multiple Screens for Heavy Agglomerants

The agglomerates were generated under the following high-shear conditions:

- Standard 1-liter ARC vessel
- 4 minutes residence time
- 2000 rpm
- 20% solids

After agglomeration was completed, the contents of the vessel were poured onto the top screen of a set of sieves. The screen designations were dependent upon the feed top size:

Feed topsize	28 mesh x 0 (600 um x 0)	200 mesh x 0 (74 um x 0)
Screen No. 1	28 mesh (600 um)	150 mesh x (106 um)
Screen No. 2	48 mesh (300 um)	200 mesh (74 um)
Screen No. 3	150 mesh (160 um)	325 mesh (45 um)
Pan	-150 mesh (160 um)	-325 mesh (45 um)

The agglomerates retained on the top screen were washed with water which passed through the two subsequent screens into the pan. Subsequently the top screen was removed and the washing procedure was repeated for the second and third screen.

The agglomerates were removed from their respective screens, dried at 40°C, weighed, and then sent for analysis. The rejects were filtered, dried at 40°C, weighed, and sent for analysis.

3.1.4.3 Single Screens for Heavy Agglomerants

The agglomerates were produced under the following high-shear conditions:

- Standard 1-liter ARC vessel
- 4 min. residence time
- 2000 rpm
- 20% solids

After agglomeration was completed the contents of the vessel were poured onto a screen. The screens were selected based on multiple screen testing and were as follows:

Feed topsize	28 mesh x 0 (600 um x 0)	200 mesh x 0 (74 um x 0)
Screen	150 mesh (106 um)	325 mesh (45 um)
Pan	-150 mesh (106 um)	-325 mesh (45 um)

The agglomerates retained on the screen were washed with water which passed into the pan. For the tests with a subsequent low-shear step, the agglomerates were transfered from the screen to the low-shear vessel along with fresh water. Binder was then added (based on the initial coal weight), and the slurry was agitated at about 20% solids for 16 minutes at 1800 rpm. The low-shear product was then screened and washed using the same screen as for the high-shear product.

The agglomerates were removed from the screen, dried at 40°C, weighed, and were sent for analysis. The combined, low- and high-shear rejects were filtered, dried at 40°C, weighed, and were sent for analysis.

3.1.4.4 Phase Separation for Light Agglomerants

The agglomerates were generated under the following conditions:

	ARC Vessel	Waring Blender
Residence time	4 min	4 min
Impeller rpm	2000	14000
Percent solids	20,5	20,5

Agglomerant was added using a syringe. After agglomeration was completed, the contents of the vessel were poured into the standard 3-liter separatory funnel which was immediately sealed. The separatory funnel was left to stand for 1 minute, after which the bottom valve was opened and the rejects slurry was allowed to empty into a container. When the phase interface reached the valve, the flow of rejects slurry was stopped by closing the bottom stopcock valve. About 1 liter of fresh water was added to the separatory funnel which was then manually shaken. The separatory vessel was then again left undisturbed for 1 minute, after which the bottom valve was opened and the drainage procedure was repeated. This process was repeated three times using approximately 1 liter of fresh water in each sequence.

The agglomerates were removed from the separatory vessel, filtered, dried at 40°C, weighed, and were sent for analysis. The same procedure was followed for the reject slurry.

For tests with a subsequent low-shear step, the agglomerates were removed from the separatory funnel, and transferred to the low-shear vessel along with fresh water. Then the binder was added, and the slurry was agitated for 16 minutes at 1800 rpm. The low-shear product was screened, dried at 40°C, weighed and was sent for analysis.

3.1.4.5 Screening for Light Agglomerants

The following conditions were used for agglomerate production:

	ARC Vessel	Waring Blender
Residence time	0.5-4 min	4 min
Impeller rpm	1000 - 2400	14000
Percent solids	5,10,15,20	20,5

Agglomerant was added using a syringe. After agglomeration was completed the contents of the vessel were poured into the separatory screening vessel which was immediately sealed. The bottom valve was opened and the reject slurry was allowed to empty into a container.

As the reject slurry was drained from the vessel, the product was collected on the 106-micron screen. An additional minute was then allowed to ensure drainage of rejects from the interstices of the mass of agglomerated product (this additional draining was the primary difference between this screen recovery process and phase separation). Approximately 1 liter of fresh water was then added and the vessel was swirled around and drained again in the same manner. This process was repeated until the product had been washed 3 times. The combined washings and the product were filtered, dried, weighed, and sent for analysis.

For tests with a subsequent low-shear step, the agglomerates were removed from the screen, transferred to a low-shear vessel along with fresh water, then the agglomerant was added, and the slurry was agitated for 16 minutes at 1800 rpm. The low-shear product was then screened and washed using an appropriate screen, dried at 40°C, weighed, and sent for analysis. The rejects are filtered, dried at 40°C, weighed, and then sent for analysis.

3.1.5 Pelletizing

Pelletizing was used for size enlargement of the diesel products.

Pelletizing procedure:

- Place the moist coal cake from the pressure filter on a 6 mesh screen and rub it through to obtain a fluffy feed for pelletization.
- Place the prepared feed in a pelletizing drum and tumble at a rotational speed of 40-50 rpm for 10 min. Spray occasionally with water in order to adjust the feed moisture, if required, for better pelletization.

If the influence of any binder was to be investigated, it would be mixed with the moist coal feed for 5 min. prior to the above mentioned procedure.

3.1.6 Agglomerant Emulsification

A series of tests was carried out with emulsified agglomerants in the high-shear stage.

Emulsions were prepared using the following procedures:
Heavy agglomerant:

- Weigh out appropriate quantity of agglomerant required for one test.
- Dilute with water in ratio of 1:20.
- Emulsify for 5 min using equipment described in 2.1.8.
- Add directly to agglomeration vessel.

Light agglomerant:

- Weigh out appropriate quantity of agglomerant for one test.
- Dilute with water in ratio of 1:10.
- Emulsify for 5 min.
- Add directly to agglomeration vessel.

3.1.7 Grinding Calibration

The grinding calibration was performed for all project coals to define the wet grinding conditions in order to produce the following size samples:

Coal feed size:	d_{50} (um)
28 mesh x 0	125 $\pm$ 5
100 mesh x 0	60 $\pm$ 5
200 mesh x 0	25 $\pm$ 5
oversize fraction	$\leq$ 5%

Wet Grinding Procedure:

- Weigh out appropriate quantity of a given coal as required for an individual test at defined solids concentration and add it to the ceramic jar mill containing known amount of zirconia cubes.
- Add equivalent amount of water to achieve coal/water ratio of 1:1 on an as-received basis.
- Close the jar mill, place it on rollers and tumble at 97 rpm for a specified period of time.
- Empty the contents of the jar mill on to the screen, the size of which is defined by the top size of the coal used for the experiment, and wet screen it.
- Dry the top fraction, weigh it to determine the amount of oversize, and perform the appropriate size analysis.
- Filtrate the bottom fraction, dry, weigh and subject to appropriate size analysis.

If the size analysis indicates that the wet milling product is coarser or finer than required for the test, the grinding time is increased or reduced accordingly. This trial-and-error method is repeated until the desired product size analysis is achieved.

3.2 Bench Scale Diesel Continuous Testing (5 Kg/hr)

3.2.1 System Operation

Various components of the continuous testing unit were calibrated prior to actual experiments defined in the test plan. The calibration data of the ball mill screw feeder, grinding, diesel delivery

pump, the air flow rates at various rpm of the flotation cell are presented in Appendix 2, Volume 2.

In the coal slurry feed system, a calculated flow of a 30% coal slurry was routed to the conditioning vessel. The remainder of the coal slurry was recycled back to the mobile slurry holding tank. Dilution water was added at this point to produce a coal slurry of 20% solids in the conditioning vessel.

The diluted coal slurry from the conditioning vessel was fed to the high-shear agglomeration vessel for processing. To improve the mixing behaviour, the inlets for the coal slurry feed and diesel were located at the bottom of the high-shear mixer. Total diesel consumption was monitored during the experiments. Different high-shear vessels were used to study the effect of residence time. These vessels are described in Section 2 of this task report.

The microagglomerates were recovered in the flotation cell. Solids concentrations in the froth cell were adjusted by adding dilution water from two spray nozzles. Frother (MIBC) was added as required. The froth level was primarily controlled by tailings discharge and secondarily by the rpm of the froth skimmer. Second stage flotation was performed in the separate unit. In order to disengage the entrained mineral matter in the froth of microagglomerates, deep penetrating spray nozzles supplied regulated quantity of water to this unit.

3.2.2 Operating Conditions and Sequence of Operation

The operating conditions of the continuous pyrite removal unit (CPRU) for the Task 5 program are tabulated in Table 3-1.

3.2.3 Sampling

During a typical test, the following samples were taken:

Feed Sample: 3 samples at the beginning; 2 at the end of a test run or between set points to determine coal feed rate; 1 sample was used to determine the solids % of the samples and another was used to determine the particle size distribution.

Product Sample: Both the first and second stage flotation products were sampled for product characterization.

Tailings Sample: 4 tailings streams were sampled during a test run. These were:

- Flotation cell tailings (FCT)
- Flotation cell settled solids (FCS)
- Second stage flotation tailings (SSFT)
- Second stage flotation settled solids (SSFS)

Table 3-1

GENERAL OPERATING CONDITIONS OF CPRU

Conditioning vessel agitator rpm	850 - 900
High-shear slurry solids concentration, %	20
High-shear rpm	2000
Flotation cell rotor rpm	1150
Flotation skimmer rpm	20 ± 2
Second stage flotation unit rotor rpm	1150
Second stage flotation unit ingesting air, m^3/min	0.83 m^3/min
Second stage flotation unit skimmer rpm	50 ± 5

SEQUENCE OF CPRU OPERATION

		Pre-test Adjustments (min)
1	Adjustment of slurry feed rate	30
2	Collection of slurry feed samples	10
3	Adjustment of frother and oil injection rates	15
		Test Run Time (min)
4	Start of set point #1	0
5	Establish steady state conditions	45
6	Second stage flotation product #1	45 - 55
7	Flotation cell product #1	60 - 70

Table 3-1 (Continued)

SEQUENCE OF CPRU OPERATION

		Test Run Time (min)
8	Set point #2 oil and frother adjustment	70 - 80
9	Establish steady state conditions	80 - 125
10	Second stage flotation product #2	125 - 135
11	Flotation cell product #2	140 - 150
12	Set point #3 oil and frother adjustment	150 - 160
13	Establish steady state condition	160 - 205
14	Second stage flotation product #3	205 - 215
15	Flotation cell product #3	220 - 230
16	Collection of slurry feed sample	230 - 240

Note: Similar procedure followed for all tests with more than 3 set points.

3.3 Heptane Bench Scale Experimental Procedure

3.3.1 Start Up Procedures

The initial operating procedure required the coordination of three systems:

- Coal slurry feed system
- High-shear mixing system
- Vibrating sieve bend

The coal slurry feed system first involved coordinating the delivery of the feed slurry for each test matrix. A matrix of test intervals usually required one or two days for completion. Hence, an adequate volume of feed slurry was required for each matrix of test intervals to improve the consistency of the results. The excess slurry was stored in a covered epoxy lined barrel equipped with a mixing system. The rod mill grinding system was used to generate a 20% coal slurry for each test coal. Once the test matrix was to begin, the portable mixing system was

wheeled to the grinding system and the feed slurry was delivered at 20% solids. The portable coal slurry feed system was subsequently moved back to the bench scale system located just a short distance away. The agitation system and circulation centrifugal pump was started immediately to ensure the slurry remained thoroughly mixed and samples were extracted for percent solids determination of the feed slurry.

Prior to any testing, the sieve bend was started and inspected for leaks. The portable coal slurry feed system was then connected back into the bench scale system and the test began by re-calibrating the coal slurry feed rate to the high-shear mixer. Several measurements were continued for approximately 30 minutes to increase the confidence in the feed rate measurements.

During these measurements, the high-shear and sieve bend water flow rates were re-determined based upon the previous calibrations and additional measurements. Typically, three water flow rates were required with each testing matrix, hence, all three set points required were usually confirmed during this period, ending with the first set point required by the test matrix. The high-shear water flow rate and the feed slurry flow rate measurements were compared to the target conditions. If they were not sufficiently accurate, adjustments were made to correct the discrepancy.

Once the water and solids feed conditions were well established in the high-shear mixer, the heptane feed rate was re-determined based upon the previous calibration plots and additional measurements. The heptane reservoir was located on a load cell, hence, highly accurate heptane additions could be achieved. Once the heptane addition levels were confirmed, the test was ready to begin.

At this point, the high-shear mixer was started and all flow streams were added simultaneously; this included the feed slurry, the high-shear water addition and the heptane addition. Once the level in the high-shear mixer achieved about 50 mm, the speed of rotation of the mixer was increased to 2000 rpm and the vibration to the sieve bend was started. The testing program then began, and followed the sequence of action items described in Section 3.3.2 - System Operation.

3.3.2 System Operation

Each test interval was fifty minutes in duration and was divided into three periods: a thirty minute stabilization period, followed by two 10-minute product yield periods. The experimental procedure is described as follows:

- Measure coal slurry feed rate in duplicate or triplicate, saving the samples extracted to generate a composite feed sample of the test matrix.
- Implement the set point changes to the high-shear water flow rate and measure the final rate in at least duplicate.
- Implement the set point changes to the high-shear heptane concentration and measure the final rate to confirm additions.
- Adjust the sieve bend water rate to the final level and measure the rate in duplicate to confirm the accuracy.
- Allow 30 minutes of operation to reach steady state conditions. Two product sample containers were labelled and tared for the yield periods during this time.
- When 30 minutes of operation had elapsed, and observations indicated no operational problems existed, the yield periods began and a product sample was extracted in duplicate, each with a testing interval of 10 minutes.
- At the same 30 minute time, the heptane load cell mass was recorded. Once the 10 minutes had elapsed, the final heptane load cell mass was recorded to determine the final mass of heptane used. The load cell mass was recorded again at the end of the second testing interval to ensure the same heptane addition occurred over both yield periods.
- Once the product samples were collected, they were securely sealed to maintain their integrity, and the total slurry masses were recorded immediately. The samples were then transported to the laboratory preparation facility, where the samples were either prepared for laboratory analysis, or stored for future consideration.
- A sealed disposable product collection container was then re-positioned into place for the stabilization period.
- After both product samples were collected, a 2 to 4 liter sample of the high-shear product was collected in a sealed container to support any further batch testing.

- All set point changes were then implemented into the apparatus and the system was allowed to operate until steady state conditions once again prevailed within the apparatus.

3.3.3 Product and Tailings Sampling

- When the testing interval was to begin, and the product isolation valve (50 mm ball valve) on the sieve bend was closed, the testing interval stop watch was started simultaneously. The product collection container was attached to the sieve bend product discharge via the sealed can-lock quick couples, and the isolation ball valve was then immediately opened to the container.

- After the 10 minute testing interval had elapsed, the product isolation valve was closed and the first testing interval sample container was removed and immediately sealed, and the second container was positioned into place and the valve was re-opened. Once the second product was collected, the valve was again closed and the second testing interval container subsequently removed and sealed.

  The large isolation ball valve and quick couples allowed for the rapid change over from one testing interval to the next, or to and from the stabilization period without any sample loss, or disturbance in the system. Both total slurry masses were recorded, and either both samples were directed for sample preparation, or one was sent for storage.

- The tailings sample system consisted of a three way valve. When a tailings sample was required, the valve was turned to the sealed tailings collection container. Once the testing interval had elapsed, the tailings were diverted back to the primary settling chamber by turning the three way valve.

3.3.4 Sample Preparation Procedure

In general, the following procedure was used for sample preparation.

- The samples were transported to the laboratory preparation facility.
- All personnel operating in the laboratory facility were supplied with activated carbon breathing masks, which they wore during the entire preparation procedure.

- The sample was initially emptied from the collection container into a pressure filter where the majority of the water was removed from the sample. The water stream reported to a sealed epoxy lined barrel, equipped with a small vent line to allow the pressure to escape.

- After filter pressing, the sample was then transported to oven where the remaining moisture and heptane were removed. After drying for approximately 24 hours at between 55 and 60°C the sample was allowed to equilibrate for 24 hours, and then prepared and submitted for analysis.

- The drying oven was explosion rated and operated on the principal of circulating air in a complex arrangement of baffles. The exhaust from the oven was reported to a sealed barrel condenser, where the major amount of the heptane and water were permitted to collect. The remaining heptane emission was captured as the exhaust passed through an activated carbon filter before being released to the ambient exhaust system.

3.4 Continuous Operation Low-Shear Tests

3.4.1 Preparation

Coal sample was prepared for the continuous low-shear tests using the 1/4 TPH IATF rod mill grinding equipment. Precrushed coal with a top size of 12 mm was fed to the rod mill and ground to obtain either 28 mesh or 100 mesh grind size. Coal was ground at specified solids concentration and stored in an agitated slurry tank in sufficient quantity to carry out 1 to 2 continuous low-shear tests.

3.4.2 Binder Preparation

Asphalt AC-5 and Cold Lake Bitumen (CLB) were used as binders in the continuous low-shear tests. Two blend ratios of 1:1 and 3:1 by weight of AC-5 and CLB to diesel were prepared for the tests. The blends were prepared by heating the AC-5 asphalt and Cold Lake Bitumen to reduce their viscosity using electrical band-type heaters secured to the metal containers. Diesel was added to the binders in appropriate quantity to achieve the desired blend ratios and then stirred until well mixed. The 1:1 ratio blends were able to be utilized at room temperature during the testing. The 3:1 blends were quite viscous and required heating to about 50 °C before they could be pumped in the testing unit.

3.4.3 Test Procedure

The following procedure was used for the continuous operation of low-shear tests.

Coal was ground to 28 mesh or 100 mesh grind size and transferred to the agitated slurry holding tank. Solids concentration was adjusted to desired level which was set at 25% for all tests. With high-shear and low-shear mixers empty, the flow of coal slurry to the high-shear mixer was started and adjusted to desired rate using the coal slurry metering pump. The slurry flowrate was set to correspond to desired residence time in the low-shear mixer. When the slurry flow was established, the high-shear mixer was activated and diesel addition to high-shear was started. The flow of diesel was adjusted to correspond to an addition rate of 1% of the total coal solids flow. As soon as the high-shear mixer began to discharge into the low-shear mixer, binder addition to the low-shear mixer was initiated and set at desired addition rate. When the level of slurry in the low-shear mixer vessel reached approximately 1/3 full, the mixer was activated. The time at which the low-shear mixer was activated was denoted as "time zero" for the test.

Processing was continued from "time zero" until five volume changes of the low-shear mixer were completed at the given feed rate. This corresponded to either 2 1/2 or 5 hours of continuous low-shear operation depending whether the low-shear residence time was 30 or 60 minutes, respectively. Coal slurry, diesel and binder flowrates were monitored periodically throughout the test. Samples of low-shear product were retrieved at the end of each test.

3.4.4 Product Analysis

Samples of low-shear product were analyzed for particle size distribution by screening and mean particle size d_{50} was determined. Particle size analysis and solids concentration determination of the coal slurry feed was performed on selected samples to confirm manual coal solids content measurements and determine d_{50} for each of the 28 mesh and 100 mesh grind sizes.

3.5 Integrated Agglomeration Test Facility (IATF) - Experimental Procedure

3.5.1 Pre-Test Activities

Some pre-test activities were a standard protocol prior to testing. The instrumentation and metering systems were all checked and calibrated at the set points ranges to be utilized during the test. The mill rod charge was adjusted as required, by either performing a grinding calibration test, or utilizing any existing calibration data for the test coal. Sample containers were labelled for the test and distributed throughout the sample locations within the plant. Overall test objectives, conditions, and the necessary sampling program was reviewed with operations personnel to ensure the run execution was accurate.

Specific pre-test activities for the IATF runs included flotation cell modifications and new equipment set up. The flotation cell volume was reduced from six cells in series to three. Hence, the effective retention time was reduced from about 14 minutes to 7 minutes. The equipment set up included the automated sampling devices and new accumulation vessel systems for the flotation cells and the second stage flotation unit.

3.5.2 System Operation

Three IATF runs were performed to determine the minimum sampling program required to ensure reliable results. Each run was performed for 8 hours in which steady state conditions and process performance were investigated.

3.5.2.1 Sample Locations

The following list describes the sample locations within the IATF.

- Rod mill feed
- Rod mill discharge to slurry holding tank
- Flotation cell feed
- Flotation cell product

- Flotation cell tailings
- Flotation cell settlings - the settling sample was collected from the dead zones within the flotation cells 1 and 3 to decrease the time required to reach steady state conditions. The sample was collected by gravity flow to accumulation vessels located directly below the cells.
- Second stage flotation product
- Second stage flotation tailings
- Second stage flotation settlings - the settling sample was collected in an accumulation vessel located below a specially designed settling zone of the second stage flotation unit.
- Low-shear product 1
- Low-shear product 2
- Dewatering screen underflow

3.5.2.2 Sampling Program

The summaries of the sampling programs are provided on Tables 3-2, 3-3 and 3-4, and the following describes the samples extracted. The sampling program for Runs 1 and 2 were similar, except for minor discrepancies detailed in the above noted tables. However, the sampling program for Run 3 was somewhat different. The key differences are discussed in the following.

Sampling Program for Runs 1 and 2

Rod Mill Feed

A composite rod mill feed sample was generated by extracting a 1 liter sample every 10 minutes for 1 hour to generate a composite sample equivalent to about 1 barrel of feed coal. Samples were riffled to 1 liter after the end of one hour sampling period for laboratory preparation. The remaining sample was stored in an air tight container. Discrete 1 liter samples were extracted every 20 minutes, with two duplicate discrete samples taken during the test. A manual coal feed rate measurement was taken every 15 minutes, while the automated coal feed rate measurements were taken continuously by the computer data acquisition system.

Classifying Screen Undersize

Composite samples were collected every hour for the first four hours by extracting a 1 liter sample every 10 minutes. During the last four hours, a two hour composite was collected in the same manner. Discrete samples were extracted every 30 minutes, with two duplicate discrete samples extracted at random.

Flotation Cell Feed

An hourly composite sample of the flotation cell feed was collected by extracting 1 liter every 10 minutes. A discrete sample was extracted every 20 minutes with two duplicate discretes taken randomly during the test. Manual measurements of slurry flowrate were performed every 15 minutes, and the computer data acquisition system logged both slurry flowrate and solids concentration.

Flotation Products

One hour composite samples from both the first and the second stages of flotation products were collected with a sampling frequency of 1 liter every 10 minutes. Discrete samples were collected every 20 minutes with two duplicate discrete samples extracted at random during the test. Manual measurements of slurry flowrate were performed from the second stage flotation product every 15 minutes.

Flotation Tailings

Automated sampling devices were commissioned into operation during these runs. The samplers were programmed to extract a composite 1 liter sample over 20 minutes with a sampling increment of 100 ml every 2 minutes. Both tailings streams were initially discharged into separate 10 liter continuous stirred tanks where the sampler inlet was positioned. The 10 liter capacity served to dampen any instantaneous disturbances experienced in the tailings stream. Discrete samples were extracted every 20 minutes from both stages of flotation tailings streams. Manual measurement of slurry flowrate were performed every 15 minutes, and the computer data acquisition system logged slurry flowrate.

Flotation Settlings

The accumulation vessels and their associated sampling probes were commissioned during these tests. The accumulation vessels were fabricated from clear cast acrylic columns. Every hour, with the use of quick connections, a separation disk was placed inside the accumulation column separating the sample being collected into hourly layers. Hence, continuous hourly samples could be separated at the end of the run for each of the settling streams. The sampling probes, that were especially designed and fabricated, permitted a composite sample for each hour to be collected. The probes were designed to slide into the accumulation column under slight hydrostatic pressure, and contained a pocket in which the gravity settling solids could collect without any disturbance in settling velocity. The probes were designed to reach across the entire diameter of the accumulation column, ensuring a representative sample. Six probe samples were extracted from each accumulation vessel every hour to generate a composite sample.

Low-Shear Mixers 1 and 2

Hourly composite samples were extracted from each mixer, every hour during the test. The sampling frequency was 1 liter every 10 minutes to generate a 1 hour composite. The sample was riffled down to 1 liter for sample analysis, and the remaining sample stored for future analysis. Discrete samples were extracted every 20 minutes, with two duplicate discretes taken randomly during the test. Manual measurements of low-shear mixer 2 were performed every 30 minutes.

Dewatering Screen Underflow

Discrete samples of the dewatering screen underflow were extracted every 30 minutes, and manual measurements of rate were performed every 30 minutes.

Sampling Program for Run 3

This run was performed to investigate a reduced sample collection and analysis program. The reduced sampling program, and the addition of the automated samplers permitted the preparation of samples during the execution of the run. Samples from the flotation cell feed, flotation cells and hydraulic separator were prepared for % solids measurements the same run day. These samples could subsequently be prepared for laboratory ash and total sulfur determination the

following day which decreased the lag time for performance calculations to be estimated on each run. Subsequently, only composite samples collected during the steady state periods were analyzed and the mass balance was determined based upon these results. If discrepancies were identified, additional discrete samples were sent for analysis.

Rod Mill Feed

Two hour composite rod mill feed samples were generated by extracting a 1 liter sample about every 10 minutes for 2 hours. Samples were riffled to 1 liter after the end of the 2 hour sampling period for laboratory preparation. The remaining sample was stored in an air tight container. Discrete 1 liter samples were extracted every 30 minutes. A manual coal feed rate measurement was taken every 15 minutes. Automated coal feed rate measurements were taken continuously by the computer data acquisition system.

Classifying Screen Undersize

Composite samples were collected every two hours by extracting a 1 liter sample every 10 minutes. Discrete samples were extracted every 30 minutes.

Flotation Cell Feed

Two hour composite samples of the flotation cell feed were collected by extracting 1 liter every 10 minutes. A discrete sample was extracted every 30 minutes. Manual measurements of slurry flow rate were performed every 15 minutes, and the computer data acquisition system logged both slurry flowrate and solids concentration.

Flotation Products

Four one hour composite samples from both stages of flotation products were collected with a sampling frequency of 1 liter every 10 minutes. Discrete samples were collected every 30 minutes with two duplicate discrete samples extracted at random during the test. Manual measurements of slurry flowrate were performed from the second stage flotation product every 15 minutes.

Flotation Tailings

The samplers were programmed to extract a composite 1 liter sample over 20 minutes with a sampling increment of 100 ml every 2 minutes. Discrete samples were extracted every 20 minutes from both stages of flotation tailings streams. Manual measurement of slurry flowrate were performed every 15 minutes, and the computer data acquisition system logged slurry flowrate.

Flotation Settlings

Every hour, with the use of quick connections, a separation disk was placed inside the accumulation column separating the sample being collected into hourly layers. Hence, continuous hourly samples could be separated at the end of the run for each of the settling streams. Probe samples were extracted from each accumulation vessel during hours 2 to 3, 3 to 4, and 6 to 7 and 7 to 8 to generate a composite sample of the testing interval.

Low-Shear Mixers 1 and 2

Hourly composite samples were extracted from each mixer every hour during the test. The sampling frequency was 1 liter every 10 minutes to generate a 1 hour composite. The sample was riffled down to 1 liter for sample analysis, and the remaining sample stored for future analysis. Discrete samples were extracted every 30 minutes, with two duplicate discretes taken randomly during the test. Manual measurements of low-shear mixer 2 were performed every 30 minutes.

Dewatering Screen Underflow

Discrete samples of the dewatering screen underflow were extracted every 30 minutes, and manual measurements of rate were performed every 30 minutes.

Table 3-2

RUN 1
SAMPLING PROGRAM

		Composite					Discrete			
No.	Sample Location	Run Time Period (hours)	Composite Volume (liters)	Composite Sample Interval (hours)	Composite Sample Increment (minutes)	Total Taken	Discrete Volume (liters)	Sample Frequency (minutes)	Total Taken	Entire Sample Collected
1	Feed Coal Hopper	0 to 8	6	1	10	8	1	20	24	No
2	Rod Mill Discharge	0 to 4	6	1	10	4	1	30	8	No
		4 to 8	12	2	10	2	1	30	8	No
3	Flotation Cell Feed	0 to 8	6	1	10	8	1	20	24	No
4	Flotation Cell Product	0 to 4	6	1	10	4	1	20	12	No
		4 to 8	12	2	10	2	1	20	12	No
5	Second Stage Flotation Product	0 to 4	6	1	10	4	1	20	12	No
		4 to 8	12	2	10	2	1	20	12	No
6	Flotation Cell Settlings	2 to 3	Entire Sample	1	Continuous	2	400 ml	10	12	Yes
		6 to 8	Entire Sample	2	Continuous	2	800 ml	10	24	Yes
7	Second Stage Flotation Settlings	2 to 3	Entire Sample	1	Continuous	1	400 ml	10	6	Yes
		6 to 8	Entire Sample	2	Continuous	1	800 ml	10	12	Yes
		0 to 8	6	1	10	8	1	20	24	
8	Flotation Cell Tailings	0 to 8	1	20 min	2	24	1	30	16	No
		2 to 3	6	1	10	1	None			No
		6 to 8	12	2	10	1	None			No
9	Second Stage Flotation Tailings	0 to 8	1	20 min	2	24	1	30	16	No
		2 to 3	6	1	10	1	None			No
		0 to 8	12	2	10	1	None			No
		0 to 8	6	1	10					
10	Low-Shear Mixers 1 & 2	0 to 8	6	1	10	16	1	20	48	Yes
11	Dewatering Screen	0 to 8	6	1	10	16	1	30	16	Yes

Table 3-3

RUN 2
SAMPLING PROGRAM

		Composite					Discrete			
No.	Sample Location	Run Time Period (hours)	Composite Volume (liters)	Composite Sample Interval (hours)	Composite Sample Increment (minutes)	Total Taken	Discrete Volume (liters)	Sample Frequency (minutes)	Total Taken	Entire Sample Collected
1	Feed Coal Hopper	0 to 8	6	1	10	8	1	20	24	No
2	Rod Mill Discharge	0 to 4	6	1	10	4	1	30	8	No
		4 to 8	12	2	10	2	1	30	8	No
3	Flotation Cell Feed	0 to 8	6	1	10	8	1	20	24	No
4	Flotation Cell Product	0 to 8	6	1	10	8	1	20	24	No
5	Second Stage Flotation Product	0 to 8	6	1	10	8	1	20	24	No
6	Flotation Cell Settlings	0 to 8	Entire Sample	1	Continuous	16	60 ml	10	48	Yes
7	Second Stage Flotation Settlings	0 to 8	Entire Sample	1	Continuous	8	60 ml	10	24	Yes
8	Flotation Cell Tailings	0 to 8	1	20 min	2	24				
		2 to 3	6	1	10	1	1	30	16	No
		6 to 7	6	1	10	1				
9	Second Stage Flotation Tailings	0 to 8	1	20 min	2	24				
		2 to 3	6	1	10	1	1	30	16	No
		6 to 7	6	1	10	1				
10	Low-Shear Mixers	0 to 8	None				1	30	32	Yes
		2 to 4	6	1	10	4				
		6 to 8	6	1	10	4				
11	Dewatering Screen	0 to 9					1	30	16	

Table 3-4

RUN 3
SAMPLING PROGRAM

		Composite					Discrete			
No.	Sample Location	Run Time Period (hours)	Composite Volume (liters)	Composite Sample Interval (hours)	Composite Sample Increment (minutes)	Total Taken	Discrete Volume (liters)	Sample Frequency (minutes)	Total Taken	Entire Sample Collected
1	Feed Coal Hopper	0 to 8	12	2	10	2	1	30	16	No
2	Rod Mill Discharge	0 to 8	12	2	10	2	1	30	16	No
3	Flotation Cell Feed	0 to 8	12	2	10	2	1	30	16	No
4	Flotation Cell Product	0 to 8 2 to 4 6 to 8	 6 6	 1 1	 10 10	 2 2	1	30	16	No
5	Second Stage Flotation Product	0 to 8 2 to 4 6 to 8	 6 6	 1 1	 10 10	 2 2	1	30	16	
6	Flotation Cell Settlings	0 to 8 2 to 4 0 to 8 6 to 8	Entire Sample Entire Sample	1 1	Continuous Continuous	4 4	60 ml 60 ml	10 10	24 24	Yes Yes
7	Second Stage Flotation Settlings	2 to 4 6 to 8	Entire Sample Entire Sample	1 1	Continuous Continuous	1 1	60 ml 60 ml	10 10	12 12	Yes Yes
8	Flotation Cell Tailings	0 to 8	1	20 min	2	24	1	30	16	No
9	Second Stage Flotation Tailings	0 to 8	1	20 min	2	24	1	30	16	No
10	Low-Shear Mixers	0 to 8 2 to 4 6 to 8	 6 6	 1 1	 10 10	 4 4	1	30	32	Yes Yes Yes
11	Dewatering Screen	0 to 8					1	30	16	

4.0 ANALYTICAL PROCEDURES AND STANDARDS

This section describes procedures used for sample analysis and other supporting functions.

4.1 Size Analysis

The procedure varies depending on the particle size and method of preparation. The particle size distribution of all feed coal samples dry ground to pass 1 mm, was determined by dry sieving using standard Tyler series 8" full height (2") sieves. The procedures for coal samples prepared by wet grinding were as follows:

For 0.6 mm (28 mesh) top size:

- Wet screen at 0.6 mm to remove plus 0.6 mm particles
- Filter the minus 0.6 mm particles, dry both size fractions at 70°C, and weigh
- Homogenize and then subsample the minus 0.6 mm fraction by taking small increments, to obtain approximately 10-20 grams of sample for sieve analysis
- Dry sieve the two size fractions using sieves of the following openings:

+0.6 mm Fraction	-0.6 mm Fraction
1.400	0.710
1.000	0.500
0.710	0.355
0.500	0.250
Pan	0.180
	0.125
	0.090
	0.063
	0.044
	Pan

For 0.15 mm (100 mesh) top size - the above described procedure was repeated with the exception that the screen size used for wet screening was 0.15 mm.

For 0.074 mm (200 mesh) top size:

- Wet sieve at 0.074 mm
- Filter the minus 0.074 mm fraction, dry both fractions at 70°C, and weigh
- Dry sieve the plus 0.074 mm fraction with sieves used for the -0.6 mm fraction above
- Homogenize the minus 0.074 mm fraction and subsample to obtain about 10 grams for size determination
- Analyze minus 0.074 mm fraction by Granulometer, (723 Laser Light Diffraction) which typically gives the size distribution in 16 increments from 1 micron to 192 microns

4.2 Analysis of Feed Coals, Clean Coals and Rejects

All the project feed coals were analyzed for total sulfur content, sulfur forms, calorific value, ash content and moisture content. The clean coals and rejects were routinely analyzed for total sulfur content, ash content and moisture content. On a selected basis, the clean coals were also characterized for sulfur forms and calorific value.

All these analyses were performed in accordance with ASTM specifications.

Proximate Analysis:	Fisher Coal Analyzer (Instrumental Prox.; ASTM draft stage)
Total Sulfur Analysis:	Leco SC-32 ASTM D 4239-85 High temperature combustion method with IR absorption procedure
Form of Sulfur:	ASTM D 2492 (SO_4 = -> S ICP) (Pyrite -> Fe ICP)
Calorific Value:	ASTM D2015

4.3 Analysis of Agglomerants

Agglomerants were analyzed for total sulfur content (ASTM D4239-85) and characterized by density and viscosity.

Density:	PAAR Densitometer Model DMA55
Viscosity:	BROOKFIELD SYNCHRO-LECTRIC VISCOMETER

API Gravity was calculated from density by the formula:

$$\text{API Gravity} = \frac{141.5}{\text{density at } 15.6^{\circ}\text{C}} - 131.5$$

4.4 Determination of Bridging Liquid Content of Agglomerates and Reject

Scope: This method determines the bridging liquid content of cleaned coal (agglomerates) and reject.

Summary: The sample of agglomerates or reject is separated into liquid and solids by refluxing with dichloromethane in a Soxhlet extraction apparatus (Figure 4-1). The solvent recycles through the extraction thimble to dissolve bridging liquid. The extractables are determined gravimetrically by determining the solids retained in the extraction thimble and/or by evaporation of solvent from the dichloromethane solution of bridging liquid.

Apparatus: Soxhlet extraction apparatus, rotovapor

Reagents: Dichloromethane

Procedure:

- Sample size 30 to 40 g.
- Prior to use, dry extraction thimble for 1 hour at 107°C and store in a desiccator.
- Weigh the extraction thimble to the nearest 0.001 g, fill with the agglomerate sample and weigh again to the nearest 0.001 g.

- Weigh the extraction flask to the nearest 0.001 g, add approximately 250 ml dichloromethane to the flask. Place the thimble in the extractor and assemble the apparatus as in Figure 4-1, ensuring all connections are vapour tight.

- Apply heat and adjust to maintain the reflux rate such that liquid does not overflow the thimble. Continue refluxing as long as solvent dripping from the thimble is colourless. Discontinue heating and disassemble the extraction apparatus.

- Remove the thimble from extractor, dry in vacuum at 90°C to constant weight, cool in desiccator and weigh to the nearest 0.001 g.

- Evaporate the solvent from the dichloromethane solution of bridging liquid, weigh to the nearest 0.001 g.

- Following the above procedure, perform extraction tests for the initial coal sample.

Calculations:

The bridging liquid content of agglomerates is given by:

$$\% \text{ Bridging Liquid} = 100 - \frac{S}{W} \times 100\% \qquad \text{or}$$

$$\% \text{ Bridging Liquid} = \frac{O}{W} \times 100\%$$

Where:

S = weight of dry solids recovered in thimble corrected for coal organic matter solubles, gm

O = weight of dichloromethane solubles corrected for coal organic matter solubles, gm

W = sample weight, gm

4.5 Determination of Moisture Content of Agglomerates by Azeotropic Distillation

Scope: This method determines the moisture content of agglomerates.

Summary: The water is separated from agglomerates by azeotropic distillation with toluene. Condensed solvent and co-distilled water are continuously separated in a trap, the water being retained in the graduated section. The moisture content is determined by measuring the volume of water in the trap. The diagram of the apparatus for azeotropic distillation is shown in Figure 4-2.

Apparatus: Distillation set-up for moisture determination.

Reagents: Saturated toluene.

Procedure:

- Sample size should range from 30 to 40 g.
- Weigh the distillation flask to the nearest 0.001 g, add approximately 30 to 40 g of agglomerate sample and weigh again to the nearest 0.001 g.
- Add approximately 250 ml of saturated toluene to the distillation flask. Assemble the distillation apparatus as in Figure 4-2, ensuring all connections are vapour tight.
- Apply heat and continue distillation for 60 minutes. Discontinue heating and add three drops of isopropyl alcohol around the inside rim of the condenser to bring water droplets adhering to the glass surface of the condenser down into the trap.
- Allow the trap and contents to cool down to room temperature. Estimate the volume of water in the trap to the nearest 0.05 ml.

Calculations:

The bridging liquid content of agglomerates is given by:

$$\% \text{ Moisture} = \frac{V}{W} \times 100\%$$

Where:

V = volume of water retained in trap, ml.

W = sample weight, grams

4.6 Determination of Heptane Content in Agglomerates and Tailings Streams

4.6.1 Agglomerates

Scope: This method determines the amount of heptane retained in agglomerates after thermal drying.

Summary: Heptane agglomerates were spread thinly (1-2 agglomerate thick) on the tray, placed in the oven and allowed to dry at specified temperature. A small sample

of agglomerates (15-20 g) was withdrawn from the oven after a certain period of drying and subjected for Soxhlet extraction.

Apparatus: Soxhlet extraction apparatus (Figure 4-1)

Reagents: Dichloromethane

Procedure: Follow the extraction procedure described in Section 4.4. After the extraction is completed, the amount of dichloromethane solution used for extraction is determined and the solution is subjected for GC analysis.

HP5890 Gas Chromatograph with
HP3396A Integrator and Crosslinked
Methyl Silicone Gum capillary column
and FID Detector

4.6.2 Tailings

Scope: The method determines the amount of heptane loss in the tailings streams.

Summary: Tailings from either high-shear or low-shear stage are collected in a beaker, covered to prevent light hydrocarbon loss, and allowed to settle in order to separate the liquid phase from solids. When the settling is completed, the liquid phase is carefully decanted into a 3-liter separatory funnel and extracted with 3 portions of dichloromethane by using the standard procedure. Extraction procedure is repeated until all the liquid phase is exhausted. Extract is collected in a flask, weighed and sent for GC analysis. The same extraction procedure is repeated for the solids and extract is analyzed separately. Methylene chloride extract, obtained as a result of this procedure is analyzed for heptane content using the same equipment as above.

Calculations:

An example for calculation of the of heptane retained in agglomerates after thermal drying is shown below:

Feed coal input	- 160 g (db)
Heptane input (high- and low-shear)	- 48 g (30% of dry feed)
Clean coal yield	- 152.72 g (db)
Asphalt emulsion (low-shear)	- 5 g (3.3% of dry clean coal)

Drying temperature	- 110°C
Drying time	- 20 min.
Sample for Soxhlet extraction	- 11.49 g (as measured after 20 min. drying)
Moisture by toluene distillation	- 1.9%
Methylene chloride used for extraction	- 276.37 g
Heptane concentration as it is shown on GC chromatogram	- 93.19 p.p.m. or 0.0093%
Amount of heptane in methylene chloride solution	- $\frac{276.37 \times 0.0093}{100} = 0.0257$ g
Percent of the heptane in the sample	- $\frac{0.0257}{11.49} \times 100 = 0.224\%$
Total moisture and heptane in the extraction sample	- 0.224% + 1.9% = 2.12%
Moisture and heptane free sample	- $11.49 \text{ g} - \frac{11.49 \times 2.12}{100} = 11.25$ g
Recalculated total sample (as received after 20 min. drying)	- $\frac{152.72 \times 11.49}{11.25} = 155.98$ g
Amount of heptane in the total sample	- $\frac{155.98 \times 0.224}{100} = 0.35$ g
Percent of heptane retained in the product (of the total heptane input into the process)	- $\frac{0.35}{48} \times 100 = 0.73\%$

Similar calculations were repeated each time when the sampling was done at a different drying time and temperature.

Calculation of the amount of heptane lost into the tailings stream was done by the following scheme.

Amount of methylene chloride used for extraction of tailings sample, g	- A
Percent of heptane as it appears on GC chromatogram, %	- B
Amount of heptane extracted from the tailings sample	- $\frac{A \times B}{100} = C(g)$
Percent of heptane retained in the tailings stream (of the total heptane input into the process)	- $\frac{C(g)}{\text{Heptane (g)}} \times 100$

4.7 Physical Characterization Tests

The objective of these tests is to obtain relevant information on product handleability properties.

The following physical characterization tests were performed:

- Compressive strength test
- Abrasion resistance test (tumbling test)
- Water resistance test
- Weatherability test

4.7.1 Compressive Strength Test

This test method is designed to determine the compressive mass strength of any pelletized material and coal agglomerates. The method was developed at Alberta Research Council. A principle objective of the test is to determine the beginning of the distinct crushing process in the burden material. The test results are presented in the form of a compressive strength curve, Figure 4-3. The proposed apparatus is schematically shown in Figure 4-4.

SI - strength index was established based on the extensive laboratory testing and was defined as a force (kPa) required to obtain 10% of the bed contraction. The results could also be

presented as a height of the bed of the pellets/ agglomerates to be stored or transported in bulk handling systems when the crushing begins.

The calculations are done by using the formula:

$$H = \frac{SI}{\rho\beta \times g} \quad \text{where}$$

H = height of agglomerate bed (m)

SI = strength index (Pa)

$\rho\beta$ = bulk density of agglomerates (kg/m^3)

g = velocity = 9.8 (m/sec^2)

4.7.2 Abrasion Resistance Test

The test is designed to measure the resistance of pellets to breakage upon abrasion and impact and is done according to ASTM tumbling test (Designation E279-69). The results are referred to as ARI-abrasion Resistance Index calculated as follows:

$$ARI = \frac{w}{W} \times 100\ [\%], \quad \text{where}$$

ARI - % retained on 28 mesh screen after tumbling a 100 g charge of pellets/agglomerates at 50 rpm for 100 revolutions.

w = weight of +28 mesh fraction after tumbling (g)

W = weight of initial sample (g)

4.7.3 Water Resistance Test

The test is designed to simulate the wet conditions a fuel might encounter during outdoor storage and is referred to as WRI - water resistance index:

WRI = 100 - % water absorbed after 30 minutes immersion

4.7.4 Weatherability Test

The test is designed to measure the resistance of pellets to disintegrate upon severe weather conditions encountered during outdoor winter storage.

The results are presented as:

$$WI = \frac{w}{W} \times 100 \ (\%)$$

WI = % retained on 28 mesh screen after 4 cycles of 4 hours each freeze/thaw

w = weight of +28 mesh fraction after four cycles (g)

W = weight of initial sample (g)

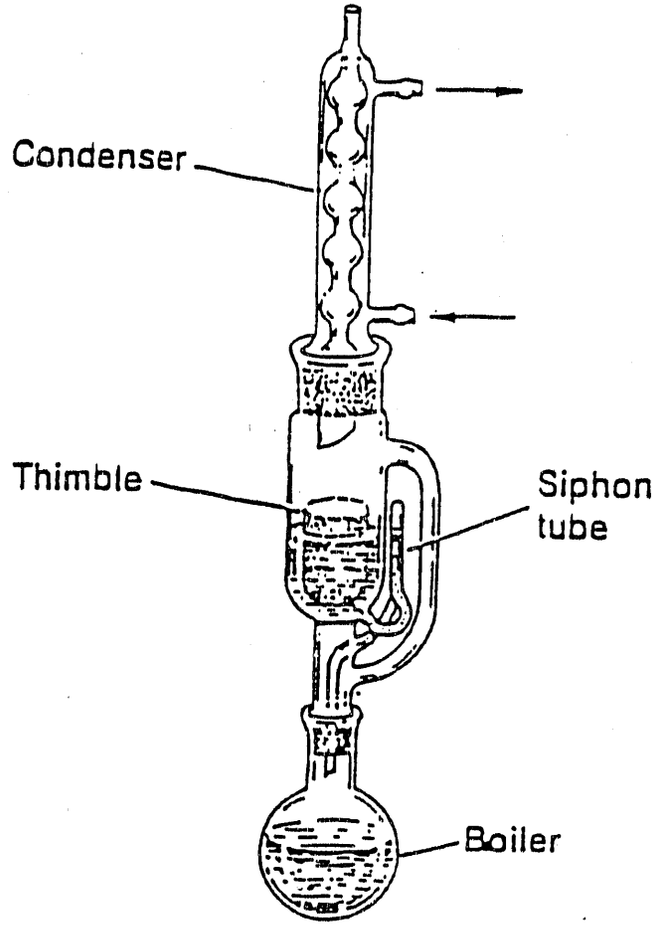


Figure 4-1 Soxhlet Extractor

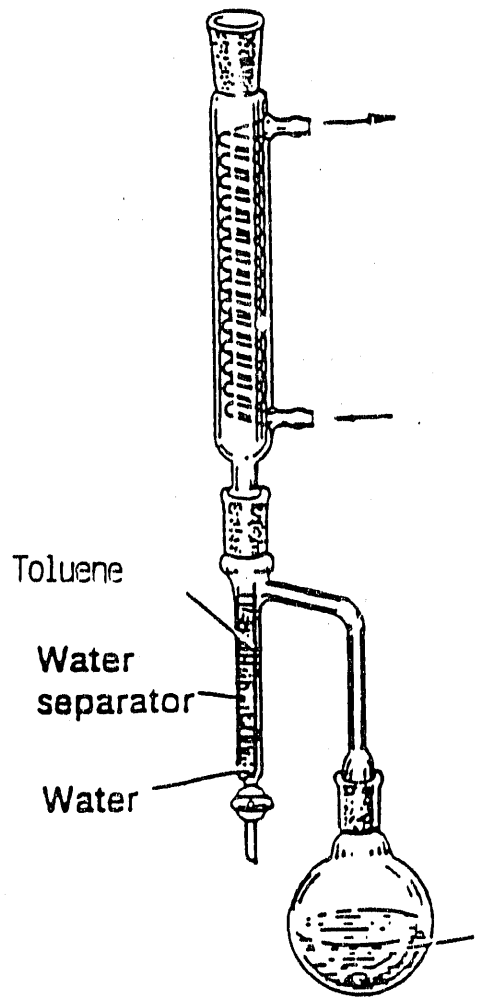


Figure 4-2 Apparatus for Azeotropic Distillation of Water

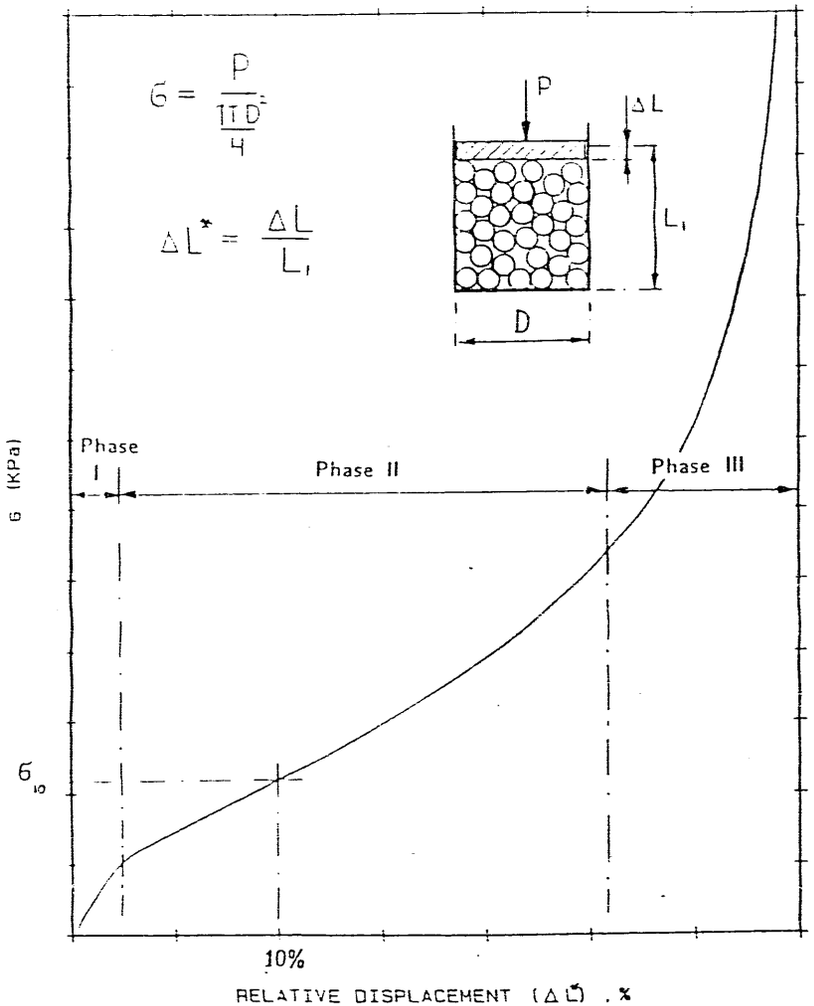


Figure 4-3 Strength of the Bed of Agglomerates as a Function of Contraction

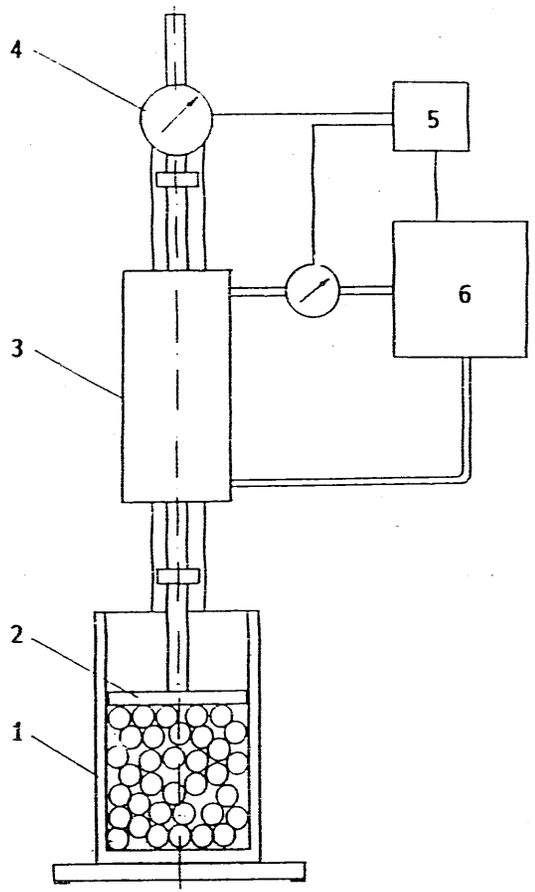


Figure 4-4 Apparatus for Mass Strength Determination 1-cylinder, 2-piston, 3-pressure cylinder, 4-displacement indicator, 5-feed and control system, 6-recorder

5.0 CRITERIA FOR PROCESS PERFORMANCE EVALUATION

The DOE contract "Engineering development of selective agglomeration" has defined a set of selection criteria for process evaluation. The selection criteria cover technical performance, product handleability, economic analysis, and environmental considerations. The technical data used in process evaluation are to be generated from Task 5, "Process testing", Task 6, "Component development", and vendor testings.

Task 5 provides data on basic process performance and information on process operation. Partial information on handleability, environmental considerations, and ancillary considerations are also available from the Task 5 test results. With the prime objectives in pyrite removal by the selective agglomeration processes, pyritic sulfur rejection at maximum BTU recovery are the key factors in process performance. In the Task 5 test program, the following indices were used to evaluate the selective agglomeration processes based on heavy agglomerant and light hydrocarbon.

- BTU Recovery or coal matter recovery (CMR)
- Pyritic sulfur rejection (PSR)
- Total sulfur rejection (TSR)
- Ash rejection (AR)

Experimental data used to calculate these indices are presented in Table 5-1. The formulas used to calculate these indices are described in the following sections.

5.1 BTU Recovery or Coal Matter Recovery (CMR)

$$\text{BTU recovery \%} = \frac{Y_c \times CV_c}{CV_F} \times 100$$

$$\text{CMR \%} = \frac{Y_c\,(100 - A_c)}{(100 - A_F)} \times 100$$

When the calorific values of the clean coal products are not available, coal matter recovery (CMR) is used as an approximate indication of BTU recovery.

5.2 Pyritic Sulfur Rejection (PSR)

$$PSR\ \% = \frac{100\ S_{PF} - Y_c\ S_{PC}}{S_{PF}} \times 100$$

Pyritic sulfur rejection is determined using the above formula when pyritic sulfur content of the product is determined directly. Since pyritic sulfur contents are not always analyzed for each product sample, it is important to be able to estimate the rejection of inorganic sulfurs (pyritic and sulfatic). As sulfatic sulfurs are usually quite small in the project coals, the calculated inorganic sulfur rejections (ISR) are good indications for pyritic sulfur rejection (PSR). The estimation of pyritic sulfur rejection can be based on the following formula for inorganic sulfur rejection:

$$ISR\ \% = \frac{100\ S_{TF} - Y_c\ S_{TC} - [100(1-A_F/100) - Y_c(1-A_c/100)]\ S_{OFDAF}}{S_{IF}} \times 100$$

5.3 Total Sulfur Rejection (TSR)

$$TSR\ \% = \frac{100\ S_{TF} - Y_c\ S_{TC}}{S_{TF}} \times 100$$

5.4 Ash Rejection (AR)

$$AR\ \% = \frac{100\ A_F - Y_c\ A_c}{A_F} \times 100$$

Table 5-1

EXPERIMENTAL DATA USED FOR CALCULATION OF PROCESS PERFORMANCE INDICES

A_F	=	ash content of the feed coal, % dry basis
A_c	=	ash content of the clean coal, % dry and agglomerant-free basis
F	=	weight of the feed coal, gms, dry basis
P_c	=	weight of the clean coal, gms, agglomerant-free, dry basis
S_{TF}	=	total sulfur content of the feed coal, % dry basis
S_{TC}	=	total sulfur content of the clean coal, % dry and agglomerant-free basis
S_{IF}	=	inorganic sulfur content of the feed coal, % dry basis
S_{PF}	=	pyritic sulfur content of the feed coal, % dry basis
S_{PC}	=	pyritic sulfur content of the clean coal, % dry and agglomerant-free basis
S_{OFDAF}	=	organic sulfur content of the feed coal, % dry ash-free basis
Y_c	=	product yield, % dry basis
CV_F	=	calorific value of feed coal, Btu/lb dry basis
CV_c	=	calorific value of clean coal, Btu/lb dry and agglomerant-free basis

6.0 PROJECT FEEDSTOCKS CHARACTERIZATION

Four high sulfur bituminous coals were studied in the main test program of Task 5, whereas, three project coals, referred to as "old project coals" were used during Subtask 5.1, "Selection of Agglomerating Liquids". Since the old project coals were used exclusively in this subtask, only the analytical data relating to these coals are summarized. The project coals used in the main program, except Illinois No. 6, were fully analyzed and characterized for washability and pyrite distribution by petrographic analysis.

6.1 Coal Analysis

The analytical data for the old project coals are summarized in Table 6-1. The origins of the four project coals used in the main program, along with the average analytical results and their ranges are presented in Table 6-2. The project coals were homogenized and split into 30 lb batches in Wilsonville; six batches of Illinois No. 6, eleven batches of Pittsburgh No. 8 and Upper Freeport, and three batches of Kentucky No. 9 were used in batch scale testing.

Table 6-1

ANALYTICAL DATA FOR PROJECT COALS USED IN SUBTASK 5.1

Seam	Illinois No. 6	Pittsburgh No. 8	Upper Freeport
County, State	Randolph, IL	Belmont, OH	Jefferson, PA
Mine Operator	Peabody Coal Co.	R&F Co.	P&N Coal Co.
Rank	hvb	hvb	mvb
Total Sulfur, %	4.4	3.7	1.7
Range	3.5 - 5.0	3.0 - 4.5	1.4 - 2.2
Pyritic Sulfur, %	3.0	2.4	1.3
Range	2.5 - 3.5	1.8 - 3.4	1.0 - 1.7
Ash, %	10.9	10.0	9.1
Range	9.0 - 16.00	9.0 - 14.00	8.0 - 14.00
BTU/lb	11,300	12,600	12,300
Range	10,800 - 12,800	12,000 - 13,500	12,000 - 14,000
Moisture, %	9.0	4.0	9.0
Range	6.0 - 13.0	2.0 - 8.0	2.0 - 10.0
Volatile Matter, %	42.0	40.2	21.5
Range	38.5 - 44.5	37.0 - 43.5	20.5 - 25.5
Grindability	60	55	70
Range	55 - 65	50 - 60	65 - 80

Table 6-2

ANALYTICAL PROPERTIES OF PROJECT COALS (DRY BASIS)

	Illinois No. 6	Upper Freeport	Pittsburgh No. 8	Kentucky No. 9
Seam				
County, State	Randolph, IL	Jefferson, PA	Belmont, OH	Webster, KY
Mine Operator	Peabody Coal Co.	P&N Coal Co.	R&F Coal Co.	Pyro Mining Co.
Moisture, %				
Average	9.9	1.9	3.2	3.1
Range	8.9-10.7	1.4-2.3	2.4-4.2	2.9-3.2
Ash, %				
Average	15.6	13.8	11.3	16.3
Range	10.6-19.6	12.4-15.8	10.1-12.5	15.5-16.9
Total Sulfur, %				
Average	4.47	2.18	4.21	4.52
Range	3.07-5.44	2.18-2.42	3.81-4.54	4.35-4.83
Sulfatic, Sulfur, %				
Average	0.20	0.13	0.15	0.05
Range	0.06-0.46	0.07-0.20	0.07-0.32	0.03-0.05
Pyritic Sulfur, %				
Average	2.30	1.56	1.87	2.98
Range	0.92-3.40	1.39-1.73	1.33-2.33	2.86-3.15
Organic Sulfur, %				
Average	1.97	0.59	2.19	1.49
Range	1.88-2.09	0.58-0.64	2.16-2.22	1.40-1.61
Calorific Value, Btu/lb				
Average	11,950	13,140	13,030	12,640
Range	11,380-12,630	12,820-13,440	12,510-13,380	12,520-12,840
Volatile Matter, %				
Average	35.6	26.3	35.7	34.1
Range	34.0-38.2	24.0-28.3	33.5-38.2	34.0-34.2

6.2 Grind Size Data

The project coals were wet ground to 28, 100 and 200 mesh top size for the batch testing program. In order to control particle size distribution, d_{50} (mass median diameter) of each grind size was determined. The grinding time for different solid contents were determined prior to the test program.

D_{50} (range and average) and grinding time for all the project coals are summarized in Table 6-3.

Table 6-3

COAL GRINDING DATA

	% Solids	Top Size Mesh	Average d50 (mm)	Average Grinding Time (min.)	Range d50 (mm)	Range Grinding Time (min.)
Pittsburgh No. 8	5	28	0.117	2	0.114-0.120	2-3
		100	0.060	5	0.060	5
		200	0.025	12	0.021-0.028	10-15
	20	28	0.124	10	0.102-0.136	6-14
		100	0.063	34	0.058-0.065	29-36
		200	0.028	41	0.025-0.031	25-54
Upper Freeport	5	28	0.123	2	0.119-0.128	1-2
		100	0.057	5	0.056-0.058	5
		200	0.025	7	0.022-0.027	6-7
	20	28	0.124	5	0.100-0.140	4-7
		100	0.062	17	0.058-0.065	16-17
		200	0.024	25	0.020-0.028	20-31
Illinois No. 6	5	28	0.125	3	0.125	3
		100	-	-	-	-
		200	0.025	14	0.023-0.25	14-15
	20	28	0.131	9	0.118-0.162	6-14
		100	0.059	28	0.059	28
		200	0.028	37	0.025-0.030	25-55
Kentucky No. 9	5	28	0.108	4	0.105-0.112	3-5
		100	0.068	6	0.068	6
		200	0.024	17	0.021-0.027	9-13
	20	28	0.123	11	0.113-0.129	9-13
		100	0.066	26	0.061-0.069	23-30
		200	0.024	47	0.022-0.026	46-48

6.3 Washability Analysis

The washability characteristics of the four project coals ground to top size of 28 mesh, 100 mesh and 200 mesh, were determined by Geochemical Testing Laboratory of Sommerset, Pennsylvania. To ensure that same particle size distributions were used in agglomeration experiments and washability testing, the samples were prepared by the Alberta Research Council following the procedures of wet grinding. A description of sampling procedures used in washability testing was summarized in Task 4.3, "Coal Characterization". All size and gravity fractions were analyzed for ash, BTU, total sulfur and pyritic sulfur contents.

While the washability data were determined at five top size levels at 2", 1/4", 28 mesh, 100 mesh, and 200 mesh, the data of the last three top sizes are particularly important for evaluating the performance of agglomeration experiments. The washability data of samples at top sizes of 2" and 1/4" were useful in overall engineering assessment when precleaning was incorporated with the agglomeration process. The washability data for Illinois No. 6, Pittsburgh No. 8, Upper Freeport, and Kentucky No. 9 are summarized in Tables 6-4 to 6-7, inclusive for discussion.

Table 6-4

ILLINOIS NO. 6
Randolph County, IL

2" x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#S02/ M BTU	(%) PSR
	1.30	53.6	4.85	2.74	0.53	13616	57.48	4.03	72.36
1.30	1.40	87.2	7.27	2.90	0.72	13207	90.67	4.39	39.25
1.40	1.50	94.0	8.13	2.98	0.81	13066	96.72	4.56	25.55
1.50	1.60	96.2	8.57	3.01	0.86	12996	98.46	4.63	19.82
1.60	1.70	97.1	8.81	3.02	0.88	12958	99.07	4.66	16.89
1.70	1.80	97.6	8.97	3.03	0.89	12932	99.41	4.68	15.19
1.80		100.0	10.25	3.12	1.03	12697	100.00	4.92	0.00

1/4" x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#S02/ M BTU	(%) PSR
	1.30	72.2	5.65	2.74	0.60	13477	76.86	4.07	57.96
1.30	1.40	86.0	6.79	2.80	0.68	13283	90.21	4.21	43.30
1.40	1.50	92.2	7.71	2.84	0.74	13138	95.72	4.32	33.48
1.50	1.60	94.8	8.25	2.87	0.79	13052	97.80	4.40	27.30
1.60	1.70	96.0	8.58	2.89	0.82	13001	98.60	4.44	23.82
1.70	1.80	96.8	8.83	2.90	0.84	12960	99.10	4.48	21.08
1.80		100.0	10.49	3.05	1.03	12656	100.00	4.82	0.00

28M x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#S02/ M BTU	(%) PSR
	1.30	42.1	2.30	2.05	0.20	14110	47.67	2.90	92.76
1.30	1.40	69.1	3.92	2.08	0.28	13836	76.63	3.01	83.89
1.40	1.50	83.4	5.74	2.12	0.35	13547	90.55	3.12	75.45
1.50	1.60	89.0	6.96	2.13	0.40	13359	95.37	3.19	70.11
1.60	1.70	91.2	7.57	2.13	0.42	13267	97.00	3.21	67.90
1.70	1.80	92.6	8.06	2.14	0.44	13189	97.93	3.24	65.78
1.80		100.0	12.23	2.79	1.19	12471	100.00	4.47	0.00

Table 6-4 (Continued)

ILLINOIS NO. 6
Randolph County, IL

100M x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#S02/ M BTU	(%) PSR
	1.30	38.8	2.05	2.01	0.13	14108	44.02	2.85	95.69
1.30	1.40	69.5	3.62	2.06	0.18	13818	77.32	2.99	89.35
1.40	1.50	83.4	5.35	2.10	0.26	13543	90.90	3.10	82.00
1.50	1.60	88.2	6.40	2.11	0.30	13385	95.03	3.15	77.91
1.60	1.70	90.4	7.04	2.11	0.32	13288	96.71	3.17	75.97
1.70	1.80	92.0	7.63	2.11	0.34	13196	97.77	3.20	73.76
1.80		100.0	12.22	2.85	1.20	12421	100.00	4.59	0.00

200M x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#S02/ M BTU	(%) PSR
	1.30	38.1	2.33	1.97	0.11	14226	42.73	2.77	96.32
1.30	1.40	71.2	3.77	1.98	0.16	13959	78.43	2.84	89.90
1.40	1.50	85.3	5.40	1.98	0.22	13708	92.24	2.89	83.71
1.50	1.60	89.3	6.14	1.98	0.24	13593	95.84	2.91	80.99
1.60	1.70	91.2	6.63	1.98	0.26	13518	97.25	2.93	79.13
1.70	1.80	92.2	7.01	1.99	0.28	13457	97.95	2.95	77.46
1.80		100.0	11.76	2.75	1.14	12672	100.00	4.35	0.00

Table 6-5

PITTSBURGH NO. 8
Belmont County, OH

2" x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#S02/ M BTU	(%) PSR
	1.30	30.1	3.81	2.91	0.51	14320	2.7	4.06	93.44
1.30	1.40	82.2	6.38	3.78	1.61	13658	85.51	5.54	42.65
1.40	1.50	93.7	7.60	4.14	2.05	13486	96.15	6.14	17.23
1.50	1.60	96.5	8.15	4.21	2.14	13403	98.44	6.28	10.73
1.60	1.70	97.2	8.30	4.23	2.17	13376	98.97	6.32	8.93
1.70	1.80	98.0	8.51	4.25	2.20	13343	99.51	6.37	6.91
1.80		100.0	9.75	4.34	2.31	13136	99.99	6.61	0.01

Table 6-5 (Continued)

PITTSBURGH NO. 8
Belmont County, OH

1/4" x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#S02/ M BTU	(%) PSR
	1.30	53.8	4.18	2.96	0.59	14260	58.10	4.16	85.70
1.30	1.40	82.5	5.74	3.47	1.19	13867	86.66	5.01	55.40
1.40	1.50	91.0	6.77	3.77	1.54	13708	94.52	5.49	36.42
1.50	1.60	94.7	7.51	3.91	1.73	13591	97.56	5.75	25.80
1.60	1.70	95.9	7.78	3.96	1.79	13545	98.41	5.85	22.05
1.70	1.80	96.8	8.04	4.01	1.85	13501	99.07	5.93	18.63
1.80		100.0	9.79	4.30	2.20	13194	100.01	6.52	0.00

28M x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#S02/ M BTU	(%) PSR
	1.30	55.0	2.85	2.63	0.17	14404	60.06	3.65	95.26
1.30	1.40	81.0	4.29	2.79	0.41	14151	86.92	3.95	82.76
1.40	1.50	89.0	5.28	2.92	0.58	13979	94.31	4.17	73.28
1.50	1.60	91.9	5.87	2.99	0.68	13878	96.69	4.31	67.62
1.60	1.70	93.3	6.25	3.05	0.75	13814	97.75	4.41	63.68
1.70	1.80	94.2	6.53	3.10	0.81	13764	98.36	4.50	60.40
1.80		100.0	9.67	4.17	1.93	13186	100.00	6.32	0.00

100M x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#S02/ M BTU	(%) PSR
	1.30	4[illegible]	2.28	2.55	0.08	14513	52.77	3.52	97.80
1.30	1.40	81.[illegible]	3.78	2.60	0.22	14230	88.35	3.66	90.13
1.40	1.50	88.6	4.56	2.65	0.31	14093	94.67	3.76	84.84
1.50	1.60	91.2	5.07	2.70	0.38	14004	96.81	3.85	81.05
1.60	1.70	92.5	5.43	2.74	0.44	13943	97.78	3.93	77.87
1.70	1.80	93.2	5.64	2.77	0.47	13906	98.21	3.99	75.78
1.80		100.0	9.42	4.06	1.82	13196	100.00	6.15	0.00

200M x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#S02/ M BTU	(%) PSR
	1.30	46.3	2.36	2.52	0.08	14417	50.69	3.50	97.88
1.30	1.40	80.4	3.83	2.56	0.20	14186	86.65	3.61	90.65
1.40	1.50	88.4	4.57	2.61	0.28	14058	94.46	3.71	85.78
1.50	1.60	91.1	5.07	2.64	0.34	13975	96.77	3.78	82.41
1.60	1.70	92.4	5.39	2.67	0.38	13921	97.73	3.84	79.75
1.70	1.80	93.3	5.66	2.71	0.42	13875	98.31	3.90	77.32
1.80		100.0	9.47	3.98	1.75	13162	100.00	6.05	0.00

Table 6-6

UPPER FREEPORT
Jefferson County, PA

2" x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#SO2/ M BTU	(%) PSR
	1.30	29.3	4.06	1.12	0.46	14885	34.33	1.51	91.35
1.30	1.40	62.8	8.16	1.41	0.75	14124	69.74	1.99	69.83
1.40	1.50	86.1	11.48	1.61	0.96	13544	91.75	2.37	46.01
1.50	1.60	92.3	12.63	1.70	1.06	13345	96.90	2.55	37.06
1.60	1.70	94.1	13.05	1.75	1.11	13271	98.20	2.63	33.05
1.70	1.80	94.8	13.26	1.78	1.14	13235	98.70	2.69	30.43
1.80		100.0	16.17	2.18	1.56	12714	100.00	3.43	0.00

1/4" x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#SO2/ M BTU	(%) PSR
	1.30	35.6	3.45	0.90	0.27	15033	42.02	1.20	94.42
1.30	1.40	68.6	6.89	1.04	0.45	14372	77.34	1.45	81.90
1.40	1.50	81.3	9.00	1.16	0.59	13998	89.26	1.66	71.85
1.50	1.60	87.2	10.35	1.25	0.69	13769	94.08	1.82	64.87
1.60	1.70	90.7	11.37	1.32	0.77	13594	96.70	1.95	59.13
1.70	1.80	92.[illegible]	12.00	1.38	0.84	13484	97.87	2.05	54.98
1.80		100.0	15.93	2.26	1.72	12755	100.00	3.55	0.00

28M x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#SO2/ M BTU	(%) PSR
	1.30	43.3	2.41	1.23	0.13	14784	49.10	1.66	95.25
1.30	1.40	71.5	4.48	1.29	0.20	14349	78.69	1.80	87.86
1.40	1.50	82.7	6.18	1.32	0.26	14061	89.20	1.88	82.13
1.50	1.60	91.0	7.65	1.33	0.30	13808	96.38	1.92	77.50
1.60	1.70	94.7	9.23	1.54	0.51	13534	98.30	2.27	59.49
1.70	1.80	95.8	9.64	1.54	0.52	13468	98.96	2.29	57.93
1.80		100.0	11.95	2.21	1.19	13033	100.00	3.39	0.00

100M x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#SO2/ M BTU	(%) PSR
	1.30	41.2	2.29	1.11	0.08	14739	47.27	1.50	97.60
1.30	1.40	71.2	4.18	1.18	0.14	14354	79.57	1.65	92.83
1.40	1.50	83.2	5.74	1.20	0.18	14092	91.33	1.71	88.96
1.50	1.60	88.1	6.79	1.22	0.21	13916	95.45	1.75	86.31
1.60	1.70	90.3	7.44	1.22	0.23	13809	97.13	1.77	84.70
1.70	1.80	91.7	7.95	1.23	0.24	13725	98.00	1.79	83.36
1.80		100.0	12.86	2.39	1.35	12840	100.00	3.73	0.00

Table 6-6 (Continued)

UPPER FREEPORT
Jefferson County, PA

200M x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#S02/ M BTU	(%) PSR
	1.30	37.6	2.08	1.12	0.06	14904	43.21	1.50	98.34
1.30	1.40	70.9	3.66	1.19	0.10	14544	79.45	1.63	94.91
1.40	1.50	83.9	5.34	1.21	0.15	14244	92.16	1.70	90.96
1.50	1.60	87.8	6.14	1.21	0.17	14111	95.54	1.72	89.13
1.60	1.70	90.1	6.77	1.22	0.19	14005	97.22	1.74	87.72
1.70	1.80	91.4	7.25	1.23	0.20	13924	98.06	1.76	86.61
1.80		100.0	12.53	2.39	1.36	12973	100.00	3.68	0.00

Table 6-7

KENTUCKY NO. 9 WASHABILITY RESULTS

2" x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#S02/ M BTU	(%) PSR
	1.30	31.0	3.42	2.35	0.41	14563	38.17	3.22	95.97
1.30	1.40	70.7	6.65	2.58	0.77	14043	83.94	3.67	82.54
1.40	1.50	78.2	7.63	2.77	1.00	13880	91.78	3.99	74.79
1.50	1.60	80.4	8.08	2.85	1.11	13806	93.84	4.13	71.47
1.60	1.70	81.8	8.43	2.94	1.20	13748	95.08	4.27	68.42
1.70	1.80	82.6	8.71	2.98	1.26	13701	95.68	4.35	66.64
1.80		100.0	19.76	4.62	3.12	11831	100.00	7.81	0.00

1/4" x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#S02/ M BTU	(%) PSR
	1.30	34.6	3.28	2.25	0.33	14611	43.26	3.08	96.00
1.30	1.40	69.3	6.31	2.50	0.67	14098	83.63	3.54	83.25
1.40	1.50	76.6	7.34	2.64	0.85	13931	91.24	3.79	77.48
1.50	1.60	79.2	7.88	2.73	0.95	13841	93.79	3.95	73.90
1.60	1.70	80.4	8.21	2.80	1.03	13786	94.88	4.06	71.49
1.70	1.80	91.3	8.49	2.85	1.08	13740	95.57	4.14	69.68
1.80		100.0	2[illegible]57	4.42	2.89	11688	100.00	7.56	0.00

Table 6-7 (Continued)

KENTUCKY NO. 9 WASHABILITY RESULTS

28M x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#S02/ M BTU	(%) PSR
	1.30	41.9	2.61	2.18	0.21	14655	52.47	2.97	96.97
1.30	1.40	65.5	4.96	2.30	0.41	14277	79.95	3.22	90.81
1.40	1.50	73.4	6.11	2.37	0.52	14090	83.35	3.37	87.03
1.50	1.60	79.1	7.30	2.43	0.61	138889	93.96	3.50	33.34
1.60	1.70	80.6	7.69	2.47	0.67	13823	95.27	3.58	81.44
1.70	1.80	81.5	8.03	2.52	0.73	13765	95.94	3.66	79.72
1.80		100.0	20.13	4.46	2.92	11700	100.00	7.62	0.00

100M x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#S02/ M BTU	(%) PSR
	1.30	40.9	2.61	2.14	0.16	14620	51.21	2.93	97.62
1.30	1.40	66.9	4.75	2.18	0.29	14268	81.67	3.05	93.14
1.40	1.50	74.4	5.98	2.22	0.37	14069	89.62	3.16	90.00
1.50	1.60	78.2	6.72	2.26	0.44	13948	93.28	3.24	87.77
1.60	1.70	80.2	7.23	2.30	0.49	13865	95.20	3.32	85.79
1.70	1.80	81.2	7.57	2.33	0.54	13808	95.93	3.38	84.35
1.80		100.0	20.04	4.33	2.78	11686	100.00	7.41	0.00

200M x 0 COMPOSITE DATA

Specific Gravity Sink	Specific Gravity Float	(%) wt	(%) Ash	(%) Total S	(%) Pyr S	BTU	(%) BTU Rec	#S02/ M BTU	(%) PSR
	1.30	34.3	2.89	2.12	0.14	14571	42.43	2.91	98.39
1.30	1.40	67.4	4.66	2.12	0.21	14297	81.94	2.97	95.17
1.40	1.50	74.7	5.69	2.14	0.27	14135	89.72	3.03	93.17
1.50	1.60	78.9	6.48	2.17	0.33	14004	93.89	3.10	91.40
1.60	1.70	80.5	6.88	2.19	0.37	13939	95.38	3.15	90.15
1.70	1.80	81.4	7.19	2.22	0.40	13887	96.04	3.20	89.10
1.80		100.0	19.77	4.55	2.98	11763	100.00	7.74	0.00

6.3.1 Illinois No. 6

The washability data of precleaned Illinois No. 6 showed that considerable amounts of material floated at low specific gravities. Approximately 84% of the material was recovered at 90% BTU recovery for the three grind sizes studied.

For this level of BTU recovery, pyritic sulfur rejections were 75%, 82% and 83% at top size of 28 mesh, 100 mesh and 200 mesh, respectively. The corresponding ash contents were all in the 5-6% range. While there was a reduction of 7% in pyritic sulfur rejection when the top size was reduced from 28 mesh to 100 mesh, there was practically no additional liberation of pyrite when the top size was further reduced to 200 mesh.

6.3.2 Pittsburgh No. 8

Similar washability characteristics were observed for Pittsburgh No. 8 project coal. At 90% BTU recovery, approximately 85% of the material was recovered for all three grind sizes investigated.

For this level of BTU recovery, the pyritic sulfur rejection was about 80% at a top size of 28 mesh and increased to about 87% when the top size was reduced to 100 and 200 mesh. The difference in pyrite rejection was negligible for the 100 mesh and 200 mesh grind. Ash contents of the clean coals at this BTU recovery level were about 5%, 4% and 4% at to sizes of 28, 100 and 200 mesh, respectively.

6.3.3 Upper Freeport

In contrast to Illinois No. 6 and Pittsburgh No. 8 coal samples, the raw Upper Freeport coal was used in this project. At 90% BTU recovery level, the amount of floated material was about 80% for 28, 100 and 200 mesh top sizes.

Pyritic sulfur rejections at 90% BTU recovery for 28, 100 and 200 grinds were 82%, 89% and 92%, respectively. The corresponding ash contents were 6.2%, 5.8% and 5.4%, respectively. Similar to the other project coals discussed above, the improvement in pyrite rejection by reducing the grind size from 100 to 200 mesh was not significant.

6.3.4 Kentucky No. 9

Kentucky No. 9 was a raw coal and replaced Illinois 6 in this project. A clean coal yield at 90% BTU recovery level was approximately 75% for 28, 100 and 200 grind sizes. Pyrite rejections

were approximately 85%, 89% and 93% for top sizes of 28, 100 and 200 mesh, respectively. The corresponding ash contents were 6.5%, 6% and 5.7%. The washability data showed that a reduction in size from 100 to 200 mesh was not beneficial.

6.4 Pyrite Characterization and Distribution by Petrographic Analysis

A selective rejection of pyrite particles from coal by agglomeration may be facilitated by estimating the pyrite distribution in the coal sample. A determination of pyrite distribution and its association was performed on three project coals, namely Upper Freeport, Pittsburgh No. 8 and Kentucky No. 9. Both 28 mesh and 200 mesh grind were studied for the Kentucky No. 9 while for the other two coals, only the 200 mesh grind was characterized.

The petrographic analyses were carried out by the Centre of Applied Energy Research at the University of Kentucky using a Leitz microscope.

The pyrite particles were categorized as "free", "edged", and "included" particles. An edged pyrite was defined as pyrite partially surrounded by coal matter while the included pyrites were particles completely surrounded by coal matter. The microscopic analyses estimated the relative number of particles in each of the above categories in specific size fractions. An estimate of the relative volume occupied by particles in each category was derived from the frequency distribution of the particles by applying an average volume for each size, using an estimate of the average diameter of the particles. The calculation method used at the University of Kentucky assumed the pyrite particle was spherical in shape. It should be noted that this analysis suffers from the drawback that interpretation of a three-dimensional object is based on a two-dimensional representation.

Detailed characterization of the three project coals is presented in Table 6-8 and summarized in Table 6-9. The summary results showed that Pittsburgh No. 8, which was a precleaned coal, had much less "free" pyrites than the other two raw coals (78% vs 88-91%). This was to be expected as free pyrites present in the Pittsburgh No. 8 coal had been removed by the precleaning process. There was also a large amount of "edged" pyrites in the Pittsburgh No. 8 coal. The summary results also showed that by reducing the top sizes of Kentucky No. 9, there was a significant increase in free pyrite and a drastic reduction of edged and included pyrites.

Table 6-8

DETAILED CHARACTERIZATION OF THREE PROJECT COALS

State	Diameter (um)	Pittsburgh No. 8 Feed 200 mesh	Upper Freeport Feed 200 mesh	Kentucky No. 9 Feed 28 mesh	Kentucky No. 9 Feed 200 mesh
Free	<5	5.45	0.65	0.69	2.08
	5 - 10	11.05	2.70	0.68	2.20
	10 - 25	32.63	10.37	2.22	12.19
	25 - 40	28.98	10.81	17.77	21.66
	40 - 75	0.00	66.74	0.00	50.15
	Total	78.11	91.27	21.36	88.28
Approx. Pyr Sul, %		1.48	1.37	0.62	2.58
Included	<5	0.81	0.15	1.30	0.33
	5 - 10	4.42	0.37	3.73	1.24
	10 - 25	0.00	0.00	10.00	2.71
	25 - 40	0.00	0.00	0.00	0.00
	40 - 75	0.00	0.00	0.00	0.00
	Total	5.22	0.51	15.03	4.28
Approx. Pyr Sul, %		0.10	0.01	0.44	0.13
Edge	<5	1.68	0.14	0.44	0.62
	5 - 10	7.73	0.41	2.03	2.75
	10 - 25	7.25	4.06	2.22	4.06
	25 - 40	0.00	3.60	17.77	0.00
	40 - 75	0.00	0.00	41.15	0.00
	Total	16.66	8.21	63.61	7.43
Approx. Pyr Sul, %		0.32	0.12	1.86	0.22

Table 6-9

SUMMARY OF PYRITE DISTRIBUTION

	Pittsburgh No. 8 200 mesh	Upper Freeport 200 mesh	Kentucky No. 9 200 mesh	Kentucky No. 9 28 mesh
Free pyrites	78.1	91.3	88.3	21.4
Edged pyrites	16.7	8.2	7.4	63.6
Included pyrites	5.2	0.5	4.3	15.0
TOTAL	100.0	100.0	100.0	100.0

A detailed characterization of pyrite distribution also provided the distribution of various types of pyrites according to size. It was noticed that relatively large free pyrites existed for Upper Freeport and Kentucky No. 9 coal, while the free pyrites in Pittsburgh No. 8 were substantially smaller.

6.5 Agglomerant Characterization

Five agglomerants were used in the batch evaluation program covering the range from light hydrocarbons to heavier crude oils. The light hydrocarbons were reported to have excellent selectivity for carbonaceous materials while heavier hydrocarbon provided better BTU recovery. The heavier liquids have been successfully used at Alberta Research Council for the formation of microagglomerates. As the conventional crude represents a mixture of light and heavy fractions, the use of a crude oil may have the combined technical benefits and at a lower agglomerant cost. Hexane was used as the light agglomerant in the early stage of the project and was replaced later by heptane. The decision was made based on economic and engineering assessment. Diesel oil, mixture of Maya crude and diesel oil (1:1 ratio) and mixture of Fuel Oil No. 6 and diesel oil (4:1 ratio) were used in a heavy agglomerant program.

Agglomerants used in the Task 5 program were analyzed for total sulfur content, density, and viscosity at two temperatures. These data are presented in Table 6-10.

Table 6-10

ANALYSIS OF AGGLOMERANTS

Agglomerants	Density g/cm³	API Gravity	Viscosity, cP 20°C	Viscosity, cP 40°	Total Sulfur %
Hexane	0.6603	81.6	0.47	0.41	-
Heptane	0.6837	75.5	0.42	-	-
Diesel	0.8613	32.8	4.60	2.90	-
Maya + Diesel (1:1)	0.8915	27.2	18.60	9.30	1.76
Fuel No. 6 + Diesel (4:1)	0.9593	16.0	209.30	70.50	1.22
Maya Crude	0.9227	21.8	177.50	60.70	3.52

7.0 BATCH SCALE TEST PROGRAM

7.1 Summary of Test Plan

The primary objective of the Task 5 batch scale test program was to simultaneously develop the selective agglomeration processes based on "heavy" agglomerant and "light" hydrocarbon. In order to critically evaluate these process options, their performances at the optimized conditions were determined and used for process comparison. The optimized process conditions were also used for the development of process flowsheets for engineering assessment and economic analysis.

The test plan for the batch scale process testing began with the selection of agglomerants (Task 5.1), and the methods for microagglomerate recovery. A significant effort was devoted to the optimization of the high-shear operations for single-stage processing for both process options, however, for the "heavy" agglomerant, a two-stage processing scheme was also investigated. In addition to the work on process optimization, a number of secondary process variables were also investigated. A short test program on low-shear operation was formulated to provide support data for low-shear testing in continuous operations.

The test plan, designed to be evolutionary, also incorporated a number of tests to support the engineering evaluation of the selective agglomeration processes. These included drying tests of agglomerates produced from both processes, tests to determine heptane balance, tests to investigate alternative size enlargement methods, and preliminary tests to assess the handleability of the products.

While the batch scale tests were mostly interactive in nature, they could be classified into test groups. These groups are summarized in Table 7-1.

Table 7-1

SUMMARY OF TEST PLAN FOR BATCH SCALE TEST PROGRAM

	Test Classification	Test Variables/Objectives
1.	Agglomerant evaluation	Hexane/heptane (light agglomerants) Diesel, Maya/diesel mixture, Maya crude, and fuel oil/diesel mixture (heavy agglomerants)
2.	Microagglomerate recovery methods	Flotation or screening
3.	High-shear optimization	Grind size Agglomerant concentration, % High-shear solids contents, % High-shear agitation rate, rpm High-shear residence time, min Flotation solids, % Flotation residence time, min Incremental flotation time, sec Screen loading
4.	Secondary process variables	Pyrite depressant Emulsification Oxidation pH effect on agglomeration and flotation Effect of slurry storage
5.	Two-stage processing (heavy agglomerant)	Product regrinding Tailing processing
6.	Low-shear operation	Binders selection on consumption, solids concentration, %
7.	Support tests	Heptane agglomerates drying Heptane balances Diesel agglomerates drying Alternative size enlargement Product handleability
8.	Confirmation tests	Heptane testing at Arcanum Corporation

7.2 Selection of Agglomerants

The first test program in Task 5 was targeted for the selection of agglomerants. Five agglomerants were studied covering the range from light hydrocarbon to heavy fraction from petroleum sources. The agglomerants used were hexane, diesel, a mixture of diesel and Maya crude (1:1), a mixture of diesel and Fuel Oil No. 6 (1:4), and Maya crude. This work was performed under Subtask 5.1, "Evaluation of Agglomerating Liquids". These agglomerants were selected based on general data available on selective agglomeration technologies. Generally the light hydrocarbons are more selective in the rejection of mineral matters, while the heavy bridging liquids are more beneficial in terms of energy recovery.

Variables studied under this program included five agglomerant types, four agglomerant concentrations and two grind sizes, of three project coals. It should be noted that these three project coals were used only in this subtask; and different project coals were used in the remainder of the Task 5 program for both the batch, bench scale continuous testing, and operation in the IATF.

Test Objectives

The primary test objective of this subtask was to select the agglomerant for the main test program of Task 5. The effects of agglomerant concentrations and grind sizes for each project coal are also revealed in this study.

Test Conditions and Descriptions

The test matrix designed for this subtask covered five agglomerants, four agglomerant concentrations, and two coal grind sizes, for all project coals. The levels of these testing parameters are listed in Table 7-2.

Table 7-2

TEST CONDITIONS

Coal	Pittsburgh No. 8, Upper Freeport, Illinois No. 6
Agglomerants	Hexane, diesel, Maya, mixture of Maya and diesel and mixture of Fuel No. 6 and diesel
Agglomerant, %	0.5, 3.0, 6.0, 10.0
Coal grind size, mesh	28, 200 top size)
High-shear solids, %	20
High-shear agitation, rpm	2000
High-shear residence time, min	4
Low-shear solids, %	20
Low-shear agitation, rpm	1800
Low-shear residence time, min	16
Recovery method	Flotation
Flotation solids%	6
Flotation stages	Two
Frother additions	(optional for low agglomerant concentration cases)

For experiments performed at higher concentrations of agglomerant (6% and 10%), a low-shear step was added after the high-shear operation. On the contrary, in the case of low dosages of agglomerants (0.5% and 3.0%), it was found that adding frother to assist the recovery of microagglomerates became necessary in some cases. Furthermore, when low dosages of hexane were used, the evaporation of hexane during the experimental procedures, particularly during the flotation stage, made the recovery of microagglomerate almost impossible without the addition of frothers.

In order to fully understand the significance of process variables, all the test results gathered from this subtask were analyzed statistically (see Section 12).

Result Analysis

While the primary objective of this subtask was to select agglomerants for further study, it was necessary to first discuss the effect of agglomerant concentrations, as they have an important impact on process performance. To a less extent, the coal particle size also affects pyrite rejection and BTU recovery. The effect of these parameters are therefore first discussed before the data are evaluated for agglomerant selection.

Test results covering the entire range of agglomerant concentrations are provided in Tables 7-3 to 7-8, for all the project coals, agglomerants and grind sizes. To illustrate the effect of agglomerant concentrations, the pyritic sulfur rejections as a function of agglomerant concentrations are plotted in Figures 7-1 to 7-6, inclusive for all the project coals and agglomerants except hexane. The data are summarized in Table 7-9. The hexane results were excluded from this data analysis because the experimental procedure employed, was not suitable for handling light hydrocarbon. The loss of hexane during testing, and particularly in the flotation cell, significantly altered the experimental results.

The trends observed in Figures 7-1 to 7-6, and Tables 7-3 to 7-9, showed that higher agglomerant concentrations resulted in the reduction of inorganic sulfur rejection. A decrease in the agglomerant consumption was beneficial in terms of pyritic sulfur rejection, however this was counter balanced by reduction in BTU recovery. The results generated in this subtask suggested that the agglomerant concentration had a significant impact on process selectivity and had to be taken into account while selecting agglomerant for further studies on process development.

Table 7-3

UPPER FREEPORT - 28 MESH

Agglomerant	Test No.	Agglomerant %	Frother lb/t	Clean Coal: Coal Matter Recovery % CMR	Clean Coal: Ash % A_c	Clean Coal: Ash Rej % ARE	Clean Coal: Total S Rej % TSR	Clean Coal: Inorganic S Rej % ISR
Diesel	UFP-1	10.0	-	96.4	10.7	18.4	14.6	20.6
	UFP-2	6.0	-	95.1	9.7	27.8	26.0	37.4
	UFP-3	3.0	-					
	UFP-4	0.5	0.25	94.1	8.2	40.6	41.3	60.3
Maya Crude + Diesel	UFP-17	10.0	-	98.9	10.7	16.3	17.7	26.7
	UFP-18	6.0	-	97.4	10.5	19.2	18.3	26.8
	UFP-19	3.0	-	96.7	9.6	27.5	26.1	38.3
	UFP-20	0.5	0.10	93.7	7.7	44.8	45.6	66.8
Maya Crude	UFP-9	10.0	-	97.8	12.0	5.8	4.7	6.0
	UFP-10	6.0	-	98.3	11.0	14.2	11.4	16.7
	UFP-11	3.0	0.05	95.6	9.2	31.5	28.4	41.3
	UFP-12	0.5	0.15	95.4	8.9	34.2	34.2	50.1
Fuel Oil No. 6	UFP-25	10.0	-	98.9	10.7	16.3	10.7	15.9
	UFP-26	6.0	-	100.3	9.8	23.0	11.1	17.3
	UFP-27	3.0	0.05	98.2	9.6	26.3	13.5	19.9
	UFP-28	0.5	0.15	90.0	6.7	54.3	38.6	54.3
Hexane	UFP-37	10.0	0.10	97.4	9.5	27.8	16.2	
	UFP-37R	10.0	-	96.5	9.3	30.1	20.3	
	UFP-38	6.0	-	85.9	8.1	46.5	37.4	
	UFP-38R	6.0	0.10	93.5	8.6	37.9	30.4	
	UFP-39	3.0	-	66.7	6.7	66.2	62.8	
	UFP-39R	3.0	0.30	93.3	7.8	44.2	34.8	
	UFP-40	0.3	-	13.7	5.1	94.8	93.9	
	UFP-40R	0.3	0.40	92.2	7.6	46.4	39.7	

Table 7-4

PITTSBURGH NO. 8 - 28 MESH

Agglomerant	Test No.	Agglomerant %	Frother lb/t	Clean Coal Coal Matter Recovery % CMR	Clean Coal Ash % A_c	Clean Coal Ash Rej % ARE	Clean Coal Total S Rej % TSR	Clean Coal Inorganic S Rej % ISR
Diesel	PIT-1	10.0	-	93.1	7.2	49.5	26.7	37.1
	PIT-2	6.0	-	89.5	6.6	55.7	34.6	47.3
	PIT-3	3.0	-	85.1	5.9	62.7	43.1	57.9
	PIT-4	0.5	0.30	83.7	5.9	63.2	43.9	58.6
Maya Crude + Diesel (1:1)	PIT-17	10.0	-	98.8	8.0	39.9	13.9	20.6
	PIT-18	6.0	-	97.8	7.6	43.7	18.7	27.5
	PIT-19	3.0	-	93.1	6.8	52.5	30.4	42.8
	PIT-20	0.5	0.45	86.3	6.1	60.8	46.6	64.0
Maya Crude	PIT-9	10.0	-	99.2	9.4	27.9	8.8	13.1
	PIT-10	6.0	-	98.1	8.5	36.2	12.3	17.7
	PIT-11	3.0	0.10	88.2	6.9	54.2	34.7	46.9
	PIT-12	0.5	0.35	75.7	6.3	64.4	48.5	61.3
Fuel Oil No. 6 + Diesel (4:1)	PIT-25	10.0	-	99.9	9.5	27.3	12.2	19.6
	PIT-26	6.0	-	98.7	8.7	34.7	19.0	29.7
	PIT-27	0.5	-	93.7	7.7	45.8	32.4	48.1
	PIT-28	0.5	0.30	85.1	6.2	61.0	47.6	67.3
Hexane	PIT-37	10.0	-	77.3	5.9	66.4	58.2	
	PIT-37R	10.0	0.20	80.4	6.3	62.5	56.1	
	PIT-38	6.0	-	66.6	5.5	73.1	64.3	
	PIT-38R	6.0	0.30	77.3	6.3	64.0	56.0	
	PIT-39	3.0	-	38.5	6.1	82.6	79.0	
	PIT-39R	3.0	0.40	71.7	7.3	60.8	57.4	
	PIT-40	0.5	-	5.9	7.0	96.9	96.9	
	PIT-40R	0.5	0.70	67.9	7.9	59.6	57.6	

Table 7-5

ILLINOIS NO. 6 - 28 MESH

Agglomerant	Test No.	Agglomerant %	Frother lb/t	Clean Coal Coal Matter Recovery % CMR	Clean Coal Ash % A_c	Clean Coal Ash Rej % ARE	Clean Coal Total S Rej % TSR	Clean Coal Inorganic S Rej % ISR
Diesel	ILL-1	10.0	-	9[illegible].8	8.5	57.8	34.7	55.2
	ILL-2	6.0	-	93.4	8.1	60.9	36.7	57.0
	ILL-3	3.0	0.10	91.4	8.2	61.2	39.7	60.6
	ILL-4	0.5	0.40	88.0	9.0	58.7	39.0	57.3
Maya Crude + Diesel	ILL-17	10.0	-	96.2	9.7	51.0	25.1	39.5
	ILL-18	6.0	-	95.8	9.1	54.4	30.1	47.5
	ILL-19	3.0	-	95.0	8.6	57.6	36.7	58.1
	ILL-20	0.5	0.45	90.8	9.3	55.8	42.1	64.3
Maya Crude	ILL-9	10.0	-	97.9	10.7	44.3	17.3	27.5
	ILL-10	6.0	-	95.1	9.7	51.5	29.3	45.8
	ILL-11	3.0	0.15	91.8	8.9	57.4	28.1	41.5
	ILL-12	0.5	0.60	87.0	9.4	57.2	39.9	58.1
Fuel Oil No. 6	ILL-25	10.0	-	96.3	11.3	49.7	20.5	34.8
	ILL-26	6.0	-	94.7	10.3	55.4	23.8	39.5
	ILL-27	3.0	0.05	93.9	9.3	60.5	35.4	60.2
	ILL-28	0.5	0.50	71.3	9.1	70.7	52.5	72.7
Hexane	ILL-37	10.0	-	54.4	6.5	84.5	69.1	
	ILL-37R	10.0	0.50	78.1	9.7	65.6	53.3	
	ILL-38	6.0	-	39.5	6.4	88.9	79.9	
	ILL-38R	6.0	0.60	71.6	9.4	69.5	58.8	
	ILL-39	3.0	-	12.8	6.3	96.5	94.1	
	ILL-39R	3.0	0.60	54.1	9.3	77.2	69.2	
	ILL-40	0.5	1.20	40.3	11.4	78.7	77.2	

Table 7-6

UPPER FREEPORT - 200 MESH

Agglomerant	Test No.	Agglomerant %	Frother lb/t	Clean Coal: Coal Matter Recovery % CMR	Ash % A_c	Ash Rej % ARE	Total S Rej % TSR	Inorganic S Rej % ISR
Diesel	UFP-5	10.0	-	95.8	9.3	30.6	37.6	55.5
	UFP-6	6.0	-	98.0	8.5	35.7	47.4	71.8
	UFP-7	3.0	-	98.7	8.2	37.7	43.5	66.3
	UFP-8	0.5	0.06	95.9	7.4	45.9	49.1	73.3
Maya Crude + Diesel	UFP-21	10.0	-	99.9	10.2	19.9	33.8	52.0
	UFP-22	6.0	-	98.1	9.7	25.5	36.5	55.2
	UFP-23	3.0	0.15	93.9	9.1	33.6	41.6	60.7
	UFP-24	0.5	0.15	95.4	7.5	45.3	50.1	74.5
Maya Crude	UFP-13	10.0	-	96.2	10.0	24.5	31.6	46.7
	UFP-14	6.0	0.10	96.1	9.1	31.1	39.8	59.2
	UFP-15	3.0	0.15	96.0	8.7	35.4	40.1	59.6
	UFP-16	0.5	0.50	96.1	8.0	41.0	43.2	64.4
Fuel Oil No. 6	UFP-31	10.0	-	100.3	10.5	16.9	-1.0	-1.4
	UFP-32	6.0	-	99.8	9.6	25.1	6.9	10.6
	UFP-29	3.0	-	98.9	7.9	40.0	26.5	40.5
	UFP-30	0.5	0.15	96.9	7.2	46.9	39.5	59.6
Hexane	UFP-33	10.0	-	95.9	7.9	41.9	34.0	
	UFP-33R	10.0	-	89.9	6.9	52.9	43.0	
	UFP-33RR	10.0	0.30	96.6	7.6	43.9	39.8	
	UFP-34	6.0	-	91.0	7.3	49.4	43.5	
	UFP-34R	6.0	0.30	92.2	7.0	51.0	49.0	
	UFP-35	3.0	0.30	95.7	7.3	55.0	40.9	
	UFP-35R	3.0	-	75.9	7.6	55.9	53.0	
	UFP-36	0.5	-	69.7	6.2	67.4	64.8	
	UFP-36R	0.5	0.30	97.5	8.2	38.4	35.0	

Table 7-7

PITTSBURGH NO. 8 - 200 MESH

Agglomerant	Test No.	Agglomerant %	Frother lb/t	Clean Coal: Coal Matter Recovery % CMR	Ash % A_c	Ash Rej % ARE	Total S Rej % TSR	Inorganic S Rej % ISR
Diesel	PIT-5	10.0	-	95.3	5.6	60.4	41.3	60.6
	PIT-6	6.0	-	94.6	5.7	60.0	42.7	62.4
	PIT-7	3.0	-	95.6	5.5	61.1	43.9	64.7
	PIT-8	0.5	0.10	86.9	4.9	68.7	56.5	79.4
Maya Crude + Diesel (1:1)	PIT-21	10.0	-	98.3	7.3	45.8	30.7	45.9
	PIT-22	6.0	-	96.8	6.9	36.2	53.6	
	PIT-23	3.0	-	94.8	6.6	53.1	42.2	61.7
	PIT-24	0.5	0.10	89.6	5.3	64.9	54.2	77.3
Maya Crude	PIT-13	10.0	-	98.7	8.4	36.6	23.8	35.7
	PIT-14	6.0	-	96.7	7.5	45.1	31.6	46.5
	PIT-15	3.0	0.20	95.5	7.0	49.7	39.9	58.6
	PIT-16	0.5	0.50	93.0	5.9	59.2	47.5	68.9
Fuel Oil No. 6 + Diesel (4:1)	PIT-29	10.0	-	99.3	8.7	34.4	19.8	31.4
	PIT-30	6.0	-	98.7	8.4	37.2	26.0	40.9
	PIT-31	3.0	-	98.3	7.2	47.1	36.6	57.6
	PIT-32	0.5	0.30	88.2	6.5	57.5	47.7	69.4
Hexane	PIT-33	10.0	-	81.5	5.6	66.5	57.6	
	PIT-33R	10.0	0.35	90.3	6.4	57.2	49.5	
	PIT-34	6.0	-	72.9	6.3	66.0	58.8	
	PIT-34R	6.0	0.40	95.1	7.8	43.7	40.7	
	PIT-35	3.0	-	37.6	6.9	80.7	79.6	
	PIT-35R	3.0	0.70	96.7	8.1	47.2	40.3	
	PIT-36	0.5	-	2.6	7.6	98.5	98.6	
	PIT-36R	0.5	0.70	96.3	7.9	42.7	40.2	

R = repeat test

Table 7-8

ILLINOIS NO. 6 - 200 MESH

Agglomerant	Test No.	Agglomerant %	Frother lb/t	Clean Coal: Coal Matter Recovery % CMR	Ash % A_c	Ash Rej % ARE	Total S Rej % TSR	Inorganic S Rej % ISR
Diesel	ILL-5	10.0	-	95.1	8.0	60.7	33.6	52.9
	ILL-6	6.0	-	93.4	7.8	62.5	34.6	53.5
	ILL-7	3.0	0.15	88.8	7.1	67.8	45.1	68.0
	ILL-8	0.5	0.30	89.,4	7.8	64.1	43.6	65.9
Maya Crude	ILL-21	10.0	-	96.3	8.3	58.6	28.1	44.5
	ILL-22	6.0	-	95.8	8.3	58.8	30.2	47.7
	ILL-23	3.0	-	96.9	8.4	57.8	32.45	2.5
	ILL-24	0.5	0.45	93.5	8.2	60.3	40.6	63.6
Maya Crude + Diesel	ILL-13	10.0	-	94.8	9.9	50.5	28.1	43.5
	ILL-14	6.0	0.15	95.5	8.8	56.3	35.6	56.6
	ILL-15	3.0	0.55	96.0	9.1	54.4	33.5	53.5
	ILL-16	0.5	1.20	94.6	8.4	58.8	38.8	61.4
Fuel Oil No. 6	ILL-32	10.0	-	97.6	9.2	59.4	29.5	52.4
	ILL-31	6.0	-	97.5	8.9	60.9	28.9	51.2
	ILL-30	3.0	0.35	99.6	9.4	57.6	30.6	56.2
	ILL-29	0.5	0.70	94.0	8.7	63.3	37.3	63.8
Hexane	ILL-33	10.0	-	53.1	8.1	80.8	68.0	
	ILL-33R	10.0	0.6	89.4	9.4	62.0	41.4	
	ILL-34	6.0	-	35.4	7.8	87.7	80.1	
	ILL-34R	6.0	0.6	87.6	10.4	58.3	40.3	
	ILL-35	3.0	-	37.8	7.7	87.1	77.6	
	ILL-35R	3.0	0.6	76.6	8.4	71.2	50.4	
	ILL-36	0.5	1.2	86.8	11.2	55.1	39.8	

TABLE 7-9

ISR VS AGGLOMERANT CONCENTRATION FOR UPPER FREEPORT COAL

Agglomerant Concentration %	28 Mesh ISR % Diesel	28 Mesh ISR % Maya+Diesel	28 Mesh ISR % Maya	28 Mesh ISR % FuelOil+Diesel	200 Mesh ISR % Diesel	200 Mesh ISR % Maya+Diesel	200 Mesh ISR % Maya	200 Mesh ISR % FuelOil+Diesel
10.0	20.6	26.7	6.0	15.9	55.5	52.0	46.7	-1.4
6.0	37.4	26.8	16.7	17.3	71.8	55.2	59.2	10.6
3.0	62.0	38.3	41.3	19.9	66.3	60.7	59.6	40.5
0.5	60.3	66.8	50.1	54.3	73.3	74.5	64.4	59.6

ISR VS AGGLOMERANT CONCENTRATION FOR PITTSBURGH NO. 8 COAL

Agglomerant Concentration %	28 Mesh ISR % Diesel	28 Mesh ISR % Maya+Diesel	28 Mesh ISR % Maya	28 Mesh ISR % FuelOil+Diesel	200 Mesh ISR % Diesel	200 Mesh ISR % Maya+Diesel	200 Mesh ISR % Maya	200 Mesh ISR % FuelOil+Diesel
10.0	37.1	20.6	13.1	19.6	60.6	45.9	35.7	31.4
6.0	47.3	27.5	17.7	29.7	62.4	53.6	46.5	40.9
3.0	57.9	42.8	46.9	48.1	64.7	61.7	58.6	57.6
0.5	58.6	64.0	61.3	67.3	79.4	77.3	68.9	69.4

ISR VS AGGLOMERANT CONCENTRATION FOR ILLINOIS NO. 6 COAL

Agglomerant Concentration %	28 Mesh ISR % Diesel	28 Mesh ISR % Maya+Diesel	28 Mesh ISR % Maya	28 Mesh ISR % FuelOil+Diesel	200 Mesh ISR % Diesel	200 Mesh ISR % Maya+Diesel	200 Mesh ISR % Maya	200 Mesh ISR % FuelOil+Diesel
10.0	55.2	39.5	27.5	34.8	52.9	44.5	43.5	52.4
6.0	57.0	47.5	45.8	39.5	53.5	47.7	56.6	51.2
3.0	60.6	58.1	41.5	60.2	68.0	52.5	53.3	56.2
0.5	57.3	64.3	58.1	72.7	65.9	63.6	61.4	63.8

The performance results for all project coals at agglomerant concentrations of 0.5% and 3.0% therefore, are summarized for the 28 mesh and 200 mesh grinds in Tables 7-10 and 7-11. In general, the agglomeration tests performed with 200 mesh grind size showed better process performance than those with 28 mesh. Out of the five agglomerants tested, diesel and mixture of Maya crude/diesel yielded the best sulfur rejections, while Maya crude alone and mixture of Fuel No. 6/diesel provided a better Btu recovery. This observation was valid for both agglomerant

concentrations. In order to simplify the process performance evaluation, only the results obtained at 0.5% agglomerant concentration will be used for discussion.

Table 7-10

PROCESS PERFORMANCE FOR DIFFERENT AGGLOMERANTS
28 MESH

	Pittsburgh No. 8		Upper Freeport		Illinois 6	
	BTU	ISR	BTU	ISR	BTU	ISR
Agglomerant 0.5%						
Diesel	83.7	58.6	94.1	60.3	88.0	57.3
Diesel + Maya Crude (1:1)	86.3	64.0	93.7	66.8	90.8	64.3
Maya Crude	75.7	61.3	95.4	50.1	87.0	58.1
Fuel Oil No. 6 + Diesel (4:1)	85.1	67.3	90.0	54.3	71.3	72.7
Agglomerant 3.0%						
Diesel	85.1	57.9	93.8	62.0	91.4	60.6
Diesel + Maya Crude (1:1)	93.1	42.8	96.7	38.3	95.0	58.1
Maya Crude	88.2	46.9	95.6	41.3	91.8	41.5
Fuel Oil No. 6 + Diesel (4:1)	93.7	48.1	98.2	19.9	93.9	60.2

Table 7-11

PROCESS PERFORMANCE FOR DIFFERENT AGGLOMERANTS
200 MESH

	Pittsburgh No. 8		Upper Freeport		Illinois 6	
	BTU	ISR	BTU	ISR	BTU	ISR
Agglomerant 0.5%						
Diesel	86.9	79.4	95.9	73.3	89.4	65.9
Diesel + Maya Crude (1:1)	89.6	77.3	95.4	74.5	93.5	63.6
Maya Crude	93.0	68.9	96.1	64.4	94.6	61.4
Fuel Oil No. 6 + Diesel (4:1)	88.2	69.4	96.9	59.6	94.0	63.8
Agglomerant 3.0%						
Diesel	95.6	64.7	98.7	66.3	88.8	68.0
Diesel + Maya Crude (1:1)	94.8	61.7	93.9	60.7	96.9	52.5
Maya Crude	95.5	58.6	96.0	59.6	96.0	53.3
Fuel Oil No. 6 + Diesel (4:1)	98.3	57.6	98.9	40.5	99.6	56.2

For Pittsburgh No. 8 coal with diesel or Maya/diesel agglomerants, the rejection of inorganic sulfur was in the range of 77%-79% at Btu recovery of 87%-90%, while about 69% ISR at similar Btu recovery, was achieved for heavier agglomerants (Maya crude or mixture of Fuel Oil No. 6/diesel).

Both, the Upper Freeport and Illinois No. 6 coals exhibited the same trend as Pittsburgh No. 8 coal. For Upper Freeport coal, diesel and Maya/diesel mixture showed a sulfur rejection of 73%-75% at a BTU recovery of 95%-96%, whereas the other two agglomerants slightly increased the BTU recovery to 96%-97% with a sulfur rejection of about 60%-64%. The corresponding data for the Illinois No. 6 coal were 64%-66% sulfur rejection at 90%-94% BTU for diesel or Maya/diesel used as agglomerants, and only a slight change in both BTU recovery (94-95%) and sulfur rejection (61%-64%) was observed for Maya crude and Fuel Oil No. 6/diesel mixture.

Diesel Oil and Maya/diesel blend were considered to be the most suitable agglomerants for all three project coals. As the project progressed, the diesel was selected for further testing as Maya crude was not available. In order to continue the testing with light hydrocarbon, an engineering analysis of pentane, hexane and heptane was carried out. As a result of this, heptane was selected for further testing of light hydrocarbon process.

7.3 Microagglomerate Recovery Methods

Successful application of the selective agglomeration technology depends on the performance of two unit operations: the agglomeration process itself and the method used to separate clean coal from tailings. While it has been demonstrated that flotation was a practical method of separating microagglomerates produced at low dosages of agglomerants, it would be both informative and valuable to compile and compare data from tests using other separation methods in the agglomeration process. Screening (size classification) and phase separation (gravimetric separation) were selected as two potential separation methods for continuous processing.

Test Objectives

The generic agglomeration experiments performed at the Alberta Research Council had the following specific objectives:

- To evaluate screening and phase separation as a separation method for heptane agglomeration
- To optimize screening for heavy oil agglomeration

- To investigate process option of using both high- and low-shear without recovery of microagglomerates

Test Descriptions and Conditions

To expedite the development of these alternative procedures, the old project samples were used in this program. Initially, Pittsburgh No. 8 and Maya/diesel combination was tested in order to develop procedures for microagglomerate recovery. After the testing conditions were established, the experimental program was extended for other project coals and agglomerants.

The scope of work for these generic agglomeration experiments is summarized below:

- Light hydrocarbon (heptane)
  - Microagglomerate recovery using screening and phase separation (Figure 7-7).
  - No microagglomerate recovery.
  - Confirmatory tests for Illinois No. 6 and Upper Freeport coals.
- Heavy agglomerants
  - Microagglomerate recovery using screening (Figure 7-8).
  - No microagglomerate recovery.
  - Staged addition of agglomerant followed by screening of agglomerates.

Result Analysis

Most of the agglomeration tests with Pittsburgh No. 8 coal and heptane as an agglomerant resulted in high BTU recoveries, i.e., over 90%. However, when phase separation was used for agglomerate recovery, BTU recoveries of less than 90% were observed for tests performed with 20% heptane in the ARC vessel and for all tests carried out with 10% heptane regardless of the vessel used. This indicated that lower heptane concentration was insufficient for phase separation and that the ARC vessel did not produce as tenacious a froth as the Waring blender.

When screening was used as a means of microagglomerate separation, good BTU recoveries were observed regardless of the heptane concentration used.

Screen vs Phase Separation

The results of heptane high-shear agglomeration tests are summarized in Table 7-12. The experiments were carried out in both, the ARC agglomeration vessel and Waring blender under the following conditions: 5% and 20% of solids concentration and 20% to 40% agglomerant concentration. The agglomeration products were separated by screening or phase separation. It was observed that tests with lower solids concentration (5%) produced a much higher pyrite rejections than the tests performed at 20% solids. This was accompanied by a slight reduction in BTU recovery. As this trend was recorded for all conditions, i.e., phase separation or screen recovery and 2,000 or 14,000 rpm high-shear, it appeared that at lower solids concentration less free pyrite particles were incorporated into agglomerates.

This trend of higher pyrite rejection with no significant BTU losses was also evident when comparing tests run in the ARC vessel (2,000 rpm) with those run in the Waring blender (14,000 rpm). Under every set of conditions tested, pyrite rejection was higher in the ARC vessel. Given that all other conditions were equal, it could be inferred that the vortexing occurring in the Waring blender created a more tenacious froth from which pyrite was more difficult to drain during the recovery process.

Higher pyrite rejection was achieved for screen recovery than for phase separation at equivalent BTU recoveries. This held true for all conditions except when high-shear agglomeration took place in the Waring blender at a 20% solids concentration. For the latter tests, good recoveries were achieved, and no significant reduction in the product sulfur content took place. The higher pyrite rejection achieved by screening was due to more complete froth drainage since in this case, unlike phase separation, water was allowed to completely drain from the interstices of the agglomerated product.

Table 7-12

COMPARISON OF PHASE SEPARATION AND SCREEN RECOVERY

Agglomeration Vessel	Test ID	% Solids	High-Shear RPM	High-Shear %Heptane	Separation Technique	Rec %	PS Rej %
Waring Blender	00266	5	14,000	30	Phase/None	96.1	39.2
	02675	5	14,000	30	Phase/None	95.1	33.2
	00299	5	14,000	20	Scr-106/None	96.9	44.8
	00300	5	14,000	20	Scr-106/None	95.0	50.0
	00263	20	14,000	20	Phase/None	97.6	-2.7
	00351	20	14,000	20	Phase/None	98.9	2.0
	00297	20	14,000	20	Scr-106/None	100.0	-0.9
	00298	20	14,000	20	Scr-106/None	99.6	4.2
ARC Vessel	00295	5	2,000	40	Phase/None	93.8	62.5
	00308	5	2,000	30	Scr-106/None	93.9	72.1
	00289	20	2,000	30	Phase/None	96.9	21.8
	00290	20	2,000	30	Phase/None	95.9	50.0
	00303	20	2,000	20	Scr-106/None	95.1	54.0
	00304	20	2,000	20	Scr-106/None	94.0	55.3

The best overall performance was reached using a 5% solids concentration in the ARC vessel followed by screen recovery. For 20% heptane concentration, 93% BTU recovery with rejection of about 72% of pyrite was achieved. The clean coal total sulfur contents were in the range of 1.9 to 2.0%, and showed a significant reduction as compared with 3.8% of total sulfur in feed coal.

Tests Incorporating High- and Low-Shear

A series of heptane high-shear experiments was repeated, incorporating a low-shear agglomeration step followed by screen recovery (low-shear/screening). Six percent Maya crude, based on initial feed coal weight, was added during the low-shear step for all these tests. Low-shear step was performed in the ARC vessel at 1,800 rpm.

For high-shear tests performed in the Waring blender with subsequent low-shear, an increase in pyritic sulfur rejection of about 10% was achieved. This trend was observed regardless of whether phase separation or screening was used to recover the microagglomerates. These results can be seen in Table 7-13.

Table 7-13

WARING BLENDER RESULTS WITH AND WITHOUT LOW-SHEAR

Test ID	% Sol	High-Shear RPM	High-Shear % Oil	Low-Shear Oil	Low-Shear % Oil	Low-Shear Min	Separation Technique	BTU Rec %	PS Rej %
00266	5	14,000	30				Phase/None	96.1	39.2
00267	5	14,000	30				Phase/None	95.1	33.2
00282	5	14,000	30	Maya	6	16	Phase/Scr-600	96.2	48.3
00299	5	14,000	20				Scr-106/None	96.9	44.8
00300	5	14,000	20				Scr-106/None	95.0	50.0
00311	5	14,000	20	Maya	6		Scr-106/Scr-75	96.0	55.0

Similar series of heptane high-shear/low-shear experiments was performed utilizing the ARC vessel as an agglomerator for both stages. The experimental results are given in Table 7-14. For the tests utilizing a phase separation after high-shear step, an addition of a low-shear/screening stage had no effect on process performance at either 5% or 20% solids. For the screening tests, no significant effect of adding a low-shear/screening stage was observed at a 5% solids concentration, but at 20% solids concentration an increase in pyritic sulfur rejection of about 20% was observed.

Table 7-14

ARC VESSEL RESULTS WITH AND WITHOUT LOW-SHEAR

Test ID	% Sol	High-Shear RPM	High-Shear % Oil	Low-Shear Oil	Low-Shear % Oil	Low-Shear Min	Separation Technique	BTU Rec %	PS Rej %
00293	5	2000	30				Phase/None	89.3	78.0
00294	5	2000	30				Phase/None	84.6	77.5
00288	5	2000	30	Maya	6	16	Phase/Scr-45	89.6	72.6
00289	20	2000	30				Phase/None	96.9	21.8
00290	20	2000	30				Phase/None	95.9	50.0
00286	20	2000	30	Maya	6	16	Phase/Scr-600	94.7	45.7
00287	20	2000	30	Maya	6	16	Phase/Scr-600	96.7	19.5
00308	5	2000	30				Scr-106/None	93.9	72.1
00313	5	2000	30	Maya	6	16	Scr-106/Scr-45	93.9	66.4
00314	5	2000	30	Maya	6	16	Scr-106/Scr-45	94.9	69.8
00305	20	2000	30				Scr-106/None	96.3	26.3
00312	20	2000	30	Maya	6	16	Scr-106/Scr-600	95.7	45.1

The effect of incorporating a low-shear/screening stage with no recovery of microagglomerates was investigated for both the Waring blender and the ARC vessel. The results are presented in Table 7-15.

When the ARC vessel was used for high-shear agglomeration, the addition of a low-shear/screening stage resulted in dramatic reductions in pyrite rejection, approximately from 75% to 40% and from 55% to 0% for 5% and 20% solids respectively. In contrast, the addition of a low-shear/screening stage subsequent to Waring blender high-shear resulted in an increase of pyrite rejection, from 45% to 60%, at heptane concentration of 20%.

Table 7-15

EFFECT OF LOW-SHEAR WITH NO MICROAGGLOMERATE RECOVERY

		High-Shear		Low-Shear			Separation	BTU	PS
Test ID	% Sol	RPM	% Oil	Oil	% Oil	Min	Technique	Rec %	Rej %
00306	5	2000	20				Scr-106/None	92.3	78.4
00307	5	2000	20				Scr-106/None	92.6	73.1
00328	5	2000	20	Maya	6	16	None/Scr-75	94.6	35.0
00329	5	2000	20	Maya	6	16	None/Scr-75	95.0	42.2
00303	20	2000	20				Scr-106/None	95.1	54.0
00304	20	2000	20				Scr-106/None	94.0	55.3
00323	20	2000	20	Maya	6	16	None/Scr-300	98.8	0.7
00299	5	14000	20				Scr-106/none	96.9	44.8
00300	5	14000	20				Scr-106/None	95.0	50.0
00326	5	14000	20	Maya	6	16	None/Scr-75	94.2	63.9
00325	5	14000	20	Maya	6	16	None/Scr-75	95.7	56.7
00301	5	14000	10				Scr-106/None	95.5	63.4
00302	5	14000	10				Scr-106/None	95.7	61.7
00327	5	14000	10	Maya	6	16	None/Scr-75	88.0	62.5

For 10% heptane concentration test (#327), no improvement in pyritic sulfur rejection was achieved and a reduction in BTU recovery was observed. This drop in BTU recovery was believed to be an anomal, but evaluation of the screening procedure used to recover the final agglomerates suggests that the use of excessive washing combined with lower heptane concentration led to the loss of coal matter.

Heavy Oils - Multiple Screen Tests

A series of tests was performed using multiple screens to recover products from the heavy agglomerant process. All of these tests were carried out using the ARC vessel (2,000 rpm) at a 20% solids concentration with varying amounts of the Maya-diesel mixture applied as a binder. These multiple screen tests consisted of high-shear agglomeration and screening and the results are given in Table 7-16.

A series of tests carried out at oil concentrations 1%, 4%, 6%, and 10% using a 28 mesh grind indicate, that higher oil concentrations allow the use of larger screens appearing to achieve satisfactory BTU recoveries. It was determined that a 106 um screen would be sufficient to recover products from 28 mesh grind tests. For this screen, the Btu recoveries ranged from 97% for a 10% oil concentration to 53% for a 1% oil concentration. The next screen of 212 um, provided recoveries in the range 76 to 28% under identical conditions.

Two tests with multiple screening were conducted for 200 mesh grind size and 6% concentration of Maya-diesel mixture. The results of these tests indicated that the smallest screen tested, i.e., 45 um, had to be used to recover about 70% of the coal. Data for the multiple-screen tests are presented in Table 7-16.

Table 7-16

MULTIPLE SCREEN TESTS

Test No.	Lab ID	Coal	Top Size	% Solids	High-Shear RPM	High-Shear Oil	High-Shear % Oil	Separation Technique	Clean Coal A%	Clean Coal TS%	Clean Coal PS%	Tailings A%	Tailings TS%	CC Y%	BTU Rec%	CM Rec%	TS Rej%	PS Rej%
240	PIT-84	Pit	28M	20	2000	M1/D1	10.0	Scr-106/None	9.03	3.46	2.26	57.98	9.35	93.58	96.93	96.53	22.91	27.28
240a								Scr-212/None	8.40	3.30	2.09	20.34	5.08	73.34	76.54	76.16	42.32	47.16
240b								Scr-300/None	8.40	3.29	2.08	17.78	4.71	66.09	68.98	68.64	48.18	52.61
240c								Scr-425/None	14.08	3.29	2.15	11.30	3.78	5.43	5.27	5.29	95.75	95.98
240d								Scr-600/None	18.09	3.83	2.74	11.30	3.76	2.06	1.90	1.92	98.12	98.05
252	PIT-87	Pit	28M	20	2000	M1/D1	6.0	Scr-106/None	9.10	3.50	2.30	33.14	6.99	85.36	88.33	87.97	21.58	16.30
252a								Scr-212/None	8.39	3.24	2.03	15.01	4.54	50.58	52.80	52.54	56.93	56.13
252b								Scr-300/None	9.00	3.16	1.96	12.16	4.04	20.98	21.74	21.65	82.58	82.46
252c								Scr-425/None	9.81	3.18	1.99	11.65	3.93	10.39	10.66	10.63	91.32	91.17
252d								Scr-600/None	10.83	3.46	2.28	11.55	3.87	4.82	4.87	4.87	95.63	95.31
253	PIT-87.1	Pit	28M	20	2000	M1/D1	6.1	Scr-106/None	8.59	3.56	2.35	24.45	5.95	81.85	85.24	84.83	23.49	17.84
253a								Scr-300/None	9.00	3.30	2.09	11.75	4.14	23.15	23.99	23.89	79.97	79.33
253b								Scr-600/None	10.33	3.54	2.35	11.14	3.96	5.55	5.65	5.64	94.84	94.42
254	PIT-94	Pit	28M	20	2000	M1/D1	4.0	Scr-106/None	8.93	3.22	2.01	14.60	4.72	57.51	59.64	59.38	51.46	50.64
254a								Scr-300/None	8.83	2.85	1.64	11.97	4.10	21.58	22.40	22.30	83.86	84.86
254b								Scr-600/None	12.27	3.28	2.12	11.16	3.84	3.29	3.27	3.28	97.17	97.02
255	PIT-90	Pit	28M	20	2000	M1/D1	1.0	Scr-106/None	9.03	3.45	2.25	14.75	4.53	51.69	53.54	53.32	53.12	50.33
255a								Scr-212/None	9.33	3.21	2.01	12.64	4.24	27.10	27.96	27.86	77.14	76.70
270	PIT-88	Pit	200M	20	2000	M1/D1	6.0	Scr-45/None	7.26	3.17	1.95	20.90	5.47	57.59	60.95	60.55	52.05	52.19
270a								Scr-74/None	7.26	2.51	1.28	13.28	4.25	7.43	7.86	7.81	95.11	95.94
270b								Scr-106/None	9.30	2.73	1.53	12.87	4.13	1.42	1.47	1.46	98.98	99.07
271	PIT-88.1	Pit	200M	20	2000	M1/D1	6.0	Scr-45/None	7.06	2.59	1.46	16.33	4.86	53.53	56.80	56.41	62.19	66.60
271a								Scr-74/None	7.98	2.24	1.02	11.55	3.79	7.27	7.63	7.59	95.72	96.82
271b								Scr-106/None	9.41	2.19	0.99	11.24	3.70	1.62	1.67	1.66	99.07	99.31

Effect of Low-Shear on Heavy Oil Agglomeration

A series of tests were conducted incorporating a low-shear/screening stage and the results are presented in Table 7-17.

For 200-mesh top size tests and 6% Maya-diesel as a binder, similar results were achieved whether or not a subsequent low-shear/screening step was used following the initial high-shear/screening step. This suggested that the coal beneficiation took place during the high-shear/screening step. However, identical tests for 28 mesh top size showed slight improvement in pyrite rejection at comparable BTU recoveries when low-shear/screening was incorporated. This additional improvement in product quality might be the result of particle degradation during low-shear mixing, which in turn resulted in additional liberation of pyrite.

Table 7-17

EFFECT OF LOW-SHEAR ON MAYA-DIESEL AGGLOMERATION TESTS

Test ID	Top Size	High-Shear Oil	High-Shear % Oil	L-S Min	Separation Technique	BTU Rec %	PS Rej %
00270	200M	M1/D1	6		Scr-45/None	61.0	52.2
00271	200M	M1/D1	6		Scr-45/None	56.8	66.6
00273	200M	M1/D1	6	16	Scr-45/Scr-45	52.6	68.5
00274	200M	M1/D1	6	16	Scr-45/Scr-45	58.2	64.4
00252	28M	M1/D1	6		Scr-106/None	88.3	16.3
00253	28M	M1/D1	6		Scr-106/None	85.3	17.8
00257	28M	M1/D1	6	16	Scr-106/Scr-106	87.6	25.9
00256	28M	M1/D1	6	16	Scr-106/Scr-106	89.6	22.5

Effect of Various Recovery Techniques in Staged Addition Tests

A series of tests was performed using staged addition of 6% Maya-diesel binder, with some diesel being added to the high-shear step and the remaining oil added to the low-shear step. The results of these tests are presented in Table 7-18. For tests without microagglomerate recovery between high- and low-shear agglomeration, no pyrite rejection was achieved. For tests in which microagglomerates were recovered prior to low-shear, good pyrite rejections were observed. In particular, tests which used a single-stage of flotation achieved significant pyrite rejection at good BTU recoveries. This led to the conclusion that for heavy oil tests utilizing a low-shear step, agglomerate recovery had to be performed prior to low-shear to reject pyrite.

Table 7-18

EFFECT OF AGGLOMERATE RECOVERY IN STAGED ADDITION TESTS

Test ID	Top Size	High-Shear Oil	High-Shear % Oil	Low-Shear Oil	Low-Shear % Oil	Low-Shear Min	Separation Technique	BTU Rec %	PS Rej %
00275	200M	Diesel	1	M3/D2	5	16	None/Scr-45	98.9	-0.9
00276	200M	Diesel	1	M3/D2	5	16	None/Scr-45	99.6	2.8
00284	200M	Diesel	1	M3/D2	5	16	Flot/Flot	95.5	41.5
00285	200M	Diesel	1	M3/D2	5	16	Flot/Flot	94.3	42.7
00260	200M	Diesel	1	M3/D2	5	16	Scr-45/Scr-45	45.1	69.1
00261	200M	Diesel	1	M3/D2	5	16	Scr-45/Scr-45	47.1	67.9

7.4 Single-Stage High-Shear Operation

7.4.1 Grinding Methods

Test Objectives

To determine the effect of wet versus dry grinding on agglomeration process performance.

Test Descriptions and Conditions

A small program designed for the evaluation of grinding methods is presented in Table 7-19.

Table 7-19

TEST CONDITIONS

Coal	Pittsburgh No. 8 (Precleaned)
Agglomerant	Maya crude + diesel oil (1:1 ratio)
Agglomerant concentration, %	1.0% for single-stage process 1.5% for two-stage process
Grinding procedure	Dry, wet
Grind size, mesh	28,200 - single-stage process 28/200 - two-stage process
High-shear, rpm	2000
High-shear residence time, min	4

Result Analysis

Test results are summarized in Table 7-20.

Table 7-20

DRY VS WET GRINDING

Serial No.	Lab ID	Top Size (mesh)	Grinding Procedure	Test Procedure	Bench Scale BTU Rec %	Bench Scale PSR %	ROM Basis BTU Rec %	ROM Basis PSR %
522	PIT-244	28	Dry	Single-stage	95.3	21.2	92.4	53.4
359	PIT-201.1	28	Wet	Single-stage	96.7	34.6	93.8	61.3
526	PIT-246.1	200	Dry	Single-stage	97.9	14.7	94.8	49.6
361	PIT-203	200	Wet	Single-stage	98.8	33.0	95.8	60.4
527	PIT-250	28 + 200	Dry	Two-stage	94.2	38.3	91.3	63.5
552	PIT-A	28 + 200	Wet	Two-stage	96.5	49.0	93.6	69.9

Analysis of the test results shows that a wet grinding of feed coal prior to high-shear agglomeration is beneficial in terms of pyritic sulfur rejection. This trend is observed for both grind sizes as well as for the different test procedures (single- and two-stage). The wet grinding method was adopted for all feed samples preparation throughout the program.

7.4.2 Confirmatory Tests

The selection of agglomerating liquids (heavy and light) and the dosages for the heavy oils were performed in Task 5.1. After completion of the task, three new coal samples were introduced into the program followed by addition of the fourth coal (Kentucky No. 9) at a later stage. Since each coal sample may have its own characteristic response to selective agglomeration, a series of test was performed to ensure the continuity between the agglomerant evaluation tests conducted on the three initial project samples and the remainder of the test work to be conducted on the new coal samples.

Test Objectives

To confirm the developed agglomeration procedure using the new coal samples and to determine the agglomeration response of each coal with various top sizes.

Test Descriptions and Conditions

Agglomeration tests with new coal samples were conducted utilizing a standard ARC procedure developed at the early stage of the program.

Table 7-21

TEST CONDITIONS

Coal	Illinois No. 6	Upper Freeport	Pittsburgh No. 8	Kentucky No. 9
Agglomerant type	Diesel, Heptane	Diesel, Heptane	Diesel, Heptane	Diesel, Heptane
Agglomerant %	1, 20	1, 20	1, 20	1, 20
Grind size, mesh	28, 200	28, 100, 200	28, 100, 200	28,100,200
Solids concentration %	20, 5	20, 5	20, 5	20, 5
High-shear rpm	2000	2000	2000	2000
High-shear residence time, min	4	4	4	4
Microagglomerate recovery method	2-Flot/Scr	2-Flot/Scr	2-Flot/Scr	2-Flot/Scr

Result Analysis

The test result are presented in Table 7-22, 7-23, 7-24 and 7-25.

Table 7-22

CHARACTERIZATION TESTS
ILLINOIS NO. 6

Serial No.	Lab ID	Sample Top Size (Mesh)	Oil	Bench Scale BTU Rec %	Bench Scale PSR %	ROM Basis BTU Rec %	ROM Basis PSR %
374	III-201	28	Diesel	80.7	48.1	75.6	81.5
381	III-206	200	Diesel	93.9	38.7	88.0	78.1
412	III-220	28	Heptane	93.1	9.5	87.2	67.7
404	III-214	200	Heptane	92.1	21.4	86.2	71.0
405	III-214.1	200	Heptane	92.0	23.7	86.2	72.8

Table 7-23

CHARACTERIZATION TESTS
UPPER FREEPORT

Serial No.	Lab ID	Sample Top Size (Mesh)	Oil	Bench Scale BTU Rec %	Bench Scale PSR %
871	UFP-264	28	Diesel	75.4	77.7
868	UFP-262	100	Diesel	84.7	76.5
367	UFP-200	200	Diesel	95.6	58.0
426	UFP-214	28	Heptane	94.2	27.1
839	UFP-258	100	Heptane	95.7	42.5
840	UFP-258.1	100	Heptane	94.0	39.7
795	UFP-256	200	Heptane	94.4	62.3
796	UFP-256.1	200	Heptane	94.8	60.2

Table 7-24

CHARACTERIZATION TESTS
PITTSBURGH NO. 8

Serial No.	Lab ID	Sample Top Size (Mesh)	Oil	Bench Scale BTU Rec %	Bench Scale PSR %	ROM Basis BTU Rec %	ROM Basis PSR %
814	PIT-281	28	Diesel	97.6	25.3	94.6	55.9
808	PIT-278	100	Diesel	98.0	34.7	95.0	61.4
823	PIT-283	100	Diesel	98.9	32.7	95.8	60.2
357	PIT-200	200	Diesel	99.0	31.6	96.0	59.6
417	PIT-216	28	Heptane	97.4	8.2	94.4	45.7
809	PIT-279	100	Heptane	97.6	37.2	94.6	62.9
810	PIT-279.1	100	Heptane	97.3	36.3	94.3	62.3
790	PIT-275	200	Heptane	98.2	38.1	95.2	63.4

Table 7-25

CHARACTERIZATION TESTS
KENTUCKY NO. 9

Serial No.	Lab ID	Sample Top Size (Mesh)	Oil	Bench Scale BTU Rec %	Bench Scale PSR %
877	KEN-42	28	Diesel	96.9	48.2
851	KEN-32	100	Diesel	97.3	38.8
852	KEN-32.1	100	Diesel	97.9	40.3
878	KEN-43	200	Diesel	97.6	43.7
891	KEN-44	28	Heptane	88.9	26.6
853	KEN-33	100	Heptane	98.2	36.1
854	KEN-33.1	100	Heptane	97.9	30.9
922	KEN-45	200	Heptane	94.6	39.3

The results of confirmatory tests performed with the "new" project coals showed similar response as observed for the "old" project coals. There was no requirement for the procedure changes in the agglomeration experiments. Analysis of the test results showed that, for heavy agglomerant case, the process performance for the raw coal samples (Upper Freeport, Kentucky) with the top size 28 mesh was considerably better in terms of pyritic sulfur rejection than those with the top size 200 mesh. For the precleaned coals (Illinois No. 6, Pittsburgh No. 8) there was no significant difference in the process performance for 28 and 200 mesh samples. For the heptane case, a finer grinding (200 mesh) was required to achieve a reasonable level of pyritic sulfur rejection.

7.4.3 Optimization Tests

An extensive laboratory program was carried out to investigate the effect of high-shear process variables and to determine the optimized conditions for both diesel and heptane processes. The process variables studied in this activity included agglomerant concentration, high-shear solids concentration, residence time, mixing intensity, flotation solids concentration, flotation time, and incremental flotation.

The test conditions for these experiments are summarized in Table 7-26, and are used for the discussion of the results in Sections 7.4.3.2 to 7.4.3.5, inclusive.

Table 7-26

EVALUATION OF HIGH-SHEAR AGGLOMERATION TESTING CONDITIONS

Parameter	Range
Agglomerant	Diesel, Maya + Diesel, Heptane
High-shear mixing intensity, rpm	1600, 2000, 2400
High-shear residence time, min	0.5, 1, 4
High-shear solids concentration, %	5, 10, 15, 20
High-shear heavy oil addition, %	1
High-shear heptane addition, %	6, 10, 20, 30, 50, 100, 150
Microagglomerate recovery by flotation (diesel, heptane)	1-stage, 2-stage
Microagglomerate recovery by screening (heptane) - screen opening, um	106, 150, 212, 425, 600
Coal top size, mesh	28, 100, 200

The batch test program was designed considering several levels for each variable that was deemed to be important for selective agglomeration. Each of these variables was evaluated for their potential effects on agglomeration performance with respect to BTU recovery and pyritic sulfur rejection by conducting tests in several series. After each test matrix was completed, variable levels for subsequent testing were fixed, the operating regions were narrowed down and set the basis for optimization.

Result Analysis

The results are presented in separate tables for each test matrix with the discussion following.

7.4.3.1 Agglomerant Concentration and High-Shear Solids Concentration

While the dosage for the heavy oil (diesel) was selected after completion of Task 5.1, optimum values for the heptane dosage were not fully explored. In this section the effect of heptane addition as well as the influence of solids concentration in the high-shear for diesel and heptane cases are discussed.

Table 7-27

EFFECT OF AGGLOMERANT ADDITION AND SOLIDS CONCENTRATION ILLINOIS NO. 6

Serial No.	Lab ID	Agglomerant Conc %	Top Size (mesh)	High-Shear Solids %	Bench Scale BTU Rec %	Bench Scale PSR %	ROM Basis BTU Rec %	ROM Basis PSR %
Maya + Diesel (1:1)								
375*	ILL-202	1.0	28	20	98.0	18.5	91.6	70.9
378*	ILL-204	1.0	28	5	96.7	17.1	90.4	70.4
382*	ILL-207	1.0	200	20	98.4	12.2	92.0	68.7
385*	ILL-209	1.0	200	5	98.7	6.6	92.3	66.7
Heptane								
468*	ILL-235	6.0	200	5	45.4	71.5	42.5	89.8
456	ILL-222	10.0	200	5	82.9	25.6	77.6	73.4 (106)
404	ILL-214	20.0	200	5	92.1	21.4	86.2	71.9 (106)
405	ILL-214.1	20.0	200	5	92.0	23.7	86.2	72.8 (106)
457	ILL-223	30.0	200	5	92.4	20.8	86.4	71.7 (106)
458	ILL-224	150.0	200	5	95.3	23.5	89.1	72.7 (106)
495	ILL-225	50.0	200	10	63.7	58.3	59.5	85.1 (106)
496	ILL-226	100.0	200	10	74.9	41.5	70.1	79.1 (106)
497	ILL-227	150.0	200	10	59.5	66.3	55.6	88.0 (106)
504	ILL-227.1	150.0	200	10	60.7	68.8	56.8	88.9 (106)
505	ILL-228.1	50.0	200	15	77.0	37.5	72.0	77.7 (106)
498	ILL-228	50.0	200	15	87.0	18.0	81.3	70.7 (106)
499	ILL-229	100.0	200	15	81.0	31.9	75.8	75.7 (106)
500	ILL-230	150.0	200	15	83.2	33.1	77.8	76.1 (106)
465	ILL-231	50.0	200	20	97.7	-0.4	91.3	64.2 (106)
466	ILL-232	100.0	200	20	97.6	-3.5	91.2	63.0 (106)
467	ILL-233	150.0	200	20	94.5	9.0	88.4	67.5 (106)
411	ILL-219	20.0	28	5	86.4	18.2	80.8	70.8 (150)
412	ILL-220	20.0	28	5	93.1	9.5	87.2	67.7 (106)

*Microagglomerate recovery by 2-stage flotation
In brackets - screen size in microns
rpm - 2000
Residence time - 4 min

Table 7-28

EFFECT OF AGGLOMERANT ADDITION AND SOLIDS CONCENTRATION
PITTSBURGH NO. 8

Serial No.	Lab ID	Agglomerant Conc %	Top Size (mesh)	High-Shear Solids %	Bench Scale BTU Rec %	Bench Scale PSR %	ROM Basis BTU Rec %	ROM Basis PSR %
Maya + Diesel (1:1)								
358*	PIT-201	1.0	28	20	97.2	18.0	94.3	51.5
363*	PIT-205	1.0	28	5	94.0	34.7	91.2	61.4
432*	PIT-217	1.0	200	20	98.6	26.7	95.6	56.7
435*	PIT-219	1.0	200	10	99.0	32.9	96.0	60.3
433*	PIT-218	1.0	200	5	98.8	40.2	95.8	64.6
Heptane								
481*	PIT-243	6.0	200	5	43.0	84.8	41.7	91.0
459	PIT-231	10.0	200	5	97.0	48.3	94.0	69.4 (106)
790	PIT-275	20.0	200	5	98.2	38.1	95.2	63.4 (106)
460	PIT-232	30.0	200	5	99.2	35.6	96.1	62.0 (106)
461	PIT-233	150.0	200	5	97.5	29.2	94.4	58.2 (106)
478	PIT-240	50.0	200	10	98.8	28.5	95.7	57.8 (106)
503	PIT-241.1	50.0	200	10	98.5	36.9	95.4	62.7 (106)
479	PIT-241	100.0	200	10	98.7	27.1	95.7	56.9 (106)
480	PIT-242	150.0	200	10	98.2	32.4	95.2	60.0 (106)
475	PIT-237	50.0	200	15	99.0	14.2	95.9	49.3 (106)
502	PIT-237.1	50.0	200	15	100.2	23.3	97.1	54.7 (106)
476	PIT-238	100.0	200	15	98.6	21.2	95.6	53.4 (106)
477	PIT-239	29%(.0	200	15	98.3	23.5	95.3	54.8 (106)
472	PIT-234	50.0	200	20	99.2	10.5	96.1	47.1 (106)
473	PIT-235	100.0	200	20	99.4	8.2	96.3	45.7 (106)
474	PIT-236	150.0	200	20	99.4	6.0	96.3	44.8 (106)
416	PIT-215	20.0	28	5	92.6	20.0	89.8	52.7 (425)
417	PIT-216	20.0	28	5	97.4	8.2	94.4	45.7 (212)
415	PIT-214	20.0	28	20	99.0	12.1	96.0	48.1 (600)
414	PIT-213	30.0	28	20	99.1	6.7	96.1	44.9 (600)

*Microagglomerate recovery by 2-stage flotation
In brackets - screen size in microns
rpm - 2000
Residence time - 4 min

Table 7-29

EFFECT OF AGGLOMERANT ADDITION AND SOLIDS CONCENTRATION
UPPER FREEPORT

Serial No.	Lab ID	Agglomerant Conc %	Top Size (mesh)	High-Shear Solids %	Bench Scale BTU Rec %	Bench Scale PSR %	ROM Basis BTU Rec %	ROM Basis PSR %
Maya + Diesel (1:1)								
387*	UFP-205	1.0	28	20	84.7	64.0	-	-
389*	UFP-207	1.0	28	5	91.2	65.5	-	-
Heptane								
483*	UFP-222	6.0	200	5	48.4	89.2	-	-
484*	UFP-222.1	6.0	200	5	49.3	89.0	-	-
462	UFP-219	10.0	200	5	94.8	62.9 (106)	-	-
795	UFP-256	20.0	200	5	94.4	62.3 (106)	-	-
796	UFP-256.1	20.0	200	5	94.8	60.2 (106)	-	-
463	UFP-220	30.0	200	5	98.2	46.0 (106)	-	-
464	UFP-221	150.0	200	5	99.7	42.4 (106)	-	-
487	UFP-224	50.0	200	10	98.2	35.2 (106)	-	-
489	UFP-225.1	100.0	200	10	96.5	35.0 (106)	-	-
488	UFP-225	100.0	200	10	97.2	34.1 (106)	-	-
491	UFP-226	150.0	200	10	96.5	32.3 (106)	-	-
490	UFP-227	50.0	200	15	100.1	16.1 (106)	-	-
492	UFP-228	100.0	200	15	98.1	36.1 (106)	-	-
493	UFP-229	150.0	200	15	96.6	30.5 (106)	-	-
506	UFP-230.1	50.0	200	20	98.4	15.5 (106)	-	-
494	UFP-230	50.0	200	20	97.7	14.6 (106)	-	-
507	UFP-231	100.0	200	20	97.2	13.3 (106)	-	-
508	UFP-232	150.0	200	20	98.3	9.6 (106)	-	-
425	UFP-213	20.0	28	5	88.1	37.4 (425)	-	-
426	UFP-214	20.0	28	5	94.2	27.1 (212)	-	-

*Microagglomerate recovery by 2-stage flotation
In brackets - screen size in microns
rpm - 2000
Residence time - 4 min

Table 7-30

EFFECT OF AGGLOMERANT ADDITION AND SOLIDS CONCENTRATION KENTUCKY NO. 9

Serial No.	Lab ID	Top Size (mesh)	High-Shear Solids %	Heptane Conc %	Screen Size (um)	Bench Scale BTU Rec %	Bench Scale PSR %
798	KEN-14	28	5	10.0	106	97.9	14.0
799	KEN-15	28	5	30.0	106	97.2	11.7
800	KEN-16	28	5	150.0	106	97.3	16.4
801	KEN-17	28	5	10.0	400	91.0	52.0
826	KEN-18	28	5	30.0	400	91.0	43.3
802	KEN-19	28	5	150.0	400	83.4	40.5
803	KEN-23	28	20	10.0	600	93.2	43.6
818	KEN-24	28	20	30.0	600	96.1	25.1
804	KEN-25	28	20	150.0	600	88.6	32.3
815	KEN-20	200	5	10.0	106	93.2	65.7
816	KEN-21	200	5	30.0	106	98.7	51.3
817	KEN-22	200	5	150.0	106	96.8	46.1
805	KEN-26	200	20	10.0	106	98.9	47.1
819	KEN-27	200	20	30.0	106	97.6	33.3
806	KEN-217.1	200	20	30.0	106	98.9	35.7
807	KEN-28	200	20	150.0	106	99.3	21.7

rpm - 2000
Residence time - 4 min

Analysis of the test data reveals that for the heavy oil (Maya + diesel) case the solids concentration does not have a significant effect on process performance for Illinois No. 6 and Upper Freeport coals, while for Pittsburgh No. 8 coal the efficiency of process increases with the decrease of high-shear solids concentration. Further experiments conducted with Pittsburgh No. 8 coal at various solids content in the flotation stage showed that the performance of the agglomeration process with a high solids content in high-shear stage (20%) can be improved by using lower solids content in the flotation step (see Section 7.4.3.3).

For the heptane process, a comparison of the results obtained for various solids concentrations shows a significant effect of this parameter on the process performance for each coal. A lower solids concentration leads to a higher pyritic sulfur rejection at a comparable BTU recovery (over 90%). For the Illinois No. 6 coal, it is observed that increasing solids concentration from 10 to

20% leads to a higher BTU recovery with the decease in pyritic sulfur rejection. It should be noted that the BTU recovery for Illinois No. 6 is lower than for other project coals due to the poorer agglomerating properties of this coal.

The effect of the heptane addition on the process performance for Illinois No. 6 coal is not significant within each solids concentration. For Pittsburgh No. 8, Upper Freeport and Kentucky No. 9 coals the results show that 10-20% of heptane is the optimum concentration range to achieve the best performance. A low heptane concentration, such as 6%, is insufficient to achieve a high BTU recovery.

A series of tests was conducted with the coal samples at 28 mesh top size using various screen size opening for the recovery of microagglomerates.

The results presented in Table 7-30 show that screen size has a significant effect on agglomeration performance. The pyritic sulfur rejections increase in all cases when a larger screen size opening is used. However, a decrease in BTU recoveries was observed at the same time. This can be concluded from the results of the tests carried out to compare screen openings of 106 and 400 microns at identical test conditions (5% solids concentration and 28 mesh grind). The set of tests carried out at 20% solids concentration using screen opening of 600 microns also shows an improvement in PSR. A positive effect of a large screen opening in this case compensates for a diminishing effect of an increased solids concentration on pyritic sulfur rejection.

A comparison of agglomeration results for all project coals at a different particle size, solids concentration, agglomerant addition and screen size opening allowed to narrow down the high-shear operating conditions to the following:

Table 7-31

HIGH-SHEAR OPERATING CONDITIONS

	Diesel Case	Heptane Case
Coal particle size, mesh	28, 100	200
Solids concentration, %	20	5
Agglomerant addition, %	1	10-20
Screen size opening, um	-	106

7.4.3.2 High-Shear Agitation and Residence Time

Several test matrices were designed to determine the influence of high-shear mixing intensity and residence time on the agglomeration products' quality. The results of these tests are presented in Tables 7-32, 7-33 and 7-34.

Table 7-32

EFFECT OF HIGH-SHEAR CONDITIONS
PITTSBURGH NO. 8 COAL

Serial No.	Lab ID	Top Size (mesh)	Res Time (min)	RPM	Bench Scale BTU Rec %	Bench Scale PSR %	ROM Basis BTU Rec %	ROM Basis PSR %
Maya-Diesel Mixture at 1%								
768*	PIT-268	200	4.0	1600	98.0	35.1	94.9	61.7
769*	PIT-269	200	4.0	2000	98.2	33.5	95.2	60.7
770*	PIT-270	200	4.0	2400	98.5	38.3	95.5	63.5
Diesel at 1%								
808*	PIT-278	100	4.0	2000	98.0	34.7	95.0	61.4
822*	PIT-282	100	1.0	2000	97.4	40.1	94.4	64.6
823*	PIT-283	100	4.0	2000	98.9	32.7	95.8	60.2
847*	PIT-285	100	4.0	1600	97.8	32.8	94.8	60.3
970*	PIT-291	100	1.0	1600	95.4	47.7	92.5	69.1
971*	PIT-292	100	1.0	2000	96.6	45.5	93.6	67.8
825*	PIT-284	28	4.0	1600	97.3	27.0	94.3	56.9
812	PIT-280	28	1.0	2000	94.8	28.6	91.9	57.8
814	PIT-281	28	4.0	2000	97.6	25.3	94.6	55.9
850	PIT-288	28	4.0	1600	98.4	11.3	95.4	47.6
848	PIT-286	28	1.0	2000	96.5	18.9	93.5	52.1
849	PIT-287	28	4.0	2000	97.8	12.8	94.8	48.5
972*	PIT-293	28	1.0	2000	91.4	44.5	88.5	67.2
Heptane at 20%								
779	PIT-272	200	0.5	1600	92.2	27.2	89.4	57.0
880	PIT-290	200	1.0	1600	86.6	54.4	84.0	73.1
780	PIT-273	200	4.0	1600	97.9	39.3	94.7	64.1
781	PIT-274	200	0.5	2000	97.2	25.7	94.3	56.1
879	PIT-289	200	1.0	2000	93.1	51.3	90.3	71.2
790	PIT-275	200	4.0	2000	97.0	34.8	94.1	61.5
791	PIT-276	200	0.5	2400	92.2	52.7	89.4	72.0
821	PIT-276.1	200	0.5	2400	93.0	51.4	90.2	71.3
792	PIT-277	200	4.0	2400	97.6	37.0	94.7	62.8
809	PIT-279	100	4.0	2000	96.8	34.0	93.9	61.0
810	PIT-279.1	100	4.0	2000	96.5	33.2	93.6	60.5

*Two stages of flotation

Table 7-33

EFFECT OF HIGH-SHEAR CONDITIONS
UPPER FREEPORT COAL

Serial No.	Lab ID	Top Size (mesh)	Res Time (min)	RPM	Bench Scale BTU Rec %	Bench Scale PSR %
Maya-Diesel Mixture at 1%						
688*	UFP-246	200	4.0	2400	85.7	67.2
689*[1]	UFP-247	200	4.0	2000	89.6	69.8
775*[1]	UFP-247.1	200	4.0	2000	91.2	72.3
690*	UFP-248	200	4.0	1600	88.5	71.9
777*	UFP-250	200	4.0	2000	92.2	69.9
Diesel at 1%						
867*	UFP-261	100	1.0	2000	85.2	77.4
868*	UFP-262	100	4.0	1600	84.1	77.8
967*[1]	UFP-282	100	1.0	2000	85.0	79.2
969*[1]	UFP-284	100	1.0	1600	84.4	80.5
871	UFP-264	28	4.0	2000	75.4	77.7
872	UFP-265	28	4.0	1600	74.9	79.6
873	UFP-266	28	1.0	2000	80.2	76.0
968[1]	UFP-283	28	1.0	2000	75.6	83.9
Heptane at 20%						
794	UFP-254	200	0.5	1600	88.7	56.5
882	UFP-268	200	1.0	1600	93.6	51.9
797	UFP-257	200	4.0	1600	93.5	67.0
793	UFP-253	200	0.5	2000	91.1	42.7
881	UFP-267	200	1.0	2000	90.4	72.8
795	UFP-256	200	4.0	2000	94.4	62.3
796	UFP-256.1	200	4.0	2000	94.8	60.2
837	UFP-252	200	0.5	2400	94.1	46.9
838	UFP-255	200	4.0	2400	95.0	63.6
839	UFP-258	100	4.0	2000	95.7	42.5
840	UFP-258.1	100	4.0	2000	94.0	39.7

*Two stages of flotation
[1]pH adjustment with lime

Table 7-34

EFFECT OF HIGH-SHEAR CONDITIONS
KENTUCKY NO. 9 COAL

Serial No.	Lab ID	Top Size (mesh)	Solids %	Microagg Rec	Res Time (min)	RPM	Bench Scale BTU Rec %	Bench Scale PSR %
Diesel at 1%								
910	KEN-38	28	20	1-Stg Flot	1.0	1600	95.4	49.2
874	KEN-38.1	28	20	1-Stg Flot	1.0	1600	93.1	53.9
875	KEN-39	28	20	1-Stg Flot	4.0	1600	97.8	43.9
911	KEN-40	28	20	1-Stg Flot	1.0	2000	97.3	43.7
876	KEN-41	28	20	1-Stg Flot	4.0	2000	96.7	43.2
877	KEN-42	28	20	2-Stg Flot	4.0	2000	96.9	48.2
961	KEN-78	28	20	2-Stg Flot	1.0	1600	92.4	63.4
851	KEN-32	100	20	2-Stg Flot	4.0	2000	97.3	38.8
852	KEN-32.1	100	20	2-Stg Flot	4.0	2000	97.9	40.3
962	KEN-79	100	20	2-Stg Flot	1.0	1600	94.1	60.5
906	KEN-56	200	20	1-Stg Flot	1.0	1600	96.4	45.8
907	KEN-57	200	20	1-Stg Flot	4.0	1600	96.9	42.9
892	KEN-50	200	20	1-Stg Flot	1.0	2000	97.2	41.9
913	KEN-50.1	200	20	1-Stg Flot	1.0	2000	96.6	42.8
878	KEN-43	200	20	2-Stg Flot	4.0	2000	97.6	43.7
893	KEN-51	200	20	1-Stg Flot	4.0	2000	97.9	34.8
963	KEN-80	200	20	2-Stg Flot	1.0	1600	96.4	56.9
Heptane at 20%								
891	KEN-44	28	5	Screen(425um)	4.0	2000	88.9	26.6
918	KEN-48	28	5	2-Stg Flot	4.0	2000	68.7	70.7
923	KEN-46	28	20	2-Stg Flot	4.0	2000	94.8	45.5
924	KEN-46.1	28	20	2-Stg Flot	4.0	2000	94.6	47.0
927	KEN-64	100	5	Screen(150um)	4.0	2000	94.2	52.0
853	KEN-33	100	5	Screen(212um)	4.0	2000	98.2	36.1
854	KEN-33.1	100	5	Screen(212um)	4.0	2000	97.9	30.9
908	KEN-59	200	5	Screen(106um)	1.0	1600	85.5	55.4
909	KEN-60	200	5	Screen(106um)	0.5	2000	95.5	55.3
920	KEN-61	200	5	Screen(106um)	1.0	2000	95.3	42.3
922	KEN-45	200	5	Screen(106um)	4.0	2000	94.6	39.3
921	KEN-62	200	5	Screen(106um)	0.5	2400	91.7	52.8
919	KEN-49	200	5	2-Stg Flot	4.0	2000	79.5	68.7
925	KEN-47	200	20	2-Stg Flot	4.0	2000	94.2	49.0
926	KEN-47.1	200	20	2-Stg Flot	4.0	2000	94.2	48.7
Heptane at 10%								
912	KEN-58	200	5	Screen(106um)	0.5	1600	91.4	22.9
932	KEN-58.1	200	5	Screen(106um)	0.5	1600	92.7	30.9
933	KEN-58.2	200	5	Screen(106um)	0.5	1600	92.4	27.7
934	KEN-63	200	5	Screen(106um)	1.0	2400	96.0	50.3
956	KEN-65	200	5	1-Stg Flot	4.0	2000	93.5	58.5
957	KEN-66	28	5	1-Stg Flot	4.0	2000	93.4	53.8

Analysis of the heavy oil test results shows that for a particular coal size, the effect of high-shear mixing intensity is not significant within the range tested. A high-shear residence time has much more impact on the process performance within the range tested.

The results for all of the coals show that increased residence time at a constant mixing intensity not always provide the best pyritic sulfur rejection. This is probably caused by the fact that there is an optimum residence time to achieve the best separation after which some of the pyrite particles are entrapped in the microagglomerates, thereby diminishing their quality.

The results prove that 1 minute residence time is sufficient to achieve a relatively high pyritic sulfur rejection at 1600 or 2000 rpm. An application of a two-stage flotation leads to a significant improvement in pyritic sulfur rejection without any loss in the coal matter as compared to the results of a single-stage of flotation.

The heptane tests show that at 2000 rpm, a 1 minute residence time provides the highest pyritic sulfur rejection for Pittsburgh No. 8 and Upper Freeport coals, while 0.5 minute residence time is sufficient to achieve the best separation for Kentucky No. 9 coal.

7.4.3.3 Flotation Solids Contents

Test Objectives

To determine the effect of solids concentration on flotation performance.

Test Descriptions and Conditions

A series of tests designed to investigate the effects of solid concentration in agglomeration and flotation operations, were carried out under the following conditions:

Table 7-35

TEST CONDITIONS

Coal	Pittsburgh No. 8
Grind size, mesh	200
Agglomerant	Maya Crude + Diesel Oil (1:1 ratio)
Agglomerant concentration, %	1
High-shear, rpm:	2000
High-shear residence time, min	4
High-shear solids concentration, %	5, 10, 20
Flotation	One-stage
Flotation solids concentration, %	1.5, 3.0, 6.0

The standard agglomeration tests with heavy agglomerant were carried out in a 1-liter agglomeration vessel utilizing approximately 800 ml of slurry while the separation of microagglomerates was performed in a 3-liter flotation cell, using a diluted agglomerate slurry (about 2.6 liters). As a result, the solids concentration in the flotation step was reduced by the factor of two as compared to agglomeration. This series of tests was carried out to determine whether the improved process performance was caused by the changes in solids concentration of the agglomeration, flotation, or both steps. In order to achieve the desired agglomeration/flotation percent solids in which flotation percent solids was less than half that of agglomeration, the high-shear product was split using a riffle. Conversely, the multiple high-shear products were combined prior to flotation, in order to achieve the flotation percent solids which would be higher than half that of agglomeration.

Result Analysis

The results of these tests are presented in Table 7-36.

An evaluation of these test results indicates that the percent solids at a high-shear agglomeration has no effect on the process performance for a constant solids concentration at flotation step. However, it can be clearly seen that the percent solids at which flotation takes place has a significant impact on overall test performance. A reduction in solids concentration after high-shear agglomeration results in higher pyritic sulfur rejection at equivalent BTU recovery.

However, from a process design stand point, lower solids concentration in the flotation step means larger float cell volume which increases fixed costs. A 6% solids concentration in flotation step has been selected for conducting other tests requiring flotation to recover the microagglomerates.

Table 7-36

INFLUENCE OF SOLIDS CONCENTRATION ON FLOTATION PERFORMANCE

Serial No.	Lab ID	High-shear % Solids	Flotation % Solids	BTU Rec	Pyrite Rej	ROM Basis BTU Rec	ROM Basis PSR
431	PIT-217	20	6	98.5	24.3	95.5	59.9
432	PIT-217.1	20	6	98.8	23.5	95.8	59.5
445	PIT-223	20	3	95.0	37.4	92.1	66.9
446	PIT-223.1	20	3	98.3	31.5	95.3	63.8
447	PIT-224	20	1.5	95.1	40.4	92.2	68.5
448	PIT-224.1	20	1.5	97.3	39.6	94.3	68.0
449	PIT-225	20	1.5	98.5	38.9	95.5	67.7
450	PIT-225.1	20	1.5	97.8	36.3	94.9	66.3
441	PIT-221	10	6	99.1	22.7	96.1	59.1
442	PIT-221.1	10	6	98.7	29.6	95.7	62.8
435	PIT-219	10	3	98.9	29.9	95.9	62.9
436	PIT-219.1	10	3	98.7	31.7	95.7	63.9
437	PIT-220	10	1.5	98.9	38.2	95.9	67.3
438	PIT-220.1	10	1.5	98.4	41.2	95.4	68.9
439	PIT-220.2	10	1.5	96.0	44.7	93.1	70.7
440	PIT-220.3	10	1.5	97.2	43.1	94.2	69.9
443	PIT-222	5	3	100.1	30.5	97.1	63.2
444	PIT-222.1	5	3	98.4	33.5	95.4	64.8
433	PIT-218	5	1.5	98.7	36.6	95.7	66.5
434	PIT-218.1	5	1.5	98.1	41.7	95.2	69.2

7.4.3.4 Flotation Residence Time

This matrix of tests was performed for each coal except Kentucky No. 9, using a Maya-diesel mixture as an agglomerant. For the Kentucky No. 9 coal (which has replaced Illinois No. 6 coal) this test matrix was carried out with diesel oil. A limited number of tests in this matrix were performed with Pittsburgh No. 8 and Upper Freeport coals using diesel oil as an agglomerant since most of the information on the floating characteristics of these coals was received from the tests using Maya-diesel mixture. The flotation products were collected as increments at 15, 30, 60 and 120 seconds from the start of flotation and the final froth (barren).

The results presented in this section reflect the quality of products collected to barren and the flotation time is given as a cumulative time over the entire collection period.

Table 7-37

EFFECT OF HIGH-SHEAR CONDITIONS
ILLINOIS NO. 6

Serial No.	Lab ID	Res Time (min	RPM	Cum Flot Time (sec)	Bench Scale BTU Rec %	Bench Scale PSR %	ROM Basis BTU Rec %	ROM Basis PSR %
Maya-Diesel Mixture at 1% - 200 Mesh								
745	ILL-246	0.5	1600	810	97.8	34.5	91.4	76.6
750	ILL-247	1.0	1600	840	98.7	24.6	92.3	73.1
755	ILL-248	2.0	1600	630	103.8	22.8	97.0	72.4
760	ILL-249	4.0	1600	660	98.0	30.0	91.6	75.0
715	ILL-242	0.5	2000	720	98.2	30.2	91.8	75.1
720	ILL-243	1.0	2000	540	100.0	31.0	93.5	75.4
725	ILL-244	2.0	2000	480	98.7	30.0	92.3	75.0
740	ILL-244.15	2.0	2000	510	95.4	27.5	89.2	74.1
730	ILL-245	4.0	2000	480	98.0	37.1	91.6	77.6
767*	ILL-252	4.0	2000	480	98.1	33.8	91.7	76.4
695	ILL-238	0.5	2400	570	97.8	30.3	91.4	75.1
700	ILL-239	1.0	2400	540	97.7	28.0	91.4	74.3
705	ILL-240	2.0	2400	480	98.3	30.0	92.0	75.0
735	ILL-240.15	2.0	2400		100.1	26.0	93.6	73.6
710	ILL-241	4.0	2400	480	98.7	27.9	92.3	74.3
761[1]	ILL-250	4.0	2400	480	96.6	38.0	90.4	77.9
762[1]	ILL-251	4.0	1600	660	98.4	31.5	92.0	75.5

*Test run with two stages of flotation
[1]Tests run using standard procedure using two-stage flotation and single froth sampling

Table 7-38

EFFECT OF HIGH-SHEAR CONDITIONS
PITTSBURGH NO. 8

Serial No.	Lab ID	Res Time (min	RPM	Cum Flot Time (sec)	Bench Scale BTU Rec %	Bench Scale PSR %	ROM Basis BTU Rec %	ROM Basis PSR %
Maya-Diesel Mixture at 1% - 200 Mesh								
597	PIT-264	0.5	1600	300	97.6	34.7	94.6	61.4
602	PIT-265	1.0	1600	240	98.2	29.9	95.1	58.6
607	PIT-266	2.0	1600	220	97.8	32.7	94.7	60.2
612	PIT-267	4.0	1600	200	98.7	29.4	95.6	58.3
539	PIT-255	0.5	2000	220	97.5	28.7	94.5	57.8
549*	PIT-259	0.5	2000	270	97.7	34.3	94.7	61.2
562	PIT-256	1.0	2000	180	98.9	26.2	95.8	56.4
567	PIT-257	2.0	2000	210	97.4	30.3	94.4	58.8
544	PIT-258	4.0	2000	210	98.6	30.3	95.5	58.8
786[1]	PIT-271	4.0	2000	390	98.8	43.6	95.7	66.7
572	PIT-260	0.5	2400	200	98.1	30.5	95.1	59.0
577	PIT-260.15	0.5	2400	200	98.3	27.9	95.3	57.4
582	PIT-261	1.0	2400	200	98.5	36.2	95.5	62.3
587	PIT-262	2.0	2400	180	98.7	29.0	95.6	58.0
592	PIT-263	4.0	2400	190	98.7	32.0	95.6	59.8
Diesel Oil at 1% - 28 Mesh								
825	PIT-284	4.0	1600	200	96.7	24.8	93.8	55.6
812	PIT-280	1.0	2000	210	94.1	26.7	91.3	56.7
814	PIT-281	4.0	2000	180	96.9	23.3	94.0	54.7
Diesel Oil at 1% - 100 Mesh								
847	PIT-285	4.0	1600	210	97.0	30.0	94.1	58.6
822	PIT-282	1.0	2000	210	96.5	36.6	93.6	62.5
823	PIT-283	4.0	2000	180	98.1	29.8	95.2	58.5

*Pyrite depressant added
[1]Two stages of flotation

Table 7-39

EFFECT OF HIGH-SHEAR CONDITIONS
UPPER FREEPORT

Serial No.	Lab ID	Res Time (min)	RPM	Cum Flot Time (sec)	Bench Scale BTU Rec %	Bench Scale PSR %
Maya-Diesel Mixture at 1% - 200 Mesh						
637	UFP-237.5	0.5	1600	390	94.0	50.4
652	UFP-240.5	1.0	1600	375	94.7	49.7
672	UFP-243.5	2.0	1600	420	92.9	54.9
682	UFP-245.5	4.0	1600	450	92.5	55.5
687	UFP-245.15	4.0	1600	450	92.6	54.6
622	UFP-234.5	0.5	2000	270	93.3	49.3
632*	UFP-236.5	0.5	2000	330	94.9	54.0
647	UFP-239.5	1.0	2000	390	93.2	52.1
667	UFP-242.5	2.0	2000	390	92.4	54.7
627	UFP-235.5	4.0	2000	330	88.4	58.4
617	UFP-233.5	0.5	2400	270	93.0	48.4
775[1]	UFP-249.5	0.5	2400	300	93.4	63.0
642	UFP-238.5	1.0	2400	390	93.4	57.4
657	UFP-241.5	2.0	2400	360	92.8	56.4
662	UFP-241.15	2.0	2400	360	92.9	54.1
677	UFP-244.5	4.0	2400	330	94.3	51.8
Diesel Oil at 1% - 28 Mesh						
842	UFP-259	4.0	2000	510	76.6	76.7
844	UFP-260	1.0	2000	480	81.5	74.7
870	UFP-263	4.0	1600	520	75.5	77.5
Diesel Oil at 1% - 100 Mesh						
867	UFP-261	1.0	2000	540	85.8	76.1
868	UFP-262	4.0	1600	510	84.7	76.5
967	UFP-282	1.0	1600	520	85.1	79.1

Table 7-40

EFFECT OF HIGH-SHEAR CONDITIONS
KENTUCKY NO. 9

Serial No.	Lab ID	Res Time (min	RPM	Cum Flot Time (sec)	Bench Scale BTU Rec %	Bench Scale PSR %
Diesel at 1% - 28 Mesh						
858	KEN-34	1.0	1600	210	94.5	45.6
862	KEN-35	4.0	1600	120	97.2	39.5
886	KEN-35.1	4.0	1600	150	97.7	37.6
866	KEN-36	1.0	2000	120	97.3	39.8
890	KEN-37	4.0	2000	180	97.6	34.3
Diesel at 1% - 200 Mesh						
901	KEN-53	4.0	1600	300	97.1	46.2
905	KEN-54	1.0	2000	240	96.7	47.1
931	KEN-54.1	1.0	2000	240	97.7	42.6
917	KEN-55	4.0	2000	150	98.6	39.0

The main conclusion that can be drawn from these series of experiments is that each coal has its individual characteristic response towards agglomeration and flotation. The cumulative flotation time varied to a great extend among the project coals, with the Kentucky No. 9 showing the fastest response to flotation then the other project coals. The Illinois No. 6 coal demonstrated the slowest floating tendencies, which can be attributed to a lower hydrophobicity of this coal as compared with other coals. The flotation response of Upper Freeport coal was slightly lower than that of Pittsburgh No. 8 coal as it is seen from tests using Maya-diesel mixture. A new Upper Freeport coal sample was used in the program after completion of Task 5.1. Several confirmatory tests have been performed using a new Upper Freeport sample and diesel oil to evaluate the flotation response. The results indicated that the flotation of microagglomerates obtained from a new Upper Freeport sample was much slower than that of Pittsburgh No. 8 or Upper Freeport used in Task 5.1. A slower response to the flotation as well as significantly reduced BTU recoveries gave an indication that this particular sample of Upper Freeport coal had undergone a natural oxidation process which significantly altered its agglomerating properties. The BTU recovery for a 28 mesh coal sample was higher at 1 minute high-shear residence time (81.5%) than at 4 minute high-shear residence time (76.6%). This could be explained by the fact that the coal sample, was characterized by high friability and as a result of that sustained additional comminution during a prolonged high-shear agitation. The agglomerant consumed at the early

stage of high-shear mixing was not available to cover the fresh and much larger coal surface areas, which were opened during the prolong agitation. This resulted in lower BTU recovery. For a 100 mesh sample the fresh unoxidized coal surfaces were disclosed during sample preparation before addition of the agglomerant. As a result, the BTU recovery for 100 mesh sample was higher than that for a 28 mesh sample at a comparable high-shear conditions and was not affected by high-shear residence time.

7.4.3.5 Incremental Flotation

The incremental froth flotation experiments provided significant information on the coal recovery at different collection times as well as an estimate on the pyrite entrapment in products.

For the tests carried out with Maya-diesel mixture and Illinois No. 6, Upper Freeport and Pittsburgh No. 8 coals, the froth was collected as five increments at 15, 30, 60, 120 seconds and the final froth (barren). These results are presented in Figures 7-9, 7-10 and 7-11. In the tests performed with diesel oil and Pittsburgh No. 8 and Upper Freeport coals the products were collected in two increments at 30 seconds and the barren (Figure 7-12). A full test matrix was carried out with Kentucky No. 9 coal and diesel oil. The products were collected as four increments at 15, 30, 60 seconds and the barren. The results are shown in Figure 7-13.

For Illinois No. 6 coal, a higher agitation (2000, 2400 rpm) and a longer residence time (120 and 240 seconds) provided better feed for flotation step. More than 80% of the clean coal could be collected in the first 120 seconds of the flotation with much lower pyritic sulfur content then the final product would have (Figure 7-9).

For Upper Freeport coal a cumulative pyritic sulfur in the product remained fairly constant throughout the collection period and most of the BTU (over 80%) could be recovered in the first 120 seconds. Unlike the other coals, the best BTU recovery was obtained for the lowest high-shear residence time (30 seconds) (Figure 7-10). The explanation of this behaviour was given in Section 7.4.3.4.

For Pittsburgh No. 8 coal, the cumulative flotation time could be limited to 60-120 seconds as most of the coal had been recovered within that period of time and pyrite content did not change much after 30 seconds of flotation.

For the Kentucky No. 9 coal, the best feed material for flotation was obtained at 1 minute residence time and 1600 rpm. The flotation could be limited to 60 seconds and provided the highest pyritic sulfur rejection without affecting the coal matter recovery (Figure 7-13).

7.4.3.6 Screen Loading Effect

Test Objectives

To investigate the effect of screen loading on process performance during microagglomerate recovery using light hydrocarbon.

Test Conditions and Descriptions

When an agglomeration test is carried out at 20% solids, the 160 grams of coal feed is used, while a 5% solids test uses only 40 grams of feed coal. Since the standard procedure calls for the screening of both high-shear products on a 106-micron screen, it is hard to determine whether the differences in process performance are due to the difference in agglomeration percent solids or due to the difference in screen loadings (4 times greater for the 20% solids case). To investigate this difference in performance, a test was completed in which four 5% high-shear products were combined prior to screening, and another test was completed in which a 20% solids agglomeration product was riffled into four parts, each being screened separately.

Table 7-41

TEST CONDITIONS

Coal	Pittsburgh No. 8
Grind size, mesh	200
Agglomerant	Heptane
Agglomerant concentration, %	20
High-shear, rpm	2000
High-shear residence time, min	4
High-shear solids, %	5, 20
Microagglomerate recovery	Screen - 106 um

Result Analysis

Analysis of the test results presented in Table 7-42, indicates that for the same high-shear agglomeration solids loading, an increased screen loading has a detrimental effect on pyrite rejection at equivalent BTU recoveries. This phenomenon occurs for both the 40 grams and 160 grams high-shear loadings. When comparisons are made at constant screen loadings, the detrimental effect of increased high-shear loading is also observed. It should be noted that for

the high-shear agglomeration solids at 5%, the effect of screen loading is not as significant (PSR = 28.1% at 40g screen loading vs PSR = 22.1% at 160g screen loading) as in the case of the 20% high-shear solids (PSR = 18.2% at 40g screen loading vs PSR = 4.0% at 160g screen loading).

Table 7-42

SCREEN LOADING TESTS

Serial No.	Lab ID	High-shear Loading(g)	Screen Loading(g)	BTU Rec	Pyrite Rej	ROM Basis BTU Rec	ROM Basis PSR
395	PIT-208	40	40	98.2	31.2	95.2	63.6
396	PIT-208.1	40	40	98.4	28.1	95.4	62.0
452	PIT-227	40	160	99.7	22.1	96.7	58.8
451	PIT-226	160	40	98.1	18.2	95.2	56.7
455	PIT-230	160	160	99.8	4.0	96.8	49.2

7.4.4 Other Process Parameters

This section discusses the effects of other process variables not covered in the optimization tests. The process parameters tested include the use of pyrite depressant, the emulsification of agglomerants, the effect of coal oxidation, the pH and storage of coal slurry.

7.4.4.1 Pyrite Depressants

Test Objectives

To determine the effect of pyrite depressants on agglomeration product quality.

Test Descriptions and Conditions

Potassium ferrocyanide and oxone monopersulfate were evaluated as the pyrite depressants. When potassium ferrocyanide was used, a lime was added to the agglomeration step, while for oxone case it was added to the flotation cell to adjust the pH of microagglomerate slurry. The depressants were introduced into coal slurry prior to the wet grinding. A two-stage flotation was used for microagglomerate recovery. The test conditions are shown in Table 7-43.

Table 7-43

TEST CONDITIONS

	Upper Freeport	Pittsburgh No. 8	Kentucky No. 9
Grind size, mesh	28, 100, 200	28, 100, 200	28, 200
Agglomerant type (heavy, light)	Diesel, Heptane	Diesel, Heptane	Diesel
Agglomerant concentration, %	1, 20	1, 20	1
High-shear rpm	2000, 2000	2000, 2000	1600
High-shear residence time, min	1	1	1
High-shear solids, %	20, 5	20,5	20, 5

Results Analysis

Test results are presented in Tables 7-44, 7-45 and 7-46.

Table 7-44

PYRITE DEPRESSANT TESTS WITH PITTSBURGH NO. 8 COAL

Serial No.	Lab ID	Top Size (mesh)	Pyrite[a] Depressant 1, (gm)	Pyrite[b] Depressant 2, (gm)	Additive (gm)	Bench Scale BTU Rec %	Bench Scale PSR %
Diesel at 1%							
980	PIT-297	28	PFCN (0.12)	LM (0.48)	-	87.7	45.0
981	PIT-297.1	28	PFCN (0.12)	LM (0.48)	-	87.7	45.0
984	PIT-298	28	OXN (0.07)	-	-	93.2	41.0
985	PIT-299	28	OXN (0.07)	-	LM (0.10)	94.7	42.9
986	PIT-299.1	28	OXN (0.07)	-	LM (0.10)	94.7	45.2
987	PIT-300	28	OXN (0.42)	-	LM (0.26)	91.0	43.9
988	PIT-301	28	OXN (0.84)	-	LM (0.30)	78.1	58.0
979	PIT-296	100	PFCN (0.12)	LM (0.48)	-	95.2	49.7
989	PIT-302	100	OXN (0.07)	-	LM (0.10)	97.8	50.3
Tests Without Pyrite Depressants Using Diesel							
972	PIT-293	28	-	-	-	91.4	44.5
971	PIT-292	100	-	-	-	96.6	45.5
Diesel at 1%							
Heptane at 20%							
976	PIT-294	200	OXN (0.07)	-	-	94.3	58.9
977	PIT-295	200	PFCN (0.03)	LM (0.12)	-	87.5	51.0
978	PIT-295.1	200	PFCN (0.03)	LM (0.12)	-	87.3	49.9
Tests Without Pyrite Depressant Using Heptane							
879	PIT-289	200	-	-	-	94.2	55.9

All tests at 2000 rpm for 1 minute residence time.

[a] Pyrite depressant 1 - PFCN - potassium ferrocyanide
- OXN - oxone monopersulfate

[b] Pyrite depressant 2 - LM - lime

Table 7-45

PYRITE DEPRESSANT TESTS WITH UPPER FREEPORT COAL

Serial No.	Lab ID	Top Size (mesh)	Pyrite[a] Depressant 1, (gm)	Pyrite[b] Depressant 2, (gm)	Additive (gm)	Bench Scale BTU Rec %	Bench Scale PSR %
Diesel at 1%							
937[1]	UFP-270	28	PFCN (0.12)	LM (0.48)	-	81.5	82.5
938	UFP-271	28	OXN (0.07)	-	LM (0.52)	79.5	79.6
939	UFP-272	28	OXN (0.42)	-	LM (0.67)	76.8	79.0
940	UFP-272.1	28	OXN (0.42)	-	LM (0.67)	78.0	79.7
941	UFP-273	28	OXN (0.84)	-	LM (0.75)	69.1	83.1
942	UFP-274	28	OXN (0.07)	-	-	76.0	81.7
948[1]	UFP-278	28	PFCN (0.12)	LM (0.48)	-	78.1	83.2
935[1]	UFP-269	100	PFCN (0.12)	LM (0.48)	-	89.0	75.7
936[1]	UFP-269.1	100	PFCN (0.12)	LM (0.48)	-	89.6	75.7
965	UFP-281	100	OXN (0.07)	-	LM (0.52)	83.8	77.0
966	UFP-281.1	100	OXN (0.07)	-	LM (0.52)	84.7	77.8
Tests Without Pyrite Depressant Using Diesel							
873	UFP-266	28	-	-	-	80.2	76.0
968	UFP-283	28	-	-	-	75.6	83.9
867	UFP-261	100	-	-	-	85.2	77.4
967	UFP-282	100	-	-	-	85.0	79.2
2-Stage Tests with Diesel							
950	UFP-280	28+200	OXN (0.07)	-	LM (0.52)	72.1	88.6
964	UFP-279	28+200	OXN (0.07)	-	-	75.8	86.6
Heptane at 20%							
943	UFP-275	200	OXN (0.02)	-	-	88.0	80.5
944	UFP-275.1	200	OXN (0.02)	-	-	89.6	76.5
945[1]	UFP-276	200	PFCN (0.12)	LM (0.48)	-	92.0	75.3
946[1]	UFP-276.1	200	PFCN (0.12)	LM (0.48)	-	91.6	73.1
Tests without depressant using heptane:							
881	UFP-267	200	-	-	-	90.4	72.8

[a] Pyrite depressant 1 - PFCN - potassium ferrocyanide
- OXN - oxone monopersulfate

[b] Pyrite depressant 2 - LM - lime

[1] Depressant added to the flotation cell

Table 7-46

PYRITE DEPRESSANT TESTS WITH KENTUCKY NO. 9 COAL

Serial No.	Lab ID	Top Size (mesh)	Pyrite[a] Depressant 1, (gm)	Pyrite[b] Depressant 2, (gm)	Additive (gm)	Bench Scale BTU Rec %	Bench Scale PSR %
Diesel at 1%							
951	KEN-67	28	PFCN (0.12)	LM (0.48)	-	89.3	65.7
952	KEN-67.1	28	PFCN (0.12)	LM (0.48)	-	91.8	62.8
954	KEN-69	28	OXN (0.07)	-	-	94.2	56.3
955	KEN-70	28	OXN (0.42)	-	LM (0.15)	87.2	65.5
959	KEN-76	28	OXN (0.84)	-	LM (0.40)	77.4	76.2
961*	KEN-78	28	-	-	-	92.4	63.4
953	KEN-68	200	PFCN (0.12)	LM (0.48)	-	89.3	63.0
958	KEN-72	200	PFCN (0.84)	-	LM (0.36)	93.0	60.3
973	KEN-75	200	OXN (0.42)	-	LM (0.30)	92.5	65.1
963*	KEN-80	200	-	-	-	96.4	56.9

[a] Pyrite depressant 1 - PFCN - potassium ferrocyanide
- OXN - oxone monopersulfate

[b] Pyrite depressant 2 - LM - lime

*Tests at the same conditions but without depressant addition

For all the project coals investigated, there was no significant improvement in process performance for both the heptane and diesel cases. For higher dosages of pyrite depressants, an increase in pyritic sulfur rejection was observed, however this was accompanied by reduction in BTU recovery. For a lower depressant concentration, the process performance was similar to that one without depressant presence. The influence of potassium ferrocyanide and oxone monopersulfate was also difficult to quantify, as different dosages of these depressants were used.

For Pittsburgh No. 8 coal, the results for a 28 mesh sample did not show any significant improvement with the use of either of the two depressants. Pyritic sulfur rejection was usually in the 40-45% range, with BTU recovery higher than 90%, and tests carried out without depressants show similar results. Mild dosages of oxone monopersulfate (in the range of 0.07 gm per 160 gm of dry coal) did not have any adverse effect on BTU recovery. However, when higher dosages were used, significant loss of BTU recovery was observed (Test Nos. 988 and

990). A relatively small dosages of potassium ferrocyanide did not provide good BTU recovery with Pittsburgh No. 8 coal. The limited number of tests with the 100 mesh Pittsburgh No. 8 coal indicated a slight improvement in the performance (about 5% increase in pyritic sulfur rejection at equivalent BTU recovery) when using depressants. Tests carried out with heptane and a 200 mesh sample also did not indicate any significant improvement with the use of pyrite depressants.

For Upper Freeport coal, in the diesel case, with both 28 and 100 mesh size, the potassium ferrocyanide and lime combination provided slightly better results than oxone monopersulfate. The heptane agglomeration with 200 mesh sample resulted in higher BTU recoveries and slightly lower pyritic sulfur rejection than diesel agglomeration. For Upper Freeport coal, characterized by the lowest BTU recovery at 28 mesh size out of all project coals, the application of depressants caused further reduction in coal matter recovery.

Analysis of the tests using Kentucky No. 9 coal 28 mesh size and diesel oil as an agglomerant lead to similar conclusion - no major improvement was observed when using pyrite depressants. At high dosages of oxone (Test No. 959) pyritic sulfur rejection improved (about 13% increase) but with the significant loss in BTU recovery. Tests carried out at 200 mesh showed significant improvement in pyritic sulfur rejection without BTU loss in case of both depressants. But the standard agglomeration performance for Kentucky No. 9 coal, using 200 mesh, was significantly lower then that of 28 mesh coal and the application of depressants had only brought the performance of 200 mesh coal to the level of the standard performance of 28 mesh coal.

7.4.4.2 Emulsification

Test Objectives

To evaluate the effect of agglomerant emulsification on product quality and the overall process performance. Emulsification of the agglomerant prior to agglomeration is expected to reduce the time required for microagglomerate formation. This reduced high-shear residence time may decrease the contact time of the pyrite with the agglomerant, thus preventing wetting of the pyrites with agglomerant.

Test Descriptions and Conditions

To determine and quantify the effect of emulsification on agglomeration performance, both heavy and light agglomerants were used. Tests were conducted using the standard batch test procedures except for agglomerant condition and mixing intensity. The agglomerants were transformed into emulsions using an ultra-sonic mixer. Besides a standard mixing intensity of 2000 rpm, testing at 1000 rpm was incorporated into the test program. The test conditions for this program are listed in Table 7-47.

Table 7-47

TEST CONDITIONS

	Diesel Case			Heptane Case		
	Upper Freeport	Pittsburgh No. 8	Kentucky No. 9	Upper Freeport	Pittsburgh No. 8	Kentucky No. 9
Grind size, mesh	28	28	28	200	200	200
Agglomerant %	1	1	1	20	20	10
High-shear rpm	2000,1000	2000,1000	1600,1000	2000,1000	2000,1000	2000,1000
High-shear residence time, min	1, 5	1, 5	1, 5	1, 5	1, 5	0.5, 5
High-shear solids %	20	20	20	5	5	5
Agglomerant-water ratio	1:20	1:20	1:20	1:10	1:10	1:10

Results Analysis

The test results for the diesel and heptane cases are presented in Tables 7-48, 7-49 and 7-50.

Table 7-48

EFFECT OF EMULSIFICATION
UPPER FREEPORT

Serial No.	Lab ID	Oil Type	H-S rpm	H-S Res Time min	Product Ash%	Product TS%	Product PS%	Performance BTU%	Performance PSR%
1030	UFP-310	Diesel	2000	1	5.3	0.98	0.28	72.2	87.1
1031	UFP-308	Diesel*	2000	1	5.1	0.97	0.27	72.6	87.6
1032	UFP-311	Diesel	1000	1	4.4	0.94	0.23	49.6	92.7
1033	UFP-309	Diesel*	1000	1	4.6	0.95	0.24	56.2	91.3
1141	UFP-320	Diesel	1000	5	4.4	0.96	0.25	55.8	91.1
1126	UFP-316	Diesel*	1000	5	4.7	0.84	0.13	63.8	94.6
1057	UFP-312	Heptane	2000	1	5.7	0.98	0.28	89.7	83.9
1058	UFP-314	Heptane*	2000	1	6.4	1.06	0.36	90.1	78.7
1059	UFP-313	Heptane	1000	1	13.6	1.84	1.19	91.6	22.0
1060	UFP-315	Heptane*	1000	1	13.2	1.83	1.18	95.3	20.1
1129	UFP-317	Heptane*	1000	5	6.4	0.91	0.21	89.8	87.6

*Agglomerant emulsion

Table 7-49

EFFECT OF EMULSIFICATION
PITTSBURGH NO. 8

Serial No.	Lab ID	Oil Type	H-S rpm	H-S Res Time min	Product Ash%	Product TS%	Product PS%	Performance BTU%	Performance PSR%
1034	PIT-313	Diesel	2000	1	6.0	3.74	1.33	92.0	37.0
1035	PIT-315	Diesel*	2000	1	6.0	3.69	1.28	91.6	39.6
1036	PIT-316	Diesel	1000	1	4.7	3.53	1.09	57.6	68.3
1037	PIT-314	Diesel*	1000	1	5.0	3.58	1.15	67.8	60.6
1140	PIT-420	Diesel	1000	5	5.0	3.37	0.94	70.2	66.7
1127	PIT-416	Diesel*	1000	5	4.9	3.30	0.86	72.5	68.3
1049	PIT-317	Heptane	2000	1	5.4	3.33	0.90	94.6	56.4
1050	PIT-318	Heptane*	2000	1	4.8	3.14	0.70	95.3	66.3
1051	PIT-319	Heptane	1000	1	9.7	3.92	1.60	91.4	20.5
1052	PIT-320	Heptane*	1000	1	9.1	3.77	1.44	93.4	27.8
1130	PIT-417	Heptane*	1000	5	9.2	3.70	1.37	88.0	35.0

*Agglomerant emulsion

Table 7-50

EFFECT OF EMULSIFICATION
KENTUCKY NO. 9

Serial No.	Lab ID	Oil Type	H-S rpm	H-S Res Time min	Product Ash%	Product TS%	Product PS%	Performance BTU%	Performance PSR%
1039	KEN-91	Diesel	1600	1	6.1	2.57	0.92	88.9	74.6
1038	KEN-90	Diesel*	1600	1	6.6	2.63	0.99	90.6	72.0
1041	KEN-93	Diesel	1000	1	5.8	2.61	0.96	77.8	77.0
1040	KEN-92	Diesel*	1000	1	5.6	2.62	0.96	78.7	76.6
1139	KEN-117	Diesel	1000	5	6.2	2.57	0.92	82.5	76.3
1128	KEN-111	Diesel*	1000	5	6.7	2.53	0.89	89.7	75.0
1054	KEN-95	Heptane	2000	1	12.4	3.42	1.88	89.3	44.2
1053	KEN-94	Heptane*	2000	1	10.2	3.32	1.74	92.8	47.6
1055	KEN-96	Heptane	1000	1	15.3	4.00	2.51	76.5	33.7
1056	KEN-97	Heptane*	1000	1	14.1	3.77	2.26	76.8	41.0
1131	KEN-112	Heptane*	1000	5	11.3	3.34	1.78	91.0	46.8

*Agglomerant emulsion

For the diesel case, emulsification of agglomerant did not affect the process performance under the standard operating condition (2000 rpm and 1 min residence time). For a lower energy input (1000 rpm), a reduction in BTU recovery was observed for both unemulsified and emulsified agglomerant with less severity in the latter case. An extension of agglomeration time from 1 minute to 5 minutes improved the coal matter recovery for unemulsified, and to a greater extent for emulsified agglomerant. However it was noticed that this improvement was coal-dependent. For Kentucky No. 9, a longer residence time yielded similar results to that obtained at standard conditions (1600 rpm and 1 minute), while for Upper Freeport and Pittsburgh No. 8 coals, the BTU recovery remained lower than that observed for standard agglomeration.

For the heptane tests performed under standard operating conditions, there was no significant impact of agglomerant emulsification on process performance for both the Upper Freeport and Kentucky No. 9 coals. An improvement in pyritic sulfur rejection by about 10% was observed for Pittsburgh No. 8. At a lower energy input level and 1 minute residence time, all the project coals showed very poor pyritic sulfur rejection (20-40%), but the BTU recovery remained comparable with the standard operating condition. By increasing the residence time to 5 minutes, similar performances, in terms of BTU recovery and pyritic sulfur rejection were observed for Upper Freeport and Kentucky No. 9 coals as those under the standard operating condition.

7.4.4.3 Oxidation Effect

Test Objectives

To determine the effect of oxidation on agglomeration process performance. It is known that coals exposed to the oxidative environment for prolonged time, may demonstrate a poor response to the conventional flotation processes. Because an oil agglomeration is also a surface-dependent process, it can be anticipated that the process performance can be affected by coal oxidation.

Test Descriptions and Conditions

To quantify the effect of oxidation on process performance, coal samples of 28 mesh top size were exposed to an open atmosphere for 14 and 49 days. Subsequently the agglomeration experiments were carried out with 28 mesh and 100 mesh grind sizes. As oxidation is known to have an effect on flotation response, the recovery of froth using an incremental flotation technique

at regular intervals was also examined in this activity. The test conditions for this activity are listed in Table 7-51.

Table 7-51

TEST CONDITIONS

Coal	Pittsburgh No. 8	Kentucky No. 9
Agglomerant	Diesel	Diesel
Agglomerant concentration, %	1.0	1.0
Grind size after oxidation, mesh	28, 100	28, 100
Oxidation time	0, 14, 49 days	0, 14, 49 days
High-shear rpm	2000	1600
High-shear residence time, min	1	1
Froth recovery method	single-stage multiple collection	single-stage multiple collection

Result Analysis

The test results for Pittsburgh No. 8 and Kentucky No. 9 coals are presented in Tables 7-52 and 7-53, respectively.

Table 7-52

EFFECT OF OXIDATION PITTSBURGH NO. 8 COAL

Ser.No.	Lab ID	Size	Oxidation Time(days)	Flot.	Product Ash%	Product PS%	BTU Rec%	PSR%
1061	PIT-307	28	0	S	6.4	1.32	99.5	34.2
1065	PIT-307.4	28	0	M	6.4	1.33	99.7	33.7
1066	PIT-308	100	0	S	6.9	1.26	98.0	38.1
1070	PIT-308.4	100	0	M	6.9	1.26	97.9	38.1
1071	PIT-309	28	14	S	7.1	1.38	98.5	31.4
1075	PIT-309.4	28	14	M	7.1	1.38	98.6	31.3
1076	PIT-310	100	14	S	7.0	1.29	99.4	35.4
1080	PIT-310.4	100	14	M	7.0	1.29	99.3	35.3
1081	PIT-311	28	49	S	6.4	1.26	89.5	43.5
1085	PIT-311.4	28	49	M	6.4	1.27	89.5	43.2
1086	PIT-312	100	49	S	6.4	1.17	96.2	43.6
1090	PIT-312.4	100	49	M	6.2	1.14	96.5	45.1

S: Single froth collection
M: Multiple froth collection

Table 7-53

EFFECTS OF OXIDATION
KENTUCKY NO. 9 COAL

Ser.No.	Lab ID	Size	Oxidation Time(days)	Flot.	Product Ash%	Product PS%	BTU Rec%	PSR%
1095	KEN-85	28	0	S	8.4	1.54	98.1	53.2
1098	KEN-85.3	28	0	M	8.4	1.55	98.1	53.1
1091	KEN-84	100	0	S	8.8	1.63	98.9	50.0
1094	KEN-84.3	100	0	M	8.8	1.63	98.9	50.0
1099	KEN-86	28	14	S	8.3	1.47	96.8	56.0
1102	KEN-86.3	28	14	M	8.3	1.47	96.8	56.1
1103	KEN-87	100	14	S	8.4	1.61	99.6	50.4
1106	KEN-87.3	100	14	M	8.5	1.61	99.5	50.4
1107	KEN-88	28	49	S	7.7	1.39	87.4	62.7
1109	KEN-88.2	28	49	M	7.6	1.36	82.7	65.4
1110	KEN-89	100	49	S	7.9	1.50	94.0	56.6
1114	KEN-89.3	100	49	M	7.9	1.51	93.9	56.5

S: Single froth collection
M: Multiple froth collection

The agglomeration experiments performed with a 28 mesh sample (no grinding after oxidation) demonstrated that the noticeable effect of oxidation was seen after a period of 49 days, for both Pittsburgh No. 8 and Kentucky No. 9 coals. For Pittsburgh No. 8 coal, the BTU recovery dropped from 98-99% to 89%, whereas the pyritic sulfur rejection increased from 31-34% to 43%. For Kentucky No. 9 coal, the BTU recovery decreased from 97-98% to 83-88%, with an increase in pyritic sulfur rejection from 54-56% to 63-65%.

Grinding of oxidized coal from 28 mesh down to 100 mesh generated fresh, unoxidized surfaces and as a result, the agglomeration properties were restored. This trend was observed for both Pittsburgh No. 8 and Kentucky No. 9 coal samples.

Examination of the flotation responses for a single or incremental collection of froth showed that the oxidation had an insignificant effect on flotation time. The oxidized samples displayed a slightly longer cumulative flotation time of barren.

7.4.4.4 Storage Effect

Test Objectives

To study the effect of slurry storage time on agglomeration performance.

Test Descriptions and Conditions

Coal samples ground to 28, 100 and 200 mesh top sizes were usually stored overnight or longer prior to the operation of the continuous testing unit at 5 Kg/hr capacity. The test condition for this short program are listed in Table 7-54.

Table 7-54

TEST CONDITIONS

Coal	Upper Freeport	Pittsburgh No. 8	Kentucky No. 9
Agglomerant	Diesel	Diesel	Diesel
Agglomerant concentration, %	1.0	1.0	1.0
Grind size, mesh	28, 100, 200	28, 100, 200	28, 100, 200
High-shear, rpm	2000	2000	1600
High-shear residence time, min	1, 4	1	1
Storage time, days	0, 1, 4	0, 1, 4	0, 1, 4

Result Analysis

The effect of slurry storage time on agglomeration process is presented in Table 7-55. The results indicated that for all project coals ground to a different size, a slurry storage time ranging from 0 to 4 days did not influence a process performance in terms of BTU recovery and pyritic sulfur rejection.

Table 7-55

EFFECT OF SLURRY STORAGE TIME

Serial No.	Lab ID	Top Size (mesh)	Storage Time, days	BTU Rec %	PSR %
995	UFP-286	28	0	75.8	83.0
996*	UFP-285	28	0	71.6	84.9
997*	UFP-287	28	1	77.2	84.6
998	UFP-288	28	1	77.5	84.9
999	UFP-289	28	4	76.3	83.9
1000*	UFP-290	28	4	77.7	82.8
1001	UFP-400	100	0	88.0	75.9
1002	UFP-401	100	1	87.1	77.2
1003	UFP-402	100	4	88.0	79.0
1004	UFP-403	200	0	93.8	70.3
1005	UFP-404	200	1	94.6	68.8
1006	UFP-405	200	4	91.3	75.4
1007	PIT-400	28	0	91.3	66.6
1008	PIT-401	28	1	91.7	65.7
1009	PIT-402	28	4	91.7	66.5
1010	PIT-403	100	0	94.3	68.0
1011	PIT-404	100	1	94.3	70.2
1012	PIT-405	100	4	95.0	67.8
1013	PIT-406	200	0	95.4	68.9
1014	PIT-407	200	1	96.0	70.3
1015	PIT-408	200	4	95.0	69.1
1016	KEN-100	28	0	94.6	59.7
1017	KEN-101	28	1	93.6	63.2
1018	KEN-102	28	4	93.8	63.5
1019	KEN-103	100	0	95.3	60.1
1020	KEN-104	100	1	95.9	59.5
1021	KEN-105	100	4	95.3	60.5
1022	KEN-106	200	0	95.7	57.4
1023	KEN-107	200	1	95.4	57.1
1024	KEN-108	200	4	95.8	57.6

*Tests with 4 minute high-shear residence time

7.4.4.5 pH Effect

Test Objectives

To determine the effect of slurry pH on agglomeration process performance. At higher pH, both the coal and mineral matter, possess a high negative surface charge resulting in a strong electrostatic repulsion between the two particle types. This phenomenon may result in a better selectivity of the agglomeration process and improve ash and pyritic sulfur rejection.

In the case when the pH adjustment is done in the flotation stage, a basic elevated pH may minimize the entrainment of free pyrite particles with the clean coal.

Test Descriptions and Conditions

Table 7-56

TEST CONDITIONS

Coal	Upper Freeport	Pittsburgh No. 8	Kentucky No. 9
Agglomerant	Diesel	Diesel	Diesel
Agglomerant concentration, %	1.0	1.0	1.0
High-shear solids, %	20.0	20.0	20.0
Grind size, mesh	28, 100	28, 100	28, 100
High-shear, rpm	2000	2000	1600
High-shear residence time, min	1	1	1
Slurry pH	11	11	11
Reagent	Hydrated lime	Hydrated lime	Hydrated lime

Result Analysis

The results presented in Table 7-57 showed that higher pH did not improve the selectivity of separation. Moreover, moderate to significant reduction in BTU recoveries were observed for all three project coals. The influence of pH on agglomeration performance was found to be coal sample dependent. For Upper Freeport coal, the basic pH resulted in higher pyritic sulfur rejection at essentially similar BTU recovery. In contrast to Upper Freeport coal, a significant reduction in BTU recovery was observed for Pittsburgh No. 8. For the third project coal, Kentucky No. 9, a little or no effect of pH on process performance was noticed.

Table 7-57

EFFECT OF SLURRY pH

Serial No.	Lab ID	Grind Size,Mesh	pH Adjustment	Product Ash%	Product TS%	Product PS%	Performance BTU%	Performance PSR%
Upper Freeport								
968	UFP-283	28	-	5.9	1.01	0.37	75.6	83.9
1132	UFP-318	28	H-S	5.9	0.89	0.19	77.9	90.3
1144	UFP-321	28	Flotation	5.4	0.99	0.29	70.0	87.0
967	UFP-282	100	-	6.4	1.06	0.42	85.0	79.2
1133	UFP-319	100	H-S	6.4	0.96	0.27	84.4	85.3
-	-	100	Flotation	-	-	-	-	-

Table 7-57 (Continued)

EFFECT OF SLURRY pH

Serial No.	Lab ID	Grind Size,Mesh	pH Adjustment	Product Ash%	Product TS%	Product PS%	Performance BTU%	Performance PSR%
Pittsburgh No. 8								
972	PIT-293	28	-	5.7	3.55	1.23	91.4	44.5
1134	PIT-418	28	H-S	5.1	3.39	0.96	72.0	64.9
1143	PIT-421	28	Flotation	5.3	3.49	1.07	55.6	69.9
971	PIT-292	100	-	5.8	8.46	1.14	96.6	45.5
1135	PIT-419	100	H-S	5.7	3.31	0.90	92.0	57.6
-	-	100	Flotation	-	-	-	-	-
Kentucky No. 9								
1039	KEN-91	28	-	6.1	2.57	0.92	88.9	74.6
1136	KEN-113	28	H-S	6.2	2.59	0.94	81.9	76.0
1142	KEN-118	28	Flotation	6.6	2.68	1.04	74.5	74.5
1138	KEN-116	100	-	6.9	2.68	1.05	93.7	69.3
1137	KEN-114	100	H-S	6.3	2.65	1.01	90.7	71.3
-	-	100	Flotation	-	-	-	-	-

7.4.5 Pyrite Distribution Analysis

Test Objectives

To determine and estimate the maximum of pyrite rejection that can be achieved by a cleaning process such as agglomeration, based on the size distribution and association of the pyrite particles.

Test Conditions and Descriptions

A few samples of clean coal and reject have been analysed for pyrite distribution and association for each tested coal. The analyses were carried out at the Center of Applied Energy Research at the University of Kentucky. Float and sink fractions separated at 1.8 specific gravity from Pittsburgh No. 8 and Upper Freeport coals were also analysed. The float-sink results of feed coals were presented and discussed in the "Coal Characterization" section.

Result Analysis

The results of pyrite distribution analysis are presented in Tables 7-58, 7-59 and 7-60.

Table 7-58

PYRITE DISTRIBUTION AND ASSOCIATION
PITTSBURGH NO. 8 - 200 MESH

		Volume, %					
State	Diameter (um)	Feed	Float 1.8	Sink 1.8	PIT-276 Product	PIT-276 Refuse	PIT-206 Product
Free	< 5	5.45	11.63	0.58	2.09	3.03	4.89
	5 - 10	11.05	3.45	2.50	3.58	7.42	11.41
	10 - 25	32.63	0.00	8.35	8.14	11.11	20.43
	25 - 40	28.98	0.00	20.02	21.68	12.69	0.00
	40 - 75	0.00	0.00	46.37	0.00	58.75	0.00
Total		78.11	15.08	77.82	35.49	92.99	36.74
Approx. Pyr Sul, %		1.48	0.06	1.04	0.29	0.99	0.38
Included	< 5	0.81	6.35	0.15	1.56	0.12	2.39
	5 - 10	4.42	12.66	0.30	3.03	0.32	12.45
	10 - 25	0.00	11.33	2.51	0.00	0.00	5.11
	25 - 40	0.00	0.00	0.00	0.00	0.00	0.00
	40 - 75	0.00	0.00	15.46	0.00	0.00	0.00
Total		5.22	30.33	18.41	4.59	0.44	19.95
Approx. Pyr Sul, %		0.10	0.25	0.04	0.005	0.21	
Edge	< 5	1.68	7.77	0.12	2.25	0.35	3.68
	5 - 10	7.73	24.16	1.14	11.57	1.45	19.20
	10 - 25	7.25	22.66	2.51	24.41	4.76	20.43
	25 - 40	0.00	0.00	0.00	21.68	0.00	0.00
	40 - 75	0.00	0.00	0.00	0.00	0.00	0.00
Total		16.66	54.59	3.77	59.92	6.57	43.31
Approx. Pyr Sul, %		0.32	0.20	0.05	0.49	0.07	0.45

Table 7-59

PYRITE DISTRIBUTION AND ASSOCIATION
UPPER FREEPORT - 200 MESH

		Volume, %				
State	Diameter (um)	Feed	Float 1.8	Sink 1.8	UFP-200 Product	UFP-200 Refuse
Free	< 5	0.65	17.42	0.56	1.31	1.31
	5 - 10	2.70	9.61	3.72	2.17	5.26
	10 - 25	10.37	0.00	11.14	2.04	16.37
	25 - 40	10.81	0.00	25.85	32.60	16.35
	40 - 75	66.74	0.00	53.22	37.75	50.49
Total		91.27	27.04	94.49	75.87	89.79
Approx. Pyr Sul, %		1.37	0.05	1.11	0.47	0.90
Included	< 5	0.15	10.82	0.06	0.41	0.02
	5 - 10	0.37	22.43	0.00	0.83	0.00
	10 - 25	0.00	0.00	0.36	1.02	0.00
	25 - 40	0.00	0.00	0.00	0.00	0.00
	40 - 57	0.00	0.00	0.00	0.00	0.00
Total		0.51	33.25	0.42	2.26	0.02
Approx. Pyr Sul, %		0.01	0.06	0.00	0.01	0.00
Edge	< 5	0.14	7.91	0.08	0.53	0.10
	5 - 10	0.41	16.02	1.06	1.97	0.55
	10 - 25	4.06	15.78	1.08	11.22	4.09
	25 - 40	3.60	0.00	2.87	8.15	5.45
	40 - 75	0.00	0.00	0.00	0.00	0.00
Total		8.21	39.71	5.09	21.86	10.19
Approx. Pyr Sul, %		0.12	0.07	0.06	0.13	0.10

Table 7-60

PYRITE DISTRIBUTION AND ASSOCIATION
KENTUCKY NO. 9 - 200 MESH

		Volume, %					
State	Diameter (um)	Feed 28 M	Feed 200 M	KEN-38 Product 28 M	KEN-38 Refuse 28 M	KEN-45 Product 200 M	KEN-45 Refuse 200 M
Free	< 5	0.69	2.08	0.68	0.00	1.64	2.39
	5 - 10	0.68	2.20	1.42	0.01	4.76	10.34
	10 - 25	2.22	12.19	5.38	0.02	7.82	25.46
	25 - 40	17.77	21.66	8.60	0.04	0.00	38.76
	40 - 75	0.00	50.15	0.00	0.15	48.23	0.00
	75 - 100	0.00	0.00	0.00	0.84	0.00	0.00
	> 150	0.00	0.00	0.00	5.47	0.00	0.00
Total		21.36	88.28	16.07	6.53	62.45	76.96
Approx. Pyr Sul, %		0.62	2.58	0.22	0.10	1.01	1.09
Included	< 5	1.20	0.33	1.02	0.00	0.40	0.07
	5 - 10	3.73	1.24	7.21	0.00	1.59	0.25
	10 - 25	10.00	2.71	11.83	0.01	3.91	0.00
	25 - 40	0.00	0.00	0.00	0.00	0.00	0.00
	40 - 75	0.00	0.00	0.00	0.00	0.00	0.00
	75 - 150	0.00	0.00	0.00	0.00	0.00	0.00
	> 150	0.00	0.00	0.00	0.00	0.00	0.00
Total		15.03	4.28	20.06	0.01	5.90	0.31
Approx. Pyr Sul, %		0.44	0.13	0.27	0.00	0.10	0.004
Edge	< 5	0.44	0.62	0.45	0.00	0.68	0.06
	5 - 10	2.03	2.75	4.26	0.00	6.22	0.86
	10 - 25	2.22	4.06	19.36	0.01	14.33	2.42
	25 - 40	17 77	0.00	0.00	0.06	10.41	19.38
	40 - 75	41.15	0.00	39.81	0.15	0.00	0.00
	75 - 150	0.00	0.00	0.00	0.00	0.00	0.00
	> 150	0.00	0.00	0.00	93.23	0.00	0.00
Total		63.61	7.43	63.87	93.46	31.65	22.73
Approx. Pyr Sul, %		1.86	0.22	0.87	1.40	0.51	0.32

For Pittsburgh No. 8 and Upper Freeport coals, an analysis of the float and sink fractions obtained at 1.8 specific gravity indicated a very efficient separation o the "free" pyrite from the clean coal. Only 15% of the particles present in the float fraction of Pittsburgh No. 8 and 27% for Upper Freeport were "free" , and almost none of those particles were larger than 10 um. The majority of the particles in the float fraction were "edge" particles, which were difficult to remove by any separation process. The sink fractions contained mostly coarse "free" pyrite particles. Analysis of the agglomeration product and refuse samples indicated a potential for additional removal of the "free" pyrite particles, especially those above 10-25 um. The particles in this size range and

above were present in a large number in the agglomeration products for both Pittsburgh No. 8 and Upper Freeport coals. For Pittsburgh No. 8 coal, the majority of the pyrite particles in the float were in the "edge" category. An agglomeration tailings in most cases contained a smaller relative proportion of "edge" and "included" pyrites then the sink fraction. This results were expected since the probability of rejection of a pyrite particles partially or completely surrounded by coal were lower in a surface-based separation process.

For Kentucky No. 9 coal, the agglomerated product at 28 mesh showed a similar distribution of pyrite particles to that of the feed coal at the same size. Most of the pyrite particles were concentrated in the "edge" category. However there was still a potential for removal of "free" pyrite particles for 200 mesh sample. The clean coal product at 200 mesh showed about 62% of the pyrite being in the "free" state, which could not be separated due to "entrainment" effect.

7.4.6 Agglomeration Using Precleaned Coals

Test Objectives

To determine the combined effects of precleaning and selective agglomeration processes.

Test Descriptions and Conditions

Simulated preclean coals were prepared by the float-sink process at specific gravity determined from the washability data. Batch agglomeration tests were conducted on the precleaned and on original samples. Because the simulated clean coals were produced by float-sink method using organic liquids, the effect of the latter on agglomeration was first determined. Raw coals were first immersed in the organic liquids and their agglomeration performances were compared with the non-treated coals. Agglomeration tests with the precleaned coals were performed under the following conditions (Table 7-61).

Table 7-61

TEST CONDITIONS

Coal	Upper Freeport	Pittsburgh No. 8	Kentucky No. 9
Agglomerant type	Diesel, Heptane	Diesel, Heptane	Diesel, Heptane
Grind size, mesh	28, 100, 200	28, 200	28, 100, 200
Agglomerant concentration, %	1, 20	1, 20	1, 10
High-shear solids, %	20, 5	20, 5	20, 5
High-shear residence time, min	1	4	1, 0.5
High-shear mixing, rpm	2000, 2000	2000, 2000	1600, 2000

Result Analysis

The properties of precleaned coals as well as precleaning efficiency for Upper Freeport, Kentucky No. 9 and Pittsburgh No. 8 are given in Table 7-62. These data were used to discuss the overall performance of precleaning followed by selective agglomeration.

Table 7-62

PROPERTIES OF RAW AND PRECLEANED COALS

	Ash%	TS%	PS%	BTU Recovery	PSR%
Kentucky No. 9					
Raw Coal (1st Series)	16.40	4.38	2.86	-	-
Clean Coal (1st Series)	9.20	2.73	1.17	92.3	65.0
Raw Coal (2nd Series)	21.70	4.59	3.29	-	-
Clean Coal (2nd Series)	9.50	2.93	1.26	95.1	69.5
Upper Freeport					
Raw Coal	16.20	2.28	1.65	-	-
Clean Coal	11.80	1.38	0.79	96.2	54.7
Pittsburgh No. 8					
Raw Coal	24.30	4.95	3.04	-	-
Clean Coal	10.90	4.83	2.29	96.9	40.9

The results of the agglomeration tests with Kentucky No. 9, Upper Freeport and Pittsburgh No. 8 coals are summarized in Tables 7-63, 7-64 and 7-65, respectively. The process performances are expressed on raw and precleaned coal basis.

*$PSR_{ROM} = PSR_{PC} + (100 - PSR_{PC}) \times PSR_{ag} \times 1/100$

$BTU_{ROM} = [BTU_{PC} \times BTU_{ag}] \times 1/100$, where:

BTU_{ROM} or PSR_{ROM} - pyritic sulfur rejection or BTU recovery calculated on raw coal basis
BTU_{PC} or PSR_{PC} - pyritic sulfur rejection or BTU recovery for the precleaning step
BTU_{ag} or PSR_{ag} - experimentally determined pyritic sulfur rejection or BTU recovery from the agglomeration step.

Table 7-63

KENTUCKY NO. 9 PRECLEANING TEST RESULTS

Serial No.	Lab ID	Coal Type	Top Size (mesh)	Oil Type	Product Quality Ash	TS	PS	Performance BTU Rec.	PSR
First Series									
1040	KEN-91	Raw*	28	Diesel	6.1	2.57	0.92	88.9	74.6
1115	KEN-99W	PrC	28	Diesel	6.5	2.52	0.94	93.4 (86.2)	27.3 (74.5)
1116	KEN-100W	PrC	100	Diesel	6.2	2.51	0.92	94.9 (87.6)	27.6 (74.6)
1117	KEN-101W	PrC	200	Diesel	6.1	2.49	0.90	96.9 (89.4)	27.9 (74.9)

PrC - Precleaned sample
Figures in brackets on raw coal basis
Precleaning performance: BTU recovery = 92.3%, PSR = 65%
*Working project sample - Batch 3

Second Series									
1118	KEN-103	Raw	28	Diesel	7.6	2.87	1.47	92.1	65.5
1119	KEN-104	Raw	100	Diesel	7.4	2.93	1.53	91.5	64.4
1120	KEN-105	Raw	200	Diesel	7.8	3.10	1.70	95.2	58.5
1124	KEN-106	Raw	200	Heptane	13.0	3.47	2.15	94.4	45.0
1121	KEN-107	PrC	28	Diesel	6.5	2.64	0.98	92.7 (88.1)	30.2 (78.7)
1122	KEN-108	PrC	100	Diesel	6.1	2.59	0.92	93.0 (88.4)	34.3 (79.9)
1123	KEN-109	PrC	200	Diesel	5.9	2.56	0.89	95.6 (90.9)	35.1 (80.2)
1125	KEN-110	PrC	200	Heptane	6.1	2.72	1.05	95.5 (90.8)	23.4 (76.6)

PrC - Precleaned sample
Figures in brackets on raw coal basis
Precleaning performance: BTU recovery = 95.1%, PSR = 69.5%

Table 7-64

UPPER FREEPORT PRECLEANING TEST RESULTS

Serial No.	Lab ID	Coal Type	Top Size (mesh)	Oil Type	Product Quality Ash	TS	PS	Performance BTU Rec.	PSR
1145	UFP-322	Raw	28	Diesel	8.7	1.16	0.58	90.6	71.1
1146	UFP-323	Raw	100	Diesel	8.6	1.25	0.66	94.1	65.9
1147	UFP-324	Raw	200	Diesel	8.7	1.28	0.69	94.1	64.3
1154	UFP-331	Raw	200	Heptane	8.9	1.15	0.56	94.3	70.6
1151	UFP-328	HVC	28	Diesel	8.7	1.15	0.58	91.9	70.0
1152	UFP-329	HVC	100	Diesel	8.7	1.15	0.58	94.1	69.3
1153	UFP-330	HVC	200	Diesel	8.8	1.18	0.61	94.6	67.5
1156	UFP-333	HVC	200	Heptane	8.9	1.14	0.56	98.1	68.7
1148	UFP-325	PrC	28	Diesel	8.3	0.98	0.43	92.7 (89.2)	51.2 (77.9)
1149	UFP-326	PrC	100	Diesel	7.9	0.94	0.39	94.9 (91.3)	55.2 (79.7)
1150	UFP-327	PrC	200	Diesel	7.8	0.94	0.39	95.2 (91.6)	55.2 (79.7)
1155	UFP-332	PrC	200	Heptane	8.2	0.92	0.37	96.6 (92.9)	56.8 (80.4)

PrC - Precleaned sample
HVC - Heavy liquid control sample
Precleaning performance: BTU recovery = 96.2%, PSR = 54.7%

Table 7-65

PITTSBURGH NO. 8 PRECLEANING TEST RESULTS

Serial No.	Lab ID	Coal Type	Top Size (mesh)	Oil Type	Product Quality Ash	TS	PS	Performance BTU Rec.	PSR
827	PIT-1R	Raw	28	Diesel	7.9	4.37	2.09	95.1	48.5
830	PIT-2R1	Raw	200	Diesel	7.0	4.34	1.96	97.3	49.3
835	PIT-3R1	Raw	200	Heptane	6.8	4.23	1.84	94.2	54.0
836	PIT-3R	Raw	200	Heptane	6.0	4.00	1.59	94.5	60.5
828	PIT-1W	PrC	28	Diesel	7.0	4.34	2.01	97.4 (94.5)	16.8 (50.8)
831	PIT-2W	PrC	200	Diesel	6.4	4.15	1.88	93.3 (95.4)	24.8 (55.6)
832	PIT-2W1	PrC	200	Diesel	6.2	4.16	1.89	98.1 (95.2)	24.9 (55.6)
833	PIT-3W	PrC	200	Heptane	6.1	4.25	1.97	97.8 (94.9)	21.9 (53.8)
834	PIT-3W1	PrC	200	Heptane	6.2	4.29	2.02	96.8 (93.9)	21.0 (53.3)

PrC - Precleaned sample
Precleaning performance: BTU recovery = 96.9%, PSR = 40.9%

Analysis of the tests with Kentucky No. 9 (Series 2) coal showed that agglomeration performance of the raw coal (PSR = 65.5% at 28 mesh) was close to that expected of conventional cleaning at 1/4" (PSR = 69.5%). When precleaning was combined with the agglomeration, the results were considerably higher (PSR = 78.7% - 80.2%) then those of conventional cleaning or raw coal

agglomeration, although with some decrease in BTU recovery. For the precleaned sample there was almost no change in PSR caused by reduction of coal size from 28 mesh (PSR = 78.7%) to 200 mesh (PSR = 80.2%). For the heptane case, the agglomeration result for raw Kentucky No. 9 (PSR = 45.0%) was considerably lower than for the precleaned sample (PSR = 76.6%). It was also observed that prolonged storage of the Kentucky No. 9, (Batch 3) reduced the BTU recovery and increased the pyritic sulfur rejection as the result of partial oxidation. A comparison of agglomeration performances of the raw and clean samples for this particular batch (Series 1) showed that the raw coal yielded a much cleaner product (PSR = 74.6%) than it would be expected from the conventional cleaning (PSR = 65%), but with lower BTU recovery. Precleaning combined with agglomeration resulted in the same pyritic sulfur rejection (74.5%) and BTU recovery (86.2%) as agglomeration of the raw coal (PSR = 74.6%, BTU = 88.9%).

For Upper Freeport coal, the test data showed that there was no effect of the organic liquids on agglomeration for all grind sizes and agglomerants investigated. These results eliminated some doubts regarding the influence of heavy organic liquids used in the precleaning stage on subsequent agglomeration.

The agglomeration results for Upper Freeport coal presented in Table 7-64, showed that process performance of 28 mesh raw coal was better (PSR = 71.1%) than the conventional cleaning at 1/4" (PSR = 54.7%). Precleaning followed by agglomeration resulted in slightly higher PSR than that of the raw coal (PSR = 77.9% vs 71.1%). For the precleaned coal there was not much difference in agglomeration performance between 28 mesh and 200 mesh samples, since most of the liberation (as in the case of Kentucky) took place during size reduction from 1/4" to 28 mesh.

For Pittsburgh No. 8 coal, a combination of precleaning with agglomeration resulted in a better quality product than the conventional cleaning (PSR - 50.8% for 28 mesh grind vs PSR = 40.9% for precleaning). Agglomeration of the raw coal yielded a similar results with those of the precleaned sample (PSR = 48.5% and PSR = 51.0% for 28 and 200 mesh, respectively for the raw coal vs PSR = 50.8% and PSR = 55.6% for clean coal). Comparable results were also ach eved for the heptane case.

In summary, the precleaning followed by agglomeration resulted in better process performance for Kentucky No. 9 (Series 1) and Upper Freeport coals. For Pittsburgh No. 8, agglomeration of precleaned coal yielded similar results as the agglomeration of a raw sample. The same observation was made for Kentucky No. 9 (Series 2) which was believed to be partially oxidized.

7.5 Two-Stage High-Shear Testing

Two process options, agglomeration-grinding-reagglomeration and tailing reprocessing were examined in the task program.

7.5.1 Product Regrinding

Test Objectives

To determine the effect of two-stage agglomeration process on process performance. Agglomeration-grinding-reagglomeration option was studied and the results were compared with the performance of single-stage agglomeration.

Test Descriptions and Conditions

Table 7-66

TEST CONDITIONS

Coal	Upper Freeport	Pittsburgh No. 8	Kentucky No. 9
Grind size, mesh	28, 200	28, 200	28, 200
Agglomerant	Diesel	Diesel	Diesel
Agglomerant concentration, %	1, 0.5	1, 0.5	1, 0.5
High-shear rpm:	2000	2000	1600
High-shear residence time, min	1	1	1
High-shear solids, %	20	20	20

Special Conditions

The coal was ground to a 28 mesh top size and subsequently subjected for agglomeration with 1% of agglomerant addition. The agglomeration product was then reground to pass 200 mesh and reagglomerated with 0.5% of agglomerant addition.

Microagglomerate recovery was done by one-stage flotation after each agglomeration stage.

Result Analysis

Test results are presented in Table 7-67.

Table 7-67

TWO-STAGE TESTS

Serial No.	Lab ID	Top Size (mesh)	Pyrite Dep Used	Additive Used	BTU Rec %	PSR %
Two-stage Tests						
947	UFP-277	28 + 200	-	LM(0.14)	74.5	86.9
949	UFP-277.1	28 + 200	-	-	70.9	88.9
950	UFP-280	28 + 200	OXN (0.07)	LM (0.52)	72.1	88.6
964	UFP-279	28 + 200	OXN (0.07)	-	75.8	86.6
Single-stage Tests						
873	UFP-266	28	-	-	80.2	76.0
867	UFP-261	100	-	-	85.2	77.4
Two-stage Tests						
960	KEN-77	28 + 200	-	-	91.6	65.4
975	KEN-77.1	28 + 200	-	-	92.6	67.3
993	KEN-82	28 + 200	OXN (0.42)	-	91.6	70.8
994	KEN-83	28 + 200	OXN (0.84)	-	90.5	74.6
510	KEN-2	28 + 200	-	-	95.8	64.7
513	KEN-4	28 + 200	-	-	98.9	61.8
516	KEN-7	28 + 200	Oxone	-	95.8	65.5
557	KEN-13	28 + 200	Oxone	-	92.6	75.7
Single-stage Tests						
961	KEN-78	28	-	-	92.4	63.4
963	KEN-80	200	-	-	96.4	56.9
Two-stage Tests						
982	PIT-306	28 + 200	-	-	90.1	54.0
983	PIT-306.1	28 + 200	-	-	91.6	50.0
990	PIT-305	28 + 200	OXN (0.84)	LM (0.20)	86.7	58.5
991	PIT-304	28 + 200	OXN (0.42)	LM (0.20)	86.4	58.8
Single-stage Tests						
972	PIT-293	28	-	-	91.4	44.5
971	PIT-292	100	-	-	96.6	45.5

For Upper Freeport coal the results of two-stage tests showed that there was an increase of pyrite rejection of about 10% with BTU recovery loss of about 5-10% as compared to a single-stage process. An application of depressants in a two-stage processing did not show any further improvement.

For the Kentucky No. 9 coal, a slight improvement in the performance was observed for the two-stage processing (2-4% PSR increase). The effect of the two-stage process was much more pronounced when oxone monopersulfate was introduced.

In the case of Pittsburgh No. 8 coal, a positive effect of both, a two-stage processing and a pyrite depressant addition on process performance was observed. There was an increase in PSR of about 6-10% at comparable BTU recovery for the two-stage processing. An application of pyrite depressants resulted in further enhancement in PSR by an additional 7% but at reduced BTU recovery. Single-stage test (#988) involving pyrite depressant showed similar PSR with the two-stage test (#991), but at significantly lower BTU recovery.

7.5.2 Tailings Reprocessing

Test Objectives

To investigate the option of reprocessing of agglomeration tailings to increase BTU recovery.

Test Descriptions and Conditions

The Upper Freeport coal has been selected for this test program because of its low BTU recovery in a single-stage processing. The tailings from a single-stage agglomeration of a 28 mesh grind were reprocessed by the following three methods (Figure 7-14).

- Direct Reagglomeration of tailings using 0.5% diesel (Scheme A).
- Tailings grinding to a 100 mesh top size and reagglomeration using 0.5% diesel (Scheme B).
- Wet screening of tailings at 150 um, grinding of the +150 um fraction to 100 mesh top size, and reagglomeration using 0.5% diesel (Scheme C).

The testing conditions for these experiments are summarized in Table 7-68.

Table 7-68

TEST CONDITIONS

Coal	Upper Freeport
Grind size, mesh	28
1st stage high-shear agglomerant	Diesel
1st stage high-shear agglomerant concentration, %	1.0
1st stage high-shear agitation, rpm	2000
1st stage high-shear residence time, min	1
1st stage microagglomerate recovery	Flotation (1 stage)
Tailings Reprocessing	
Grind size, mesh	28, 100
2nd stage high-shear agglomerant	Diesel
2nd stage high-shear agglomerant concentration, %	0.5
2nd stage high-shear agitation, rpm	2000
2nd stage high-shear residence time, min	1 min
2nd stage microagglomerate recovery	Flotation (1 stage)

Result Analysis

The results of tailings reprocessing by different methods are presented in Table 7-69. The reprocessing of the entire tailings stream (Scheme A and Scheme B) improved the BTU recovery however at the expense of pyritic sulfur rejection. Reagglomeration of tailings ground to a 100 mesh top size gave a slight improvement in BTU recovery then the reagglomeration of tailings at the original grind size (28 mesh).

By screening off the plus 150 um fraction from agglomeration tailings and their subsequent reprocessing (size reduction to 100 mesh top size followed by agglomeration) a similar BTU recovery with standard test was achieved at a higher pyritic sulfur rejection (PSR = 90.8 vs PSR = 84.7% at standard conditions).

Table 7-69

EFFECT OF TAILINGS REPROCESSING
UPPER FREEPORT COAL

Serial No.	Lab ID	Processing Scheme	Product Ash	Product TS	Product PS	BTU Rec %	PSR %
1026	UFP-305	Scheme A	6.8	1.21	0.51	85.9	71.2
1027	UFP-307	Scheme B	7.2	1.16	0.46	89.1	72.8
1028	UFP-317	Scheme C	5.6	0.92	0.22	78.6	88.8
1048	UFP-317.1	Scheme C	5.4	0.89	0.19	76.0	90.8
1025	UFP-304	Standard	5.6	1.01	0.31	76.2	84.7

Processing schemes detailed in Figure 7-14

7.6 Low-Shear Operation

Test Objectives

To determine the effect of binder types and concentrations, solids contents in low-shear, and the influence of surfactant addition on agglomerate formation.

Test Conditions and Descriptions

The batch low-shear program was carried out in ARC's agglomeration vessel using an agitation rate of 1800 rpm. During the low-shear experiments, the agglomerates were sampled at various residence time in order to determine the sizes of the agglomerates. The mass median diameters (d_{50}) of the agglomerates and feedstock microagglomerates were compared to evaluate the effectiveness of the low-shear operation. The feedstock were agglomerates produced in a high-shear agglomeration with 1% diesel addition. The test conditions of a batch low-shear operation are summarized in Table 7-70.

Table 7-70

TEST CONDITIONS FOR LOW-SHEAR EXPERIMENTS

Coal	Upper Freeport
Grind size, mesh	28
Binder types	Mixtures of Cold Lake Bitumen and diesel (1:1, 4:1, 9:1) Mixtures of asphalt AC-5 and diesel (1:1, 4:1, 9:1)
Binder concentration, %	6, 9, 10, 11
Low-shear solids concentration, %	25, 30, 40
Surfactant	PDS (Polydimethylsyloxane)
Surfactant addition, lbs/ton	0.4

Result Analysis

Effect of Binder Concentrations on Agglomerate Size

The experimental data showing the effect of binder concentration on agglomerate size are presented in Table 7-71 and graphically in Figure 7-15. These experiments were conducted at 30% solids in the low-shear, with a one-stage binder addition and for six concentrations of binder.

Mixture of Cold Lake Bitumen and diesel (1:1) was used as a binder for this study. The d_{50} of the products were compared with the d_{50} of the feedstock at various residence times.

Table 7-71

LOW-SHEAR TESTING
EFFECT OF BINDER ADDITION ON AGGLOMERATE SIZE

Residence Time (min)	Agglomerate Size (d_{50}) mm					
	6%	9%	10%	10.4%	10.8%	11%
0	0.11	0.11	0.11	0.11	0.11	0.11
5	0.21	0.36	0.36	0.45	0.59	0.75
10	0.21	0.39	0.39	0.54	0.69	0.98
20	0.22	0.43	0.47	0.55	0.84	1.36
30	0.24	0.48	0.52	0.72	1.08	1.87
40	0.24	0.53	0.53	0.80	1.08	2.00
60	0.25	0.54	0.53	0.83	1.37	2.20
90	0.25	0.68	0.68	0.99	1.41	2.80
120	0.23	0.74	0.78	1.12	2.47	3.30

The kinetics of agglomeration was highly dependent on the bridging liquid concentration. For binder additions lower than 10%, a slow growth in agglomerate sizes was observed at extended residence time (up to 120 minutes). However, when the binder concentrations were increased to 10.8 and 11.0%, a significant agglomerate growth was recorded at a short residence time (i.e. 20 minutes). Based on the results from this series of experiments, a binder addition above 10% was recommended for further studies on low-shear agglomeration.

Effect of Binder Types

The results of low-shear testing with five different binders are given in Table 7-72 and Figure 7-16. All these experiments were carried out using a 30% solids concentration in the low-shear, and a 10.4% of binder addition. The data showed that higher concentration of diesel in the binder was beneficial in terms of agglomeration kinetics. Cold Lake bitumen was found to be more effective than Asphalt AC-5.

Table 7-72

LOW-SHEAR TESTING
EFFECT OF TYPE OF BINDER ON AGGLOMERATE SIZE

Residence Time (min)	Agglomerate Size (d_{50}) mm				
	CLB+D(1:1)	CLB+D(9:1)	AC-5+D(9:1)	CLB+D(4:1)	AC-5+D(1:1)
0	0.11	0.11	0.11	0.11	0.11
5	0.45	0.28	0.31	0.11	0.32
10	0.54	0.30	0.32	0.11	0.35
20	0.55	0.35	0.33	0.47	0.42
30	0.72	0.40	0.38	0.57	0.48
40	0.80	0.42	0.38	0.64	0.49
60	0.83	0.42	0.41	0.75	0.59
90	0.99	0.43	0.47	0.77	0.71
120	1.12	0.43	0.50	1.10	0.81

Effect of Solids Contents in Low-shear

A series of experiments was carried out to investigate the effect of solids concentration in low-shear on agglomerate size. A mixture of Cold Lake bitumen and diesel (1:1) at 10% concentration was employed as a binder. The experimental data presented in Table 7-73 and Figure 7-17, showed that very slight differences in agglomerate sizes were observed for the solids content of 25% and 30%, but some acceleration in agglomerate growth was noticed when solids concentration was increased up to 40%.

Table 7-73

LOW-SHEAR TESTING
EFFECT OF SOLIDS CONCENTRATION ON AGGLOMERATE SIZE

Residence Time (min)	Agglomerate Size (d_{50}) mm		
	25%	30%	40%
0	0.11	0.11	0.11
5	0.35	0.36	0.34
10	0.36	0.39	0.42
20	0.45	0.43	0.53
30	0.50	0.48	0.57
40	0.51	0.53	0.62
60	0.52	0.54	0.76
90	0.64	0.68	0.73
120	0.73	0.74	0.77

Effect of Surfactant on Agglomerate Size Growth in Low-shear

A series of preliminary experiments was conducted to evaluate the benefit of surfactant addition (PDS of 0.4 lbs/tonne) on the low-shear operation. These experiments were carried out at 30% solids content using a mixture of Cold Lake bitumen and diesel (1:1) at 10% concentration. The data presented in Table 7-74 and Figure 7-18 revealed that in the presence of surfactant, a slight improvement in agglomeration kinetics as well as agglomerate size was achieved.

Table 7-74

LOW-SHEAR TESTING
EFFECT OF SURFACTANT ON AGGLOMERATE SIZE

Residence Time (min)	Agglomerate Size (d_{50}) mm	
	CLB + D (1:1)	CLB + D (1:1) + PDS6
0	0.11	0.11
5	0.36	0.38
10	0.39	0.43
20	0.47	0.51
30	0.52	0.55
40	0.53	0.58
60	0.53	0.65
90	0.68	0.79
120	0.78	0.92

7.7 Support Tests

The support tests were incorporated in the batch scale program as the project progressed. These tests covered areas which were not identified in the initial test plan, but were considered to be important for both engineering assessment and economic analysis of the selective agglomeration processes.

7.7.1 Drying Tests for Heptane Agglomerates

Test Objectives

To determine the moisture and heptane contents after drying the heptane low-shear products at temperatures selected for heptane recovery.

Test Descriptions and Conditions

The heptane low-shear products were generated from Pittsburgh No. 8 coal under the following conditions: 200 mesh grind, 10% heptane in the high-shear operation followed by 20% heptane and 3.3% asphalt in the low-shear operation. The low-shear products were dried in an oven at 110°C and 140°C. The agglomerates were sampled at regular intervals and analyzed for both moisture and heptane contents. Heptane concentrations were determined by extraction of hydrocarbons present in agglomerates, using methylene chloride followed by a gas chromatographic analysis of the extract, for the heptane concentration.

Result Analysis

The results given in Table 7-75 showed that after 40 minutes of drying at 140°C, the moisture and heptane contents were reduced to the levels of 0.3% and 0.33% respectively. For a lower temperature (110°C) about 60 minutes of drying was required to reduce the heptane and moisture contents to 0.2% and 0.22%, respectively. An extension of the drying process up to 16 hours showed that a small, but constant amount of heptane was still retained in the dried agglomerates.

Table 7-75

THERMAL DRYING OF AGGLOMERATES
HEPTANE BASE CASE

Drying Time min	Agglomerates Moisture %		Residual Heptane in Agglomerates %	
	110°C	140°C	110°C	140°C
0	11.5	11.5	-	-
10	10.4	9.8	15.4	11.9
20	7.2	6.2	0.70	0.34
30	1.4	0.7	0.46	0.38
40	0.9	0.3	0.36	0.33
60	0.2	0.0	0.22	-
120	-	-	0.16	-
240	-	-	0.11	-
960	-	-	0.11	-

7.7.2 Tests for Heptane Balance

Test Objectives

To determine heptane concentrations in all streams of the heptane process.

Test Descriptions and Conditions

It is expected that heptane will be present in all process streams of the light hydrocarbon agglomeration process. In order to determine its distribution, all streams were analyzed for heptane concentrations. In particular:

- High-shear tailings, both solid and liquid phases
- Low-shear tailings, both solid and liquid phases
- Low-shear products, after thermal drying at 110°C for 40 minutes

The process streams were generated by performing an agglomeration test with Pittsburgh No. 8 coal under standard conditions developed for the heptane case.

Result Analysis

The results of this study are summarized in Table 7-76, and schematically presented in Figure 7-19. Heptane contents in various process streams are expressed in percentage of the total heptane input to the process, (high- or low-shear heptane addition). The data indicated that 0.9% out of a 10% heptane input to high-shear was lost to the high-shear tailings (solid phase), and an additional 0.1% out of a 10% heptane input was found in the process water (liquid phase). For the low-shear tailings, 0.1% and 0.8% of the initial heptane addition were detected in the liquid and solid phases, respectively. In addition to that, the final product of the heptane process, i.e. dried agglomerates, contained up to 0.3% of the initial heptane input and this amount had to be recognized as non-recoverable heptane.

Table 7-76

HEPTANE DISTRIBUTION IN VARIOUS STREAMS

High-Shear	
Heptane input	10%
Tailings - liquid phase	0.1%
Tailings - solid phase	0.9%
Low-Shear	
Heptane input	20%
Tailings - liquid phase	0.1%
Tailings - solid phase	0.8%
Dried agglomerates	0.3%

7.7.3 Particle Size of Heptane Agglomerates

Test Objectives

To determine the particle size of heptane agglomerates after thermal drying. This information is required to assess product handleability.

Test Descriptions and Conditions

Various low-shear products from the heptane process were generated using Pittsburgh No. 8 coal (200 mesh x 0) and subsequently were subjected to the thermal drying. The dried agglomerates were screened at 28 mesh in order to determine the agglomerate disintegration during drying. Both fractions i.e., plus 28 mesh and minus 28 mesh, were subjected to particle size determination by screening. The conditions used to generate the heptane low-shear agglomerates are summarized in Table 7-77.

Table 7-77

TEST CONDITIONS

Coal	Pittsburgh No. 8
Grind size, mesh	200
High-shear heptane concentration, %	10, 20, 10 + 0.1 asphalt
High-shear agitation, rpm	2000
High-shear residence time, min	1
High-shear solids, %	20
Low-shear heptane/binder (asphalt) concentration, %	10, 20/3.3, 4, 5

Result Analysis

The results presented in Table 7-78 showed that for different ranges of operating conditions used in the high- and low-shear operations, the plus 28 mesh fraction varied from 70 to 76%. The maximum value of 76.1% was obtained for the process where small amount of binder (0.1%) was introduced into the high-shear stage. For this process configuration d_{50} of the plus 28 mesh fraction was one of the highest (3.40 mm) along with the d_{50} of agglomerates obtained at the highest binder content (3.66 mm). However it has to be pointed out that the addition of binder to the high-shear stage decreased the product quality in terms of total sulfur content. A complete set of results for particle size distribution of the product generated with 20% heptane and 3.3% asphalt is presented in Figure 7-20.

Table 7-78

HEPTANE AGGLOMERATES QUALITY AND SIZE DISTRIBUTION
PITTSBURGH NO. 8 COAL

Binder Addition			Product Distribution %	
High-Shear	Low-Shear	Total S, %	+28 mesh	-28 mesh
10%H	20%H + 3.3% A	3.88	70.2 d_{50} = 2.80 mm	29.2 d_{50} = 0.130 mm
10%H	20%H + 4% A	3.86	70.3 d_{50} = 2.85 mm	29.7 d_{50} = 0.174 mm
10%H	20%H + 5% A	3.80	71.8 d_{50} = 3.66 mm	28.2 d_{50} = 0.201 mm
10%H + 0.1%A	21%H + 3.3% A	3.98	76.1 d_{50} = 3.40 mm	23.9 d_{50} = 0.134 mm
20%H	10%H + 3.3% A	3.86	73.5 d_{50} = 3.36 mm	26.5 d_{50} = 0.134 mm

7.7.4 Alternative Size Enlargement Methods for Diesel High-Shear

Test Objectives

To investigate alternative size enlargement methods other than low-shear operation to generate products with good handleability.

Test Descriptions and Conditions

A laboratory drum pelletizer and an extrusion apparatus were used in this study. These preliminary experiments were carried out under the conditions listed below.

Table 7-79

TEST CONDITIONS

Coal	Upper Freeport
Grind size, mesh	100
High-shear product dewatering	Pressure filter
Binder	Asphalt emulsion RS-1
Co-binder additives	Starch/P-3.15 polymer
Binder content, %	2
Pelletization conditions:	
drum revolution, rpm	40 - 50
Time, min	10 - 15
Extrusion conditions	Limited number of tests were performed on the laboratory type extruder, Model No. 387475, Cranfordsville, Ind., using standard procedure for this equipment

Result Analysis

Two types of product were produced, (1) extrusion rods and (2) pellets. The size of extrusion rods was 3 mm x 1 mm and could vary depending on the cutting knife position. The compaction of extrusion rods was greatly dependent on a feed moisture content which was in the range of 16% to 20%. The size of drum pellets was also greatly dependent on the pelletizer feed moisture content (20 to 25% range), as well as feed particle size, feed rate and drum inclination. An example of the particle size distribution for pellets is given in Table 7-80.

Table 7-80

PARTICLE SIZE DISTRIBUTION OF DRUM PELLETS

Particle Size Limits, um	Incremental wt, g	Incremental wt, %	Cumulative wt, %
1000-1400	0.07	0.04	0.04
1400-1700	0.03	0.02	0 06
1700-2000	0.15	0.09	0.15
2000-2360	0.35	0.20	0.35
2360-2800	0.91	0.53	0.88
2800-3350	1.77	1.03	1.91
3350-4000	7.15	4.18	6.09
4000-4750	37.78	22.10	28.19
4750-5600	37.94	22.19	50.38
5600-6700	39.44	23.07	73.45
6700-	45.39	26.55	100.00

7.7.5 Drying Tests of Diesel Agglomerates

Test Objectives

To determine the moisture content of diesel low-shear agglomerates, pellets and extrusion rods after drying at a temperature of 40°C.

Test Descriptions and Conditions

The products generated in low-shear agglomeration, pelletization and extrusion were dried in the conventional oven at 40°C. Subsequently, the dried products (agglomerates, pellets or rods) were subjected to moisture determination by toluene distillation. The conditions used to generate the diesel products are summarized in Table 7-81.

Table 7-81

SIZE ENLARGEMENT OF DIESEL HIGH-SHEAR PRODUCTS
METHODS AND CONDITIONS

Coal	Upper Freeport		
Procedure for size enlargement:	Low-shear agglomeration	Pelletization	Extrusion
Grind size, mesh	28	100	100
Agglomerant in high-shear, %	1	1	1
Binder, %	11 (Bitumen+Diesel)	2 (Asphalt)	2 (Asphalt)

Result Analysis

The drying curves for all three products are shown in Figure 7-21.

For the pellets and rods, 2 hours of drying at a temperature of 40°C reduced the moisture from 24% to 5%. An extension of drying to 4 hours provided a product with moisture content below 1%.

In contrast to the pelletization and/or extrusion products, the low-shear agglomerates were characterized by a lower initial moisture content. The low-shear agglomerates generated with 11% binder and at extended agglomeration time (up to 1 hour) contained about 10% of moisture (after simple mechanical separation by screening). The drying rate of these agglomerates was found to be slower then that of pellets and rods. This difference could be attributed to a different level of compaction for these products and their binder content.

7.7.6 Preliminary Handleability Tests

Test Objectives

To provide preliminary handleability data for the products generated from the diesel process and enlarged by low-shear agglomeration, pelletization and extrusion, and products from the heptane process.

Test Descriptions and Conditions

The products subjected to handleability tests were:

- o Diesel low-shear agglomeration product (28 mesh Upper Freeport coal and 11% Cold Lake Bitumen and diesel mixture in ratio 1:1).
- o Diesel pellets (100 mesh Upper Freeport coal, 2% asphalt emulsion and 1% starch).
- o Diesel extrusion rods (100 mesh Upper Freeport coal, 2% asphalt emulsion and 1% starch).
- o Diesel extrusion rods (2% asphalt emulsion and various additives).
- o Heptane product (200 mesh grind of Upper Freeport coal, 3.3% asphalt).

The preliminary handleability tests included the following analyses:

- o Abrasion Resistance Index (ARI)
- o Strength Index (SI)
- o Water Resistance Index (WRI)
- o Weatherability Index (WI)

The significance and methods for determination of these indices are summarized in Table 7-82.

Table 7-82

SELECTED INDICES FOR PRODUCT HANDLEABILITY EVALUATION

Index	Calculation	Experimental Method	Significance
ARI	w/W x 100%	w - wt of +28 mesh after tumbling W - wt of initial sample Tumbled at 50 RPM for 100 revolutions	To simulate the tumbling action and the impact forces encountered handling operations
SI		Crushing force at a relative displacement of 10%, kPa or height equivalent for pressure, m	To simulate the crushing forces encountered during transportation and stockpiling
WRI	100 - % water absorbed after 30 minutes immersion	Immersing products in water for 30 minutes	To simulate the wet conditions a fuel might encountered during outdoor storage
WI	w/W x 100%	w - wt of +28 mesh after 4 cycles of freeze/thaw W - wt of initial sample	To simulate the severe weather conditions a fuel might encounter during outdoor winter storage

Influence of Additives on Product Handleability

Extrusion rods were prepared using the Upper Freeport clean coal (100 mesh x 0) from the diesel process employing asphalt emulsion RS-1. Additives P3.15 and starch were mixed with coal prior to the addition of asphalt emulsion. Both the green and air dried products were subject to the handleability tests. The results are shown in Table 7-83.

Table 7-83

INFLUENCE OF ADDITIVES ON QUALITY OF EXTRUSION PRODUCTS
Diesel Base Case - Alternative Methods for Size Enlargement

	Asphalt emulsion (2%)		Asphalt emulsion (2%+0.1% P-3.15)		Asphalt emulsion (2%+1% starch)	
	green	dry	green	dry	green	dry
Abrasion resistance (AI)	96.1	47.8	99.1	64.8	99.0	98.9
Strength index (SI)						
Crushing force, kPa	25.0	29.0	23.0	28.0	-	197.0
Height equivalent for pressure, m	3.4	4.0	3.2	4.0	-	27.0
Water resistance (WRI)	-	99.2	-	99.8	-	96.8
Weatherability Index (WI)	-	24.9	-	25.7	-	99.2

These preliminary results showed that the addition of starch to the extrusion process, resulted in significant increase in strength and the weatherability indices of the dried products. There was no impact of starch addition on the water resistance index.

These preliminary tests also indicated that the presence of starch had a considerable impact on rods' resistance for abrasion . The extrusion products without starch addition showed a significant decrease in abrasion index from the green stage to the dried products. The strength measurements also proved that the addition of starch as a co-binder resulted in the strongest product. The extrusion rods product with asphalt and starch could withstand the pressure of a 27m high stockpile without disintegration.

Handleability of Products Generated by Different Size Enlargement Methods

A preliminary evaluation of enlarged products from various methods is presented in Table 7-84.

Table 7-84

SELECTED PHYSICAL PROPERTIES OF HEPTANE AND DIESEL FINAL PRODUCTS

		Diesel Product						
	Heptane Agglomerates (20%H+3.3%A)	Agglomerates (11% CLB+D)		Pellets (2% A em +1% St.)		Rods (2% A em +1% St.)		Pellets 2% A em + 0.5% St.)
		green	dry	green	dry	green	dry	dry
Abrasion resistance (AI)	88.7	99.9	99.9	99.7	99.8	99.0	98.8	97.1
Strength Index (SI)								
Crushing force, kPa	59.0	44.0	47.0	35.0	433.0	-	197.0	159.0
Height equivalent for pressure, m	8.0	6.0	6.5	4.8	60.0	-	27.0	21.9
Water resistance (WRI)	97.5	-	99.9	-	96.8	-	89.2	-
Weatherability Index (WI)	98.0	-	99.0	-	100.0	-	99.2	-

All enlarged products exhibited similar behavior in terms of water resistance and weatherability. The strength index was the highest for pelletization products (433 and 159) followed by extrusion rods (197) and heptane agglomerates (59). The strength of low-shear agglomerates was found to be the lowest one (47). This was believed to be caused by the higher plasticity of agglomerates resulting from high binder concentration. The abrasion index for all diesel products was about 99%, while for heptane, lower resistance for abrasion (89) was observed.

7.8 Comparison Tests with Other Laboratories

Test Objectives

To examine an alternative heptane procedure and simultaneously provide confirmatory results to the project data base.

Arcanum Corporation was subcontracted to conduct batch agglomeration tests with three project coals, namely Illinois No. 6, Pittsburgh No. 8 and Upper Freeport.

Test Descriptions and Conditions

Table 7-85

TEST CONDITIONS

Coal	Pittsburgh No. 8, Illinois No. 6, Upper Freeport
Grind size, mesh	200
Agglomerant concentration, %	30, 50, 150
High-shear solids, %	5, 15
Procedure	Developed by Arcanum: Waring Blender, 10000-14000 rpm, 2 stages of high-shear with additional amount of heptane in the second stage, unlimited water for washing of product agglomerates

The coal samples were supplied by Alberta Research Council. Arcanum Corporation was provided with the wet grinding conditions to ensure that identical feeds were used in both the ARC and Arcanum testing.

The agglomeration products (clean coal and tailings) were analysed for total sulfur and ash content. Both partners, the ARC and Arcanum performed an independent product evaluation.

Results Analysis

The results of heptane agglomeration generated by Arcanum Corporation are given in Tables 7-86, 7-87 and 7-88 along with the results obtained by ARC. Analysis of the agglomeration results showed that an independent testing of three project coals using different procedures yielded similar results in terms of sulfur rejection and coal matter recovery. The ARC procedure resulted in slightly higher product ash then the Arcanum one. This difference was probably caused by more extensive washing of agglomerates employed in the Arcanum procedure.

Table 7-86

HEPTANE TESTS WITH PITTSBURGH NO. 8 COAL

COMPARISON OF ARCANUM AND ALBERTA RESEARCH COUNCIL RESULTS

		BTU Recovery %			Total Sulfur % - Clean Coal			Ash % - Clean Coal		
			Arcanum Test			Arcanum Test			Arcanum Test	
Test No.	Test Conditions	ARC Test	Analyzed By Arcanum	Analyzed By ARC	ARC Test	Analyzed By Arcanum	Analyzed By ARC	ARC Test	Analyzed By Arcanum	Analyzed By ARC
BA35503P	Pit (5-30)	98.7	95.5	-	3.67	3.2	3.63	6.1	4.7	5.8
BA35504P	Pit (15-30)	-	98.1	-	-	3.9	3.93	-	6.3	6.5
BA36801P	Pit (5-50)	-	99.4	-	-	3.7	3.73	-	6.2	5.7
BA36802P	Pit (15-50)	99.0	98.6	-	4.07	4.1	3.98	6.8	5.7	6.2
BA36901P	Pit (5-150)	97.0	85.8	-	3.81	3.7	3.69	6.4	6.1	6.1
BA36902P	Pit (15-150)	98.3	95.2	-	3.90	3.8	3.89	6.7	6.9	6.9

Table 7-87

HEPTANE TESTS WITH ILLINOIS NO. 6 COAL

COMPARISON OF ARCANUM AND ALBERTA RESEARCH COUNCIL RESULTS

Test No.	Test Conditions	BTU Recovery %			Total Sulfur % - Clean Coal			Ash % - Clean Coal		
			Arcanum Test			Arcanum Test			Arcanum Test	
		ARC Test	Analyzed By Arcanum	Analyzed By ARC	ARC Test	Analyzed By Arcanum	Analyzed By ARC	ARC Test	Analyzed By Arcanum	Analyzed By ARC
BA402021	III (5-30)	92.4	98.0	-	2.95	2.7	2.79	8.5	4.8	5.0
BA403011	III (15-30)	-	96.4	-	-	2.8	2.93	-	5.5	6.2
BA403021	III (5-50)	-	96.2	-	-	2.6	2.71	-	4.7	4.6
BA403031	III (15-50)	87.0	97.7	-	2.94	2.9	2.90	7.5	5.5	6.0
BA404011	III (5-150)	95.3	95.3	-	2.96	2.8	2.82	6.6	5.8	6.0
BA404021	III (15-150)	83.2	125.6	-	2.93	3.0	3.03	7.6	12.2	9.2

Table 7-88

HEPTANE TESTS WITH UPPER FREEPORT COAL

COMPARISON OF ARCANUM AND ALBERTA RESEARCH COUNCIL RESULTS

Test No.	Test Conditions	BTU Recovery %			Total Sulfur % - Clean Coal			Ash % - Clean Coal		
			Arcanum Test			Arcanum Test			Arcanum Test	
		ARC Test	Analyzed By Arcanum	Analyzed By ARC	ARC Test	Analyzed By Arcanum	Analyzed By ARC	ARC Test	Analyzed By Arcanum	Analyzed By ARC
BA37501F	UFP (5-30)	98.5	97.5	-	1.50	1.4	1.37	8.3	9.2	8.9
BA37601F	UFP (15-30)	-	97.7	-	-	1.6	1.64	-	9.6	10.3
BA39401F	UFP (5-50)	-	93.8	-	-	1.1	1.13	-	7.8	8.3
BA39701F	UFP (15-50)	100.1	97.2	-	1.93	1.5	1.48	10.3	9.3	9.3
BA39501F	UFP (5-150)	99.7	96.1	-	1.54	1.4	1.35	8.6	9.6	9.4
BA39601F	UFP (15-150)	96.6	93.3	-	1.76	1.8	1.84	9.3	13.3	13.1

7.9 Light and Heavy Agglomerants - Summary

The batch scale tests were conducted with each coal using heavy agglomerants such as diesel and Maya-diesel mixture and heptane as light agglomerant. The selected results from tests carried out in Task 5.1 are presented in Table 7-89.

Table 7-89

COMPARISON OF AGGLOMERATION PERFORMANCES FOR HEAVY OIL AND HEPTANE CASES (Standard High-Shear Conditions)*

Serial No.	Lab ID	High-Shear Solids %	Oil Type	Oil %	Bench Scale BTU Rec %	Bench Scale PSR %	ROM Basis BTU Rec %	ROM Basis PSR %
Pittsburgh No. 8 (200 Mesh)								
Heavy Oil								
364	PIT-206	5	Diesel	1.0	98.2	47.1	95.1	68.7
365	PIT-207	5	M/D	1.0	99.9	49.2	96.8	70.0
366	PIT-207.1	5	M/D	1.0	98.3	50.4	95.2	70.7
434	PIT-218.1	5	M/D	1.0	99.2	44.4	96.2	67.1
447	PIT-224	20	M/D	0.9	96.1	42.7	93.1	66.2
448	PIT-224.1	20	M/D	1.0	98.3	42.1	95.2	65.8
Heptane								
395	PIT-208	5	Heptane	20.0	99.1	33.1	96.0	60.5
397	PIT-209	5	Heptane	20.0	100.8	34.6	97.7	61.3
459	PIT-231	5	Heptane	10.0	97.0	48.3	94.0	69.4
460	PIT-232	5	Heptane	30.0	99.2	35.6	96.1	62.0
790	PIT-275	5	Heptane	20.0	98.2	38.1	95.2	63.4
Illinois No. 6 (200 Mesh)								
Heavy Oil								
381	ILL-206	20	Diesel	1.0	93.7	38.3	87.6	78.0
392	ILL-212	5	Diesel	1.0	87.4	44.1	81.7	80.0
471	ILL-237	5	Diesel	2.0	92.8	45.0	86.8	80.4
Heptane								
405	ILL-214.1	5	Heptane	20.0	92.0	23.7	86.2	72.8
456	ILL-222	5	Heptane	10.0	82.9	25.6	77.6	73.4
Upper Freeport (200 Mesh)								
Heavy Oil								
367	UFP-200	20	Diesel	1.0	95.1	59.2		
369	UFP-202	5	Diesel	1.0	93.5	65.2		
371	UFP-203.1	5	M/D	1.0	96.4	71.9		
689	UFP-247	20	M/D	1.0	89.0	71.0		

Table 7-89 (Continued)

COMPARISON OF AGGLOMERATION PERFORMANCES FOR HEAVY OIL AND HEPTANE CASES (Standard High-Shear Conditions)*

Serial No.	Lab ID	High-Shear Solids %	Oil Type	Oil %	Bench Scale BTU Rec %	Bench Scale PSR %	ROM Basis BTU Rec %	ROM Basis PSR %
Upper Freeport (200 Mesh) (Continued)								
Heptane								
419	UFP-208.1	5	Heptane	20.0	96.8	49.1		
462	UFP-219	5	Heptane	10.0	94.3	64.2		
795	UFP-256	5	Heptane	20.0	94.4	62.3		
796	UFP-256.1	5	Heptane	20.0	94.8	60.2		

*High-shear mixing intensity - 2000 rpm, high-shear residence time - 4 min

For the comparison purpose, the data in this table has been selected from tests which were performed under optimal conditions for each process option. For the heptane case, solids concentration, grind size and agglomerant addition were 5%, 200 mesh and 10%-20%, respectively. For the heavy oil case, agglomerant addition was 1%, and two solids concentration, 5% and 20% were employed.

Analysis of the data showed that there was a difference in agglomeration performance between the heavy oils and a light oil.

For Pittsburgh No. 8 coal, the heavy oils yielded better pyritic sulfur rejection than heptane tests. On the average, about 10% higher pyritic sulfur rejection was achieved at equivalent BTU recovery. The above observation held true for Illinois No. 6 coal. For Upper Freeport coal, similar results were obtained for both agglomerants.

For a proper comparison of the performances of heptane and heavy oil processes, series of tests were conducted under optimized high-shear conditions in terms of residence time and mixing intensity. This test matrix was conducted with the new project coals and diesel oil. A mixture of Maya and diesel was excluded from the program. Selected results from these tests are presented in Table 7-90.

Table 7-90

COMPARISON OF AGGLOMERATION PERFORMANCES FOR DIESEL AND HEPTANE CASES - NEW PROJECT COALS (Optimized High-Shear Conditions)*

Serial No.	Lab ID	Top-Size mesh	Oil Type	Oil %	Bench Scale BTU Rec %	Bench Scale PSR %	ROM Basis BTU Rec %	ROM Basis PSR %
Pittsburgh No. 8 (Precleaned)								
971	PIT-292	100	Diesel	1	96.6	45.5	93.6	67.8
972	PIT-293	28	Diesel	1	91.4	44.5	88.5	67.2
879	PIT-289	200	Heptane	20	93.1	51.3	90.3	71.2
Upper Freeport (Raw)								
967	UFP-282	100	Diesel	1	85.0	79.2	-	-
968	UFP-283	28	Diesel	1	75.6	83.9	-	-
881	UFP-267	200	Heptane	20	90.4	72.8	-	-
Kentucky No. 9 (Raw)								
962	KEN-79	100	Diesel	1	94.1	60.5	-	-
961	KEN-78	28	Diesel	1	92.4	63.4	-	-
909	KEN-60	200	Heptane	10	95.5	55.3	-	-

*High-Shear Conditions:

Diesel Oil
Residence time - 1 min
High-shear mixing intensity - 2000 rpm (Pittsurgh No. 8, Upper Freeport)
1600 rpm (Kentucky No. 9)

Heptane
Residence time - 1 min (Pittsburgh No. 8, Upper Freeport)
.5 min (Kentucky No. 9)
High-shear mixing intensity - 2000 rpm

Analysis of these results showed that under optimized high-shear conditions there was no significant difference in the performance for diesel and heptane processes in case of precleaned coal (Pittsburgh No. 8). For Upper Freeport coal the differences in pyritic sulfur rejection could be explained by the changes in BTU recovery. At identical BTU recoveries, the performances for diesel and heptane cases, might be considered as similar. Kentucky No. 9 coal demonstrated better performance in the diesel process.

A series of tests was carried out with the precleaned Kentucky No. 9 and Upper Freeport coals. The results are summarized in Table 7-91.

Table 7-91

COMPARISON OF AGGLOMERATION PERFORMANCES FOR DIESEL AND HEPTANE CASES WITH PRECLEANED COALS (Optimized High-Shear Conditions)

Serial No.	Lab ID	Top-Size mesh	Oil Type	Oil %	Bench Scale BTU Rec %	Bench Scale PSR %	ROM Basis BTU Rec %	ROM Basis PSR %
Upper Freeport								
1148	UFP-325	28	Diesel	1	92.7	51.2	89.2	77.9
1149	UFP-326	100	Diesel	1	94.9	55.2	91.3	79.7
1155	UFP-332	200	Heptane	20	96.6	56.8	92.9	80.4
Kentucky No. 9								
1121	KEN-107	28	Diesel	1	92.7	30.2	88.1	78.7
1122	KEN-108	100	Diesel	1	93.0	34.3	88.4	79.9
1125	KEN-110	200	Heptane	10	95.5	23.4	90.8	76.6

Analysis of the process performances for the precleaned coals suggested that both diesel and heptane processes would provide similar results in terms of BTU recovery and pyrite rejection.

7.10 Conclusions of Batch Scale Testing

The following major conclusions can be drawn from the batch test results:

- The agglomeration response was coal-dependent for a fixed set of process conditions.
- The agglomeration results obtained with the channel samples and the project coals were similar.
- An analysis of test results from Subtask 5.1, "Evaluation of Agglomerating Liquids" concluded in the selection of diesel oil and Maya/diesel (1:1) mixture as the most suitable heavy agglomerants for all project coals. Diesel was selected for further investigations based on availability basis. Heptane was selected for light agglomerant testing based on engineering analysis of various light hydrocarbons.
- For the heavy agglomerant, flotation was selected for microagglomerate recovery, while screening was recommended for the light hydrocarbon.

- An analysis of a single-stage high-shear operation led to the selection of operating variables which are summarized in Table 7-92.

Table 7-92

SINGLE-STAGE HIGH-SHEAR OPERATION - OPTIMIZED CONDITIONS

Variables Tested Case	Selected Levels	
	Heavy Oil	Light Oil
Agglomerating liquid	Diesel	Heptane
Agglomerant dosage	1%	10-30%
Grinding method	wet	wet
Particle size	28M/100M	200M
High-shear solids	20%	5%
High-shear residence time	1 minute	0.5/1 minute
High-shear mixing intensity	1600/2000 rpm	2000 rpm
Microagglomerate recovery	flotation	screening
Flotation solids	6%	-
Flotation stages	2-stage	-
Screen size	-	106 um

- Each project coal was characterized by its individual response towards agglomeration and flotation. Kentucky No. 9 exhibited the fastest response to flotation followed by Pittsburgh No. 8, Upper Freeport and Illinois No. 6 coals.

- The incremental flotation tests determined the optimal flotation time for each coal. For Pittsburgh No. 8 and Kentucky No. 9 coals, the flotation time of 60-120 seconds provided the best pyritic sulfur rejection at satisfactory BTU recovery. The other two coals required a longer flotation time.

- There was no major impact on pyritic sulfur rejection caused by conventional pyrite depressants. For some coals, an improvement (up to 10%) in pyritic sulfur rejection was observed; however, this was usually accompanied by a loss in BTU recovery.

- The emulsification of agglomerant did not appear to be a very promising option for the improvement of the agglomeration process performance within the range of parameters tested. However, some results indicated a potential for using this option at low mixing rates and extended residence time.

- A prolonged coal oxidation had a negative impact on overall process performance.

- A slurry storage showed no influence on process performance within the time range tested.

- The effect of pH on overall process performance was coal-dependent. A positive effect of elevated pH in high-shear agglomeration stage was observed for Upper

Freeport coal. In contrast, for Pittsburgh No. 8 coal, basic pH resulted in low BTU recoveries. The adjustment of pH in the flotation cell led to a substantial loss in BTU for all tested coals.

- A combination of precleaning and agglomeration could achieve project goals in BTU recovery and pyrite rejection.

- The two-stage high-shear processing demonstrated a potential for improvement of overall process performance. In the case of product regrinding, a slight decrease in BTU recovery was accompanied by quite a significant increase in pyritic sulfur rejection (up to 10%) with further improvement when the depressants were introduced to the regrinding stage. In the case of tailings reprocessing, the BTU recovery was improved at the expense of pyritic sulfur rejection, otherwise a complex procedure was required to achieve overall improvement of the performance.

- Low-shear testing with diesel product showed that up to 10% of heavy binder was required to produce handleable agglomerates. By adding surfactants and varying the low-shear solids content, a slight improvement in the process kinetics was recorded.

- The drying tests of the diesel product were conducted at 40°C. For both pellets and extrusion rods, one hour of drying reduced moisture content from 24% to 15%.

- Drying of heptane agglomerates at 110°C decreased their moisture content below 1% after 20 minutes of drying.

- The balance of heptane for light hydrocarbon agglomeration showed that up to 0.3% of heptane input to the process was retained in the solid product after thermal drying at 140°C for 40 minutes, and up to 2% was lost in the tailings streams.

- The particle size distribution of heptane products after drying showed a bimodal character with about 30% of the product being disintegrated to the size below 28 mesh. An addition of heavy binder to the high-shear stage has slightly improved the agglomerate strength and their resistance to disintegration; however, this was accompanied by deterioration in the product quality.

- Laboratory pelletization tests generated a handleable product from diesel high-shear microagglomerates utilizing asphalt and starch as binders. The mechanical strength of the pelletized product was comparable or better to that of diesel low-shear agglomerates or the heptane product.

- The confirmatory tests for light hydrocarbon agglomeration performed by Arcanum Corporation showed no difference in the heptane process performance when the alternate procedure was applied.

- Diesel and heptane processes showed comparable performance in terms of BTU recovery and pyrite rejection under fixed optimized conditions for each process.

Figure 7-1 Illinois ISR for Different Agglomerants and Agglomerant Concentrations, 28 Mesh

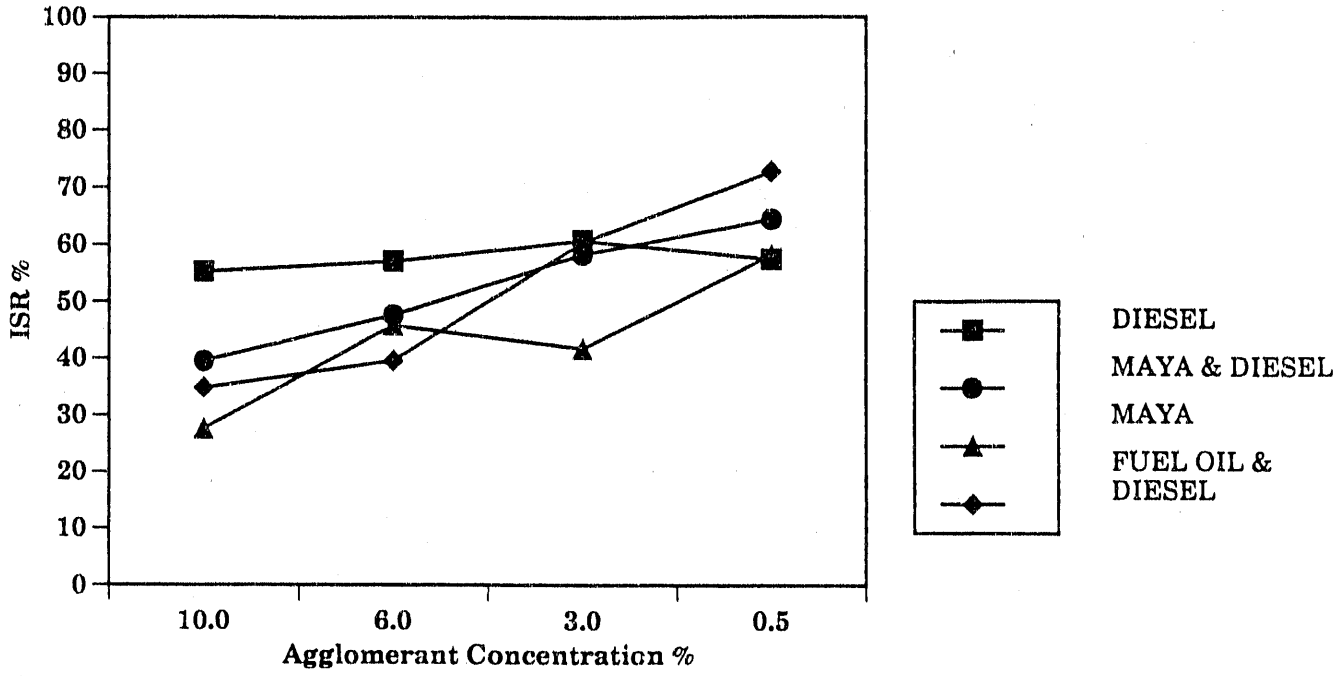


Figure 7-2 Illinois ISR for Different Agglomerants and Agglomerant Concentrations, 200 Mesh

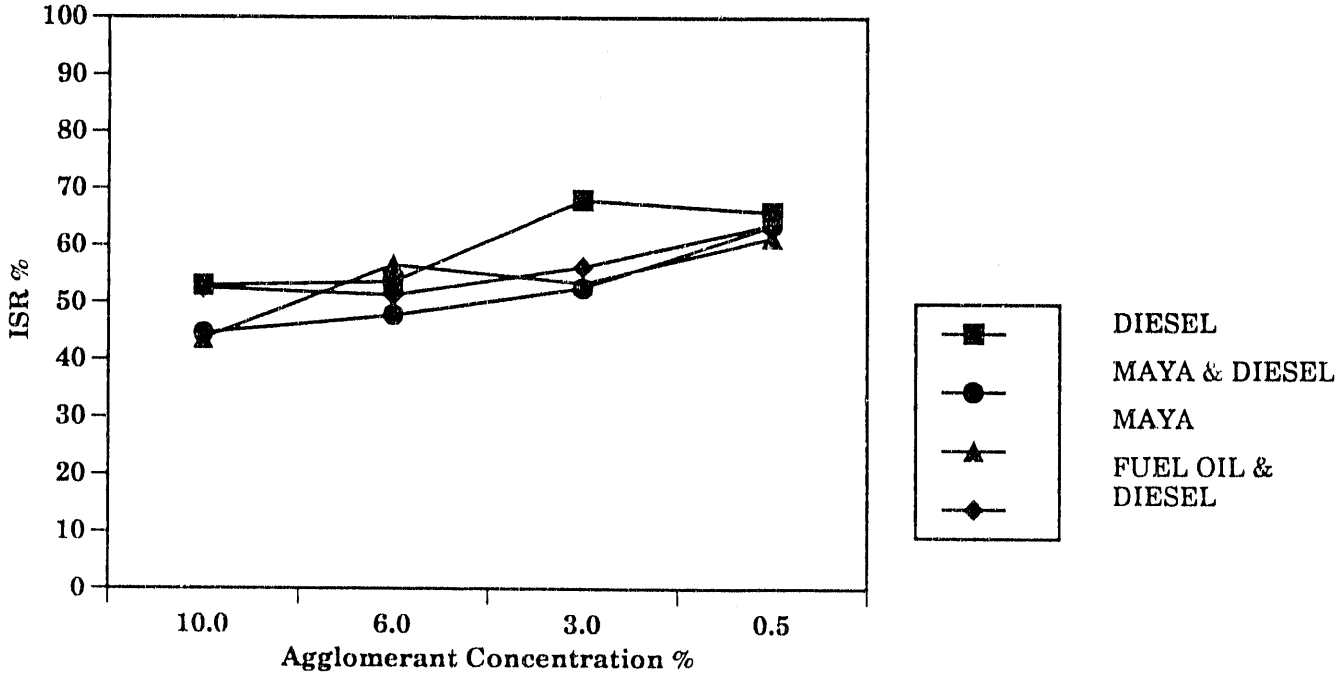


Figure 7-3 Pittsburgh ISR for Different Agglomerants and Agglomerant Concentrations, 28 Mesh

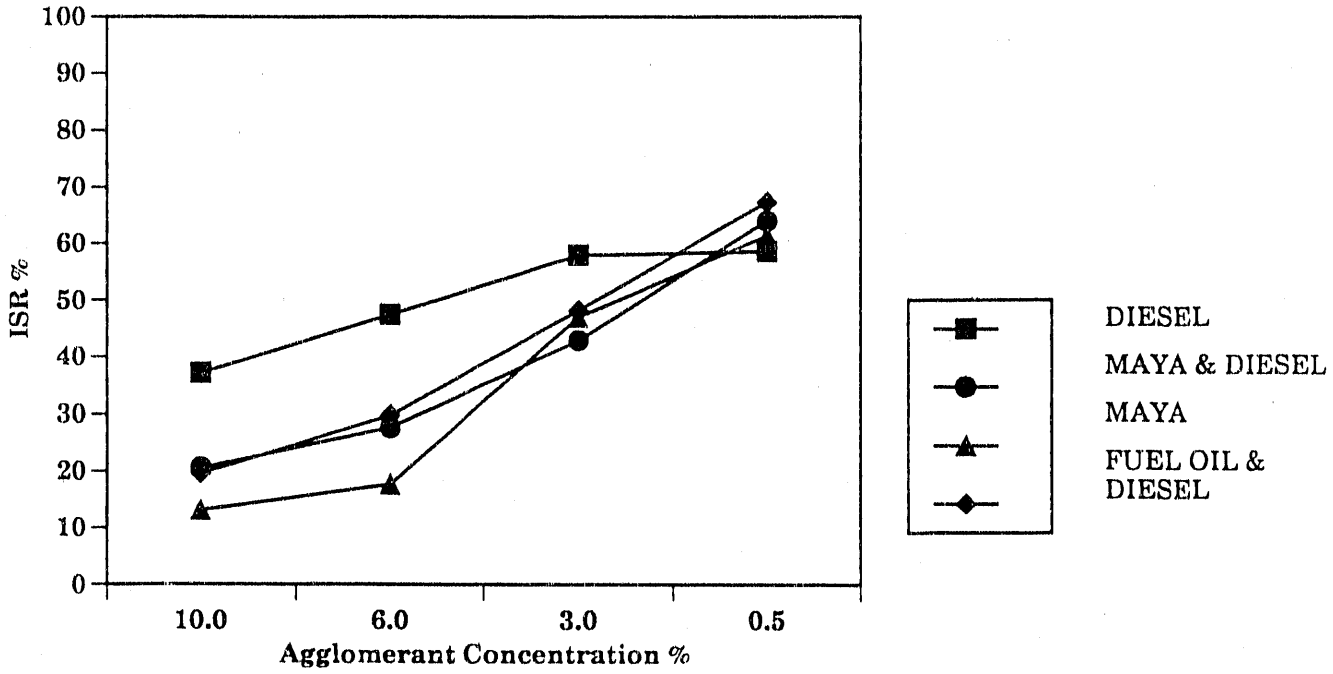


Figure 7-4 Pittsburgh ISR for Different Agglomerants and Agglomerant Concentrations, 200 Mesh

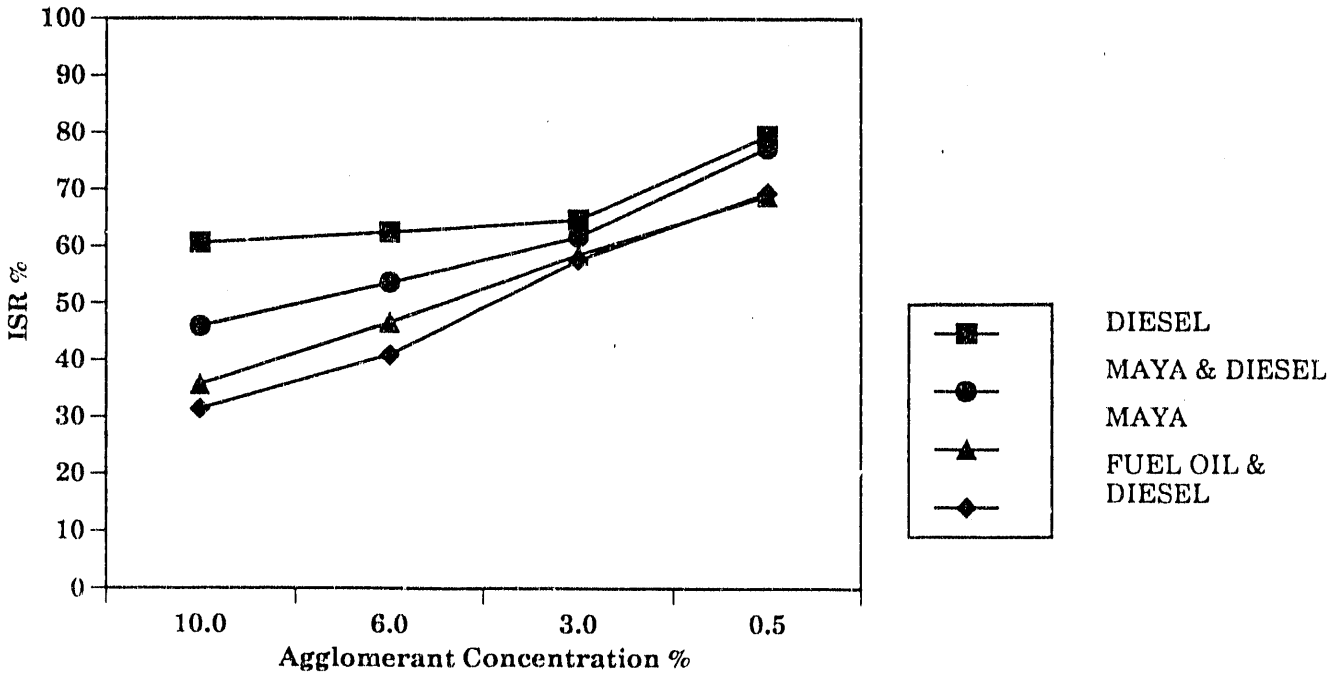


Figure 7-5 Upper Freeport ISR for Different Agglomerants and Agglomerant Concentrations, 28 Mesh

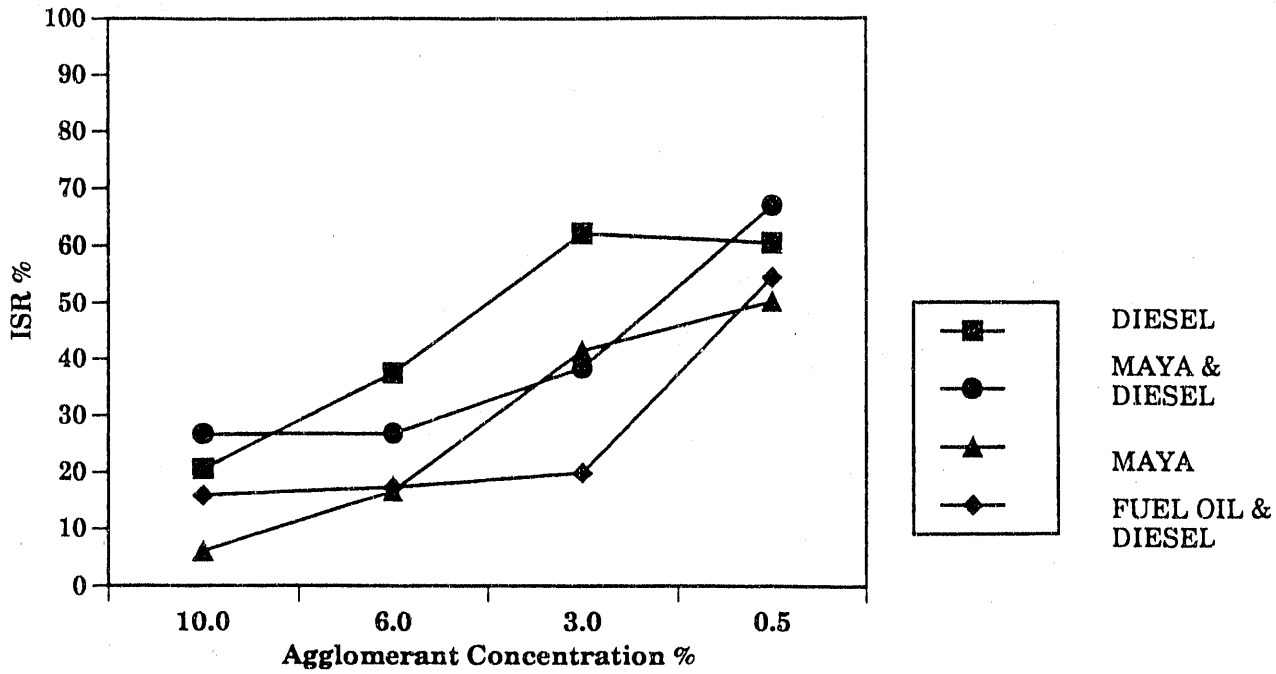
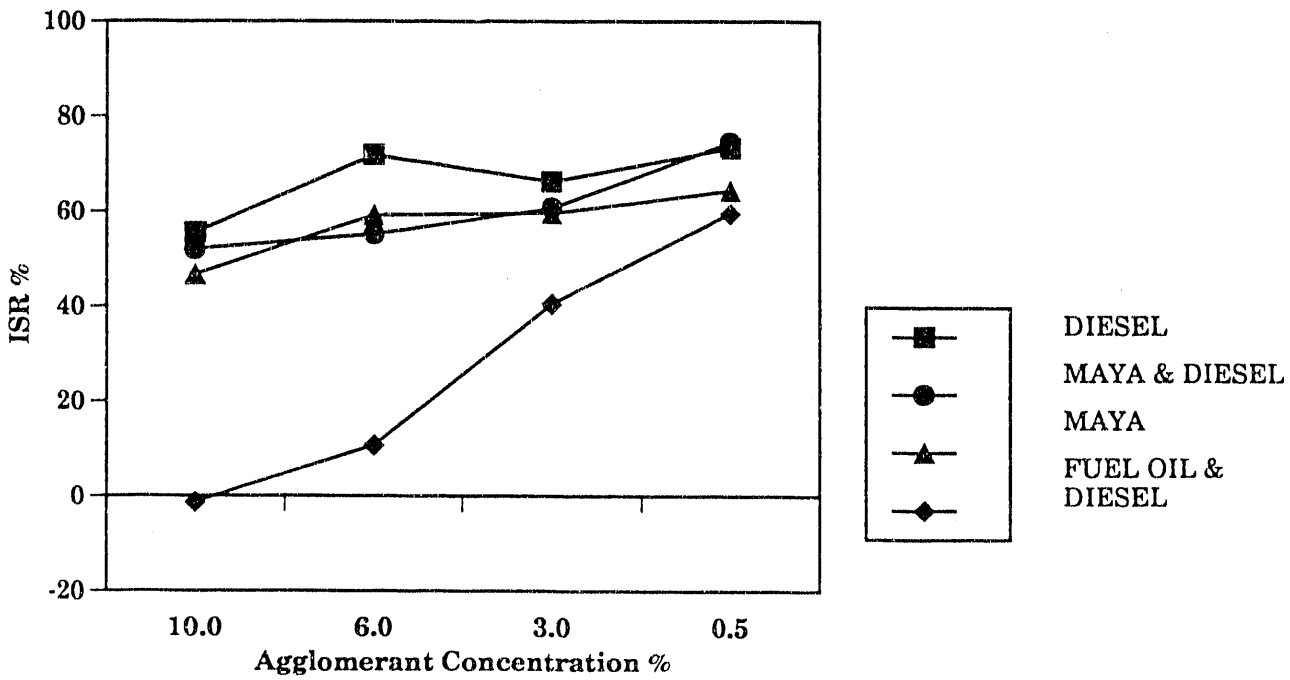


Figure 7-6 Upper Freeport ISR for Different Agglomerants and Agglomerant Concentrations, 200 Mesh



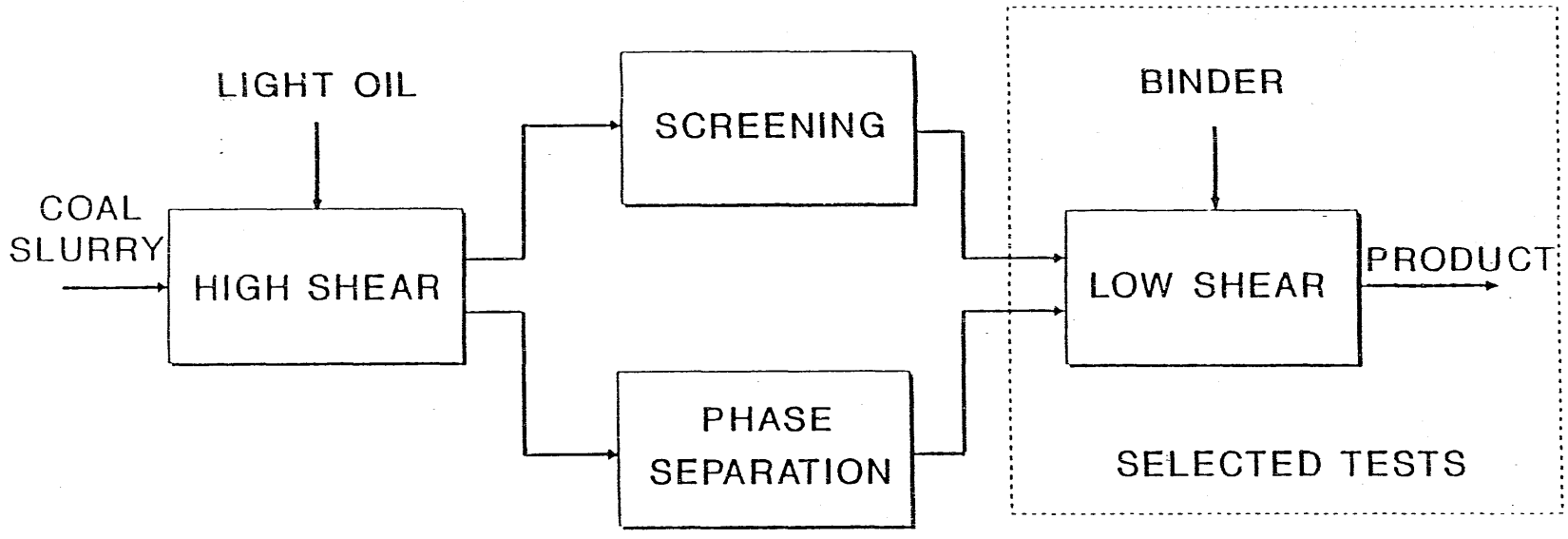


Figure 7-7 Microagglomerate Recovery by Screening and Phase Separation (Light Oil)

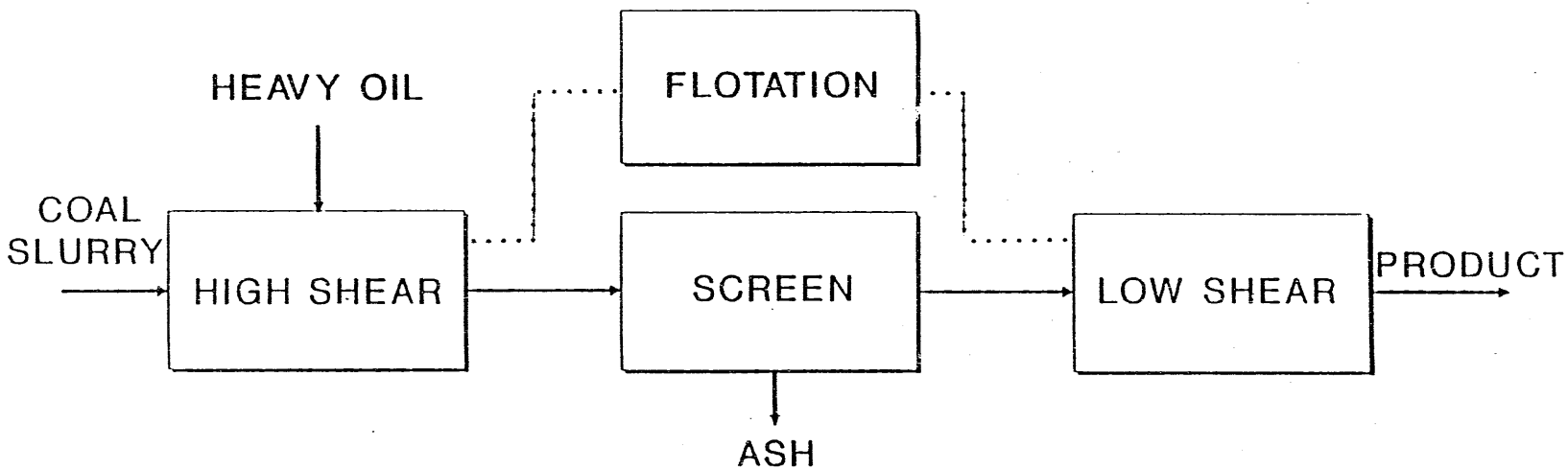


Figure 7-8 Microagglomerate Recovery by Screening and Flotation (Heavy Oil)

Figure 7-9 Incremental Flotation-Illinois No. 6

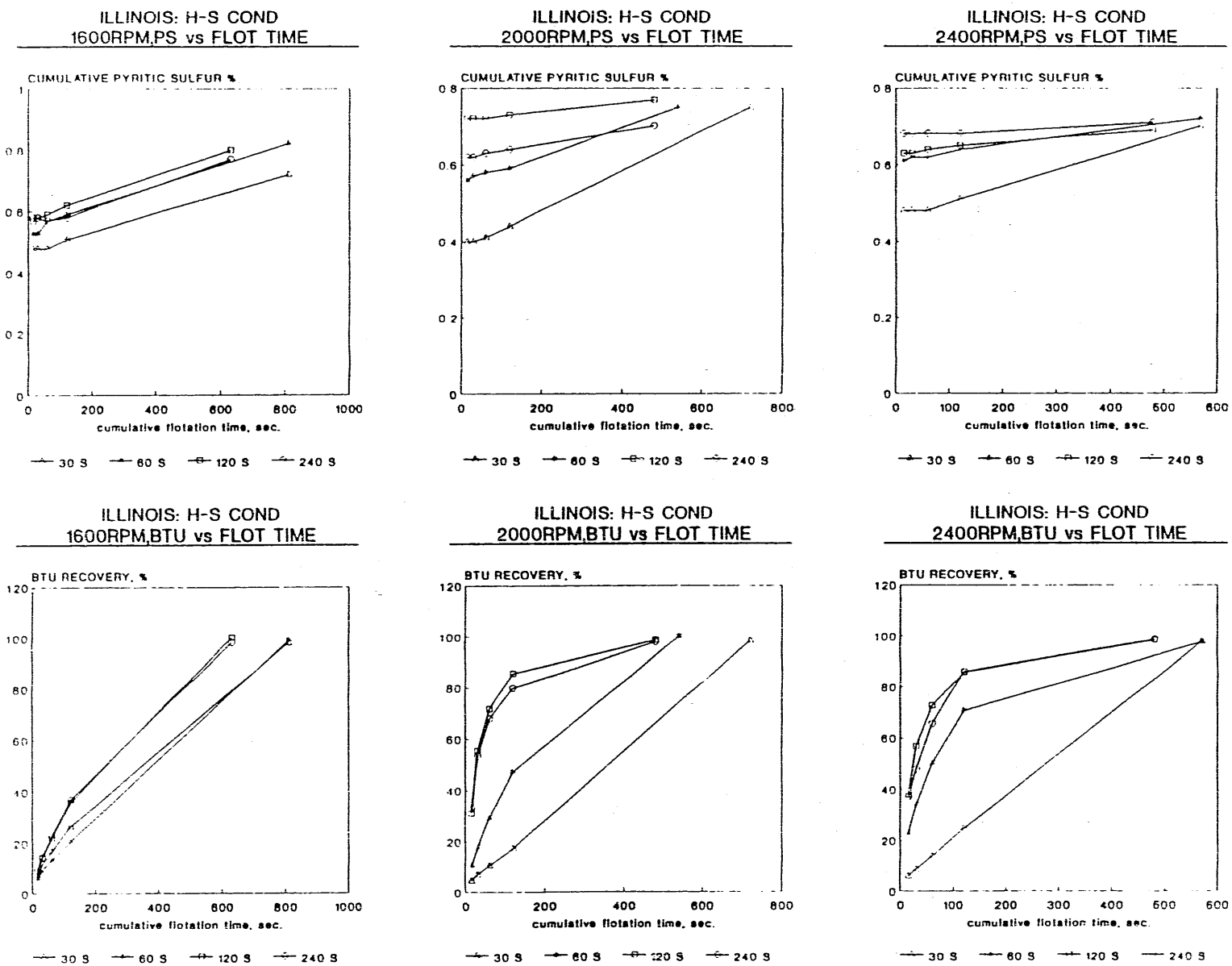


Figure 7-10 Incremental Flotation-Upper Freeport

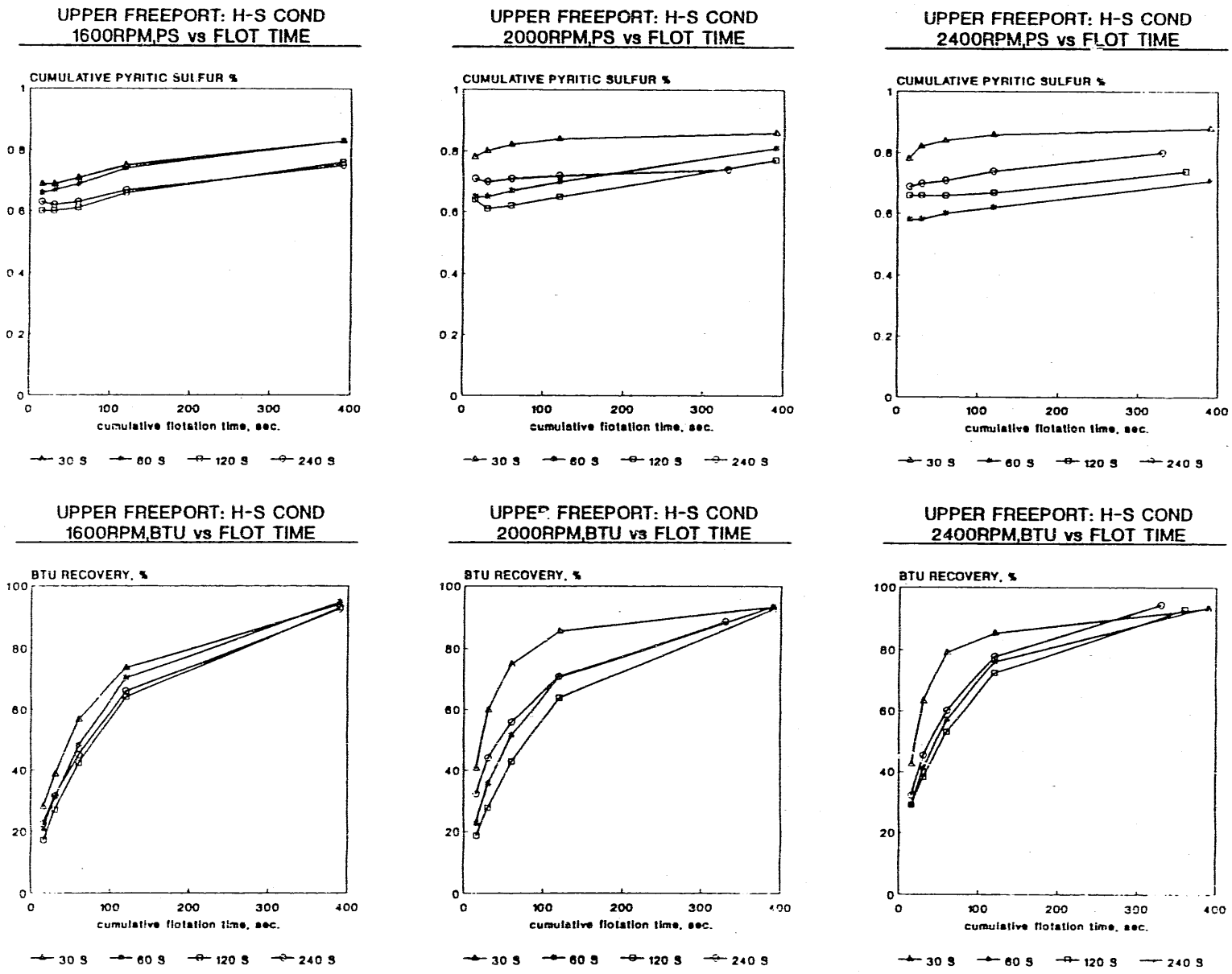


Figure 7-11 Incremental Flotation-Pittsburgh No. 8

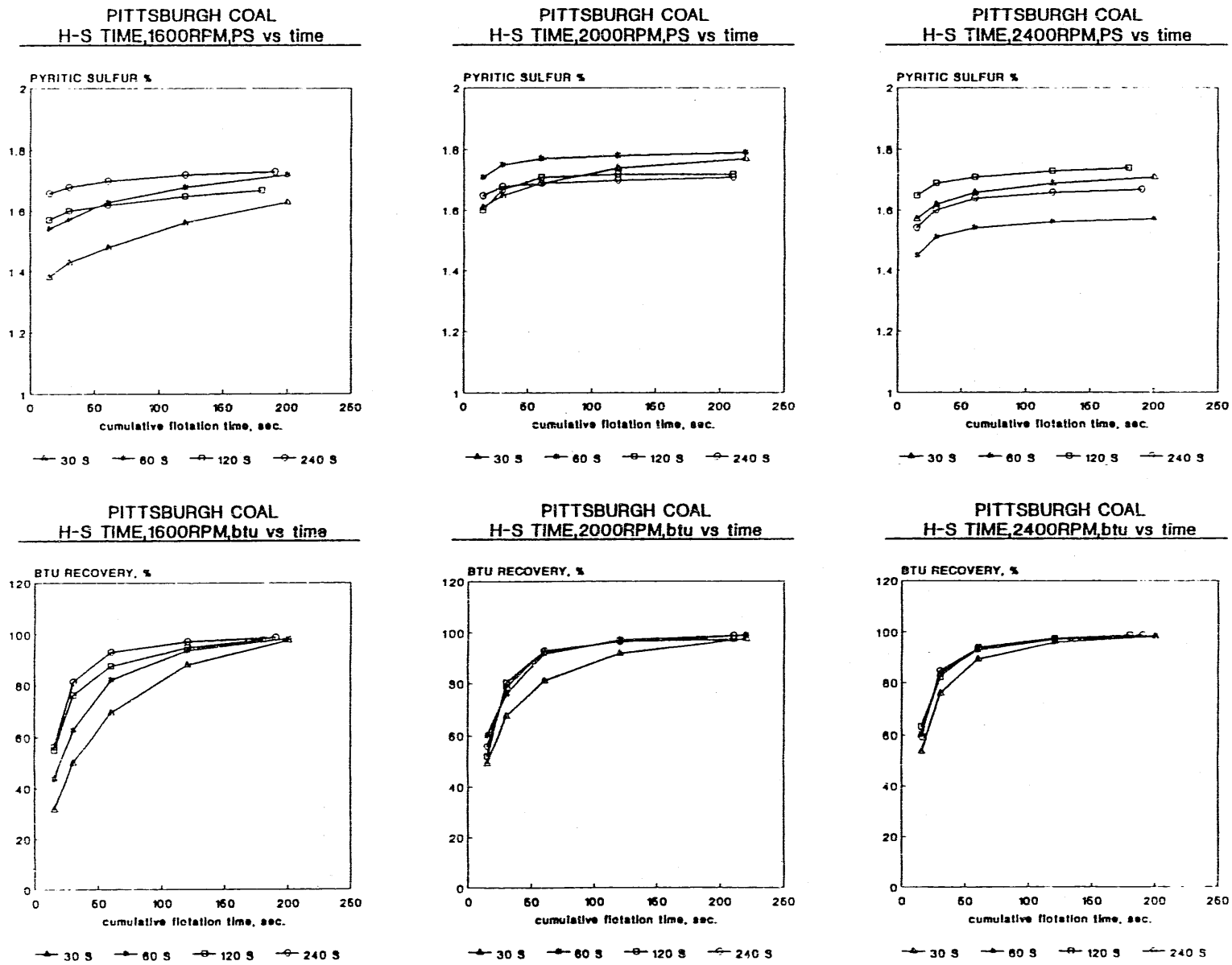
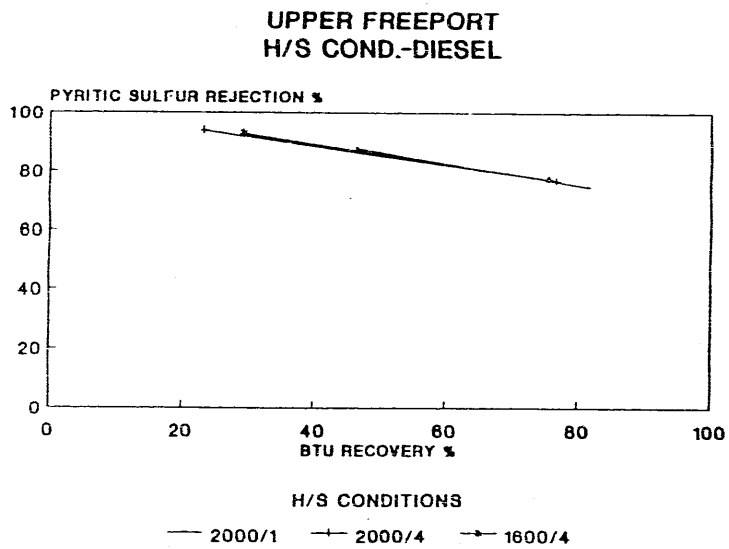


Figure 7-12 Incremental Flotation-Confirmatory Tests with New Project Coals



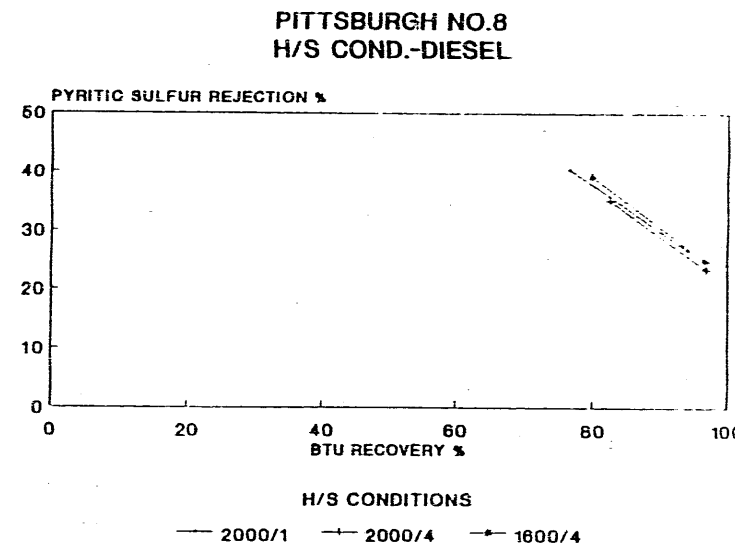
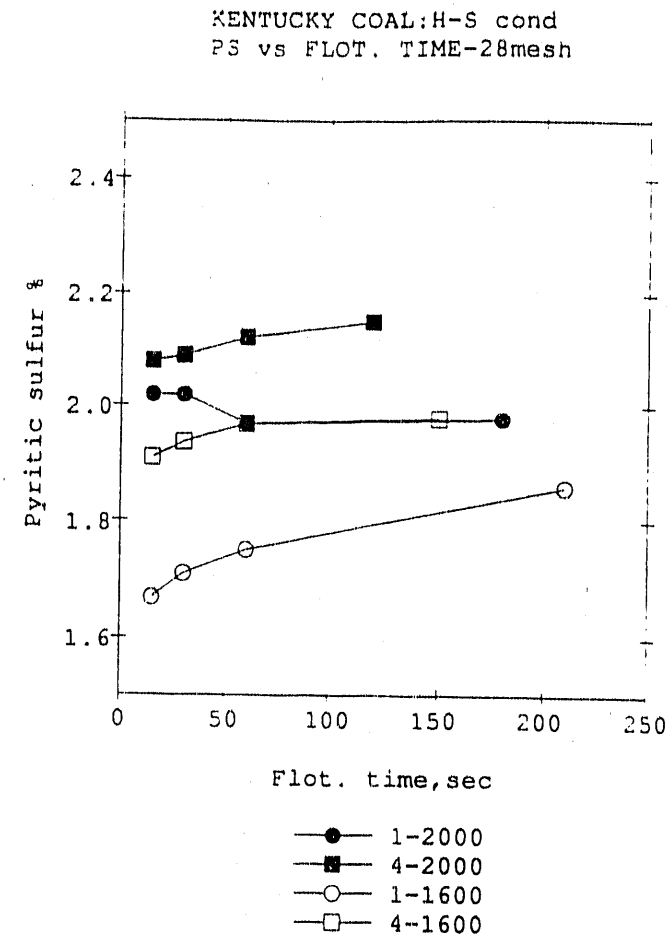
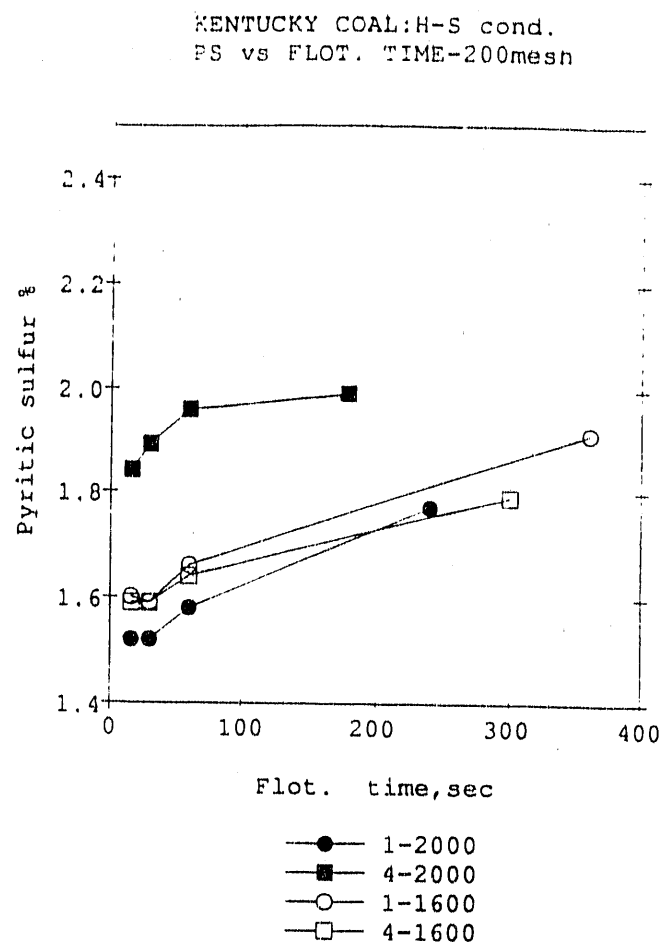
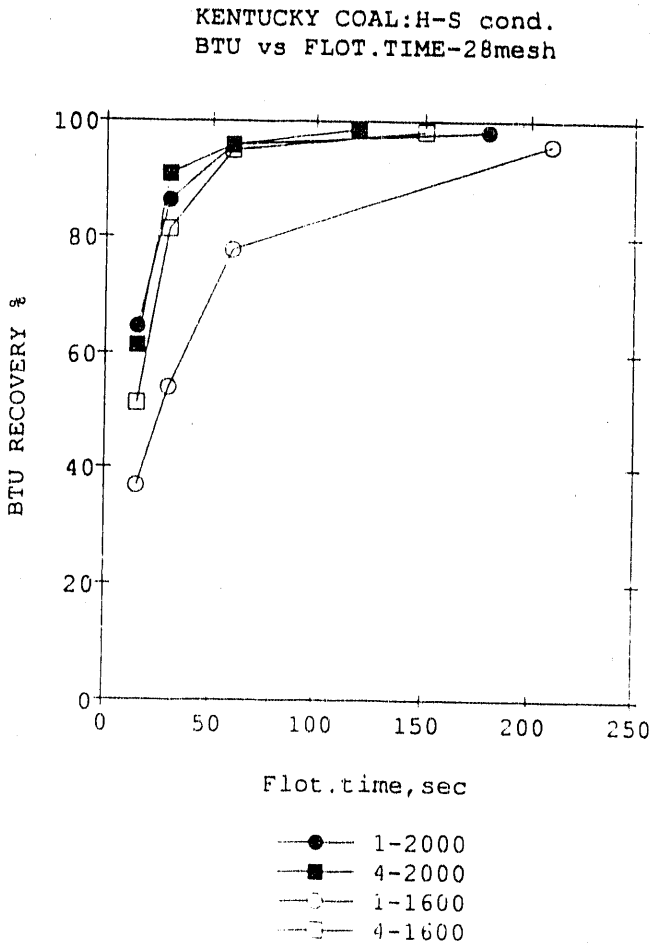


Figure 7-13 Incremental Flotation-Kentucky No. 9







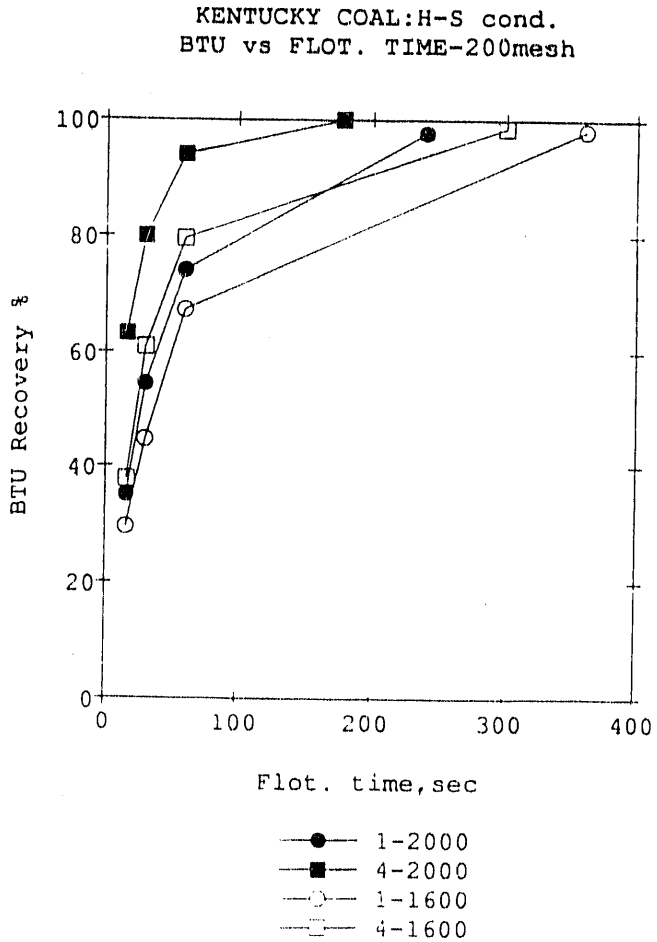


Figure 7-14 Tailings Reprocessing Schemes

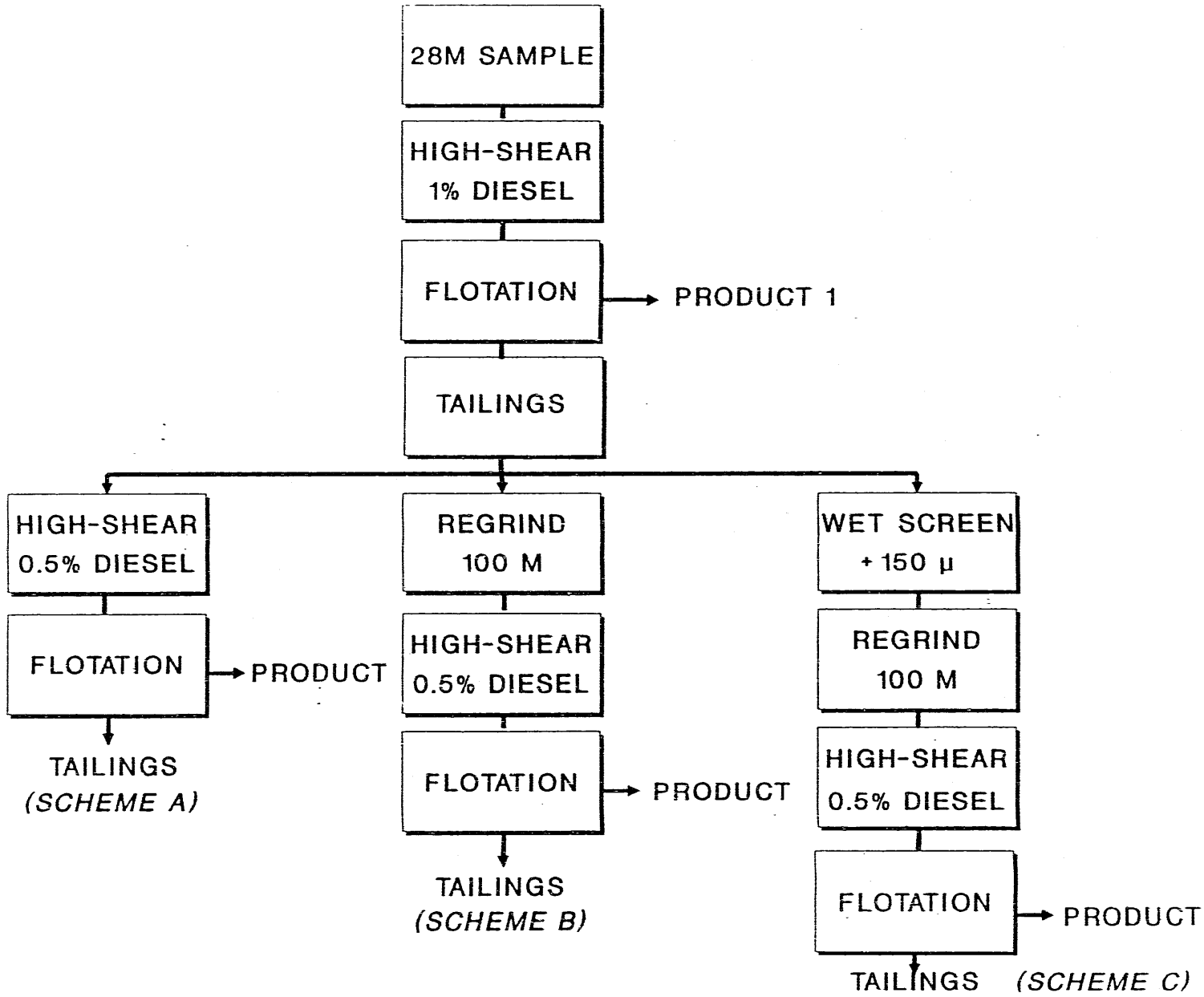
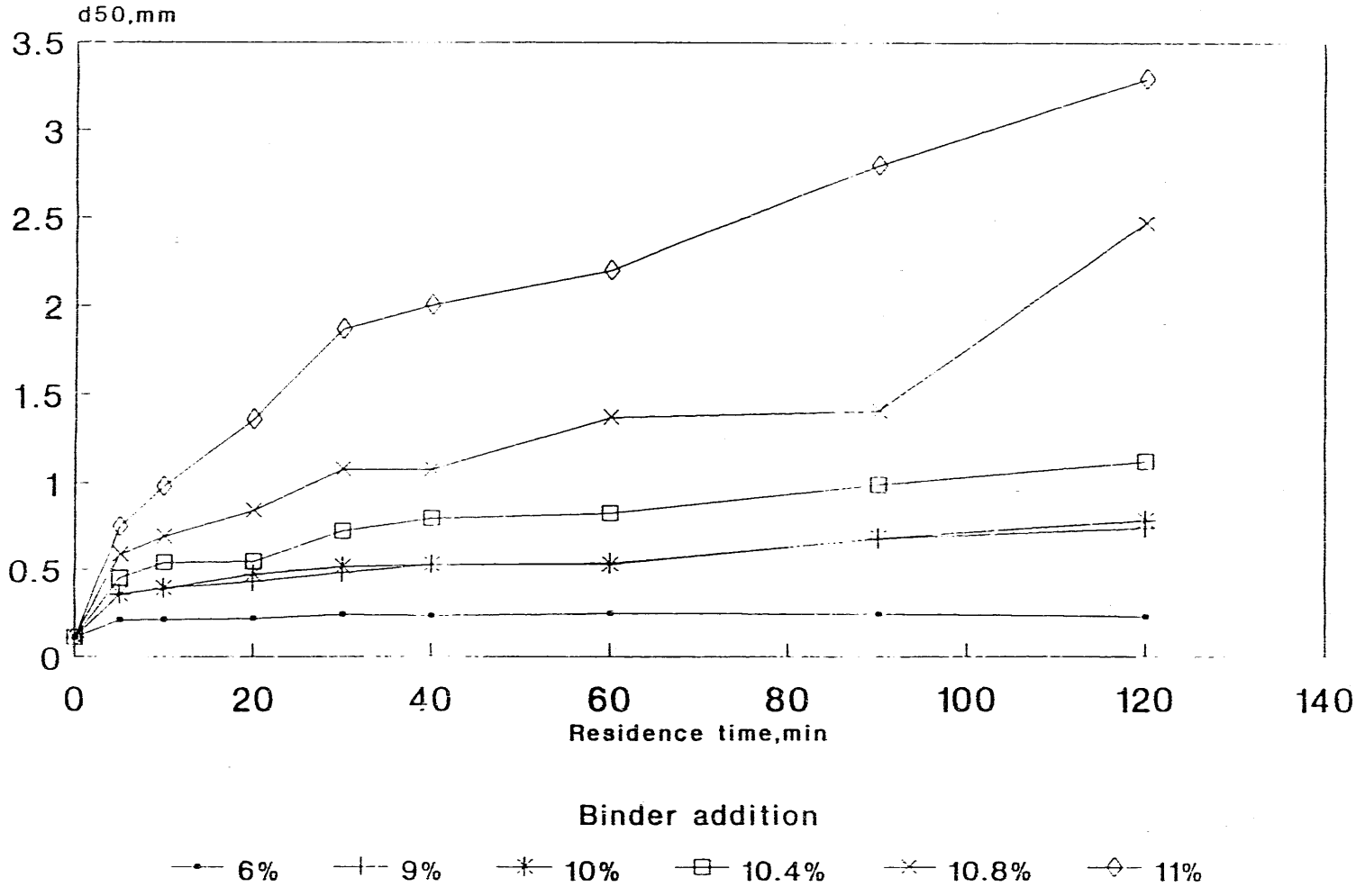
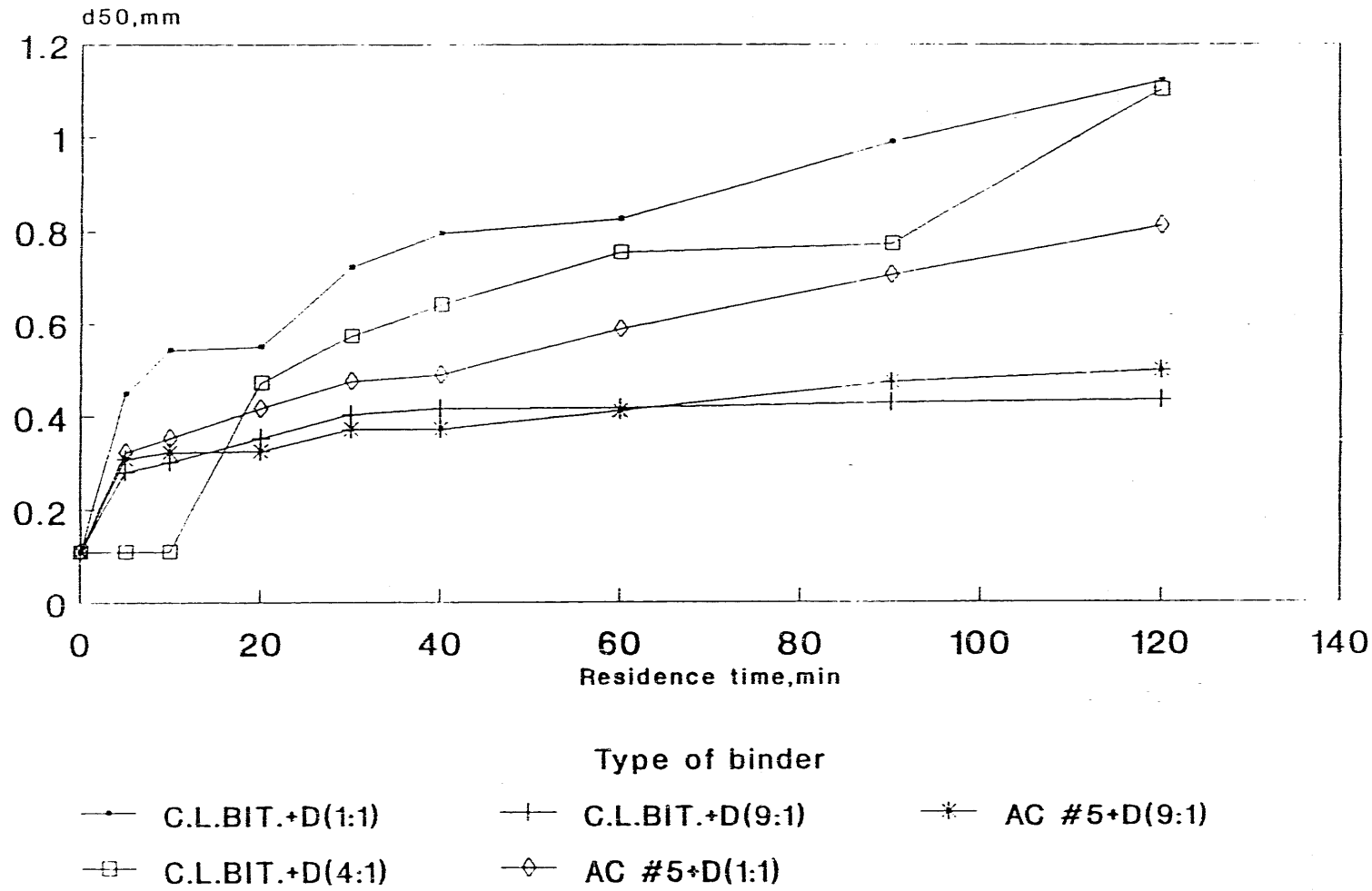


Figure 7-15 Low Shear Testing - Effect of Binder Addition on Agglomerate Size



UPPER FREEPORT - CLB+D(1:1),30%sol.

Figure 7-16 Low Shear Testing - Effect of Type of Binder on Agglomerate Size



UPPER FREEPORT - 10.4% of binder addition,30%sol.

Figure 7-17 Low Shear Testing - Effect of Solids Concentration on Agglomerate Size

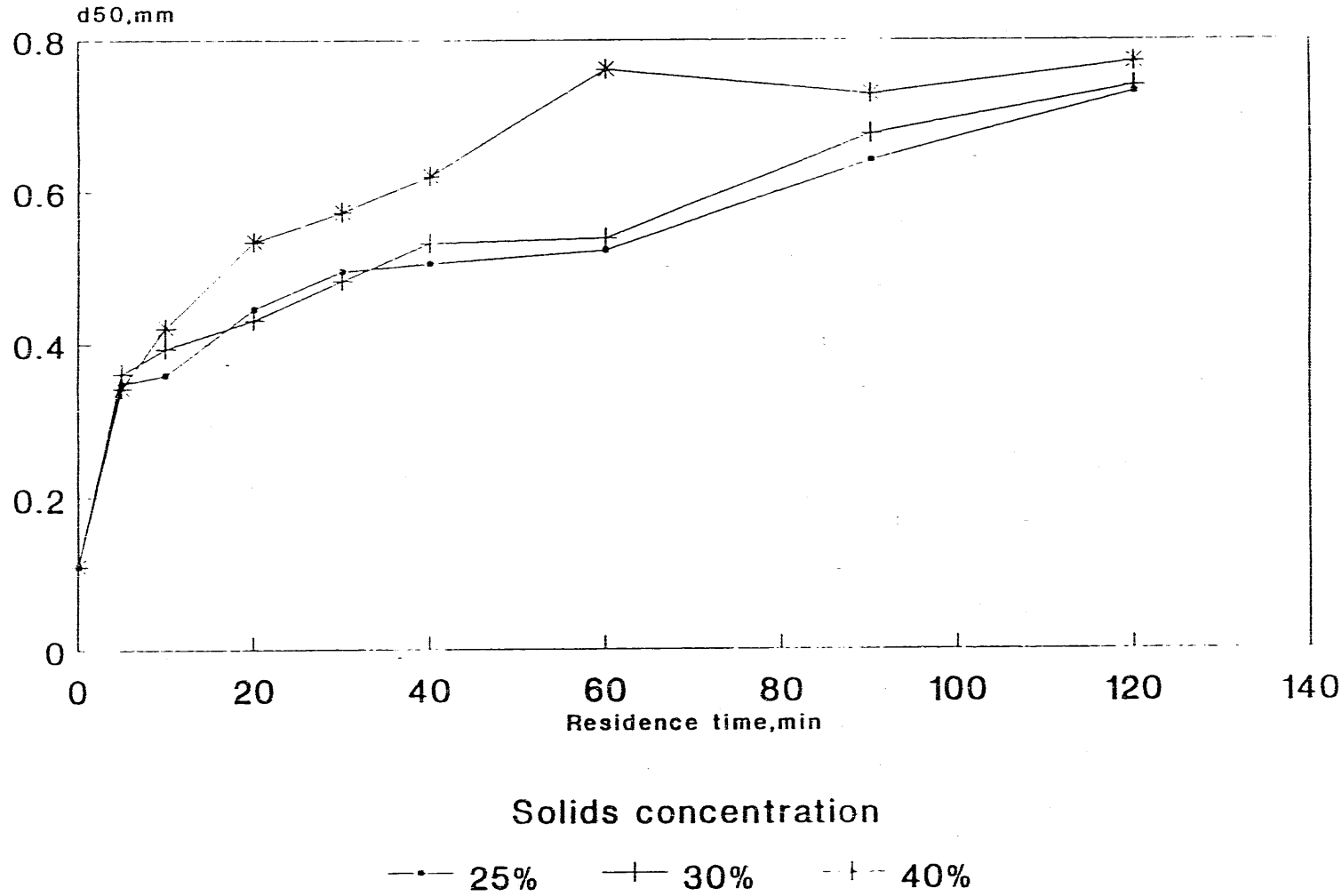
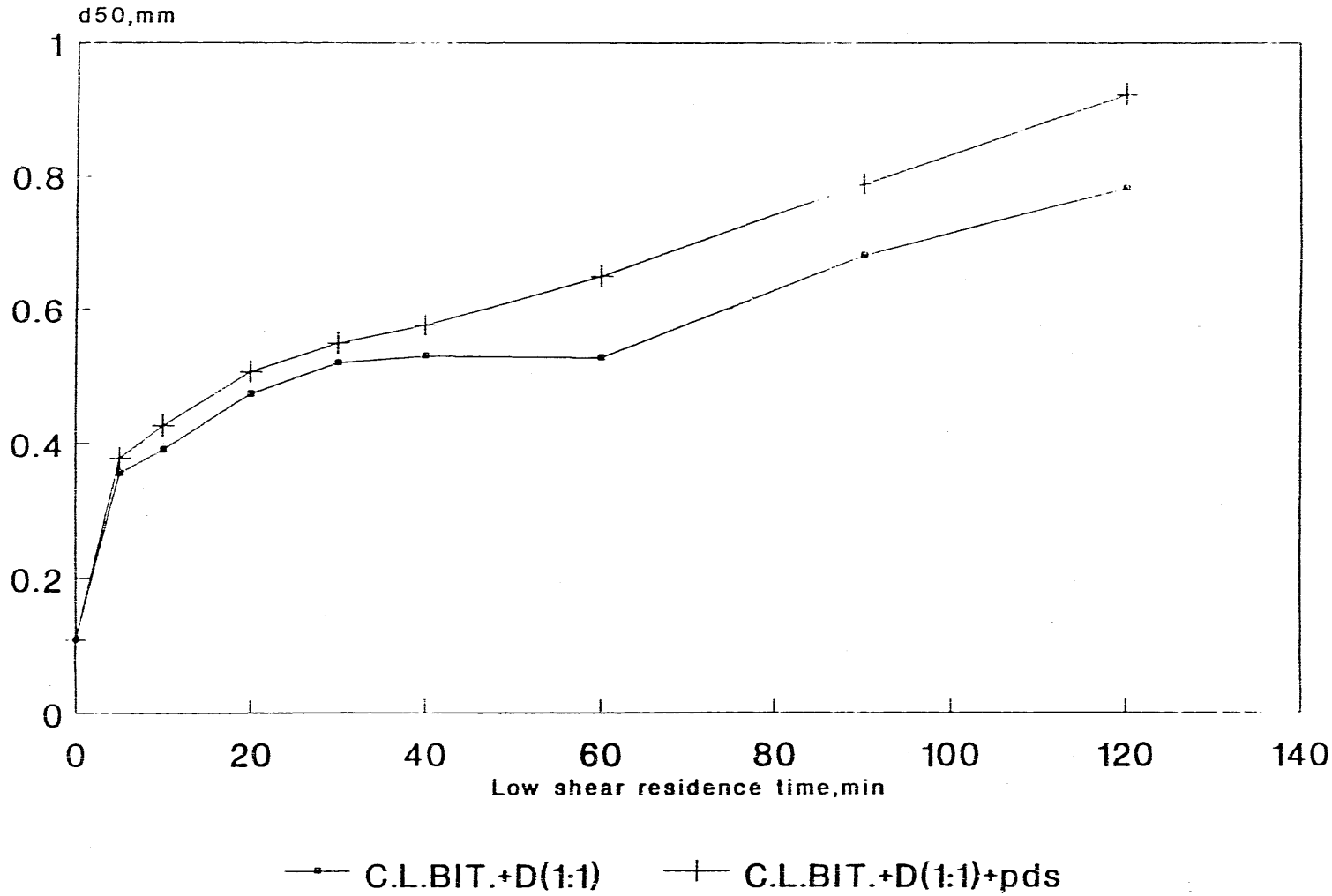


Figure 7-18 Low Shear Testing - Effect of Surfactant on Agglomerate Size



UPPER FREEPORT - CLB+D(1:1)-10%,30%sol.

Figure 7-19 Heptane Balance - Pittsburgh No. 8

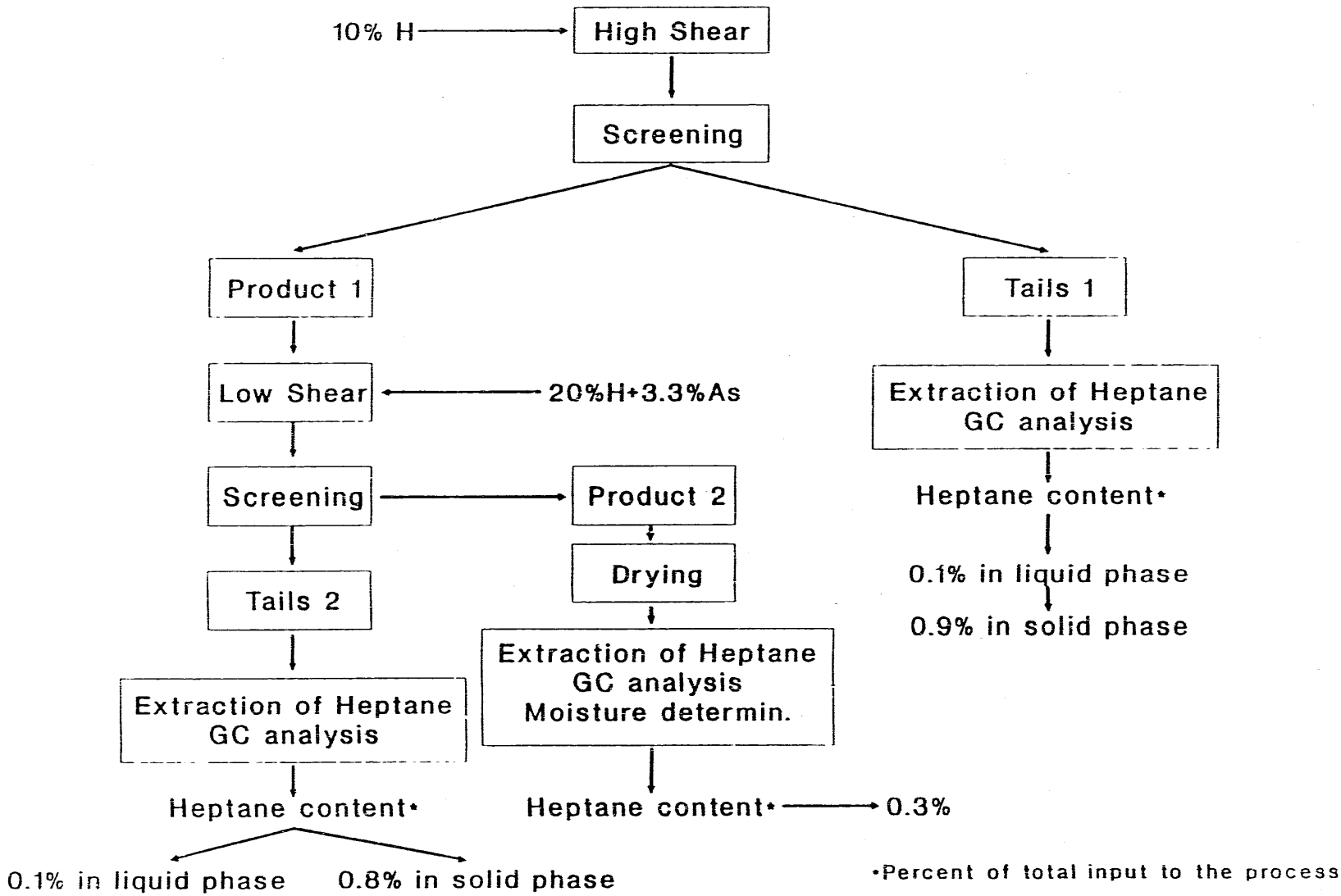
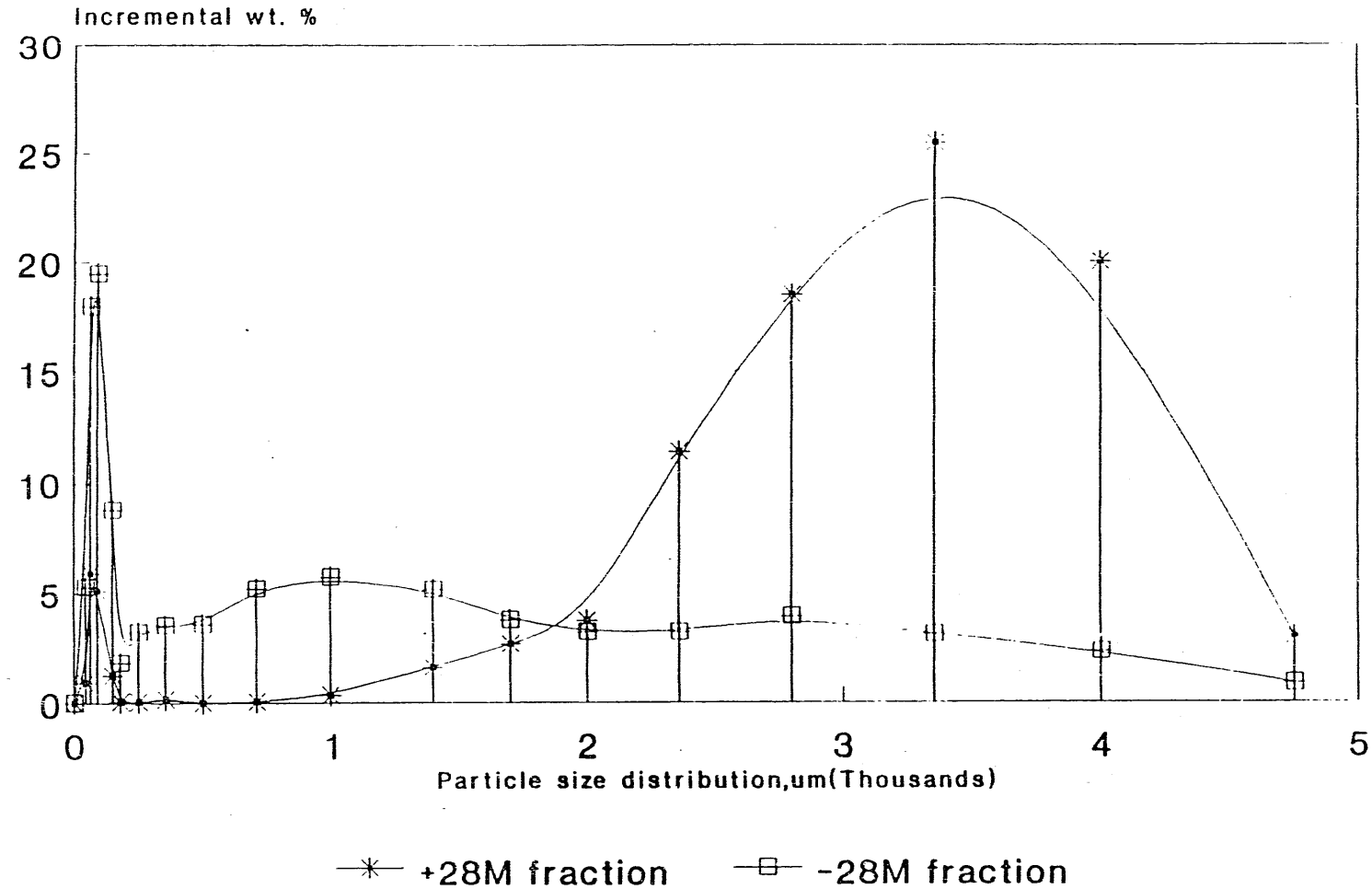
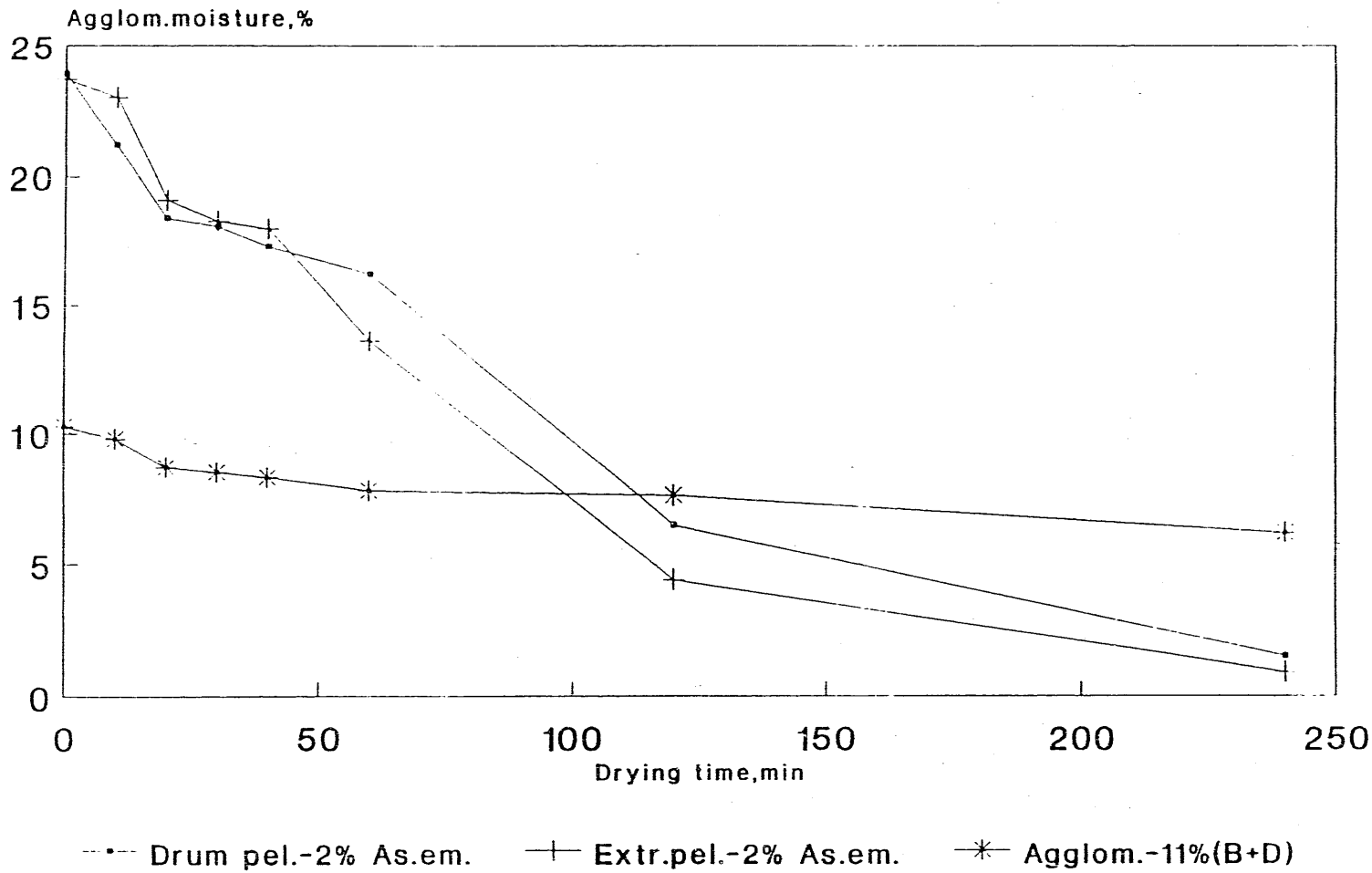


Figure 7-20 Product Size Distribution - Heptane Process



Pittsburgh No.8,10%H/20%H+3.3%As.

Figure 7-21 Thermal Drying at 40°C - Diesel Product



8.0 BENCH SCALE DIESEL CONTINUOUS TESTING (CPRU)

Bench scale continuous testing of the agglomeration process using diesel was performed on the Continuous Pyrite Removal Unit (CPRU). The primary objective of these tests was to verify the data obtained in batch scale testing. The results of these tests were also used for process performance comparison with the agglomeration process using heptane as the agglomerant. This section summarizes the test plan and discusses the results of the testings.

8.1 Summary of Test Plan

The bench scale diesel continuous testing can be classified into two experimental groups: commissioning tests and confirmatory tests which also include tests to determine the mass balance across the continuous processing system for each project coal.

The commissioning tests were carried out after modification of the existing unit to evaluate the performance of slurry feeding system, to establish the time requirement for steady state operation, to develop sampling protocol, and to examine mass balances in system operation. Upper Freeport coal of a 28 mesh grind was used for these experiments.

The confirmatory tests were performed to generate process data for engineering evaluation and to examine data comparability between the batch and continuous testings. The test program covered all three project coals (Upper Freeport, Pittsburgh No. 8, Kentucky No. 9) at two different grind sizes (28 mesh and 100 mesh). Process variables studied in the test matrix included diesel dosage, frother dosages, solids concentrations in flotation cells, and high-shear configurations in the operation to cover the effect of residence time.

The mass balance tests were performed at a selected set point for each project coal. Samples of inlet and outlet streams were collected. These included feed coal slurry, tailings from first stage of microagglomerates recovery (flotation cell), tailings and clean coal product after the second stage of flotation.

The mass flow rates for coal matter, ash and total sulfur were calculated for the mass balance analysis.

8.2 Coal Slurry Feed Characterization

The coal slurry feed for each test run was prepared the night before the scheduled test and was characterized for slurry density and particle size distribution.

8.2.1 Slurry Density

A known weight of a representative portion of slurry was filtered on a weighed Whatman No. 4 filter paper. The solids recovered along with the filter paper were dried in an oven regulated at 60°C. The percent solids (wt% basis) was determined and this value was used for initial adjustment of the solids flow and to regulate the diesel dosage in the high-shear mixers.

8.2.2 Particle Size Distribution

A known weight of a representative portion of slurry was wet-screened using Cascade Screening System (Six Tyler screens). These fractions were dried in an oven regulated at 60°C, cooled to room conditions and weighed. A typical size distribution data of a slurry feed sample (CPRU-7) is presented in Table 8-1. D_{50} of the slurry feed was determined by plotting cumulative weight increments vs screen openings. Figure 8-1 presents data of Table 8-1 and the d_{50} of the feed slurry.

Table 8-1

DETERMINATION OF SIZE DISTRIBUTION OF UPPER FREEPORT COAL SLURRY FEED FOR CPRU-7

Coal: Upper Freeport d_{50}: 125 um

Size Range um	Direct wt %	Cumulative wt %
+300	21.43	21.43
300 x 212	11.74	33.17
212 x 150	11.92	45.09
150 x 106	10.76	55.85
106 x 75	7.47	63.32
75 x 53	4.97	68.29
-53	31.71	100.00

8.2.3 Size Degradation

A typical CPRU test would last for at least six hours. Some particle size degradation especially for the 28 mesh x 0 feed slurry was expected. In order to establish the level of degradation, a 28 mesh x 0 coal slurry of 30% solids of the Upper Freeport coal was prepared for the study.

Agitator was kept running for a period of six hours. Two samples, one after 0.5 hour and the second after 5.5 hours, were collected from the recirculating system of the slurry holding tank. These samples were wet-screened and the size analysis data summarized in Table 8-2, indicated that size degradation was minimal and would not bias the agglomeration performance results.

Table 8-2

EVALUATION OF SIZE DEGRADATION IN SLURRY HOLDING TANK

Coal Type:	Upper Freeport Raw Coal
Slurry Density, wt%:	33.5
Slurry Volume, liter:	80

Size Range um	Stirring Time 0.5 hr Cumulative wt%	Stirring Time 5.5 hr Cumulative wt%
+600	3.7	2.3
600 x 300	16.1	16.9
300 x 212	25.7	28.9
212 x 150	35.4	39.9
150 x 106	45.1	50.5
106 x 75	54.4	59.9
75 x 53	70.5	68.5
-53	100.0	100.0

8.3 Commissioning Tests

The conditions used in the commissioning tests are summarized in Table 8-3 (CPRU-1). The consistency of the feed sample, the response of the system to achieve steady state, and the initial mass balance data are discussed below.

Table 8-3

UPPER FREEPORT COAL
DIESEL COMMISSIONING TEST CPRU-1: TEST CONDITIONS

Coal:	Upper Freeport
Size distribution:	28 mesh x 0, d_{50} = 125 $\pm$ 5 um, ball mill product
Agglomerant concentration:	1%, 1.5%, 2%, 3%
Frother:	MIBC
Frother concentration:	0%, 0.005%, 0.01%, 0.015%
High-shear % solids:	20
High-shear residence time:	4 minutes
High-shear impeller rpm:	2000
Flotation % solids:	6
Flotation residence time:	Approximately 4 minutes
Second stage flotation % solids:	6
Second stage flotation residence time:	Approximately 7 minutes

8.3.1 Feed Consistency

Table 8-4 provides data indicating the performance of the feed system during the test run. Twelve samples were collected over a period of about 10 hours. Each sample composed of 4 minutes of total flow of coal slurry discharge routed to the conditioning vessel. The targeted flow was 148 grams per minute. The small variation in the slurry feed rate was a cumulative effect of many influencing factors such as level of slurry holding tank, performance of the slurry pumps, and flow splitter, etc. The main factor was the time involved in sampling and sample retrieval procedure. A variation of one second would introduce an error of $\pm$ 2.5 grams in the weight of collected sample for these flow conditions. However, the mass flow in the dynamic system is expected to be closer to the intended flow rate. The data also showed a trend of relatively constant coal feed rate (dry basis) and consistent composition of the dry solids.

Table 8-4

UPPER FREEPORT COAL
CPRU-1 FEED RATES TO CONDITIONING VESSEL

Feed Sample No.	Time From Start min	Slurry Rate g/min	Coal Rate* g/min	% Solids*	% Ash	% Total Sulfur
1	0	-	-	-	15.3	2.24
2	8	147	50.7	34.4	-	-
3	16	148	51.5	34.8	14.7	2.16
4	196	150	51.4	34.2	14.3	2.05
5	256	150	50.7	33.9	14.3	1.94
6	316	149	50.8	34.0	14.8	2.33
7	376	149	49.8	33.5	14.6	2.09
8	386	148	49.4	33.3	14.3	1.97
9	396	148	49.4	33.3	-	-
10	456	148	48.3	32.7	14.1	1.92
11	516	147	47.5	32.3	14.2	2.06
12	576	147	46.5	31.7	14.0	1.99
Average		148.3	49.6	33.5	14.5	2.07

*40°C air-dried basis

8.3.2 Steady State and Sampling Protocol

The CPRU provided a two-stage recovery system for the microagglomerates, a flotation cell and a hydraulic separator connected in series. To determine the overall efficiency of the operation, it was necessary to collect clean coal product samples after the second stage of flotation.

Table 8-5 summarized the second stage flotation samples taken for steady state analysis. The following symbols are used to identify the second stage flotation products: SSFCC (second stage flotation clean coal), SSFS (second stage flotation settlings) and SSFT (second stage flotation tailings). Table 8-5 also presents data on the % ash contents and % total sulfur of these samples.

Based on the clean coal product data, the system reached steady state between 35-45 minutes of duration of the test run. The SSFS and SSFT samples still showed some variation in flow rates of solids although % ash and % total sulfur remained consistent after a period of 45 minutes.

Figures 8-2 to 8-4 illustrate some of the data trends of Table 8-5. Figure 8-2 indicates the flow rate of second stage flotation clean coal (SSFCC); Figures 8-3 and 8-4 indicate % ash content and % total sulfur in the SSFCC samples collected during the test. These three figures show that after 45 minutes (indicated by an arrow) the system reaches a steady state. Any fluctuations in ash or sulfur contents are within analytical error.

The schedule for sampling the products calls for a 10 minute sample from 45 to 55 after establishing the steady state conditions. The consistent results obtained during the CPRU-1 confirmed that this schedule of sampling would provide satisfactory data for the required evaluations.

Table 8-5

UPPER FREEPORT COAL
STEADY STATE ANALYSIS: CPRU-1

Sample No.	Time Taken min	Rate (dry) Solids g/min	% Ash	% Total Sulfur
SSFCC-1	5 - 15	35.9	7.0	1.16
-2	20 - 30	34.8	7.1	1.20
-3	35 - 45	36.2	6.8	1.17
-4	50 - 60	36.1	6.7	1.14
-5	65 - 75	36.0	6.6	1.13
-6	80 - 90	34.9	6.5	1.15
-7	95 - 105	34.6	6.5	1.09
-8	110 - 120	34.4	6.5	1.12
SSFS-1	5 - 15	0.2	23.1	2.53
-2	20 - 30	0.4	22.6	2.95
-3	35 - 45	0.7	27.6	4.37
-4	50 - 60	0.4	25.4	3.46
-5	65 - 75	0.8	25.1	3.82
-6	80 - 90	0.8	24.7	3.74
-7	95 - 105	0.8	23.4	3.27
-8	110 - 120	0.8	23.7	3.38
SSFT-1	5 - 15	2.1	17.8	2.10
-2	20 - 30	2.1	17.8	2.10
-3	35 - 45	3.4	19.0	2.31
-4	50 - 60	4.4	18.9	2.19
-5	65 - 75	3.8	18.3	2.18
-6	80 - 90	4.0	19.0	2.54
-7	95 - 105	4.4	18.5	2.63
-8	110 - 120	5.6	20.1	2.68

8.3.3 Mass Balance of CPRU-1

To quantify the distribution of mass in the CPRU system after attaining steady state, sample of clean coal product and samples of tailings from flotation cell and the second stage of flotation were simultaneously procured and mass flow determined in each stream.

Figure 8-5, a block diagram, illustrates the process flow streams for the CPRU, and the approach used for mass balance calculations. Table 8-6 summarizes the mass balance analysis. During mass balance analysis, it was assumed that the contribution from diesel and frother were negligible. Therefore, mass flows for these two components were not included in the mass balance data.

The results of the mass balance analysis in Table 8-6 shows satisfactory recoveries for coal mass (100.7%), coal matter (99.9%) and ash (99.8%). The recovery for sulfur is relatively low. Being the smallest component of the process stream, cumulative effect of many influencing factors, especially quantification of sulfur, would have contributed for this low recovery.

Table 8-6

UPPER FREEPORT COAL
MASS BALANCE OF CPRU-1

Coal Upper Freeport 0.60 mmx 0 (d_{50} = 125 um)

	Inlet Streams Kg/hr	Material Outlet Streams Kg/hr							Mass Recovery wt%
		FCC	FT	FS	Total	SSFCC	SSFT	SSFS	
Frother	0								
Oil	0.025								
Coal	3.074	2.309	0.587	0.132	3.028	2.118	0.221	0.037	100.7
CM	2.628	2.125	0.367	0.066	2.558	1.991	0.174	0.028	99.9
Ash	0.446	0.184	0.185	0.066	0.435	0.142	0.043	0.009	99.8
Sulfur	0.065	0.030	0.019	0.011	0.060	0.023	0.005	0.001	90.8

$$\text{Mass Recovery, wt \%} = \frac{(SSFCC + SSFT + SSFS) + (FT + FS)}{Feed} \times 100$$

8.4 Confirmatory Tests

The confirmatory tests covered the following three project coals at two different grind sizes:

Coal	Grind Size	Runs Identifications
Upper Freeport	28 mesh, 100 mesh	3 to 12, 30, 31
Kentucky No. 9	28 mesh, 100 mesh	13 to 15, 20 to 25, 28, 29
Pittsburgh No. 8	28 mesh, 100 mesh	26, 27

The objective of the test program was to evaluate the process response for the following five variables:

- diesel dosage
- frother concentration
- grind size
- flotation solid concentration
- high-shear mixer configuration (residence time)

The process response for each variable was measured from changes in the following two parameters which reflected the efficiency of the overall process:

- coal matter recovery or BTU recovery
- pyritic sulfur rejection

8.4.1 Upper Freeport Coal

Total twelve tests were performed using two grind sizes. These test runs were designated with the same serial numbers as given in the data base, i.e.

	Runs
o 28 mesh feed	5, 6, 7, 8, 10, 11, 12, 30
o 100 mesh feed	3, 4, 9, 31

Testing conditions and the results are summarized in Table 8-7. Runs 3 to 8 covered the effect of first four process variables. After the completion of these tests, two high-shear mixers in series were installed and the effect of high-shear configuration was studied through Runs 9 to 12, 30 and 31.

The process responses for each of the variables tested are discussed in the following sections.

Table 8-7
UPPER FREEPORT
CPRU DIESEL CASE SUMMARY OF TEST RESULTS

Run No.	Set Point	Feed Top Size mesh	d_{50} um	1-High-Shear Slurry g/min	1-High-Shear Coal g/min	1-High-Shear Oil %	1-High-Shear RT min	Feed Coal Analysis %A db	Feed Coal Analysis %TS db	Flotation Cell % Coal	Flotation Cell %Froth MIBC	Product Flow g/min	Product %A db	Product %TS db	Yield %	AR %	CMR %	TSR %	PSR %
3	1	100	54	158.30	44.12	1.27	4	15.8	1.91	5.7	0.005	32.14	8.6	1.22	73.08	60.22	79.33	53.32	66.15
	2A			158.50	45.60	1.01	4	16.0	2.12	5.9	0.015	33.34	9.6	1.31	73.57	55.86	79.18	54.19	65.53
	2B			158.50	45.60	1.10	4	16.0	2.12	5.9	0.015	36.60	9.7	1.35	80.83	51.00	86.89	48.53	60.56
	3A			158.70	46.02	1.05	4	15.8	1.93	11.8	0.015	39.27	12.2	1.62	85.15	34.25	88.80	28.52	35.23
	3B			158.70	46.02	1.05	4	15.8	1.93	11.8	0.015	38.47	12.4	1.59	83.36	34.58	86.72	31.33	38.32
	4			151.35	42.09	1.06	4	15.7	1.93	11.0	0.005	39.55	10.5	1.36	93.65	41.12	100.62	34.01	47.22
	5			151.35	41.39	1.53	4	15.1	1.74	10.8	0.005	35.87	10.4	1.37	86.57	40.38	91.36	38.55	50.27
	6			150.30	41.16	1.55	4	15.1	1.78	10.8	0.015	34.61	12.1	1.57	84.56	32.24	87.55	25.42	31.11
	7			151.00	41.34	1.66	4	15.2	1.81	5.4	0.015	37.65	10.2	1.33	91.47	38.62	96.86	32.79	45.49
4	1	100	52	159.80	45.58	1.42	4	15.2	2.02	5.9	0.005	39.33	8.4	1.19	86.20	53.29	93.44	49.22	64.82
	2A			159.80	45.58	1.42	4	15.5	2.02	5.9	0.000	30.80	7.7	1.11	67.54	66.45	73.78	62.89	76.29
	2B			159.80	45.58	1.42	4	15.5	2.02	5.9	0.000	28.47	7.7	1.11	62.47	68.97	68.23	65.67	78.07
	3A			160.40	45.79	1.00	4	15.4	1.98	5.9	0.000	27.82	7.1	1.08	60.73	77.99	57.56	66.87	78.21
	3B			160.40	45.79	1.00	4	15.4	1.98	5.9	0.000	27.10	7.0	1.04	59.34	73.03	65.23	68.83	81.65
	4			160.40	45.49	1.01	4	15.3	1.99	5.9	0.005	32.59	8.1	1.14	71.34	62.23	77.40	59.13	72.81
	5A			157.70	44.73	1.25	4	15.6	2.00	8.7	0.010	37.36	11.4	1.47	83.70	38.83	87.87	38.48	48.23
	5B			156.63	44.20	1.26	4	15.5	1.93	8.6	0.010	38.63	11.6	1.42	87.49	34.52	91.53	35.63	46.20
5	1	28	102	155.10	46.47	0.96	4	15.6	2.19	6.0	0.005	24.32	6.7	1.20	52.32	77.53	58.84	71.33	80.88
	2A			156.10	46.71	1.00	4	15.6	2.18	6.0	0.015	42.00	9.3	1.43	90.11	46.28	96.83	40.89	53.32
	2B			156.10	46.71	0.98	4	15.6	2.18	6.0	0.015	43.39	9.3	1.44	92.98	44.57	99.92	38.58	51.26
	3A			154.00	45.38	1.03	4	15.4	2.12	11.8	0.015	43.24	11.5	1.67	95.38	28.77	99.78	24.86	33.32
	3B			154.00	45.38	0.99	4	15.4	2.12	11.8	0.015	43.81	12.3	1.85	96.56	22.88	100.10	15.74	21.17
	4			156.00	45.95	1.00	4	15.1	1.96	11.8	0.005	43.26	9.8	1.41	94.06	38.96	99.93	32.34	44.71
	5			158.30	45.92	1.45	4	14.8	2.07	11.8	0.005	43.51	10.5	1.52	94.66	32.84	99.44	30.49	41.19
6	1A	28	125	156.90	45.56	1.48	4	14.6	1.91	11.7	0.015	40.81	10.7	1.49	89.49	34.42	93.58	30.19	39.72
	1B			156.90	45.56	1.52	4	14.6	1.91	11.7	0.015	40.25	10.5	1.46	88.34	36.47	92.58	32.47	42.52
	2			157.40	45.38	1.49	4	14.2	1.94	5.9	0.015	34.97	8.3	1.19	77.23	54.86	82.55	52.13	66.02
	3			157.10	42.93	1.58	4	14.2	1.99	5.5	0.005	27.52	6.9	1.11	64.38	68.72	69.86	64.09	77.03
7	1A	28	125	160.90	49.35	1.45	4	15.7	1.77	6.3	0.000	32.48	8.5	1.19	65.96	64.29	71.60	55.65	67.60
	1B			160.90	49.35	1.45	4	15.7	1.77	6.3	0.000	32.50	8.1	1.12	65.89	66.00	71.83	58.30	71.52
	2A			161.20	47.81	0.96	4	15.7	1.92	6.1	0.000	22.49	6.5	1.02	47.00	80.54	52.13	75.03	85.65
	2B			161.20	47.81	0.96	4	15.7	1.92	6.1	0.000	21.98	6.4	0.98	45.92	81.28	50.98	76.56	87.33
8	1	28	115	162.30	45.25	1.22	4	16.2	1.89	10.2	0.010	40.00	12.8	1.57	88.13	30.37	91.71	26.79	34.12
	2			161.90	44.86	1.34	4	16.4	2.03	10.1	0.010	36.02	12.0	1.53	79.65	41.72	83.84	39.97	48.49
	3			162.50	44.61	0.98	4	16.3	2.00	10.1	0.005	28.96	7.8	1.13	64.71	69.03	71.28	63.44	76.14

Table 8-7 (Continued)
UPPER FREEPORT
CPRU DIESEL CASE SUMMARY OF TEST RESULTS

Run No.	Set Point	Feed Top Size mesh	d_{50} um	2-High-Shears Slurry g/min	2-High-Shears Coal g/min	2-High-Shears Oil %	2-High-Shears RT min	Feed Coal Analysis %A db	Feed Coal Analysis %TS db	Flotation Cell % Coal	Flotation Cell %Froth MIBC	Product Flow g/min	Product %A db	Product %TS db	Yield %	AR %	CMR %	TSR %	PSR %
9	1	100	53	297.65	72.09	1.0	0.7	16.3	2.17	7.5	0.000	26.22	5.6	0.98	36.55	87.44	41.22	83.49	91.60
	2		53	297.65	72.09	1.0	0.7	16.3	2.17	7.5	0.005	40.46	6.8	1.08	56.01	76.63	62.37	72.12	83.43
	3		53	297.65	72.09	1.0	0.7	16.3	2.17	7.5	0.011	51.01	8.2	1.19	70.62	64.48	77.45	61.27	73.97
	4		53	297.65	72.09	1.0	0.7	16.3	2.17	7.5	0.017	62.86	10.8	1.55	87.02	42.34	92.74	37.84	47.87
10	1	28	120	268.4	79.53	0.99	1.8	17.2	2.18	6.0	0.000	47.85	7.0	1.17	60.16	75.52	67.57	74.95	84.83
	2		120	268.4	79.53	0.99	1.8	17.2	2.18	6.0	0.005	53.63	7.5	1.26	67.43	70.60	75.33	69.76	80.24
	3		120	268.4	79.53	0.99	1.8	17.2	2.18	6.0	0.010	64.86	9.1	1.46	81.56	56.85	89.54	57.62	68.59
	4		120	268.4	79.53	0.99	1.8	17.2	2.18	6.0	0.015	77.54	10.5	1.71	97.51	40.47	105.40	40.66	51.37
11*	1	28	120	280.0	82.97	0.93	0.9	17.2	2.18	6.0	0.000	39.45	6.6	1.17	47.55	81.75	53.64	80.20	88.07
	2		120	280.0	82.97	0.90	0.9	17.2	2.18	6.0	0.005	53.10	7.8	1.25	64.01	70.97	71.27	71.53	81.47
	3		120	280.0	82.97	1.06	0.9	17.2	2.18	6.0	0.015	63.36	8.4	1.28	76.36	62.71	84.48	65.22	76.77
12	1	28	125	297.8	88.60	0.91	3.6	14.5	1.89	6.0	0.005	32.11	7.8	1.10	36.25	80.90	39.22	80.55	87.72
	2		125	297.8	88.60	0.91	3.6	14.5	1.89	6.0	0.006	46.44	8.1	1.19	52.42	71.31	56.54	69.57	79.04
	3		125	297.8	88.60	0.91	3.6	14.5	1.89	6.0	0.012	68.90	9.3	1.38	77.77	51.13	82.79	47.64	58.68
	4		125	297.8	88.60	0.91	3.6	14.5	1.89	6.0	0.015	75.69	9.7	1.56	85.44	44.00	90.55	34.98	44.24
	5		125	297.8	88.60	0.91	3.6	14.5	1.89	6.0	0.010	65.40	8.6	1.10	73.81	57.11	79.19	52.83	64.43
	6		125	297.8	88.60	0.91	3.6	14.5	1.89	6.0	0.005	52.84	6.9	1.10	59.65	72.19	65.18	67.99	80.02
	7		125	297.8	88.60	0.91	3.6	14.5	1.89	6.0	0.000	35.21	5.9	1.03	39.74	84.16	43.89	80.03	88.70
30	1a	28	120	167	42.68	1.01	4.5	13.8	1.77	5.0	0.0000	30.19	6.9	1.28	70.75	64.63	76.41	48.84	60.27
	1b		120	167	42.68	1.01	4.5	13.8	1.77	5.0	0.0000	39.55	8.3	1.37	92.69	44.25	98.61	28.25	40.42
	2a		120	167	42.68	1.03	4.5	13.8	1.77	5.0	0.0050	36.80	8.6	1.37	85.02	47.01	90.15	34.19	45.21
	2b		120	167	42.68	1.03	4.5	13.8	1.77	5.0	0.0050	40.54	10.9	1.68	95.00	24.96	98.20	9.83	13.46
	3a		120	167	42.68	1.27	4.5	13.8	1.77	5.0	0.0000	36.45	7.0	1.22	84.56	56.48	91.02	41.72	56.69
	3b		120	167	42.68	1.27	4.5	13.8	1.77	5.0	0.0000	39.19	8.1	1.39	91.84	45.30	97.69	27.88	39.49
31	1a	100	80	204	50.09	1.04	4.5	15.8	2.01	6	0.0000	24.36	6.1	0.99	48.63	81.22	54.23	76.05	67.14
	1b		80	204	50.09	1.04	4.5	15.8	2.01	6	0.0000	32.12	8.1	1.22	64.13	67.12	70.00	61.07	72.45
	2a		80	204	50.09	1.06	4.5	15.8	2.01	6	0.0050	42.83	9.5	1.34	85.52	48.58	91.97	42.99	55.78
	2b		80	204	50.09	1.06	4.5	15.8	2.01	6	0.0050	45.86	12.2	1.66	93.65	27.69	97.65	22.66	30.10
	3a		80	204	50.09	1.30	4.5	15.8	2.01	6	0.0000	35.40	7.6	1.07	70.67	66.01	77.55	62.38	77.01
	3b		80	204	50.09	1.30	4.5	15.8	2.01	6	0.0000	40.70	9.7	1.30	81.27	50.10	87.16	47.44	60.11

NOTE:
- * - Single high-shear was used
- "A", "B" - duplicate tests at same set point
- "a" - microagglomerates recovered by two stages of flotation
- "b" - microagglomerates recovered by one stage of flotation

8.4.1.1 Effect of Diesel Dosage Rate

The information relating effect of diesel dosage is summarized in Table 8-8 and is presented by Figure 8-6. The effect of diesel dosage in the high-shear mixer has been compared at several frother concentrations for both grind sizes. Run 7 was conducted with 28 mesh feed and had no frother added. It is observed that increase of diesel dosage from about 1% to 1.45% improves BTU recovery from 53% to 72% and at the same time decreases PSR from ~86% to 68%. At 100 mesh grind size for Run 4, Set Point 2A, 3A, an increase of diesel dosage from 1% to 1.43% increases the BTU recovery from 57% to 74% and decreases PSR from 78% to ~76%. Similar trends are observed for Runs 30 and 31; an increase of diesel dosage improves BTU and at the same time decreases PSR. Data for these set points indicate that increase of diesel improves %BTU recovery for both grind sizes.

In the presence of 0.005% frother, an increase of diesel from 1.0% to 1.42% (Run 4, Set Points 4, 1) improves %BTU from 78% to 94% and decreases PSR from 72.8% to 64.8%.

Table 8-8

UPPER FREEPORT COAL
EFFECT OF DIESEL CONCENTRATION

Run No.	Set Point No.	Top Size mesh	Diesel %	Flot Solids %	Froth Conc %	BTU Rec %	PSR %
4	4	100	1.01	5.9	0.005	78	72.8
4	1	100	1.42	5.9	0.005	94	64.8
3	3A	100	1.00	11.8	0.015	89	35.2
3	6	100	1.55	10.8	0.015	87	31.1
4	3A	100	1.00	5.9	0.00	57	78.2
4	2A	100	1.42	5.9	0.00	74	76.3
31	1a	100	1.64	6.0	0.000	54	87.1
31	3a	100	1.30	6.0	0.000	78	77.0
5	2A	28	1.00	6.0	0.015	97	53.3
6	2	28	1.49	5.9	0.015	83	66.0
30	1a	28	1.01	6.9	0.000	76	60.3
30	3a	28	1.27	7.0	0.000	91	56.7
7	2A	28	0.96	6.0	0.000	53	85.6
7	1A	28	1.45	6.0	0.000	72	67.6

The effect of diesel concentration on process performance is not clearly demonstrated under high frother dosages or higher solids contents in the flotation cell. For 28 mesh feed, Runs 5, Set Points 2A and Run 6, Set Point 2, an increase of diesel from 1.0 to 1.49, in the presence of 0.015% frother decreases BTU recovery from 100% to 83% and improves PSR from 51.3% to 66%. Probably the effect of increased diesel dosage is masked by the high concentration (0.015%) of frother. At 100 mesh grind size for Run 3, Set Points 3A, 6, at ~12% flotation solids and 0.015% frother, an increase of diesel from 1% to 1.55% has minimal effect on BTU recovery (88%) and on PSR (33%).

8.4.1.2 Effect of Frother Concentration

Data pertaining to the effect of frother on the process response parameters is summarized in Table 8-9 and presented in Figure 8-7. Run 7, Set Point 2B and Run 5, Set Points 1, 2A, both are conducted at 28 mesh feed, ~1% diesel dosage, and 6% flotation solids. An increase of frother concentration increases BTU recovery from 52% to 97% and at the same time decreases PSR from ~87% to 53%. For Run 10, the frother concentration is increased in each successive set point. It is observed that with successive increase of frother, BTU recovery increases and PSR decreases for each set point. In the absence of frother BTU recovery is 68% and improves to 100% at 0.015% frother.

Run 4, Set Points 3B, 4, and Run 3, Set Point 2B are conducted at 100 mesh, 6% flotation solids, and have identical testing conditions. An increase of frother from 0 to 0.015% increases BTU recovery from 66% to 88% and at the same time decreases PSR from 81.7% to 60.6%. In Run 9, a similar trend is observed; BTU recovery improves from 41% to 93% at 0.015% frother and PSR decreases from ~92% to 48%.

Table 8-9

UPPER FREEPORT COAL
EFFECT OF FROTHER CONCENTRATION

Run No.	Set Point No.	Top Size mesh	Diesel %	Flot. Solids %	Froth Conc %	BTU Rec %	PSR %
7	2B	28	0.96	6.0	0.000	52	87.3
5	1	28	0.96	6.0	0.005	58	80.9
5	2A	28	1.00	6.0	0.015	97	53.3
5	4	28	1.00	11.8	0.005	100	44.7
5	3A	28	1.03	11.8	0.015	100	33.3
10	1	28	0.99	6.0	0.000	68	84.8
10	2	28	0.99	6.0	0.005	75	80.2
10	3	28	0.99	6.0	0.010	90	68.6
10	4	28	0.99	6.0	0.015	100	51.4
4	3F	100	1.00	6.0	0.000	66	81.7
4	4	100	1.01	5.9	0.005	78	72.8
3	2B	100	1.10	5.9	0.015	88	60.6
9	1	100	1.00	7.5	0.000	41	91.6
9	2	100	1.00	7.5	0.005	62	83.4
9	3	100	1.00	7.5	0.011	78	74.0
9	4	100	1.00	7.5	0.017	93	47.9

Run 5, Set Points 3A, 4, are conducted at 28 mesh feed, ~12% flotation cell solids and ~1% diesel, has 100% BTU recovery at 0.005% frother. Further increase of frother concentration to 0.015% for Set Point 3A has no effect on BTU recovery but pyritic sulfur rejection decreases from 44.7% to 33.3%.

These data indicate that increase of frother dosage improves BTU recovery and simultaneously decreases PSR. High flotation solids mask the effect of the process variable being investigated.

8.4.1.3 Effect of Grind Size

To evaluate the effect of grind size, related data is summarized in Table 8-10 and presented in Figure 8-8.

Table 8-10

UPPER FREEPORT COAL
EFFECT OF GRIND SIZE

Run No.	Set Point No.	Top Size mesh	Diesel %	Flot. Solids %	Froth Conc %	BTU Rec %	PSR %
7	2A	28	1.00	6.0	0.000	53	85.6
4	3A	100	1.00	6.0	0.000	58	78.2
7	2B	28	0.96	6.0	0.000	52	87.3
4	3B	100	1.00	6.0	0.000	66	81.7
5	1	28	0.96	6.0	0.005	59	80.9
4	4	100	1.01	5.9	0.005	78	72.8
5	3A	28	1.00	11.8	0.015	100	33.3
3	3A	100	1.05	11.8	0.015	89	35.2

Run 7, Set Points 2A, 2B, conducted at 28 mesh, and Run 4, Set Points 3A, 3B, conducted at 100 mesh have identical operating conditions, i.e. ~1.0% diesel, 6% flotation solids, and no frother. Reduction of particle size improves BTU recoveries from ~53% to 58% in the first set and from 52% to 66% in the second set, and decreases PSR from 86% to 80%. In the presence of 0.005% frother, the size reduction from 28 mesh to 100 mesh, for Runs 5 and 4, Set Points 1, 4, has improved BTU recovery from 59% to 78% but has decreased PSR from ~81% to 73%.

Size reduction during Run 5, Set Point 3A, and Run 3, Set Point 3A, in the presence of 0.015% frother, and at ~12% flotation solids, reduces BTU recovery from 100% to 89%, and has little effect on PSR. Again, high frother concentration and high flotation solids show their influence on process performance.

8.4.1.4 Effect of Flotation Solids Concentration

Table 8-11 and Figure 8-9 present results showing the effect of the flotation cell % solids on process performance. It is observed that an increase of flotation solids at 28 mesh feed for Runs 6 and 5, Set Points 3 and 5, and at low level of frother (0.005%) increases BTU recovery from 70% to 100% and decreases PSR from 77% to ~41%.

Increase of flotation solids at 28 mesh feed, and 0.015% frother, for Run 5, Set Points 2B, 3A, has no effect on BTU recovery which remains 100% but decreases PSR from ~51% to 33%.

For 100 mesh grind size and similar testing conditions, in Run 3, Set Points 2A, 2B and 3A, 3B, a change of flotation solids has no effect on BTU recovery but again decreases PSR from an average of 63% to ~35%. It is observed that increase of flotation solids at both grind sizes has negative effect on %PSR.

Table 8-11

UPPER FREEPORT COAL
EFFECT OF FLOTATION SOLIDS CONCENTRATION

Run No.	Set Point No.	Top Size mesh	Diesel %	Flot. Solids %	Froth Conc %	BTU Rec %	PSR %
3	2A	100	1.01	5.9	0.015	80	65.5
3	3A	100	1.05	11.8	0.015	89	35.2
3	2B	100	1.10	5.9	0.015	88	60.6
3	3A	100	1.05	11.8	0.015	89	35.2
3	3B	100	1.05	11.8	0.015	87	38.3
5	2B	28	0.98	6.0	0.015	100	51.3
5	3A	28	1.03	11.8	0.015	100	33.3
6	3	28	1.58	5.5	0.005	70	77.0
5	5	28	1.45	11.8	0.005	100	41.2

8.4.1.5 Effect of High-Shear Configuration

For evaluating the effect of high-shear configuration, two high-shear mixers were installed in series and coal flow was 5 Kg/hr. As discussed earlier, both mixers had multiple discharge points to allow change of residence time. The combination of two high-shear mixers would not permit conducting testing at ~1 minute residence time. Therefore, Run 11 was carried out with a single high-shear mixer.

The effect of high-shear configuration is summarized in Tables 8-12 and 8-13 and presented in Figures 8-10 and 8-11. Data in Table 8-12 and Figure 8-10 show the effect of residence time at different frother levels; Table 8-13 and Figure 8-11 show the effect of frother at different residence times. These are discussed separately in the following sections.

Table 8-12 shows the effect of change of residence time from ~1 minute to 3.6 minutes at three different frother concentrations. During these runs, the diesel concentration and flotation solids are kept constant.

In Run 11, Set Point 1, Run 10, Set Point 1, and Run 12, Set Point 7, are showing the effect of increasing residence time on process parameters. Increase of residence time from 0.9 minutes to 1.8 minutes improves BTU recovery from 54% to 68% and further increase of residence time to 3.6 minutes decreases BTU recovery from 68% to 44%. The change of residence time shows little effect on the %PSR. Similar trend is observed at 0.005% frother for Runs 11, 10, 12, at respective Set Points 2, 2, 1. At 0.015% frother, BTU recovery maximizes at 1.8 minutes but the PSR decreases each time the residence time is increased.

Table 8-12

UPPER FREEPORT COAL
EFFECT OF RESIDENCE TIME
5 KG/HR BENCH CONTINUOUS DIESEL RUNS 28 MESH TESTS

Run No.	Set Point	Top Size mesh	Diesel %	Res Time min	Flot Solids %	MIBC %	BTU Rec %	PSR %
11*	1	28	0.93	0.9	6.0	0.000	54	88.1
10	1	28	0.99	1.8	6.0	0.000	68	84.8
12	7	28	0.91	3.6	6.0	0.000	44	88.7
11*	2	28	0.90	0.9	6.0	0.005	72	81.5
10	2	28	0.99	1.8	6.0	0.005	76	80.2
12	1	28	0.91	3.6	6.0	0.005	40	87.7
11*	3	28	1.06	0.9	6.0	0.015	85	76.8
10	4	28	0.99	1.8	6.0	0.015	106	51.4
12	4	28	0.91	3.6	6.0	0.015	91	44.2

*Single high-shear

Table 8-13 summarizes the conditions for maximizing BTU recovery and %PSR at different residence times. The diesel concentration is kept constant (1%) and concentration of frother is varied from 0 to 0.015%. Results of Run 11 indicate that at 0.9 minutes residence time, an increase of frother from 0 to 0.015% improves BTU recovery from 54% to 85% and decreases

PSR from ~88% to 77%. For 1.8 minutes of residence time for Run 10, 0.01% frother is required to achieve 90% BTU recovery and ~69% PSR. Similar dosage of frother at 3.6 minutes residence time improves BTU from 44% to 80% and decreases PSR from ~89% to 64%. These observations are made at specific testing conditions and may not produce the same effect on the process performance if applied at different process conditions.

For 100 mesh feed, during Run 9, an increase of frother concentration increases BTU recovery from 42% to 93% and decreases PSR from 92% to 48%. The overall trend is similar to one observed for 28 mesh feed.

Table 8-13

UPPER FREEPORT COAL
EFFECT OF FROTHER AND DIFFERENT RESIDENCE TIME

Run No.	Set Point	Diesel %	MIBC %	Res Time min	BTU Rec %	PSR %
28 Mesh Tests						
11*	1	0.90	0.000	0.9	54	88.1
11*	2	0.90	0.005	0.9	72	81.5
11*	3	0.90	0.015	0.9	85	76.8
10	1	0.99	0.000	1.8	68	84.8
10	2	0.99	0.005	1.8	76	80.2
10	3	0.99	0.010	1.8	90	68.6
10	4	0.99	0.015	1.8	106	51.4
12	7	0.91	0.000	3.6	44	88.7
12	1	0.91	0.005	3.6	40	87.7
12	2	0.91	0.006	3.6	57	79.0
12	5	0.91	0.010	3.6	80	64.4
12	3	0.91	0.012	3.6	83	58.7
12	4	0.91	0.015	3.6	91	44.2
100 Mesh Tests						
9	1	1.0	0.000	0.7	42	91.6
9	2	1.0	0.005	0.7	63	83.4
9	3	1.0	0.011	0.7	78	74.0
9	4	1.0	0.017	0.7	93	47.9

*Single high-shear stage

8.4.1.6 Comparative Evaluation of High-Shear Configuration

Runs 3 to 8 are conducted with one high-shear mixer and Runs 30 and 31 have two high-shear mixers installed in series. Both modes of operation have similar testing condition. The testing conditions and the results for these runs are summarized in Table 8-7. For comparative evaluation of these two modes of operation, the relevant data are summarized in Table 8-14.

Table 8-14

COMPARATIVE EVALUATION OF HIGH-SHEAR CONFIGURATION

Run No.	Set Point	High-Shear Config	Top Size mesh	Diesel %	Frother %	RT min	BTU Rec %	PSR %
30	1a	S	28	1.01	0.000	4.5	76	60.27
7	2a	1	28	0.96	0.000	4.0	52	85.65
30	2a	S	28	1.03	0.005	4.5	90	45.21
5	1	1	28	0.96	0.005	4.0	59	86.88
31	2	S	100	1.06	0.005	4.5	92	55.78
4	4	1	100	1.01	0.005	4.0	77	72.81

S - two high-shear mixers in series
1 - single high-shear mixer

For 28 mesh feed, Run 30, Set Point 1a (two high-shear mixers) has 72% BTU recovery compared to 52% obtained with a single high-shear mixer. For Run 30, PSR is ~60% compared to ~86% for Run 7, Set Point 2a (single high-shear mixer). The results of Run 30, Set Point 2a, and Run 5, Set Point 1, also show similar trend.

For 100 mesh feed, Run 31, Set Point 2 has 92% BTU recovery compared to 77% for Run 4, Set Point 4 and %PSR again shows the opposite trend, i.e. 73% for single high-shear mixer (Run 4) and 56% for two high-shear mixers (Run 31). These results indicate that for similar residence time two high-shear mixers installed in series give higher BTU recovery than a single high-shear mixer and the opposite is true for %PSR. The cumulative effect of comparatively high energy input in the two high-shear mixers and to a certain degree, the short circuiting in the single high-shear mixer may have caused this effect on BTU recovery and %PSR.

8.4.1.7 Mass Balance Analysis

Samples of clean coal product and tailings from flotation cell and second stage of flotation were simultaneously collected at the CPRU-30 Set Point 2a. These were prepared and analysed for residual moisture, ash and total sulfur content. From the recovered dry weight and analysis of each sample, mass balances for coal, combustible matter, ash, and total sulfur were calculated. The mass balance data for these four components are provided in Table 8-15. The final dry weights of the samples of inlet and outlet streams had only trace quantities of diesel and frother, therefore, mass flows of these two components were not included in the mass balance data.

The results of the mass balance analysis in Table 8-15 show satisfactory recoveries for coal mass, coal matter and ash. This confirms that the procedures used in sampling of the feed and products are accurate. For sulfur, being the smallest component in the overall process streams, small discrepancy (95.6% recovery) in the mass balance is within the overall accuracy of the operation.

Table 8-15

UPPER FREEPORT COAL
MASS BALANCE OF CPRU-30 SET POINT 2A

	Streams kg/hr	Material Outlet Streams kg/hr					Mass Recovery wt%
		SSFCC	SSFT	SSFS	FT	FS	
Frother	138×10^{-3}						
Oil	0.026						
Coal	2.561	2.208	0.124	0.016	0.147	0.032	98.67
CM	2.208	2.025	0.079	0.011	0.049	0.012	98.55
Ash	0.353	0.183	0.046	0.005	0.098	0.021	100.00
Sulfur	0.045	0.030	0.004	0.001	0.005	0.003	95.56

$$\text{Mass Recovery, wt \%} = \frac{(SSFCC + SSFT + SSFS) + (FT + FS)}{\text{Feed}} \times 100$$

8.4.2 Kentucky No. 9 Coal

A total of eleven test runs were conducted at two grind sizes of this coal. The overall approach for evaluating the effects of the variables was similar to the one followed for the Upper Freeport coal.

The variables investigated included:

- Effect of diesel dosage
- Effect of frother concentration
- Effect of grind size
- Effect of residence time

Information on the testing conditions and the results for these runs are summarized in Table 8-16. For Runs 13 to 15, the clean coal product samples were collected after the second stage of recovery of microagglomerates (flotation followed by second stage flotation). For the rest of test runs at each set point, clean coal samples were collected after the first stage and the second stage of the recovery process.

Test Runs 13 to 15, 20 to 25, and 28, 29, covered the range of diesel dosage and of frother concentration for evaluating process responses in terms of BTU recovery and pyritic sulfur rejection. Run 28, Set Point 2a was used for mass balance calculations. The process response for each of the variables tested is discussed in the following sections.

Table 8-16
KENTUCKY NO. 9
CPRU DIESEL CASE SUMMARY OF TEST RESULTS (CPRU 13-29 INCLUSIVE)

Run No.	Set Point	Feed Top Size mesh	d_{50} um	2-High-Shears Slurry g/min	2-High-Shears Coal g/min	2-High-Shears Oil %	2-High-Shears RT min	Feed Coal Analysis %A db	Feed Coal Analysis %TS db	Flotation Cell % Coal	Flotation Cell %Froth MIBC	Product Flow g/min	Product %A db	Product %TS db	Yield %	AR %	CMR %	TSR %	PSR %
13	1	100	55	322.28	86.05	0.96	3.4	17.40	3.87	6.0	0.003	55.22	7.9	3.33	64.16	70.87	71.54	49.10	61.64
	2			320.00	85.44	1.14	3.4	17.40	3.87	6.0	0.007	69.01	9.0	3.57	80.75	58.23	88.96	32.19	45.03
	3			325.55	86.92	1.08	3.4	17.40	3.87	6.0	0.010	74.58	10.0	3.69	85.79	50.69	93.48	26.40	38.47
	4			327.79	87.52	1.11	3.4	17.40	3.87	6.0	0.013	80.73	11.4	3.91	92.23	39.57	98.93	17.30	27.16
	5			325.99	87.04	0.96	3.4	17.40	3.87	6.0	0.010	76.99	10.1	3.76	88.51	48.63	96.33	22.70	34.25
14	1	28	115	245.00	75.00	0.93	4.3	16.07	3.66	5.7	0.000	61.84	9.3	3.28	82.33	52.36	88.97	26.22	36.60
	2			239.20	73.34	0.83	2.2	16.07	3.66	6.9	0.000	66.15	9.9	3.29	90.21	44.43	96.84	18.91	29.67
	3			267.70	82.08	0.80	0.7	16.07	3.66	6.2	0.000	55.38	7.7	2.86	67.48	67.67	74.21	47.27	61.95
	4			245.00	75.00	0.76	4.3	16.07	3.66	8.8	0.000	56.06	8.2	3.07	74.15	62.16	81.10	37.80	50.72
	5			239.20	73.34	0.76	2.2	16.07	3.66	8.5	0.000	54.71	8.3	2.96	74.61	61.46	81.52	39.98	54.54
	6			267.70	82.00	0.80	0.7	16.07	3.66	9.2	0.000	59.09	8.6	3.00	68.98	63.09	75.12	43.46	56.15
15	1	100	58	273.00	77.80	1.03	4.3	18.15	3.93	6.0	0.000	55.02	8.4	3.09	71.58	66.87	80.10	43.72	57.33
	2			273.00	77.80	1.04	2.2	18.15	3.93	6.0	0.000	56.84	8.3	3.02	73.95	66.18	82.84	43.18	58.37
	3			273.00	77.80	1.04	0.7	18.15	3.93	6.0	0.000	56.06	6.2	2.69	72.93	75.09	83.58	50.08	69.73
	4			273.00	77.80	1.04	4.3	18.15	3.93	9.0	0.000	59.71	7.8	3.01	77.69	66.61	87.51	40.50	56.85
	5			273.00	77.80	1.04	2.2	18.15	3.93	9.0	0.000	59.49	8.5	3.07	77.39	63.76	86.52	39.54	54.76
	6			273.00	77.80	1.04	0.7	18.15	3.93	9.0	0.000	59.22	7.8	2.85	77.04	66.89	86.78	44.13	62.18
20	1a	28	130	282.29	65.76	1.26	4.4	17.2	3.95	6.0	0.0087	55.61	8.9	3.13	84.49	56.28	92.96	33.05	48.39
	1b			282.29	65.76	1.26	4.4	17.2	3.95	6.0	0.0087	61.33	11.6	3.39	93.27	37.09	99.58	19.95	31.47
	2a			282.29	65.76	1.02	4.4	17.2	3.95	6.0	0.0086	56.77	8.3	3.01	86.34	58.34	95.62	34.21	51.80
	2b			282.29	65.76	1.02	4.4	17.2	3.95	6.0	0.0086	61.25	12.1	3.42	93.15	34.47	98.89	19.35	30.10
	3a			282.29	65.76	1.28	4.4	17.2	3.95	6.0	0.0000	56.98	8.1	3.01	86.65	59.19	96.18	32.65	49.66
	3b			282.29	65.76	1.28	4.4	17.2	3.95	6.0	0.0000	60.83	10.5	3.26	92.51	43.53	99.99	23.65	37.66
	4a			282.29	65.76	1.06	4.4	17.2	3.95	6.0	0.0000	57.25	7.9	2.95	87.07	60.01	96.85	34.97	53.74
	4b			282.29	65.76	1.06	4.4	17.2	3.95	6.0	0.0000	60.36	9.3	3.10	91.79	47.70	99.99	27.96	44.45
21	5a	28	135	281.60	105.8	1.11	1.9	18.0	3.95	7.5	0.0080	88.80	8.9	3.11	85.03	57.96	94.47	33.05	49.04
	5b			281.60	105.8	1.11	1.9	18.0	3.95	7.5	0.0080	94.32	11.5	3.48	90.33	42.29	97.49	20.42	30.82
	6a			281.60	105.8	0.91	1.9	18.0	3.95	7.5	0.0080	75.50	8.5	3.09	72.36	65.86	80.68	43.44	57.45
	6b			281.60	105.8	0.91	1.9	18.0	3.95	7.5	0.0080	89.50	10.9	3.35	85.71	48.16	93.13	27.31	39.18
	7a			281.60	105.8	1.12	1.9	18.0	3.95	7.5	0.0000	75.74	8.2	2.98	72.53	66.96	81.20	45.28	60.66
	7b			281.60	105.8	1.12	1.9	18.0	3.95	7.5	0.0000	91.08	10.7	3.19	87.22	48.15	94.99	29.56	43.82
	8a			281.60	105.8	0.87	1.9	18.0	3.95	7.5	0.0000	74.53	7.1	2.82	71.37	71.85	80.86	49.05	66.42
	8b			281.60	105.8	0.87	1.9	18.0	3.95	7.5	0.0000	87.62	10.1	3.04	83.90	52.92	91.99	35.43	51.35

Table 8-16 (Continued)
KENTUCKY NO. 9
CPRU DIESEL CASE SUMMARY OF TEST RESULTS (CPRU 13-29 INCLUSIVE)

Run No.	Set Point	Feed Top Size mesh	d50 um	2-High-Shears Slurry g/min	2-High-Shears Coal g/min	2-High-Shears Oil %	2-High-Shears RT min	Feed Coal Analysis %A db	Feed Coal Analysis %TS db	Flotation Cell % Coal	Flotation Cell %Froth MIBC	Product Flow g/min	Product %A db	Product %TS db	Yield %	AR %	CMR %	TSR %	PSR %
22	9a	100	55	287.57	83.86	1.23	3.8	18.8	4.44	6.0	0.0080	68.71	8.9	3.07	83.10	63.98	93.34	42.54	59.71
	9b			287.57	83.86	1.23	3.8	18.8	4.44	6.0	0.0080	71.09	11.7	3.39	85.98	44.32	93.50	34.35	47.68
	10a			287.57	83.86	1.01	3.8	18.8	4.44	6.0	0.0080	63.62	8.9	3.08	76.94	63.11	86.42	46.62	62.44
	10b			287.57	83.86	1.01	3.8	18.8	4.44	6.0	0.0080	71.53	12.1	3.48	86.51	46.46	93.65	32.20	44.56
	11a			287.57	83.86	1.22	3.8	18.8	4.44	6.0	0.0000	66.66	8.6	3.14	80.65	68.73	90.78	42.97	59.12
	11b			287.57	83.86	1.22	3.8	18.8	4.44	6.0	0.0000	70.54	11.8	3.48	85.31	49.31	92.66	33.14	45.48
	12a			287.57	83.86	0.99	3.8	18.8	4.44	6.0	0.0000	59.97	8.1	3.02	72.53	61.10	82.09	50.66	66.34
	12b			287.57	83.86	0.99	3.8	18.8	4.44	6.0	0.0000	69.13	11.4	3.33	83.60	46.49	91.22	37.30	50.95
23	13a	100	55	277.0	83.10	1.25	1.9	19.4	4.46	6.0	0.0080	65.62	9.2	3.16	80.00	62.06	90.12	45.75	61.58
	13b			277.0	83.10	1.25	1.9	19.4	4.46	6.0	0.0080	72.13	12.9	3.43	87.45	41.52	95.04	35.27	48.64
	14a			277.0	83.10	1.00	1.9	19.4	4.46	6.0	0.0080	70.49	9.6	3.34	85.94	57.47	96.39	38.41	53.76
	14b			277.0	83.10	1.00	1.9	19.4	4.46	6.0	0.0080	73.72	12.3	3.59	89.89	43.01	97.80	30.75	43.35
	15a			277.0	83.10	1.25	1.9	19.4	4.46	6.0	0.0000	72.67	8.3	3.06	88.60	62.09	100.80	41.82	60.63
	15b			277.0	83.10	1.25	1.9	19.4	4.46	6.0	0.0000	73.62	11.0	3.38	89.76	49.10	99.12	34.89	49.90
	16a			277.0	83.10	1.00	1.9	19.4	4.46	6.0	0.0000	65.92	8.2	3.06	80.37	66.03	91.54	47.22	64.33
	16b			277.0	83.10	1.00	1.9	19.4	4.46	6.0	0.0000	71.66	10.7	3.29	87.37	51.81	96.80	38.69	54.35
24	17a	28	135	277.18	82.52	1.31	3.8	17.93	3.76	6.0	0.0040	71.88	8.9	3.08	87.10	56.77	96.68	28.65	44.60
	17b			277.18	82.52	1.31	3.8	17.93	3.76	6.0	0.0040	74.72	10.8	3.27	90.55	45.46	98.41	21.25	33.63
	18a			277.18	82.52	1.27	3.8	17.93	3.76	6.0	0.0040	72.50	8.8	3.09	87.85	56.88	97.62	27.80	43.81
	18b			277.18	82.52	1.27	3.8	17.93	3.76	6.0	0.0040	73.68	10.9	3.30	89.28	45.72	96.93	21.64	33.33
	19a			277.18	82.52	1.0	3.8	17.93	3.76	6.0	0.0040	61.45	8.9	3.12	74.46	63.04	82.66	38.21	51.35
	19b			277.18	82.52	1.0	3.8	17.93	3.76	6.0	0.0040	73.94	11.2	3.39	89.60	44.03	96.95	19.22	29.39
	20a			277.18	82.52	1.0	3.8	17.93	3.76	9.0	0.0040	69.91	8.7	3.10	84.72	58.89	94.24	30.15	45.51
	20b			277.18	82.52	1.0	3.8	17.93	3.76	9.0	0.0040	73.03	10.7	3.32	88.50	47.19	96.30	21.86	33.28
	21a			277.18	82.52	1.0	3.8	17.93	3.76	9.0	0.0040	67.43	8.5	3.03	81.71	61.26	91.10	34.15	50.05
	21b			277.18	82.52	1.0	3.8	17.93	3.76	9.0	0.0040	72.37	11.1	3.32	87.70	45.71	95.00	22.56	33.62
25	22a	100	62	277.0	82.19	1.29	3.8	19.0	4.30	6.0	0.0040	70.87	9.4	3.30	86.24	57.34	96.46	33.62	48.96
	22b			277.0	82.19	1.29	3.8	19.0	4.30	6.0	0.0040	75.75	12.3	3.54	92.17	40.33	99.79	24.12	36.08
	23a			277.0	82.19	1.29	3.8	19.0	4.30	6.0	0.0000	70.80	9.2	3.27	86.14	58.29	96.56	34.49	50.03
	23b			277.0	82.19	1.29	3.8	19.0	4.30	6.0	0.0000	75.21	12.3	3.57	91.51	40.76	99.08	24.02	35.58
	24a			277.0	82.19	1.06	3.8	19.0	4.30	6.0	0.0040	68.98	8.7	3.17	83.93	61.57	94.60	38.13	54.50
	24b			277.0	82.19	1.06	3.8	19.0	4.30	6.0	0.0040	75.70	12.2	3.51	92.11	40.86	99.84	24.81	37.15

Table 8-16 (Continued)
KENTUCKY NO. 9
CPRU DIESEL CASE SUMMARY OF TEST RESULTS (CPRU 13-29 INCLUSIVE)

Run No.	Set Point	Feed Top Size mesh	d50 um	2-High-Shears Slurry g/min	2-High-Shears Coal g/min	2-High-Shears Oil %	2-High-Shears RT min	Feed Coal Analysis %A db	Feed Coal Analysis %TS db	Flotation Cell % Coal	Flotation Cell %Froth MIBC	Product Flow g/min	Product %A db	Product %TS db	Yield %	AR %	CMR %	TSR %	PSR %
28	1a	28	115	170	50.79	1.08	4.5	18.2	4.0	6	0.0000	37.56	9.2	2.98	73.93	62.63	82.07	44.92	60.23
	1b		115	170	50.79	1.08	4.5	18.2	4.0	6	0.0000	40.08	11.9	3.25	78.91	48.40	84.99	35.88	47.73
	2a		115	170	50.79	1.08	4.5	18.2	4.0	6	0.0050	42.56	9.8	3.11	83.79	54.88	92.40	34.85	50.31
	2b		115	170	50.79	1.08	4.5	18.2	4.0	6	0.0050	45.48	11.5	3.30	89.55	43.42	96.88	26.12	39.17
	3a		115	170	50.79	1.26	4.5	18.2	4.0	6	0.0000	44.59	9.3	2.95	87.80	55.13	97.36	35.24	53.74
	3b		115	170	50.79	1.26	4.5	18.2	4.0	6	0.0000	45.23	11.1	3.16	89.06	45.68	96.79	29.64	44.64
29	1a	100	60	172.4	50.78	1.02	4.5	18.5	4.12	6	0.0000	36.91	8.4	2.89	72.69	66.99	81.70	49.01	65.55
	1b		60	172.4	50.78	1.02	4.5	18.5	4.12	6	0.0000	43.44	10.1	3.15	85.56	53.29	94.38	34.59	50.19
	2a		60	172.4	50.78	1.02	4.5	18.5	4.12	6	0.0050	42.11	9.4	3.11	83.03	57.81	92.30	37.32	53.28
	2b		60	172.4	50.78	1.02	4.5	18.5	4.12	6	0.0050	44.73	11.6	3.61	88.10	44.76	95.56	22.80	32.70
	3a		60	172.4	50.78	1.20	4.5	18.5	4.12	6	0.0000	40.69	8.3	2.93	80.14	64.05	90.17	43.07	60.88
	3b		60	172.4	50.78	1.20	4.5	18.5	4.12	6	0.0000	43.30	9.9	3.15	85.27	54.37	94.27	34.81	50.47

NOTE: "a" - microagglomerates recovered by two stages of flotation
"b" - microagglomerates recovered by one stage of flotation
2-High-shears in series

8.4.2.1 Effect of Diesel Dosage Rate

The results of the test runs relating to the effect of diesel dosages on the agglomeration performance for both grind sizes are summarized in Table 8-17 and presented in Figure 8-12. The process response is compared at various residence times and frother concentrations.

For Run 28, Set Points 3a, 1a at residence time of 4.5 minutes and in the absence of frother, an increase of diesel from 1.08% to 1.26% increases BTU recovery from 82% to 97% and decreases PSR from ~60% to 54%. In the presence of 0.008% frother for Run 20, Set Points 1a, 2a an increase of diesel dosage from 1.02% to 1.26% decreases BTU recovery and PSR from 96% to 93% and from ~52% to 48%, respectively. The presence of frother masks the effect of increased diesel concentration.

Table 8-17

CPRU TEST RUNS WITH KENTUCKY NO. 9 COAL
EFFECT OF DIESEL CONCENTRATION

Run No.	Set Point	Feed Top Size mesh	Feed Top Size d50	Diesel %	MIBC %	RT min	Flot Solids %	Yield %	BTU %	PSR %
20	1a	28	130	1.26	0.0087	4.4	6.0	84.49	93	48.39
20	2a	28	130	1.02	0.0086	4.4	6.0	86.34	96	51.81
21	5a	28	135	1.11	0.0080	1.9	6.0	85.03	95	49.04
21	6a	28	135	0.91	0.0080	1.9	6.0	72.36	81	57.45
28	3a	28	115	1.26	0.000	4.5	6.0	87.80	97	53.74
28	1a	28	115	1.08	0.000	4.5	6.0	83.82	82	60.23
22	9a	100	55	1.23	0.0080	3.8	6.0	83.10	94	59.71
22	10a	100	55	1.01	0.0080	3.8	6.0	76.94	87	62.44
22	11a	100	55	1.22	0.0000	3.8	6.0	80.65	91	59.12
22	12a	100	55	0.99	0.0000	3.8	6.0	72.53	83	66.34
29	3a	100	60	1.20	0.000	4.5	6	80.14	96	60.88
29	1a	100	60	1.02	0.000	4.5	6	72.69	82	65.55
23	15a	100	55	1.25	0.0000	1.9	6.0	88.60	100	60.63
23	16a	100	55	1.00	0.0000	1.9	6.0	80.37	92	64.33

Run 21 has similar testing conditions, except the residence time which is reduced from 4.4 minutes to 1.9 minutes. In the presence of 0.008% frother (Set Points 5a, 6a), an increase of diesel from 0.91% to 1.11% increases BTU recovery from 81% to 95%; at the same time the pyritic sulfur rejection decreases from ~58% to 49%.

For 100 mesh feed, an increase of diesel dosage from ~1.0% to 1.22% (Run 22, Set Points 11a, 12a), and at 3.8 minutes of residence time, increases BTU recovery from 83% to 91% and decreases pyritic sulfur rejection from ~66% to 59%. Similarly, an increase of diesel dosage at the reduced residence time of 1.9 minutes for Run 23, Set Points 15a, 16a, increases BTU recovery to 100% and decreases pyritic sulfur rejection value from 64% to 60%. Run 22, Set Points 11a, 12a, and Run 29, Set Points 3a, 1a, again show that an increase of diesel dosage increases BTU recovery and decreases %PSR.

Figure 8-12 indicates the effect of an increased diesel dosage on BTU recovery and %PSR. For both grind sizes an increase of diesel dosage improves BTU recovery and decreases %PSR.

8.4.2.2 Effect of Frother Concentration

Data related to effect of frother is summarized in Table 8-18 and presented in Figure 8-13.

Table 8-18

CPRU TEST RUNS WITH KENTUCKY NO. 9 COAL
EFFECT OF FROTHER CONCENTRATION

Run No.	Set Point	Feed Top Size mesh	Feed Top Size d50	Diesel %	MIBC %	RT min	Flot Solids %	Yield %	BTU %	PSR %
20	1a	28	130	1.26	0.0087	4.4	6.0	84.49	93	48.39
20	3a	28	130	1.28	0.0000	4.4	6.0	86.65	96	49.66
20	2a	28	130	1.02	0.0086	4.4	6.0	86.34	96	51.80
20	4a	28	130	1.06	0.0000	4.4	6.0	87.07	97	53.74
23	13a	100	55	1.25	0.0080	1.9	6.0	80.00	90	61.58
23	15a	100	55	1.25	0.0000	1.9	6.0	88.60	100	60.63
23	14a	100	55	1.00	0.0080	1.9	6.0	85.94	96	53.76
23	16a	100	55	1.00	0.0000	1.9	6.0	80.37	92	64.33
22	9a	100	55	1.23	0.0080	3.8	6.0	83.10	93	59.71
22	11a	100	55	1.22	0.0000	3.8	6.0	80.65	91	59.12
22	10a	100	55	1.01	0.0080	3.8	6.0	76.94	86	62.44
22	12a	100	55	0.99	0.0000	3.8	6.0	72.53	82	66.34

For 28 mesh feed, 1% diesel and 4.4 minutes of residence time (Run 20 Set Points 1a, 3a and 2a, 4a), an increase of frother from 0 to 0.008% has little effect on BTU recovery and pyrite sulfur rejection. At reduced residence time of 1.9 minutes, an addition of 0.008% frother decreases pyritic sulfur rejection from ~66% to 57%. The effect of frother on %PSR at lower residence time is more predominant compared to that observed for tests conducted at 4.4 minutes residence time.

For 100 mesh feed (Run 22, Set Points 9a, 11a and 10a, 12a), and residence time of 3.8 minutes, an increase of frother concentration from 0 to 0.008%, at 1.22% diesel, has little effect on the BTU recovery and pyritic sulfur rejection. But at 1% diesel (Run 22) BTU recovery increases from 82% to 86% and PSR decreases from ~66% to 62%.

Run 23, Set Points 14a, 16a conducted at 1.9 minutes of residence time shows similar trend; an increase of frother from 0 to 0.008% increases BTU recovery from 92% to 96% and pyritic sulfur rejection goes down from ~64% to 54%.

8.4.2.3 Effect of Grind Size

The effect of grind size at different levels of diesel and residence time is summarized in Table 8-19 and presented in Figure 8-14.

Table 8-19

CPRU TEST RUNS WITH KENTUCKY NO. 9 COAL
EFFECT OF GRIND SIZE

Run No.	Set Point	Feed Top Size mesh	Feed Top Size d50	Diesel %	MIBC %	RT min	Flot Solids %	Yield %	BTU %	PSR %
20	1a	28	130	1.26	0.0087	4.4	6.0	84.49	93	48.39
22	9a	100	55	1.23	0.0080	3.8	6.0	83.10	93	59.71
20	2a	28	130	1.02	0.0086	4.4	6.0	86.34	96	51.80
22	10a	100	55	1.01	0.0080	3.8	6.0	76.94	87	62.44
20	3a	28	130	1.28	0.0000	4.4	6.0	86.65	96	49.66
22	11a	100	55	1.22	0.0000	3.8	6.0	80.65	91	59.12
28	3a	28	115	1.26	0.0000	4.5	6.0	87.80	97	53.74
29	3a	100	60	1.20	0.0000	4.5	6.0	80.14	90	60.88

Reduction of grind size from 28 mesh to 100 mesh for Run 28, Set Point 3a and Run 29, Set Point 3a, with ~1.25 diesel and in the absence of frother shows decrease of %BTU and increase of %PSR. Addition of 0.008% frother in Run 20, Set Point 1a and in Run 22, Set Point 9a, has changed the flotation kinetics. Therefore, %BTU remains similar and PSR improves from 48.39% for 28 mesh top size to 59.71% for 100 mesh feed. For Run 20, Set Point 2a, with ~1% diesel, and 0.008% frother, a reduction of grind size from 28 mesh to 100 mesh decreases BTU recovery from 96% to 87% and increases PSR from 51.8% to 62.44%.

8.4.2.4 Effect of Residence Time

Table 8-20 and Figure 8-15 summarize the results showing the effect of residence time on BTU recovery and pyritic sulfur rejection. For 28 mesh feed (Run 14, Set Points 4, 5 and 6) an increase of residence time from 0.7 minutes to 2.2 minutes improves BTU recovery from 75% to 82%, while %PSR remains almost unchanged. Further increase of residence time has no effect on %BTU recovery, but reduces PSR from ~55% to 51%. These results indicate that for these given testing conditions, optimum residence time for 28 mesh is ~2.2 minutes.

For 100 mesh feed, at ~1% diesel and in the absence of frother (Run 15, Set Point 1, Run 22, Set Point 10a, Run 23, Set Point 16a and Run 15, Set Point 3) an increase of residence time from 0.7 minutes to 1.9 minutes increases BTU recovery from 83% to 92% and decreases PSR from ~70% to 64%. Further increase of residence time to 3.8 minutes decreases both BTU recovery and %PSR. It is possible that extensive agitation for a prolonged period of time exposes new surfaces which are not covered with oil and this causes a decrease of %BTU and %PSR. It appears that optimum residence time for 100 mesh grind size for these testing conditions is also ~2 minutes. Run 22, Set Point 9a and Run 23, Set Point 13a both are carried out with ~1.25% diesel and 0.008% frother. The change of residence time from 1.9 minutes to 3.8 minutes has little effect on the BTU recovery and on %PSR. For the higher diesel dosage and in the presence of frother, the effect of residence time on process performance becomes obscure.

Table 8-20

CPRU TEST RUNS WITH KENTUCKY NO. 9 COAL
EFFECT OF RESIDENCE TIME

Run No.	Set Point	Feed Top Size mesh	Feed Top Size d50	Diesel %	MIBC %	RT min	Flot Solids %	Yield %	BTU %	PSR %
14	4	28	115	0.76	0.0000	4.3	8.8	82.33	81	50.42
14	5	28	115	0.76	0.0000	2.2	8.5	90.21	82	54.54
14	6	28	115	0.80	0.0000	0.7	9.2	67.48	75	56.14
15	1	100	58	1.03	0.0000	4.3	6.0	71.58	80	57.63
22	10a	100	55	1.01	0.0000	3.8	6.0	76.94	86	62.44
23	16a	100	55	1.00	0.0000	1.9	6.0	80.37	92	64.33
15	3	100	58	1.04	0.0000	0.7	6.0	72.93	83	69.73
22	9a	100	55	1.23	0.0080	3.8	6.0	83.10	93	59.71
23	13a	100	55	1.25	0.0080	1.9	6.0	80.00	90	61.58

8.4.2.5 Mass Balance Analysis

Samples of clean coal product and tailings from flotation cell and second stage flotation unit were simultaneously collected at CPRU-28 Set Point 2a. To calculate mass balances for the four components the procedure followed was similar to that described in Section 8.4.1.7. The mass balance data summarized in Table 8-21 show satisfactory recoveries for coal mass, coal matter, ash and sulfur.

Table 8-21

KENTUCKY NO. 9 COAL
MASS BALANCE OF CPRU-28 SET POINT 2a

	Streams kg/hr	Material Outlet Streams kg/hr SSFCC	SSFT	SSFS	FT	FS	Mass Recovery wt%
Frother	156×10^{-3}						
Oil	0.033						
Coal	3.047	2.554	0.133	0.029	0.219	0.092	99.33
CM	2.493	2.303	0.070	0.013	0.050	0.020	98.52
Ash	0.555	0.250	0.063	0.015	0.169	0.071	102.34
Sulfur	0.122	0.079	0.010	0.003	0.014	0.013	97.54

$$\text{Mass Recovery, wt \%} = \frac{(SSFCC + SSFT + SSFS) + (FT + FS)}{Feed} \times 100$$

8.4.3 Pittsburgh No. 8 Coal

The overall approach for evaluating the effects of process variables on process response for this coal was similar to that followed for the Upper Freeport and Kentucky No. 9 coal. It should be pointed out that the results for BTU recovery and PSR for Pittsburgh No. 8 coal are presented on a precleaned basis (Tables 8-22 to 8-26). The variables investigated included:

- Effect of diesel dosage
- Effect of frother concentration
- Effect of particle size

Two runs, No. 26 and No. 27, carried out with two grind sizes, had a total of twelve set points. At each set point, two clean coal product samples, one after the first stage of recovery (flotation cell) and the second after the second stage of recovery were collected for evaluating process performance. For Run 26, at Set Point 2a, along with the clean coal products, samples of tailings from the flotation cell and from the second stage flotation unit were simultaneously recovered for the mass balance calculations. The testing conditions and the results of the Runs 26 and 27 are summarized in Table 8-22. The effects of these three variables on the process performance are summarized in the following sections.

Table 8-22

PITTSBURGH NO. 8 COAL
CPRU DIESEL CASE SUMMARY OF TEST RESULTS (CPRU 26 - 27 INCLUSIVE)

Run No.	Set Point	Feed Top Size mesh	d_{50} um	2-High-Shears Slurry g/min	2-High-Shears Coal g/min	2-High-Shears Oil %	2-High-Shears RT min	Feed Coal Analysis %A db	Feed Coal Analysis %TS db	Flotation Cell % Coal	Flotation Cell %Froth MIBC	Product Flow g/min	Product %A db	Product %TS db	Yield %	AR %	CMR %	TSR %	PSR %
26	1a	28	140	171.26	52.85	1.02	4.5	9.2	3.77	6	0.000	47.90	6.3	3.48	90.63	37.94	93.53	16.34	30.83
	1b		140	171.26	52.85	1.02	4.5	9.2	3.77	6	0.000	48.41	7.5	3.52	91.60	25.32	93.32	14.47	25.91
	2a		140	171.26	52.85	1.04	4.5	9.2	3.77	6	0.005	49.07	6.9	3.60	92.76	30.43	95.11	11.43	21.02
	2b		140	171.26	52.85	1.04	4.5	9.2	3.77	6	0.005	51.70	7.8	3.65	97.92	16.98	99.43	4.35	9.22
	3a		140	171.26	52.85	1.04	4.5	9.2	3.77	6	0.010	48.89	6.7	3.55	92.50	32.64	95.04	12.90	24.57
	3b		140	171.26	52.85	1.04	4.5	9.2	3.77	6	0.010	51.23	7.3	3.72	96.93	23.09	98.96	4.35	9.22
	4a		140	171.26	52.85	1.21	4.5	9.2	3.77	6	0.000	50.32	6.4	3.52	95.22	33.76	98.15	10.59	23.43
	4b		140	171.26	52.85	1.21	4.5	9.2	3.77	6	0.000	50.36	7.4	3.66	95.29	23.35	97.18	7.49	14.35
	5a		140	171.26	52.85	1.17	4.5	9.2	3.77	6	0.005	50.00	6.8	3.61	94.60	30.08	97.10	9.41	18.98
	5b		140	171.26	52.85	1.17	4.5	9.2	3.77	6	0.005	51.38	8.1	3.67	95.66	15.78	96.82	6.88	12.30
	6a		140	171.26	52.85	1.23	4.5	9.2	3.77	6	0.010	47.99	6.9	3.62	90.80	31.90	93.10	12.81	21.49
	6b		140	171.26	52.85	1.23	4.5	9.2	3.77	6	0.010	51.28	7.5	3.60	97.03	20.90	98.84	7.35	16.44
27	1a	100	70	169.22	48.69	1.03	4.5	10.3	3.95	6	0.000	41.94	6.3	3.39	86.19	47.28	90.03	26.03	46.55
	1b		70	169.22	48.69	1.03	4.5	10.3	3.95	6	0.000	45.99	8.5	3.63	94.45	22.05	96.35	13.20	25.40
	2b		70	169.22	48.69	1.01	4.5	10.3	3.95	6	0.005	41.32	6.5	3.44	84.87	46.44	88.46	26.09	44.68
	2b		70	169.22	48.69	1.01	4.5	10.3	3.95	6	0.005	46.05	8.0	3.77	94.60	26.52	97.03	9.71	18.31
	3a		70	169.22	48.69	1.03	4.5	10.3	3.95	6	0.010	43.84	7.2	3.51	90.05	37.05	93.16	19.98	36.77
	3b		70	169.22	48.69	1.03	4.5	10.3	3.95	6	0.010	46.09	8.5	3.74	94.66	21.88	96.56	10.37	19.23
	4a		70	169.22	48.69	1.25	4.5	10.3	3.95	6	0.000	41.14	6.6	3.58	84.50	45.86	87.98	23.42	37.98
	4b		70	169.22	48.69	1.25	4.5	10.3	3.95	6	0.000	45.12	8.0	3.59	92.57	28.10	94.94	15.87	29.68
5a		70	169.22	48.69	1.25	4.5	10.3	3.95	6	0.005	43.02	6.7	3.51	86.98	43.42	90.47	22.71	39.55	
	5b		70	169.22	48.69	1.25	4.5	10.3	3.95	6	0.005	45.10	7.9	3.67	92.63	28.95	95.11	13.94	25.49
	6a		70	169.22	48.69	1.25	4.5	10.3	3.95	6	0.010	41.64	6.7	3.40	85.53	44.36	88.96	26.38	45.98
	6b		70	169.22	48.69	1.25	4.5	10.3	3.95	6	0.010	45.60	8.0	3.75	93.66	27.25	96.06	11.08	20.21

NOTE: "a" - microagglomerates recovered by two stages of flotation
"b" - microagglomerates recovered by one stage of flotation
2-High-shears in series

8.4.3.1 Effect of Diesel Dosage

To evaluate the effect of the diesel dosage the related data from Table 8-22 is further regrouped in Table 8-23 and presented in Figure 8-16.

Table 8-23

CPRU TEST RUNS WITH PITTSBURGH NO. 8 COAL
EFFECT OF DIESEL CONCENTRATION

Run No.	Set Point	Feed Top Size mesh	Feed Top Size d50	Diesel %	MIBC %	RT min	Flot Solids %	Yield %	BTU %	PSR %
26	1a	28	140	1.02	0.000	4.5	6	90.63	94	30.83
26	4a	28	140	1.21	0.000	4.5	6	95.22	98	23.43
26	2a	28	140	1.04	0.005	4.5	6	92.76	95	21.02
26	5a	28	140	1.17	0.005	4.5	6	94.60	97	18.98
26	3a	28	140	1.04	0.010	4.5	6	92.50	95	24.57
26	6a	28	140	1.23	0.010	4.5	6	90.80	93	21.49
27	1a	100	70	1.03	0.000	4.5	6	86.19	90	46.55
27	4a	100	70	1.25	0.000	4.5	6	84.50	87	37.98

For the 28 mesh grind size (Run 26, Set Points 1a, 4a) it is observed that an increase of diesel dosage from 1.02% to 1.21% increases BTU recovery from 94% to 98% and decreases PSR from ~31% to 24%. In the presence of 0.005% to 0.01% of frother the effect of higher diesel dosage (Run 26, Set Points 2a, 5a, 3a, 6a) on the response parameters decreases. For Run 26, Set Points 3a, 6a, increased diesel dosage from 1.04% to 1.23% in the presence of 0.01% frother, decreases BTU recovery from 95% to 93% and decreases PSR from ~25% to 22%.

For 100 mesh grind size, an increase of diesel from 1.03% to 1.25 (Run 27, Set Points 1a, 4a) has little effect on the BTU recovery but PSR decreases from ~47% to 38%.

The results indicate that in general, increase of diesel dosage increases BTU recovery for both grind sizes and decreases %PSR. The high frother concentration (0.01%) masks the effect of increased diesel dosage.

8.4.3.2 Effect of Frother

The data relating to the effect of frother addition on process response is summarized in Table 8-24 and presented in Figure 8-17.

Table 8-24

CPRU TEST RUNS WITH PITTSBURGH NO. 8 COAL
EFFECT OF FROTHER CONCENTRATION

Run No.	Set Point	Feed Top Size mesh	Feed Top Size d50	Diesel %	MIBC %	RT min	Flot Solids %	Yield %	BTU %	PSR %
26	1a	28	140	1.02	0.000	4.5	6	90.63	94	30.83
26	2a	28	140	1.04	0.005	4.5	6	92.76	95	21.02
26	3a	28	140	1.04	0.010	4.5	6	92.56	95	24.57
27	1a	100	70	1.03	0.000	4.5	6	86.19	90	46.55
27	2a	100	70	1.01	0.005	4.5	6	84.87	89	44.68
27	3a	100	70	1.03	0.010	4.5	6	90.05	93	36.77

For 28 mesh feed, increased frother dosage from 0 to 0.01% (Run 26, Set Points 1a, 2a and 3a) shows little effect on the BTU recovery. The pyritic sulfur rejection decreases from ~31% (0% frother) to ~25% (0.01% frother).

For 100 mesh grind size (Run 27, Set Points 1a, 2a and 3a) increased frother concentration from 0 to 0.01% again has little effect on the BTU recovery. The pyritic sulfur rejection remains unchanged for up to 0.005% frother addition, and further increase of frother to 0.01% significantly reduces the PSR from ~47% to 37%.

8.4.3.3 Effect of Grind Size

Data relating to the effect of the grind size is summarized in Table 8-25 and presented in Figure 8-18. Comparative evaluation of the data for Runs 26 and 27 indicate that at ~1% diesel and 0 to 0.005% frother, the BTU recovery at 28 mesh feed is higher than at 100 mesh grind size. The pyritic sulfur rejection improves with the reduction of grind size from ~30% to 47%. Similar trend is observed at all other levels of diesel and frother concentrations.

Table 8-25

CPRU TEST RUNS WITH PITTSBURGH NO. 8 COAL
EFFECT OF GRIND SIZE

Run No.	Set Point	Feed Top Size mesh	Feed Top Size d50	Diesel %	MIBC %	RT min	Flot Solids %	Yield %	BTU %	PSR %
26	1a	28	140	1.02	0.000	4.5	6	90.63	94	30.83
27	1a	100	70	1.03	0.000	4.5	6	86.19	90	46.55
26	2a	28	140	1.04	0.005	4.5	6	92.76	95	21.02
27	2a	100	70	1.01	0.005	4.5	6	84.87	89	44.68
26	3a	28	140	1.04	0.010	4.5	6	92.50	95	24.57
27	3a	100	70	1.03	0.010	4.5	6	90.05	93	36.77
26	6a	28	140	1.23	0.010	4.5	6	90.80	93	21.49
27	6b	100	70	1.25	0.010	4.5	6	85.53	89	45.98

8.4.3.4 Mass Balance Analysis

Samples of clean coal product and tailings from flotation cell and second stage flotation unit were simultaneously collected at CPRU-26 Set Point 2a. The procedure followed to calculate mass balances for the four components was similar to that described in Section 8.4.1.7. The mass balance data summarized in Table 8-26 show satisfactory recoveries for coal mass, coal matter, ash and sulfur.

Table 8-26

PITTSBURGH NO. 8 COAL
MASS BALANCE OF CPRU-26 SET POINT 2A

	Streams kg/hr	Material Outlet Streams kg/hr SSFCC	SSFT	SSFS	FT	FS	Mass Recovery wt%
Frother	156×10^{-3}						
Oil	0.033						
Coal	3.171	2.941	0.064	0.028	0.063	0.012	98.01
CM	2.879	2.738	0.036	0.002	0.025	0.005	97.46
Ash	0.292	0.203	0.029	0.006	0.038	0.007	96.92
Sulfur	0.120	0.106	0.004	0.002	0.004	0.001	97.50

$$\text{Mass Recovery, wt \%} = \frac{(SSFCC + SSFT + SSFS) + (FT + FS)}{\text{Feed}} \times 100$$

8.5 Conclusions

The effects of diesel dosage, frother concentration, grind size, solids content in flotation cell and high-shear configuration were studied in the bench scale continuous unit. The competing influences of these variables greatly complicated the interpretation of their effect on the process performance. However, under testing conditions when the influences of the competing variables were minimal, general trends were derived from selected cases of the test runs.

Table 8-27 summarizes the results of the promising operation conditions for all the project coals. The analysis of the results given in the respective sections of this study program leads to the following conclusions.

Table 8-27

PROMISING OPERATING CONDITIONS AND RESULTS

Grind Size	Run No.	Set Point	Diesel %	Frother %	Flot Solids %	RT min	Ash %	TS %	BTU %	PSR %
Upper Freeport										
28 mesh	10	3	0.99	0.010	6.0	1.8	9.1	1.46	90	68.6
	11	3	1.06	0.015	6.0	0.9	8.4	1.28	85	76.8
100 mesh	4	1	1.42	0.005	5.9	4.0	8.4	1.19	94	64.8
	10	3	0.99	0.010	6.0	1.8	9.1	.146	90	68.6
Kentucky No. 9										
28 mesh	20	4a	1.06	0.000	6.0	4.4	7.9	2.95	97	53.7
	21	8a	0.87	0.000	7.5	1.9	7.1	2.82	81	66.4
	24	21a	1.00	0.004	9.0	3.8	8.5	3.03	91	50.1
100 mesh	15	3	1.04	0.000	6.0	0.7	6.2	2.69	84	69.7
	22	9a	1.23	0.008	6.0	3.8	8.9	3.07	93	59.7
	29	3a	1.20	0.000	6.0	4.5	8.3	2.93	90	60.9
	29	1a	1.02	0.000	6.0	4.5	8.4	2.89	82	65.5
Pittsburgh No. 8										
28 mesh	26	1a	1.02	0.000	6.0	4.5	6.3	3.48	94(92)*	30.8(59.1)*
100 mesh	27	1	1.03	0.000	6.0	4.5	6.3	3.39	90(87)*	46.6(68.4)*

*numbers in brackets on ROM basis

Upper Freeport Coal

- Pyritic sulfur rejection and BTU recovery are highly influenced by the diesel dosage for both grind sizes. The increase of diesel dosage above 1% in the presence of 0 to 0.01% frother increases %BTU recovery and simultaneously decreases %PSR, but increase of diesel in the presence of more than 0.01% frother has little effect on BTU recovery.

- The increase of frother concentration at ~1% diesel dosage significantly improves BTU recovery with simultaneous decrease of %PSR, but at higher dosage of diesel, ~1.25%, an increase of frother has less dominant effect on BTU recovery and has little effect on %PSR.

- Change of grind size from 28 to 100 mesh shows increase of BTU recovery and has little effect on %PSR. The effect of grind size was less prominant at high dosages of either diesel or frother.

- Increase of flotation solids increases %BTU and decreases %PSR. Increased frother concentration (0.015%) masks the effect of the flotation solids content on the process performance.

- It is observed that shorter residence time in high-shear gives better process selectivity at the expense of BTU recovery. However due to the influence of other variables it is difficult to confirm a definite trend.

For 28 mesh feed the promising testing conditions observed are ~1% diesel, 0.01 to 0.015% frother, 6% flotation solids, and 1 to 2 minutes of residence time. The range for BTU recovery is 85% to 90%, while for PSR it is from 69% to 77%. For 100 mesh feed, 1% to 1.42% diesel, 0.005% to 0.01% frother, 6% flotation solids, and 2 to 4 minutes of residence time are the promising testing conditions. The range for BTU recovery is 90% to 92% and PSR varies from 65% to 69%.

Kentucky No. 9 Coal

- The increase of diesel dosage improves BTU recovery and has less significant effect on %PSR. The presence of frother masks the effect of increased diesel dosage.

- Unlike the Upper Freeport coal, the increase of frother concentration has insignificant effect on BTU recovery and on %PSR.

- Reduction in grind size from 28 mesh to 100 mesh also has an insignificant effect on BTU recovery, but improves PSR by an average of ~10%.

- An increase of residence time improves %BTU and decreases %PSR. At higher residence time, (4.3 minutes) extensive agitation possibly exposes new surfaces which effect BTU recovery and %PSR.

Based on the results, the most promising conditions at 28 mesh grind size are 1.0% to 1.06% diesel, 6% solids, and 1.9 to 3.8 minutes of residence time. The range of BTU recovery is 82% to 91% and PSR varies from 54% to 66%. For 100 mesh feed the promising conditions are 1% to 1.2% diesel, up to 0.004% frother, and 3.8 minutes of residence time. The BTU recovery is about 95% and PSR is in the range 55% to 70%.

Pittsburgh No. 8 Coal

- The increase of diesel concentration above 1% has little effect on BTU recovery but decrease %PSR for both grind sizes.

- Higher frother addition at both grind sizes has little effect on BTU recovery but decreases % PSR.

- Reduction of grind size from 28 mesh to 100 mesh has little effect on BTU recovery but significantly improves %PSR.

For 28 mesh feed, the promising testing conditions for precleaned coal are 1.02 diesel, no frother and 4.5 minutes of residence time. The BTU recovery is 94% and PSR is 31%. For 100 mesh grind size the promising testing conditions are similar to 28 mesh feed. The BTU recovery is 90% and PSR is 47%. Relatively low values for PSR are explained by the fact that Pittsburgh No. 8 is a precleaned coal. Results, recalculated on raw coal basis are presented in Table 8-27 and they are: BTU - 87% and 92%, PSR - 68.4% and 59.1% for 100 and 28 mesh grind respectively.

Figure 8-1

Size Distribution Curve of Upper Freeport Feed Coal Slurry

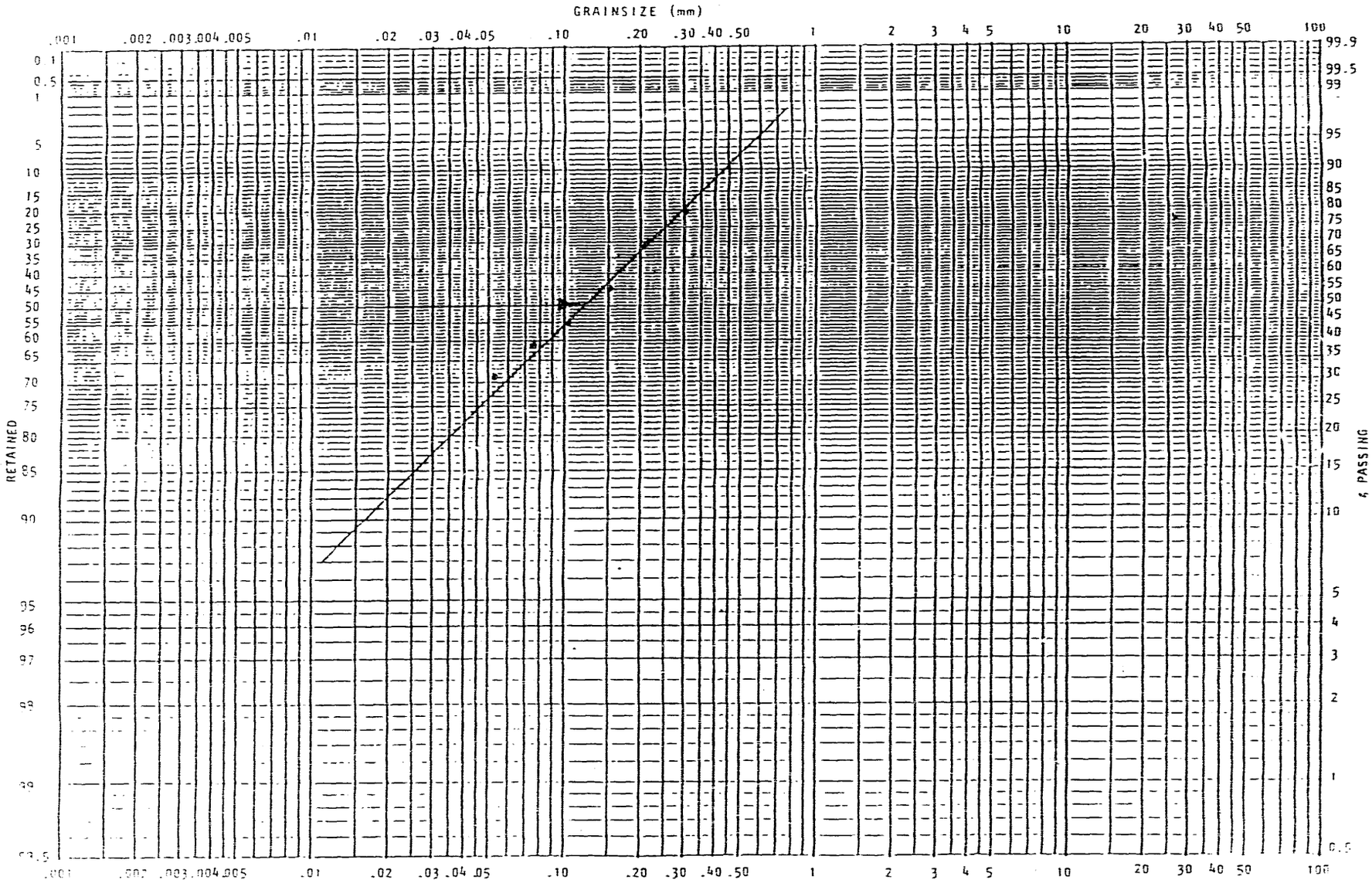
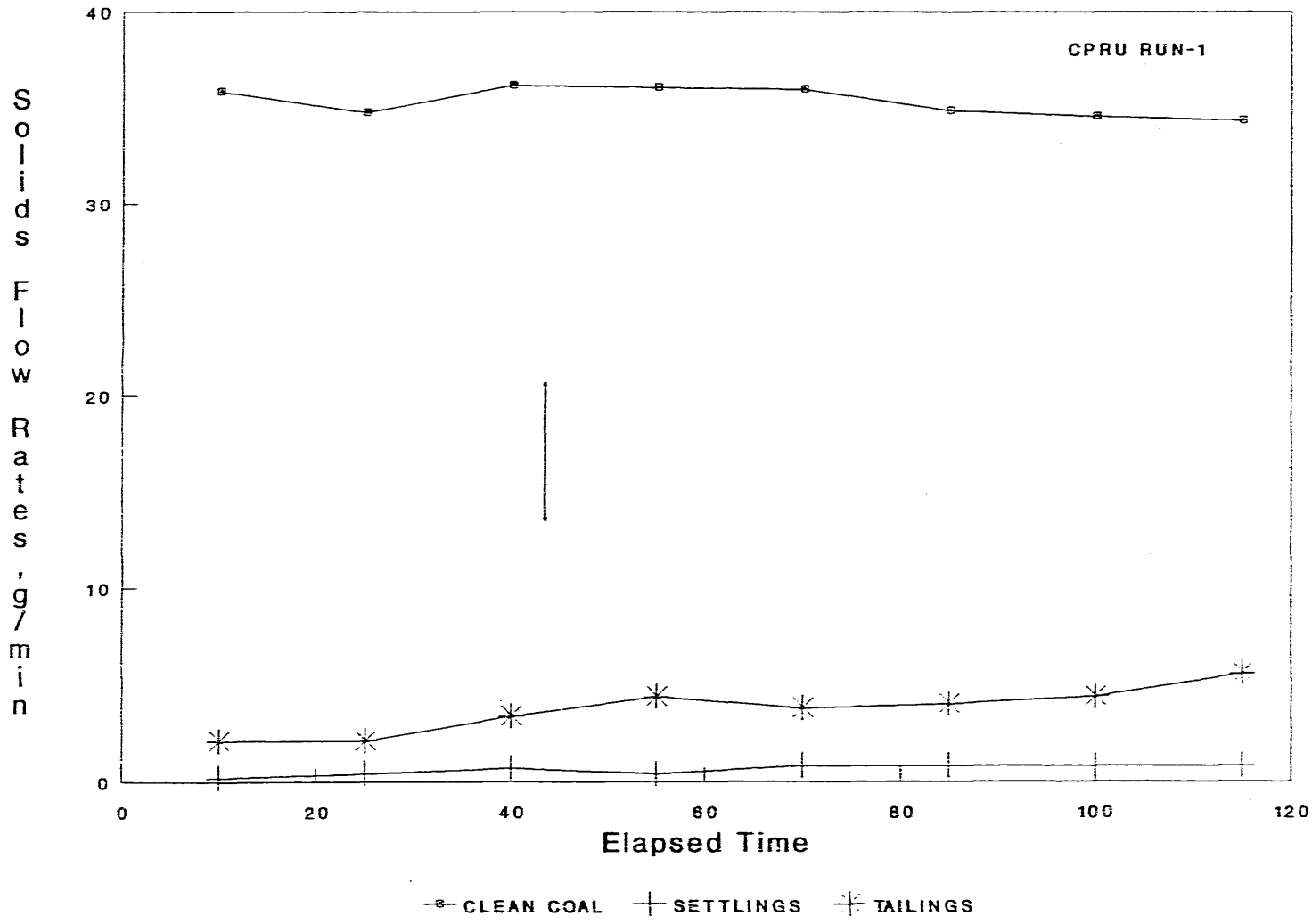


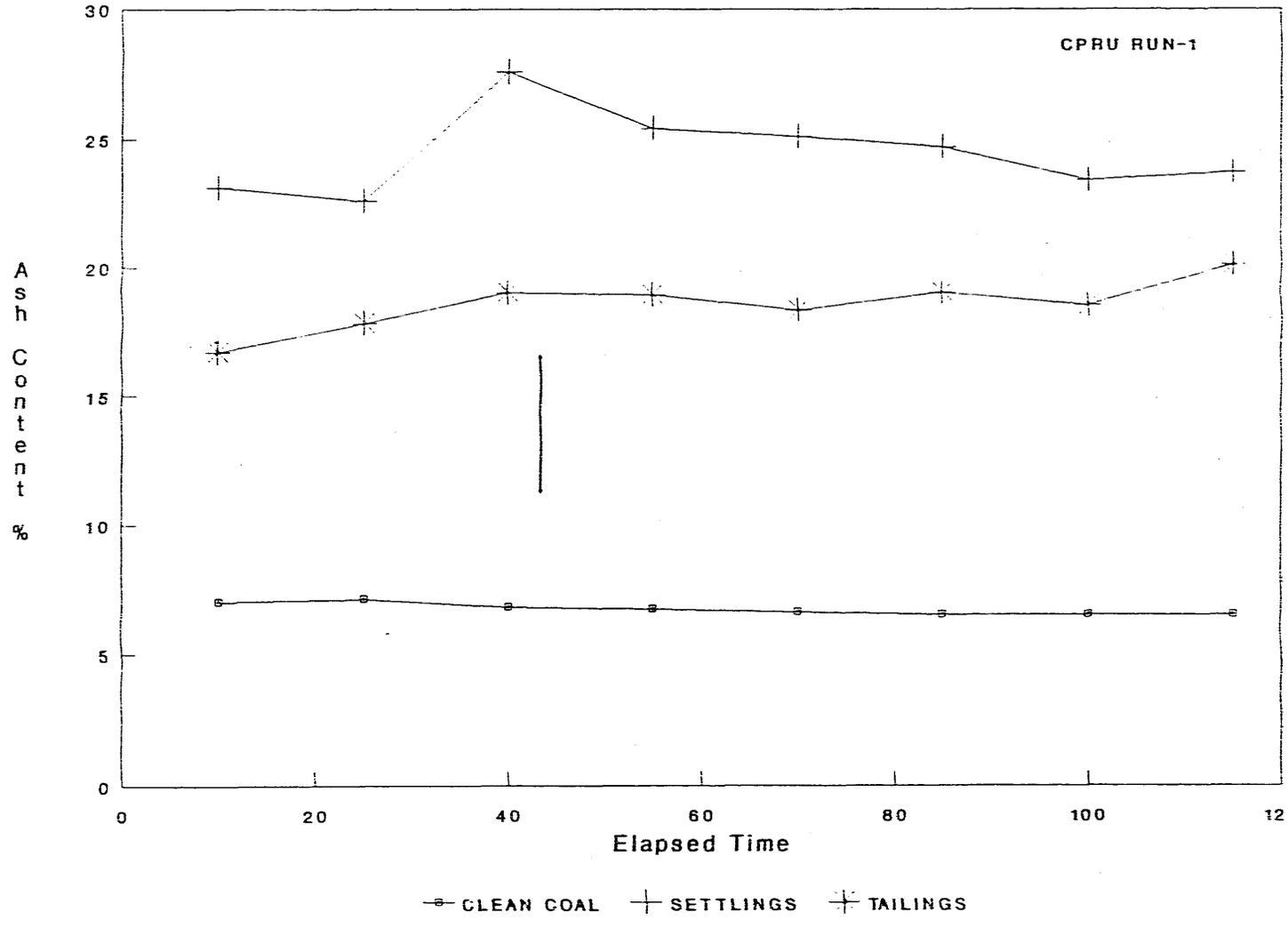
Figure 8-2

Steady State Analysis for Second Stage Flotation Solids Streams



F Y3 E PA3 H

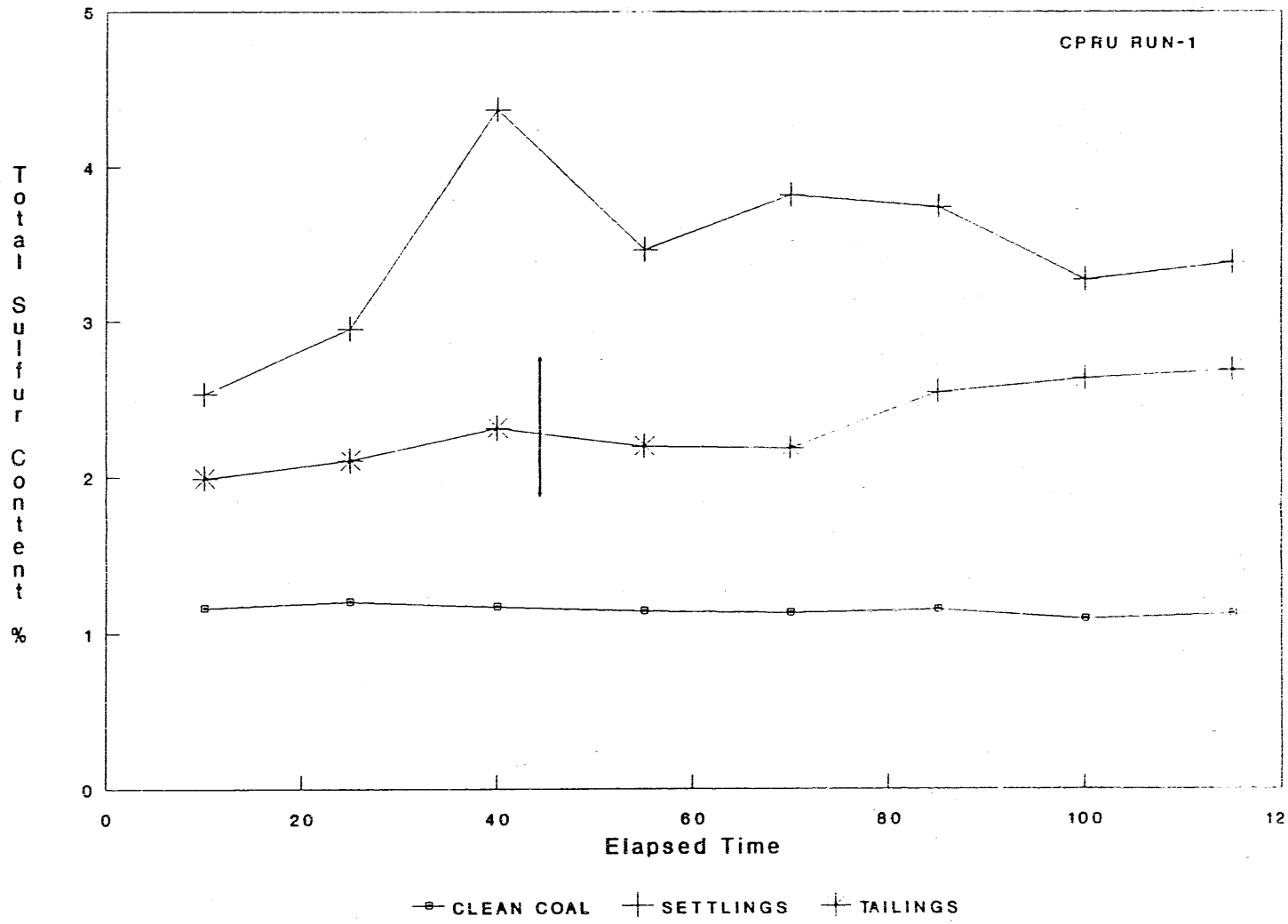
Figure 8-3
Steady State Analysis for Second Stage Flotation Ash Streams



PYSEPASH

Figure 8-4

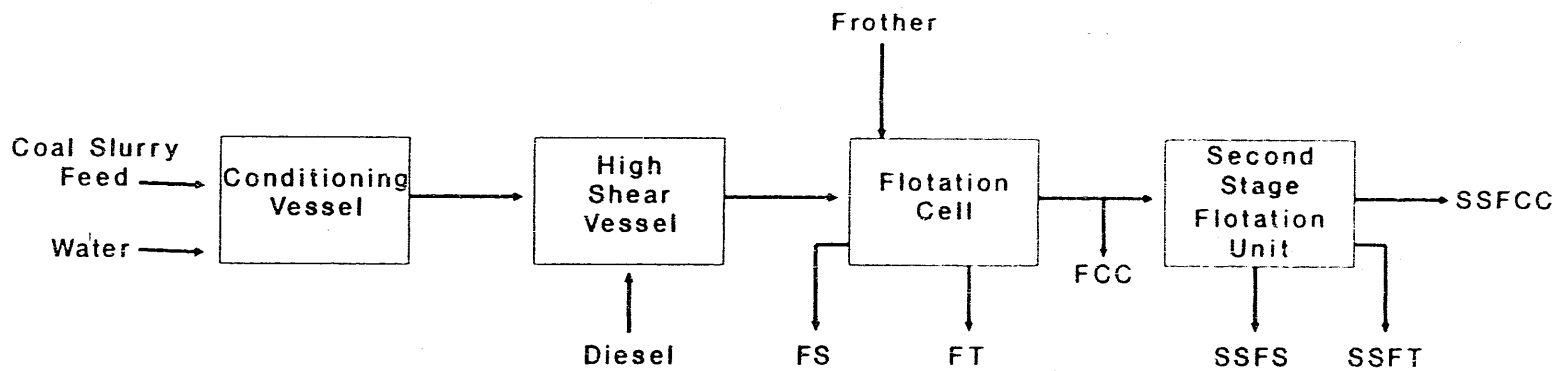
Steady State Analysis for Second Stage Flotation Sulfur Streams



PYSEPTOSUL

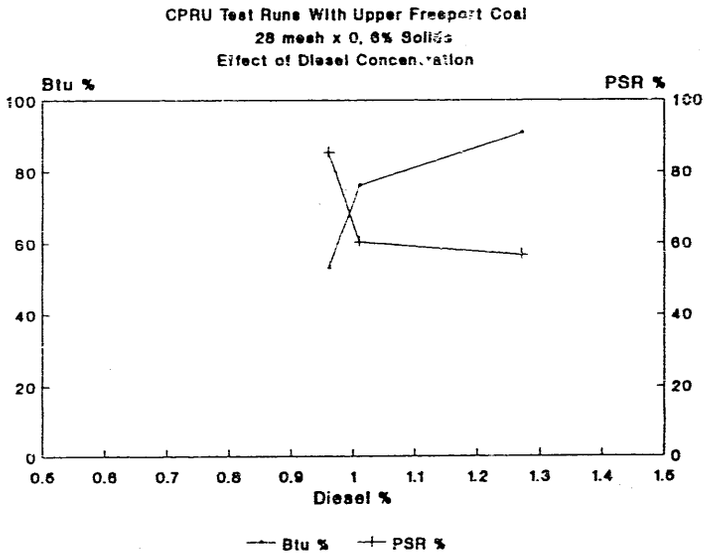
Figure 8-5

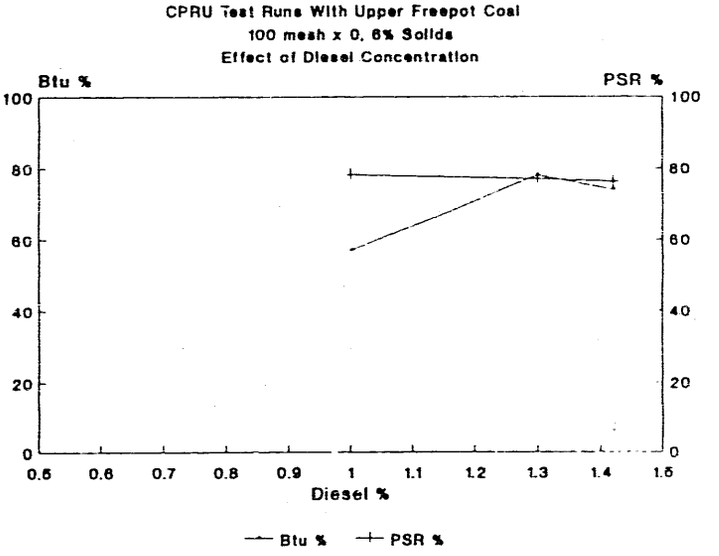
MASS BALANCE OF CPRU



$$\text{Mass Recovery, wt \%} = \frac{(SSFCC + SSFT + SSFS) + (FT + FS)}{\text{Feed}} \times 100$$

Figure 8-6
CPRU Test Runs with Upper Freeport Coal

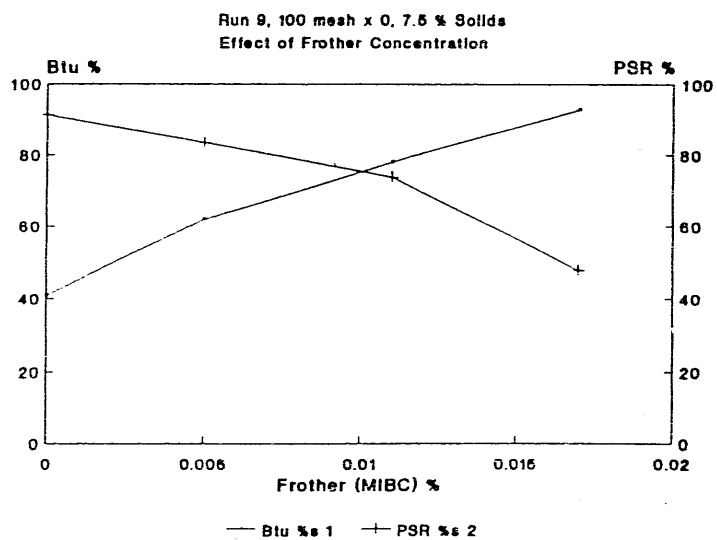




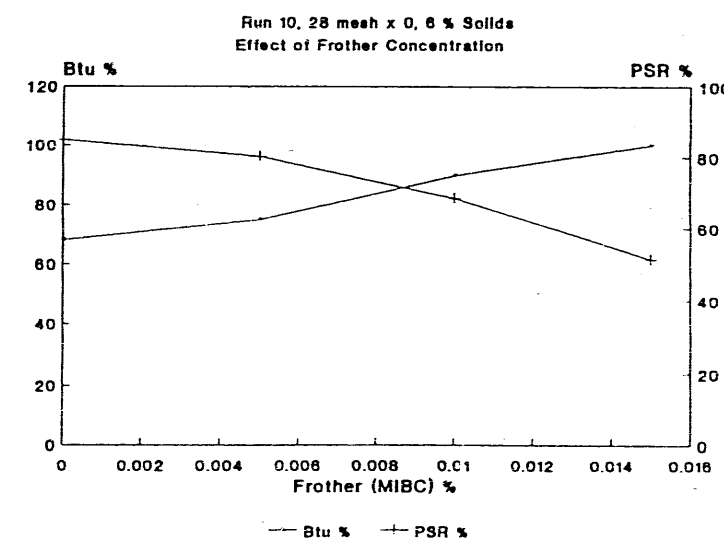
upd2

Figure 8-7

CPRU Test Runs with Upper Freeport Coal



upf100



upf28

Figure 8-8
CPRU Test Runs with Upper Freeport Coal

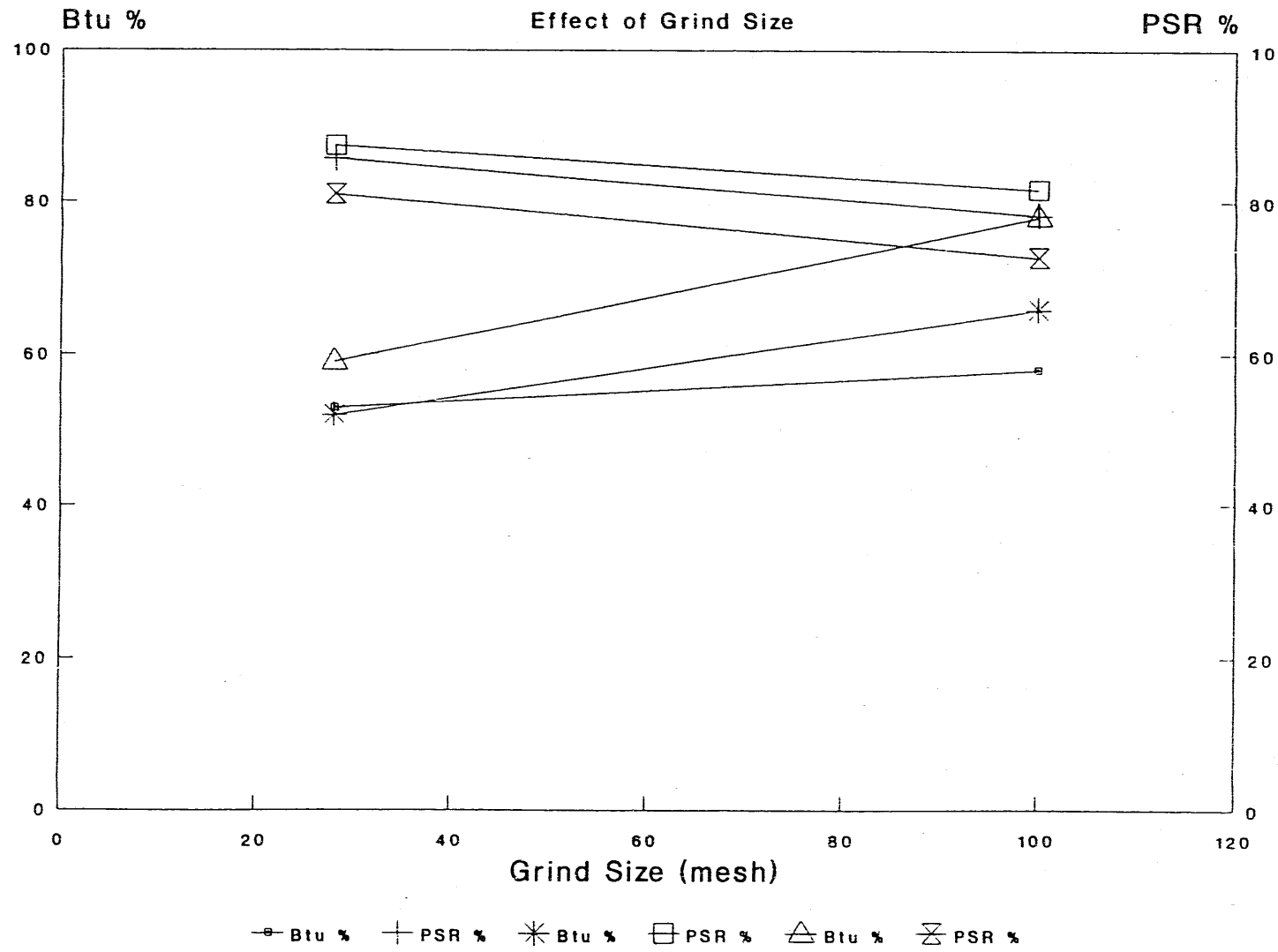


Figure 8-9

CPRU Test Runs with Upper Freeport Coal

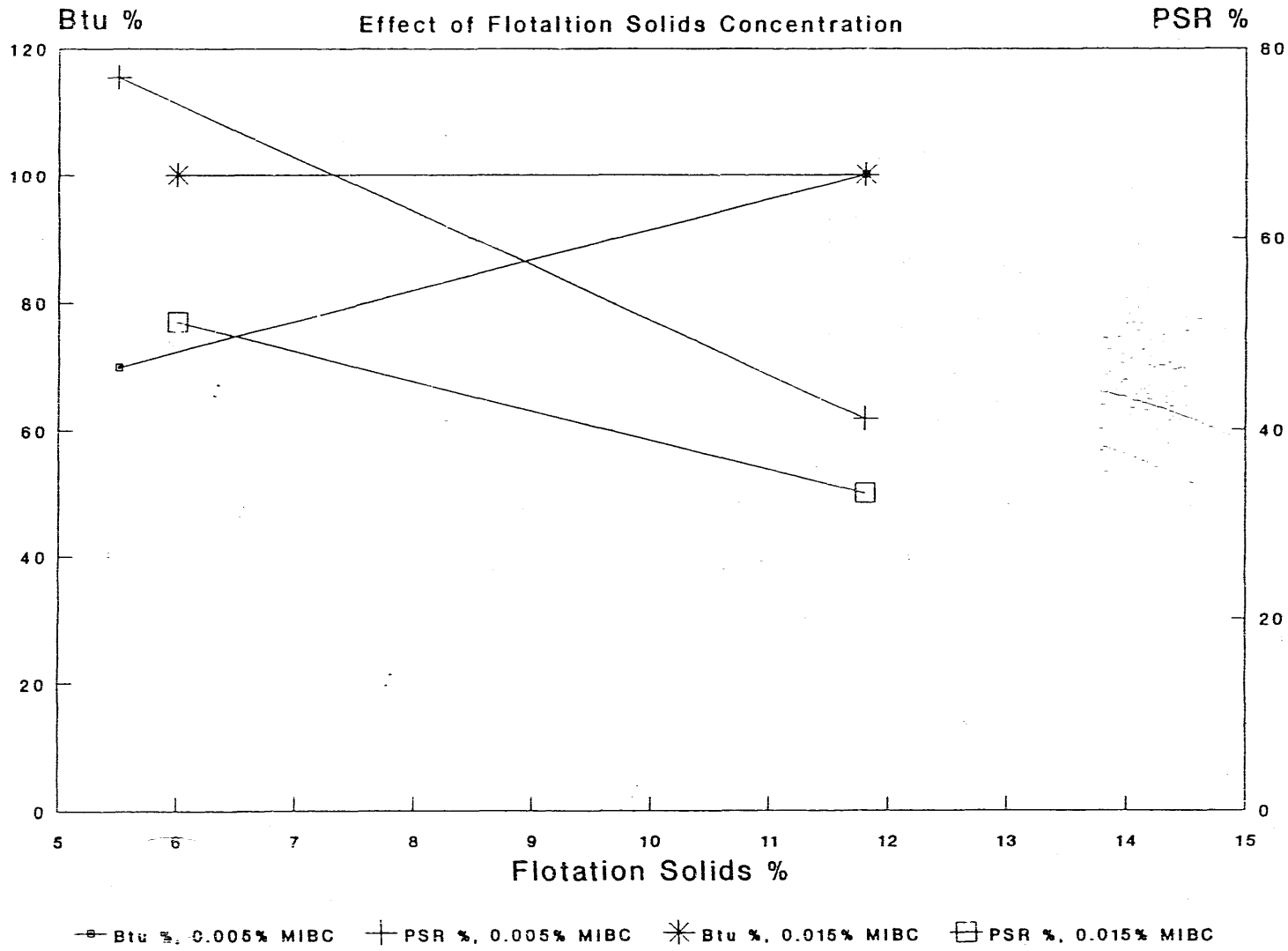


Figure 8-10
CPRU Test Runs with Upper Freeport Coal

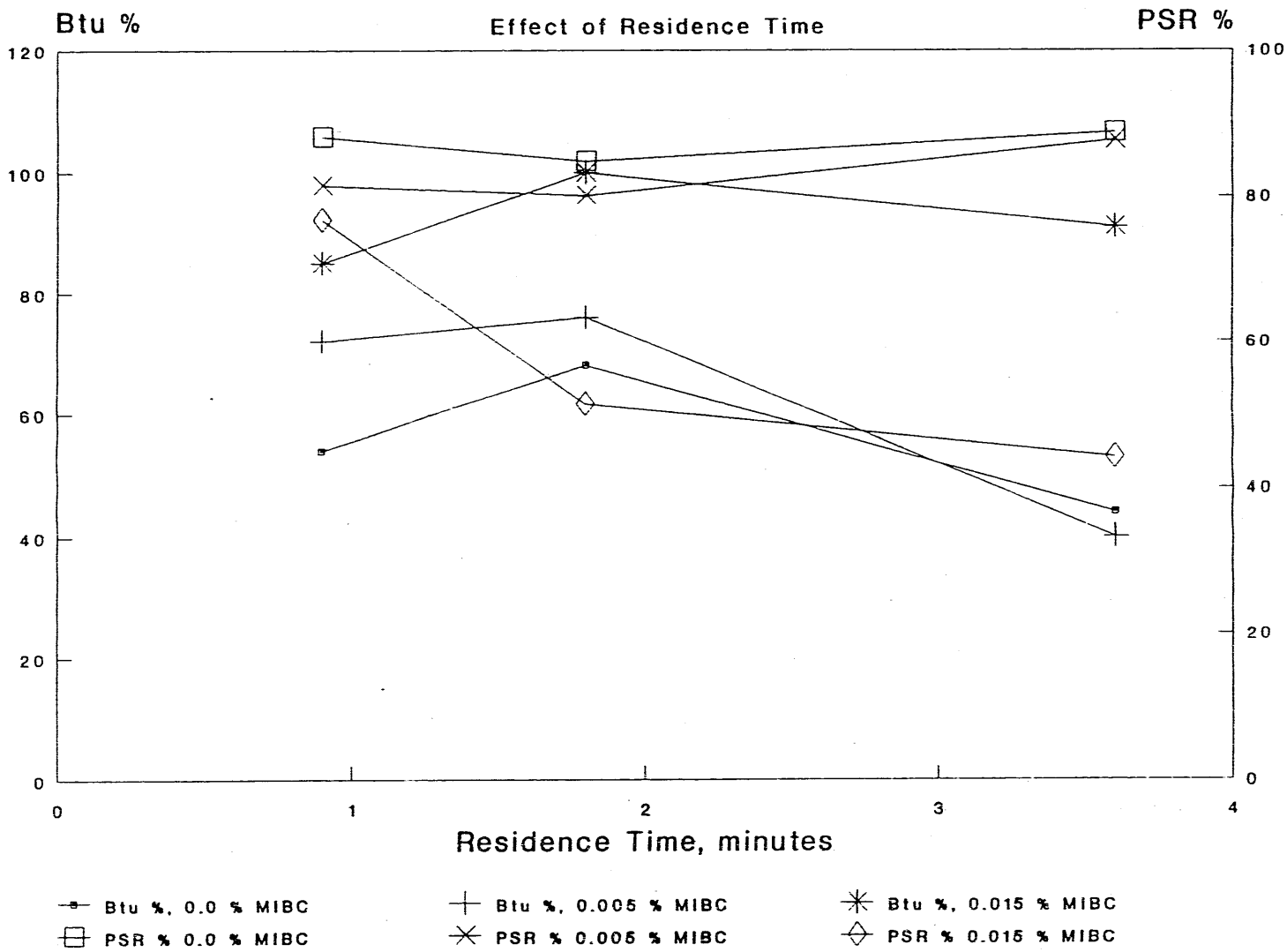
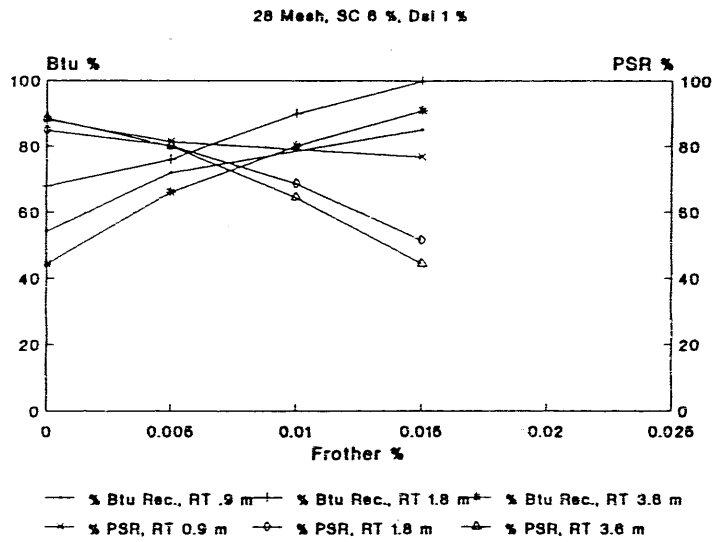
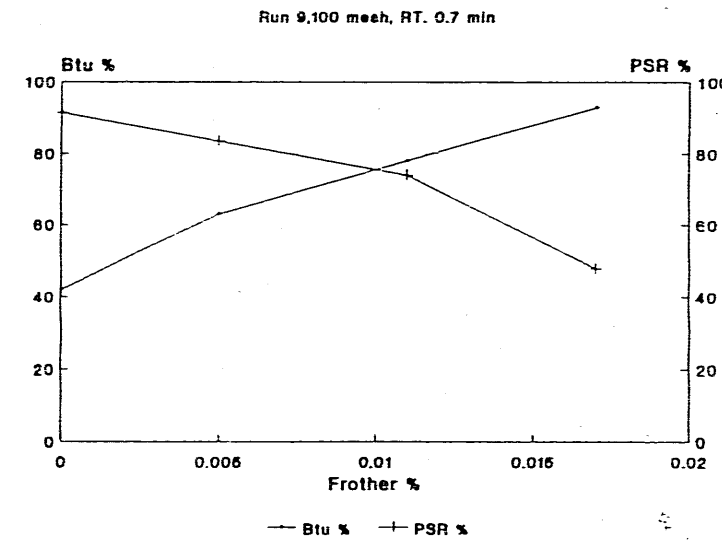


Figure 8-11
Effect of Frother at Different Residence Time
CPRU Test Runs with Upper Freeport Coal



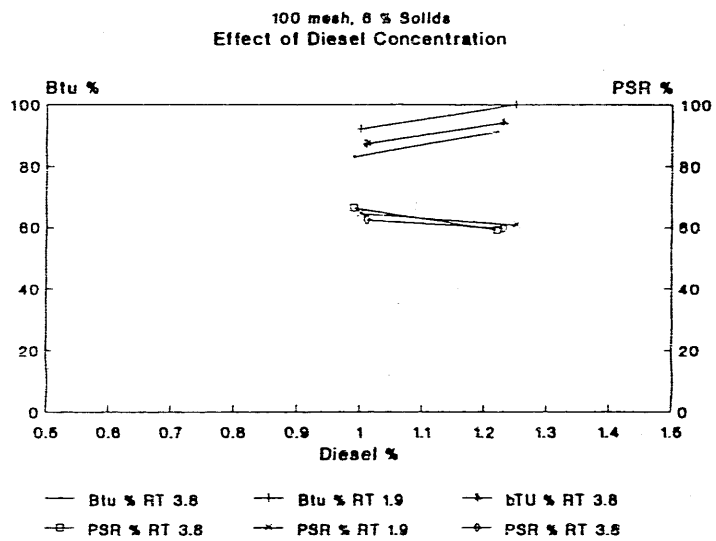
uprf28



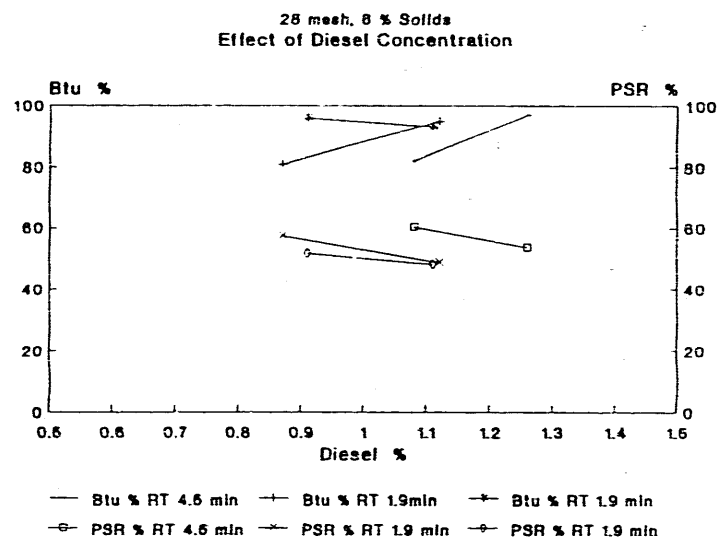
uprtf

Figure 8-12

CPRU Test Runs with Kentucky No. 9 Coal



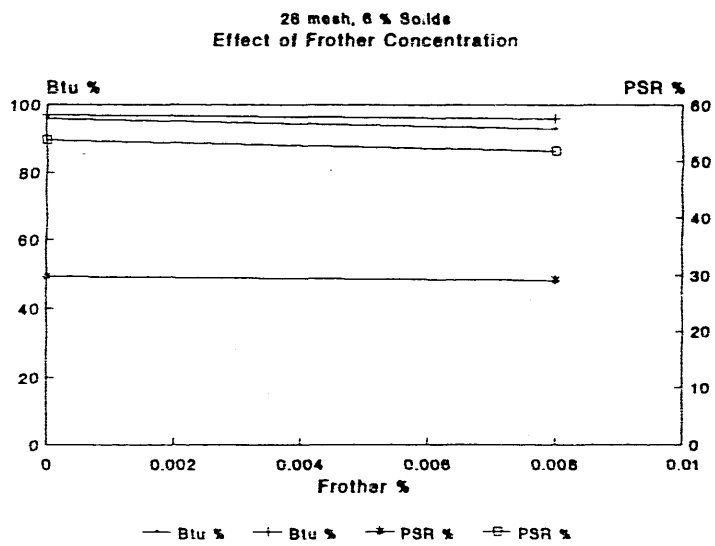
kd100



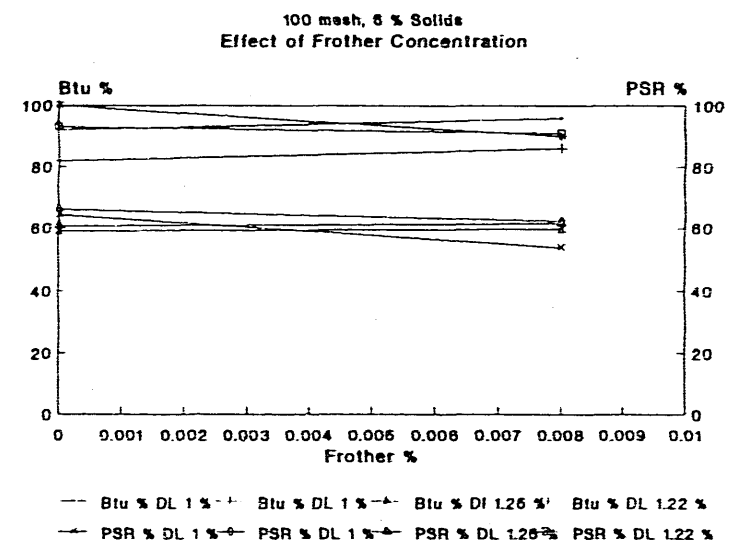
Kd28

Figure 8-13

CPRU Test Runs with Kentucky No. 9 Coal



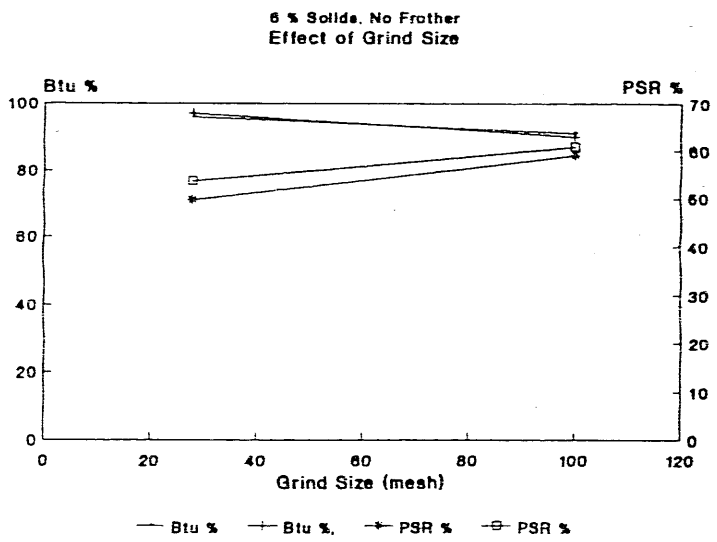
kf28



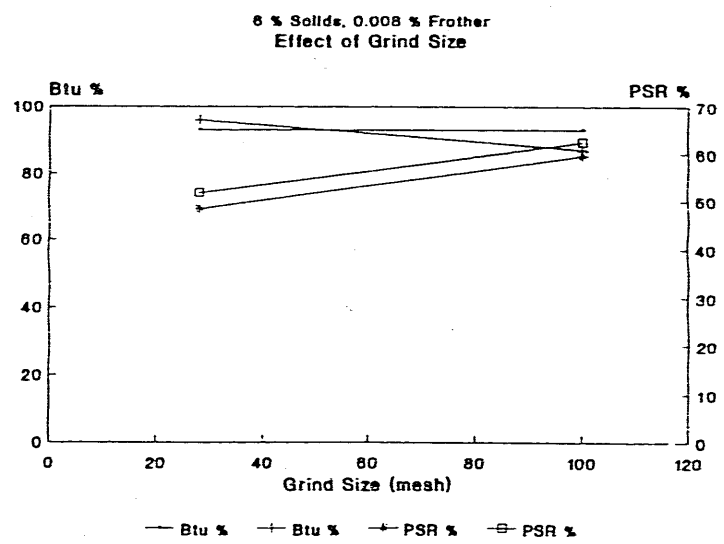
kf100

Figure 8-14

CPRU Test Runs with Kentucky No. 9 Coal



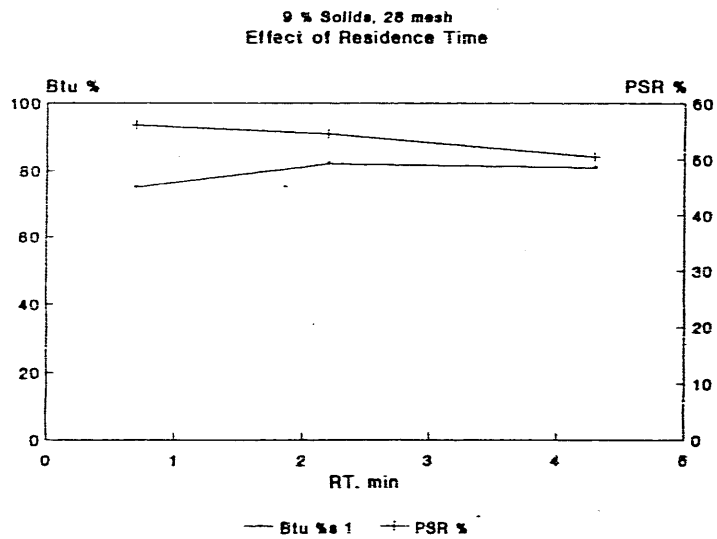
kgs2



kgs2

Figure 8-15

CPRU Test Runs with Kentucky No. 9 Coal



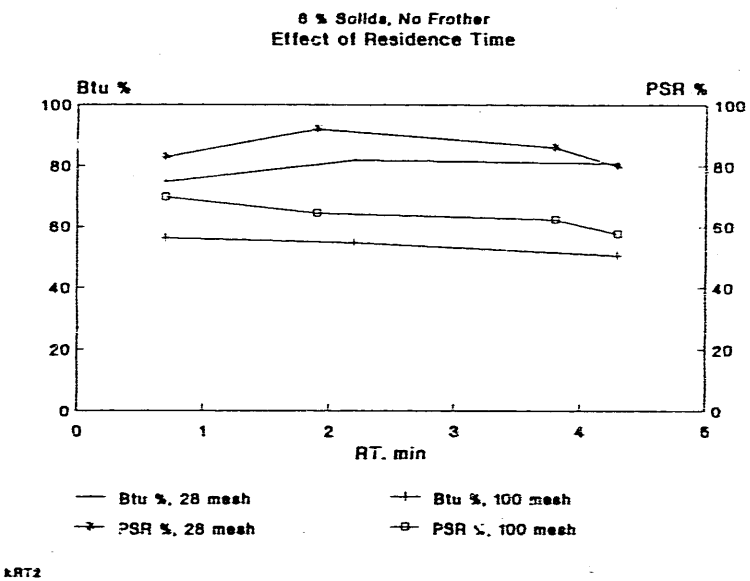
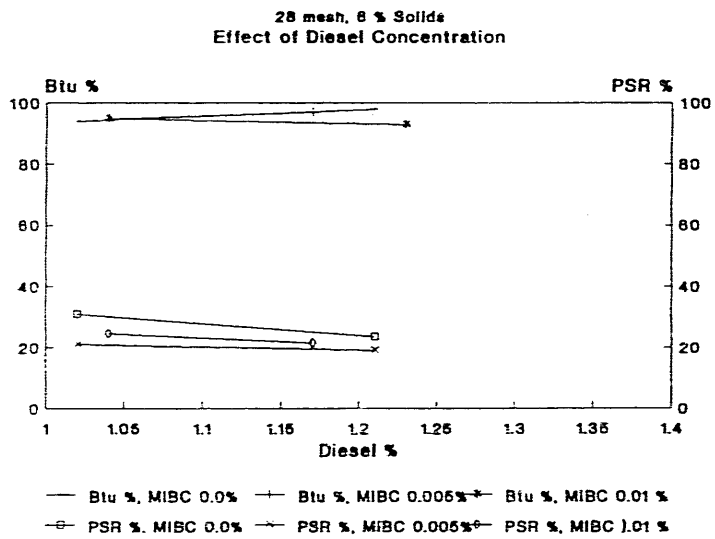
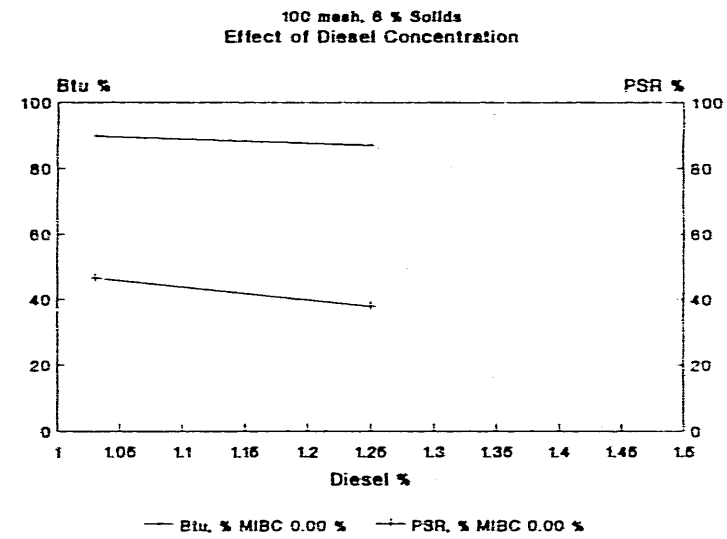


Figure 8-16

CPRU Test Runs with Pittsburgh No. 8 Coal



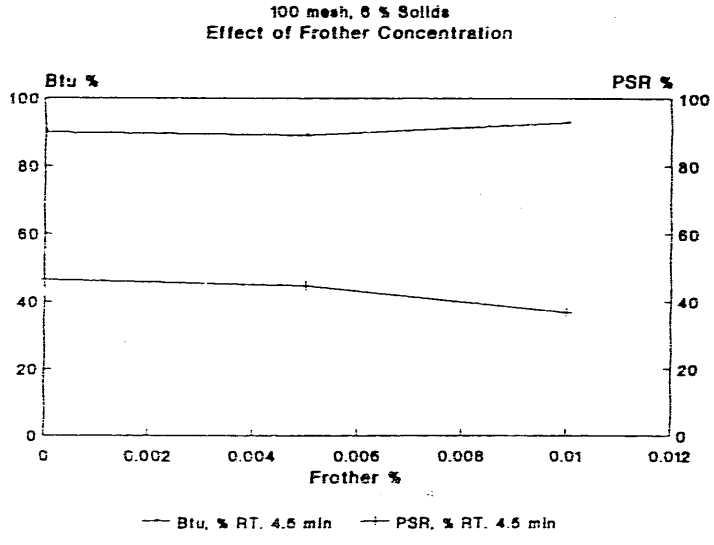
Fd28



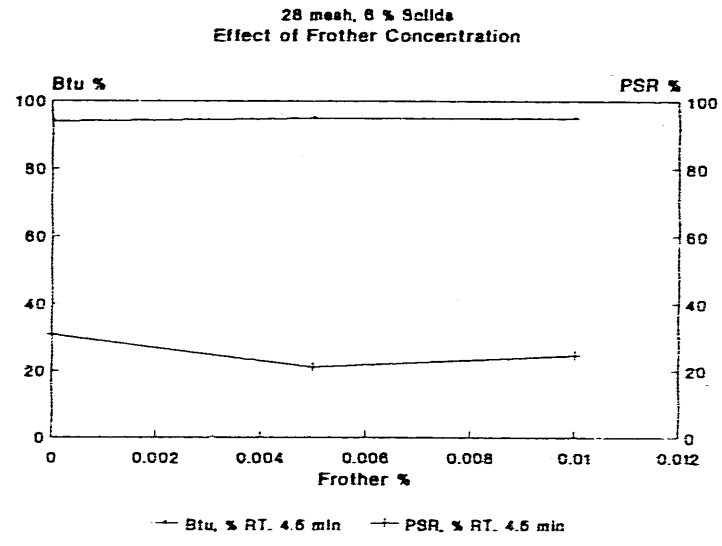
FIT.8

Figure 8-17

CPRU Test Runs with Pittsburgh No. 8 Coal



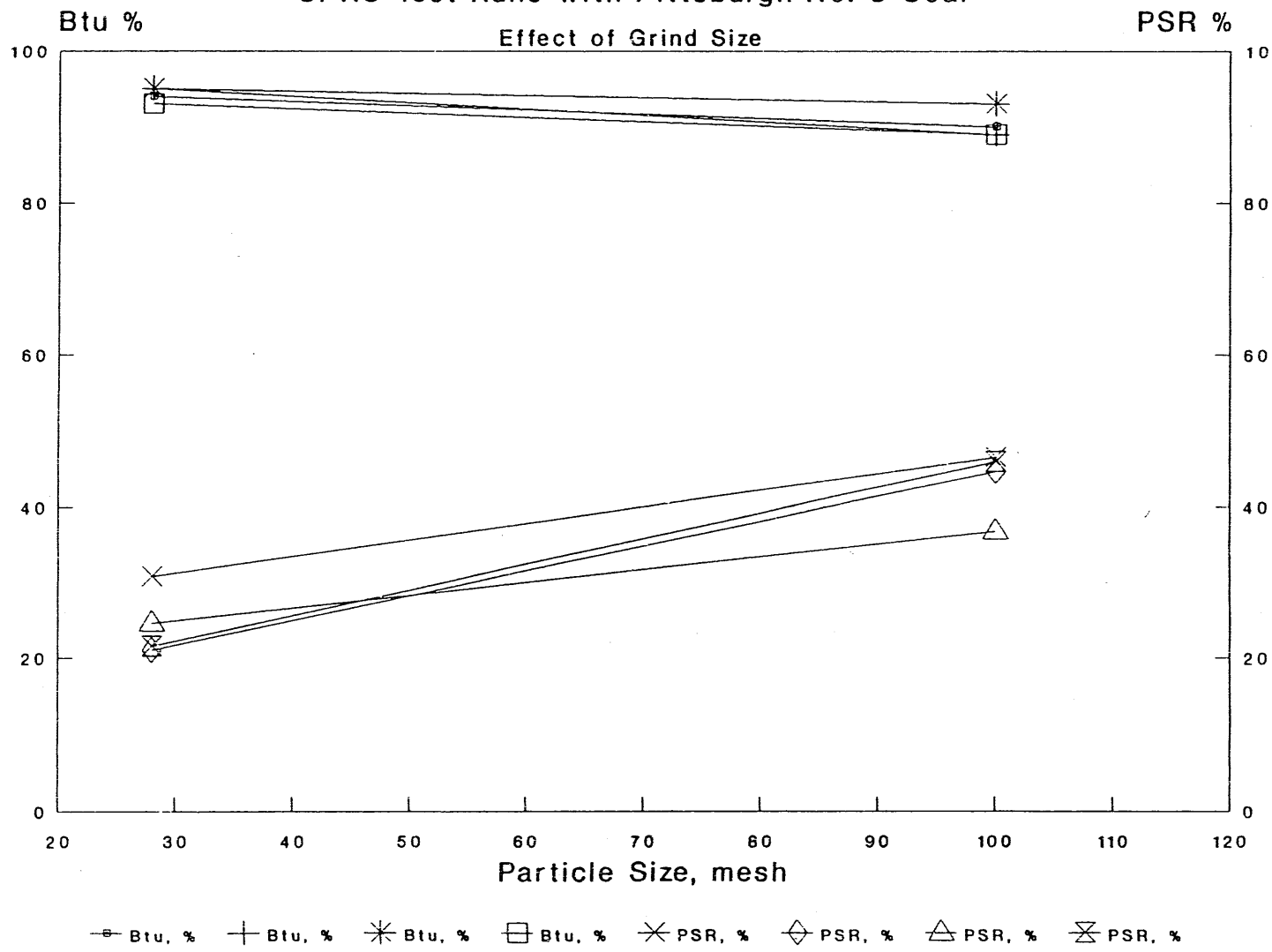
PIT.8F



PIT.8

Figure 8-18

CPRU Test Runs with Pittsburgh No. 8 Coal



PIT.6P

9.0 HEPTANE TEST PROGRAM

9.1 Summary of Test Plan

The bench scale heptane testing consisted of four series of experiments:

- o Series 1: Commissioning Tests
- o Series 2: Upper Freeport Test Program
- o Series 3: Pittsburgh No. 8 Test Program
- o Series 4: Kentucky No. 9 Test Program

The first objective of the Series 1 testing was to develop a continuous heptane bench scale unit which operates reliably and safely for extended periods of 8 to 10 hours. The test plan required a range of operating conditions, hence, Series 1 testing was performed over a wide range of % solids in high-shear and heptane concentration, to ensure reliable operation and minimal heptane emissions. The second objective of the Series 1 testing was the confirmation of the experimental method. This included testing for steady state analysis, test repeatability, and mass balance runs.

The Series 2 testing program examined how three main factors influenced the cleaning efficiency of Upper Freeport Coal. Heptane concentration, the high-shear mixing time and % solids, and the water loading to the sieve bend were all included in this matrix. The heptane concentration and % solids in high-shear set points were selected based upon the batch scale test results. In Series 2, a continued quality assurance and control program was implemented to support the testing.

In Series 3 and 4, tests were performed to evaluate how the same factors influenced the cleaning efficiency of the Pittsburgh No. 8 and Kentucky No. 9 test coals.

9.2 Grind Size Distributions

All Heptane tests were performed with the coal samples of a minus 200 mesh grind size, prepared in the IATF rod mill under the same operating conditions (500 kg rod charge and 2.2 kg/hr coal feed rate at 50% slurry concentration). Tables 9-1, 9-2 and 9-3 summarize the size distributions performed by Laser Granulometry method for each test coal. The tables provide both the incremental and cumulative mass of material in each size interval. In Table 9-1, the Upper Freeport coal size distribution is described, indicating a d_{50} of 16.6 microns, and a top size of 128 microns. Table 9-2 for the Kentucky No. 9 coal indicates a d_{50} of 25.9 microns and a slightly larger top size of 192 microns. Table 9-3 provides for the results from the Pittsburgh No. 8 coal, indicating a d_{50} of 21.2 microns and a top size of 128 microns. Figures 9-1, 9-2, and 9-3 are presented as bar charts of the particle size distributions for the three test coals. The results indicate a similar size distribution for each of the test coals. To reduce complexity of the slurry preparation procedure, it was decided to grind all three test coals at the same rod mill operating conditions.

Table 9-1

UPPER FREEPORT GRIND TEST
PARTICLE SIZE DISTRIBUTION BY LASER GRANULOMETRY

Particle Size (microns)	Particle Size Limits	Incr Wt % Run No. 1	Cumm Wt % Run No. 1	Incr Wt % Run No. 2	Cumm Wt % Run No. 2
1.0	< / = 1.0	3.5	3.5	3.6	3.6
1.5	1.0 - 1.5	0.8	4.4	0.9	4.6
2.0	1.5 - 2.0	2.2	6.6	2.4	7.1
3.0	2.0 - 3.0	4.5	11.2	4.8	12.0
4.0	3.0 - 4.0	5.0	16.3	5.1	17.1
6.0	4.0 - 6.0	7.3	23.6	7.0	24.2
8.0	6.0 - 8.0	6.2	29.8	5.9	30.1
12.0	8.0 - 12.0	10.3	40.2	10.0	40.2
16.0	12.0 - 16.0	8.6	48.8	8.6	48.9
24.0	16.0 - 24.0	13.7	62.6	13.9	62.8
32.0	24.0 - 32.0	9.8	72.5	9.7	72.6
48.0	32.0 - 48.0	16.7	89.2	16.8	89.4
64.0	48.0 - 64.0	3.9	93.1	3.7	93.2
96.0	64.0 - 96.0	6.6	99.8	6.6	99.9
128.0	96.0 - 128.0	0.1	100.0	0.0	100.0
192.0	128.0 - 192.0	0.0	100.0	0.0	100.0

Run No. 1 median size = 16.6 microns
Run No. 2 median size - 16.6 microns

Table 9-2

KENTUCKY NO. 9 GRIND TEST
PARTICLE SIZE DISTRIBUTION BY LASER GRANULOMETRY

Particle Size (microns)	Particle Size Limits	Incr Wt % Run No. 1	Cumm Wt % Run No. 1	Incr Wt % Run No. 2	Cumm Wt % Run No. 2
1.0	< / = 1.0	2.4	2.4	2.5	2.5
1.5	1.0 - 1.5	0.6	3.0	0.6	3.1
2.0	1.5 - 2.0	1.9	5.0	1.9	5.1
3.0	2.0 - 3.0	2.9	8.0	2.9	8.1
4.0	3.0 - 4.0	3.5	11.5	3.5	11.6
6.0	4.0 - 6.0	4.4	15.9	4.3	16.0
8.0	6.0 - 8.0	5.1	21.1	5.1	21.2
12.0	8.0 - 12.0	7.6	28.8	7.3	28.8
16.0	12.0 - 16.0	8.0	36.8	7.8	36.6
24.0	16.0 - 24.0	10.5	47.4	11.1	47.7
32.0	24.0 - 32.0	10.4	57.9	10.1	57.9
48.0	32.0 - 48.0	16.7	74.6	16.7	74.6
64.0	48.0 - 64.0	8.1	82.7	8.4	83.0
96.0	64.0 - 96.0	11.2	93.9	11.0	94.1
128.0	96.0 - 128.0	4.5	98.5	4.4	98.6
192.0	128.0 - 192.0	1.4	100.0	1.3	100.0

Run No. 1 median size = 26.0 microns
Run No. 2 median size = 25.8 microns

Table 9-3

PITTSBURGH NO. 8 GRIND TEST
PARTICLE SIZE DISTRIBUTION BY LASER GRANULOMETRY

Particle Size (microns)	Particle Size Limits	Incr Wt % Run No. 1	Cumm Wt % Run No. 1	Incr Wt % Run No. 2	Cumm Wt % Run No. 2
1.0	< / = 1.0	2.6	2.6	2.7	2.7
1.5	1.0 - 1.5	1.8	5.2	1.8	5.2
3.0	2.0 - 3.0	2.9	8.2	2.9	8.1
4.0	3.0 - 4.0	3.6	11.8	3.6	11.8
6.0	4.0 - 6.0	5.1	16.9	5.0	16.9
8.0	6.0 - 8.0	5.6	22.5	5.5	22.4
12.0	8.0 - 12.0	9.2	31.8	9.2	31.6
16.0	12.0 - 16.0	9.2	41.0	9.2	40.9
24.0	16.0 - 24.0	13.6	54.7	13.7	54.6
32.0	24.0 - 32.0	12.4	67.1	12.4	67.0
48.0	32.0 - 48.0	18.0	85.2	18 0	85.1
64.0	48.0 - 64.0	7.6	92.9	7.5	92.6
96.0	64.0 - 96.0	6.2	99.1	6.3	98.9
128.0	96.0 - 128.0	0.7	99.9	1.0	100.0
192.0	128.0 - 192.0	0.0	100.0	0.0	100.0

Run No. 1 median size = 21.1 microns
Run No. 2 median size = 21.3 microns

9.3 Commissioning Test

During the commissioning test, serious safety problems and health hazards were revealed. Initially, the bench scale heptane unit was constructed in a common piloting area. After continuous operation, operators working in the area began to experience both headaches and nausea, for period which extended well beyond working hours. Measurements with a portable detector indicated the apparatus was emitting substantial levels of heptane at the high-shear mixer, the vibrating sieve bend, and the sample drying oven. As a result, the heptane bench scale system was relocated to an isolated operating cell which was explosion rated. The cell was equipped with high rate exhaust fans and combustible detectors. The apparatus was modified to include explosion proof equipment and conduit electrical wiring, before a safe operating permit for the cell was granted. In addition, an explosion rated drying oven was acquired, and the sample preparation equipment was modified and transferred to an isolated laboratory, also rated as explosion proof.

9.3.1 Operational Debugging

After extensive modifications and the transfer into the isolated cell, the bench scale heptane system could be operated reliably and safely for extended periods of 8 to 10 hours. The unit was capable of operating under a wide range of conditions, without any problems related directly to the operation of the unit, or the collection and preparation of the samples for laboratory analysis. Categorized below are the major modifications which were undertaken during, or as a result of the commissioning test.

High-Shear Mixer

Initially, the high-shear mixer system experienced vessel plugging as heptane and combustible rich solids became compacted around the baffle system, restricting the flow and causing the high-shear to overflow. Two apparatus modifications were implemented to correct this problem. The discharge was re-designed, whereby the outlet was angled slightly into the vessel, against the direction of agitation. This created a slight pump action which helped slurry flow from the mixer. Secondly, the high-shear mixing baffles were removed. The mixer was subsequently tested for an eight hour period to ensure that plugging would not re-occur.

Separation System

Two separation systems were tested, a vibrating inclined screen and a sieve bend. The inclined screen was plugged extensively after about 2 to 3 hours of operation. The vibrating sieve was selected based upon the trapezoidal shaped grid bars, and the bouncing effect the sieve bend demonstrated on the feed particles. However, initial testing with the sieve bend demonstrated serious plugging problems, until the vibration source was re-positioned directly onto the sieve bend. After this modification, the feed solids could be seen to bounce on the sieve bend. Flow channels were also installed to regulate and promote more control of the product flow. Nozzles were directed to a region directly past the grid system of the sieve bend, where solids were required to travel about 50 mm before discharge. Observations indicated that the solids demonstrated a high tendency to plug in this region, especially at higher heptane concentration due to the extreme dryness of the product. Hence, the sieve bend discharge distance was shortened to reduce the chance of plugging. After that, the sieve bend was commissioned for over 8 hours without any indications of plugging.

Heptane Emission Control

Both the high-shear mixer and the sieve bend were totally sealed units. The high-shear mixer was equipped with a mechanical seal, and an o-ring sealed top flange to eliminate any emission of heptane. Once all sieve bend modifications and positioning were complete, an enclosure housing was placed over the apparatus and sealed. The unit was subsequently placed under a small air pressure and tested for leaks. The housing sealed successfully, and this ensured no heptane would be leaked from this stage during normal operation. The entire pilot plant was located within an isolated cell to monitor the operation for heptane emission. The cell was equipped with sensitive combustion detectors, and provided the opportunity for developing the sample collection and disposal procedure. Samples could be collected and stored with virtually no emission of heptane.

Sample Preparation Facility

When the heptane testing was underway, numerous samples were generated. Hence, an isolated and explosion rated sample preparation facility was required. An isolated laboratory equipped with explosion rated lighting and switches, and a high rate exhaust fan system were used to serve as the sample preparation facility. An explosion proof oven, equipped with a post condensation

system and large activated carbon filter system were installed to strip the heptane from the oven air exhaust.

9.3.2 Performance Observations

A commissioning test was performed to define steady state conditions, repeatability within tests, and the testing interval time requirement. Table 9-4 summarizes the target conditions for the commissioning test, during which three parameters were investigated: heptane concentration (% db), high-shear % solids and retention time (min.). Table 9-5 summarizes both the actual test conditions and results. The summary of the test conditions includes: the testing interval (minutes), the heptane concentration (% db), the high-shear % solids and the feed conditions (solids feed rate, and ash and total sulphur contents, % db). The comparison of the target and actual test conditions indicated good agreement, as the set points were only slightly different. The explanation of the difference relates to the feed rate used during testing. The target conditions for solids feed rate were 2.5 kg/hr, however, at this rate some line plugging was observed. To alleviate this problem, the slurry feed rate was increased slightly (approximately 10 %), hence, the heptane and high-shear water additions required further adjustments during the run. Some initial difficulty was experienced in performing these adjustments with a high level of accuracy, hence, additional calibrations were performed and new plots generated for the heptane and water additions. The grind size of the Upper Freeport coal was reported to be 26.6 microns which compares well to the target of 25 microns.

Table 9-4

TARGET TEST CONDITIONS FOR HEPTANE COMMISSIONING TEST

Coal:	Upper Freeport
Size distribution:	200 mesh x 0, d_{50} = 25 $\pm$ 5 um (rod mill)
Solids feed rate:	2.5 kg/hr
Heptane concentrations:	10% to 30% (on dry coal basis)
High-shear solids %:	5%, 15%
High-shear impeller rpm:	2000
Heptane agglomerate separation:	Vibrating sieve bend (125 um opening)
Water, spray on sieve bend:	On and off

Table 9-5

SUMMARY OF HEPTANE COMMISSIONING TEST CONDITIONS

Run No.	Yield Period min	Heptane %	% Solids in High-Shear	Hydraulic Retention Time min	Feed Rate g/min	Feed Ash % db	Feed T S % db
16-1a	10	8.42	6.14	1.30	46.2	15.80	1.98
16-1b	10	8.42	6.14	1.30	46.2	15.80	1.98
16-1c	10	8.42	6.14	1.30	46.2	15.80	1.98
16-2a	10	13.49	14.50	3.14	46.2	15.80	1.98
16-2b	10	13.49	14.50	3.14	46.2	15.80	1.98
17-1a	5	28.51	6.06	1.31	45.6	15.80	1.98
17-1b	5	28.51	6.06	1.31	45.6	15.80	1.98
17-1c	5	28.51	6.06	1.31	45.6	15.80	1.98
17-1d	5	28.51	6.06	1.31	45.6	15.80	1.98
17-1e	5	28.51	6.06	1.31	45.6	15.80	1.98
18-1a	10	28.51	6.06	1.31	45.6	15.80	1.98
18-1b	10	28.51	6.06	1.31	45.6	15.80	1.98
18-1c	10	28.51	6.06	1.31	45.6	15.80	1.98
18-1d	10	28.51	6.06	1.31	45.6	15.80	1.98
19-1a	10	28.51	14.85	3.21	45.6	15.80	1.98
19-1b	10	28.51	14.85	3.21	45.6	15.80	1.98
19-1c	10	28.51	14.85	3.21	45.6	15.80	1.98
19-1d	10	28.51	14.85	3.21	45.6	15.80	1.98

SUMMARY OF HEPTANE COMMISSIONING TEST RESULTS

Run No.	Product Recovery g/min	Product Ash % db	Product T S % db	Comb. Recovery %	Ash Reject %	T S Reject %	P S Reject %
16-1a	31.87	7.80	1.33	75.37	66.02	53.76	64.6[illegible]
16-1b	33.45	7.90	1.30	79.04	64.37	52.61	64.44
16-1c	28.53	7.90	1.32	67.37*	69.20	58.94	68.78
16-2a	35.21	8.60	1.47	82.58	58.59	43.52	53.28
16-2b	39.31	9.00	1.52	91.73	51.65	34.85	44.78
17-1a	37.80	9.60	1.74	88.38	49.42	26.84	32.91
17-1b	41.55	9.50	1.65	97.95	45.20	24.06	32.28
17-1c	39.74	9.40	1.64	93.89	48.09	27.73	35.81
17-1d	38.30	9.50	1.64	90.27	49.50	30.43	38.18
17-1e	38.27	9.50	1.60	90.27	49.50	32.13	40.51
18-1a	35.11	9.50	1.69	82.77	53.70	34.27	40.67
18-1b	35.13	9.40	1.66	82.90	54.17	35.41	42.28
18-1c	38.11	9.70	1.68	89.59	48.71	29.12	36.10
18-1d	38.76	9.50	1.68	91.35	48.90	27.88	35.08
19-1a	41.91	10.20	1.51	98.07**	40.67	29.87	40.32
19-1b	41.91	10.20	1.68	98.03	40.01	21.92	29.38
19-1c	41.14	10.30	1.75	96.05	40.59	20.23	26.31
19-1d	41.16	10.40	1.75	96.05	40.59	20.23	26.31

*Spray added to sieve bend after yield period R1-3
**Dilution water added to sieve bend after yield period R4-1

Average Feed Assay	Ash % db	T S % db	P S % db	O S % db	S S % db
	15.80	1.98	1.44	0.54	0.00

Table 9-5 also summarizes the results from these tests: product solids recovery (g/min.), product ash content (% db), product total sulfur content (% db), combustible matter recover in % (CMR), ash rejection in % (AR), total sulfur rejection in % (TSR) and pyritic sulfur rejection in % (PSR). Figures 9-4 and 9-5 summarize the results reported in Table 9-5. Figure 9-4 is a plot of CMR and PSR versus heptane concentration and % solids in the high-shear mixer, and Figure 9-5 contains the CMR and AR versus heptane concentration and % solids. For test conditions where repeat yield periods were available, the average value was plotted in Figures 9-4 and 9-5 (p.p. 9-27 and 9-28).

The performance trends from Figures 9-4 and 9-5 indicate that as the heptane concentration increases, the CMR increases, and conversely, the PSR and AR both decrease. Furthermore, as the % solids in the high-shear increases, the CMR also increases, however, the selectivity of the process is reduced, as the PSR and AR levels are lower. These trends are the expected responses of the system, which indicates the apparatus and method are both performing reliably.

9.3.3 Test Repeatability

Table 9-5 contains results which help to establish the experimental method. Product samples were extracted in duplicate or triplicate to confirm steady state and repeatability. Four sets of test conditions were used: Tests 16, 17, 18 and 19.

Test intervals 16-1a, 1b, and 1c indicate very good repeatability for product ash and total sulfur content (% db), while slightly larger variations were observed for the product recovery (g/min). The addition of spray water onto the sieve bend appears to influence product recovery, as a small addition during interval 16-1c lowered the recovery. Test intervals 16-2a and 2b demonstrate a lower repeatability, likely because of the addition of spray water directly onto the sieve bend grid system. These nozzles were eventually re-positioned, and reduced in volume, to target the immediate discharge from the sieve bend grid system where plugging at higher heptane concentrations was observed.

Test intervals 17-1a,1b,1c,1d and 1e and test intervals 18-1a,1b,1c and 1d indicate that the apparatus is demonstrating very good repeatability, and steady conditions, as the ash and total

sulfur contents (% db) are very consistent, and the product flow rates are within reasonable range. Furthermore, a testing interval of 5 minutes appears to be sufficient to ensure a representative product mass flow. Nevertheless, a conservative approach of a 10 minute testing interval was selected to maintain consistency within the diesel operation.

Test intervals 19-1a,1b and 1c indicated very good repeatability for product mass flow, ash and total sulfur contents, however, interval 19-1a demonstrated a large variation in total sulfur content.

The longest retention time of the heptane bench scale test facility is about 3.25 minutes for the high-shear mixer and, based upon observations, is less than 20 seconds for the sieve bend, therefore a total unit retention time is about 3.58 minutes. Assuming that 6 retention volumes are required for steady state conditions to be obtained, the operation should be steady after about 21 minutes. Based upon this standard engineering practice, and the commissioning test, a 30 minute stabilization period was selected for the heptane test program.

A continued quality assurance and control program was undertaken during Series 2. Duplicate product samples were extracted for each test window and prepared simultaneously. These results are summarized in Tables 9-6 and 9-7. Table 9-6 contains a summary of all repeat test intervals performed during Series 2 testing with Upper Freeport coal. The table describes the test interval, the main factors investigated (heptane concentration %, high-shear solids concentration %), and the main responses of the systems (product recovery in g/min, product total sulfur content % db, and product ash content % db). The results show very high level of test repeatability. Table 9-7 was prepared to evaluate the test repeatability, and contains four indicators. For each main response, the average variation and percent relative error of the variation was calculated. In addition, the range of these two indicators was provided. The results indicated that for all three responses (product recovery, ash and total sulfur content) the average relative error was less than 2%. Product recovery demonstrated the highest range of relative error, from 0 to 7.5%, while the ash and total sulfur contents were similar, with the relative error ranging from 0 to 4.9% and 0 to 4.4%, respectively.

Table 9-6

TEST REPEATABILITY

Test Interval	Heptane Concentration % db	High-Shear Concentration % Solids	Product Recovery g/min (db)	Product T S % db	Product Ash % db
35-1a	12.2	12	47.88	1.00	7.6
35-1b	12.2	12	N/A	1.02	8.3
35-2a	23.6	12	64.93	1.20	9.3
35-2b	23.6	12	64.17	1.16	9.3
36-1a	11.8	5	36.66	0.96	7.7
36-1b	11.8	5	36.37	0.96	7.8
36-2a	19.3	6	31.74	0.82	7.4
36-2b	19.3	6	33.12	0.86	8.1
36-3a	9.5	11	46.62	1.32	8.8
36-3b	9.5	11	43.42	1.29	8.6
36-5a	9.2	16	55.69	1.55	10.6
36-5b	9.2	16	47.94	1.57	10.2
36-6a	13.0	14	41.56	1.32	9.4
36-6b	13.0	14	43.30	1.44	9.3
36-7a	27.3	5	49.66	1.25	8.0
36-7b	27.3	5	48.77	1.22	7.8
36-8a	26.7	10	N/A	1.22	7.8
36-8b	26.7	10	49.12	1.33	8.6
36-9a	9.6	10	35.77	1.13	8.0
36-9b	9.6	10	37.13	1.16	7.9
36-10a	18.9	10	38.36	1.15	7.7
36-10b	18.9	10	41.55	1.17	7.7
36-11a	27.8	10	39.89	1.09	7.5
36-11b	27.8	10	41.27	1.02	7.3
36-12a	9.3	9	37.35	1.08	7.0
36-12b	9.3	9	37.29	1.14	7.1
36-13a	18.7	9	N/A	1.29	8.2
36-13b	18.7	9	49.67	1.33	8.7
36-14a	9.2	14	40.78	1.21	7.7
36-14b	9.2	14	40.99	1.21	7.8
36-15a	18.7	14	48.00	1.41	8.8
36-15b	18.7	14	48.00	1.42	8.7

Table 9-7

STATISTICAL INDICATORS OF REPEATABILITY

	Average Variation	Average Relative Error	Range of Variation	Range of Relative Error
Product Solids Flow g/min	0.88	1.98	0.03 - 3.88	0 - 7.49
Ash Content % db	0.13	1.72	0 - 0.4	0 - 4.88
Total Sulfur Content % db	0.02	.148	0 - 0.06	0 - 4.35

Definitions:

$$\text{Average Variation} = \frac{\text{(Mean of Two Repeat Test) - Low or High Value}}{\text{Total Number of Repeat Test Intervals}}$$

$$\text{Average Relative Error} = \frac{\text{Variation}}{\text{Mean of Two Repeat Test Interval}}$$

9.3.4 Mass Balance Test Intervals

Table 9-8 contains the results from the mass balance experiments. Discrepancies associated with mass balance test intervals are not simple to diagnose, however, they are most often caused by: inaccurate solids feed rate measurements, velocity changes in the feed sample system, losses during sample handling and preparation, and laboratory analysis for moisture, ash, and total sulfur.

Table 9-8

DETAILED MASS BALANCES

Test Interval	Coal	Component	Feed Slurry (g)	High Shear Input (g)	High Shear Output (g)	Sieve Bend Input (g)	Sieve Bend Product (g)	Sieve Bend Tailings (g)	% Recovery of Mass (%)
34-6	Pittsburgh	Water	178.9	337.6	516.5	589	215.7	926.7	103.3
		Solids	57.8	0	57.8	0	43.7	13.4	99.0
		Combustibles	51.9	0	51.9	0	41.0	9.3	97.0
		Ash	5.9	0	5.9	0	2.7	3.2	99.5
		Total Sulphur	2.2	0	2.2	0	1.3	0.7	93.2
37-6	Kentucky	Water	191.0	344	53.5	503	151.0	896.3	100.9
		Solids	53.4	0	53.4	0	27.7	20.5	94.0
		Combustibles	43.8	0	43.8	0	25.9	13.7	92.3
		Ash	9.6	0	9.6	0	1.8	6.8	91.4
		Total Sulphur	2.1	0	2.1	0	0.7	1.1	86.9
37-9	Kentucky	Water	202.6	845	1047.6	0	149.9	848.0	95.3
		Solids	56.6	0	56.6	0	29.6	28.3	102.3
		Combustibles	46.4	0	46.4	0	27.6	23.1	109.3
		Ash	10.2	0	10.2	0	2.0	7.7	95.6
		Total Sulphur	2.3	0	2.3	0	0.8	1.3	91.6
34-4	Pittsburgh	Heptane in High-Shear 20% db Heptane in Tailings 0.54% db CMR = about 80%							
Duplicate Test	Pittsburgh	Heptane in High-Shear 17% db Heptane in Tailings 1.59% db Duplicate Tailings Sample 1.13% db							

Three test intervals were performed for mass balance analysis. Test 34-6 was performed on Pittsburgh No. 8 coal and the results indicate excellent recovery of water (i.e. 103%), total solids (i.e. 99%), combustible solids (i.e. 97%) and ash solids (i.e. 99.5%). However, some discrepancy is indicated for the total sulfur mass balance (i.e. 93.2%). Possible explanations are errors in the feed or product assay determinations, although the most probable explanation is the feed assay.

Tests 37-6 and 37-9 were performed on Kentucky No. 9 coal, and the results were not as promising as the previous mass balance. The results from test interval 37-6 show that 94% of the feed stream is recovered. The combustible solids balance is 92.3%, the ash balance is

91.4% and the total sulfur balance is on the lower side (86.9% recovery). There are likely two causes for these discrepancies. With respect to the total, combustible and ash solids, some solids may have been lost during sample handling, or the feed conditions were not as well defined during this test interval (i.e. solids flow rate and % solids). In was noted that during this test interval the feed rate was slightly lower than than that observed during other test intervals. The total sulfur balance demonstrated a higher discrepancy, which might be related to the above noted losses and errors in laboratory analysis.

Test interval 9 indicates that the total solids balance is reasonable (i.e. 102%), being only 2% out of balance which can be accounted for by errors in moisture determination, sample handling, or feed rate measurements. However, the combustible solids balance is too high to be considered as reasonable (i.e. 109%), and the most likely explanation is an error in the ash determinations, as the total ash balance demonstrates the opposite trend recovering only 95.65 of the stream. The total sulfur balance recovers only 91.6%, indicating a systematic discrepancy which may exist in the apparatus or experimental method with respect to the total sulfur balance.

The explanation for the mass balance discrepancy is too complicated to be conclusively defined, based on limited data. However, it appears to be a systematic problem with the apparatus or method as in each test interval the total sulfur balance is low. Mass balance should be improved as the operating experience of this continuous heptane processing unit is further accumulated.

9.3.5 Heptane Content in Tailings Solids

Table 9-8 contains the summary of the heptane extraction analysis performed on the tailings solids from selected test intervals. During test interval 34-4, performed with Pittsburgh No. 8 coal, a tailings sample was collected, dried and delivered for laboratory analysis for heptane content. The results indicated that for a high-shear heptane concentration of about 20%, and a corresponding CMR of about 80%, the tailings stream showed 0.54% heptane concentration. Subsequent to this test interval, an additional test was performed on Pittsburgh coal to further confirm this trend. The results indicated that at a high-shear heptane concentration of 17% db, the tailings sample contained about 1.13 to 1.59% heptane.

9.4 Heptane Continuous Testing

Series 2, 3, and 4 testing were performed on the bench scale continuous heptane system, one matrix for each test coal. Series 2 was performed on Upper Freeport coal, Series 3 on Kentucky No. 9, and Series 4 on Pittsburgh No. 8. The bench scale system operated effectively, however, due to the limited testing performed on each coal, the results could not be considered as optimum. Further experiments on the bench scale unit would be required to optimize both the design and the process parameters.

9.4.1 Test Matrix

Tables 9-9, 9-10, and 9-11 summarize the test matrix for the Series 2, 3, and 4 testing. These matrix were designed to investigate three process parameters:

- Heptane concentration in the high-shear mixer
- % solids and retention time in the high-shear mixer
- Sieve bend water loading $g/cm^2/min$

Table 9-9

TEST PLAN FOR UPPER FREEPORT

Test Interval	Heptane %	% Solids in High-Shear	Retention in High-Shear min	Sieve Bend Water Load g/cm² min	Sieve Bend Solids Load g/cm² min
1	10	5	0.9	3.14	.16
2	20	5	0.9	3.14	.16
3	10	10	1.8	1.57	.16
4	20	10	1.8	1.57	.16
5	10	15	2.6	1.05	.16
6	20	15	2.6	1.05	.16
7	30	5	0.9	3.14	.16
8	30	10	1.8	1.57	.16
9	10	10	1.8	1.57	.16
10	20	10	1.8	3.14	.16
11	30	10	1.8	3.14	.16
12	10	10	1.8	3.14	.16
13	20	10	1.9	3.14	.16
14	10	15	2.6	3.14	.16
15	20	15	2.6	3.14	.16

Table 9-10

TEST PLAN FOR KENTUCKY NO. 9

Test Interval	Solids Feed Rate g/min	High-Shear Conditions Heptane % db	High-Shear Conditions % Solids	Retention Time min	Sieve Bend Conditions Solids Loading g/cm² min	Sieve Bend Conditions Water Loading g/cm² min
1	52.8	10	5	0.90	0.16	3.30
2	52.8	10	10	1.77	0.16	3.30
3	52.8	10	15	2.57	0.16	3.30
4	52.8	20	5	0.90	0.16	3.30
5	52.8	20	10	1.77	0.16	3.30
6	52.8	10	10	1.77	0.16	1.57
7	52.8	10	10	1.77	0.16	2.36
8	52.8	20	10	1.77	0.16	1.57
9	52.8	20	10	1.77	0.16	2.36

Table 9-11

TEST PLAN FOR PITTSBURGH NO. 9

Test Interval	Solids Feed Rate g/min	High-Shear Conditions Heptane % db	High-Shear Conditions % Solids	Retention Time min	Sieve Bend Conditions Solids Loading g/cm² min	Sieve Bend Conditions Water Loading g/cm² min
1	52.8	10	5	0.90	0.16	3.30
2	52.8	10	10	1.77	0.16	3.30
3	52.8	20	15	2.57	0.16	3.30
4	52.8	20	10	0.90	0.16	3.30
5	52.8	20	10	1.77	0.16	1.57
6	52.8	10	15	1.77	0.16	3.30

Series 2 testing with the Upper Freeport coal consisted of 15 test intervals. Series 3 involved 9 intervals as the range of heptane concentration investigated was narrowed, and the scope of sieve bend water loading investigations was reduced. Six test intervals were performed in Series 4 where heptane concentration and % solids in the high-shear were investigated.

The solids feed rate was to be held constant during the matrix, and hence, the sieve bend solids loading rate was constant at 0.16 g/cm²/min. Tables 9-12, 9-13, and 9-14 summarize the set points used during the three matrix of tests. A comparison indicated that the target set points obtained were reasonably accurate; however, some discrepancies were observed in the heptane concentration. The cause for this discrepancy was related to the final % solids of the feed stream which was not usually available until the day following the test matrix.

Table 9-12

TEST CONDITIONS FOR UPPER FREEPORT

Test Interval	Solids Feed Rate g/min	Heptane Concentration %	Solids in High-Shear %	Retention Time in High-Shear min	Sieve Bend Water Loading g/cm² min
35-1	73.9	12.2	11.8	1.59	1.87
35-2	73.8	23.6	13.0	1.59	1.87
36-1	53.4	11.8	5.3	0.98	2.93
36-2	52.3	19.3	5.4	1.03	2.93
36-3	56.1	9.5	10.9	1.95	1.61
36-4	56.1	18.2	10.9	1.93	1.61
36-5	56.2	9.2	16.3	2.90	1.02
36-6	56.2	13.0	13.9	2.48	1.25
36-7	56.2	27.3	5.3	0.94	2.99
36-8	57.0	26.7	9.7	1.70	1.59
36-9	56.6	9.6	9.6	1.69	1.07
36-10	56.2	18.9	9.7	1.72	1.59

Table 9-12 (Continued)

TEST CONDITIONS FOR UPPER FREEPORT

Test Interval	Solids Feed Rate g/min	Heptane Concentration %	Solids in High-Shear %	Retention Time in High-Shear min	Sieve Bend Water Loading g/cm² min
36-11	56.2	27.8	9.7	1.73	3.19
36-12	56.2	9.3	9.5	1.69	3.21
36-13	56.2	18.7	9.4	1.67	3.21
36-14	56.2	9.2	13.9	2.47	3.03
36-15	56.2	18.7	13.9	2.48	3.03

Table 9-13

TEST CONDITIONS FOR KENTUCKY NO. 9

Test Interval	Solids Feed Rate g/min	Heptane Concentration %	Solids in High-Shear %	Retention Time in High-Shear min	Sieve Bend Water Loading g/cm² min
37-1	58.6	8.6	5.4	0.91	3.07
37-2	567.4	9.3	9.6	1.67	2.03
37-3	58.2	17.8	14.2	2.45	3.11
37-4	57.8	9.3	9.6	1.66	2.46
37-5	58.0	18.7	9.6	1.65	2.46
37-6	53.4	20.2	9.1	1.70	3.09
37-7	56.9	19.0	9.3	1.64	1.64
37-8	57.0	9.6	9.4	1.64	1.63
37-9	56.6	18.6	5.1	0.91	3.12

Table 9-14

TEST CONDITIONS FOR PITTSBURGH NO. 8

Test Interval	Solids Feed Rate g/min	Heptane Concentration %	Solids in High-Shear %	Retention Time in High-Shear min	Sieve Bend Water Loading g/cm² min
34-1	55.8	9.2	5.4	0.97	2.89
34-2	57.0	9.1	9.5	1.67	3.17
34-3	57.1	18.3	5.1	0.90	4.70
34-4	57.6	17.9	9.4	1.64	3.40
34-5	57.6	17.9	9.4	1.64	1.64
34-6	57.7	8.7	13.9	2.40	3.20

9.4.2 Results from Continuous Heptane Testing

Tables 9-15, 9-16, 9-17 summarize the results from Series 2, 3, and 4 testing for all three test coals. The tables summarize the test intervals, solids feed rate, and contains all major process variables including:

- Heptane concentration in the high-shear mixer
- % solids and retention time in the high-shear mixer
- Sieve bend water loading $g/cm^2/min$

The tables noted above also summarize all major process responses including the following:

- Product solids mass flow rate (g/min)
- Product % solids
- Product ash content % db
- Product total sulfur content % db
- Solids yield %
- Combustible matter recovery % (CMR)
- Ash rejection % db (AR)
- Total sulfur rejection % db (TSR)
- Pyrite sulfur rejection % db (PSR)

Figures 9-6, 9-8 and 9-10 are the pyritic sulfur performance plots for each of the test coals. In these plots, the CMR is plotted against the PSR to provide an evaluation of the pyrite cleaning potential for each test coal. The results for each test coal are plotted as well as the pyritic sulfur 200 mesh washability data to provide a comparison to the theoretical cleaning potential of each coal.

Figures 9-7, 9-9 and 9-11 are the ash content performance plots for each of the test coals.In these plots, the CMR is plotted against the AR to provide an evaluation of the ash cleaning potential for each test coal. The results for each test coal are plotted as well as the ash 200 mesh washability data to provide a comparison to the theoretical cleaning potential of each coal.

Table 9-15: Performance Summary for Upper Freeport

TEST INTERVAL	SOLIDS FEED RATE g/min	HEPTANE CONCENTRATION % db	HIGH SHEAR CONCENTRATION % solids	HIGH SHEAR RETENTION TIME min.	SIEVE BEND WATER LOAD g/cm^2*min	PRODUCT SOLIDS FLOW g/min	PRODUCT % SOLIDS %	PRODUCT ASH % db	PRODUCT TS % db	SOLIDS YIELD %	CMR %	AR %	TSR %	PSR %
35-1	73.9	12.2	11.8	1.59	1.87	47.6	20.8	8.0	1.02	64.4	69.5	64.3	68.7	82.1
35-2	73.8	23.6	13.0	1.59	1.87	64.1	29.0	9.3	1.18	86.9	93.1	47.2	51.2	66.6
36-1	53.4	11.8	5.3	0.98	2.93	36.5	17.1	7.8	0.96	68.4	74.4	65.2	68.8	83.8
36-2	52.3	19.3	5.4	1.03	2.93	32.4	19.4	7.8	0.84	61.9	67.4	68.4	75.2	90.1
36-3	56.1	9.5	10.9	1.95	1.61	44.7	25.6	8.7	1.31	79.7	85.9	54.7	50.7	63.4
36-4	56.1	18.2	10.9	1.93	1.61	52.1	26.6	9.6	1.46	92.9	99.2	41.7	35.4	47.4
36-5	56.2	9.2	16.3	2.90	1.02	51.6	23.2	10.4	1.56	91.9	97.2	37.6	31.8	41.8
36-6	56.2	13.0	13.9	2.48	1.25	42.2	22.9	9.4	1.38	75.1	80.3	53.9	50.7	61.4
36-7	56.2	27.3	5.3	0.94	2.99	49.9	14.0	8.3	1.24	88.8	95.8	50.1	46.7	61.5
36-8	57.0	26.7	9.7	1.70	1.59	49.5	18.5	8.6	1.33	86.8	93.6	51.2	45.0	58.5
36-9	56.6	9.6	9.6	1.69	1.07	36.4	17.4	8.0	1.15	64.3	69.8	66.4	64.8	76.9
36-10	56.2	18.9	9.7	1.72	1.59	39.7	11.1	7.7	1.16	70.6	76.9	64.5	61.0	74.2
36-11	56.2	27.8	9.7	1.73	3.19	40.4	16.3	7.4	1.06	71.8	78.5	65.3	63.8	79.5
36-12	56.2	9.3	9.5	1.69	3.21	40.7	22.9	7.1	1.11	66.0	72.4	69.4	65.1	78.2
36-13	56.2	18.7	9.4	1.67	3.21	49.3	18.7	8.5	1.31	87.8	94.9	51.2	45.2	59.2
36-14	56.2	9.2	13.9	2.47	3.03	40.6	20.0	7.8	1.21	72.2	78.8	63.2	58.4	71.3
36-15	56.2	18.7	13.9	2.48	3.03	48.6	19.3	8.8	1.42	86.5	99.6	50.3	42.5	56.4

Table 9-16: Performance Summary for Kentucky #9

TEST INTERVAL	SOLIDS FEED RATE g/min	HEPTANE CONCENTRATION % db	HIGH SHEAR CONCENTRATION % solids	HIGH SHEAR RETENTION TIME min.	SIEVE BEND WATER LOAD g/cm^2*min	PRODUCT SOLIDS FLOW g/min	PRODUCT % SOLIDS %	PRODUCT ASH % db	PRODUCT TS % db	SOLIDS YIELD %	CMR %	AR %	TSR %	PSR %
37-1	58.6	8.6	5.4	0.91	3.07	36.7	20.2	7.1	2.76	62.6	70.9	75.3	56.8	72.6
37-2	57.4	9.3	9.6	1.67	2.63	36.8	21.0	7.1	2.79	63.7	72.2	74.9	56.0	72.1
37-3	58.2	17.8	14.2	2.45	3.11	45.0	22.8	7.5	2.93	77.4	87.4	67.7	43.3	60.7
37-4	57.8	9.3	9.6	1.66	2.46	40.1	25.8	7.4	2.79	69.3	78.5	72.0	52.1	69.3
37-5	58.0	18.7	9.6	1.65	2.46	46.2	21.7	8.4	3.07	79.6	88.9	62.9	39.2	55.1
37-6	53.4	20.2	2.1	1.70	3.09	27.8	16.6	6.5	2.65	52.0	58.8	80.6	65.1	79.1
37-7	56.9	19.0	9.3	1.64	1.64	32.6	18.7	7.7	2.72	57.3	64.5	75.5	61.1	75.6
37-8	57.0	9.6	9.4	1.64	1.63	29.1	19.5	8.1	2.80	51.0	57.2	77.0	64.3	76.5
37-9	56.6	18.6	5.1	0.91	3.12	29.5	16.7	6.7	2.62	52.2	59.4	80.6	65.8	80.1

Table 9-17: Performance Summary for Pittsburgh #8

TEST INTERVAL	SOLIDS FEED RATE g/min	HEPTANE CONCENTRATION % db	HIGH SHEAR CONCENTRATION % solids	HIGH SHEAR RETENTION TIME min.	SIEVE BEND WATER LOAD g/cm^2*min	PRODUCT SOLIDS FLOW g/min	PRODUCT % SOLIDS %	PRODUCT ASH % db	PRODUCT TS % db	SOLIDS YIELD %	CMR %	AR %	TSR %	PSR %
34-1	55.8	9.2	5.4	0.97	2.89	37.4	17.8	6.0	2.94	67.1	70.4	61.3	48.1	73.9
34-2	57.0	9.1	9.5	1.67	3.17	40.8	15.7	5.7	3.08	71.5	75.3	61.2	42.1	66.3
34-3	57.1	18.3	5.1	0.90	4.70	35.3	14.4	5.3	3.05	61.9	65.6	70.0	50.3	72.5
34-4	57.6	17.9	9.4	1.64	3.40	43.3	16.7	5.6	3.10	75.2	79.3	59.5	38.6	63.6
34-5	57.8	17.9	9.4	1.64	1.64	46.0	21.7	6.5	3.20	79.9	83.5	50.5	30.9	52.2
34-6	57.7	8.7	13.9	2.40	3.20	38.7	14.1	6.1	3.10	67.0	70.3	60.7	45.3	67.0

Figures 9-12 to 9-38 were developed to support the discussion on the effect of three main factors: the heptane concentration in the high-shear mixer, the % solids in the high-shear mixer, and the sieve bend water loading rate for all three test coals. Figures 9-12 to 9-14 contain results for the Upper Freeport coal, and were developed to analyze the effect % heptane concentration in high-shear on CMR, PSR, and AR. Each of these responses, CMR, PSR, and AR, were plotted separately against the % heptane concentration in high-shear for all test intervals. Test intervals which were performed at similar set point conditions for the two main factors, (eg. % solids in high-shear and water loading on the sieve bend), were connected to observe the effect of varying heptane concentration. Figures 9-15 to 9-17 were constructed to demonstrate the effect of % solids in the high-shear mixer. Each of the responses, CMR, PSR, and AR, were plotted separately against the % solids in the high-shear mixer; and test intervals performed at similar heptane concentration and sieve bend water loading were connected to demonstrate independently the effect of % solids in high-shear. Figures 9-18 to 9-20 were constructed to observe the effect of sieve bend water loading rate. The CMR, PSR and AR were plotted separately against sieve bend water loading rate. Test intervals containing similar conditions for heptane concentration and % solids were connected to try to determine the effect of water loading. Figures 9-21 to 9-38 contain the same plots for the Kentucky No. 8 and Pittsburgh No. 9 coals.

9.4.3 Discussion of Heptane Continuous Testing

The discussion first evaluates the cleaning efficiency comparing the heptane continuous testing data with the washability data for each of the test coals. Secondly, the discussion considers each of the main factors investigated to study their effect on process performance.

9.4.3.1 Process Performance vs Washability Data

Figure 9-6 summarizes the pyrite rejection process performance data for the Upper Freeport coal. The results indicate that the potential cleaning efficiency of the Heptane Continuous system falls below the theoretical 200 mesh washability PSR curve. The heptane process performance curve indicates that the potential PSR for the Upper Freeport coal is in the range of 70 to 80%, for a

CMR range of 90 to 80%. The 200 mesh washability curve indicates a PSR rejection range of 92 to 94% for the above CMR range.

Figure 9-7 summarizes the ash rejection process performance data for the Upper Freeport coal. The process performance curve indicates that the potential AR for the Upper Freeport coal is in the range of 55 to 60% for a CMR range of 90 to 80%. The performance of the Heptane system also falls below the 200 mesh washability curve for AR, as the 200 mesh washability curve indicates an AR range of 69 to 80% for a corresponding CMR range of 90 to 80%.

Figure 9-8 indicates that for the Kentucky No. 9 coal a PSR range of 55 to 70% can be achieved while maintaining CMR in the 90 to 80% range. The cleaning performance of the heptane system also falls below the 200 mesh Washability PSR curve, as the 200 mesh washability curve indicates a PSR rejection range of 92 to 96% for a corresponding CMR range of 90 to 80%.

Figure 9-9 indicates that an AR range of 60 to 72% can be achieved while maintaining CMR in the 90 to 80% range. The cleaning efficiency also falls below the 200 mesh washability curve for AR, as the 200 mesh washability curve indicates an AR rejection range of 79 to 88% for a corresponding CMR range of 90 to 80%.

The results for the Pittsburgh No. 8 coal indicate that a PSR range of 50 to 60% can be achieved while maintaining a CMR range of 85 to 80% (see Figure 9-10). The 200 mesh washability curve indicates a PSR rejection range of 89 to 92% for a corresponding CMR range of 90 to 80%.

The results summarized on Figure 9-11 indicate that AR range of 50 to 60% can be achieved while maintaining a CMR range of 85 to 80%. The process performance curve indicated by the data falls below the 200 mesh washability curve for AR, as the 200 mesh washability curve indicates an AR range of 66 to 75% for a corresponding CMR range of 90 to 80%.

9.4.3.2 Main Factor Effects

Three main factors were investigated for each test coal:

- Heptane concentration in the high-shear mixer
- % solids concentration in the high-shear mixer
- sieve bend water loading rate

Heptane Concentration

Figures 9-12 to 9-14 contain the results demonstrating the effect of heptane concentration for the Upper Freeport coal. The results in Figure 9-12 indicate that CMR increases as the heptane concentration increases. This seems reasonable as the higher heptane concentration will result in more complete agglomeration of the combustible material, and the formation of stronger and larger microagglomerates. Figures 9-13 and 9-14 both indicate the PSR and AR are somewhat reduced with higher heptane additions, although the AR does not appear to be as sensitive to heptane concentration as does the PSR. These results confirm the expected trend that with an increase of heptane concentration, the relative selectivity of the process is reduced. The results also suggest that the heptane concentration in the high-shear stage is the most sensitive of the parameters investigated to overall process performance. The most effective range of heptane concentrations for the Upper Freeport coal appears to be 10 to 20%. Figures 9-21 to 9-23 for the Kentucky No. 9 test coal, and Figures 9-30 to 9-32 for the Pittsburgh No. 8 coal also seem to confirm the same trends. Although, it must be noted that the data for these two coals is not as extensive as for the Upper Freeport coal, hence, interpretations are not as conclusive.

% Solids in the High-Shear Mixer

Figures 9-15 to 9-17 contain the results used to study the effect of % solids and retention time in the high-shear mixer. When the % solids in the high-shear mixer is varied, the retention time also varies. As the % solids is reduced, so does the retention time, hence, a similar effect on the process response is expected from the variation in retention time as variations in % solids. Therefore, the effects of both these values were evaluated simultaneously via the plots of CMR, PSR and AR vs. % solids in high-shear. For a high-shear solids concentration of 5%, the retention time is about 1 minute, and for 15% solids, the retention time is about 2.5 minutes. The results in Figure 9-15 indicate that CMR increases as the % solids and retention time in the high-shear mixer are increased. As the kinetics of agglomeration is known to be the fastest at higher % solids in the high-shear mixer, and at longer retention times, the probability of higher CMR

seems to be in order. The selectivity of the process is reduced at higher % solids and retention times as it is indicated in Figures 9-16 and 9-17 for PSR and AR plots. The increase in % solids and retention time is expected to reduce the selectivity of the process because the chance of pyrite and ash entrapment, or surface modification, is increased by the higher particle collisions and higher mixing time. The results suggest that the best selectivity occurs in the 5% to 10% solids range. However, because an increase in % solids simultaneously increases the retention time in the high-shear mixer, it is premature to conclude on the optimal high-shear design. It may be stated, however, that the best high-shear conditions for the heptane continuous unit appear to be in the range of 5 to 10% solids, with a corresponding retention time of 1 to 2 minutes for the single reactor. The power uptake of the high-shear mixer was very low, measured to be about 1 to 2 Watts/liter. Figures 9-24 to 9-26 for the Kentucky No. 9 test coal, and Figures 9-33 to 9-35 for the Pittsburgh coal also seem to confirm the same trends. Although, it must be noted the data for these two coals is not as extensive as for the Upper Freeport coal, hence, interpretations are not as conclusive.

Sieve Bend Water Loading

A conclusive effect of sieve bend water loading cannot be made based upon the continuous heptane data. The results from the Upper Freeport test matrix (see Figures 9-18 to 9-20) seems to suggest that CMR may be reduced at high loading rates. However, other data within the Upper Freeport test matrix suggests the opposite trend, where an increase in the loading rate results in higher CMR values. The effect of loading rate may depend on two factors influencing the sieve bend performance, the washing effect at higher loading rates, and an increase in retention time on the sieve bend at lower loading rates. At lower loading rates, it is observed that the heptane microagglomerate retention time on the sieve bend is increased. The increased time may permit weaker agglomerates to disintegrate during an extended period and subsequently pass through the mesh. At higher loading rates, the increased velocity and impact onto the sieve bend may cause weaker microagglomerates to pass to the tailings stream. Furthermore, the optimum loading rate may be further complicated by other operating parameters, such as the concentration of heptane or % solids in the high-shear mixer, as these parameters may influence microagglomerate size and strength.

The results from the Kentucky No. 9 coal seems to support that a local optimum exists for sieve bend loading (see Figures 9-27 to 9-29). These plots indicate that at low sieve bend loading rates, the CMR is decreased and correspondingly the PSR and AR are increased. At higher loading rates the CMR increases and the PSR and AR are correspondingly reduced. However, when further increases in the loading rate are implemented, the reverse trend is observed. The same trends are not observed for the Pittsburgh No. 8 coal, hence no conclusive arguments can be formulated (see Figures 9-36 to 9-38).

In conclusion, the data appears to be insufficient to offer conclusive interpretation on the effect of sieve bend loading on the overall process efficiency. However, the results indicate that it appears to be a process factor which influences the process performance.

9.5 Conclusions

- The potential cleaning efficiencies summarized below can be expected from the existing Continuous Heptane Agglomeration Unit. These results are based upon the graphical interpolation of the performance curves, plotted for each of the test coals (see Figures 9-6 to 9-11).

Test Coal	CMR Range	PSR Range	AR Range
Upper Freeport	90 to 80	70 to 80	55 to 60
Kentucky No. 9	90 to 80	55 to 70	60 to 72
Pittsburgh No. 8	85 to 90	50 to 60	50 to 60

- The effect of heptane concentration in high-shear appears to be the most sensitive parameter for overall process performance. An increase in heptane concentration increases CMR, and decreases PSR. The heptane concentration range which appears to demonstrate the best combination of potential process selectivity (i.e. PSR and CMR) falls in the range of 10 to 20% heptane.

- An increase in % solids, which simultaneously increases the retention time in the high-shear mixer, improves CMR; however, the process PSR appears to be reduced. The selection of the optimum high-shear conditions is premature, although the data suggest higher PSR at 5% solids. Further optimization of both the design and process variables, may improve the performance at higher solids concentrations, hence, the best conditions may be stated as the range of 5% to 10% solids in high-shear, with a corresponding retention time of 1 to 2 minutes.

- A conclusive effect of sieve bend water loading cannot be made based upon the continuous heptane data. However, the sieve bend water loading rate does appear to influence the process performance, and a local optimum may exist.

- The performance of the heptane continuous system indicates that the apparatus is reliable and can be safely operated for extended periods of 8 to 10 hours. The design of the sample collection and preparation system ensures minimal exposure of heptane to operators.

Figure 9-1

SIZE DISTRIBUTION - UPPER FREEPORT
200 MESH - ROD MILL GRIND

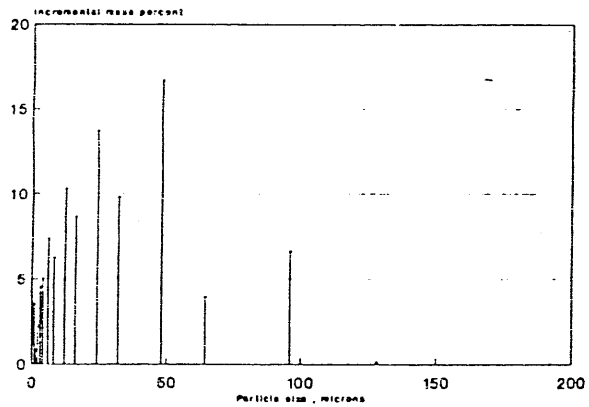


Figure 9-2

SIZE DISTRIBUTION - KENTUCKY No.9
200 MESH - ROD MILL GRIND

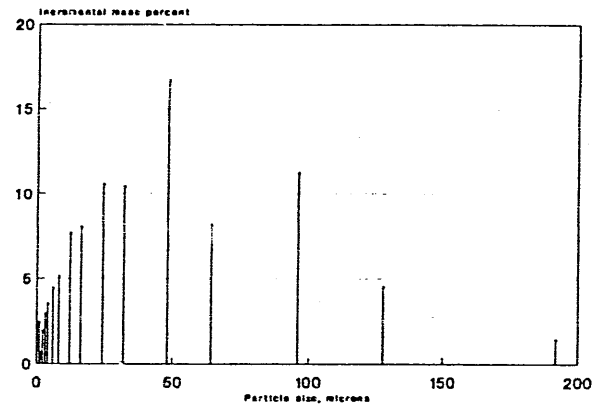


Figure 9-3

SIZE DISTRIBUTION - PITTSBURGH No.8
200 MESH - ROD MILL GRIND

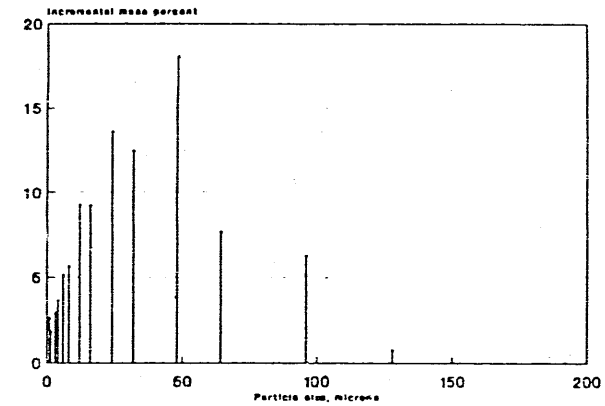


Figure 9-4 CMR and PSR vs Heptane Concentration

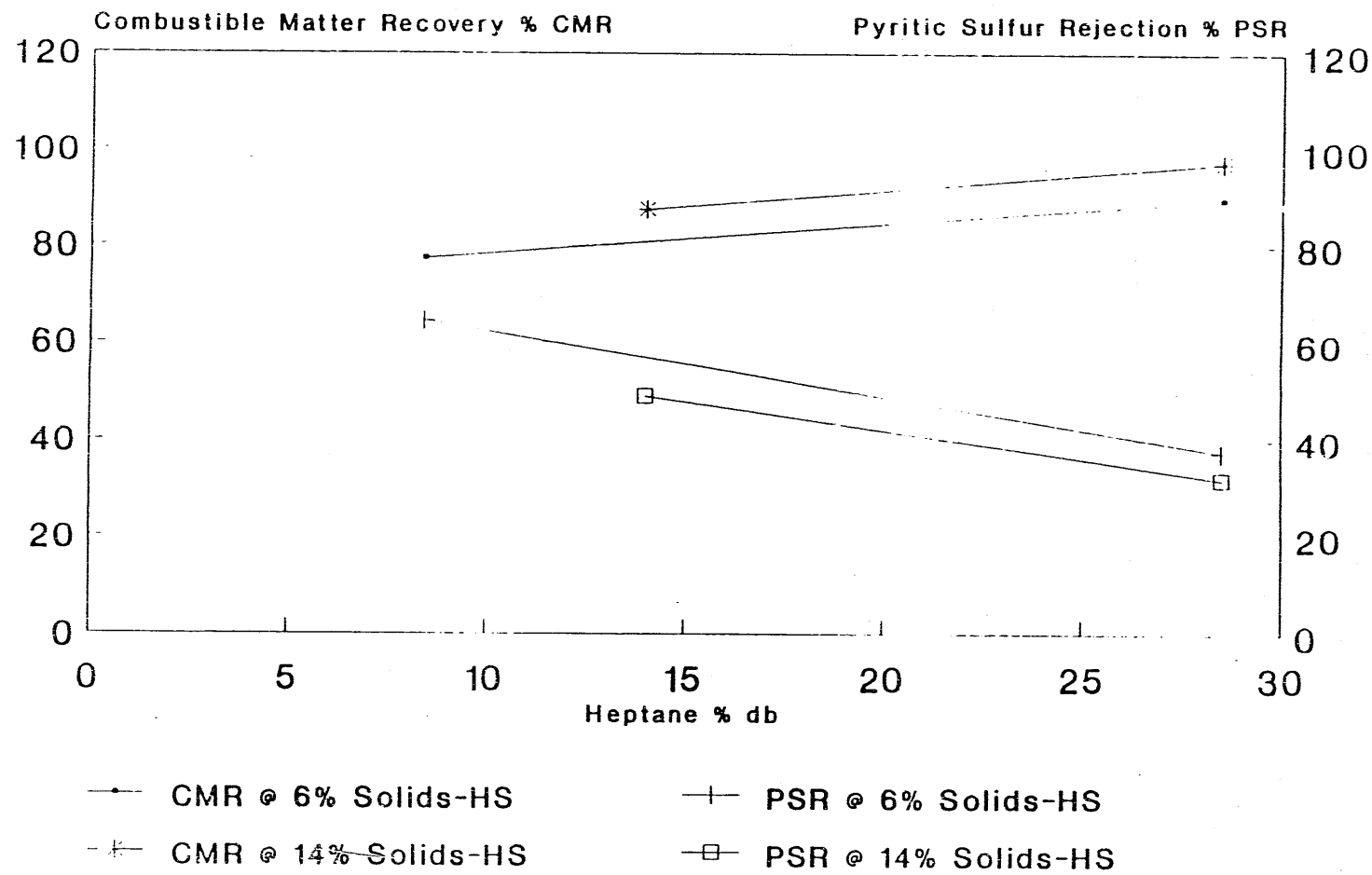


Figure 9-5 CMR and AR vs Heptane Concentration

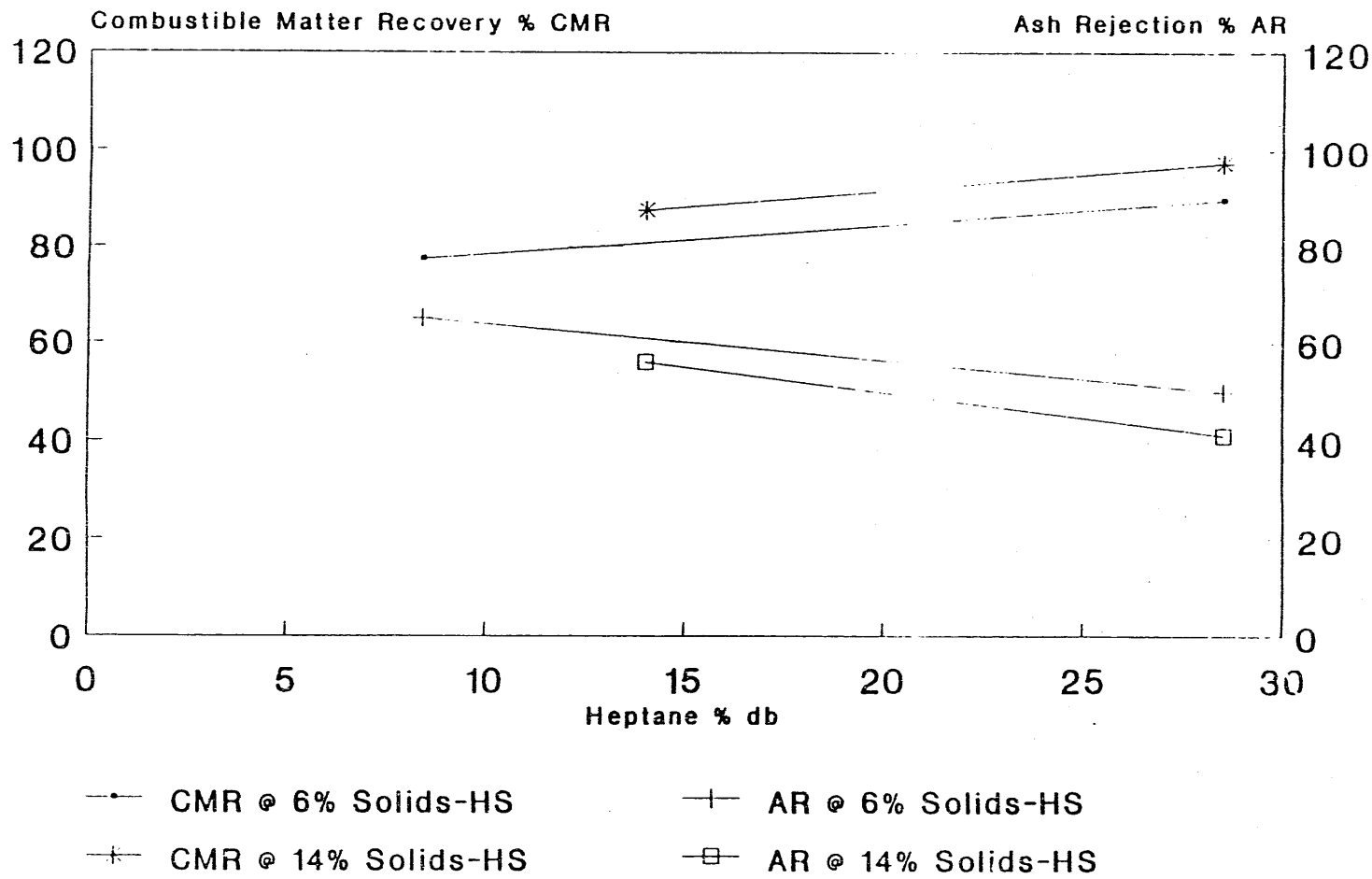


Figure 9-6 % Combustible Matter Recovery vs Pyritic Sulphur Rejection for Upper Freeport Coal

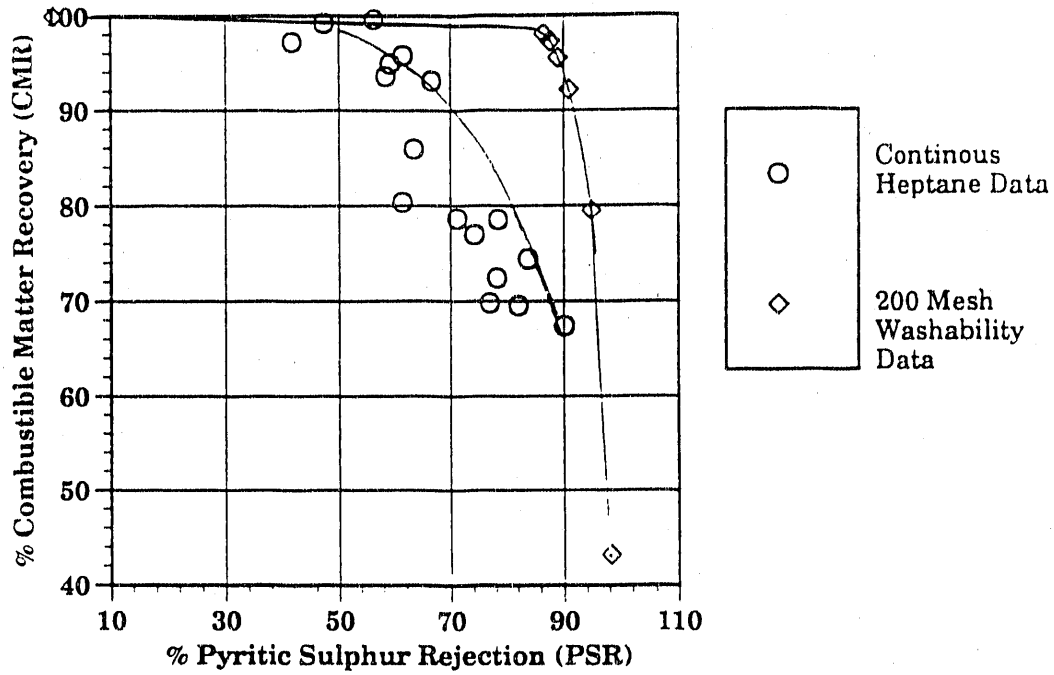


Figure 9-7 % Combustible Matter Recovery vs % Ash Rejection for Upper Freeport Coal

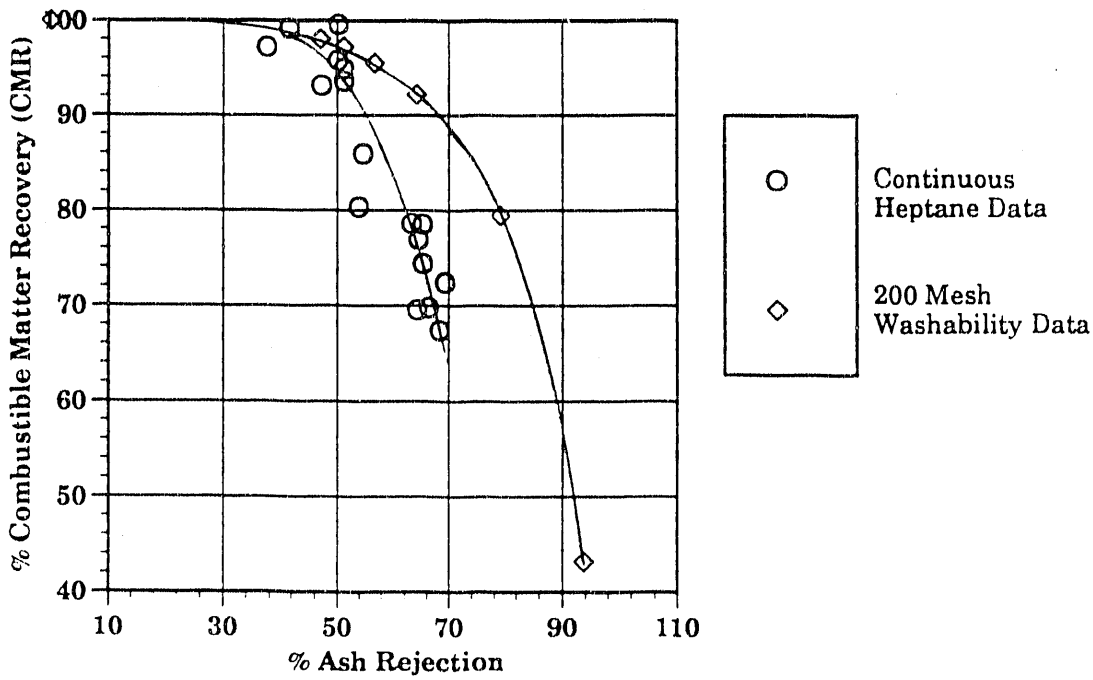


Figure 9-8 % Combustible Matter Recovery vs Pyritic Sulphur Rejection for West Kentucky No. 9

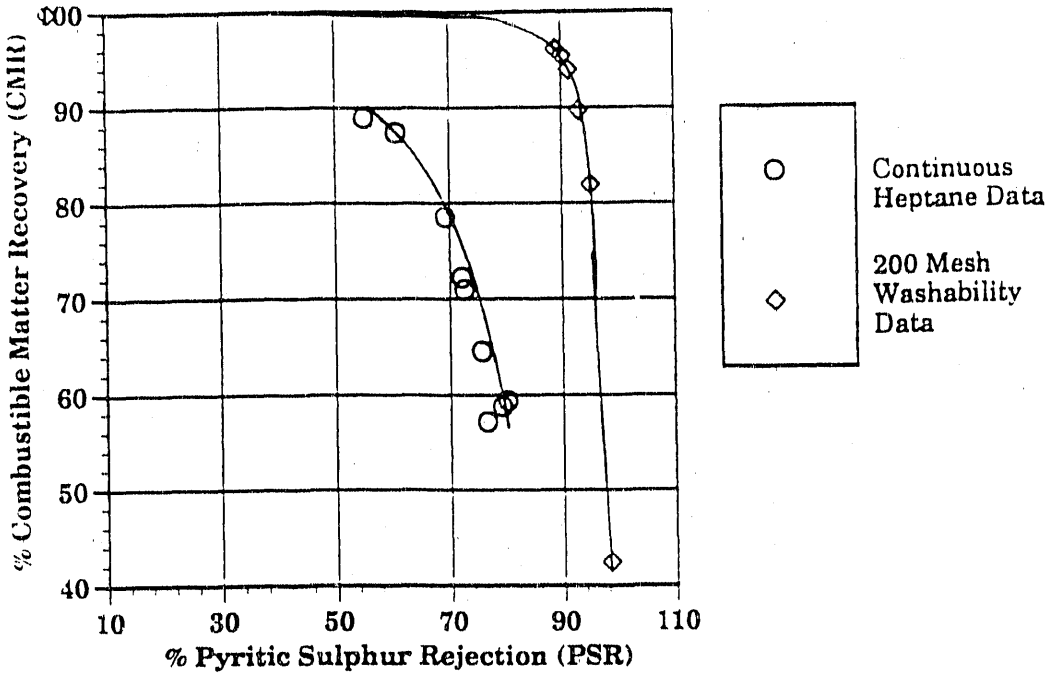


Figure 9-9 % Combustible Matter Recovery vs % Ash Rejection for West Kentucky No. 9 Coal

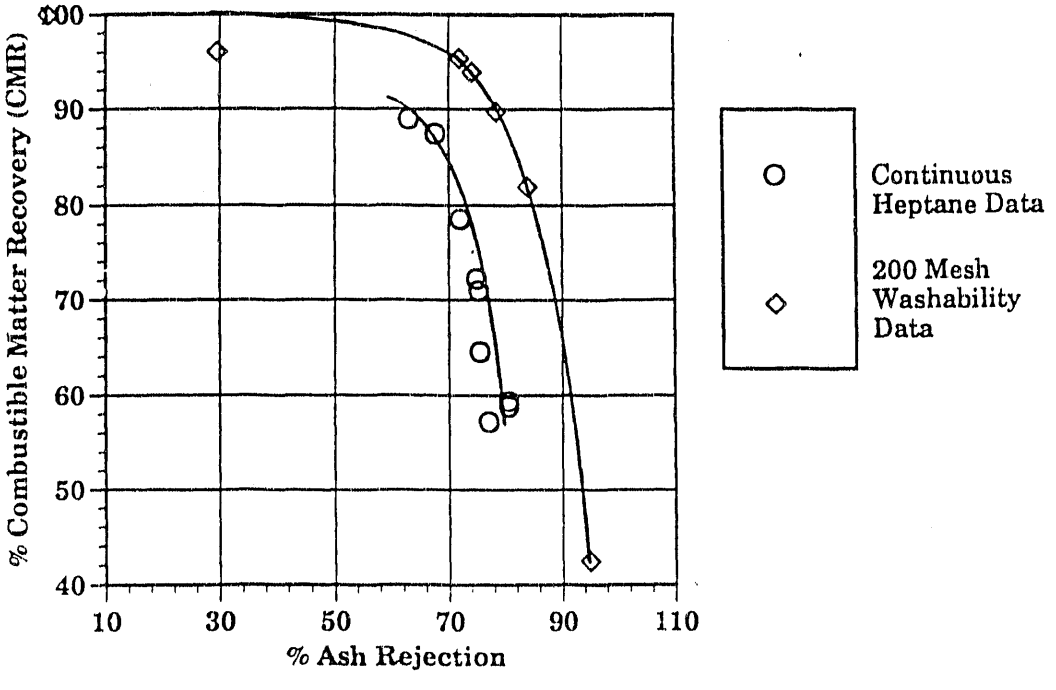


Figure 9-10 % Combustible Matter Recovery vs Pyritic Sulfur Rejection for Pittsburgh No. 8 Coal

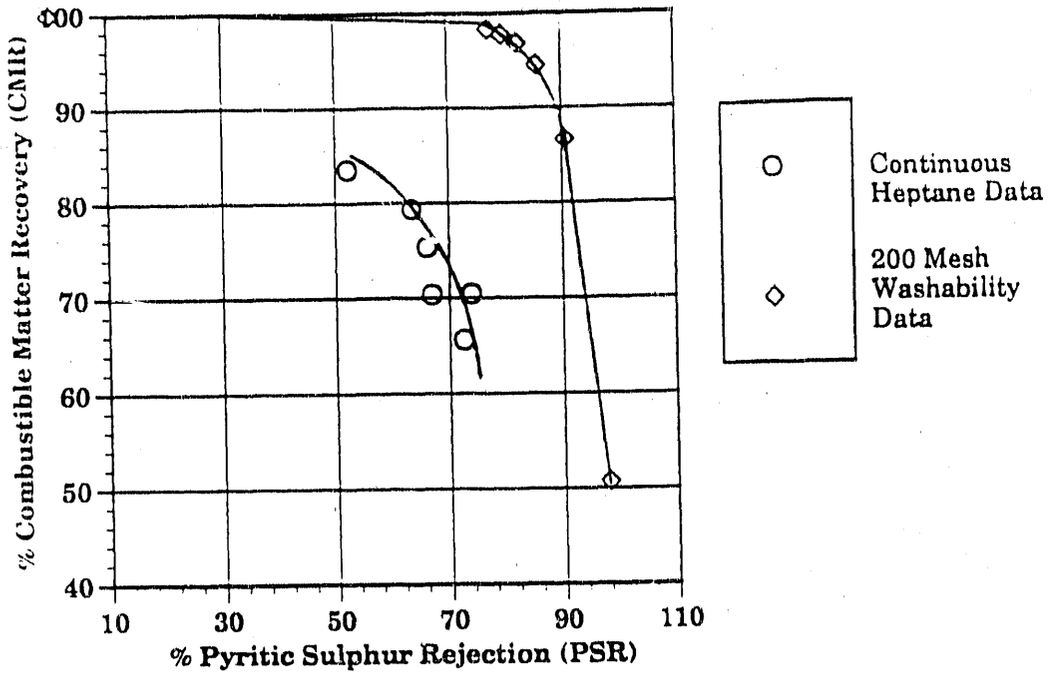


Figure 9-11 % Combustible Matter Recovery vs Pyritic Sulphur Rejection for Pittsburgh No. 8 Coal

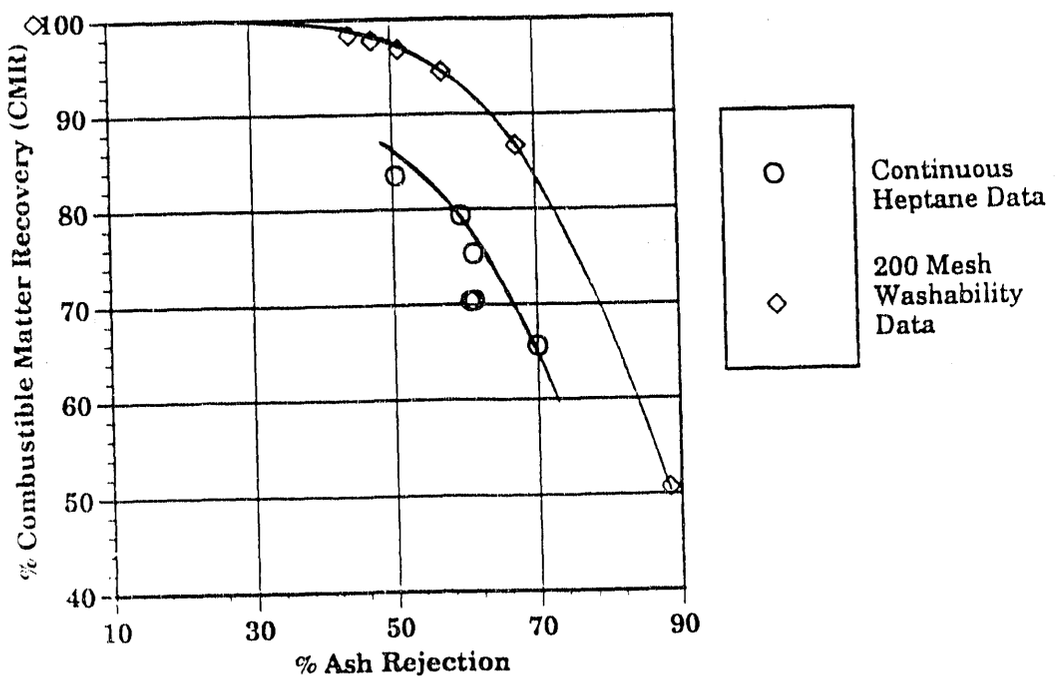


Figure 9-12 % Combustible Matter Recovery vs % Heptane Concentration in the High Shear Mixer for Upper Freeport Coal

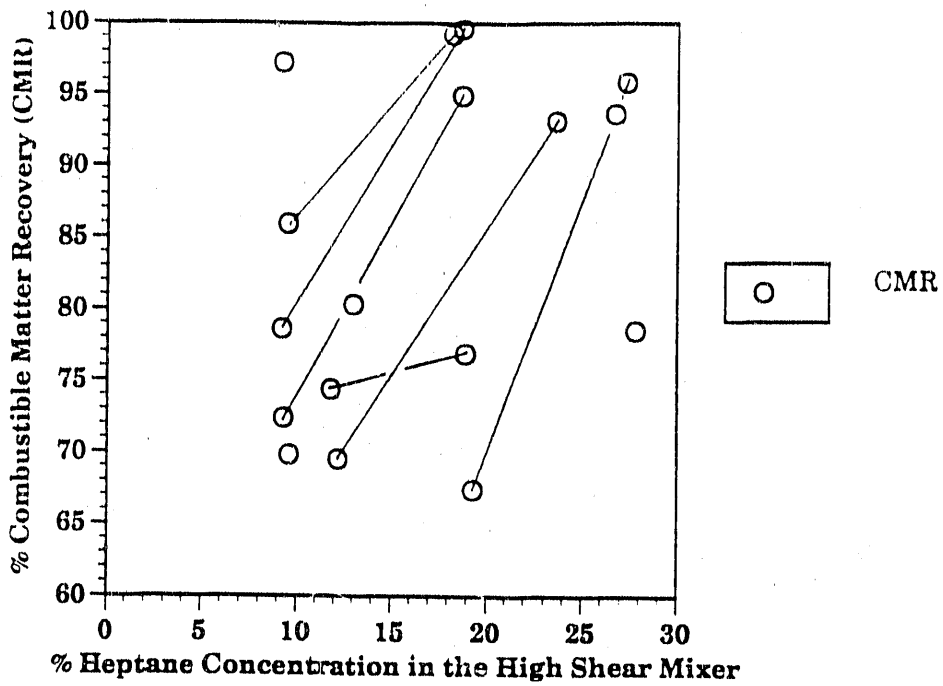


Figure 9-13 % Pyritic Sulphur Rejection vs % Heptane Concentration in the High Shear Mixer for Upper Freeport Coal

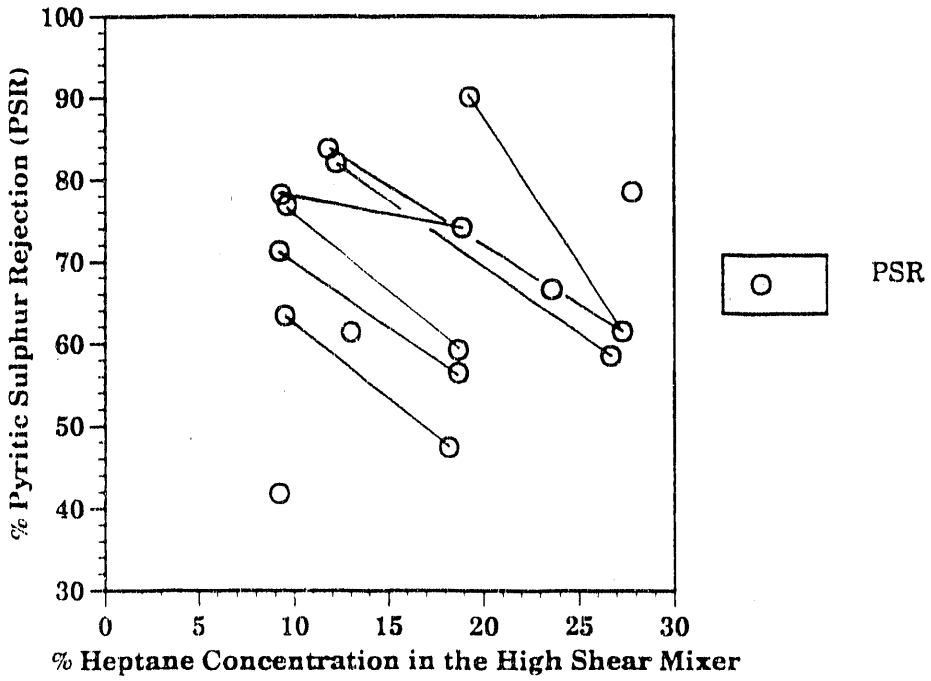


Figure 9-14 % Ash Rejection vs % Heptane Concentration in the High Shear Mixer for Upper Freeport Coal

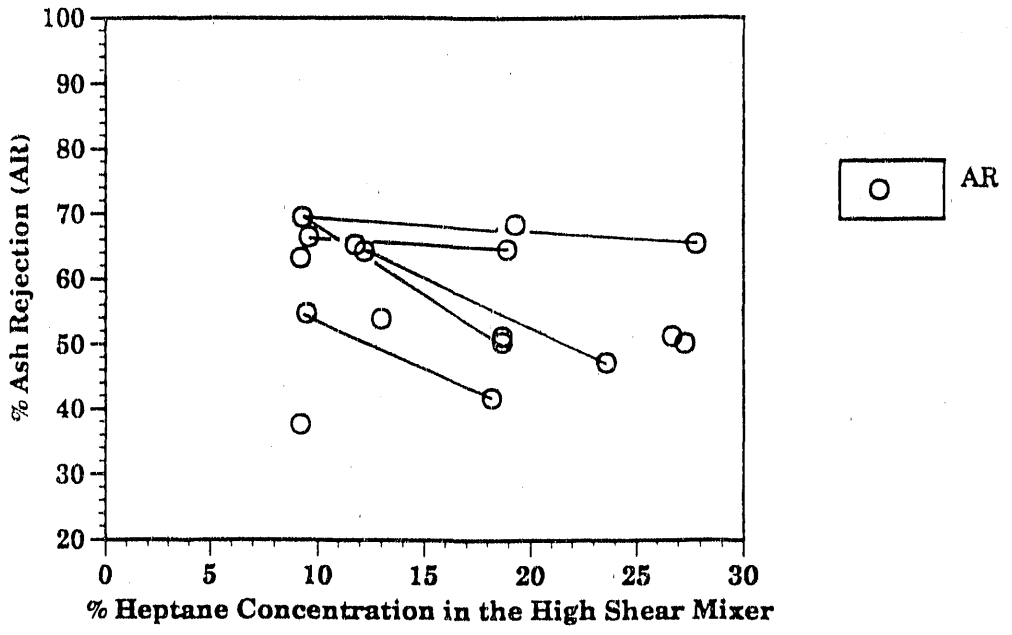


Figure 9-15 % Combustible Matter Recovery vs % Solids in the High Shear Mixer for Upper Freeport Coal

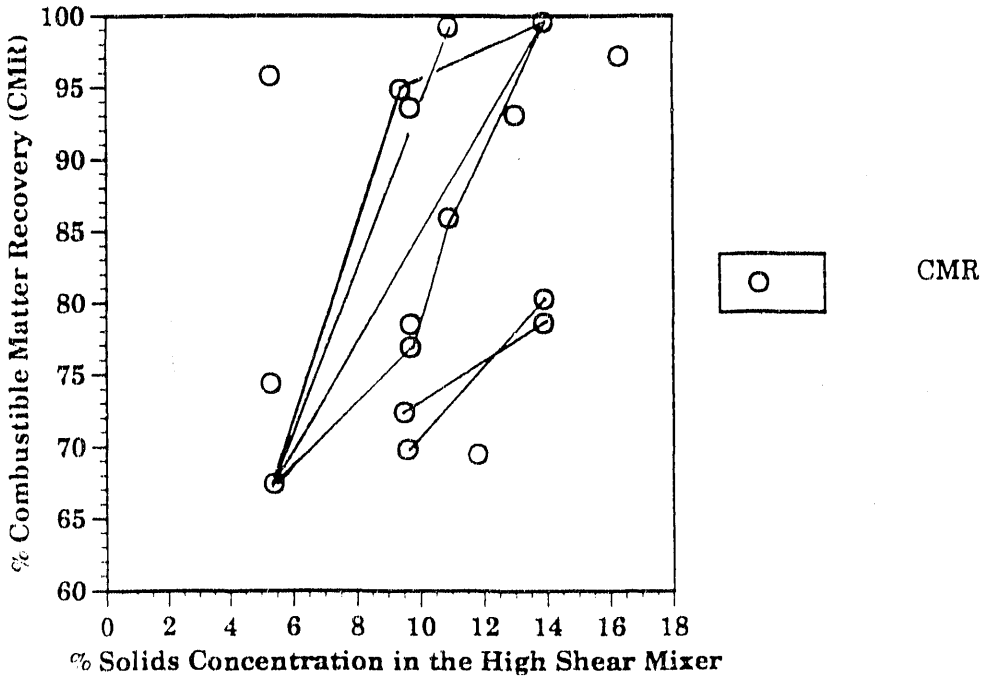


Figure 9-16 % Pyritic Sulphur Rejection vs % Solids in the High Shear Mixer for Upper Freeport Coal

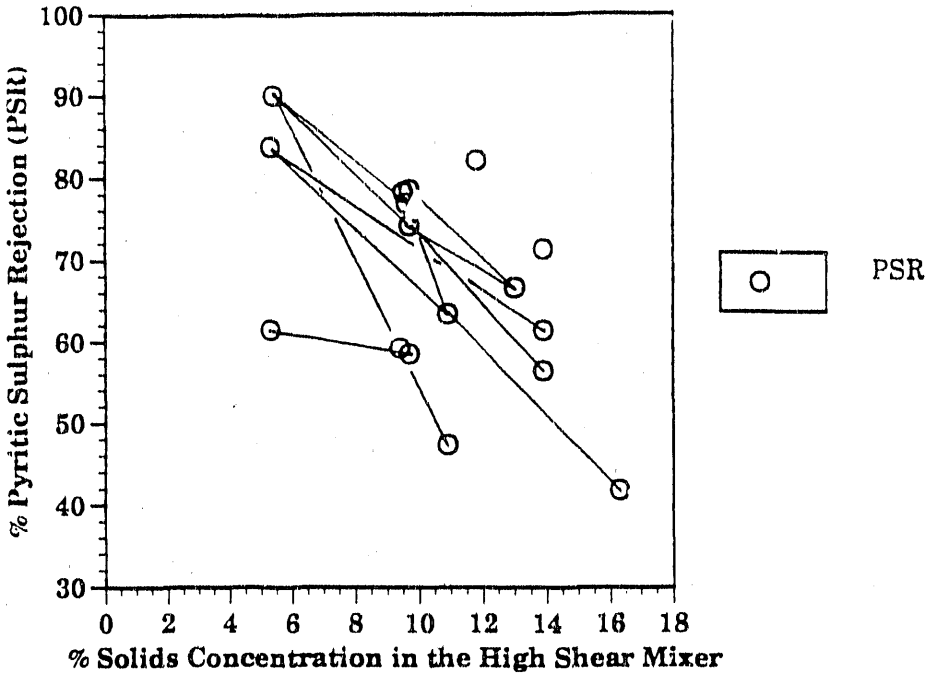


Figure 9-17 Ash Rejection vs % Solids in the High Shear Mixer for Upper Freeport Coal

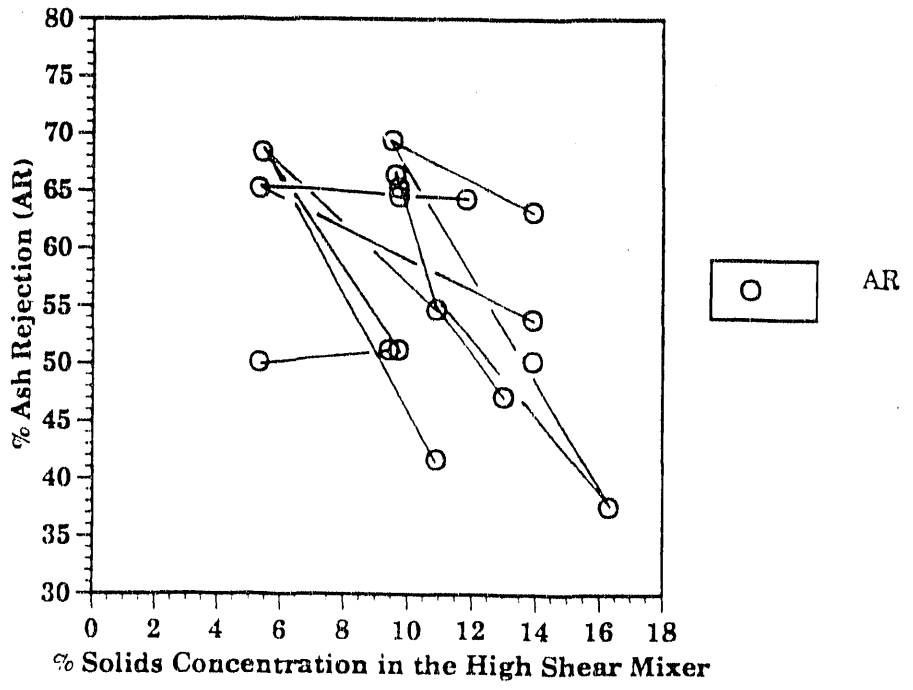


Figure 9-18 Combustible Matter Recovery vs Sieve Bend Water Loading Rate for Upper Freeport Coal

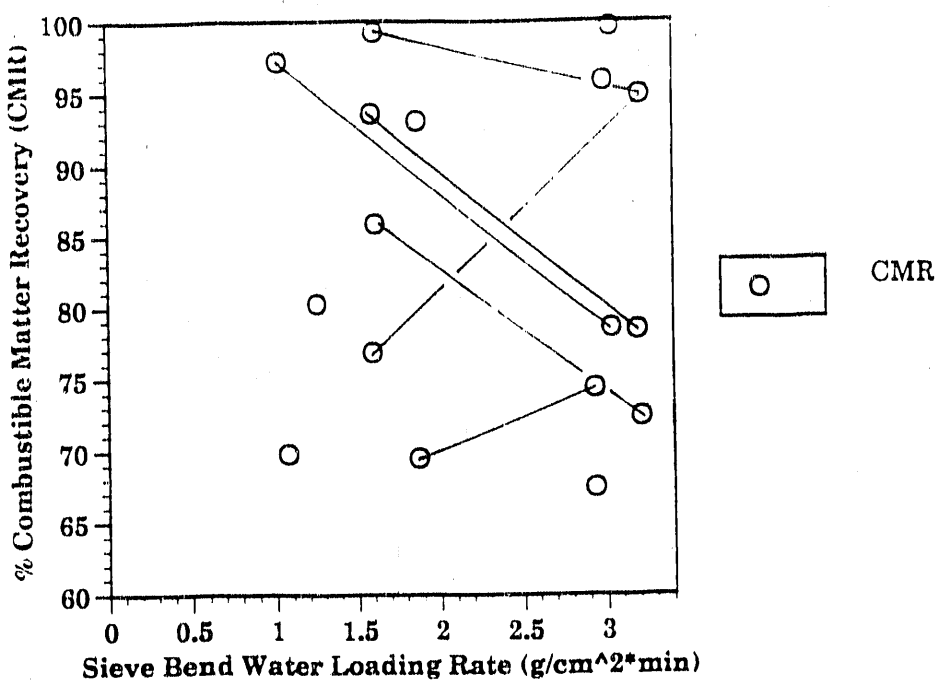


Figure 9-19 % Pyritic Sulphur Rejection vs Sieve Bend Water Loading Rate for Upper Freeport Coal

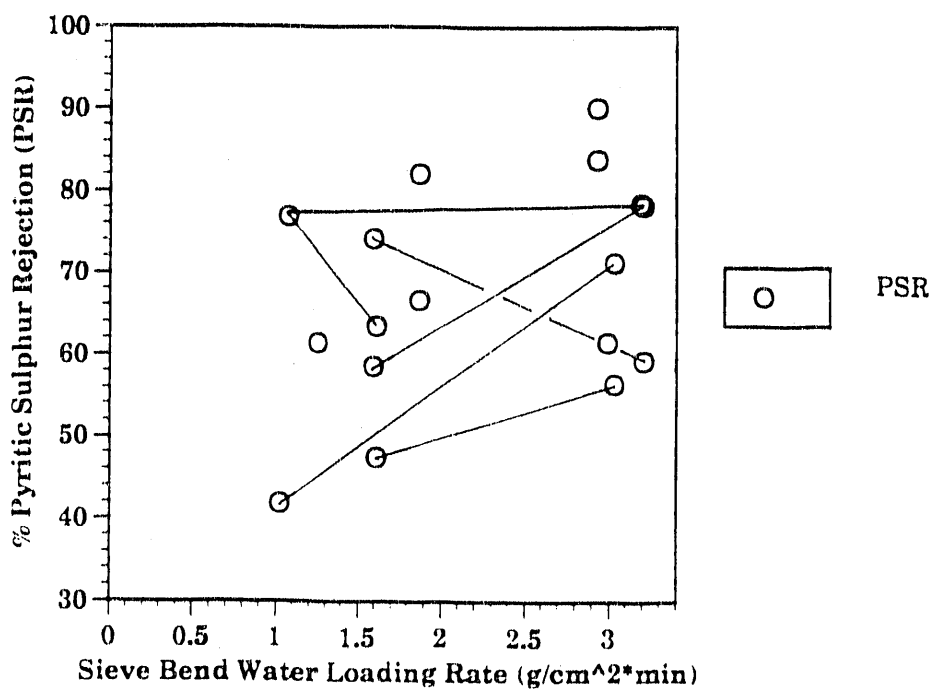


Figure 9-20 % Ash Rejection vs Sieve Bend Water Loading for Upper Freeport Coal

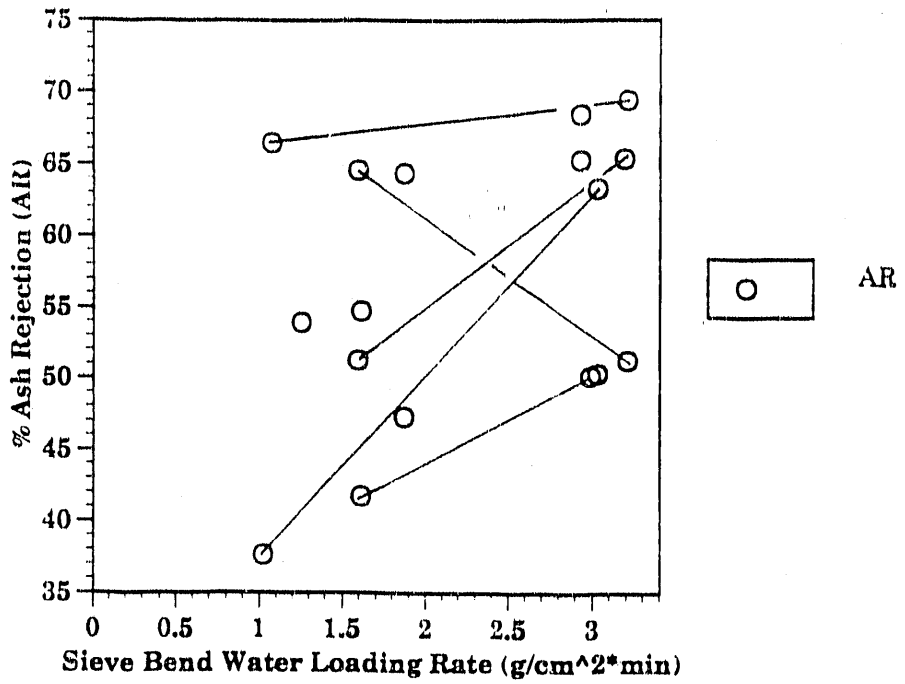


Figure 9-21 % Combustible Matter Recovery vs % Heptane Concentration in the High Shear Mixer for West Kentucky No. 9 Coal

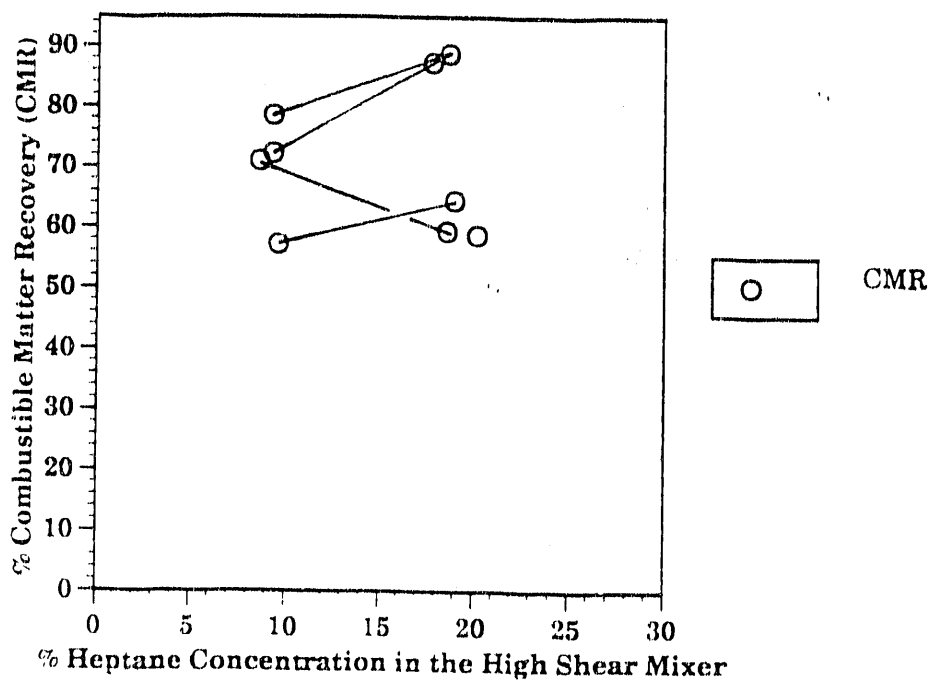


Figure 9-22 % Pyritic Sulphur Rejection vs % Heptane Concentration in the High Shear Mixer for West Kentucky No. 9 Coal

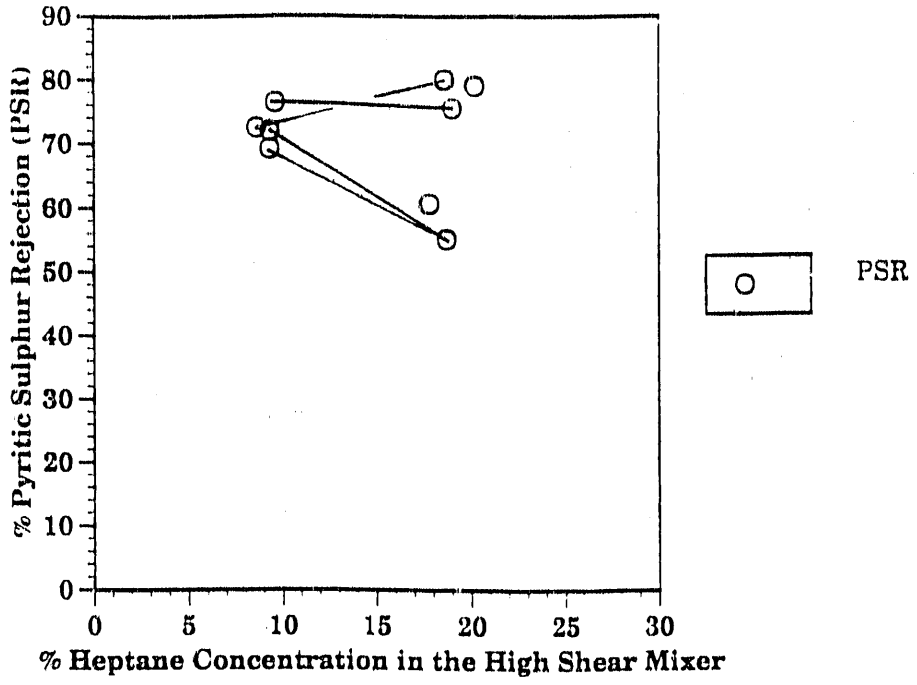


Figure 9-23 % Ash Rejection vs % Heptane Concentration in the High Shear Mixer for West Kentucky No. 9

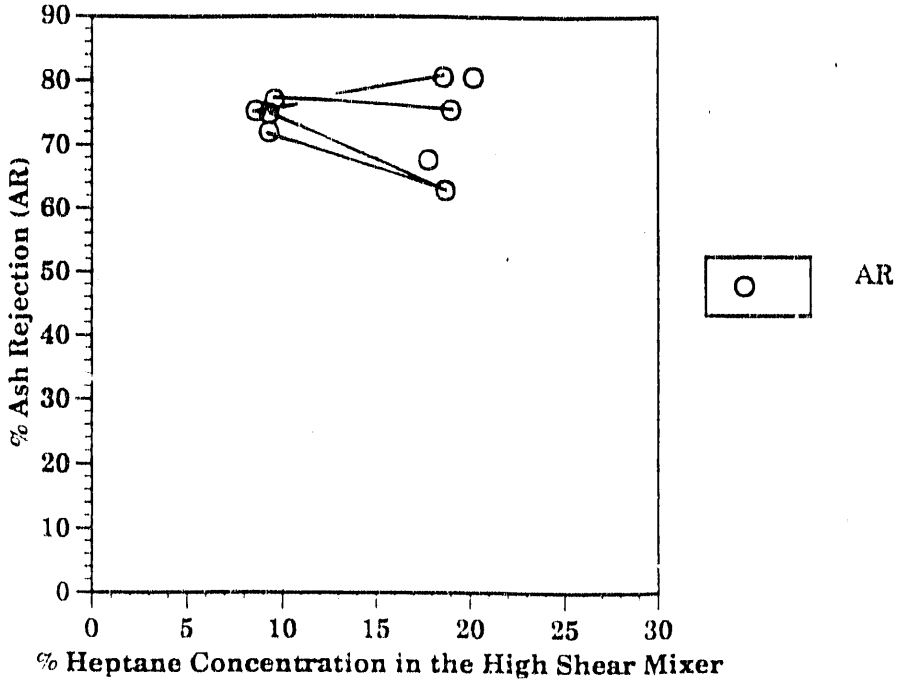


Figure 9-24 % Combustible Matter Recovery vs % Solids in the High Shear Mixer for West Kentucky No. 9 Coal

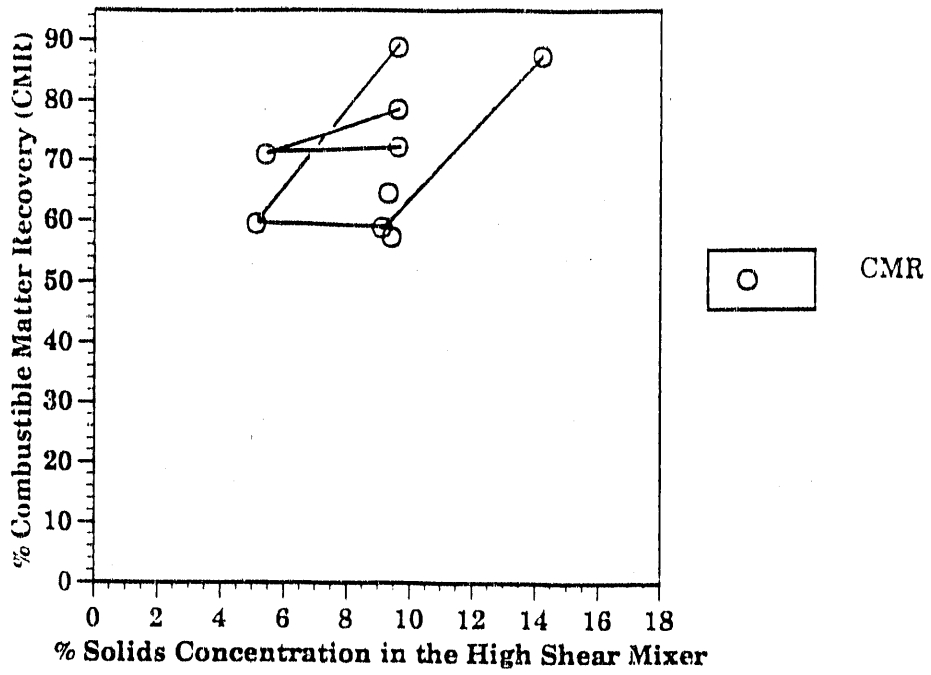


Figure 9-25 % Pyritic Sulphur Rejection vs % Solids in the High Shear Mixer for West Kentucky No. 9 Coal

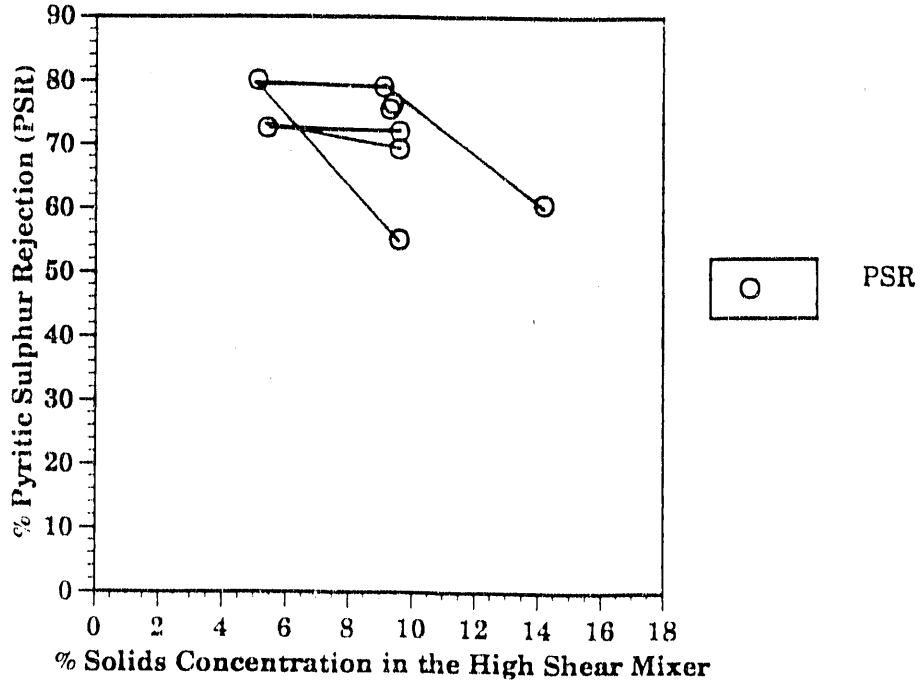


Figure 9-26 % Ash Rejection vs % Solids in the High Shear Mixer for West Kentucky No. 9 Coal

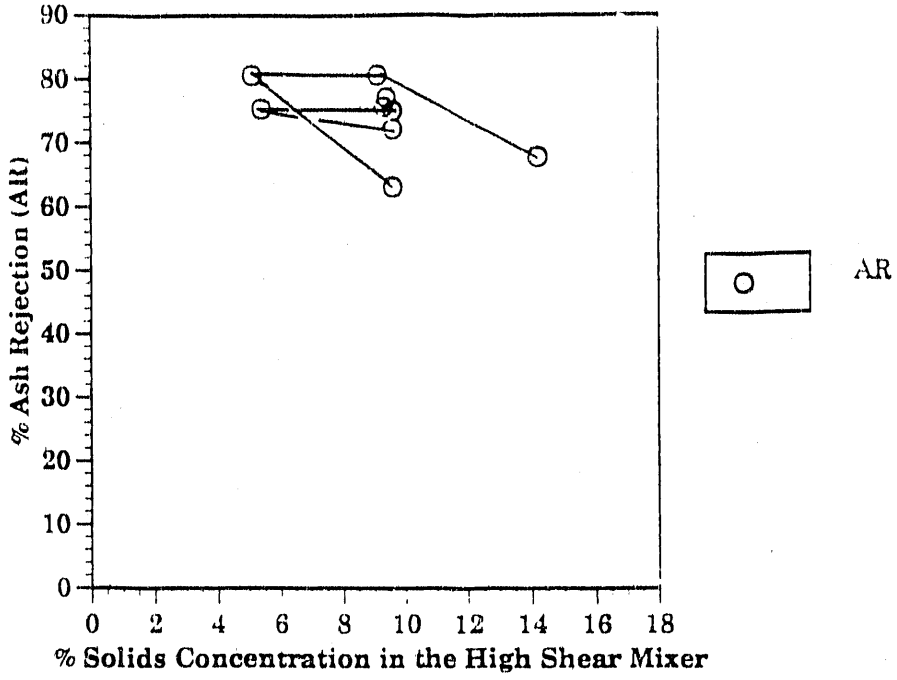


Figure 9-27 Combustible Matter Recovery vs Sieve Bend Water Loading Rate for West Kentucky No. 9 Coal

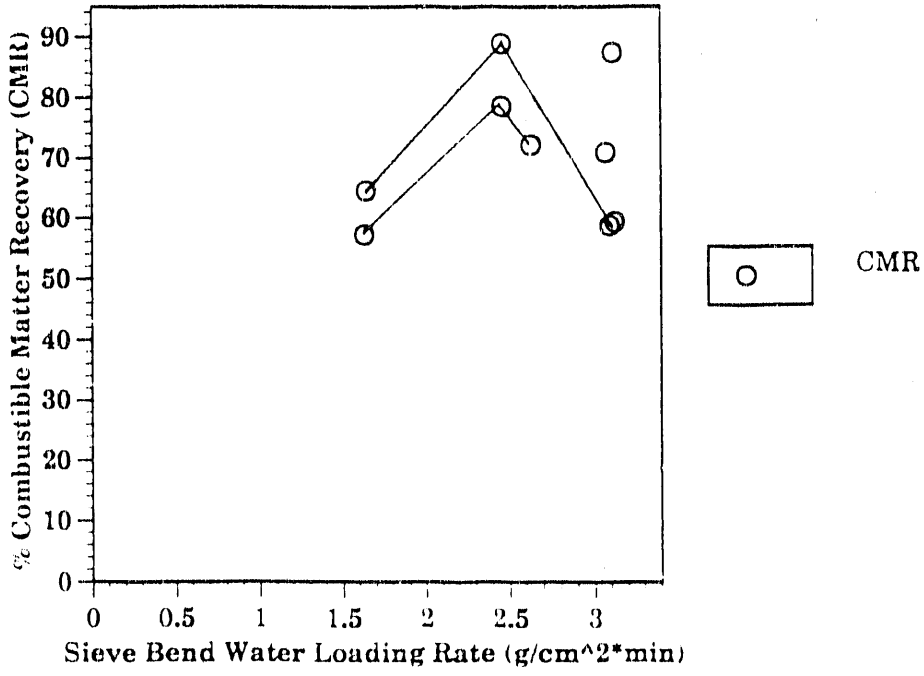


Figure 9-28 % Pyritic Sulphur Rejection vs Sieve Bend Water Loading Rate for West Kentucky No. 9 Coal

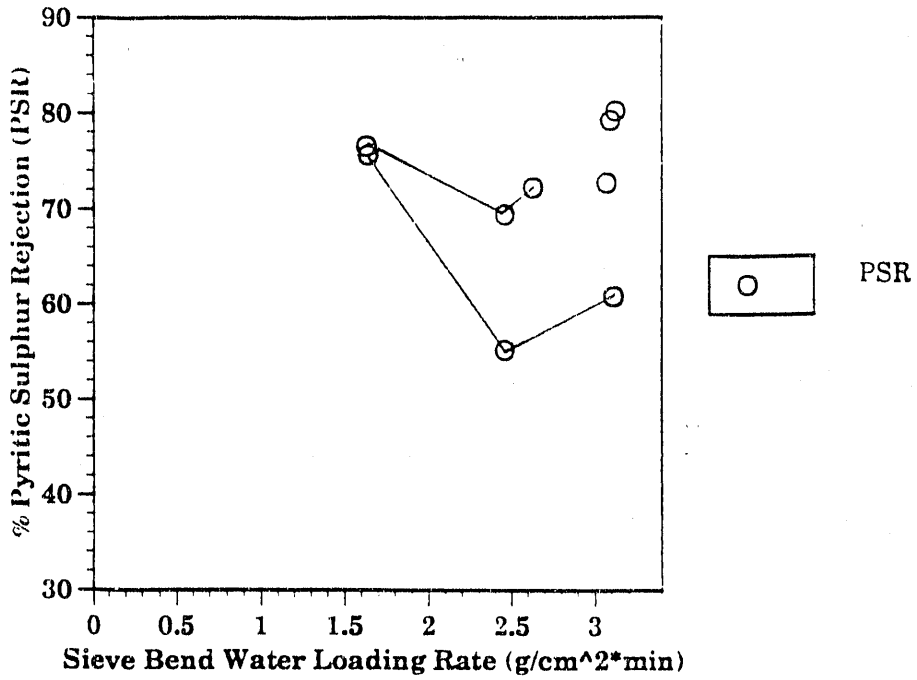


Figure 9-29 % Ash Rejection vs Sieve Bend Water Loading Rate for West Kentucky No. 9 Coal

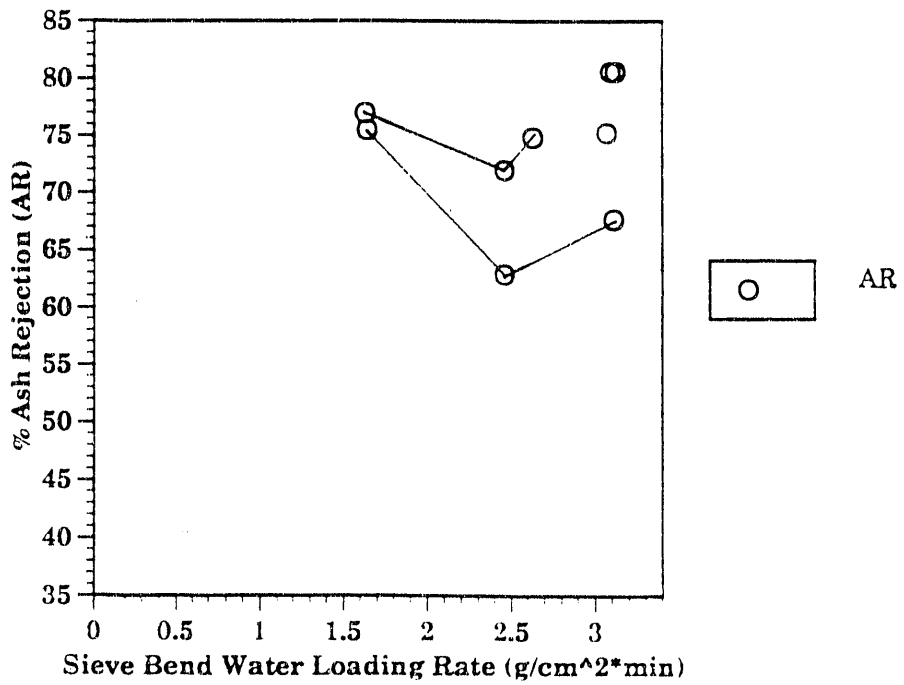


Figure 9-30 % Combustible Matter Recovery vs % Heptane Concentration in the High Shear Mixer for Pittsburgh No. 8 Coal

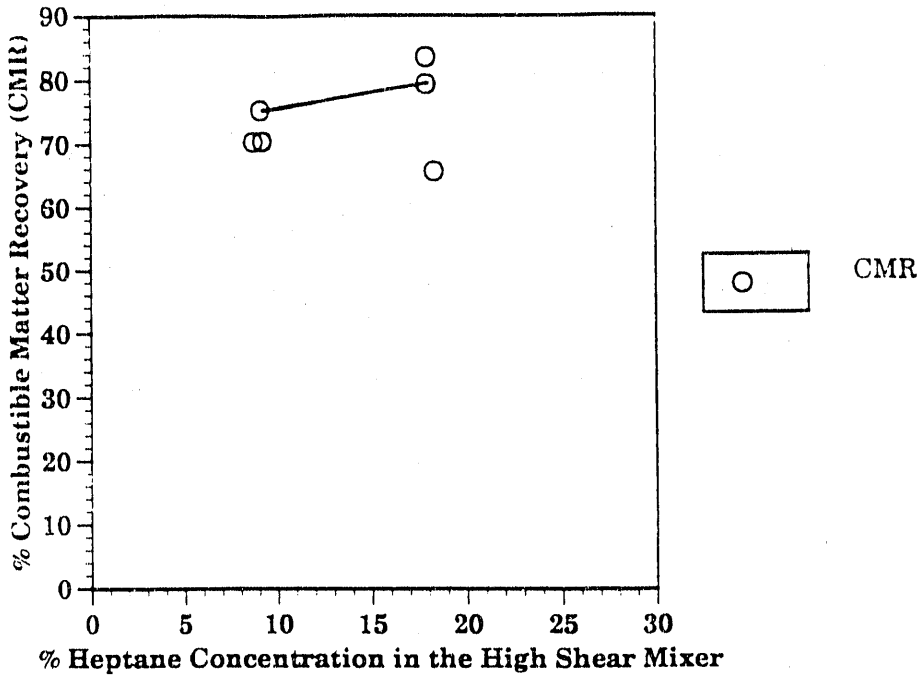


Figure 9-31 % Pyritic Sulphur Rejection vs % Heptane Concentration in the High Shear Mixer for Pittsburgh No. 8 Coal

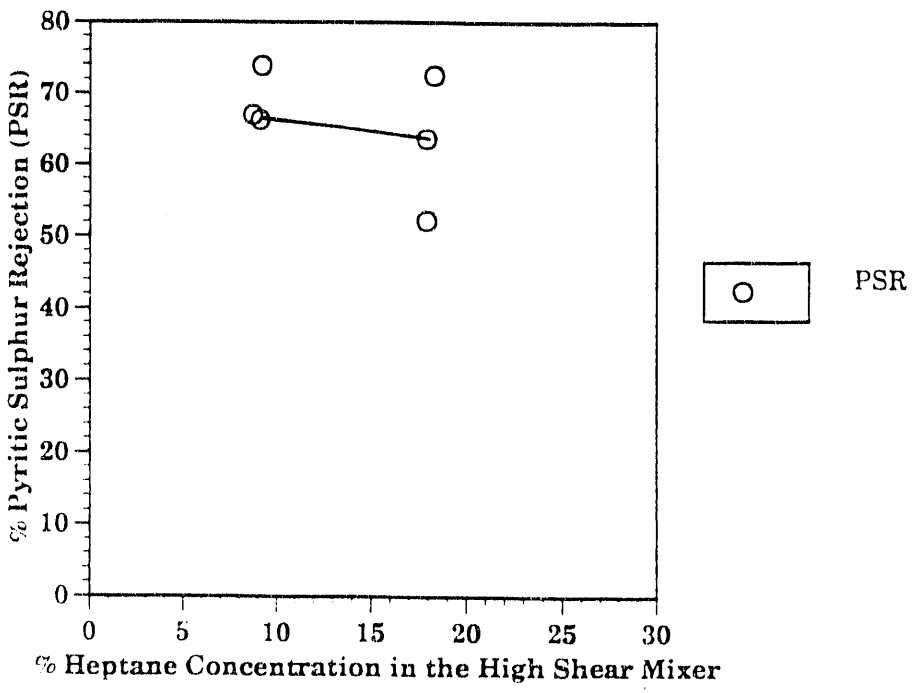


Figure 9-32 % Ash Rejection vs % Heptane Concentration in the High Shear Mixer for Pittsburgh No. 8 Coal

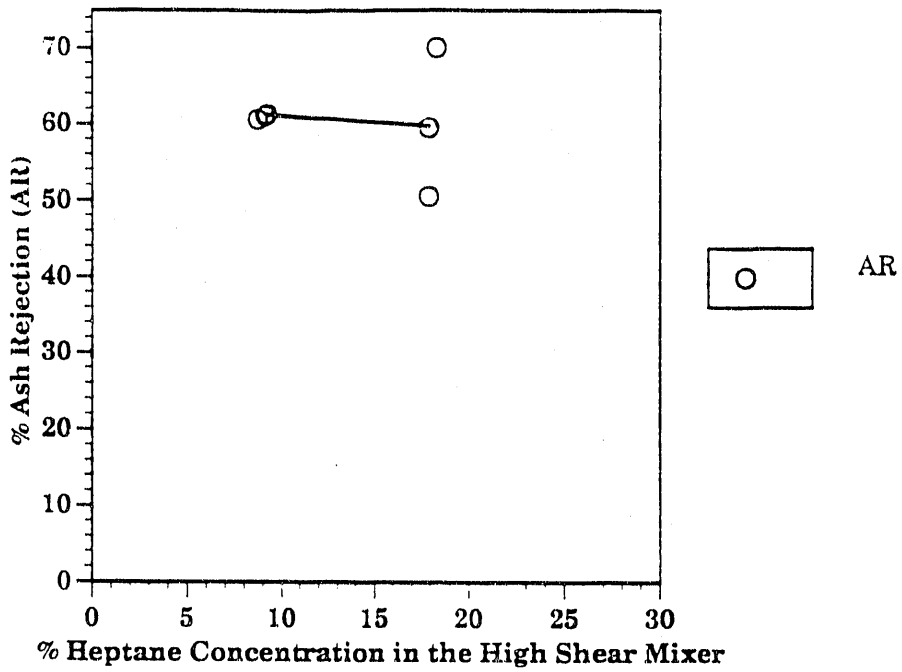


Figure 9-33 % Combustible Matter Recovery vs % Solids in the High Shear Mixer for Pittsburgh No. 8 Coal

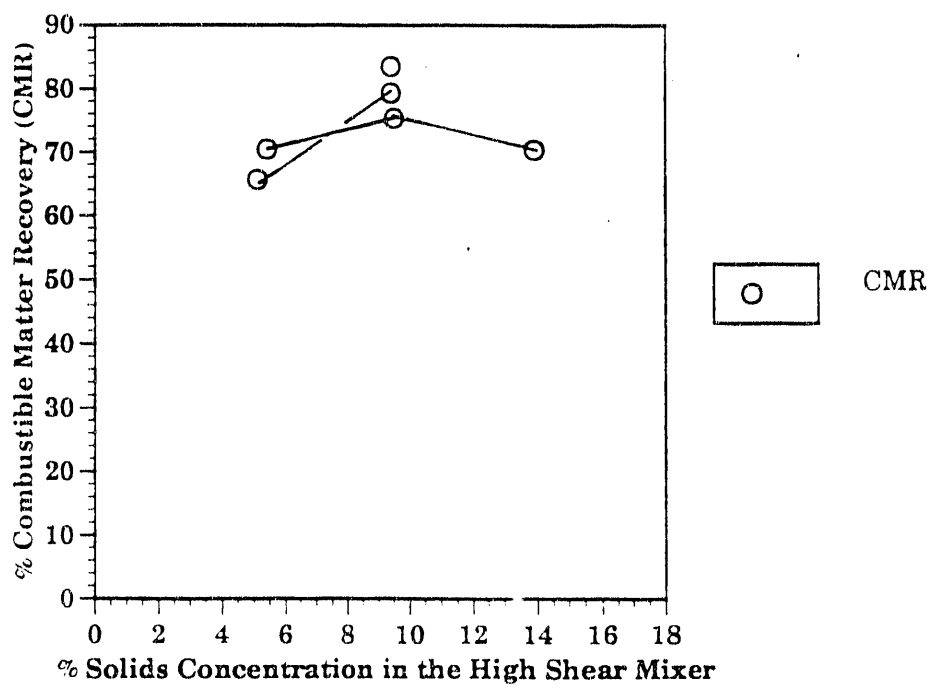


Figure 9-34 % Pyritic Sulphur Rejection vs % Solids in the High Shear Mixer for PIttsburgh No. 8 Coal

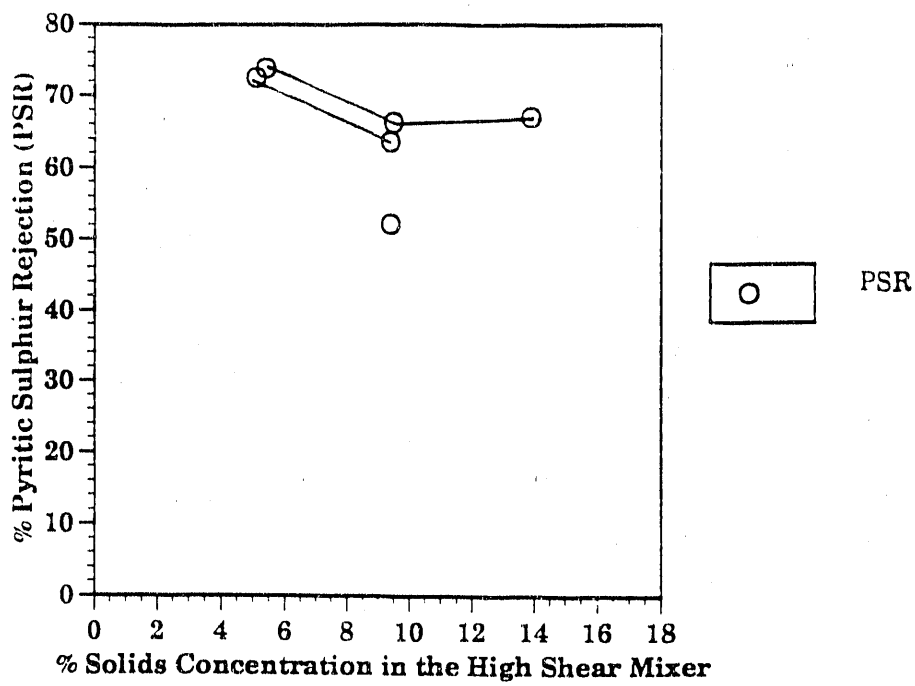


Figure 9-35 Ash Rejection vs % Solids in the High Shear Mixer for Pittsburgh No. 8 Coal

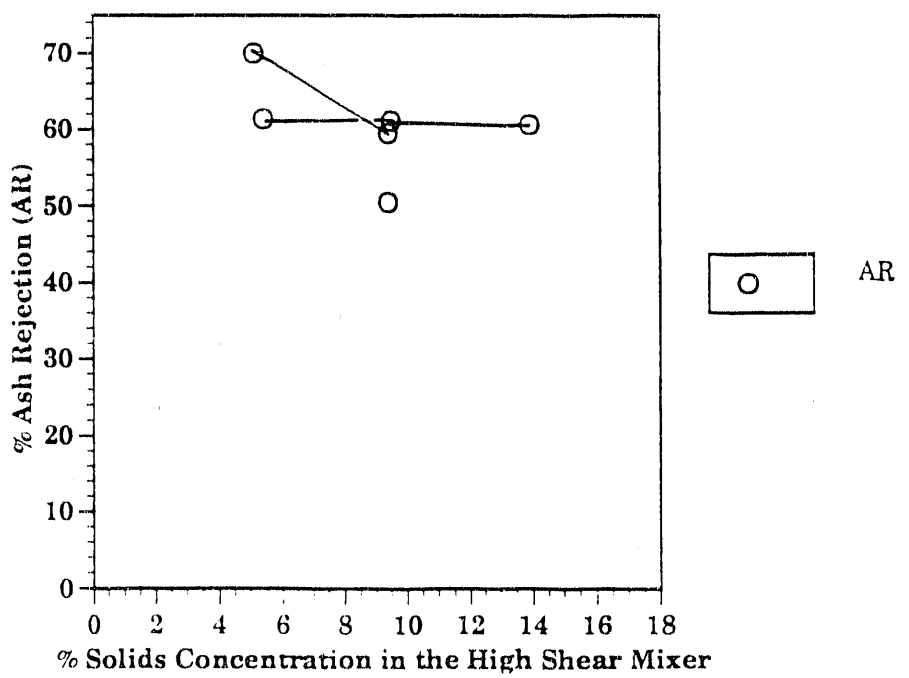


Figure 9-36 Combustible Matter Recovery vs Sieve Bend Water Loading Rate for Pittsburgh No. 8

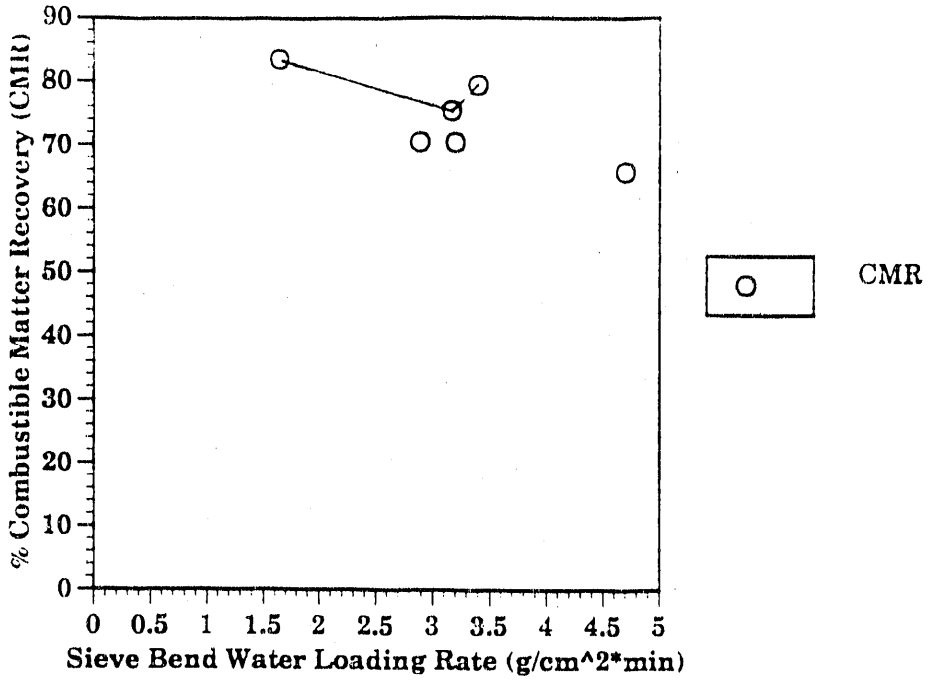


Figure 9-37 % Pyritic Sulphur Rejection vs Sieve Bend Water Loading Rate for Pittsburgh No. 8

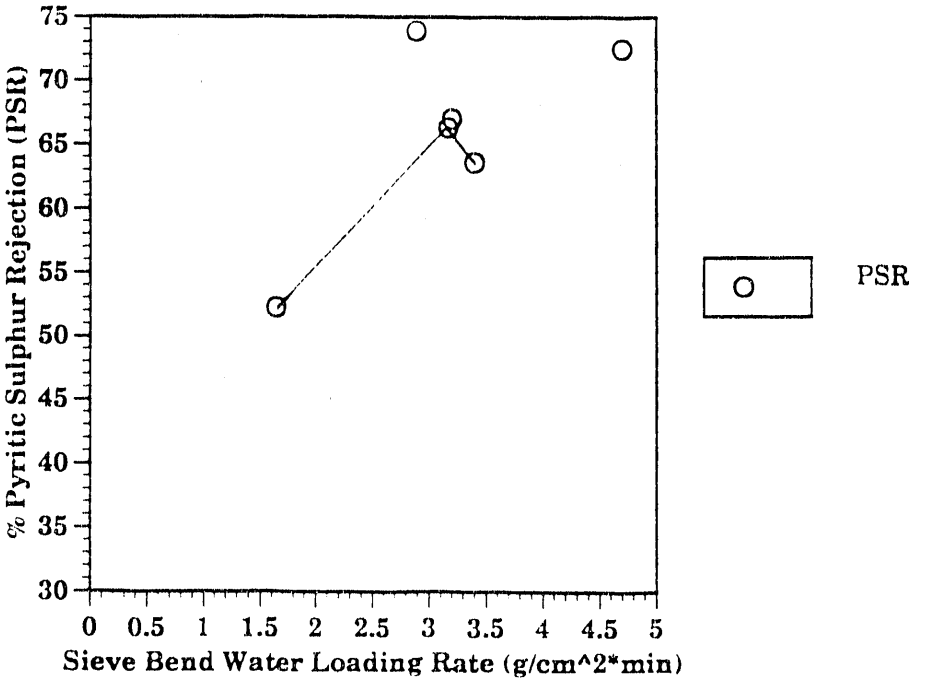
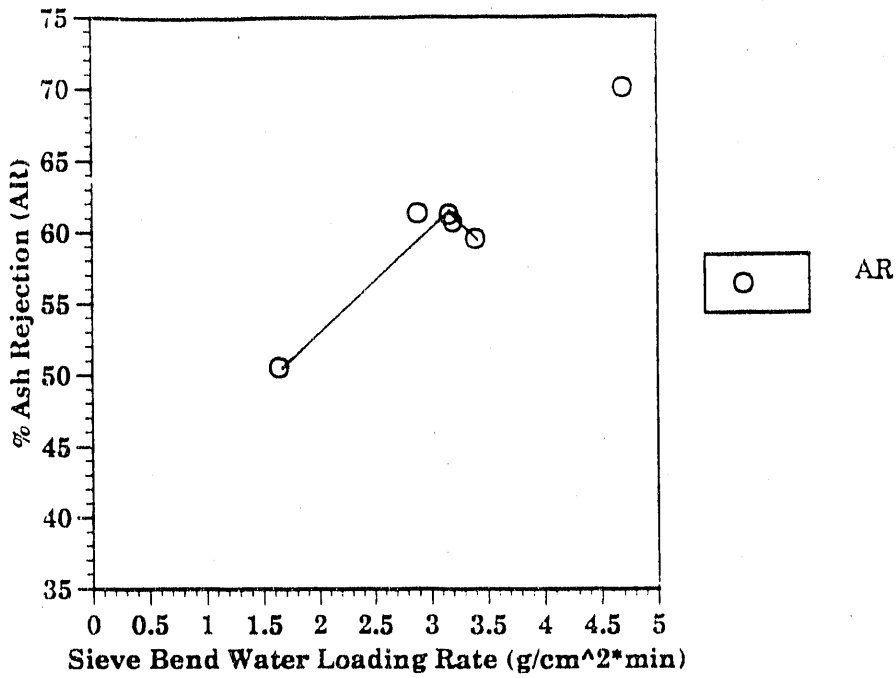


Figure 9-38 % Ash Rejection vs Sieve Bend Water Loading for Pittsburgh No. 8 Coal



10.0 CONTINUOUS LOW-SHEAR OPERATION

10.1 Summary of Test Plan

A factorial design test plan was developed to investigate the effect of several variables on production of agglomerates in a continuous low-shear operation. The main variables investigated were:

- Binder type
- Binder concentration
- Coal particle size
- Low-Shear residence time

Binder types studied in this work were AC-5 Asphalt and Cold Lake Bitumen blended with diesel at ratios of 1:1 and 3:1. Asphalt emulsion was originally included in the test plan, however, since the CDTF operation was using asphalt/diesel blends only, no experiments were performed using this material. Three binder concentrations of 8%, 10%, and 12% and two coal particle sizes of 28 mesh and 100 mesh were used in the experiments. Residence times of 30 minutes and 60 minutes were selected for the low-shear operation.

Coal type, coal slurry solids concentration, mixer set up and processing configuration were fixed for all tests. Upper Freeport coal was utilized as the test coal and solids concentration was set at 25%. Mixer set up, such as impeller type, number of baffles, etc., were kept the same for all tests. Low-shear mixer RPM was set at 1050 for all tests except for the experiment with higher input power (1600 RPM). The measured power input at 1050 RPM corresponded to about 20 Watts/litre. The high-shear mixing followed by low-shear mixing process configuration was also maintained for all tests.

Forty tests were planned for the continuous low-shear testing program, including a limited number of tests to examine higher power input to the low-shear mixer. Due to limited AC-5 binder supply

and the results achieved, 18 key tests were completed. The information was judged sufficient to provide data for the evaluation of the continuous low-shear operation on a preliminary basis.

10.2 Coal Feedstock for Continuous Low-Shear Tests

Coal feedstock for the continuous low-shear test program was conditioned in a high-shear vessel with 1% addition of diesel (based on dry coal solids) prior to feeding to the low-shear operation. The purpose of this was to simulate processing conditions in larger scale continuous operations, with the exception of the froth flotation process. The flotation step was not included as part of the continuous test procedure because: a) the flotation process would make it difficult to control processing conditions, namely maintaining consistent solids concentration of the slurry feeding into the low-shear operation and b) the high-shear step was considered more critical than flotation for evaluating the continuous low-shear operation due to its role in conditioning the coal.

Coal slurry solids concentration was maintained at 25% for all tests. This solids content was selected because it reflected a typical level of solids that would be produced by the flotation process in actual large scale testing.

10.3 Effect of Operating Variables

The results of the continuous low-shear tests are given in Table 10-1. These results show the mean agglomerate size d_{50} that was produced using AC-5 and Cold Lake Bitumen binders at the given operating conditions after five complete low-shear mixer volume changes. Five volume changes were allowed to permit conditions in the mixer to stabilize.

Table 10-1

RESULTS OF CONTINUOUS LOW-SHEAR TESTS

Binder Type	Binder/Diesel Blend Ratio	Coal Size (mesh)	Coal d_{50} (mm)	Binder Addition to Low-Shear (%, db)	Low-Shear Residence Time (min)	Low-Shear Mixer RPM	Product Agglomerate d_{50} (mm)
AC-5	1:1	100	0.092	12	30	1050	1.92
AC-5	1:1	100	-	10	30	1050	0.34
AC-5	3:1	100	-	12	30	1050	no growth observed
CLB	1:1	100	0.052	12	30	1050	0.81
CLB	1:1	100	-	12	60	1050	1.60
CLB	1:1	100	-	10	30	1050	0.50
CLB	1:1	100	-	10	60	1050	0.35
CLB	3:1	100	-	12	30	1050	no growth observed
CLB	3:1	100	-	12	60	1050	no growth observed
CLB	3:1	100	-	12	30	1600	1.17
AC-5	1:1	28	0.120	8	30	1050	0.69
AC-5	3:1	28	-	8	30	1050	no growth observed
CLB	1:1	28	0.123	10	30	1050	1.76
CLB	1:1	28	-	10	30	1050	3.67
CLB	1:1	28	-	8	30	1050	1.18
CLB	1:1	28	-	8	60	1050	0.96
CLB	3:1	28	-	8	30	1050	no growth observed
CLB	3:1	28	-	8	60	1050	micro-agglomerates observed

10.3.1 Effect of Binder Type

Figure 10-1 shows the effect of binder type on agglomerate size for the continuous low-shear operation. Results are given in Table 10-2. For both the AC-5 asphalt and Cold Lake Bitumen binders, blends of 3:1 (binder:diesel) performed poorly. No production of agglomerates was observed for either the 28 mesh or 100 mesh feed coal sizes at 30 minutes of low-shear residence time. Binder blends of 1:1 with diesel performed much better. Agglomerates ranging in size from 0.69 to 1.92 mm were produced from the 28 mesh and 100 mesh coal sizes depending on the amount of binder added. The proportion of diesel in the binder blends appears to strongly influence the performance.

Table 10-2

CONTINUOUS LOW-SHEAR TEST RESULTS
BINDER TYPE VS AGGLOMERATE SIZE
(30 minute Low-Shear Residence Time)

Binder	Coal Size (Mesh)	Binder Addition to Low-Shear (%)	Product Agglomerate d_{50} (mm) 1:1 blend	3:1 blend
AC-5	100	12	1.92	no growth observed
AC-5	28	8	0.69	no growth observed
CLB	100	12	0.81	no growth observed
CLB	28	8	1.18	no growth observed

10.3.2 Effect of Binder Content

The effect of binder content on agglomerate size is shown in Figure 10-2. Results are given in Table 10-3. These results were obtained for binder-diesel blends of 1:1 at 30 minutes low-shear residence time. The results show that for both AC-5 and CLB, the agglomerate size increased in response to an increase in binder content. For the AC-5 binder and 100 mesh coal, an

increase in agglomerate size of more than five times (d_{50} of 0.34 vs 1.92 mm) was observed when the binder content was increased from 10% to 12%. Identical test with CLB resulted in a similar trend but with lower corresponding increase in agglomerate size (d_{50} 0.50 vs 0.81).

Table 10-3

CONTINUOUS LOW-SHEAR TEST RESULTS
BINDER CONTENT VS AGGLOMERATE SIZE
(Binder Blend 1:1, 30 minutes Low-Shear Residence Time)

Binder	Coal Size (mesh)	Product Agglomerate d_{50}(mm) 8%	10%	12%
AC-5	100	-	0.34	1.92
AC-5	28	0.69	-	-
CLB	100	-	0.50	0.81
CLB	28	1.18	1.76	-

10.3.3 Effect of Coal Particle Size

Figure 10-3 shows the effect of initial coal size on agglomerate size. Tests were performed using CLB 1:1 binder at an addition rate of 10%. The test results are contained in Table 10-4. These results indicate that at the same binder addition rate, agglomerates produced from the 28 mesh initial coal size were significantly larger than agglomerates produced from the 100 mesh initial size, at both low-shear residence times. Depending on the residence time, agglomerates produced using the 28 mesh coal were 3.5 to 10 times larger than those produced under the same conditions using 100 mesh coal.

Table 10-4

CONTINUOUS LOW-SHEAR TEST RESULTS
INITIAL COAL SIZE VS AGGLOMERATE SIZE
(Cold Lake Bitumen 1:1, 10% Binder Addition to Low-Shear)

Low-Shear Residence Time (min)	Product Agglomerate d_{50} (mm) 100 mesh coal	28 mesh coal
30	0.50	1.76
60	0.35	3.67

10.3.4 Effect of Low-Shear Residence Time

The effect of operating the continuous low-shear at 30 and 60 minutes residence times is shown in Figure 10-4. These results, given in Table 10-5, are based on using CLB 1:1 as binder. The results indicated that extended low-shear residence times can either benefit the production of larger size agglomerates or be of no further aid in increasing the size of agglomerates, depending on the level of binder addition to the low-shear operation. For the 100 mesh initial size coal at the 12% level of binder addition, agglomerate size increased from 0.81 to 1.60 mm (d_{50}) by extending low-shear residence time from 30 to 60 minutes. However at the 10% level of binder addition, extending the mixing time from 30 to 60 minutes resulted in a reduction of agglomerate size by about 30% (0.50 to 0.35 mm). This same trend was observed for 28 mesh coal at 10% and 8% levels of binder addition.

Table 10-5

CONTINUOUS LOW-SHEAR TEST RESULTS
LOW-SHEAR RESIDENCE TIME VS AGGLOMERATE SIZE
(Cold Lake Bitumen 1:1)

Binder Addition to Low-Shear (%)	Coal Size (mesh)	Product Agglomerate d_{50} (mm) 30 min	60 min
10	100	0.50	0.35
12	100	0.81	1.60
8	28	1.18	0.96
10	28	1.76	3.67

10.3.5 Other Variables

A single continuous low-shear test was performed to observe the effect of increased power input into the low-shear mixer. Power input was determined as the difference between the measured power draw when the mixer was operated empty and when it was operated full of coal slurry, at the same rotational speed.

For this test, CLB 3:1 at an addition level of 12% and 100 mesh initial coal size were used. The results are shown in Figure 10-5. At a power input of about 60 Watts/litre or approximately three times the standard power input for the other continuous low-shear tests, and 30 minutes low-shear residence time, agglomerates of size 1.17 mm were produced in comparison to no agglomerate growth at the standard power input. While only a single test was performed, there is indication that a higher power input into the low-shear mixer could be beneficial towards producing agglomerates from binders having lower diesel composition.

10.3.6 Preliminary Comparison with Batch Low-Shear Data

Table 10-6 and Figure 10-6 contains comparative data for batch and continuous low-shear tests. These results are for tests performed using AC-5 and CLB binders at blends of 1:1 with diesel, 28 mesh initial coal size, and 30 and 60 minutes of low-shear residence time.

Table 10-6

COMPARISON OF BATCH AND CONTINUOUS LOW-SHEAR TEST RESULTS
28 Mesh Upper Freeport Coal

Binder Type	Total Binder Addition* (%)	Low-Shear Residence Time (min)	Agglomerate d_{50} (mm) Batch	Agglomerate d_{50} (mm) Continuous
AC-5 + Diesel (1:1)	10.4	30	0.48	-
AC-5 + Diesel (1:1)	10.4	60	0.59	-
AC-5 + Diesel (1:1)	9.0	30	-	0.69
CLB + Diesel (1:1)	9.0	30	0.48	1.18
CLB + Diesel (1:1)	9.0	60	0.54	0.96
CLB + Diesel (1:1)	11.0	30	1.87	1.76
CLB + Diesel (1:1)	11.0	60	2.20	3.67

*Includes 1% addition of diesel in high-shear for continuous tests.

For the AC-5 binder, given the same low-shear residence times, agglomerates produced from the continuous low-shear operation using 9% total binder addition (total binder addition includes the 1% diesel added to the high-shear process) were larger in size than agglomerates produced in the batch operation at a higher rate of 10.4% binder addition. For CLB binder at addition levels of 9% and 11% and residence times of 30 and 60 minutes, in all but one of the tests (11%, 30 min.), agglomerates produced by the continuous low-shear operation had a d_{50} of 1.5 to 2.5 times larger than those produced in batch tests.

These preliminary test results indicate that batch and continuous low-shear operations produce different size agglomerates under similar processing conditions. Agglomerates produced from a continuous operation low-shear can be significantly larger than those produced from a batch operation.

10.4 Conclusion for Continuous Operation Low-Shear Tests

A list of preliminary conclusions from the evaluation of the test results obtained is given below:

- Agglomerates produced from a continuous low-shear operation can differ significantly from agglomerates produced by batch operation in terms of size. Test results showed that less binder is required in the continuous operation to produce agglomerates of similar size to the batch operation.
- At similar binder addition levels, agglomerates produced in the continuous operation were up to 2.5 times larger than agglomerates produced in a batch operation.
- Binder-diesel blends in ratio 3:1 were ineffective for both AC-5 asphalt and Cold Lake Bitumen at standard test conditions. Binder compositions of 1:1 produced agglomerates much more readily in the continuous low-shear operation.
- 100 mesh coal required 2% to 4% more binder than 28 mesh coal to produce agglomerates of similar size.
- Increased low-shear residence time was only beneficial in terms of increasing the size of agglomerates at the higher binder addition rates of 12% and 10% for 100 mesh and 28 mesh coal sizes respectively. No beneficial effect was observed at the lower binder addition levels.

- Increased power input into low-shear was beneficial in producing agglomerates using the 3:1 CLB binder composition.

Figure 10-1
Effect of Binder Type on Agglomerate Size
(30 Minute Low-Shear Residence Time)

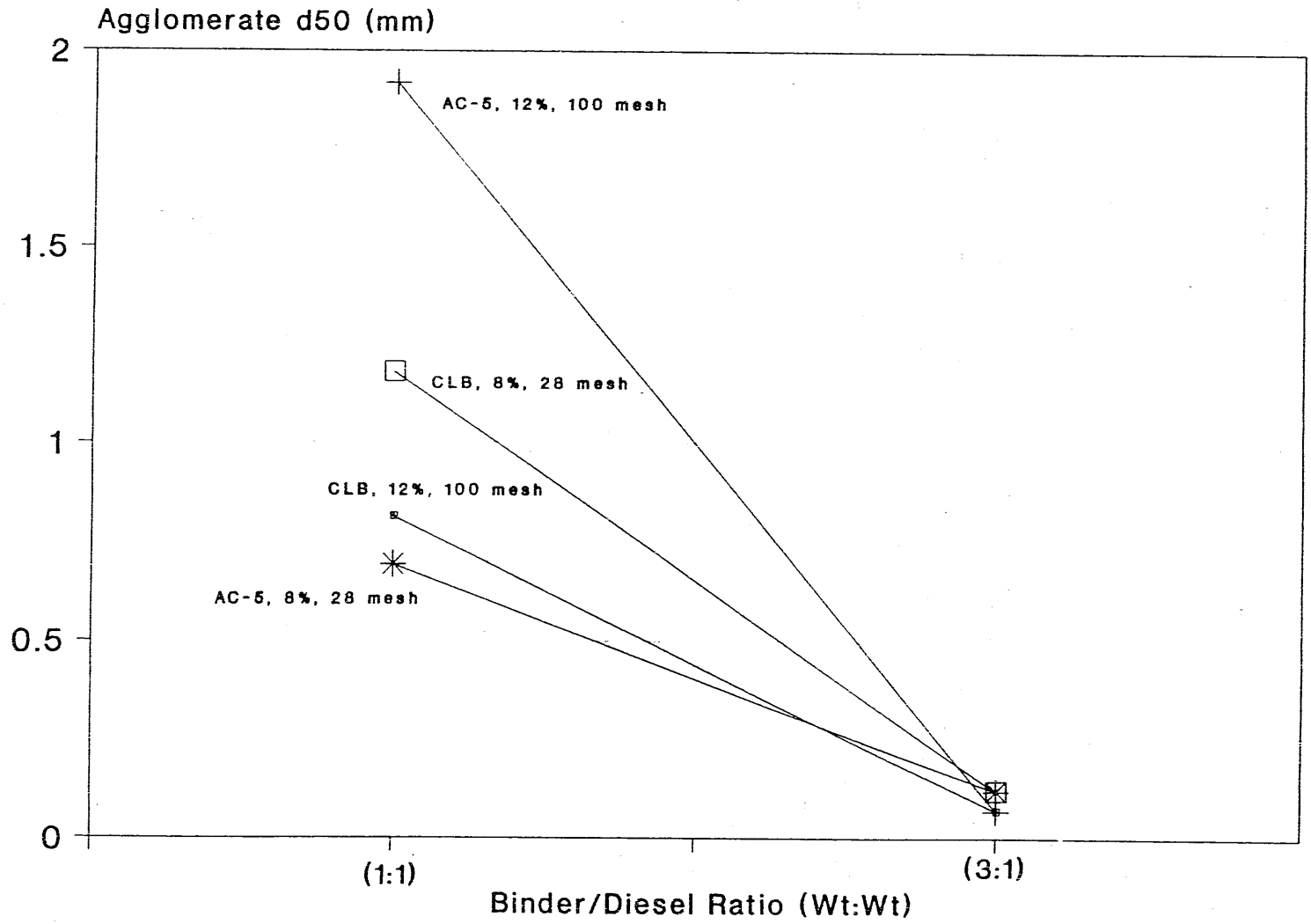


Figure 10-2
Effect of Binder Content on Agglomerate Size
(1:1 Binder Blends, 30 Minute Low-Shear Residence Time)

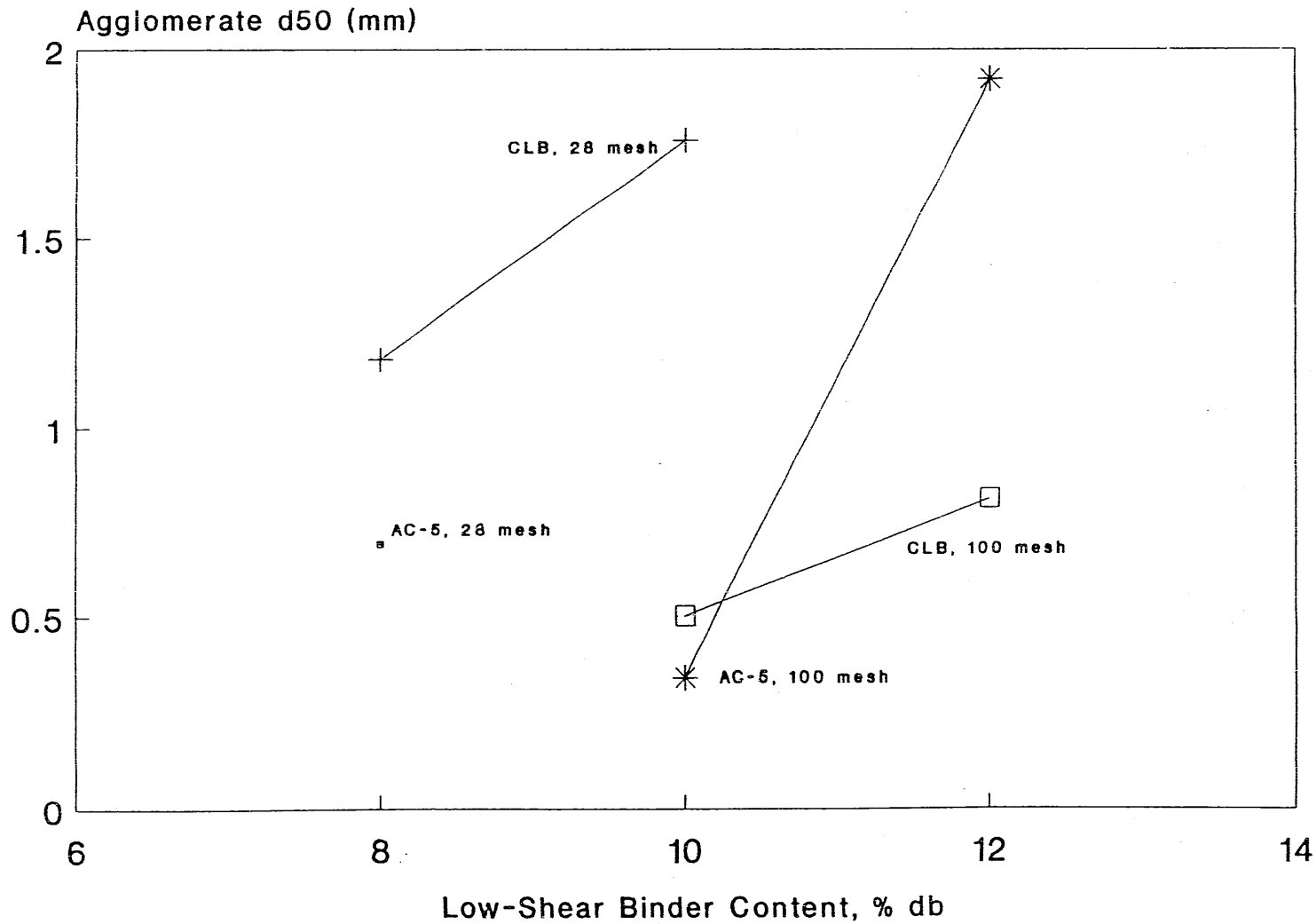


Figure 10-3
Effect of Initial Coal Size on Agglomerate Size
(CLB 1:1, 10% Addition)

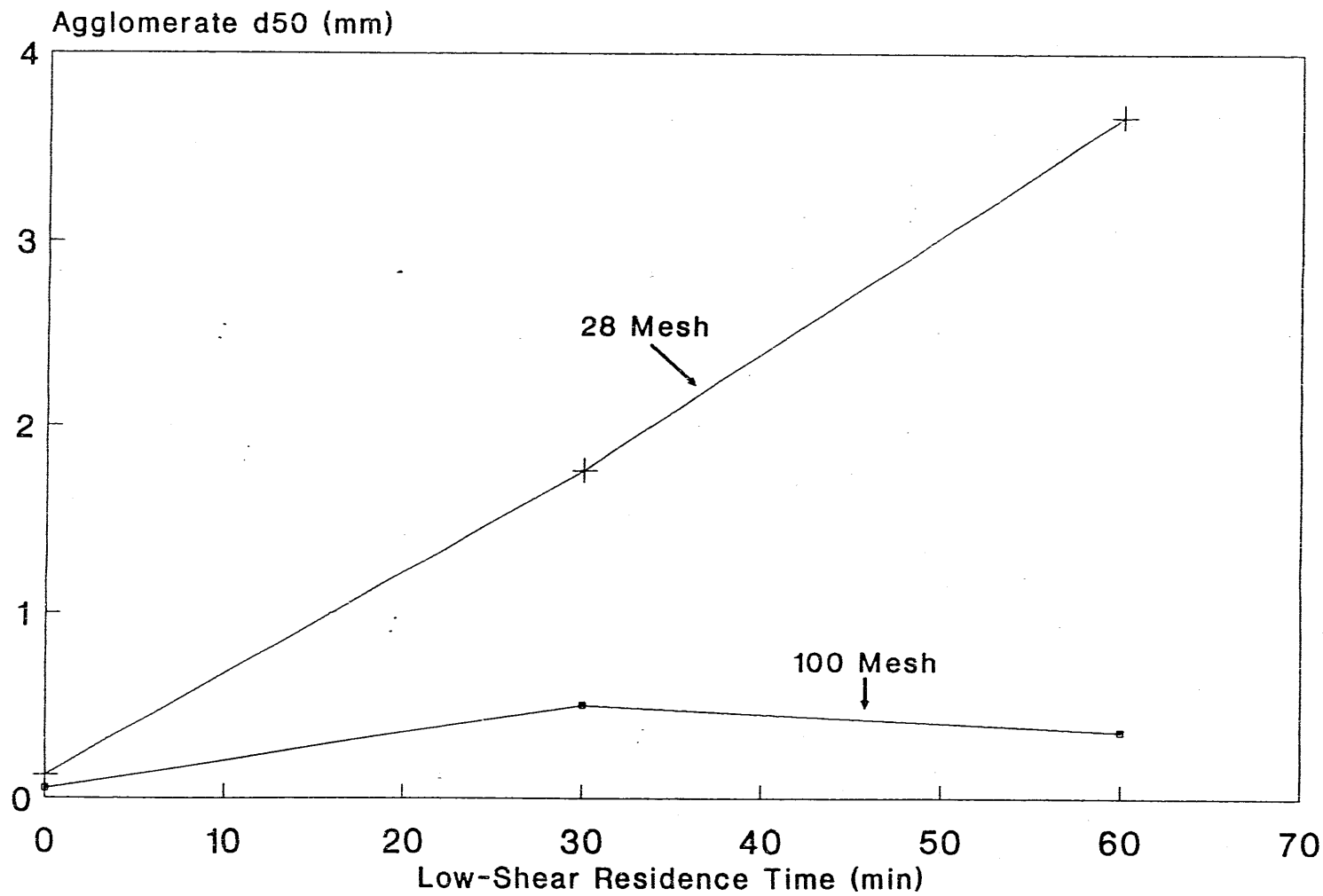


Figure 10-4
Effect of Low-Shear Residence Time on Agglomerate Size
(Cold Lake Bitumen 1:1)

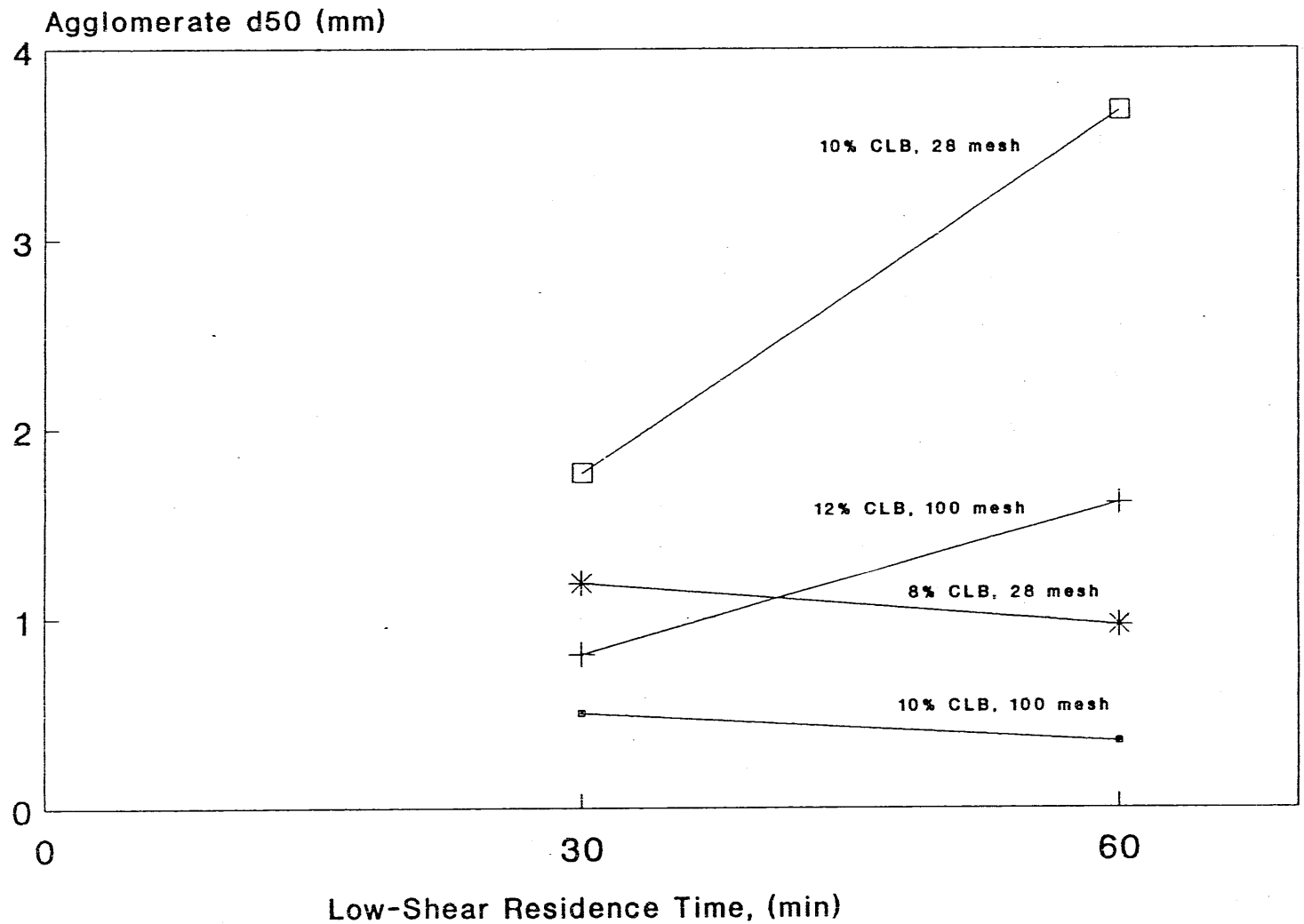


Figure 10-5
Effect of Low-Shear Mixer Power Input on Agglomerate Size
(12% CLB 3:1, 100 Mesh Coal)

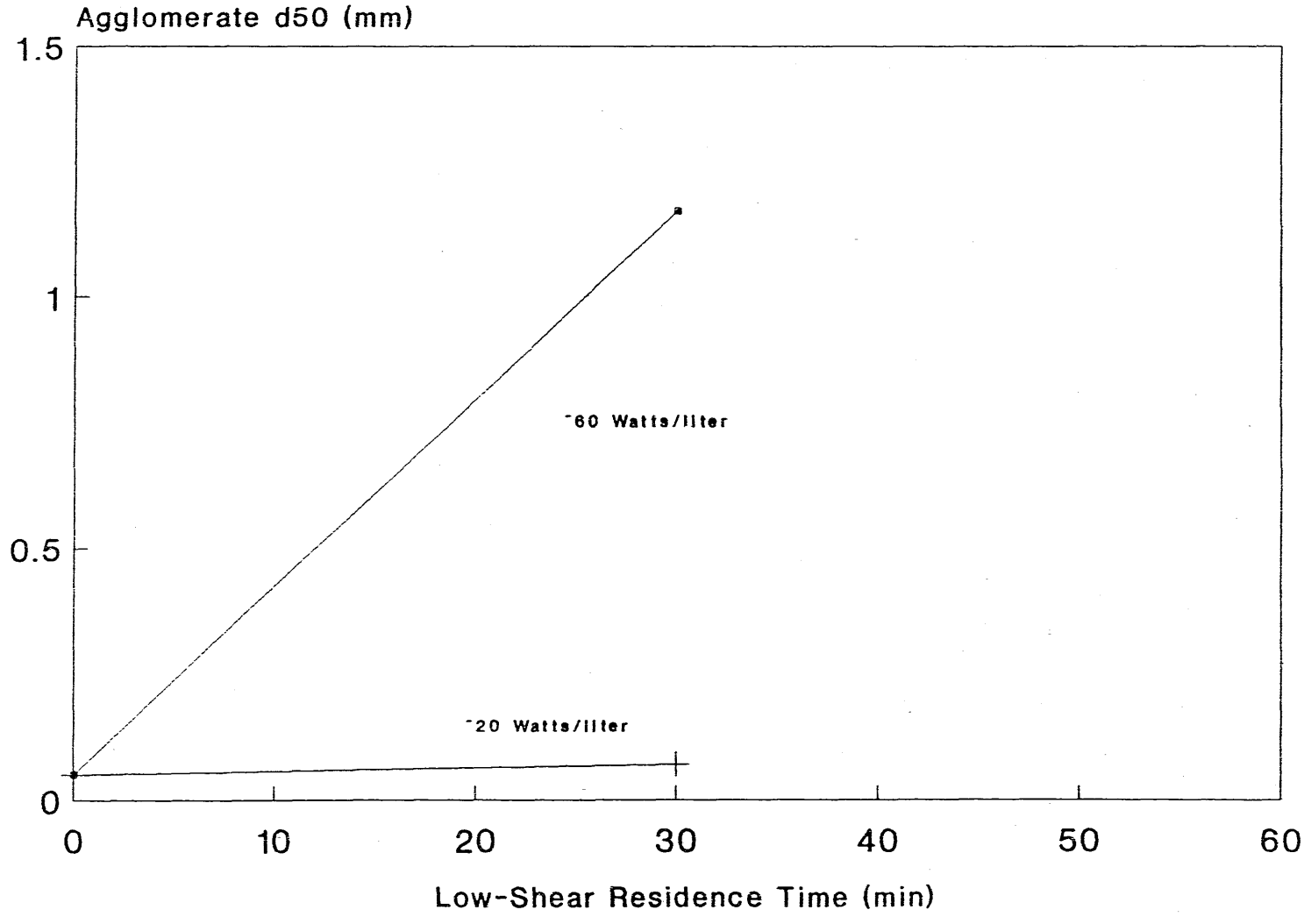
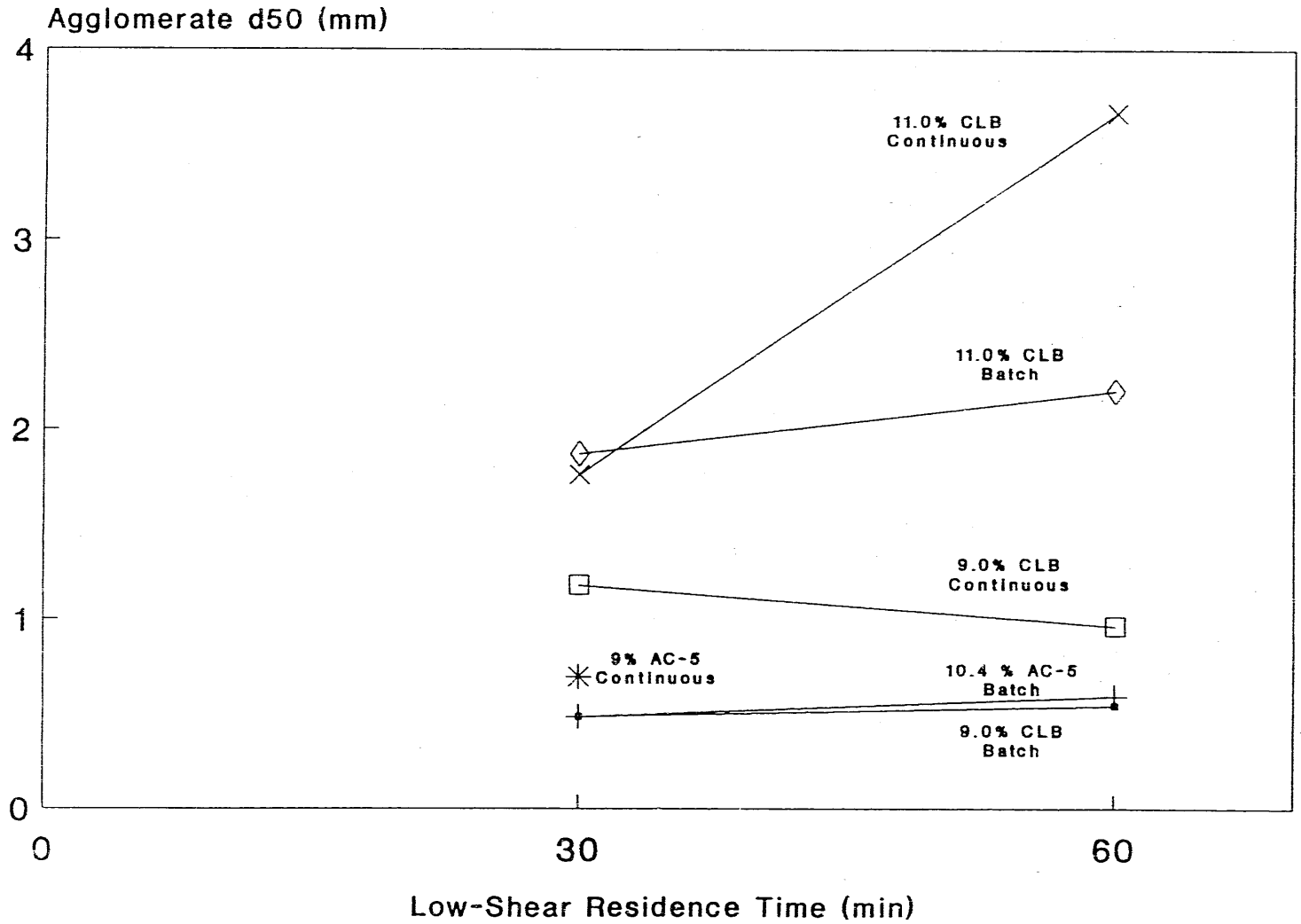


Figure 10-6
Comparison of Agglomerate Size Produced from
Batch and Continuous Low-Shear Operation
(1:1 Binder Blends, 28 Mesh Coal)



11.0 IATF CONTINUOUS TESTING

Three continuous runs in a scale of 1/4 TPH were carried out in Alberta Research Council's IATF (Integrated Agglomeration Testing Facility). These IATF runs were performed with Upper Freeport coal (28 mesh x 0) with the following objectives:

- Commission new sampling and control equipment and sampling procedures.
- Test the minimum sampling and analysis program for mass balance.
- Confirm steady state conditions within the process by closing the mass balance for solids, ash and pyritic sulfur.
- Demonstrate process repeatability.
- Investigate process performance.

11.1 Summary of Test Plan

The process conditions used during IATF Runs 1, 2, 3 are summarized in Tables 11-1, 11-2 and 11-3. Run 1 contained one eight hour period performed at 1% diesel addition to the high-shear mixer. Runs 2 and 3 involved step changes in diesel concentration into the high-shear mixer. Run 2 contained two four-hour periods, the first performed at 1.0% diesel addition to the high-shear mixer, followed by a decrease in diesel to 0.5%. This low diesel concentration was used to provide a sharp change/response of the operating system in Period 2. Run 3 also contained a step change in high-shear diesel content at hour four. For Period 1, the high-shear diesel content was set at 1.5%, and then decreased to 1.0% in Period 2. The low-shear binder additions were based upon an estimated coal matter recovery from the high-shear and separation circuit.

Table 11-1

RUN 1
SUMMARY OF PROCESS CONDITIONS

(1)	Rod Mill	
	Rod Charge	200 kg
	d_{50}	128 um
	d_{95}	600 um
	C_s	50%
	Coal Feed Rate	250 kg/hr
(2)	Conditioning Vessel	
	C_s	20%
	Retention Time (Approximately)	20 min
(3)	High-Shear	
	Single-Stage	Yes
	C_s	20%
	RPM's	1750
	Retention Time	3 min
	Co (Oil Concentration) % db	1%
	Oil Type	Diesel
(4)	Flotation Cell	
	Number of Cells	3
	C_s	12%
	Retention Time (Approximately)	7 min
	Frother - MIBC	0.012%
(5)	Second Stage Flotation Unit	
	Single-Stage	Yes
	C_s	15%
	RPM's (Approximately)	840
	Flotation Zone Retention Time (Approximately)	4.1 min
	Baffle Angle	45%
	Wash Water Rate	10 kg/min
(6)	Low-Shear Mixers	
	C_o, % db Feed Basis	7%
	C_s	25%
	RPM's	575, 380
	Retention Time	30 min, 60 min
	Oil Type	Diesel/Bitumen (1:1)
	No. of Mixers	2

Table 11-2

RUN 2
SUMMARY OF PROCESS CONDITIONS

(1) Rod Mill

Rod Charge	200 kg
d_{50}	128 um
d_{95}	600 um
C_s	50%
Coal Feed Rate	250 kg/hr

(2) Conditioning Vessel

C_s	20%
Retention Time (Approximately)	20 min

(3) High-Shear

Single-Stage	Yes
C_s	20%
RPM's	1750
Retention Time	3 min
Co (Oil Concentration) % db	1%, 0.5%
Oil Type	Diesel

(4) Flotation Cell

No. of Cells	3
C_s	12%
Retention Time (Approximately)	7 min
Frother	0.012%

(5) Second Stage Flotation Unit

Single Stage	Yes
C_s	15%
RPM's	840
Flotation Zone Retention Time (Approximately)	4.1 min
Baffle Angle	45%
Wash Water Rate	10 kg/min

(6) Low-Shear Mixers

C_o % db Feed Basis	7%
C_s	25%
RPM's	575, 380
Retention Time	30 min, 60 min
Oil Type	Diesel/Bitumen (1:1)
No. of Mixers	2

Table 11-3

RUN 3
SUMMARY OF PROCESS CONDITIONS

(1) Rod Mill

Rod Charge	200 kg
d_{50}	128 um
d_{95}	600 um
C_s	50%
Coal Feed Rate	250 kg/hr

(2) Conditioning Vessel

C_s	20%
Retention Time (Approximately)	20 min

(3) High-Shear

Single-Stage	Yes
C_s	20%
RPM's	1750
Retention Time	3 min
C_o (Oil Concentration) % db	1.5%, 1.0%
Oil Type	Diesel

(4) Flotation Cell

Number of Cells	3
C_s	12%
Retention Time (Approximately)	7 min
Frother	0.012%

(5) Second Stage Flotation Unit

Single-Stage	Yes
C_s	15%
RPM's	840
Flotation Zone Retention Time (Approximately)	4.1 min
Baffle Angle	45%
Wash Water Rate	10 kg/min

(6) Low-Shear Mixers

C_o % db Feed Basis	7%
C_s	25%
RPM's	575, 380
Retention Time	30 min, 60 min
Oil Type	Diesel/Bitumen (1:1)
No. of Mixers	

11.2 IATF Test Results

11.2.1 Mass Balance Calculations

The following mass flows were determined in all the process streams:

- Ash mass balance (e.g. ash % db)
- Pyritic sulfur mass balance (e.g. pyritic sulfur, % db)
- Total solids balance (e.g. water/solids ratio)

A computerized minimum variance balance program (MATBAL II) was used in this analysis. A nodal representation of the IATF flotation cell, hydraulic separator and low-shear mixer/dewatering screen was developed (Figure 11-1). The tailings and settling streams were combined into a single stream for the mass balance calculation.

Assumptions and error estimates used in the calculation of mass balances are summarized below.

- Feed Coal

  As the entire feed coal sample was blended prior to delivery to Alberta Research Council, and the barrels were selected randomly from storage, the average assay values for the feedstock was used based upon results from all three runs.

  Ash, % db = 15.37
  Pyritic Sulfur, % db = 1.52

- Process Streams

  The error estimates in Table 11-4 were used for the mass balance computer program. These values would expect to change as more information becomes available. The tailings and settlings streams were assigned the highest percent relative error (10%) because of the slowest response to steady state due to their higher hydraulic retention time. Furthermore, the very low solids contents in the tailings stream increases the potential for higher relative error during sample preparation.

Table 11-4

ERROR ESTIMATIONS FOR MASS BALANCE CALCULATIONS

No.	Stream	Ash % db % R.E.	PS % db % R.E.	Water/Solids Ratio % R.E.
1.	Flotation cell feed	0.001	0.001	0.001
2.	Flotation cell product	2.0	2.0	2.0
3.	Second stage flotation feed	2.0	2.0	2.0
4.	Second stage flotation product	2.0	2.0	2.0
5.	Low-shear mixer product	2.0	2.0	2.0
6.	Flotation cell settlings and tailings	10.0	10.0	10.0
7.	Second stage flotation settlings and tailings	10.0	10.0	10.0
8.	Dewatering screen tailings	0.001	0.001	2.0
9.	Second stage flotation water addition	0.001	0.001	0.001

Tables 11-5 through 11-9 contain the mass balance results for Runs 1 to 3. The tables summarize the stream masses and assays analyzed. For stream masses, the table includes the observed or measured solids streams (kg/hr), the computer calculated value (kg/hr), and its corresponding weight percent recovery or yield. Three additional calculations are provided; ash rejection (%AR), pyritic sulfur rejection (%PSR), and coal matter recovery (CMR) for the flotation cell, second stage flotation and low-shear product streams.

The assay analysis table portion contains four columns of information. The first two columns contain the process measured assays (%) and the computer calculated values (%). The third column summarizes the percentage of recovery for each assay analyzed within all process streams. The fourth column represents the weight (kg/hr) recovery of the assay component in each stream.

Table 11-5

CALCULATED MATERIAL BALANCES
FINAL RESULTS AFTER 7 ITERATIONS

Run 1 - Period 1

Stream Weights

M	Stream	Observed	Calculated	Wt. PCT.	%AR	%PSR	%CMR
1	Upper Freeport	242.80	242.80	100.0	-	-	-
2	Flot Prod	231.99	224.61	92.5	28.4	21.6	96.3
3	SS Feed	231.99	224.67	92.5	-	-	-
4	SS Prod	216.66	217.15	89.4	38.9	35.1	94.5
5	Low-shear	N/A	N/A	N/A	40.2	35.1	-
6	FC Talls and Set	19.38	18.19	7.5	-	-	-
7	SS Talls and Set	7.50	7.51	3.1	-	-	-
8	S-600	N/A	0.47	0.2	-	-	-
9	Pyrite H_2O	0.06	0.06	0.0	-	-	-

Analyses

Ash % db

M	Stream	Observed	Calculated	Recovery	Wt Units
1	Upper Freeport	15.37	15.37	100.0	37.3
2	Flot Prod	11.90	11.89	71.5	26.7
3	SS Feed	11.90	11.91	71.7	26.9
4	SS Prod	10.80	10.50	61.1	22.8
5	Low-shear	9.90	10.31	59.8	22.3
6	FC Talls and Set	65.60	58.36	28.5	10.6
7	SS Talls and Set	50.00	52.66	10.6	4.0
8	S-600	100.00	100.00	1.3	0.5
9	Pyrite H_2O	100.00	100.00	0.2	0.0

Pyritic Sulfur % db

M	Stream	Observed	Calculated	Recovery	Wt Units
1	Upper Freeport	1.52	1.52	100.0	3.7
2	Flot Prod	1.25	1.27	77.3	2.9
3	SS Feed	1.25	1.27	77.3	2.9
4	SS Prod	1.11	1.09	64.4	2.4
5	Low-shear	1.11	1.10	64.4	2.4
6	FC Talls and Set	4.52	4.60	22.7	0.8
7	SS Talls and Set	7.52	6.36	13.0	0.5
8	S-600	0.00	0.00	0.0	0.0
9	Pyrite H_2O	0.00	0.00	0.0	0.0

Water/Solids Ratio

M	Stream	Observed	Calculated	Recovery	Wt Units
1	Upper Freeport	9.12	9.12	100.0	22.1
2	Flot Prod	2.71	2.69	27.3	6.0
3	SS Feed	5.31	5.36	54.3	12.0
4	SS Prod	2.59	2.60	25.5	5.6
5	Low-shear	0.43	0.43	4.2	0.9
6	FC Talls and Set	88.10	88.54	72.7	16.1
7	SS Talls and Set	77.20	85.00	28.8	6.4
8	S-600	1000.00	999.97	21.3	4.7
9	Pyrite H_2O	10000.00	10000.00	27.1	6.0

Table 11-6

CALCULATED MATERIAL BALANCES
FINAL RESULTS AFTER 6 ITERATIONS

Run 2 - Period 1

Stream Weights

M	Stream	Observed	Calculated	Wt. PCT.	%AR	%PSR	%CMR
1	Upper Freeport	235.58	235.58	100.0	-	-	-
2	Flot Prod	N/A	220.82	93.7	29.3	22.2	97.9
3	SS Feed	N/A	220.88	93.8	-	-	-
4	SS Prod	211.60	211.84	89.9	39.8	36.1	95.3
5	Low-shear	N/A	211.33	89.7	41.2	36.1	-
6	FC Tails and Set	15.10	14.76	6.3	-	-	-
7	SS Tails and Set	5.15	9.04	3.8	-	-	-
8	S-600	N/A	0.51	0.2	-	-	-
9	Pyrite H_2O	0.06	0.06	0.0	-	-	-

Analyses

Ash % db

M	Stream	Observed	Calculated	Recovery	Wt Units
1	Upper Freeport	15.37	15.37	100.0	36.2
2	Flot Prod	11.60	11.60	70.7	25.6
3	SS Feed	11.60	11.62	70.9	25.7
4	SS Prod	10.60	10.28	60.1	21.8
5	Low-shear	9.67	10.06	58.7	21.3
6	FC Tails and Set	70.00	71.81	29.3	10.6
7	SS Tails and Set	47.00	43.06	10.7	3.9
8	S-600	100.00	100.00	1.4	0.5
9	Pyrite H_2O	100.00	100.00	0.2	0.0

Pyritic Sulfur % db

M	Stream	Observed	Calculated	Recovery	Wt Units
1	Upper Freeport	1.52	1.52	100.0	3.6
2	Flot Prod	1.24	1.26	77.8	2.8
3	SS Feed	1.24	1.26	77.8	2.8
4	SS Prod	1.10	1.08	64.1	2.3
5	Low-shear	1.10	1.09	64.1	2.3
6	FC Tails and Set	5.30	5.39	22.2	0.8
7	SS Tails and Set	6.49	5.40	13.6	0.5
8	S-600	0.00	0.00	0.0	0.0
9	Pyrite H_2O	0.00	0.00	0.0	0.0

Water/Solids Ratio

M	Stream	Observed	Calculated	Recovery	Wt Units
1	Upper Freeport	8.80	8.80	100.0	20.7
2	Flot Prod	2.75	2.71	28.8	6.0
3	SS Feed	5.30	5.42	57.8	12.0
4	SS Prod	2.81	2.82	28.8	6.0
5	Low-shear	0.43	0.43	4.4	0.9
6	FC Tails and Set	98.60	99.97	71.2	14.8
7	SS Tails and Set	60.00	66.32	28.9	6.0
8	S-600	1000.00	999.97	24.5	5.1
9	Pyrite H_2O	10000.00	10000.00	28.9	6.0

Table 11-7

CALCULATED MATERIAL BALANCES
FINAL RESULTS AFTER 6 ITERATIONS

Run 2 - Period 2

Stream Weights

M	Stream	Observed	Calculated	Wt. PCT.	%AR	%PSR	%CMR
1	Upper Freeport	237.10	237.10	100.0	-	-	-
2	Flot Prod	N/A	214.08	90.3	35.2	30.6	95.0
3	SS Feed	N/A	214.14	90.3	-	-	-
4	SS Prod	200.10	200.77	84.7	48.1	47.2	90.6
5	Low-shear	N/A	200.28	84.5	49.2	47.2	-
6	FC Tails and Set	19.87	23.02	9.7	-	-	-
7	SS Tails and Set	8.17	13.37	5.6	-	-	-
8	S-600	N/A	0.49	0.2	-	-	-
9	Pyrite H_20	0.06	0.06	0.0	-	-	-

Analyses

Ash % db

M	Stream	Observed	Calculated	Recovery	Wt Units
1	Upper Freeport	15.37	15.37	100.0	36.4
2	Flot Prod	11.00	11.00	64.6	23.6
3	SS Feed	11.00	11.03	64.8	23.6
4	SS Prod	9.50	9.43	52.0	18.9
5	Low-shear	9.16	9.21	50.6	18.5
6	FC Tails and Set	54.00	56.00	35.4	13.0
7	SS Tails and Set	60.00	34.93	12.8	4.7
8	S-600	100.00	100.00	1.4	0.5
9	Pyrite H_20	100.00	100.00	0.2	0.0

Pyritic Sulfur % db

M	Stream	Observed	Calculated	Recovery	Wt Units
1	Upper Freeport	1.52	1.52	100.0	3.6
2	Flot Prod	1.14	1.15	68.5	2.5
3	SS Feed	1.14	1.15	68.5	2.5
4	SS Prod	0.96	0.95	52.9	1.9
5	Low-shear	0.96	0.95	52.9	1.9
6	FC Tails and Set	5.00	4.93	31.5	1.1
7	SS Tails and Set	5.00	4.20	15.6	0.6
8	S-600	0.00	0.00	0.0	0.0
9	Pyrite H_20	0.00	0.00	0.0	0.0

Water/Solids Ratio

M	Stream	Observed	Calculated	Recovery	Wt Units
1	Upper Freeport	8.75	8.75	100.0	20.7
2	Flot Prod	2.94	2.88	29.8	6.2
3	SS Feed	5.52	5.68	58.7	12.2
4	SS Prod	2.87	2.88	27.9	5.8
5	Low-shear	0.43	0.43	4.2	0.9
6	FC Tails and Set	59.65	63.30	70.2	14.6
7	SS Tails and Set	43.40	47.78	30.8	6.4
8	S-600	1000.00	999.98	23.7	4.9
9	Pyrite H_20	10000.00	10000.00	28.9	6.0

Table 11-8

CALCULATED MATERIAL BALANCES
FINAL RESULTS AFTER 7 ITERATIONS

Run 3 - Period 1

Stream Weights

M	Stream	Observed	Calculated	Wt. PCT.	%AR	%PSR	%CMR
1	Upper Freeport	249.14	249.14	100.0	-	-	-
2	Flot Prod	N/A	234.70	94.2	27.7	21.1	98.2
3	SS Feed	N/A	234.76	94.2	-	-	-
4	SS Prod	219.32	229.81	92.2	37.9	31.6	-
5	Low-shear	N/A	229.27	92.0	39.2	31.6	97.7
6	FC Tails and Set	11.49	14.44	5.8	-	-	-
7	SS Tails and Set	5.13	4.96	2.0	-	-	-
8	S-600	N/A	0.53	0.2	-	-	-
9	Pyrite H_2O	0.06	0.06	0.0	-	-	-

Analyses

Ash % db

M	Stream	Observed	Calculated	Recovery	Wt Units
1	Upper Freeport	15.37	15.37	100.0	38.3
2	Flot Prod	11.86	11.82	72.4	27.7
3	SS Feed	11.86	11.84	72.6	27.8
4	SS Prod	10.48	10.36	62.2	23.8
5	Low-shear	9.78	10.15	60.8	23.3
6	FC Tails and Set	70.60	73.09	27.6	10.6
7	SS Tails and Set	54.10	80.63	10.4	4.0
8	S-600	100.00	100.00	1.4	0.5
9	Pyrite H_2O	100.00	100.00	0.2	0.0

Pyritic Sulfur % db

M	Stream	Observed	Calculated	Recovery	Wt Units
1	Upper Freeport	1.52	1.52	100.0	3.8
2	Flot Prod	1.26	1.26	78.2	3.0
3	SS Feed	1.26	1.26	78.2	3.0
4	SS Prod	1.10	1.11	67.4	2.6
5	Low-shear	1.10	1.11	67.4	2.6
6	FC Tails and Set	4.91	5.72	21.8	0.8
7	SS Tails and Set	7.65	8.26	10.8	0.4
8	S-600	0.00	0.00	0.0	0.0
9	Pyrite H_2O	0.00	0.00	0.0	0.0

Water/Solids Ratio

M	Stream	Observed	Calculated	Recovery	Wt Units
1	Upper Freeport	8.96	8.96	100.0	22.3
2	Flot Prod	2.50	2.52	26.5	5.9
3	SS Feed	5.15	5.07	53.4	11.9
4	SS Prod	2.76	2.75	28.3	6.3
5	Low-shear	0.43	0.43	4.4	1.0
6	FC Tails and Set	145.00	113.66	73.5	16.4
7	SS Tails and Set	123.20	112.88	25.1	5.6
8	S-600	1000.00	1000.03	23.9	5.3
9	Pyrite H_2O	10000.00	10000.00	26.9	6.0

Table 11-9

CALCULATED MATERIAL BALANCES
FINAL RESULTS AFTER 7 ITERATIONS

Run 3 - Period 2

Stream Weights

M	Stream	Observed	Calculated	Wt. PCT.	%AR	%PSR	%CMR
1	Upper Freeport	251.60	251.60	100.0	-	-	-
2	Flot Prod	N/A	234.21	93.1	30.2	23.7	97.3
3	SS Feed	N/A	234.26	93.1	-	-	-
4	SS Prod	221.00	226.39	90.0	41.6	36.8	95.7
5	Low-shear	N/A	225.83	89.8	42.9	36.8	-
6	FC Tails and Set	17.20	17.40	6.9	-	-	-
7	SS Tails and Set	6.09	7.88	3.1	-	-	-
8	S-600	N/A	0.56	0.2	-	-	-
9	Pyrite H_2O	0.06	0.06	0.0	-	-	-

Analyses

Ash % db

M	Stream	Observed	Calculated	Recovery	Wt Units
1	Upper Freeport	15.37	15.37	100.0	38.7
2	Flot Prod	11.55	11.53	69.9	27.0
3	SS Feed	11.55	11.56	70.0	27.1
4	SS Prod	9.96	10.00	58.5	22.6
5	Low-shear	9.78	9.77	57.1	22.1
6	FC Tails and Set	67.00	67.01	30.1	11.7
7	SS Tails and Set	48.00	56.39	11.5	4.4
8	S-600	100.00	100.00	1.4	0.6
9	Pyrite H_2O	100.00	100.00	0.2	0.0

Pyritic Sulfur % db

M	Stream	Observed	Calculated	Recovery	Wt Units
1	Upper Freeport	1.52	1.52	100.0	3.8
2	Flot Prod	1.26	1.24	76.1	2.9
3	SS Feed	1.26	1.24	76.1	2.9
4	SS Prod	1.05	1.05	62.2	2.4
5	Low-shear	1.05	1.05	62.2	2.4
6	FC Tails and Set	7.18	5.26	23.9	0.9
7	SS Tails and Set	6.63	6.74	13.9	0.5
8	S-600	0.00	0.00	0.0	0.0
9	Pyrite H_2O	0.00	0.00	0.0	0.0

Water/Solids Ratio

M	Stream	Observed	Calculated	Recovery	Wt Units
1	Upper Freeport	8.87	8.87	100.0	22.3
2	Flot Prod	2.75	2.75	28.9	6.4
3	SS Feed	5.28	5.31	55.8	12.4
4	SS Prod	2.90	2.90	29.4	6.6
5	Low-shear	0.43	0.43	4.4	1.0
6	FC Tails and Set	80.12	91.26	71.1	15.9
7	SS Tails and Set	75.80	74.66	26.4	5.9
8	S-600	1000.00	1000.01	25.0	5.6
9	Pyrite H_2O	10000.00	10000.00	26.9	6.0

11.2.2 Process Performance

Table 11-10 contains a summary of key operating conditions and performance indicators. The following operating conditions are included:

- Feed coal size (d_{50})
- High-shear diesel content (% db)
- Flotation cell frother content (% db)
- Low-shear binder addition (% db feed basis and % daf product basis)

The following performance indicators are included for analysis of the results:

- Ash rejection % (AR)
- Pyrite sulfur rejection % (PSR)
- Coal matter recovery % (CMR)
- Low-shear agglomerate size (d_{30}, d_{50} and d_{80}, um)

As these initial runs were performed to commission the new sampling and control equipment, they were not carried out under the optimum process conditions. Optimization would include the variations of flotation cell solids content, and the addition rates of diesel and frother. Nevertheless, the methods for sampling and mass balance calculations were well defined for detailed evaluation.

The results showed that tests with diesel concentrations in the range of 0.5 to 1.5% db, with a frother concentration of 0.012% db, yielded very high levels of coal matter recovery (CMR), ranging from 90.6 to 97.7%. However, pyritic sulfur rejections were low, ranging from 31.6 to 47.2% PSR. Higher selectivity could be expected at lower flotation solids concentration and more optimum diesel and frother concentrations. Changing the oil concentration from 1.0 to 1.5% db with all other process conditions constant, caused a minimal increase in CMR from about 96 to 98% CMR. However, implementing this change in oil concentration reduced the selectivity of the process, evident by the reduction in PSR from about 37 to 32% PSR.

Decreasing the oil concentration from 1.0 to 0.5% db, with all other process conditions constant, caused a 5% drop in CMR from 96% to 91%. However, the selectivity of the process dramatically improved as PSR increased from about 36% to 47%, an improvement of 11%. The results also indicated that the uniform sized low-shear agglomerates could be produced with a low-shear binder concentration of 5.9% of dry feed coal basis. Expressed on a dry ash free product basis, the low-shear binder addition was 7.7%.

Table 11-10

PERFORMANCE CALCULATIONS

Test*	Feed Size d_{50} um	High-Shear Oil Conc % db	% Solids In Flot %	Frother Conc % db	Low-Shear Binder Conc Feed Basis % db	Low-Shear Binder Conc Product Basis % daf	AR%	TSR%	PSR%	CMR%	Final Agg Size d_{30} um	Final Agg Size d_{50} um	Final Agg Size d_{80} um
R1-P1	137	1.00	12.0	0.012	7.00	8.8	40.2	-	35.1	94.5	-	-	-
R2-P1	137	1.00	12.0	0.012	6.90	8.6	41.2	33.4	36.1	95.3	630	800	1000
R2-P2	137	0.50	12.0	0.012	5.90	7.7	49.2	48.7	47.2	90.6	640	700	1000
R3-P1	137	1.50	12.0	0.012	6.60	8.0	39.2	30.0	31.6	97.7	600	800	1000
R3-P2	137	1.00	12.0	0.012	7.00	8.6	42.9	36.0	36.8	95.7	550	800	900

AR = % ash rejection
TSR = % total sulfur rejection
PSR = % pyrite sulfur rejection
CMR = % combustible matter recovery

*P1 = Period 1
P2 = Period 2
R1 = Run 1
R2 = Run 2
R3 = Run 3

11.3 Conclusions

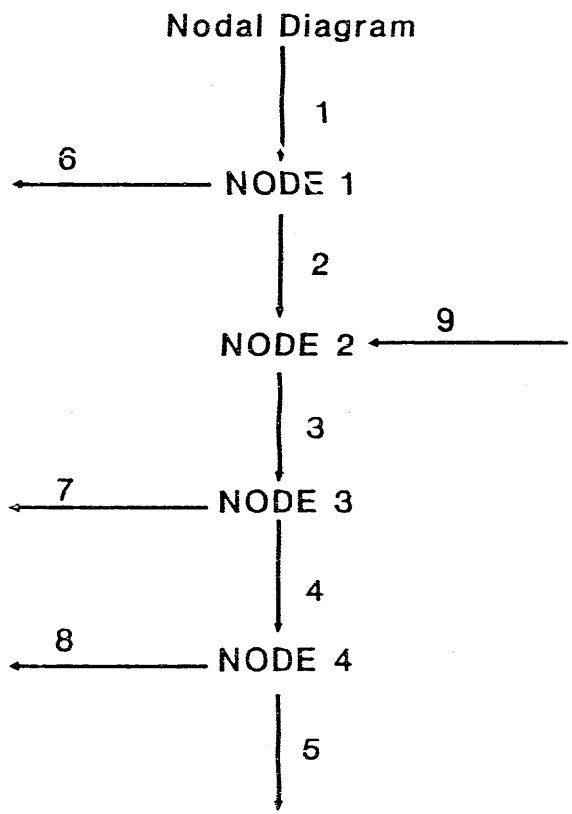
The computerized mass balance program can scrutinize process measurements, and adjust the balance according to the best measurements within the process. The mass balance method can be used to assist in the development of a minimized sampling and analysis program. Computerized simulations and testing of the mass balance can also help to identify sensitive process measurements, and confirm steady state conditions to ensure the integrity of the results.

Based upon the mass balance analysis of the IATF runs, the following conclusions can be made:

- The new equipment and sampling procedures appear to perform satisfactory. The minimum sampling program utilized in Run 3 produced a satisfactory mass balance.
- Steady state conditions appear to be achieved in the IATF after three to four hours at key locations in the process. All mass balances for the runs close very well, with some indications that the tailings streams are slower to respond. These streams also demonstrate a fairly high level of percent relative error because of their low percent solids.
- The mass balances indicate a high level of process repeatability (Run 1, Run 2 - Period 1, Run 3 - Period 2).
- The effects of process parameters on performance are consistent with those observed in batch scale testing.

Figure 11-1

NODAL DIAGRAM FOR MASS BALANCE ANALYSIS
OF IATF EXPERIMENTS



NODE	DESCRIPTION
1	Flotation cell
2	Pyrite separator water addition
3	Pyrite separator
4	Low-shear mixer/dewatering screen

STREAM	DESCRIPTION
1	Flotation cell feed
2	Flotation cell product
3	Pyrite separator feed
4	Pyrite separator product
5	Low-shear mixer product
6	Flotation cell settlings and tailings
7	Pyrite separator settlings and tailings
8	Dewatering screen tailings
9	Pyrite separator water addition

12.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) AND STATISTICAL ANALYSIS OF DATA

12.1 Quality Assurance/Quality Control

A number of Quality Assurance/Quality Control (QA/QC) activities were performed during the Task 5 Test Program. These QA/QC activities focused on:

- Implementation of standard procedures and documentation of non-standard procedures
- Analytical quality
- Experimental repeatability

Each of these activities is discussed in the following sections.

12.1.1 Procedures

The QA/QC objectives related to establishment of standard test procedures are:

- To establish and document equipment and procedures so that inadvertent changes do not occur during the test program
- To establish standard conditions and corresponding test data that can be used to measure and evaluate the effects of deliberate changes during the test program

The standard test procedures that were developed are presented in Sections 3 and 4. These procedures include:

- Wet grinding
- Size analysis
- Agglomeration experiments
- Product sample preparation

- Product analyses including determination of bridging liquid content and moisture content by azeotropic distillation

- Heptane content determination

12.1.2 Analytical Quality

Several quality control measures were implemented to ensure the quality of the analytical work.

- Analytical equipment, such as the Leco SC-32 sulfur analyzer and the Fisher Coal Analyzer, are calibrated each day using appropriate standards available commercially.

- NBS standards are selected to match both the matrix and the range of the parameter being measured. For example, oil, coal, and inorganic standards are used for calibration of sulfur determination in agglomerants, clean coals and rejects.

- A quality control reference sample is analysed on a regular basis, often daily. This reference sample is an actual product, such as agglomerated coal. The daily analyses are plotted to produce a quality control reference chart which illustrates the consistency of analytical performance. Any indication of inconsistent performance is investigated and rectified.

- Standard procedure involves duplicate determinations. The values obtained from the duplicate determinations are compared to ASTM limits for repeatability. The ASTM limits are posted in the laboratory and all duplicate determinations are immediately checked. When duplicate determinations are outside of ASTM repeatability limits, then one or more additional analyses are done until acceptable repeatability is obtained. The results of all replicate determinations are averaged and reported as the average of the specific number of determinations. Values are not discarded unless there is an obvious reason to do so, such as obvious sample segregation, equipment malfunction, analysis outside of calibrated range, etc.

- The actual printouts for all analyses are kept on file for a minimum of one year. Analytical reports (the averaged values described above) are kept on permanent file.

- Occasionally, raw data is randomly checked to ensure proper data entry from printouts to computer.

In addition to the above routine quality control procedures, the Alberta Research Council's Coal Microanalytical Laboratory participates in various round-robin programs and is a member of ASTM

Committee D-5 on Coal and Coke. In particular, the laboratory recently participated in the ASTM round-robin test for developing a new standard for determination of total sulfur in ash. This is relevant to the total sulfur determinations done on the reject samples which have high ash contents.

12.1.3 Experimental Repeatability

12.1.3.1 Pyrite Rejection by Calculation and Measurement

During the Task 5 Test Program, approximately 25% of the product samples were analysed for pyritic sulfur content, due to time and cost factors. Pyritic sulfur rejection, therefore, was calculated based on the analyses of other parameters in both the feedstock and the products. The method used for this calculation is discussed in Section 5.

For products, when pyritic sulfur contents were actually determined, pyritic sulfur rejections obtained by calculation and measurement could be compared. These comparisons were documented in the biweekly reports. A typical set of results is provided below to demonstrate the agreement between the actual measured pyritic sulfur rejection and the calculated one (Table 12-1).

Table 12-1

PYRITIC SULFUR REJECTIONS FOR CALCULATED VS MEASURED PYRITIC SULFUR CONTENTS

Test No.		Pyritic Sulfur Rejection, %		
Ser.	Lab.	Calculated	Measured	Difference
928	KEN-54.11*	79.6	81.7	-2.1
929	KEN-54.12*	69.3	72.6	-3.3
930	KEN-54.13*	57.8	62.4	-4.6
931	KEN-54.14*	42.6	48.4	-5.8
934	KEN-63	50.3	54.2	-3.9
935	UFP-269	75.7	74.0	1.7
937	UFP-270	82.5	81.1	1.4
938	UFP-271	79.6	81.1	-1.5
939	UFP-272	79.0	79.6	-0.6
941	UFP-273	83.1	83.7	-0.6
942	UFP-274	81.7	82.1	-0.4
944	UFP-275.1	76.5	75.1	1.4
946	UFP-276.1	73.1	73.3	-0.2
951	KEN-67	65.7	67.6	-1.9
955	KEN-70	65.5	69.9	-4.4
964	UFP-279	86.6	86.5	0.1
965	UFP-281	77.0	77.6	-0.6

*Results are for the four cumulative increments of each test produced using the incremental froth sampling procedure.

12.1.3.2 Test Repeatability

A number of tests were repeated to determine the overall repeatability. The tests were randomly selected and the process performances were compared. The repeatability of experiments carried out in two-stage agglomeration tests is presented in Table 12-2. As each of these tests actually represents two single-stage tests and involves a number of sample preparation and analytical procedures, this data represents the worst conditions in test repeatability. It is noted that even under these extreme conditions, the repeatability of these tests is excellent in terms of both BTU recovery and pyrite rejection.

Table 12-2

REPEATABILITY OF TEST RESULTS

Ser. Test No.		BTU Recovery, %			Pyritic Sulfur Rejection, %		
Initial	Repeat	Initial	Repeat	Diff.	Initial	Repeat	Diff.
932	933	93.0	92.7	0.3	30.9	27.7	3.2
935	936	89.0	89.6	-0.6	75.7	75.7	0.0
939	940	76.8	78.0	-1.2	79.0	79.7	-0.7
943	944	88.0	89.6	-1.6	80.5	76.5	4.0
945	946	92.0	91.6	0.4	75.3	73.1	2.2
947	949	74.5	70.9	3.6	86.9	88.9	-2.0
951	952	89.3	91.8	-2.5	65.7	62.8	2.9
965	966	83.8	84.7	-0.9	77.0	77.8	-0.8

12.2 Statistical Analysis of Data

Multiple regression analysis was used to determine the influence of independent experimental variables on process performance. This analysis is restricted to the test program when a large data base is available. The results from Task 5.1, "Evaluation of Agglomerating Liquids" and tests performed on the bench-scale diesel continuous testing are analyzed by this method.

The multiple regression analysis is not meant to substitute data evaluation presented in the various sections of this report. Rather it is used to provide data evaluation from a different approach.

12.2.1 Method

Application of standardized independent variables in a regression equation allows to find the coefficients which are a good measure of the influence of respective variables. Standardizing depends on centering and scaling of the variables. Centering depends on subtracting the variable mean from each observation of the variable, and scaling depends on dividing the variable by its standard deviation.

Thus, any standardized variable x' can be represented as follows:

$$x' = \frac{x_i - \overline{x}}{s_x} \qquad (1)$$

where $\overline{x}$ - mean value
s_x - standard deviation

Any criterion, such as CMR, TSR, etc., is denoted generally by y_j; j is the successive number of criterion, or dependent variable (response). The independent variables (factors), such as concentration of agglomerant, size of coal particles, residence time, etc., are generally denoted by x_k', where k is the successive number of independent variable.

Considerations are based on the linear relation between the mean value of any dependent variable y_j and the independent variables x_1, x_2, x_3, ..., according to the following equation:

$$y_j = b_o + b_1 x_1 + b_2 x_2 + b_3 x_3 + \ldots \qquad (2)$$

or in short:

$$y_j = b_o + \sum_{k=1}^{k=m} b_k x_k \qquad (3)$$

where b_o is a constant (intercept) and the constants b_k are the partial regression coefficients (slopes). Equation (3) is the empirical mathematical model for predicting the response y_i over a limited range of the factors x_k.

The values of standardized coefficients for particular independent variables are proportional to their respective influence. Positive algebraic sign of coefficient denotes that the variable has a proportional influence while negative sign means inverse proportional influence.

Significance of the regression coefficients was tested. To check the significance of the partial regression coefficients the t test can be used. The calculated t test values for the slope must be greater than the tabulated critical values for a given probability, α. Calculated value of t defines the significance level α which has to be acceptably low. The higher the t, the lower the α. The higher the t, the higher the influence of respective independent variable. If a regression coefficient is found not to be statistically significant, the equation is revised. The independent variables which do not significantly influence the dependent variable are deleted, and new regression coefficients are calculated.

Significance of the whole regression equation is determined by test F . Calculated value of F defines the significance level α_F which has to be acceptably low. The higher the F, the more significant the regression equation.

12.2.2 Analysis of Batch Process

The results of the first 210 tests performed on the batch scale were taken for statistical analysis. Three "old" project coals were tested: Illinois No. 6, Pittsburgh No. 8 and Upper Freeport. In the statistical analysis, the following variables were examined:

<u>Independent Variables</u>

- Relative density of agglomerant (related to the density of water)
- Residence time in stirred vessel

- Size of coal particle (dimensionless)
- Concentration of agglomerant
- Amount of frother addition in first stage flotation
- Amount of frother addition in second stage flotation

Dependent Variables

- Coal matter recovery index
- Total sulfur rejection index
- Ash rejection index

The purpose of this analysis was to determine the influence of experimental independent variables on the agglomeration performance process criteria: coal matter recovery (CMR), total sulfur rejection (TSR), and ash rejection (AR).

The concept of relative density was used as a mathematical indicator of agglomerant type. The values of relative (dimensionless) density of applied agglomerants are shown in Table 12-3.

Table 12-3

RELATIVE DENSITY VALUES FOR AGGLOMERANTS

Agglomerant	Relative Density
Hexane	0.6603
Diesel	0.8613
Maya + Diesel (1:1)	0.8915
Maya	0.9227
Fuel No. 6 + Diesel (4:1)	0.9593
Fuel No. 6	0.9838

Concentration of agglomerant was determined as the percentage weight content of agglomerant in relation to the feed dry coal. The initial size of coal particles was determined by the relative (dimensionless) diameter defined as the ratio of real median diameter d_{50} of tested coal and the size of screen opening for the 200 mesh (74 μm).

Independent variables with significance of t greater than 10% ($\alpha > 0.1$), were neglected. The values of standardized coefficients for independent variables are shown in Table 12-4. There are three independent variables of the greatest influence:

- Relative density of agglomerant (type of agglomerant)
- Concentration of agglomerant
- Amount of first frother addition

Smaller significance was found for the coal particle size, amount of the second frother addition and for the residence time.

Table 12-4

COEFFICIENTS IN REGRESSION EQUATIONS WITH STANDARDIZED VARIABLES

	Illinois No. 6 (58 Tests)			Pittsburgh No. 8 (80 Tests)			Upper Freeport (72 Tests)		
	CMR	TSR	AR	CMR	TSR	AR	CMR	TSR	AR
Density	16.9	-15.7	-6.7	14.4	-14.9	-12.3	6.3	-8.5	-97
Residence time				3.2				3.1	22
Coal diameter				4.1	-2.6	-2.3			
Oil content	4.4	-6.9	-3.8	11.1	-13.1	-11.2	4.9	-12.4	-120
I froth amount	4.6	-3.9		5.7	-3.8	-5.5	4.3	-5.2	-42
II froth amount						2.5			

12.2.3 Analysis of Bench Scale Continuous Process with Diesel

The 5 kg/hr continuous agglomeration process with diesel as agglomerant, was analysed. One hundred and sixty-six tests were taken into account. In the statistical analysis the following variables were examined:

Independent Variables

- Size of coal particle (d_{50})
- Initial concentration of diesel oil
- Residence time
- Coal content in flotation cell
- Frother amount added in flotation cell

Dependent Variables

- Coal matter recovery index
- Total sulfur rejection index
- Inorganic sulfur rejection index

Independent variables with significance of t greater than 10%, ($\alpha > 0.1$), were neglected. The influence of significant independent variables on coal matter recovery (CMR), total sulfur rejection (TSR), and inorganic sulfur rejection (ISR) is shown in Tables 12-5, 12-6 and 12-7, respectively.

The results of this statistical analysis showed that the effect of the independent variables on the performance of all project coals is different. If frother concentration has a significant impact on the performance for Upper Freeport coal, coal particle size is more important in determining the process performance for Pittsburgh No. 8. This statistical analysis therefore provides further support for data evaluation presented in Section 8.

Table 12-5

INDEPENDENT VARIABLES IN DESCENDING ORDER OF INFLUENCE ON CMR

Independent Variable	Coefficient	t	α
Upper Freeport			
Frother addition	9.45	5.73	~0
Residence time	5.23	3.17	0.002
	Number of data points		65
	Standard deviation of regression		13.1
	Test F		19.4
	Significance level of F, (α_F)		~0
Kentucky No. 9			
Oil concentration	3.64	5.65	~0
Frother addition	1.73	2.69	0.009
	Number of data points		77
	Standard deviation of regression		5.58
	Test F		21.3
	Significance level of F, (α_F)		~0
Pittsburgh No. 8			
Coal particle size	1.77	2.86	0.009
	Number of data points		24
	Standard deviation of regression		2.96
	Test F		8.16
	Significance level of F, (α_F)		0.009

Table 12-6

INDEPENDENT VARIABLES IN DESCENDING ORDER OF INFLUENCE ON TSR

Independent Variable	Coefficient	t	α
Upper Freeport			
Residence time	-8.48	-5.13	~0
Frother addition	-8.37	-4.63	0.00002
Coal % in flotation	-4.70	-2.62	0.01
	Number of data points		65
	Standard deviation of regression		13.0
	Test F		23.1
	Significance level of F, (α_F)		~0
Kentucky No. 9			
Frother addition	-3.22	-3.84	0.0003
Coal particle size	-3.15	-3.72	0.0004
Residence time	-2.01	-2.27	0.026
Oil concentration	-1.54	-1.72	0.089
	Number of data points		77
	Standard deviation of regression		7.27
	Test F		10.7
	Significance level of F, (α_F)		~0
Pittsburgh No. 8			
Coal particle size	-4.27	-3.8	0.001
	Number of data points		24
	Standard deviation of regression		5.39
	Test F		14.44
	Significance level of F, (α_F)		0.001

Table 12-7

INDEPENDENT VARIABLES IN DESCENDING ORDER OF INFLUENCE ON ISR

Independent Variable	Coefficient	t	α
Upper Freeport			
Frother addition	-8.75	-4.08	0.0001
Residence time	-6.88	-3.51	0.0008
Coal % in flotation	-5.22	-2.46	0.017
	Number of data points		65
	Standard deviation of regression		15.4
	Test F		15.9
	Significance level of F, (α_F)		~0
Kentucky No. 9			
Frother addition	-4.22	-4.11	0.0001
Coal particle size	-3.18	-3.10	0.0028
Residence time	-2.73	-2.66	0.0096
	Number of data points		77
	Standard deviation of regression		8.94
	Test F		11.88
	Significance level of F, (α_F)		~0
Pittsburgh No. 8			
Coal particle size	-6.90	-3.68	0.0013
	Number of data points		24
	Standard deviation of regression		8.98
	Test F		13.57
	Significance level of F, (α_F)		0.0013

13.0 TASK 5 - FINAL CONCLUSIONS

This section summarizes the major conclusions which can be drawn from all the activities under the Task 5 test program. Specific conclusions are documented for each category of testing unit in the appropriate sections.

Task 5 concentrated on the parallel development of agglomeration processes based on diesel and heptane, with particular emphasis on high-shear operations. Bench-scale continuous processing units for diesel and heptane performed satisfactorily with good mass balances at the Alberta Research Council.

Although there were small variations in the operating conditions and intrinsic differences between batch and continuous processing, it has been observed that process responses were similar and data from these two modes of operation were comparable. An extensive comparison of the batch and continuous data is summarized in Task 7 under process recommendations.

The results of the Task 5 test program show that the overall efficiency of pyrite rejection is enhanced by using precleaned coal, with minimal sacrifice of BTU recovery. For the Upper Freeport and Kentucky No. 9 project coals, pyrite rejection of 80% at 90% BTU recovery has been achieved. For Pittsburgh No. 8 project coal, a pyrite rejection of 70% at 90% BTU recovery has been observed. Clean coal ash contents were in the 6% to 8% range.

While the use of precleaned coal gives the best overall performance data, the effectiveness of the agglomeration process on raw coals is also demonstrated.

The performance of the diesel and heptane process in the high-shear stage is highly comparable. However, the operating conditions for these two processes are drastically different. The diesel process uses coarser grinds (28/100 mesh), lower agglomerant concentration (1%), higher solids content (20%), and flotation for microagglomerate recovery. The heptane process requires finer grind (200 mesh), higher agglomerant concentration (20%), lower solids contents (5-10%), and screening for microagglomerate separation. While the diesel will remain with the agglomerates,

heptane must be recovered from the agglomerates and all other processing streams to comply with environmental regulations and safety standards.

Work performed on the low-shear operation showed that 8% to 12% of binder is required for the diesel process to produce handleable agglomerates. Preliminary comparison of batch and continuous low-shear data reveal that larger agglomerates are produced in the continuous operation than in the batch unit, at the same binder level. Pelletizing at a 2-3% binder level provides a good alternative for size enlargement. Laboratory tests on the pelletizing of high-shear diesel microagglomerates showed very promising results.

Three processing options and two variants result from the Task 5 test program. The options have been extensively evaluated for the POC module in Wilsonville. These process options are:

1. Diesel-pelletizing Option

   Diesel-power Plant site (Variant)

2. Diesel-low shear option

3. Heptane-low shear option

   Heptane-power plant site (Variant)

APPENDIX 1

BATCH TEST PROGRAM

APPENDIX 1

Table of Contents | Page

Table A1-1	Feed Coal Analysis	A1-1
Table A1-2	Coal Grinding Data	A1-4
Table A1-3	Oil Analysis Report	A1-7
Table A1-4	Oil Extraction Experimental Data	A1-8
Table A1-5	Experimental Data for Batch Tests	A1-10
Table A1-6	Clean Coal and Tailings Analysis	A1-32
Table A1-7	Batch Test Results	A1-54

Table A1-1

FEED COAL ANALYSIS

Coal Name	Sub Samp No.	Date	Moisture %	Ash % mf	Total Sulfur % mf	Sufatic Sulfur % mf	Pyritic Sulfur % mf	Organic Sulfur % mf	Calorific Value Btu/lb
Ill	1	9/15/89	10.00	17.40	5.44	.11	3.40	1.93	11,670
Ill	3	11/01/89	9.08	19.60	4.78	.19	2.71	1.88	11,380
Ill	5		10.00	17.00	5.14	.31	2.89	1.94	11,431
Ill	6		8.90	18.30	5.18	.46	2.81	1.91	
Ill	8.1	7/11/90	10.20	10.40	3.09	.06	.93	2.10	12,624
Ill	8.4	7/11/90	11.00	10.70	3.07	.06	.92	2.09	12,567
Ill	8.8	7/11/90	10.90	10.60	3.09	.07	.93	2.09	12,654
Ill	8.A	7/11/90	10.70	10.60	3.07	.06	.92	2.09	12,628
Ill	8.C	11/07/90	10.20	10.70	3.08	.06	.93	2.09	12,658
Ill	812	7/11/90	10.90	10.60	3.04	.07	.88	2.09	12,638
Ill	9.1	9/19/90	10.70	10.70	3.20	.07	1.04	2.09	12,515
Ill	9.4	9/19/90	10.40	10.80	3.23	.07	1.07	2.09	12,580
Ill	9.8	9/19/90	10.30	11.00	3.18	.08	1.02	2.08	12,627
Ill	9.A	9/19/90	10.40	10.90	3.20	.07	1.04	2.09	12,639
Ill	9.C	9/19/90	10.20	10.60	3.21	.07	1.05	2.09	12,708
Ill	912	9/19/90	10.50	11.20	3.20	.07	1.05	2.08	12,702
Ill	916	9/19/90	10.30	10.80	3.18	.07	1.02	2.09	12,703
Ken	1.1	10/04/90	3.10	15.20	4.98	.06	3.31	1.61	12,962
Ken	1.4	10/04/90	3.20	15.50	4.74	.07	3.06	1.61	12,814
Ken	1.8	10/04/90	3.30	15.50	4.85	.07	3.17	1.61	12,777
Ken	1.A	10/04/90	3.20	15.50	4.83	.07	3.15	1.61	12,842
Ken	1.C	10/04/90	3.30	15.70	4.75	.07	3.08	1.60	12,813
Ken	2.1	11/20/90	3.10	16.70	4.25	.03	2.96	1.26	12,569
Ken	2.4	11/20/90	3.30	16.50	4.32	.03	2.75	1.54	12,426
Ken	2.8	11/20/90	3.20	16.90	4.42	.04	2.94	1.44	12,567
Ken	2.A	11/20/90	3.20	16.90	4.35	.03	2.92	1.40	12,562
Ken	2.C	11/20/90	3.50	16.90	4.23	.03	2.89	1.30	12,616
Ken	2.W	4/08/91	2.70	9.20	2.73	.02	1.17	1.54	
Ken	212	11/20/90	3.10	17.10	4.40	.03	2.97	1.39	12,654
Ken	216	11/20/90	3.00	17.10	4.48	.03	2.98	1.47	12,539
Ken	3.1	2/06/91	3.00	16.50	4.40	.05	2.83	1.53	12,493
Ken	3.4	2/06/91	2.90	16.40	4.33	.05	2.87	1.41	12,524
Ken	3.8	2/06/91	3.00	16.50	4.49	.05	2.86	1.58	12,535
Ken	3.A	2/06/91	2.90	16.40	4.38	.05	2.86	1.47	12,524
Ken	3.C	2/06/91	2.80	16.50	4.37	.05	2.88	1.44	12,488
Ken	312	2/06/91	3.10	16.20	4.39	.06	3.13	1.20	12,543
Ken	316	2/06/91	2.70	16.50	4.31	.03	2.60	1.68	12,559
Ken	4.R	6/06/91	1.90	21.70	4.59	.11	3.29	1.19	
Ken	4.W	6/06/91	1.60	9.50	2.93	.06	1.26	1.61	
Pit	1	9/13/89	3.90	12.50	4.32	.12	2.04	2.16	12,770
Pit	101	10/30/90	3.10	10.40	4.21	.07	1.93	2.21	
Pit	104	10/30/90	3.10	10.30	4.16	.07	1.88	2.21	
Pit	108	10/30/90	3.00	10.40	4.12	.07	1.84	2.21	
Pit	10A	10/30/90	3.10	10.40	4.17	.07	1.89	2.21	13,382

Table A1-1 (Continued)

FEED COAL ANALYSIS

Coal Name	Sub Samp No.	Date	Moisture %	Ash % mf	Total Sulfur % mf	Sufatic Sulfur % mf	Pyritic Sulfur % mf	Organic Sulfur % mf	Calorific Value Btu/lb
Pit	10C	10/30/90	3.40	10.50	4.21	.07	1.93	2.21	
Pit	11	4/24/91	2.90	9.90	4.25	.11	1.84	2.31	13,215
Pit	112	10/30/90	2.90	10.30	4.16	.07	1.88	2.21	
Pit	116	10/30/90	2.90	10.30	4.17	.07	1.89	2.21	
Pit	1R	11/07/90	3.00	24.30	4.95	.04	3.04	1.87	11,112
Pit	1W	11/07/90	2.70	10.90	4.83	.34	2.29	2.20	13,443
Pit	3	11/01/89	4.20	12.60	4.54	.15	2.23	2.16	12,510
Pit	5		3.50	11.80	4.20	.13	1.89	2.18	12,790
Pit	6		3.10	11.80	3.81	.30	1.33	2.18	
Pit	7		3.30	12.10	4.09	.32	1.60	2.17	
Pit	8.1	7/11/90	2.70	10.00	4.19	.07	1.90	2.22	13,404
Pit	8.4	7/11/90	2.80	10.00	4.23	.07	1.94	2.22	13,375
Pit	8.8	7/11/90	2.80	10.10	4.21	.07	1.92	2.22	13,420
Pit	8.A	7/11/90	2.70	10.10	4.24	.07	1.95	2.22	13,341
Pit	8.C	7/11/90	2.40	10.20	4.35	.06	2.08	2.21	13,133
Pit	812	7/11/90	2.70	10.10	4.24	.07	1.95	2.22	13,387
Pit	816	7/11/90	2.70	10.10	4.23	.06	1.95	2.22	13,328
Pit	9.1	9/19/90	2.40	10.50	4.53	.14	2.18	2.21	13,210
Pit	9.4	9/19/90	2.30	10.50	4.45	.14	2.10	2.21	13,213
Pit	9.8	9/19/90	2.20	10.40	4.44	.14	2.09	2.21	13,224
Pit	9.A	9/19/90	2.40	10.50	4.47	.15	2.11	2.21	13,205
Pit	9.C	9/19/90	2.60	10.60	4.51	.16	2.15	2.20	13,126
Pit	912	9/19/90	2.20	10.40	4.43	.15	2.07	2.21	13,217
Pit	916	9/19/90	2.60	10.50	4.46	.16	2.09	2.21	13,241
Pit	98	6/21/90	10.91	10.57	3.09	.07	.81	2.21	
Pit	99	6/21/90	10.90	10.65	3.04	.07	.77	2.20	
Ufp	1	9/19/89	1.40	12.40	2.37	.07	1.70	.60	13,440
Ufp	101	2/06/91	2.40	15.60	2.24	.14	1.58	.52	12,855
Ufp	104	2/06/91	2.30	15.60	2.20	.14	1.54	.52	12,813
Ufp	108	2/06/91	2.30	16.20	2.27	.14	1.56	.57	12,821
Ufp	10A	2/06/91	2.30	15.80	2.24	.14	1.56	.54	12,832
Ufp	10C	2/06/91	2.00	15.80	2.25	.14	1.57	.54	12,840
Ufp	11	4/24/91	2.30	14.30	2.18	.15	1.39	.64	13,002
Ufp	12H	7/04/91	1.30	16.30	2.22	.08	1.61	.53	
Ufp	12R	7/04/91	1.50	16.20	2.28	.10	1.65	.54	
Ufp	12W	7/04/91	1.40	11.80	1.38	.06	.79	.53	
Ufp	3	11/01/89	1.80	12.40	2.42	.09	1.73	.60	13,451
Ufp	5		1.70	12.90	2.27	.09	1.58	.60	13,356
Ufp	6		1.30	13.00	2.30	.20	1.50	.60	
Ufp	8.1	7/11/90	2.30	14.40	2.14	.11	1.44	.59	13,105
Ufp	8.4	7/11/90	2.20	14.50	2.21	.11	1.52	.58	13,020
Ufp	8.8	7/11/90	2.30	14.40	2.18	.10	1.49	.59	13,052
Ufp	8.A	7/11/90	2.20	14.40	2.19	.11	1.49	.59	13,061
Ufp	8.C	7/11/90	2.20	14.40	2.22	.11	1.52	.59	13,040
Ufp	812	7/11/90	2.20	14.40	2.18	.11	1.48	.59	13,074

Table A1-1 (Continued)

FEED COAL ANALYSIS

Coal Name	Sub Samp No.	Date	Moisture %	Ash % mf	Total Sulfur % mf	Sufatic Sulfur % mf	Pyritic Sulfur % mf	Organic Sulfur % mf	Calorific Value Btu/lb
Ufp	816	7/11/90	2.20	14.40	2.18	.10	1.49	.59	13,077
Ufp	9.1	9/19/90	1.50	15.40	2.32	.18	1.56	.58	12,831
Ufp	9.4	9/19/90	1.80	15.10	2.29	.18	1.53	.58	12,836
Ufp	9.8	9/19/90	2.00	15.20	2.34	.18	1.58	.58	12,866
Ufp	9.A	9/19/90	1.80	15.20	2.32	.18	1.56	.58	12,824
Ufp	9.C	9/19/90	2.10	14.70	2.26	.17	1.51	.58	12,945
Ufp	912	9/19/90	1.60	15.30	2.39	.18	1.63	.58	12,840
Ufp	916	9/19/90	1.80	15.40	2.34	.17	1.59	.58	12,623

Table A1-2

COAL GRINDING DATA

Grind ID	Coal Name & Batch #	Grind Method	Time min	Percent Solids	Percent Passing	Topsize Mesh	D-50 mm	Test Used
1	Ill-8	wet	13	20		28	.124	Y
2	Ill-8	wet	3	5		28	.125	Y
3	Ill-8	wet	47	20		200	.030	Y
4	Ill-8	wet	14	5		200	.025	Y
5	Pit-8	wet	13	20		28	.124	Y
6	Pit-8	wet	52	20		200	.029	Y
7	Pit-8	wet	3	5		28	.120	Y
8	Pit-8	wet	12	5		200	.028	Y
9	Ufp-8	wet	27	20		200	.027	Y
10	Ufp-8	wet	7	5		200	.027	Y
11	Ufp-8	wet	4	20		28	.129	Y
12	Ufp-8	wet	1	5		28	.128	Y
13	Pit-8	wet	22	10		200	.029	Y
14	Pit-8	wet	36	15		200	.028	Y
15	Ufp-8	wet	15	10		200	.025	Y
16	Ufp-8	wet	24	15		200	.025	Y
17	Ill-8	wet	25	10		200	.029	Y
18	Ill-8	wet	39	15		200	.028	Y
19	Pit-9	wet	13	20	***	28	.131	Y
20	Pit-9	wet	54	20	99	200	.028	Y
21	Ufp-9	wet	6	20	98	28	.128	Y
22	Ufp-9	wet	27	20	96	200	.028	y
23	Ill-9	wet	14	20	99	28	.120	Y
24	Ill-9	wet	55	20	97	200	.030	y
25	Pit-9	wet	29	20	97	100	.058	Y
26	Ufp-9	wet	16	20	96	100	.058	Y
27	Ill-9	wet	28	20	98	100	.059	Y
28	Pit-9	dry				28	.125	Y
29	Pit-9	dry				200	.042	Y
30	Pit-9	dry.w				28	.120	Y
31	Pit-9	dry.w				200	.044	Y
32	Ken-1	wet	9	20	99	28	.125	Y
33	Ken-1	wet	48	20	99	200	.022	Y
34	Ken-1	dry				28	.130	Y
35	Ken-1	dry				200	.039	y
36	Ufp-9	WET	7	5	98	200	.024	A
37	Pit-10	WET	14	20	97	28	.121	E
38	Pit-10	WET	54	20	99	200	.026	E
39	Pit-1	WET	10	20	98	28	.132	RAW
40	Pit-1	WET	50	20	100	200	.020	RAW
41	Pit-1	WET	12	20	99	28	.124	WAS
42	Pit-1	WET	54	20	99	200	.023	WAS
43	Pit-10	WET	12	5	99	200	.025	E
44	Ken-1	WET	2	5	97	28	.128	W
45	Ken-1	WET	9	5	97	200	.027	W
46	Pit-1	WET	12	5	100	200	.023	W
47	Pit-1	WET	11	5	99	200	.021	R
48	Pit-10	WET	36	20	98	100	.065	E
49	Pit-10	WET	6	5	97	100	.060	E
50	Ken-2	WET	46	20	98	200	.023	W
51	Ken-2	WET	9	5	96	200	.027	W
52	Ken-2	WET	11	20	97	28	.113	W

Table A1-2 (Continued)

COAL GRINDING DATA

Grind ID	Coal Name & Batch #	Grind Method	Time min	Percent Solids	Percent Passing	Topsize Mesh	D-50 mm	Test Used
53	Ken-2	WET	2	5	95	28	.112	W
54	Ken-2	WET	23	20	96	100	.067	W
55	Ken-2	WET	6	5	97	100	.068	W
56	Ufp-9	WET	4	5	99	100	.056	A
57	Ufp-10	WET	6	20	96	28	.114	A
58	Ufp-10	WET	17	20	96	100	.062	A
59	Ufp-10	WET	27	20	96	200	.025	A
60	Ufp-10	WET	2	5	96	28	.119	A
61	Ufp-10	WET	5	5	99	100	.058	A
62	Ufp-10	WET	7	5	98	200	.024	A
63	Ken-3	WET	11	20	98	28	.129	E
64	Ken-3	WET	24	20	96	100	.061	E
65	Ken-3	WET	46	20	99	200	.023	E
66	Ken-3	WET	3	5	99	28	.105	E
67	Ken-3	WET	6	5	99	100	.068	E
68	Ken-3	WET	13	5	99	200	.021	E
69	Ufp-11	WET	7	20	97	28	.128	E
70	Ufp-11	WET	17	20	96	100	.065	E
71	Ufp-11	WET	31	20	96	200	.026	E
72	Ufp-11	WET	7	5	97	200	.023	E
73	Pit-11	WET	12	20	97	28	.131	E
74	Pit-11	WET	36	20	99	100	.065	E
75	Pit-11	WET	54	20	98	200	.026	E
76	Pit-11	WET	12	5	99	200	.023	E
77	Ken-3	WET	11	20	98	28	.131	E
78	Ken-3	WET	26	20	97	100	.064	E
79	Ken-3	WET	50	20	98	200	.030	E
80	Ken-4	WET	13	20	96	28	.124	R
81	Ken-4	WET	27	20	96	100	.066	R
82	Ken-4	WET	48	20	98	200	.026	R
83	Ken-4	WET	50	20	95	200	.029	W
84	Ken-4	WET	14	20	96	28	.136	W
85	Ken-4	WET	30	20	96	100	.069	W
86	Ken-4	WET	12	5	97	200	.022	R
87	Ken-4	WET	13	5	99	200	.024	W
88	Ufp-12	WET	8	20	98	28	.133	R
89	Ufp-12	WET	10	20	99	28	.128	Pr
90	Ufp-12	WET	9	20	98	28	.132	H
91	Ufp-12	WET	23	20	99	100	.064	R
92	Ufp-12	WET	23	20	99	100	.067	Pr
93	Ufp-12	WET	25	20	99	100	.072	H
94	Ufp-12	WET	33	20	97	200	.026	R
95	Ufp-12	WET	35	20	96	200	.025	Pr
96	Ufp-12	WET	39	20	98	200	.029	H
97	Ufp-12	WET	7	5	98	200	.027	R
98	Ufp-12	WET	7	5	96	200	.029	Pr
99	Ufp-12	WET	8	5	99	200	.024	H
100	Ill-1	wet	6	20	99	28	.113	y
101	Ill-1	WET	25	20	95	200	.026	Y
102	Ill-3	wet	7	20	96	28	.137	y
103	Ill-3	wet	30	20	93	200	.027	y
104	Ill-6	wet	9	20	97	28	.136	y
105	Ill-6	wet	39	20	95	200	.028	y

Table A1-2 (Continued)

COAL GRINDING DATA

Grind ID	Coal Name & Batch #	Grind Method	Time min	Percent Solids	Percent Passing	Topsize Mesh	D-50 mm	Test Used
106	Ill-6	wet	15	5	99	200	.023	y
107	Pit-1	wet	6	20	99	28	.127	y
108	Pit-1	wet	26	20	93	200	.031	y
109	Pit-3	wet	7	20	97	28	.102	y
110	Pit-3	wet	30	20	92	200	.027	y
111	Pit-6	wet	8	20	97	28	.123	y
112	Pit-6	wet	36	20	92	200	.030	y
113	Pit-6	wet	15	5	99	200	.023	y
114	Ufp-1	wet	5	20	99	28	.138	y
115	Ufp-1	wet	20	20	98	200	.020	yu
116	Ufp-3	wet	6	20	98	28	.100	y
117	Ufp-3	wet	25	20	94	200	.023	y
118	Ufp-6	wet	4	20	97	28	.126	y
119	Ufp-6	wet	25	20	96	200	.023	y
120	Ufp-6	wet	6	5	97	200	.022	y

Table A1-3

OIL ANALYSIS REPORT

Oil Type	Date	Technician	Specific Gravity	API Gravity	Ash % Dry	Water %	Sulfur %	Cal. Val. Btu/lb	Viscosity cp @20 C	Viscosi cp @40
Asphalt	5/14/91	A.L.			0.00	0.00	4.96			
Diesel			.86	32.80			0.00		4.60	2.90
F4/D1			.96	16.00			1.22		209.30	70.50
Fuel #6			.98	12.20			1.53		2180.00	401.00
HD4/D1			.94	19.00			3.98			
Heptane			.68	75.50			0.00		.42	
Hexane			.66	81.60			0.00		.47	.41
Hondo			.96	15.90			4.97			
M1/D1			.89	27.20			1.76		18.60	9.30
Maya			.92	21.80			3.52		177.50	60.70

Table A1-4

OIL EXTRACTION EXPERIMENTAL DATA

Lab ID	Date	Technician	Coal	Sub Sample	Top Size	Feed Coal gm, db	Feed Coal Ash %, mf	Oil	Oil Wt., g	Oil Conc.	Yield @ 40 C, g	H20 @ 40 C, g	Oil @ 40 C, g	Yield @ 107 C, g	Clean Coal Ash %, mf
ASSUME	5/15/91	A.L.	Pit	10A	200M	160.00	10.40	Asphalt	1.60	1.00	161.60	0.000	1.600	161.60	6.50
ASSUME-1			Ill		28M	160.00	17.40	Hexane	1.60	1.00	160.00	0.000	0.000	160.00	
ASSUME-11	4/25/91	A.L.	Pit	10	200	160.00	10.40								
ASSUME-2			Pit		28M	160.00	12.50	Hexane	1.60	1.00	160.00	0.000	0.000	160.00	
ASSUME-3			Ufp		28M	160.00	12.40	Hexane	1.60	1.00	160.00	0.000	0.000	160.00	
ASSUME-4			Ill		28M	160.00	17.40	Heptane	1.60	1.00	160.00	0.000	0.000	160.00	
ASSUME-5			Pit		28M	160.00	12.50	Heptane	1.60	1.00	160.00	0.000	0.000	160.00	
ASSUME-6			Ufp		28M	160.00	12.40	Heptane	1.60	1.00	160.00	0.000	0.000	160.00	
ASSUME-7			Ill		28M	160.00	17.40	HD4/D1	16.00	10.00	160.00	0.000	0.000	160.00	
ASSUME-8			Ufp		28M	160.00	12.40	HD4/D1	16.00	10.00	160.00	0.000	0.000	160.00	
Assume-10	11/15/90		Ken		200M	160.00	1.60	Heptane	1.60	1.00	160.00	0.000	0.000	160.00	
ILL-17R			Ill		28M	160.00	17.40	M1/D1	16.00	10.00	155.08	4.540	11.210	148.41	9.10
ILL-1R			Ill		28M	160.00	17.40	Diesel	16.10	10.00	156.19	14.300	10.110	135.78	11.83
ILL-25			Ill		28M	160.00	17.40	F4/D1	16.00	10.00	155.72	1.350	14.640	150.89	10.50
ILL-26			Ill		28M	160.00	17.40	F4/D1	9.60	6.00	145.55	3.780	6.110	141.62	9.90
ILL-31			Ill		200M	160.00	17.40	F4/D1	9.80	6.00	147.03	3.280	5.730	143.50	8.50
ILL-32			Ill		200M	160.00	17.40	F4/D1	16.00	10.00	159.78	8.280	13.260	149.87	8.50
ILL-9R			Ill		28M	160.00	17.40	Maya	16.00	10.00	156.80	2.590	13.030	153.35	9.90
Ill-200	9/24/90	W.G.	Ill	8.A	28M	160.00	10.60	Diesel	1.60	1.00	143.58	3.120	1.580	139.27	6.10
Ill-202	9/24/90	W.G.	Ill	8.A	28M	160.00	10.60	M1/D1	1.60	1.00	164.19	13.140	1.070	150.89	6.80
Ill-205	9/24/90	W.G.	Ill	8.A	200M	160.00	10.60	Diesel	1.60	1.00	158.63	10.400	1.590	147.05	5.60
Ill-207	9/24/90	W.G.	Ill	8.A	200M	160.00	10.60	M1/D1	1.60	1.00	161.79	10.830	1.600	150.39	6.10
Ill-215	9/24/90	W.G.	Ill	8.A	200M	40.00	10.60	Maya	2.40	6.00	33.97	1.010	2.050	32.95	5.40
Ken-5	10/04/90	W.G.	Ken	1.1	200M	159.90	15.50	M1/D1	1.60	1.00	144.56	.970	2.010	142.10	7.80
Ken-6	10/04/90	W.G.	Ken	1.1	200M	159.90	15.50	Diesel	1.60	1.00	148.16	1.530	.440	146.38	8.40
PIT-17R			Pit		28M	160.00	12.50	M1/D1	16.00	10.00	163.67	4.260	9.000	156.14	7.70
PIT-1R			Pit		28M	160.00	12.50	Diesel	16.00	10.00	157.57	6.410	8.190	144.81	7.20
PIT-25			Pit		28M	160.00	12.50	F4/D1	15.40	10.00	176.16	9.620	12.190	165.06	8.90
PIT-26			Pit		28M	160.00	12.50	F4/D1	9.98	6.00	161.21	4.610	5.370	156.21	8.40
PIT-29			Pit		200M	160.00	12.50	F4/D1	15.96	10.00	166.13	2.110	11.940	162.48	8.10

Table A1-4 (Continued)

OIL EXTRACTION EXPERIMENTAL DATA

Lab ID	Date	Technician	Coal	Sub Sample	Top Size	Feed Coal gm, db	Feed Coal Ash %, mf	Oil	Oil Wt., g	Oil Conc.	Yield @ 40 C, g	H20 @ 40 C, g	Oil @ 40 C, g	Yield @ 107 C, g	Clean Coal Ash %, mf
PIT-30			Pit		200M	160.00	12.50	F4/D1	9.60	6.00	157.71	1.620	4.200	155.82	8.10
PIT-9R			Pit		28M	160.00	12.50	Maya	16.00	10.00	170.49	3.240	11.930	165.04	8.80
Pit-115-1			Pit		28M	160.00	11.80	HD4/D1	16.00	10.00	167.14	3.360	6.300	161.76	10.50
Pit-200	9/24/90	E.T.	Pit	8.A	28M	160.00	10.10	Diesel	1.60	1.00	153.10	1.500	1.660	150.04	6.80
Pit-201	9/24/90	E.T.	Pit	8.A	28M	160.00	10.10	M1/D1	1.60	1.00	152.24	1.430	1.320	149.95	6.60
Pit-202	9/24/90	E.T.	Pit	8.A	200M	160.00	10.10	Diesel	1.60	1.00	153.75	1.540	1.380	150.98	6.10
Pit-203	9/24/90	E.T.	Pit	8.A	200M	160.00	10.10	M1/D1	1.60	1.00	153.45	1.090	1.600	151.15	6.20
Pit-209.1	9/24/90	E.T.	Pit	8.A	200M	40.00	10.10	Maya	2.40	6.00	39.70	.340	1.540	38.79	5.40
UPP-17R			Ufp		28M	160.00	12.40	M1/D1	16.00	10.00	169.00	2.320	9.970	162.75	10.30
UPP-1R			Ufp		28M	160.00	12.40	Diesel	16.00	10.00	162.20	2.430	8.630	155.50	10.40
UPP-25			Ufp		28M	160.00	12.40	F4/D1	16.00	10.00	168.88	1.010	12.730	165.50	10.00
UPP-26			Ufp		28M	160.00	12.40	F4/D1	9.60	6.00	161.94	.810	6.480	159.51	10.10
UPP-31			Ufp		200M	160.00	12.40	F4/D1	16.00	10.00	173.50	3.070	13.360	168.29	9.80
UPP-32			Ufp		200M	160.00	12.40	F4/D1	9.60	6.00	143.62	.360	6.350	141.90	9.30
UPP-9R			Ufp		28M	160.00	12.40	Maya	16.00	10.00	171.30	.990	14.250	168.50	11.10
Ufp-200	9/24/90	A.L.	Ufp	8.A	200M	160.00	14.40	Diesel	1.60	1.00	142.41	.840	.990	140.99	7.70
Ufp-201	9/24/90	A.L.	Ufp	8.A	200M	160.00	14.40	M1/D1	1.60	1.00	144.83	.980	1.100	143.38	8.40
Ufp-204	9/24/90	A.L.	Ufp	8.A	28M	160.00	14.40	Diesel	1.60	1.00	109.97	.600	1.730	108.21	5.60
Ufp-205	9/24/90	A.L.	Ufp	8.A	28M	160.00	14.40	M1/D1	1.60	1.00	124.57	1.000	.700	123.44	6.70
Ufp-209	9/24/90	A.L.	Ufp	8.A	200M	40.00	14.40	Maya	2.40	6.00	38.04	.380	1.860	37.62	8.00

Table A1-5

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Conc	Pyr Depr	Add. Used	High Shear Conditions Oil Type & Wt		Rate	Time	Low Shear Conditions Oil Type & Wt		Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
357	Pit-200	7/11	Pit-8.A	164.44	Diesel	1.60	13	28	.124	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
358	Pit-201	7/11	Pit-8.A	164.44	M1/D1	1.60	13	28	.124	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
359	Pit-201.1	7/11	Pit-8.A	164.44	M1/D1	1.60	13	28	.124	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
360	Pit-202	7/11	Pit-8.A	164.44	Diesel	1.60	52	200	.029	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
361	Pit-203	7/11	Pit-8.A	164.44	M1/D1	1.60	52	200	.029	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
362	Pit-204	7/11	Pit-8.A	41.11	Diesel	.40	3	28	.120	5	N	N	Diesel	.4	2000	4.0					2-Floa				None			
363	Pit-205	7/11	Pit-8.A	41.11	M1/D1	.40	3	28	.120	5	N	N	M1/D1	.4	2000	4.0					2-Floa				None			
364	Pit-206	7/11	Pit-8.A	41.11	Diesel	.40	12	200	.028	5	N	N	Diesel	.4	2000	4.0					2-Floa				None			
365	Pit-207	7/11	Pit-8.A	41.11	M1/D1	.40	12	200	.028	5	N	N	M1/D1	.4	2000	4.0					2-Floa				None			
366	Pit-207.1	7/11	Pit-8.A	41.11	M1/D1	.40	12	200	.028	5	N	N	M1/D1	.4	2000	4.0					2-Floa				None			
367	Ufp-200	7/11	Ufp-8.A	163.59	Diesel	1.60	27	200	.027	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
368	Ufp-201	7/11	Ufp-8.A	163.59	M1/D1	1.60	27	200	.027	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
369	Ufp-202	7/11	Ufp-8.A	40.90	Diesel	.40	7	200	.027	5	N	N	Diesel	.4	2000	4.0					2-Floa				None			
370	Ufp-203	7/11	Ufp-8.A	40.90	M1/D1	.40	7	200	.027	5	N	N	M1/D1	.4	2000	4.0					2-Floa				None			
371	Ufp-203.1	7/11	Ufp-8.A	40.90	M1/D1	.40	7	200	.027	5	N	N	M1/D1	.4	2000	4.0					2-Floa				None			
372	Ufp-204	7/11	Ufp-8.A	163.59	Diesel	1.60	4	28	.129	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
373	Ill-200	7/12	Ill-8.A	179.17	Diesel	1.60	13	28	.124	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None	9.0	9.0	
374	Ill-201	7/12	Ill-8.A	179.17	Diesel	1.60	13	28	.124	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
375	Ill-202	7/12	Ill-8.A	179.17	M1/D1	1.60	13	28	.124	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
376	Ill-202.1	7/12	Ill-8.A	179.17	M1/D1	1.60	13	28	.124	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
377	Ill-203	7/12	Ill-8.A	44.79	Diesel	1.60	3	28	.125	5	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
378	Ill-204	7/12	Ill-8.A	44.79	M1/D1	1.60	3	28	.125	5	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
379	Ill-204.1	7/12	Ill-8.A	44.79	M1/D1	1.60	3	28	.125	5	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
380	Ill-205	7/12	Ill-8.A	179.17	Diesel	1.60	47	200	.030	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None	9.0	9.0	
381	Ill-206	7/12	Ill-8.A	179.17	Diesel	1.60	47	200	.030	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
382	Ill-207	7/12	Ill-8.A	179.17	M1/D1	1.60	47	200	.030	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
383	Ill-208	7/12	Ill-8.A	44.79	Diesel	1.60	14	200	.025	5	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
384	Ill-208.1	7/12	Ill-8.A	44.79	Diesel	1.60	14	200	.025	5	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
385	Ill-209	7/12	Ill-8.A	44.79	M1/D1	1.60	14	200	.025	5	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
386	Ufp-204.1	7/12	Ufp-8.A	163.59	Diesel	1.60	4	28	.129	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
387	Ufp-205	7/12	Ufp-8.A	163.59	M1/D1	1.60	4	28	.129	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
388	Ufp-206	7/12	Ufp-8.A	40.90	Diesel	.40	1	28	.128	5	N	N	Diesel	.4	2000	4.0					2-Floa				None			
389	Ufp-207	7/12	Ufp-8.A	40.90	M1/D1	.40	1	28	.128	5	N	N	M1/D1	.4	2000	4.0					2-Floa				None			
390	Ill-210	7/19	Ill-8.A	44.79	Diesel	.40	3	28	.125	5	N	N	Diesel	.4	2000	4.0					2-Floa				None			
391	Ill-211	7/19	Ill-8.A	44.79	M1/D1	.40	3	28	.125	5	N	N	M1/D1	.4	2000	4.0					2-Floa				None			
392	Ill-212	7/19	Ill-8.A	44.79	Diesel	.40	14	200	.025	5	N	N	Diesel	.4	2000	4.0					2-Floa				None			
393	Ill-213	7/19	Ill-8.A	44.79	M1/D1	.40	14	200	.025	5	N	N	M1/D1	.4	2000	4.0					2-Floa				None			
394	Ill-213.1	7/19	Ill-8.A	44.79	M1/D1	.40	14	200	.025	5	N	N	M1/D1	.4	2000	4.0					2-Floa				None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Conc	Pyr Depr	Add. Used	High Shear Conditions Oil Type & Wt		Rate	Time	Low Shear Conditions Oil Type & Wt		Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
395	Pit-208	7/25	Pit-8.A	41.11	Heptane	8.00	12	200	.028	5	N	N	Heptane	8.0	2000	4.0					Screen			106	None			
396	Pit-208.1	7/25	Pit-8.A	41.11	Heptane	8.00	12	200	.028	5	N	N	Heptane	8.0	2000	4.0					Screen			106	None			
397	Pit-209	7/25	Pit-8.A	41.11	Maya	2.15	12	200	.028	5	N	N	Heptane	8.0	2000	4.0	Maya	2.15	1800	16	Screen			106	Screen			106
398	Pit-209.1	7/25	Pit-8.A	41.11	Maya	2.44	12	200	.028	5	N	N	Heptane	8.0	2000	4.0	Maya	2.44	1800	16	Screen			106	Screen			106
399	Pit-210	7/25	Pit-8.A	41.11	Maya	2.55	12	200	.028	5	N	N	Heptane	8.0	14000	4.0	Maya	2.55	1800	16	Screen			106	Screen			106
400	Pit-211	7/25	Pit-8.A	41.11	Maya	2.44	12	200	.028	5	N	N	Heptane	8.0	14000	4.0	Maya	2.44	1800	16	None				Screen			106
401	Pit-211.1	7/25	Pit-8.A	41.11	Maya	2.40	12	200	.028	5	N	N	Heptane	8.0	14000	4.0	Maya	2.40	1800	16	None				Screen			106
402	Pit-212	7/25	Pit-8.A	41.11	Maya	2.40	12	200	.028	5	N	N	Heptane	8.0	2000	4.0	Maya	2.40	1800	16	None				Screen			106
403	Pit-212.1	7/25	Pit-8.A	41.11	Maya	2.40	12	200	.028	5	N	N	Heptane	8.0	2000	4.0	Maya	2.40	1800	16	None				Screen			106
404	Ill-214	7/26	Ill-8.A	44.79	Heptane	8.00	14	200	.025	5	N	N	Heptane	8.0	2000	4.0					Screen			106	None			
405	Ill-214.1	7/26	Ill-8.A	44.79	Heptane	8.00	14	200	.025	5	N	N	Heptane	8.0	2000	4.0					Screen			106	None			
406	Ill-215	7/26	Ill-8.A	44.79	Maya	2.40	14	200	.025	5	N	N	Heptane	8.0	2000	4.0	Maya	2.40	1800	16	Screen			106	Screen			106
407	Ill-216	7/26	Ill-8.A	44.79	Maya	2.40	14	200	.025	5	N	N	Heptane	8.0	14000	4.0	Maya	2.40	1800	16	Screen			106	Screen			106
408	Ill-216.1	7/26	Ill-8.A	44.79	Maya	2.40	14	200	.025	5	N	N	Heptane	8.0	14000	4.0	Maya	2.40	1800	16	Screen			106	Screen			106
409	Ill-217	7/26	Ill-8.A	44.79	Maya	2.40	14	200	.025	5	N	N	Heptane	8.0	2000	4.0	Maya	2.40	1800	16	None				Screen			106
410	Ill-218	7/26	Ill-8.A	44.79	Maya	2.40	14	200	.025	5	N	N	Heptane	8.0	14000	4.0	Maya	2.40	1800	16	None				Screen			106
411	Ill-219	7/26	Ill-8.A	44.79	Heptane	8.00	3	28	.125	5	N	N	Heptane	8.0	2000	4.0					Screen			150	None			
412	Ill-220	7/26	Ill-8.A	44.79	Heptane	8.00	3	28	.125	5	N	N	Heptane	8.0	2000	4.0					Screen			106	None			
413	Ill-221	7/26	Ill-8.A	44.79	Heptane	8.00	14	200	.025	5	N	N	Heptane	8.0	14000	4.0					Screen			106	None			
414	Pit-213	7/26	Pit-8.A	164.44	Heptane	48.00	13	28	.124	20	N	N	Heptane	48.0	2000	4.0					Screen			600	None			
415	Pit-214	7/26	Pit-8.A	164.44	Heptane	32.00	13	28	.124	20	N	N	Heptane	32.0	2000	4.0					Screen			600	None			
416	Pit-215	7/26	Pit-8.A	41.11	Heptane	8.00	3	28	.120	5	N	N	Heptane	8.0	2000	4.0					Screen			425	None			
417	Pit-216	7/26	Pit-8.A	41.11	Heptane	8.00	3	28	.120	5	N	N	Heptane	8.0	2000	4.0					Screen			212	None			
418	Ufp-208	7/26	Ufp-8.A	40.90	Heptane	8.00	7	200	.027	5	N	N	Heptane	8.0	2000	4.0					Screen			106	None			
419	Ufp-208.1	7/26	Ufp-8.A	40.90	Heptane	8.00	7	200	.027	5	N	N	Heptane	8.0	2000	4.0					Screen			106	None			
420	Ufp-209	7/26	Ufp-8.A	40.90	Maya	2.40	7	200	.027	5	N	N	Heptane	8.0	2000	4.0	Maya	2.40	1800	16	Screen			106	Screen			106
421	Ufp-209.1	7/26	Ufp-8.A	40.90	Maya	2.40	7	200	.027	5	N	N	Heptane	8.0	2000	4.0	Maya	2.40	1800	16	Screen			106	Screen			106
422	Ufp-210	7/26	Ufp-8.A	40.90	Maya	2.40	7	200	.027	5	N	N	Heptane	8.0	14000	4.0	Maya	2.40	1800	16	Screen			106	Screen			106
423	Ufp-211	7/26	Ufp-8.A	40.90	Maya	2.40	7	200	.027	5	N	N	Heptane	8.0	2000	4.0	Maya	2.40	1800	16	None				Screen			106
424	Ufp-212	7/26	Ufp-8.A	40.90	Maya	2.40	7	200	.027	5	N	N	Heptane	8.0	14000	4.0	Maya	2.40	1800	16	None				Screen			106
425	Ufp-213	7/26	Ufp-8.A	40.90	Heptane	8.00	1	28	.128	5	N	N	Heptane	8.0	2000	4.0					Screen			425	None			
426	Ufp-214	7/26	Ufp-8.A	40.90	Heptane	8.00	1	28	.128	5	N	N	Heptane	8.0	2000	4.0					Screen			212	None			
427	Ufp-215	7/26	Ufp-8.A	163.59	Diesel	1.60	4	28	.129	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None	9.0	4.5	
428	Ufp-216	7/26	Ufp-8.A	163.59	M1/D1	1.60	4	28	.129	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None	9.0	4.5	
429	Ufp-217	7/26	Ufp-8.A	40.90	Diesel	.40	1	28	.128	5	N	N	Diesel	.4	2000	4.0					2-Floa				None	4.5	4.5	
430	Ufp-218	7/26	Ufp-8.A	40.90	Heptane	8.00	7	200	.027	5	N	N	Heptane	8.0	14000	4.0					Screen			106	None			
431	Pit-217	8/03	Pit-8.A	164.44	M1/D1	1.60	52	200	.029	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
432	Pit-217.1	8/03	Pit-8.A	164.44	M1/D1	1.60	52	200	.029	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Conc	Pyr Depr	Add. Used	High Shear Conditions Oil Type & Wt		Rate	Time	Low Shear Conditions Oil Type & Wt		Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
433	Pit-218	8/03	Pit-8.A	41.11	M1/D1	.40	12	200	.028	5	N	N	M1/D1	.4	2000	4.0					2-Floa				None			
434	Pit-218.1	8/03	Pit-8.A	41.11	M1/D1	.40	12	200	.028	5	N	N	M1/D1	.4	2000	4.0					2-Floa				None			
435	Pit-219	8/03	Pit-8.A	82.22	M1/D1	.80	22	200	.029	10	N	N	M1/D1	.8	2000	4.0					2-Floa				None			
436	Pit-219.1	8/03	Pit-8.A	82.22	M1/D1	.80	22	200	.029	10	N	N	M1/D1	.8	2000	4.0					2-Floa				None			
437	Pit-220	8/03	Pit-8.A	45.15	M1/D1	.40	22	200	.029	10	N	N	M1/D1	.4	2000	4.0					2-Floa				None			
438	Pit 220.1	8/03	Pit-8.A	37.47	M1/D1	.40	22	200	.029	10	N	N	M1/D1	.4	2000	4.0					2-Floa				None			
439	Pit-220.2	8/03	Pit-8.A	37.17	M1/D1	.40	22	200	.029	10	N	N	M1/D1	.4	2000	4.0					2-Floa				None			
440	Pit-220.3	8/03	Pit-8.A	45.06	M1/D1	.40	22	200	.029	10	N	N	M1/D1	.4	2000	4.0					2-Floa				None			
441	Pit-221	8/03	Pit-8.A	164.44	M1/D1	1.60	22	200	.029	10	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
442	Pit-221.1	8/03	Pit-8.A	164.44	M1/D1	1.60	22	200	.029	10	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
443	Pit-222	8/03	Pit-8.A	82.22	M1/D1	.80	12	200	.028	5	N	N	M1/D1	.8	2000	4.0					2-Floa				None			
444	Pit-222.1	8/03	Pit-8.A	82.22	M1/D1	.80	12	200	.028	5	N	N	M1/D1	.8	2000	4.0					2-Floa				None			
445	Pit-223	8/03	Pit-8.A	71.60	M1/D1	.80	52	200	.029	20	N	N	M1/D1	.8	2000	4.0					2-Floa				None			
446	Pit-223.1	8/03	Pit-8.A	76.12	M1/D1	.80	52	200	.029	20	N	N	M1/D1	.8	2000	4.0					2-Floa				None			
447	Pit-224	8/03	Pit-8.A	45.92	M1/D1	.40	52	200	.029	20	N	N	M1/D1	.4	2000	4.0					2-Floa				None			
448	Pit-224.1	8/03	Pit-8.A	39.89	M1/D1	.40	52	200	.029	20	N	N	M1/D1	.4	2000	4.0					2-Floa				None			
449	Pit-225	8/03	Pit-8.A	46.92	M1/D1	.40	52	200	.029	20	N	N	M1/D1	.4	2000	4.0					2-Floa				None			
450	Pit-225.1	8/03	Pit-8.A	48.44	M1/D1	.40	52	200	.029	20	N	N	M1/D1	.4	2000	4.0					2-Floa				None			
451	Pit-226	8/13	Pit-8.A	164.44	Heptane	32.00	52	200	.029	20	N	N	Heptane	32.0	2000	4.0					Screen			106	None			
452	Pit-227	8/13	Pit-8.A	164.44	Heptane	32.00	12	200	.028	5	N	N	Heptane	32.0	2000	4.0					Screen			106	None			
453	Pit-228	8/13	Pit-8.A	164.44	Heptane	32.00	52	200	.029	20	N	N	Heptane	32.0	2000	4.0					Screen			106	None			
454	Pit-229	8/13	Pit-8.A	41.11	Heptane	8.00	12	200	.028	5	N	N	Heptane	8.0	14000	4.0					Screen			106	None			
455	Pit-230	8/13	Pit-8.A	164.44	Heptane	32.00	52	200	.029	20	N	N	Heptane	32.0	2000	4.0					Screen			106	None			
456	Ill-222	8/15	Ill-8.A	44.79	Heptane	4.00	14	200	.025	5	N	N	Heptane	4.0	2000	4.0					Screen			106	None			
457	Ill-223	8/15	Ill-8.A	44.77	Heptane	12.00	14	200	.025	5	N	N	Heptane	12.0	2000	4.0					Screen			106	None			
458	Ill-224	8/15	Ill-8.A	44.79	Heptane	60.00	14	200	.025	5	N	N	Heptane	60.0	2000	4.0					Screen			106	None			
459	Pit-231	8/15	Pit-8.A	41.11	Heptane	4.00	12	200	.028	5	N	N	Heptane	4.0	2000	4.0					Screen			106	None			
460	Pit-232	8/15	Pit-8.A	41.11	Heptane	12.00	12	200	.028	5	N	N	Heptane	12.0	2000	4.0					Screen			106	None			
461	Pit-233	8/15	Pit-8.A	41.11	Heptane	60.00	12	200	.028	5	N	N	Heptane	60.0	2000	4.0					Screen			106	None			
462	Ufp-219	8/15	Ufp-8.A	40.90	Heptane	4.00	7	200	.027	5	N	N	Heptane	4.0	2000	4.0					Screen			106	None			
463	Ufp-220	8/15	Ufp-8.A	40.90	Heptane	12.00	7	200	.027	5	N	N	Heptane	12.0	2000	4.0					Screen			106	None			
464	Ufp-221	8/15	Ufp-8.A	40.90	Heptane	60.00	7	200	.027	5	N	N	Heptane	60.0	2000	4.0					Screen			106	None			
465	Ill-231	9/04	Ill-8.A	179.17	Heptane	80.00	47	200	.030	20	N	N	Heptane	80.0	2000	4.0					Screen			106	None			
466	Ill-232	9/04	Ill-8.A	179.17	Heptane	160.00	47	200	.030	20	N	N	Heptane	160.0	2000	4.0					Screen			106	None			
467	Ill-233	9/04	Ill-8.A	179.17	Heptane	240.00	47	200	.030	20	N	N	Heptane	240.0	2000	4.0					Screen			106	None			
468	Ill-235	9/04	Ill-8.A	44.79	Heptane	2.40	14	200	.025	5	N	N	Heptane	2.4	2000	4.0					Flotat				None	44.8		
469	Ill-236	9/04	Ill-8.A	44.79	Diesel	.80	3	28	.125	5	N	N	Diesel	.8	2000	4.0					2-Floa				None			
470	Ill-236.1	9/04	Ill-8.A	44.79	Diesel	.80	3	28	.125	5	N	N	Diesel	.8	2000	4.0					2-Floa				None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Conc	Pyr Depr	Add. Used	High Shear Conditions Oil Type & Wt		Rate	Time	Low Shear Conditions Oil Type & Wt		Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
471	Ill-237	9/04	Ill-8.A	44.79	Diesel	.80	14	200	.025	5	N	N	Diesel	.8	2000	4.0					2-Floa				None			
472	Pit-234	9/04	Pit-8.A	164.44	Heptane	80.00	52	200	.029	20	N	N	Heptane	80.0	2000	4.0					Screen			106	None			
473	Pit-235	9/04	Pit-8.A	164.44	Heptane	160.00	52	200	.029	20	N	N	Heptane	160.0	2000	4.0					Screen			106	None			
474	Pit-236	9/04	Pit-8.A	164.44	Heptane	240.00	52	200	.029	20	N	N	Heptane	240.0	2000	4.0					Screen			106	None			
475	Pit-237	9/04	Pit-8.A	123.33	Heptane	60.00	36	200	.028	15	N	N	Heptane	60.0	2000	4.0					Screen			106	None			
476	Pit-238	9/04	Pit-8.A	123.33	Heptane	120.00	36	200	.028	15	N	N	Heptane	120.0	2000	4.0					Screen			106	None			
477	Pit-239	9/04	Pit-8.A	123.33	Heptane	180.00	36	200	.028	15	N	N	Heptane	180.0	2000	4.0					Screen			106	None			
478	Pit-240	9/04	Pit-8.A	82.22	Heptane	40.00	22	200	.029	10	N	N	Heptane	40.0	2000	4.0					Screen			106	None			
479	Pit-241	9/04	Pit-8.A	82.22	Heptane	80.00	22	200	.029	10	N	N	Heptane	80.0	2000	4.0					Screen			106	None			
480	Pit-242	9/04	Pit-8.A	82.22	Heptane	120.00	22	200	.029	10	N	N	Heptane	120.0	2000	4.0					Screen			106	None			
481	Pit-243	9/04	Pit-8.A	41.11	Heptane	2.40	12	200	.028	5	N	N	Heptane	2.4	2000	4.0					2-Floa				None			
482	Pit-243.1	9/04	Pit-8.A	41.11	Heptane	2.40	12	200	.028	5	N	N	Heptane	2.4	2000	4.0					2-Floa				None			
483	Ufp-222	9/04	Ufp-8.A	40.90	Heptane	2.40	7	200	.027	5	N	N	Heptane	2.4	2000	4.0					2-Floa				None			
484	Ufp-222.1	9/04	Ufp-8.A	40.90	Heptane	2.40	7	200	.027	5	N	N	Heptane	2.4	2000	4.0					2-Floa				None			
485	Ufp-223	9/04	Ufp-8.A	40.90	Diesel	.80	1	28	.128	5	N	N	Diesel	.8	2000	4.0					2-Floa				None			
486	Ufp-223.1	9/04	Ufp-8.A	40.90	Diesel	.80	1	28	.128	5	N	N	Diesel	.8	2000	4.0					2-Floa				None			
487	Ufp-224	9/04	Ufp-8.A	81.80	Heptane	40.00	15	200	.025	10	N	N	Heptane	40.0	2000	4.0					Screen			106	None			
488	Ufp-225	9/04	Ufp-8.A	81.80	Heptane	80.00	15	200	.025	10	N	N	Heptane	80.0	2000	4.0					Screen			106	None			
489	Ufp-225.1	9/04	Ufp-8.A	81.80	Heptane	80.00	15	200	.025	10	N	N	Heptane	80.0	2000	4.0					Screen			106	None			
490	Ufp-227	9/04	Ufp-8.A	122.70	Heptane	60.00	24	200	.025	15	N	N	Heptane	60.0	2000	4.0					Screen			106	None			
491	Ufp-226	8/15	Ufp-8.A	81.80	Heptane	120.00	15	200	.025	10	N	N	Heptane	120.0	2000	4.0					Screen			106	None			
492	Ufp-228	8/15	Ufp-8.A	122.70	Heptane	120.00	24	200	.025	15	N	N	Heptane	120.0	2000	4.0					Screen			106	None			
493	Ufp-229	8/16	Ufp-8.A	122.70	Heptane	180.00	24	200	.025	15	N	N	Heptane	180.0	2000	4.0					Screen			106	None			
494	Ufp-230	8/17	Ufp-8.A	163.59	Heptane	80.00	27	200	.027	20	N	N	Heptane	80.0	2000	4.0					Screen			106	None			
495	Ill-225	8/16	Ill-8.A	89.59	Heptane	40.00	25	200	.029	10	N	N	Heptane	40.0	2000	4.0					Screen			106	None			
496	Ill-226	8/15	Ill-8.A	89.59	Heptane	80.00	25	200	.029	10	N	N	Heptane	80.0	2000	4.0					Screen			106	None			
497	Ill-227	8/15	Ill-8.A	89.59	Heptane	120.00	25	200	.029	10	N	N	Heptane	120.0	2000	4.0					Screen			106	None			
498	Ill-228	8/14	Ill-8.A	134.38	Heptane	60.00	39	200	.028	15	N	N	Heptane	60.0	2000	4.0					Screen			106	None			
499	Ill-229	8/14	Ill-8.A	134.38	Heptane	120.00	39	200	.028	15	N	N	Heptane	120.0	2000	4.0					Screen			106	None			
500	Ill-230	8/14	Ill-8.A	134.38	Heptane	180.00	39	200	.028	15	N	N	Heptane	180.0	2000	4.0					Screen			106	None			
501	Ill-234	8/09	Ill-8.A	44.79	Heptane	2.40	14	200	.025	5	N	N	Heptane	2.4	2000	4.0					Flotat				None			
502	Pit-237.1	8/24	Pit-8.A	123.33	Heptane	60.00	36	200	.028	15	N	N	Heptane	60.0	2000	4.0					Screen			106	None			
503	Pit-240.1	8/24	Pit-8.A	82.22	Heptane	40.00	22	200	.029	10	N	N	Heptane	40.0	2000	4.0					Screen			106	None			
504	Ill-227.1	9/17	Ill-8.A	89.59	Heptane	120.00	25	200	.029	10	N	N	Heptane	120.0	2000	4.0					Screen			106	None			
505	Ill-228.1	9/17	Ill-8.A	134.39	Heptane	60.00	39	200	.028	15	N	N	Heptane	60.0	2000	4.0					Screen			106	None			
506	Ufp-230.1	9/17	Ufp-8.A	163.59	Heptane	80.00	27	200	.027	20	N	N	Heptane	80.0	2000	4.0					Screen			106	None			
507	Ufp-231	9/17	Ufp-8.A	163.59	Heptane	160.00	27	200	.027	20	N	N	Heptane	160.0	2000	4.0					Screen			106	None			
508	Ufp-232	9/17	Ufp-8.A	163.59	Heptane	240.00	27	200	.027	20	N	N	Heptane	240.0	2000	4.0					Screen			106	None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Conc	Pyr Depr	Add. Used	High Shear Conditions Oil Type & Wt		Rate	Time	Low Shear Conditions Oil Type & Wt		Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
509	Ken-1	10/04	Ken-1.A	165.17	M1/D1	1.60		28	.130	20	N	N	M1/D1	1.6	2000	1.0					2-Floa				None			
510	Ken-2	10/04	Ken-1.A	165.17	M1/D1	2.40		28	.130	20	N	N	M1/D1	2.4	2000	1.0					2-Floa				None			
511	Ken-3	10/04	Ken-1.A	165.17	Diesel	1.60		28	.130	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
512	Ken-3.1	10/04	Ken-1.A	165.17	Diesel	1.60		28	.130	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
513	Ken-4	10/04	Ken-1.A	165.17	Diesel	2.40		28	.130	20	N	N	Diesel	2.4	2000	1.0					2-Floa				None			
514	Ken-5	10/04	Ken-1.A	165.17	M1/D1	1.60		200	.039	20	N	N	M1/D1	1.6	2000	1.0					2-Floa				None			
515	Ken-6	10/04	Ken-1.A	165.17	Diesel	1.60		200	.039	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
516	Ken-7	10/04	Ken-1.A	165.17	Diesel	2.40		28	.130	20	y	N	Diesel	2.4	2000	1.0					2-Floa				None			
517	Ken-8	10/04	Ken-1.A	164.27	M1/D1	1.60	9	28	.125	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
518	Ken-9	10/04	Ken-1.A	164.27	Diesel	1.60	9	28	.125	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
519	Ken-10	10/04	Ken-1.A	164.27	M1/D1	1.60	9	28	.125	20	Y	N	M1/D1	1.6	2000	4.0					2-Floa				None			
520	Ken-11	10/04	Ken-1.A	164.27	M1/D1	1.60	9	28	.125	20	Y	N	M1/D1	1.6	2000	4.0					2-Floa				None			
521	Ken-12	10/04	Ken-1.A	164.27	M1/D1	1.60	9	28	.125	20	Y	N	M1/D1	1.6	2000	4.0					2-Floa				None			
522	Pit-244	10/05	Pit-9.A	163.93	M1/D1	1.60		28	.125	20	N	N	M1/D1	1.6	2000	1.0					2-Floa				None			
523	Pit-245	10/05	Pit-9.A	163.93	M1/D1	2.40		28	.125	20	N	N	M1/D1	2.4	2000	1.0					Flotat				None			
524	Pit-245.1	10/05	Pit-9.A	163.93	M1/D1	2.40		28	.125	20	N	N	M1/D1	2.4	2000	1.0					Flotat				None			
525	Pit-246	10/05	Pit-9.A	163.93	M1/D1	1.60		200	.042	20	N	N	M1/D1	1.6	2000	1.0					2-Floa				None			
526	Pit-246.1	10/05	Pit-9.A	163.93	M1/D1	1.60		200	.042	20	N	N	M1/D1	1.6	2000	1.0					2-Floa				None			
527	Pit-248	10/05	Pit-9.A	163.93	M1/D1	2.40		28	.125	20	N	N	M1/D1	2.4	2000	1.0					2-Floa				None			
528	Pit-249	10/05	Pit-9.A	163.03	M1/D1	1.60		28	.120	20	N	N	M1/D1	1.6	2000	1.0					2-Floa				None			
529	Pit-250	10/05	Pit-9.A	163.03	M1/D1	2.40		28	.120	20	N	N	M1/D1	2.4	2000	1.0					2-Floa				None			
530	Pit-250.1	10/05	Pit-9.A	163.93	M1/D1	2.40		28	.120	20	N	N	M1/D1	2.4	2000	1.0					2-Floa				None			
531	Pit-251	10/05	Pit-9.A	163.03	M1/D1	1.60		200	.044	20	N	N	M1/D1	1.6	2000	1.0					2-Floa				None			
532	Pit-251.1	10/05	Pit-9.A	163.03	M1/D1	1.60		200	.044	20	N	N	M1/D1	1.6	2000	1.0					2-Floa				None			
533	Pit-253	10/05	Pit-9.A	163.03	M1/D1	1.60	13	28	.131	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
534	Pit-254	10/05	Pit-9.A	163.03	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
535	Pit-255.1	10/05	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	.5					Flotat				None			
536	Pit-255.2	10/05	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	.5					Flotat				None			
537	Pit-255.3	10/05	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	.5					Flotat				None			
538	Pit-255.4	10/05	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	.5					Flotat				None			
539	Pit-255.5	10/05	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	.5					Flotat				None			
540	Pit-258.1	10/10	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	4.0					Flotat				None			
541	Pit-258.2	10/10	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	4.0					Flotat				None			
542	Pit-258.3	10/10	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	4.0					Flotat				None			
543	Pit-258.4	10/10	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	4.0					Flotat				None			
544	Pit-258.5	10/10	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	4.0					Flotat				None			
545	Pit-259.1	10/10	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	Y	N	M1/D1	1.6	2000	.5					Flotat				None			
546	Pit-259.2	10/10	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	Y	N	M1/D1	1.6	2000	.5					Flotat				None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Conc	Pyr Depr	Add. Used	High Shear Conditions Oil Type & Wt	Rate	Time	Low Shear Conditions Oil Type & Wt	Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
547	Pit-259.3	10/10	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	Y	N	M1/D1	1.6	2000	.5			Flotat				None			
548	Pit-259.4	10/10	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	Y	N	M1/D1	1.6	2000	.5			Flotat				None			
549	Pit-259.5	10/10	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	Y	N	M1/D1	1.6	2000	.5			Flotat				None			
550	Pit-254.1	10/10	Pit-9.A	163.03	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	4.0			2-Floa				None			
552	Pit-A	10/11	Pit-9.A	163.93	M1/D1	2.10	54	200	.028	20	N	N	M1/D1	2.1	2000	4.0			2-Floa				None			
553	Pit-B	10/11	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	4.0			2-Floa				None			
554	Pit-C	10/11	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	Y	N	M1/D1	1.6	2000	4.0			2-Floa				None			
555	Pit-D	10/11	Pit-9.A	163.93	M1/D1	1.30	54	200	.028	20	N	N	M1/D1	1.3	2000	4.0			2-Floa				None			
556	Pit-E	10/11	Pit-9.A	163.93	M1/D1	.80	54	200	.028	20	N	N	M1/D1	.8	2000	4.0			2-Floa				None			
557	Ken-13	10/11	Ken-1.A	164.27	M1/D1	1.60	48	200	.022	20	Y	N	M1/D1	1.6	2000	4.0			2-Floa				None			
558	Pit-256.1	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	1.0			Flotat				None			
559	Pit-256.2	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	1.0			Flotat				None			
560	Pit-256.3	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	1.0			Flotat				None			
561	Pit-256.4	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	1.0			Flotat				None			
562	Pit-256.5	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	1.0			Flotat				None			
563	Pit-257.1	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	2.0			Flotat				None			
564	Pit-257.2	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	2.0			Flotat				None			
565	Pit-257.3	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	2.0			Flotat				None			
566	Pit-257.4	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	2.0			Flotat				None			
567	Pit-257.5	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	2.0			Flotat				None			
568	Pit-260.1	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	.5			Flotat				None			
569	Pit-260.2	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	.5			Flotat				None			
570	Pit-260.3	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	.5			Flotat				None			
571	Pit-260.4	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	.5			Flotat				None			
572	Pit-260.5	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	.5			Flotat				None			
573	Pit-260.11	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	.5			Flotat				None			
574	Pit-260.12	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	.5			Flotat				None			
575	Pit-260.13	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	.5			Flotat				None			
576	Pit-260.14	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	.5			Flotat				None			
577	Pit-260.15	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	.5			Flotat				None			
578	Pit-261.1	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	1.0			Flotat				None			
579	Pit-261.2	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	1.0			Flotat				None			
580	Pit-261.3	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	1.0			Flotat				None			
581	Pit-261.4	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	1.0			Flotat				None			
582	Pit-261.5	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	1.0			Flotat				None			
583	Pit-262.1	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	2.0			Flotat				None			
584	Pit-262.2	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	2.0			Flotat				None			
585	Pit-262.3	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	2.0			Flotat				None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Pyr Conc	Depr	Add. Used	High Shear Conditions Oil Type & Wt		Rate	Time	Low Shear Conditions Oil Type & Wt		Rate	Time	Microaggl. Rec. (LS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
586	Pit-262.4	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	2.0					Flotat				None			
587	Pit-262.5	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	2.0					Flotat				None			
588	Pit-263.1	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	4.0					Flotat				None			
589	Pit-263.2	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	4.0					Flotat				None			
590	Pit-263.3	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	4.0					Flotat				None			
591	Pit-263.4	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	4.0					Flotat				None			
592	Pit-263.5	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	4.0					Flotat				None			
593	Pit-264.1	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	.5					Flotat				None			
594	Pit-264.2	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	.5					Flotat				None			
595	Pit-264.3	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	.5					Flotat				None			
596	Pit-264.4	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	.5					Flotat				None			
597	Pit-264.5	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	.5					Flotat				None			
598	Pit-265.1	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	1.0					Flotat				None			
599	Pit-265.2	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	1.0					Flotat				None			
600	Pit-265.3	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	1.0					Flotat				None			
601	Pit-265.4	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	1.0					Flotat				None			
602	Pit-265.5	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	1.0					Flotat				None			
603	Pit-266.1	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	2.0					Flotat				None			
604	Pit-266.2	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	2.0					Flotat				None			
605	Pit-266.3	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	2.0					Flotat				None			
606	Pit-266.4	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	2.0					Flotat				None			
607	Pit-266.5	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	2.0					Flotat				None			
608	Pit-267.1	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
609	Pit-267.2	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
610	Pit-267.3	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
611	Pit-267.4	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
612	Pit-267.5	10/18	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
613	Ufp-233.1	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	.5					Flotat				None			
614	Ufp-233.2	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	.5					Flotat				None			
615	Ufp-233.3	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	.5					Flotat				None			
616	Ufp-233.4	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	.5					Flotat				None			
617	Ufp-233.5	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	.5					Flotat				None			
618	Ufp-234.1	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	.5					Flotat				None			
619	Ufp-234.2	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	.5					Flotat				None			
620	Ufp-234.3	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	.5					Flotat				None			
621	Ufp-234.4	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	.5					Flotat				None			
622	Ufp-234.5	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	.5					Flotat				None			
623	Ufp-235.1	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	4.0					Flotat				None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Pyr Conc	Depr	Add. Used	High Shear Conditions Oil Type & Wt		Rate	Time	Low Shear Conditions Oil Type & Wt	Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
624	Ufp-235.2	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	4.0				Flotat				None			
625	Ufp-235.3	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	4.0				Flotat				None			
626	Ufp-235.4	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	4.0				Flotat				None			
627	Ufp-235.5	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	4.0				Flotat				None			
628	Ufp-236.1	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	Y	N	M1/D1	1.6	2000	.5				Flotat				None			
629	Ufp-236.2	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	Y	N	M1/D1	1.6	2000	.5				Flotat				None			
630	Ufp-236.3	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	Y	N	M1/D1	1.6	2000	.5				Flotat				None			
631	Ufp-236.4	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	Y	N	M1/D1	1.6	2000	.5				Flotat				None			
632	Ufp-236.5	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	Y	N	M1/D1	1.6	2000	.5				Flotat				None			
633	Ufp-237.1	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	.5				Flotat				None			
634	Ufp-237.2	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	.5				Flotat				None			
635	Ufp-237.3	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	.5				Flotat				None			
636	Ufp-237.4	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	.5				Flotat				None			
637	Ufp-237.5	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	.5				Flotat				None			
638	Ufp-238.1	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	1.0				Flotat				None			
639	Ufp-238.2	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	1.0				Flotat				None			
640	Ufp-238.3	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	1.0				Flotat				None			
641	Ufp-238.4	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	1.0				Flotat				None			
642	Ufp-238.5	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	1.0				Flotat				None			
643	Ufp-239.1	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	1.0				Flotat				None			
644	Ufp-239.2	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	1.0				Flotat				None			
645	Ufp-239.3	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	1.0				Flotat				None			
646	Ufp-239.4	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	1.0				Flotat				None			
647	Ufp-239.5	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	1.0				Flotat				None			
648	Ufp-240.1	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	1.0				Flotat				None			
649	Ufp-240.2	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	1.0				Flotat				None			
650	Ufp-240.3	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	1.0				Flotat				None			
651	Ufp-240.4	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	1.0				Flotat				None			
652	Ufp-240.5	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	1.1				Flotat				None			
653	Ufp-241.1	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	2.0				Flotat				None			
654	Ufp-241.2	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	2.0				Flotat				None			
655	Ufp-241.3	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	2.0				Flotat				None			
656	Ufp-241.4	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	2.0				Flotat				None			
657	Ufp-241.5	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	2.0				Flotat				None			
658	Ufp-241.11	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	2.0				Flotat				None			
659	uFP-241.12	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	2.0				Flotat				None			
660	Ufp-241.13	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	2.0				Flotat				None			
661	Ufp-241.14	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	2.0				Flotat				None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Pyr Add. Conc	Depr	Used	High Shear Conditions Oil Type & Wt		Rate	Time	Low Shear Conditions Oil Type & Wt		Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
662	Ufp-241.15	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	2.0					Flotat				None			
663	Ufp-242.1	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	2.0					Flotat				None			
664	Ufp-242.2	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	2.0					Flotat				None			
665	Ufp-242.3	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	2.0					Flotat				None			
666	Ufp-242.4	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	2.0					Flotat				None			
667	Ufp-242.5	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	2.0					Flotat				None			
668	Ufp-243.1	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	2.0					Flotat				None			
669	Ufp-243.2	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	2.0					Flotat				None			
670	Ufp-243.3	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	2.0					Flotat				None			
671	Ufp-243.4	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	2.0					Flotat				None			
672	Ufp-243.5	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	2.0					Flotat				None			
673	Ufp-244.1	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	4.0					Flotat				None			
674	Ufp-244.2	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	4.0					Flotat				None			
675	Ufp-244.3	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	4.0					Flotat				None			
676	Ufp-244.4	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	4.0					Flotat				None			
677	Ufp-244.5	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	4.0					Flotat				None			
678	Ufp-245.1	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
679	Ufp-245.2	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
680	Ufp-245.3	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
681	Ufp-245.4	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
682	Ufp-245.5	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
683	Ufp-245.11	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
684	Ufp-245.12	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
685	Ufp-245.13	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
686	Ufp-245.14	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
687	Ufp-245.15	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
688	Ufp-246	10/22	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	4.0					2-Floa				None			
689	Ufp-247	10/25	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
690	Ufp-248	10/25	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	1600	4.0					2-Floa				None			
691	Ill-238.1	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	.5					Flotat				None			
692	Ill-238.2	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	.5					Flotat				None			
693	Ill-238.3	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	.5					Flotat				None			
694	Ill-238.4	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	.5					Flotat				None			
695	Ill-238.5	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	.5					Flotat				None			
696	Ill-239.1	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	1.0					Flotat				None			
697	Ill-239.2	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	1.0					Flotat				None			
698	Ill-239.3	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	1.0					Flotat				None			
699	Ill-239.4	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	1.0					Flotat				None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Conc	Pyr Depr	Add. Used	High Shear Conditions Oil Type & Wt		Rate	Time	Low Shear Conditions Oil Type & Wt		Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
700	Ill-239.5	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	1.0					Flotat				None			
701	Ill-240.1	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	2.0					Flotat				None			
702	Ill-240.2	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	2.0					Flotat				None			
703	Ill-240.3	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	2.0					Flotat				None			
704	Ill-240.4	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	2.0					Flotat				None			
705	Ill-240.5	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	2.0					Flotat				None			
706	Ill-241.1	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	4.0					Flotat				None			
707	Ill-241.2	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	4.0					Flotat				None			
708	Ill-241.3	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	4.0					Flotat				None			
709	Ill-241.4	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	4.0					Flotat				None			
710	Ill-241.5	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	4.0					Flotat				None			
711	Ill-242.1	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	.5					Flotat				None			
712	Ill-242.2	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	.5					Flotat				None			
713	Ill-242.3	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	.5					Flotat				None			
714	Ill-242.4	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	.5					Flotat				None			
715	Ill-242.5	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	.5					Flotat				None			
716	Ill-243.1	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	1.0					Flotat				None			
717	Ill-243.2	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	1.0					Flotat				None			
718	Ill-243.3	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	1.0					Flotat				None			
719	Ill-243.4	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	1.0					Flotat				None			
720	Ill-243.5	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	1.0					Flotat				None			
721	Ill-244.1	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	2.0					Flotat				None			
722	Ill-244.2	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	2.0					Flotat				None			
723	Ill-244.3	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	2.0					Flotat				None			
724	Ill-244.4	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	2.0					Flotat				None			
725	Ill-244.5	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	2.0					Flotat				None			
726	Ill-245.1	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	4.0					Flotat				None			
727	Ill-245.2	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	4.0					Flotat				None			
728	Ill-245.3	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	4.0					Flotat				None			
729	Ill-245.4	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	4.0					Flotat				None			
730	Ill-245.5	10/25	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	4.0					Flotat				None			
731	Ill-240.11	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	2.0					Flotat				None			
732	Ill-240.12	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	2.0					Flotat				None			
733	Ill-240.13	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	2.0					Flotat				None			
734	Ill-240.14	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	2.0					Flotat				None			
735	Ill-240.15	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	2.0					Flotat				None			
736	Ill-244.11	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	2.0					Flotat				None			
737	Ill-244.12	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	2.0					Flotat				None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Pyr Conc	Depr	Add. Used	High Shear Conditions Oil Type & Wt		Rate	Time	Low Shear Conditions Oil Type & Wt		Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
738	Ill-244.13	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	2.0					Flotat				None			
739	Ill-244.14	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	2.0					Flotat				None			
740	Ill-244.15	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	2.0					Flotat				None			
741	Ill-246.1	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	.5					Flotat				None			
742	Ill-246.2	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	.5					Flotat				None			
743	Ill-246.3	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	.5					Flotat				None			
744	Ill-246.4	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	.5					Flotat				None			
745	Ill-246.5	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	.5					Flotat				None			
746	Ill-247.1	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	1.0					Flotat				None			
747	Ill-247.2	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	1.0					Flotat				None			
748	Ill-247.3	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	1.0					Flotat				None			
749	Ill-247.4	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	1.0					Flotat				None			
750	Ill-247.5	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	1.0					Flotat				None			
751	Ill-248.1	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	2.0					Flotat				None			
752	Ill-248.2	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	2.0					Flotat				None			
753	Ill-248.3	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	2.0					Flotat				None			
754	Ill-248.4	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	2.0					Flotat				None			
755	Ill-248.5	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	2.0					Flotat				None			
756	Ill-249.1	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
757	Ill-249.2	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
758	Ill-249.3	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
759	Ill-249.4	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
760	Ill-249.5	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	4.0					Flotat				None			
761	Ill-250	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2400	4.0					2-Floa				None			
762	Ill-251	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	1600	4.0					2-Floa				None			
763	Ill-252.1	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
764	Ill-252.2	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
765	Ill-252.3	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
766	Ill-252.4	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
767	Ill-252.5	10/30	Ill-9.A	178.57	M1/D1	1.60	55	200	.030	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
768	Pit-268	10/30	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	1600	4.0					2-Floa				None			
769	Pit-269	10/30	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
770	Pit-270	10/30	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2400	4.0					2-Floa				None			
771	Ufp-249.1	11/07	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	.5					2-Floa				None			
772	Ufp-249.2	11/07	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	.5					2-Floa				None			
773	Ufp-249.3	11/07	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	.5					2-Floa				None			
774	Ufp-249.4	11/07	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	.5					2-Floa				None			
775	Ufp-249.5	11/07	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2400	.5					2-Floa				None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Conc	Pyr Depr	Add. Used	High Shear Conditions Oil Type & Wt		Rate	Time	Low Shear Conditions Oil Type & Wt		Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
776	Ufp-247.1	11/07	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	Y	M1/D1	1.6	2000	4.0					2-Floa				None			
777	Ufp-250	11/07	Ufp-9.A	162.93	M1/D1	1.60	27	200	.028	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
778	Ufp-251	11/07	Ufp-9.A	162.93	Diesel	1.60	16	100	.058	20	N	Y	Diesel	1.6	2000	4.0					2-Floa				None			
779	Pit-272	11/07	Pit-10A	41.24	Heptane	8.00	12	200	.025	5	N	N	Heptane	8.0	1600	.5					Screen			106	None			
780	Pit-273	11/07	Pit-10A	41.24	Heptane	8.00	12	200	.025	5	N	N	Heptane	8.0	1600	4.0					Screen			106	None			
781	Pit-274	11/07	Pit-10A	41.24	Heptane	8.00	12	200	.025	5	N	N	Heptane	8.0	2000	.5					Screen			106	None			
782	Pit-271.1	11/07	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
783	Pit-271.2	11/07	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
784	Pit-271.3	11/07	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
785	Pit-271.4	11/07	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
786	Pit-271.5	11/07	Pit-9.A	163.93	M1/D1	1.60	54	200	.028	20	N	N	M1/D1	1.6	2000	4.0					2-Floa				None			
787	Ken-29	11/07	Ken-1.A	165.29	Diesel	1.60	9	28	.125	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
788	Ken-30	11/07	Ken-1.A	165.29	Diesel	1.60	48	200	.022	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
789	Ken-30.1	11/07	Ken-1.A	165.29	Diesel	1.60	48	200	.022	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
790	Pit-275	11/14	Pit-10A	41.24	Heptane	8.00	12	200	.025	5	N	N	Heptane	8.0	2000	4.0					Screen			106	None			
791	Pit-276	11/14	Pit-10A	41.24	Heptane	8.00	12	200	.025	5	N	N	Heptane	8.0	2400	.5					Screen			106	None			
792	Pit-277	11/14	Pit-10A	41.24	Heptane	8.00	12	200	.025	5	N	N	Heptane	8.0	2400	4.0					Screen			106	None			
793	Ufp-253	11/14	Ufp-9.A	40.73	Heptane	8.00	7	200	.024	5	N	N	Heptane	8.0	2000	.5					Screen			106	None			
794	Ufp-254	11/14	Ufp-9.A	40.73	Heptane	8.00	7	200	.024	5	N	N	Heptane	8.0	1600	.5					Screen			106	None			
795	Ufp-256	11/14	Ufp-9.A	40.73	Heptane	8.00	7	200	.024	5	N	N	Heptane	8.0	2000	4.0					Screen			106	None			
796	Ufp-256.1	11/14	Ufp-9.A	40.73	Heptane	8.00	7	200	.024	5	N	N	Heptane	8.0	2000	4.0					Screen			106	None			
797	Ufp-257	11/14	Ufp-9.A	40.73	Heptane	8.00	7	200	.024	5	N	N	Heptane	8.0	1600	4.0					Screen			106	None			
798	Ken-14	11/14	Ken-1.A	41.32	Heptane	4.00	2	28	.128	5	N	N	Heptane	4.0	2000	4.0					Screen			106	None			
799	Ken-15	11/14	Ken-1.A	41.32	Heptane	12.00	2	28	.128	5	N	N	Heptane	12.0	2000	4.0					Screen			106	None			
800	Ken-16	11/14	Ken-1.A	41.32	Heptane	60.00	2	28	.128	5	N	N	Heptane	60.0	2000	4.0					Screen			106	None			
801	Ken-17	11/14	Ken-1.A	41.32	Heptane	4.00	2	28	.128	5	N	N	Heptane	4.0	2000	4.0					Screen			400	None			
802	Ken-19	11/15	Ken-1.A	41.32	Heptane	60.00	2	28	.128	5	N	N	Heptane	60.0	2000	4.0					Screen			400	None			
803	Ken-23	11/15	Ken-1.A	165.29	Heptane	16.00	9	28	.125	20	N	N	Heptane	16.0	2000	4.0					Screen			600	None			
804	Ken-25	11/15	Ken-1.A	165.29	Heptane	240.00	9	28	.125	20	N	N	Heptane	240.0	2000	4.0					Screen			600	None			
805	Ken-26	11/15	Ken-1.A	165.29	Heptane	16.00	48	200	.022	20	N	N	Heptane	16.0	2000	4.0					Screen			106	None			
806	Ken-27.1	11/15	Ken-1.A	165.29	Heptane	48.00	48	200	.022	20	N	N	Heptane	48.0	2000	4.0					Screen			106	None			
807	Ken-28	11/15	Ken-1.A	165.29	Heptane	240.00	48	200	.022	20	N	N	Heptane	240.0	2000	4.0					Screen			106	None			
808	Pit-278	11/16	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
809	Pit-279	11/16	Pit-10A	41.24	Heptane	8.00	6	100	.060	5	N	N	Heptane	8.0	2000	4.0					Screen			106	None			
810	Pit-279.1	11/16	Pit-10A	41.24	Heptane	8.00	6	100	.060	5	N	N	Heptane	8.0	2000	4.0					Screen			106	None			
811	Pit-280.1	11/16	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
812	Pit-280.2	11/16	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
813	Pit-281.1	11/16	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	4.0					Flotat				None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Conc	Pyr Depr	Add. Used	High Shear Conditions Oil Type & Wt		Rate	Time	Low Shear Conditions Oil Type & Wt		Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
814	Pit-281.2	11/16	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	4.0					Flotat				None			
815	Ken-20	11/16	Ken-1.A	41.32	Heptane	4.00	9	200	.027	5	N	N	Heptane	4.0	2000	4.0					Screen			106	None			
816	Ken-21	11/16	Ken-1.A	41.32	Heptane	12.00	9	200	.027	5	N	N	Heptane	12.0	2000	4.0					Screen			106	None			
817	Ken-22	11/16	Ken-1.A	41.32	Heptane	60.00	9	200	.027	5	N	N	Heptane	60.0	2000	4.0					Screen			106	None			
818	Ken-24	11/19	Ken-1.A	165.29	Heptane	48.00	9	28	.125	20	N	N	Heptane	48.0	2000	4.0					Screen			600	None			
819	Ken-27	11/19	Ken-1.A	165.29	Heptane	48.00	48	200	.022	20	N	N	Heptane	48.0	2000	4.0					Screen			106	None			
820	Pit-274.1	11/22	Pit-10A	41.24	Heptane	8.00	12	200	.025	5	N	N	Heptane	8.0	2000	.5					Screen			106	None			
821	Pit-276.1	11/19	Pit-10A	41.24	Heptane	8.00	12	200	.023	5	N	N	Heptane	8.0	2400	.5					Screen			106	None			
822	Pit-282	11/19	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
823	Pit-283	11/19	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
824	Pit-284.1	11/19	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
825	Pit-284.2	11/19	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
826	Ken-18	11/19	Ken-1.A	41.32	Heptane	12.00	2	28	.128	5	N	N	Heptane	12.0	2000	4.0					Screen			400	None			
827	Pit-1R	11/20	Pit-1R	164.95	Diesel	1.60	10	28	.132	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
828	Pit-1W	11/20	Pit-1W	164.44	Diesel	1.60	12	28	.124	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
829	Pit-2R	11/20	Pit-1R	164.95	Diesel	1.60	50	200	.020	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
830	Pit-2R1	11/20	Pit-1R	164.95	Diesel	1.60	50	200	.020	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
831	Pit-2W	11/20	Pit-1W	164.44	Diesel	1.60	54	200	.023	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
832	Pit-2W1	11/20	Pit-1W	164.44	Diesel	1.60	54	200	.023	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
833	Pit-3W	11/20	Pit-1W	41.11	Heptane	4.00	12	200	.025	5	N	N	Heptane	8.0	2000	4.0					Screen			106	None			
834	Pit-3W1	11/20	Pit-1W	41.11	Heptane	4.00	12	200	.025	5	N	N	Heptane	8.0	2000	4.0					Screen			106	None			
835	Pit-3R1	11/20	Pit-1R	41.24	Heptane	4.00	11	200	.021	5	N	N	Heptane	8.0	2000	4.0					Screen			106	None			
836	Pit-3R	11/20	Pit-1R	41.24	Heptane	4.00	11	200	.021	5	N	N	Heptane	8.0	2000	4.0					Screen			106	None			
837	Ufp-252	11/21	Ufp-9.A	40.73	Heptane	8.00	7	200	.024	5	N	N	Heptane	8.0	2400	.5					Screen			106	None			
838	Ufp-255	11/21	Ufp-9.A	40.73	Heptane	8.00	7	200	.024	5	N	N	Heptane	8.0	2400	4.0					Screen			106	None			
839	Ufp-258	11/21	Ufp-9.A	40.73	Heptane	8.00	4	100	.056	5	N	N	Heptane	8.0	2000	4.0					Screen			106	None			
840	Ufp-258.1	11/21	Ufp-9.A	40.73	Heptane	8.00	4	100	.056	5	N	N	Heptane	8.0	2000	4.0					Screen			106	None			
841	Ufp-259.1	11/21	Ufp-9.A	162.93	Diesel	1.60	6	28	.128	20	N	N	Diesel	1.6	2000	4.0					Flotat				None			
842	Ufp-259.2	11/21	Ufp-9.A	162.93	Diesel	1.60	6	28	.128	20	N	N	Diesel	1.6	2000	4.0					Flotat				None			
843	Ufp-260.1	11/21	Ufp-9.A	162.93	Diesel	1.60	6	28	.128	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
844	Ufp-260.2	11/21	Ufp-9.A	162.93	Diesel	1.60	6	28	.128	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
845	Ufp-260.11	11/21	Ufp-9.A	162.93	Diesel	1.60	6	28	.128	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
846	Ufp-260.12	11/21	Ufp-9.A	162.93	Diesel	1.60	6	28	.128	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
847	Pit-285	11/22	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	1600	4.0					2-Floa				None			
848	Pit-286	11/23	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
849	Pit-287	11/23	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	4.0					Flotat				None			
850	Pit-288	11/23	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
851	Ken-32	11/26	Ken-2.A	165.29	Diesel	1.60	23	100	.067	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Conc	Pyr Depr	Add. Used	High Shear Conditions Oil Type & Wt		Rate	Time	Low Shear Conditions Oil Type & Wt		Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
852	Ken-32.1	11/26	Ken-2.A	165.29	Diesel	1.60	23	100	.067	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
853	Ken-33	11/26	Ken-2.A	41.32	Heptane	12.00	6	100	.068	5	N	N	Heptane	12.0	2000	4.0					Screen			212	None			
854	Ken-33.1	11/26	Ken-2.A	41.32	Heptane	12.00	6	100	.068	5	N	N	Heptane	12.0	2000	4.0					Screen			212	None			
855	Ken-34.1	11/26	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	1600	1.0					Flotat				None			
856	Ken-34.2	11/26	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	1600	1.0					Flotat				None			
857	Ken-34.3	11/26	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	1600	1.0					Flotat				None			
858	Ken-34.4	11/26	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	1600	1.0					Flotat				None			
859	Ken-35.1	11/26	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
860	Ken-35.2	11/26	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
861	Ken-35.3	11/26	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
862	Ken-35.4	11/26	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
863	Ken-36.1	11/26	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
864	Ken-36.2	11/26	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
865	Ken-36.3	11/26	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
866	Ken-36.4	11/26	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
867	Ufp-261	11/26	Ufp-9.A	162.93	Diesel	1.60	16	100	.058	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
868	Ufp-262	11/26	Ufp-9.A	162.93	Diesel	1.60	16	100	.058	20	N	N	Diesel	1.6	1600	4.0					2-Floa				None			
869	Ufp-263.1	11/26	Ufp-9.A	162.93	Diesel	1.60	6	28	.128	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
870	Ufp-263.2	11/26	Ufp-9.A	162.93	Diesel	1.60	6	28	.128	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
871	Ufp-264	11/26	Ufp-9.A	162.93	Diesel	1.60	6	28	.128	20	N	N	Diesel	1.6	2000	4.0					Flotat				None			
872	Ufp-265	11/26	Ufp-9.A	162.93	Diesel	1.60	6	28	.128	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
873	Ufp-266	11/26	Ufp-9.A	162.93	Diesel	1.60	6	28	.128	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
874	Ken-38.1	11/26	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	1600	1.0					Flotat				None			
875	Ken-39	11/26	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
876	Ken-41	11/26	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	2000	4.0					Flotat				None			
877	Ken-42	11/26	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
878	Ken-43	11/26	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
879	Pit-289	12/06	Pit-10A	41.24	Heptane	8.00	12	200	.025	5	N	N	Heptane	8.0	2000	1.0					Screen			106	None			
880	Pit-290	12/06	Pit-10A	41.24	Heptane	8.00	12	200	.025	5	N	N	Heptane	8.0	1600	1.0					Screen			106	None			
881	Ufp-267	12/06	Ufp-9.A	40.73	Heptane	8.00	7	200	.024	5	N	N	Heptane	8.0	2000	1.0					Screen			106	None			
882	Ufp-268	12/06	Ufp-9.A	40.73	Heptane	8.00	7	200	.024	5	N	N	Heptane	8.0	1600	1.0					Screen			106	None			
883	Ken-35.11	12/06	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
884	Ken-35.12	12/06	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
885	Ken-35.13	12/06	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
886	Ken-35.14	12/06	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
887	Ken-37.1	12/06	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	2000	4.0					Flotat				None			
888	Ken-37.2	12/06	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	2000	4.0					Flotat				None			
889	Ken-37.3	12/06	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	2000	4.0					Flotat				None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Pyr Add. Conc	Depr	Used	High Shear Conditions Oil Type & Wt		Rate	Time	Low Shear Conditions Oil Type & Wt		Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
890	Ken-37.4	12/06	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	2000	4.0					Flotat				None			
891	Ken-44	12/06	Ken-2.A	41.32	Heptane	4.00	2	28	.128	5	N	N	Heptane	4.0	2000	4.0					Screen			425	None			
892	Ken-50	12/06	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
893	Ken-51	12/06	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	2000	4.0					Flotat				None			
894	Ken-52.1	12/06	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	1600	1.0					Flotat				None			
895	Ken-52.2	12/06	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	1600	1.0					Flotat				None			
896	Ken-52.3	12/06	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	1600	1.0					Flotat				None			
897	Ken-52.4	12/06	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	1600	1.0					Flotat				None			
898	Ken-53.1	12/06	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
899	Ken-53.2	12/06	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
900	Ken-53.3	12/06	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
901	Ken-53.4	12/06	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
902	Ken-54.1	12/06	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
903	Ken-54.2	12/06	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
904	Ken-54.3	12/06	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
905	Ken-54.4	12/06	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
906	Ken-56	12/06	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	1600	1.0					Flotat				None			
907	Ken-57	12/06	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	1600	4.0					Flotat				None			
908	Ken-59	12/06	Ken-2.A	41.32	Heptane	4.00	9	200	.027	5	N	N	Heptane	4.0	1600	1.0					Screen			106	None			
909	Ken-60	12/06	Ken-2.A	41.32	Heptane	4.00	9	200	.027	5	N	N	Heptane	4.0	2000	.5					Screen			106	None			
910	Ken-38	12/10	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	1600	1.0					Flotat				None			
911	Ken-40	12/10	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
912	Ken-58	12/10	Ken-2.A	41.32	Heptane	4.00	9	200	.027	5	N	N	Heptane	4.0	1600	.5					Screen			106	None			
913	Ken-50.1	12/12	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
914	Ken-55.1	12/12	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	2000	4.0					Flotat				None			
915	Ken-55.2	12/12	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	2000	4.0					Flotat				None			
916	Ken-55.3	12/12	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	2000	4.0					Flotat				None			
917	Ken-55.4	12/12	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	2000	4.0					Flotat				None			
918	Ken-48	12/12	Ken-2.A	41.32	Heptane	4.00	2	28	.112	5	N	N	Heptane	4.0	2000	4.0					2-Floa				None			
919	Ken-49	12/12	Ken-2.A	41.32	Heptane	4.00	9	200	.027	5	N	N	Heptane	4.0	2000	4.0					2-Floa				None			
920	Ken-61	12/12	Ken-2.A	41.32	Heptane	4.00	9	200	.027	5	N	N	Heptane	4.0	2000	1.0					Screen			106	None			
921	Ken-62	12/12	Ken-2.A	41.32	Heptane	4.00	9	200	.027	5	N	N	Heptane	4.0	2400	.5					Screen			106	None			
922	Ken-45	12/17	Ken-2.A	41.32	Heptane	4.00	9	200	.027	5	N	N	Heptane	4.0	2000	4.0					Screen			106	None			
923	Ken-46	12/17	Ken-2.A	165.29	Heptane	16.00	11	28	.113	20	N	N	Heptane	16.0	2000	4.0					2-Floa				None			
924	Ken-46.1	12/17	Ken-2.A	165.29	Heptane	16.00	11	28	.113	20	N	N	Heptane	16.0	2000	4.0					2-Floa				None			
925	Ken-47	12/17	Ken-2.A	165.29	Heptane	16.00	46	200	.023	20	N	N	Heptane	16.0	2000	4.0					2-Floa				None			
926	Ken-47.1	12/17	Ken-2.A	165.29	Heptane	16.00	46	200	.023	20	N	N	Heptane	16.0	2000	4.0					2-Floa				None			
927	Ken-64	12/17	Ken-2.A	41.32	Heptane	4.00	6	100	.068	5	N	N	Heptane	4.0	2000	4.0					Screen			150	None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type	Extr. Oil & Wt	Grinding Data Time	Grinding Data Size	Grinding Data D-50	Sol. Conc	Pyr Depr	Add. Used	High Shear Conditions Oil Type	High Shear Conditions & Wt	High Shear Conditions Rate	High Shear Conditions Time	Low Shear Conditions Oil Type	Low Shear Conditions & Wt	Low Shear Conditions Rate	Low Shear Conditions Time	Microaggl. Rec. (HS) Method	Microaggl. Rec. (HS) FR-1	Microaggl. Rec. (HS) FR-2	Microaggl. Rec. (HS) Scr	Product Rec. (LS) Method	Product Rec. (LS) FR-1	Product Rec. (LS) FR-2	Product Rec. (LS) Scr
928	Ken-54.11	12/20	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
929	Ken-54.12	12/20	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
930	Ken-54.13	12/20	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
931	Ken-54.14	12/20	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	2000	1.0					Flotat				None			
932	Ken-58.1	12/20	Ken-2.A	41.32	Heptane	4.00	9	200	.027	5	N	N	Heptane	4.0	1600	.5					Screen			106	None			
933	Ken-58.2	12/20	Ken-2.A	41.32	Heptane	4.00	9	200	.027	5	N	N	Heptane	4.0	1600	.5					Screen			106	None			
934	Ken-63	12/20	Ken-2.A	41.32	Heptane	4.00	9	200	.027	5	N	N	Heptane	4.0	2400	1.0					Screen			106	None			
935	Ufp-269	1/03	Ufp-9.A	162.93	Diesel	1.60	16	100	.058	20	Y	N	Diesel	1.6	2000	1.0					2-Floa				None			
936	Ufp-269.1	1/03	Ufp-9.A	162.93	Diesel	1.60	16	100	.058	20	Y	N	Diesel	1.6	2000	1.0					2-Floa				None			
937	Ufp-270	1/03	Ufp-9.A	162.93	Diesel	1.60	6	28	.128	20	Y	N	Diesel	1.6	2000	1.0					2-Floa				None			
938	Ufp-271	1/03	Ufp-9.A	162.93	Diesel	1.60	6	28	.128	20	Y	Y	Diesel	1.6	2000	1.0					2-Floa				None			
939	Ufp-272	1/03	Ufp-9.A	162.93	Diesel	1.60	6	28	.128	20	Y	Y	Diesel	1.6	2000	1.0					2-Floa				None			
940	Ufp-272.1	1/03	Ufp-9.A	162.93	Diesel	1.60	6	28	.128	20	Y	Y	Diesel	1.6	2000	1.0					2-Floa				None			
941	Ufp-273	1/03	Ufp-9.A	162.93	Diesel	1.60	6	28	.128	20	Y	Y	Diesel	1.6	2000	1.0					2-Floa				None			
942	Ufp-274	1/03	Ufp-9.A	162.93	Diesel	1.60	6	28	.128	20	Y	N	Diesel	1.6	2000	1.0					2-Floa				None			
943	Ufp-275	1/03	Ufp-9.A	40.73	Heptane	8.00	7	200	.024	5	Y	N	Heptane	8.0	2000	1.0					Screen			106	None			
944	Ufp-275.1	1/03	Ufp-9.A	40.73	Heptane	8.00	7	200	.024	5	Y	N	Heptane	8.0	2000	1.0					Screen			106	None			
945	Ufp-276	1/03	Ufp-9.A	40.73	Heptane	8.00	7	200	.024	5	Y	N	Heptane	8.0	2000	1.0					Screen			106	None			
946	Ufp-276.1	1/03	Ufp-9.A	40.73	Heptane	8.00	7	200	.024	5	Y	N	Heptane	8.0	2000	1.0					Screen			106	None			
947	Ufp-277	1/03	Ufp-9.A	162.93	Diesel	2.40	6	28	.128	20	N	Y	Diesel	2.4	2000	1.0					2-Floa				None			
948	Ufp-278	1/03	Ufp-9.A	162.93	Diesel	1.60	6	28	.128	20	Y	N	Diesel	1.6	2000	1.0					2-Floa				None			
949	Ufp-277.1	1/07	Ufp-9.A	162.93	Diesel	2.40	6	28	.128	20	N	N	Diesel	2.4	2000	1.0					2-Floa				None			
950	Ufp-280	1/07	Ufp-9.A	162.93	Diesel	2.40	6	28	.128	20	Y	Y	Diesel	2.4	2000	1.0					2-Floa				None			
951	Ken-67	1/07	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	Y	N	Diesel	1.6	1600	1.0					2-Floa				None			
952	Ken-67.1	1/07	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	Y	N	Diesel	1.6	1600	1.0					2-Floa				None			
953	Ken-68	1/07	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	Y	N	Diesel	1.6	1600	1.0					2-Floa				None			
954	Ken-69	1/07	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	Y	N	Diesel	1.6	1600	1.0					2-Floa				None			
955	Ken-70	1/07	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	Y	Y	Diesel	1.6	1600	1.0					2-Floa				None			
956	Ken-65	1/14	Ken-2.A	41.32	Heptane	4.00	9	200	.027	5	N	N	Heptane	4.0	2000	4.0					Flotat				None			
957	Ken-66	1/14	Ken-2.A	41.32	Heptane	4.00	2	28	.112	5	N	N	Heptane	4.0	2000	4.0					Flotat				None			
958	Ken-72	1/14	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	Y	Y	Diesel	1.6	1600	1.0					2-Floa				None			
959	Ken-76	1/14	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	Y	Y	Diesel	1.6	1600	1.0					2-Floa				None			
960	Ken-77	1/14	Ken-2.A	165.29	Diesel	2.40	11	28	.113	20	N	N	Diesel	2.4	1600	1.0					2-Floa				None			
961	Ken-78	1/14	Ken-2.A	165.29	Diesel	1.60	11	28	.113	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
962	Ken-79	1/14	Ken-2.A	165.29	Diesel	1.60	23	100	.067	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
963	Ken-80	1/14	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
964	Ufp-279	1/14	Ufp-9.A	162.93	Diesel	2.40	6	28	.128	20	Y	N	Diesel	2.4	2000	1.0					2-Floa				None			
965	Ufp-281	1/14	Ufp-9.A	162.93	Diesel	1.60	16	100	.058	20	Y	Y	Diesel	1.6	2000	1.0					2-Floa				None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Conc	Pyr Depr	Add. Used	High Shear Conditions Oil Type & Wt		Rate	Time	Low Shear Conditions Oil Type & Wt		Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
966	Ufp-281.1	1/14	Ufp-9.A	162.93	Diesel	1.60	16	100	.053	20	Y	Y	Diesel	1.6	2000	1.0					2-Floa				None			
967	Ufp-282	1/14	Ufp-9.A	162.93	Diesel	1.60	16	100	.058	20	N	Y	Diesel	1.6	2000	1.0					2-Floa				None			
968	Ufp-283	1/14	Ufp-9.A	162.93	Diesel	1.60	6	28	.128	20	N	Y	Diesel	1.6	2000	1.0					2-Floa				None			
969	Ufp-284	1/14	Ufp-9.A	162.93	Diesel	1.60	16	100	.058	20	N	Y	Diesel	1.6	1600	1.0					2-Floa				None			
970	Pit-291	1/14	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
971	Pit-292	1/14	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
972	Pit-293	1/14	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
973	Ken-75	2/06	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	Y	Y	Diesel	1.6	1600	1.0					2-Floa				None			
974	Ken-75	1/22	Ken-2.A	165.29	Diesel	1.60	46	200	.023	20	Y	Y	Diesel	1.6	1600	1.0					2-Floa				None			
975	Ken-77.1	1/22	Ken-2.A	165.29	Diesel	2.40	11	28	.113	20	N	N	Diesel	2.4	1600	1.0					2-Floa				None			
976	Pit-294	1/22	Pit-10A	41.24	Heptane	8.00	12	200	.025	5	Y	N	Heptane	8.0	2000	1.0					Screen			106	None			
977	Pit-295	1/22	Pit-10A	41.24	Heptane	8.00	12	200	.025	5	y	N	Heptane	8.0	2000	1.0					Screen			106	None			
978	Pit-295.1	1/22	Pit-10A	41.24	Heptane	8.00	12	200	.025	5	Y	N	Heptane	8.0	2000	1.0					Screen			106	None			
979	Pit-296	1/22	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	Y	N	Diesel	1.6	2000	1.0					2-Floa				None			
980	Pit-297	1/22	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	Y	N	Diesel	1.6	2000	1.0					2-Floa				None			
981	Pit-297.1	1/22	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	Y	N	Diesel	1.6	2000	1.0					2-Floa				None			
982	Pit-306	1/22	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	2.4	2000	1.0					2-Floa				None			
983	Pit-306.1	1/22	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	2.4	2000	1.0					2-Floa				None			
984	Pit-298	2/04	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	Y	N	Diesel	1.6	2000	1.0					2-Floa				None			
985	Pit-299	2/04	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	Y	Y	Diesel	1.6	2000	1.0					2-Floa				None			
986	Pit-299.1	2/04	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	Y	Y	Diesel	1.6	2000	1.0					2-Floa				None			
987	Pit-300	2/04	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	Y	Y	Diesel	1.6	2000	1.0					2-Floa				None			
988	Pit-301	2/04	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	Y	Y	Diesel	1.6	2000	1.0					2-Floa				None			
989	Pit-302	2/04	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	Y	Y	Diesel	1.6	2000	1.0					2-Floa				None			
990	Pit-305	2/04	Pit-10A	164.95	Diesel	2.40	14	28	.121	20	Y	Y	Diesel	2.4	2000	1.0					2-Floa				None			
991	Pit-304	2/04	Pit-10A	164.95	Diesel	2.40	14	28	.121	20	Y	y	Diesel	2.4	2000	1.0					2-Floa				None			
992	Pit-304	2/04	Pit-10A	164.95	Diesel	2.40	14	28	.121	20	y	y	Diesel	2.4	2000	1.0					2-Floa				None			
993	Ken-82	2/04	Ken-2.A	165.29	Diesel	2.40	11	28	.113	20	Y	N	Diesel	2.4	1600	1.0					2-Floa				None			
994	Ken-83	2/04	Ken-2.A	165.29	Diesel	2.40	11	28	.113	20	Y	N	Diesel	2.4	1600	1.0					2-Floa				None			
995	Ufp-286	2/15	Ufp-9.A	160.00	Diesel	1.60	6	28	.128	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
996	Ufp-285	2/15	Ufp-9.A	160.00	Diesel	1.60	6	28	.128	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
997	Ufp-287	2/15	Ufp-9.A	160.00	Diesel	1.60	6	28	.128	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
998	Ufp-288	2/15	Ufp-9.A	160.00	Diesel	1.60	6	28	.128	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
999	Ufp-289	2/15	Ufp-9.A	160.00	Diesel	1.60	6	28	.128	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	UfP-290	2/15	Ufp-9.A	160.00	Diesel	1.60	6	28	.128	20	N	N	Diesel	1.6	2000	4.0					2-Floa				None			
***	Ufp-400	3/20	Ufp-10A	163.59	Diesel	1.60	17	100	.062	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ufp-401	3/20	Ufp-10A	163.59	Diesel	1.60	17	100	.062	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ufp-402	3/20	Ufp-10A	163.59	Diesel	1.60	17	100	.062	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Conc	Pyr Depr	Add. Used	High Shear Conditions Oil Type & Wt		Rate	Time	Low Shear Conditions Oil Type & Wt		Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
***	Ufp-403	3/20	Ufp-10A	163.59	Diesel	1.60	27	200	.025	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ufp-404	3/20	Ufp-10A	163.59	Diesel	1.60	27	200	.025	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ufp-405	3/20	Ufp-10A	163.59	Diesel	1.60	27	200	.025	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Pit-400	3/20	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Pit-401	3/20	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Pit-402	3/20	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Pit-403	3/20	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Pit-404	3/20	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Pit-405	3/20	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Pit-406	3/20	Pit-10A	164.95	Diesel	1.60	54	200	.023	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Pit-407	3/20	Pit-10A	164.95	Diesel	1.60	54	200	.023	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Pit-408	3/20	Pit-10A	164.95	Diesel	1.60	54	200	.023	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ken-100	3/20	Ken-3.A	164.78	Diesel	1.60	11	28	.129	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
***	Ken-101	3/20	Ken-3.A	164.78	Diesel	1.60	11	28	.129	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
***	Ken-102	3/20	Ken-3.A	164.78	Diesel	1.60	11	28	.129	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
***	Ken-103	3/20	Ken-3.A	164.78	Diesel	1.60	24	100	.061	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
***	Ken-104	3/20	Ken-3.A	164.78	Diesel	1.60	24	100	.061	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
***	Ken-105	3/20	Ken-3.A	164.78	Diesel	1.60	24	100	.061	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
***	Ken-106	3/20	Ken-3.A	164.78	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
***	Ken-107	3/20	Ken-3.A	164.78	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
***	Ken-108	3/20	Ken-3.A	164.78	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
***	Ufp-304	4/24	Ufp-11	163.77	Diesel	1.60	7	28	.128	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ufp-305	4/24	Ufp-11	163.77	Diesel	1.77	7	28	.128	20	N	N	Diesel	1.8	2000	1.0					2-Floa				None			
***	Ufp-306	4/24	Ufp-11	163.77	Diesel	1.77	7	28	.128	20	N	N	Diesel	1.8	2000	1.0					2-Floa				None			
***	Ufp-317	4/24	Ufp-11	163.77	Diesel	1.77	7	28	.128	20	N	N	Diesel	1.8	2000	1.0					2-Floa				None			
***	Pit-410	4/25	Pit-10A	164.95			54	200	.026	20			Heptane								Screen			106	None			
***	Ufp-310	4/25	Ufp-11	163.77	Diesel	1.60	7	28	.128	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ufp-308	4/25	Ufp-11	163.77	Diesel	1.60	7	28	.128	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ufp-311	4/25	Ufp-11	163.77	Diesel	1.60	7	28	.128	20	N	N	Diesel	1.6	1000	1.0					2-Floa				None			
***	Ufp-309	4/25	Ufp-11	163.77	Diesel	1.60	7	28	.128	20	N	N	Diesel	1.6	1000	1.0					2-Floa				None			
***	Pit-313	4/25	Pit-11	164.78	Diesel	1.60	12	28	.131	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Pit-315	4/25	Pit-11	164.78	Diesel	1.60	12	28	.131	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Pit-316	4/25	Pit-11	164.78	Diesel	1.60	12	28	.131	20	N	N	Diesel	1.6	1000	1.0					2-Floa				None			
***	Pit-314	4/25	Pit-11	164.78	Diesel	1.60	12	28	.131	20	N	N	Diesel	1.6	1000	1.0					2-Floa				None			
***	Ken-90	4/25	Ken-3.A	164.78	Diesel	1.60	11	28	.129	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
***	Ken-91	4/25	Ken-3.A	164.78	Diesel	1.60	11	28	.129	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
***	Ken-92	4/25	Ken-3.A	164.78	Diesel	1.60	11	28	.129	20	N	N	Diesel	1.6	1000	1.0					2-Floa				None			
***	Ken-93	4/25	Ken-3.A	164.78	Diesel	1.60	11	28	.129	20	N	N	Diesel	1.6	1000	1.0					2-Floa				None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Conc	Pyr Depr	Add. Used	High Shear Conditions Oil Type & Wt		Rate	Time	Low Shear Conditions Oil Type & Wt	Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
***	Ufp-316	4/25	Ufp-11	163.77	Diesel	1.60	31	200	.026	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Ufp-316.1	4/25	Ufp-11	163.77	Diesel	1.60	31	200	.026	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-321	4/25	Pit-11	164.78	Diesel	1.60	54	200	.026	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-321.1	4/25	Pit-11	164.78	Diesel	1.60	54	200	.026	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Ken-98	4/25	Ken-3.A	164.78	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None			
***	Ken-98.1	4/25	Ken-3.A	164.78	Diesel	1.60	46	200	.023	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None			
***	Ufp-317.1	5/03	Ufp-11	163.77	Diesel	1.77	7	28	.128	20	N	N	Diesel	1.8	2000	1.0				2-Floa				None			
***	Pit-317	5/03	Pit-11	41.20	Heptane	8.00	12	200	.023	5	N	N	Heptane	8.0	2000	1.0				Screen			106	None			
***	Pit-318	5/03	Pit-11	41.20	Heptane	8.00	12	200	.023	5	N	N	Heptane	8.0	2000	1.0				Screen			106	None			
***	Pit-319	5/03	Pit-11	41.20	Heptane	8.00	12	200	.023	5	N	N	Heptane	8.0	1000	1.0				Screen			106	None			
***	Pit-320	5/03	Pit-11	41.20	Heptane	8.00	12	200	.023	5	N	N	Heptane	8.0	1000	1.0				Screen			106	None			
***	Ken-94	5/03	Ken-3.A	41.20	Heptane	8.00	13	200	.021	5	N	N	Heptane	8.0	2000	.5				Screen			106	None			
***	Ken-95	5/03	Ken-3.A	41.20	Heptane	8.00	13	200	.021	5	N	N	Heptane	8.0	2000	.5				Screen			106	None			
***	Ken-96	5/03	Ken-3.A	41.20	Heptane	8.00	13	200	.021	5	N	N	Heptane	8.0	1000	.5				Screen			106	None			
***	Ken-97	5/03	Ken-3.A	41.20	Heptane	8.00	13	200	.021	5	N	N	Heptane	8.0	1000	.5				Screen			106	None			
***	Ufp-312	5/03	Ufp-11	40.94	Heptane	8.00	7	200	.023	5	N	N	Heptane	8.0	2000	1.0				Screen			106	None			
***	Ufp-314	5/03	Ufp-11	40.94	Heptane	8.00	7	200	.023	5	N	N	Heptane	8.0	2000	1.0				Screen			106	None			
***	Ufp-313	5/03	Ufp-11	40.94	Heptane	8.00	7	200	.023	5	N	N	Heptane	8.0	1000	1.0				Screen			106	None			
***	Ufp-315	5/03	Ufp-11	40.94	Heptane	8.00	7	200	.023	5	N	N	Heptane	8.0	1000	1.0				Screen			106	None			
***	Pit-307	6/05	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-307.1	6/05	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-307.2	6/05	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-307.3	6/05	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-307.4	6/05	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-308	6/05	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-308.1	6/05	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-308.2	6/05	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-308.3	6/05	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-308.4	6/05	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-309	6/05	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-309.1	6/05	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-309.2	6/05	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-309.3	6/05	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-309.4	6/05	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-310	6/05	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-310.1	6/05	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-310.2	6/05	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			
***	Pit-310.3	6/05	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Conc	Pyr Depr	Add. Used	High Shear Conditions Oil Type & Wt	Rate	Time	Low Shear Conditions Oil Type & Wt	Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
***	Pit-310.4	6/05	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None		
***	Pit-311	6/05	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None		
***	Pit-311.1	6/05	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None		
***	Pit-311.2	6/05	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None		
***	Pit-311.3	6/05	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None		
***	Pit-311.4	6/05	Pit-10A	164.95	Diesel	1.60	14	28	.121	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None		
***	Pit-312	6/05	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None		
***	Pit-312.1	6/05	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None		
***	Pit-312.1	6/05	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None		
***	Pit-312.3	6/05	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None		
***	Pit-312.4	6/05	Pit-10A	164.95	Diesel	1.60	36	100	.065	20	N	N	Diesel	1.6	2000	1.0				2-Floa				None		
***	Ken-84	6/05	Ken-2.A	164.78	Diesel	1.60	24	100	.061	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-84.1	6/05	Ken-2.A	164.78	Diesel	1.60	24	100	.061	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-84.2	6/05	Ken-2.A	164.78	Diesel	1.60	24	100	.061	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-84.3	6/05	Ken-2.A	164.78	Diesel	1.60	24	100	.061	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-85	6/05	Ken-2.A	164.78	Diesel	1.60	11	28	.129	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-85.1	6/05	Ken-2.A	164.78	Diesel	1.60	11	28	.129	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-85.2	6/05	Ken-2.A	164.78	Diesel	1.60	11	28	.129	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-85.3	6/05	Ken-2.A	164.78	Diesel	1.60	11	28	.129	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-86	6/05	Ken-2.A	164.78	Diesel	1.60	11	28	.129	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-86.1	6/05	Ken-2.A	164.78	Diesel	1.60	11	28	.129	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-86.2	6/05	Ken-2.A	164.78	Diesel	1.60	11	28	.129	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-86.3	6/05	Ken-2.A	164.78	Diesel	1.60	11	28	.129	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-87	6/05	Ken-2.A	164.78	Diesel	1.60	24	100	.061	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-87.1	6/05	Ken-2.A	164.78	Diesel	1.60	24	100	.061	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-87.2	6/05	Ken-2.A	164.78	Diesel	1.60	24	100	.061	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-87.3	6/05	Ken-2.A	164.78	Diesel	1.60	24	100	.061	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-88	6/05	Ken-2.A	164.78	Diesel	1.60	11	28	.129	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-88.1	6/05	Ken-2.A	164.78	Diesel	1.60	11	28	.129	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-88.2	6/05	Ken-2.A	164.78	Diesel	1.60	11	28	.129	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-88.3	6/05	Ken-2.A	164.78	Diesel	1.60	11	28	.129	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-89	6/05	Ken-2.A	164.78	Diesel	1.60	24	100	.061	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-89.1	6/05	Ken-2.A	164.78	Diesel	1.60	24	100	.061	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-89.2	6/05	Ken-2.A	164.78	Diesel	1.60	24	100	.061	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-89.3	6/05	Ken-2.A	164.78	Diesel	1.60	24	100	.061	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-99W	4/08	Ken-2.W	164.49	Diesel	1.60	11	28	.131	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-100W	4/08	Ken-2.W	164.49	Diesel	1.60	26	100	.064	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		
***	Ken-101W	4/08	Ken-2.W	164.49	Diesel	1.60	50	200	.030	20	N	N	Diesel	1.6	1600	1.0				2-Floa				None		

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Pyr Add. Conc	Depr	Used	High Shear Conditions Oil Type & Wt		Rate	Time	Low Shear Conditions Oil Type & Wt		Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
***	Ken-103	6/06	Ken-4.R	163.10	Diesel	1.60	13	28	.124	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
***	Ken-104	6/06	Ken-4.R	163.10	Diesel	1.60	27	100	.066	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
***	Ken-105	6/06	Ken-4.R	163.10	Diesel	1.60	48	200	.026	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
***	Ken-107	6/06	Ken-4.W	162.65	Diesel	1.60	14	28	.136	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			600
***	Ken-108	6/06	Ken-4.W	162.65	Diesel	1.60	30	100	.069	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
***	Ken-109	6/06	Ken-4.W	162.65	Diesel	1.60	50	200	.029	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
***	Ken-106	6/06	Ken-4.R	40.80	Heptane	4.00	13	200	.024	5	N	N	Heptane	4.0	2000	.5					Screen		106		None			
***	Ken-110	6/06	Ken-4.W	40.70	Heptane	4.00	12	200	.022	5	N	N	Heptane	4.0	2000	.5					Screen		106		None			
***	Ufp-316	6/19	Ufp-11	163.77	Diesel	1.60	7	28	.128	20	N	N	Diesel	1.6	1000	5.0					2-Floa				None			
***	Pit-416	6/19	Pit-11	164.79	Diesel	1.60	12	28	.131	20	N	N	Diesel	1.6	1000	5.0					2-Floa				None			
***	Ken-111	6/19	Ken-3.A	164.78	Diesel	1.60	11	28	.131	20	N	N	Diesel	1.6	1000	5.0					2-Floa				None			
***	Ufp-317	6/19	Ufp-11	40.90	Heptane	8.00	7	200	.023	5	N	N	Heptane	8.0	1000	5.0					Screen		106		None			
***	Pit-417	6/19	Pit-11	41.20	Heptane	8.00	12	200	.023	5	N	N	Heptane	8.0	1000	5.0					Screen		106		None			
***	Ken-112	6/19	Ken-3.A	41.20	Heptane	8.00	13	200	.024	5	N	N	Heptane	8.0	1000	5.0					Screen		106		None			
***	Ufp-318	6/19	Ufp-11	163.77	Diesel	1.60	7	28	.128	20	N	Y	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ufp-319	6/19	Ufp-11	163.77	Diesel	1.60	17	100	.065	20	N	Y	Diesel	1.6	2000	1.0					2-Floa				None			
***	Pit-418	6/19	Pit-11	164.78	Diesel	1.60	12	28	.131	20	N	Y	Diesel	1.6	2000	1.0					2-Floa				None			
***	Pit-419	6/19	Pit-11	164.78	Diesel	1.60	36	100	.065	20	N	Y	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ken-113	6/19	Ken-3.A	164.95	Diesel	1.60	11	28	.131	20	N	Y	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ken-114	6/19	Ken-3.A	164.95	Diesel	1.60	26	100	.064	20	N	Y	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ken-116	7/04	Ken-3.A	164.78	Diesel	1.60	26	100	.064	20	N	N	Diesel	1.6	1600	1.0					2-Floa				None			
***	Ken-117	7/04	Ken-3.A	164.78	Diesel	1.60	11	28	.131	20	N	N	Diesel	1.6	1000	5.0					2-Floa				None			
***	Pit-420	7/04	Pit-11	164.79	Diesel	1.60	12	28	.131	20	N	N	Diesel	1.6	1000	5.0					2-Floa				None			
***	Ufp-320	7/04	Ufp-11	163.77	Diesel	1.60	7	28	.128	20	N	N	Diesel	1.6	1000	5.0					2-Floa				None			
***	Ken-118	7/04	Ken-3.A	164.78	Diesel	1.60	11	28	.131	20	N	Y	Diesel	1.6	1600	1.0					2-Floa				None	9.0		
***	Pit-421	7/04	Pit-11	164.79	Diesel	1.60	12	28	.131	20	N	Y	Diesel	1.6	2000	1.0					2-Floa				None	13.4		
***	Ufp-321	7/04	Ufp-11	163.77	Diesel	1.60	7	28	.128	20	N	Y	Diesel	1.6	2000	1.0					2-Floa				None	17.9		
***	Ufp-322	7/04	Ufp-12R	162.44	Diesel	1.60	8	28	.133	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ufp-323	7/04	Ufp-12R	162.44	Diesel	1.60	23	100	.064	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ufp-324	7/04	Ufp-12R	162.44	Diesel	1.60	33	200	.026	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ufp-325	7/04	Ufp-12W	162.44	Diesel	1.60	10	28	.128	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ufp-326	7/04	Ufp-12W	162.44	Diesel	1.60	23	100	.067	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ufp-327	7/04	Ufp-12W	162.44	Diesel	1.60	35	200	.025	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ufp-328	7/04	Ufp-12H	162.10	Diesel	1.60	9	28	.132	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ufp-329	7/04	Ufp-12H	162.10	Diesel	1.60	25	100	.072	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ufp-330	7/04	Ufp-12H	162.10	Diesel	1.60	39	200	.029	20	N	N	Diesel	1.6	2000	1.0					2-Floa				None			
***	Ufp-331	7/04	Ufp-12R	40.61	Heptane	8.00	7	200	.027	5	N	N	Heptane	8.0	2000	1.0					Screen		106		None			
***	Ufp-332	7/04	Ufp-12W	40.57	Heptane	8.00	7	200	.029	5	N	N	Heptane	8.0	2000	1.0					Screen		106		None			

Table A1-5 (Continued)

EXPERIMENTAL DATA FOR BATCH TESTS

Ser No	Lab ID	Date	Coal & Samp No	Coal Wt (g, ar)	Extr. Oil Type & Wt		Grinding Data Time	Size	D-50	Sol. Conc	Pyr Depr	Add. Used	High Shear Conditions Oil Type & Wt		Rate	Time	Low Shear Conditions Oil Type & Wt		Rate	Time	Microaggl. Rec. (HS) Method	FR-1	FR-2	Scr	Product Rec. (LS) Method	FR-1	FR-2	Scr
***	Ufp-333	7/04	Ufp-12H	40.57	Heptane	8.00	8	200	.024	5	N	N	Heptane	8.0	2000	1.0					Screen			106	None			

Table A1-6

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
357	Pit-200	Pit-8.A	7/11	153.10	2.00	6.8	3.83						9.65	1.50	55.4	9.62					
358	Pit-201	Pit-8.A	7/11	152.24	1.90	6.6	4.04	.02	1.60	2.42			10.72	1.50	55.4	10.15	.11	9.33	.72		
359	Pit-201.1	Pit-8.A		150.74	1.40	6.6	3.71						10.72	1.20	53.5	10.20					
360	Pit-202	Pit-8.A	7/11	153.75	1.80	6.1	3.75						8.89	1.60	71.0	13.00					
361	Pit-203	Pit-8.A	7/11	153.45	1.50	6.2	3.73	.03	1.47	2.23			8.03	1.40	72.2	13.38	.12	13.06	.20		
362	Pit-204	Pit-8.A	7/11	36.41	1.50	6.4	3.80						3.70	1.30	37.8	8.86					
363	Pit-205	Pit-8.A		36.51	1.40	6.3	3.76	.01	1.51	2.24			3.19	1.20	42.4	10.32	.60	9.30	.96		
364	Pit-206	Pit-8.A	7/11	37.25	1.50	5.3	3.46						3.01	1.40	56.7	12.38					
365	Pit-207	Pit-8.A	7/11	37.76	1.00	5.2	3.41	.01	1.17	2.23			2.72	.90	62.0	14.12					
366	Pit-207 1	Pit-8.A	7/11	37.30	1.30	5.3	3.40						3.06	.90	62.1	13.72					
367	Ufp-200	Ufp-8.A	6/25	142.41	1.00	7.7	1.32						19.11	1.50	63.6	8.38					
368	Ufp-201	Ufp-8.A	6/25	144.83	1.00	8.4	1.53	.03	.89	.60			16.47	1.40	66.[illegible]	8.27	.16	8.09	.02		
369	Ufp-202	Ufp-8.A	6/26	34.67	1.00	6.9	1.24	.02	.62	.60			5.12	1.40	61.8	8.53	.14	8.34	.04		
370	Ufp-203	Ufp-8.A	6/26	36.17	1.10	7.7	1.37	.02	.73	.61			4.11	1.30	67.1	8.38	.16	8.21	.01		
371	Ufp-203.1	Ufp-8.A	6/28	36.15	1.40	7.5	1.12						4.58	1.90	66.3	8.53					
372	Ufp-204	Ufp-8.A	6/27	109.97	1.60	5.6	1.03	.02	.45	.56			50.71	1.80	32.3	4.21	.07	4.01	.13		
373	Ill-200	Ill-8.A	6/25	143.58	3.00	6.1	2.89						18.34	2.30	38.4	3.55					
374	Ill-201	Ill-8.A	6/25	125.19	2.70	5.3	2.84						37.02	4.50	26.1	3.58					
375	Ill-202	Ill-8.A	6/25	164.19	8.10	6.8	2.98						9.58	2.60	61.9	3.45					
376	Ill-202.1	Ill-8.A	6/29	165.09	9.00	7.0	3.01						9.39	2.70	68.1	4.02					
377	Ill-203	Ill-8.A	6/26	35.93	3.70	5.5	2.84	.01	.74	2.10			9.72	2.60	32.1	3.73	.04	2.38	1.30		
378	Ill-204	Ill-8.A	6/26	39.44	3.40	7.0	2.99						1.79	2.30	46.6	3.95					
379	Ill-204.1	Ill-8.A	6/26	40.56	5.10	6.9	3.05						1.88	1.90	48.9	4.37					
380	Ill-205	Ill-8.A	6/26	158.63	7.30	5.6	2.87	.02	.75	2.10			14.16	3.40	60.0	3.99	.08	3.48	.42		
381	Ill-206	Ill-8.A	6/26	156.39	9.10	5.6	2.84						19.26	4.70	44.3	3.87					
382	Ill-207	Ill-8.A	6/27	161.79	7.10	6.1	3.06	.02	.85	2.18			9.20	2.60	73.4	3.38	.08	2.86	.44		
383	Ill-208	Ill-8.A	6/27	39.68	5.50	5.0	2.92						2.93	2.90	64.1	3.83					
384	Ill-208.1	Ill-8.A	6/27	39.15	4.60	5.0	2.94						3.27	2.80	61.2	4.29					
385	Ill-209	Ill-8.A	6/27	40.17	4.80	5.6	3.12	.01	.75	2.36			2.41	1.90	59.0	2.92					
386	Ufp-204.1	Ufp-8.A	6/28	109.70	1.70	5.6	1.02						52.54	1.80	32.3	4.08					
387	Ufp-205	Ufp-8.A	6/27	124.57	.90	6.7	1.33						36.45	1.20	40.5	4.80					
388	Ufp-206	Ufp-8.A	6/27	29.01	.90	5.9	1.01						11.25	1.20	34.6	4.72					
389	Ufp-207	Ufp-8.A	6/27	33.90	1.00	7.5	1.24						6.28	1.20	48.5	7.06					
390	Ill-210	Ill-8.A	7/06	30.00	5.00	5.2	2.87	.02	.61	2.24			11.68	4.20	18.7	3.58	.04	1.67	1.87		
391	Ill-211	Ill-8.A	7/06	38.42	5.10	6.3	2.91						1.96	3.30	45.3	4.02					
392	Ill-212	Ill-8.A	7/09	34.61	4.80	5.0	2.84						7.25	4.00	28.2	3.99					
393	Ill-213	Ill-8.A	7/09	39.53	5.00	5.6	2.91						2.48	2.80	62.7	3.90					
394	Ill-213.1	Ill-8.A	7/09	39.84	6.30	5.6	2.92						2.76	3.00	61.1	3.42					

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
395	Pit-208	Pit-8.A		37.81	1.60	5.7	3.73						2.25	1.40	70.7	14.10					
396	Pit-208.1	Pit-8.A		37.97	1.90	5.6	3.80						2.20	1.40	72.3	13.19					
397	Pit-209	Pit-8.A		39.40	2.10	5.3	3.80	.01	1.13	2.65			2.53	1.70	70.0	13.42					
398	Pit-209.1	Pit-8.A		39.70	2.30	5.4	3.94						2.53	1.70	65.0	12.72					
399	Pit-210	Pit-8.A		40.07	2.80	5.7	3.99						2.02	1.70	68.4	10.58					
400	Pit-211	Pit-8.A		39.99	2.60	5.7	4.04	.01	1.35	2.68			1.82	1.70	77.0	10.78					
401	Pit-211.1	Pit-8.A		40.15	1.90	6.0	3.81						1.94	1.50	66.5	10.25					
402	Pit-212	Pit-8.A		40.58	2.50	5.9	3.75						2.02	1.60	74.4	13.92					
403	Pit-212.1	Pit-8.A	7/19	39.56	2.20	6.1	3.91						2.09	1.80	46.5	7.57					
404	Ill-214	Ill-8.A	7/04	37.37	4.00	8.4	2.95	.03	.87	2.05			3.07	4.10	9.4	3.26	.03	1.11	2.12		
405	Ill-214.1	Ill-8.A	7/04	37.22	4.10	8.0	2.94						3.26	4.10	11.8	3.53					
406	Ill-215	Ill-8.A	7/05	33.97	3.00	5.4	3.16	.01	.78	2.37			7.94	6.90	20.3	3.10	.04	1.34	1.72		
407	Ill-216	Ill-8.A	7/05	39.37	5.40	5.0	3.06						3.50	3.40	50.4	3.69					
408	Ill-216.1	Ill-8.A	7/05	37.75	2.80	4.8	3.06						4.51	5.10	44.1	3.82					
409	Ill-217	Ill-8.A	7/06	41.26	4.50	5.7	3.25						2.28	2.20	78.5	1.88					
410	Ill-218	Ill-8.A	7/06	41.19	6.90	5.3	3.21						2.35	2.40	80.4	1.84					
411	Ill-219	Ill-8.A	7/09	35.41	5.40	8.0	3.05						5.90	4.30	18.5	3.54					
412	Ill-220	Ill-8.A	7/09	37.36	2.90	8.4	3.06						3.00	6.60	27.6	3.80					
413	Ill-221	Ill-8.A	7/23	41.41	8.50	6.8	2.97						1.81	4.20	44.9	3.45					
414	Pit-213	Pit-8.A	7/19	157.87	2.40	7.8	4.17						4.78	2.60	70.8	5.73					
415	Pit-214	Pit-8.A	7/19	157.48	2.40	7.7	4.07						5.02	2.40	69.3	6.25					
416	Pit-215	Pit-8.A	7/19	36.30	1.90	6.9	4.06						4.19	1.90	32.0	8.04					
417	Pit-216	Pit-8.A	7/19	38.31	1.90	7.2	4.20						2.18	1.70	46.8	10.28					
418	Ufp-208	Ufp-8.A	7/05	36.54	1.00	8.2	1.56						3.35	1.50	73.2	8.37					
419	Ufp-208.1	Ufp-8.A	7/05	36.33	.80	8.5	1.47						3.32	1.50	71.9	7.68					
420	Ufp-209	Ufp-8.A	7/06	38.04	1.10	8.0	1.86						3.45	1.40	71.3	7.94					
421	Ufp-209.1	Ufp-8.A	7/10	38.20	1.30	8.2	1.75						3.41	1.50	72.0	7.62					
422	Ufp-210	Ufp-8.A	7/09	39.13	1.20	9.1	1.91						2.48	1.30	77.8	7.71					
423	Ufp-211	Ufp-8.A	7/10	39.12	1.30	9.4	2.34						2.27	1.20	74.8	3.99					
424	Ufp-212	Ufp-8.A	7/10	39.67	1.10	10.3	2.20						1.95	1.30	76.5	3.70					
425	Ufp-213	Ufp-8.A	7/13	33.85	1.70	10.0	1.73						6.67	2.00	34.9	4.53					
426	Ufp-214	Ufp-8.A	7/16	36.11	.80	10.5	1.82						3.62	1.70	49.4	5.91					
427	Ufp-215	Ufp-8.A	7/16	111.67	1.30	6.3	1.22						48.89	1.10	31.9	4.46					
428	Ufp-216	Ufp-8.A	7/17	128.63	1.40	7.1	1.41						32.96	1.20	41.2	5.45					
429	Ufp-217	Ufp-8.A	7/17	28.08	1.00	5.8	1.04						11.81	1.10	32.8	4.77					
430	Ufp-218	Ufp-8.A	7/18	37.38	1.20	10.3	1.94						2.32	1.70	76.1	7.24					
431	Pit-217	Pit-8.A	7/18	154.30	2.20	6.2	3.86	.03	1.45	2.38			8.82	1.50	69.9	13.19	.15	12.80	.24		
432	Pit-217.1	Pit-8.A	7/23	154.13	1.50	6.5	3.86						7.40	2.00	75.5	12.14					

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
433	Pit-218	Pit-8.A	7/18	38.22	1.80	5.6	3.61						3.31	1.70	43.8	8.27					
434	Pit-218.1	Pit-8.A	7/23	37.69	1.50	5.2	3.52						2.56	2.70	74.8	2.93					
435	Pit-219	Pit-8.A	7/23	76.99	2.20	5.7	3.75						4.50	1.50	69.1	13.20					
436	Pit-219.1	Pit-8.A	7/24	76.34	1.50	5.8	3.71						4.53	2.00	70.0	13.98					
437	Pit-220	Pit-8.A	7/18	42.06	2.10	5.4	3.58						2.96	1.60	61.0	12.61					
438	Pit-220.1	Pit-8.A	7/18	34.74	2.10	5.4	3.52						2.63	1.60	56.1	13.41					
439	Pit-220.2	Pit-8.A	7/24	33.62	1.90	5.5	3.47						2.89	1.90	56.1	13.76					
440	Pit-220.3	Pit-8.A	7/24	41.08	1.60	5.5	3.49						3.24	1.90	62.8	13.86					
441	Pit-221	Pit-8.A	7/24	155.51	2.30	6.3	3.88	.02	1.50	2.35			5.18	1.60	72.5	12.60					
442	Pit-221.1	Pit-8.A	7/19	153.61	1.60	6.2	3.74						8.39	1.90	74.0	13.76					
443	Pit-222	Pit-8.A	7/18	78.57	3.00	5.7	3.72						4.92	1.60	68.5	13.01					
444	Pit-222.1	Pit-8.A	7/24	76.50	2.10	5.7	3.68						5.09	2.00	70.7	13.78					
445	Pit-223	Pit-8.A	7/19	64.34	2.00	5.8	3.64						5.20	1.50	56.6	12.08					
446	Pit-223.1	Pit-8.A	7/23	70.58	1.40	6.1	3.71						4.31	1.50	71.0	13.50					
447	Pit-224	Pit-8.A	7/19	41.05	1.80	5.5	3.58						3.63	1.50	52.1	12.38					
448	Pit-224.1	Pit-8.A	7/23	36.43	1.40	5.7	3.56						2.83	1.40	60.1	13.80					
449	Pit-225	Pit-8.A	7/19	43.55	1.90	5.6	3.56						2.26	1.40	53.1	12.98					
450	Pit-225.1	Pit-8.A	7/24	44.66	1.70	5.8	3.62						3.12	1.50	60.7	13.60					
451	Pit-226	Pit-8.A	7/26	153.06	2.20	6.2	4.00						9.15	1.90	67.2	9.67					SLURRY SPLIT INTO 4 PARTS AND EACH
452	Pit-227	Pit-8.A	7/26	156.42	2.90	6.1	3.89						8.31	2.00	77.6	11.63					4 SLURRIES COMBINED TOGETHER AND W
453	Pit-228	Pit-8.A	7/19	.43	1.50	18.4	3.85						159.68	1.80	9.8	4.20					
454	Pit-229	Pit-8.A	7/23	38.81	2.00	6.3	4.07						1.72	1.80	78.6	9.69					
455	Pit-230	Pit-8.A	7/27	159.35	3.80	6.8	4.25						5.85	1.90	83.9	7.43					
456	Ill-222	Ill-8.A	7/26	33.42	3.30	8.4	2.99	.04	.75	2.20			7.15	3.90	10.5	3.00	.04	1.01	1.95		
457	Ill-223	Ill-8.A	7/26	38.04	5.30	8.5	2.95	.03	.82	2.10			3.18	4.40	9.5	3.20	.03	1.13	2.04		
458	Ill-224	Ill-8.A	7/26	38.44	5.40	6.6	2.96	.03	.72	2.21			3.26	3.80	37.5	3.54	.10	2.27	1.18		PRODUCT IS A STICKY PASTE THAT FLO
459	Pit-231	Pit-8.A	7/30	37.35	2.00	5.3	3.47						3.33	1.60	54.4	11.89					
460	Pit-232	Pit-8.A	7/30	38.55	2.00	6.1	3.67						2.08	1.50	76.5	14.11					
461	Pit-233	Pit-8.A	7/30	38.01	2.00	6.4	3.81						2.49	1.80	54.4	10.28					
462	Ufp-219	Ufp-8.A	7/27	35.29	1.70	7.5	1.25	.02	.63	.60			5.13	2.00	56.7	7.71	.15	7.48	.09		
463	Ufp-220	Ufp-8.A	7/27	36.89	1.60	8.3	1.50	.02	.87	.62			3.70	2.10	72.6	8.41					
464	Ufp-221	Ufp-8.A	7/27	37.61	1.60	8.6	1.54	.02	.92	.61			3.79	2.00	68.9	8.34					PRODUCT IS A STICKY PASTE.
465	Ill-231	Ill-8.A	8/10	169.29	8.80	9.6	3.07						3.43	6.10	22.1	3.52					
466	Ill-232	Ill-8.A	8/13	166.23	6.90	9.9	3.09						4.54	6.00	14.1	3.42					
467	Ill-233	Ill-8.A	8/13	153.96	2.60	9.9	3.00	.06	.79	2.14			6.94	7.00	18.9	3.64	.08	1.64	1.92		
468	Ill-235	Ill-8.A	8/09	18.23	4.80	6.7	2.79						22.96	5.00	11.0	3.18					
469	Ill-236	Ill-8.A	8/09	27.36	5.20	4.9	2.80						14.82	4.40	16.2	3.54					
470	Ill-236.1	Ill-8.A	8/10	28.54	7.20	4.9	2.83						14.90	7.00	16.2	3.50					

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
471	Ill-237	Ill-8.A	8/09	37.54	4.60	6.9	2.73						3.96	3.50	40.3	4.09					
472	Pit-234	Pit-8.A	8/14	155.07	1.50	7.0	4.13	.06	1.74	2.33			6.08	2.00	81.5	8.63					
473	Pit-235	Pit-8.A	8/14	158.12	2.40	7.7	4.14						5.09	2.10	78.1	7.17					
474	Pit-236	Pit-8.A	8/15	157.33	2.10	7.5	4.18						4.66	2.00	74.2	7.76					
475	Pit-237	Pit-8.A	8/15	116.47	2.10	6.8	4.07	.04	1.74	2.30			5.22	2.10	76.9	9.65					
476	Pit-238	Pit-8.A	8/21	115.90	2.30	6.5	3.95						6.00	2.10	71.4	11.65					
477	Pit-239	Pit-8.A	8/21	118.45	4.50	6.7	3.90						5.49	2.40	72.8	11.98					
478	Pit-240	Pit-8.A	8/21	79.29	4.90	6.3	3.81						3.96	2.10	73.0	12.77					
479	Pit-241	Pit-8.A	8/21	83.56	9.80	6.3	3.84						4.36	2.30	70.2	12.38					
480	Pit-242	Pit-8.A	8/22	79.44	5.60	6.3	3.74						4.69	2.30	68.7	12.38					
481	Pit-243	Pit-8.A	8/13	16.35	2.20	4.1	3.15						24.00	2.10	12.7	4.84					
482	Pit-243.1	Pit-8.A	8/13	17.97	2.10	4.2	3.10						22.63	2.10	13.5	4.91					
483	Ufp-222	Ufp-8.A	8/08	17.46	1.10	5.4	.99	.03	.32	.64			19.45	1.40	21.6	3.10	.06	2.56	.48		Tailings are presented as combined
484	Ufp-222.1	Ufp-8.A	8/08	17.82	1.10	5.5	.99						19.31	1.40	21.8	3.11					
485	Ufp-223	Ufp-8.A	8/09	32.34	1.20	6.9	1.19						7.96	1.40	41.5	6.01					
486	Ufp-223.1	Ufp-8.A	8/21	30.04	1.30	6.6	1.06						10.18	1.80	36.1	5.30					
487	Ufp-224	Ufp-8.A	8/19	73.98	1.10	8.9	1.67						5.84	1.90	72.1	7.04					
488	Ufp-225	Ufp-8.A	8/14	73.40	1.40	8.9	1.70						6.55	1.90	69.9	7.25					
489	Ufp-225.1	Ufp-8.A	8/13	72.98	1.40	9.0	1.69						6.95	2.20	69.9	7.23					
490	Ufp-227	Ufp-8.A	8/15	115.53	1.50	10.3	1.93						5.33	2.10	72.7	5.90					
491	Ufp-226	Ufp-8.A		73.17	1.30	9.3	1.73	.04	1.17	.52			5.95	1.90	69.9	7.22	.23	7.05	0.00		
492	Ufp-228	Ufp-8.A		111.74	1.50	9.2	1.65						8.82	2.00	70.0	7.41					
493	Ufp-229	Ufp-8.A		110.38	1.70	9.3	1.76						10.17	2.10	67.2	6.17					
494	Ufp-230	Ufp-8.A		150.27	1.50	10.2	1.99						9.69	2.40	72.1	5.86					
495	Ill-225	Ill-8.A		50.65	4.40	6.3	2.83						31.81	3.10	14.5	3.22					
496	Ill-226	Ill-8.A		62.81	8.30	7.2	2.92						22.72	3.50	13.6	3.21					
497	Ill-227	Ill-8.A		45.77	2.50	5.1	2.78	.04	.48	2.26			34.93	2.70	16.3	3.36	.09	1.24	2.03		
498	Ill-228	Ill-8.A		104.78	3.20	8.2	3.04						21.21	3.40	18.2	3.25					
499	Ill-229	Ill-8.A		98.15	4.30	7.7	2.96						24.69	3.70	18.6	3.35					
500	Ill-230	Ill-8.A		98.70	2.40	7.6	2.93	.06	.66	2.21			21.91	2.70	19.8	3.42	.13	1.41	1.89		
501	Ill-234	Ill-8.A		0.00									40.00	0.00	10.6	3.07					No product - numbers in tailings a
502	Pit-237.1	Pit-8.A		119.62	3.50	6.8	3.87						5.18	2.20	78.3	10.13					
503	Pit-240.1	Pit-8.A		76.37	1.70	6.2	3.65						4.03	1.90	75.0	12.03					
504	Ill-227.1	Ill-8.A	8/24	47.68	4.10	5.4	2.72						34.61	3.80	15.8	3.35					
505	Ill-228.1	Ill-8.A	8/27	92.35	3.50	7.5	2.94						29.05	3.00	16.0	3.20					
506	Ufp-230.1	Ufp-8.A	8/21	150.40	1.20	10.0	1.97						9.30	1.50	68.0	5.51					
507	Ufp-231	Ufp-8.A	8/21	149.69	1.20	10.6	2.01						9.58	1.70	73.7	5.21					
508	Ufp-232	Ufp-8.A	8/21	153.88	1.10	11.9	2.02						5.84	1.70	70.6	2.57					

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
509	Ken-1	Ken-1.A	9/25	144.62	1.90	7.9	3.42	.01	1.57	1.83			18.86	1.20	72.5	17.31	.11	17.15	.05		
510	Ken-2	Ken-1.A	9/25	159.80	13.10	6.5	3.08	.02	1.28	1.78			23.23	1.20	69.9	16.08	.10	15.79	.20		REGRINDING, STAGE1-1& OIL. STAGE2-
511	Ken-3	Ken-1.A	9/25	145.00	1.90	8.2	3.44						18.13	.90	73.6	15.81					
512	Ken-3.1	Ken-1.A	9/25	147.38	2.60	8.3	3.51						17.70	1.30	75.4	15.71					
513	Ken-4	Ken-1.A	9/25	155.16	7.90	6.6	3.12						21.56	1.20	73.6	15.18					REGRINDING, STAGE1-1% OIL, STAGE2-
514	Ken-5	Ken-1.A	9/25	144.56	1.70	7.8	3.58						18.60	1.30	72.8	13.67					
515	Ken-6	Ken-1.A	9/25	148.16	1.20	8.4	3.70						15.85	1.00	77.0	13.23					
516	Ken-7	Ken-1.A	9/25	159.61	13.30	6.6	3.03	.02	1.22	1.79			23.45	.90	68.5	17.66	.12	16.48	1.06		REGRINDING WITH OXONE(1lb/t), STAG
517	Ken-8	Ken-1.A	9/27	136.90	1.10	7.1	3.04						22.95	1.00	63.6	13.84					
518	Ken-9	Ken-1.A	9/27	141.90	1.10	7.9	3.23						17.81	1.10	73.8	16.78					
519	Ken-10	Ken-1.A	9/27	138.63	1.60	7.5	3.16						22.90	1.00	66.8	15.65					DEPRESSANT ADDED TO THE GRINDER
520	Ken-11	Ken-1.A	9/27	136.20	1.80	7.0	3.01	.01	1.19	1.81			23.69	1.00	65.4	15.60	.09	15.06	.40		depressant added to the grinder
521	Ken-12	Ken-1.A	9/27	138.75	1.60	7.2	3.08						21.76	.90	66.5	16.05					DEPRESSANT ADDED TO THE GRINDER
522	Pit-244	Pit-9.A	9/18	149.97	1.50	7.7	4.09						12.13	2.00	39.5	7.22					
523	Pit-245	Pit-9.A	9/18	146.88	1.80	6.6	3.81	.02	1.54	2.25			15.55	1.90	42.1	9.26					REGRINDING
524	Pit-245.1	Pit-9.A	9/20	152.56	1.30	6.4	3.75	.04	1.44	2.27			11.36	1.80	53.5	10.26					
525	Pit-246	Pit-9.A	9/18	153.78	1.60	7.9	4.24						7.54	2.10	52.0	6.13					
526	Pit-246.1	Pit-9.A	9/20	155.12	1.50	8.3	4.16	.04	2.07	2.06			6.61	2.00	57.7	7.21					
527	Pit-248	Pit-9.A	9/22	147.24	2.10	6.5	3.77						16.03	1.80	42.5	8.71					REGRINDING. STAGE1-1% OIL, STAGE2-
528	Pit-249	Pit-9.A	9/24	149.74	1.90	7.9	4.31						13.95	1.60	32.0	6.59					HOT WATER WASHED COAL-DRY GR.
529	Pit-250	Pit-9.A	9/24	144.38	1.60	6.5	3.75	.03	1.57	2.16			18.76	1.60	36.1	8.18					HOT WATER WASHED COAL-DRY GR.-REGR
530	Pit-250.1	Pit-9.A	9/25	144.51	1.20	6.7	3.75						18.40	1.40	36.0	8.32					
531	Pit-251	Pit-9.A	9/25	156.74	1.10	8.4	4.22						5.27	1.60	51.1	5.02					
532	Pit-251.1	Pit-9.A	9/26	156.42	1.70	8.3	4.23						5.93	1.50	47.7	5.34					
533	Pit-253	Pit-9.A	9/27	151.01	1.10	7.1	3.93						10.82	1.30	47.8	8.80					HOT WATER WASHED COAL-WET GR.
534	Pit-254	Pit-9.A	9/27	153.94	1.20	6.5	3.74						8.44	1.20	69.7	12.95					
535	Pit-255.1	Pit-9.A	9/28	75.90	1.70	6.2	3.78						8.39	1.30	61.7	12.05					15 SEC FROTH,30sec-high shear
536	Pit-255.2	Pit-9.A	9/28	28.49	1.60	6.8	3.91						8.39	1.30	61.7	12.05					30 SEC FROTH,30sec-high shear
537	Pit-255.3	Pit-9.A	9/28	21.28	1.50	7.3	4.03						8.39	1.30	61.7	12.05					60 SEC FROTH,30sec-high shear
538	Pit-255.4	Pit-9.A	9/28	17.38	1.50	8.4	4.19						8.39	1.30	61.7	12.05					2 MIN FROTH,30sec-high shear
539	Pit-255.5	Pit-9.A	9/28	9.12	1.50	9.1	4.31						8.39	1.30	61.7	12.05					BARREN, 30sec -high shear
540	Pit-258.1	Pit-9.A	9/28	87.12	1.60	7.0	3.80						6.69	1.30	69.5	13.07					15sec froth,4min-high shear
541	Pit-258.2	Pit-9.A	9/28	35.20	1.50	7.2	3.90						6.69	1.30	69.5	13.07					30sec froth, 4min-high shear
542	Pit-258.3	Pit-9.A	9/28	22.61	1.50	7.2	3.86						6.69	1.30	69.5	13.07					60sec froth, 4min-high shear
543	Pit-258.4	Pit-9.A	9/28	6.14	1.50	8.2	4.05						6.69	1.30	69.5	13.07					120sec FROTH, 4 min-HIGH SHEAR
544	Pit-258.5	Pit-9.A	9/28	3.13	1.60	9.3	4.36						6.69	1.30	69.5	13.07					BARREN, 4min-HIGH SHEAR
545	Pit-259.1	Pit-9.A	9/28	33.18	1.50	5.9	3.48	.03	1.16	2.29			8.61	.40	64.5	14.66	.31	13.11	1.24		15sec froth,0.5min-high shear, dep
546	Pit-259.2	Pit-9.A	9/28	20.85	1.50	6.2	3.60	.03	1.25	2.33			8.61	.40	64.5	14.66	.31	13.11	1.24		30sec froth,0.5min-high shear

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
547	Pit-259.3	Pit-9.A	9/28	34.75	1.50	6.8	3.72	.03	1.41	2.28			8.61	.40	64.5	14.66	.31	13.11	1.24		60sec froth, 0.5min-high shear
548	Pit-259.4	Pit-9.A	9/28	38.29	1.40	7.5	3.93	.03	1.63	2.27			8.61	.40	64.5	14.66	.31	13.11	1.24		120sec froth,0.5min-high shear
549	Pit-259.5	Pit-9.A	9/28	25.42	1.40	8.9	4.18	.03	2.04	2.11			8.61	.40	64.5	14.66	.31	13.11	1.24		BARREN,0.5min-high shear
550	Pit-254.1	Pit-9.A	9/27	153.89	1.30	6.4	3.75	.04	1.44	2.27			8.94	1.00	69.1	13.13					
552	Pit-A	Pit-9.A	10/09	147.45	1.20	5.4	3.46						11.36	1.30	60.5	11.28					28mesh x200-regr.+200meshx0
553	Pit-B	Pit-9.A	10/09	143.20	1.10	5.0	3.41						17.11	1.20	46.8	9.35					28meshx0 regr.
554	Pit-C	Pit-9.A	10/09	139.65	1.00	4.9	3.34						20.91	1.10	41.6	9.22					28meshx0 regr. with oxone
555	Pit-D	Pit-9.A	10/09	140.57	.80	5.2	3.38						15.02	1.10	48.8	10.15					28meshx0 regr. + 200meshx0
556	Pit-E	Pit-9.A	10/09	148.99	1.30	6.5	3.72						11.51	1.30	49.4	9.09					28meshx0 + 200meshx0
557	Ken-13	Ken-1.A	10/09	131.94	1.00	5.7	2.74						27.15	.90	60.6	14.73					28meshx0 regr.with oxone
558	Pit-256.1	Pit-9.A	10/02	94.45	2.40	6.9	3.86						6.54	1.40	68.6	11.96					15 sec froth
559	Pit-256.2	Pit-9.A	10/02	24.38	1.10	7.5	4.06						6.54	1.40	68.6	11.96					30 sec froth
560	Pit-256.3	Pit-9.A	10/02	24.96	1.00	7.8	3.96						6.54	1.40	68.6	11.96					60 sec froth
561	Pit-256.4	Pit-9.A	10/02	8.66	1.20	8.3	4.15						6.54	1.40	68.6	11.96					120 sec froth
562	Pit-256.5	Pit-9.A	10/02	2.97	1.30	9.5	4.35						6.54	1.40	68.6	11.96					barren-3 min
563	Pit-257.1	Pit-9.A	10/02	80.43	1.30	6.9	3.75						6.67	1.30	68.1	11.95					15 sec froth
564	Pit-257.2	Pit-9.A	10/02	44.28	1.10	7.4	3.94						6.67	1.30	68.1	11.95					30 sec froth
565	Pit-257.3	Pit-9.A	10/02	19.68	1.20	8.0	4.05						6.67	1.30	68.1	11.95					60 sec froth
566	Pit-257.4	Pit-9.A	10/02	6.21	1.30	8.4	4.17						6.67	1.30	68.1	11.95					120 sec froth
567	Pit-257.5	Pit-9.A	10/02	1.53	1.40	9.4	4.22						6.67	1.30	68.1	11.95					barren-3.5 min
568	Pit-260.1	Pit-9.A	10/04	82.91	1.30	6.7	3.72						6.95	1.60	67.0	11.99					15 sec froth,0.5 min- res. time
569	Pit-260.2	Pit-9.A	10/04	35.13	1.10	7.2	3.89						6.95	1.60	67.0	11.99					30 sec froth, 0.5 min res. time
570	Pit-260.3	Pit-9.A	10/04	20.70	1.30	7.9	4.03						6.95	1.60	67.0	11.99					60 sec froth, 0.5min-res. time
571	Pit-260.4	Pit-9.A	10/04	10.95	1.10	8.9	4.21						6.95	1.60	67.0	11.99					120 sec froth, 0.5min res. time
572	Pit-260.5	Pit-9.A	10/04	3.38	1.20	10.0	4.46						6.95	1.60	67.0	11.99					barren-3 min 20sec
573	Pit-260.11	Pit-9.A	10/05	64.87	1.20	6.6	3.71						7.42	1.50	66.2	12.59					15 sec froth
574	Pit-260.12	Pit-9.A	10/05	44.21	1.20	6.8	3.81						7.42	1.50	66.2	12.59					30 sec froth
575	Pit-260.13	Pit-9.A	10/05	23.16	1.80	7.6	4.04						7.42	1.50	66.2	12.59					60 sec froth
576	Pit-260.14	Pit-9.A	10/05	15.24	1.80	8.4	4.26						7.42	1.50	66.2	12.59					120 sec froth
577	Pit-260.15	Pit-9.A	10/05	5.95	1.70	9.7	5.50						7.42	1.50	66.2	12.59					barren- 3min 20sec
578	Pit-261.1	Pit-9.A	10/04	94.44	1.80	6.9	3.60						6.75	1.30	69.3	13.68					15 sec froth
579	Pit-261.2	Pit-9.A	10/04	36.20	1.80	7.7	3.79						6.75	1.30	69.3	13.68					30 sec froth
580	Pit-261.3	Pit-9.A	10/04	15.04	1.70	7.7	3.95						6.75	1.30	69.3	13.68					60 sec froth
581	Pit-261.4	Pit-9.A	10/04	6.85	1.70	8.6	4.20						6.75	1.30	69.3	13.68					120 sec froth
582	Pit-261.5	Pit-9.A	10/04	2.21	1.70	10.1	4.37						6.75	1.30	69.3	13.68					barren-3min 20sec
583	Pit-262.1	Pit-9.A	10/04	98.48	1.70	6.9	3.80						6.33	1.30	70.2	12.26					15sec froth
584	Pit-262.2	Pit-9.A	10/04	29.85	1.70	7.4	3.94						6.33	1.30	70.2	12.26					30sec froth
585	Pit-262.3	Pit-9.A	10/04	18.64	1.70	7.9	4.03						6.33	1.30	70.2	12.26					60sec froth

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
586	Pit-262.4	Pit-9.A	10/04	5.82	1.60	9.3	4.17						6.33	1.30	70.2	12.26					120sec froth
587	Pit-262.5	Pit-9.A	10/04	1.97	1.70	9.9	4.45						6.33	1.30	70.2	12.26					barren-3min
588	Pit-263.1	Pit-9.A	10/04	92.54	1.60	6.9	3.69						6.61	1.30	70.0	12.97					15sec froth
589	Pit-263.2	Pit-9.A	10/04	39.53	1.70	7.3	3.89						6.61	1.30	70.0	12.97					30sec froth
590	Pit-263.3	Pit-9.A	10/04	14.29	1.70	7.9	4.10						6.61	1.30	70.0	12.97					60sec froth
591	Pit-263.4	Pit-9.A	10/04	6.20	1.50	8.8	4.32						6.61	1.30	70.0	12.97					120sec froth
592	Pit-263.5	Pit-9.A	10/04	2.01	1.60	9.8	4.27						6.61	1.30	70.0	12.97					barren
593	Pit-264.1	Pit-9.A	10/12	48.94	1.20	6.2	3.55						8.06	1.20	62.8	12.14					15sec froth
594	Pit-264.2	Pit-9.A	10/12	27.61	1.30	6.3	3.69						8.06	1.20	62.8	12.14					30sec froth
595	Pit-264.3	Pit-9.A	10/12	30.78	1.40	6.9	3.76						8.06	1.20	62.8	12.14					60sec froth
596	Pit-264.4	Pit-9.A	10/12	28.77	1.40	7.8	3.98						8.06	1.20	62.8	12.14					120sec froth
597	Pit-264.5	Pit-9.A	10/12	15.90	1.30	9.5	4.28						8.06	1.20	62.8	12.14					barren-5min
598	Pit-265.1	Pit-9.A	10/12	67.44	1.20	6.5	3.70						8.00	1.30	68.0	13.00					15sec froth, TAILINGS ARE LOST DUR
599	Pit-265.2	Pit-9.A	10/12	29.28	1.20	6.8	3.80						8.00	1.30	68.0	13.00					30sec froth
600	Pit-265.3	Pit-9.A	10/12	30.26	1.30	7.3	3.94						8.00	1.30	68.0	13.00					60sec froth
601	Pit-265.4	Pit-9.A	10/12	18.70	1.30	8.5	4.19						8.00	1.30	68.0	13.00					120sec froth
602	Pit-265.5	Pit-9.A	10/12	7.36	1.30	10.3	4.57						8.00	1.30	68.0	13.00					barren-4min
603	Pit-266.1	Pit-9.A	10/12	84.80	1.30	6.7	3.72						7.72	1.20	64.4	12.65					15sec froth
604	Pit-266.2	Pit-9.A	10/12	33.63	1.30	7.1	3.82						7.72	1.20	64.4	12.65					30sec froth
605	Pit-266.3	Pit-9.A	10/12	17.32	1.30	7.7	3.91						7.72	1.20	64.4	12.65					60sec froth
606	Pit-266.4	Pit-9.A	10/12	11.90	1.30	8.5	4.14						7.72	1.20	64.4	12.65					120sec froth
607	Pit-266.5	Pit-9.A	10/12	4.83	1.20	9.9	4.21						7.72	1.20	64.4	12.65					barren-3min 40sec
608	Pit-267.1	Pit-9.A	10/12	87.66	1.20	6.9	3.81						6.63	1.10	68.1	12.43					15sec froth
609	Pit-267.2	Pit-9.A	10/12	38.69	1.30	7.1	3.87						6.63	1.10	68.1	12.43					30sec froth
610	Pit-267.3	Pit-9.A	10/12	18.23	1.30	7.6	3.99						6.63	1.10	68.1	12.43					60sec froth
611	Pit-267.4	Pit-9.A	10/12	6.74	1.40	8.4	4.20						6.63	1.10	68.1	12.43					120sec froth
612	Pit-267.5	Pit-9.A	10/12	2.54	1.40	9.4	4.27						6.63	1.10	68.1	12.43					barren-3min 20sec
613	Ufp-233.1	Ufp-9.A	9/27	62.39	.50	7.8	1.47						19.66	.70	59.1	6.36					15sec froth,0.5min-res. time
614	Ufp-233.2	Ufp-9.A	9/27	30.49	.50	8.6	1.56						19.66	.70	59.1	6.36					30sec froth, 0.5min res. time
615	Ufp-233.3	Ufp-9.A	9/27	23.85	.50	9.2	1.61						19.66	.70	59.1	6.36					60sec froth
616	Ufp-233.4	Ufp-9.A	9/27	9.41	.40	10.9	1.80						19.66	.70	59.1	6.36					120sec froth
617	Ufp-233.5	Ufp-9.A	9/27	12.08	.50	11.4	1.72						19.66	.70	59.1	6.36					barren- 4min 30sec
618	Ufp-234.1	Ufp-9.A	9/27	59.84	.50	8.1	1.46						19.60	.90	57.8	5.93					15sec froth, 0.5min-res. time
619	Ufp-234.2	Ufp-9.A	9/27	28.44	.60	8.3	1.52						19.60	.90	57.8	5.93					30sec froth
620	Ufp-234.3	Ufp-9.A	9/27	22.17	.50	9.0	1.57						19.60	.90	57.8	5.93					60sec froth
621	Ufp-234.4	Ufp-9.A	9/27	16.24	.60	10.2	1.70						19.60	.90	57.8	5.93					120sec froth
622	Ufp-234.5	Ufp-9.A	9/27	12.03	.50	10.9	1.69						19.60	.90	57.8	5.93					barren-4min 30sec
623	Ufp-235.1	Ufp-9.A	9/28	46.99	.40	7.3	1.40						27.43	.60	46.2	5.06					15sec froth

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
624	Ufp-235.2	Ufp-9.A	9/28	17.27	.40	7.6	1.38						27.43	.60	46.2	5.06					30sec froth
625	Ufp-235.3	Ufp-9.A	9/28	17.34	.40	7.8	1.40						27.43	.60	46.2	5.06					60sec froth
626	Ufp-235.4	Ufp-9.A	9/28	21.87	.40	8.4	1.45						27.43	.60	46.2	5.06					120sec froth
627	Ufp-235.5	Ufp-9.A	9/28	26.54	.50	9.4	1.50						27.43	.60	46.2	5.06					barren-5min 30sec
628	Ufp-236.1	Ufp-9.A	9/28	64.12	1.10	7.3	1.31	.02	.64	.66			17.88	.60	62.3	7.00					15sec froth ,0.5min res. time
629	Ufp-236.2	Ufp-9.A	9/28	28.12	.90	8.0	1.38	.02	.69	.68			17.88	.60	62.3	7.00					30sec froth
630	Ufp-236.3	Ufp-9.A	9/28	23.29	1.10	8.9	1.47	.02	.77	.68			17.88	.60	62.3	7.00					60sec froth
631	Ufp-236.4	Ufp-9.A	9/28	14.84	1.00	10.5	1.58	.03	.88	.66			17.88	.60	62.3	7.00					120sec froth
632	Ufp-236.5	Ufp-9.A	9/28	11.36	1.10	16.0	2.06	.02	1.38	.66			17.88	.60	62.3	7.00					barren-5min 30sec total flot. time
633	Ufp-237.1	Ufp-9.A	10/01	40.91	.70	7.6	1.38						17.85	1.00	60.4	6.76					15sec froth, 0.5min-res. time
634	Ufp-237.2	Ufp-9.A	10/01	15.89	.60	7.5	1.36						17.85	1.00	60.4	6.76					30sec froth
635	Ufp-237.3	Ufp-9.A	10/01	26.48	.70	8.2	1.46						17.85	1.00	60.4	6.76					60sec froth
636	Ufp-237.4	Ufp-9.A	10/01	25.37	.60	9.3	1.52						17.85	1.00	60.4	6.76					120sec froth
637	Ufp-237.5	Ufp-9.A	10/01	31.74	.50	12.4	1.77						17.85	1.00	60.4	6.76					barren-6min 30sec total flot time
638	Ufp-238.1	Ufp-9.A	10/02	42.02	.60	7.1	1.27						19.73	.80	59.0	6.91					15sec froth
639	Ufp-238.2	Ufp-9.A	10/02	17.75	.40	7.2	1.28						19.73	.80	59.0	6.91					30sec froth
640	Ufp-238.3	Ufp-9.A	10/02	23.49	.60	7.7	1.33						19.73	.80	59.0	6.91					60sec froth
641	Ufp-238.4	Ufp-9.A	10/02	28.53	.70	9.0	1.38						19.73	.80	59.0	6.91					120sec froth
642	Ufp-238.5	Ufp-9.A	10/02	26.94	.80	12.3	1.72						19.73	.80	59.0	6.91					barren-6min 30sec total flot. time
643	Ufp-239.1	Ufp-9.A	10/02	32.90	.60	7.0	1.34						19.54	.90	59.2	6.37					15sec froth
644	Ufp-239.2	Ufp-9.A	10/02	18.74	.60	7.1	1.35						19.54	.90	59.2	6.37					30sec froth
645	Ufp-239.3	Ufp-9.A	10/02	23.32	.60	7.6	1.41						19.54	.90	59.2	6.37					60sec froth
646	Ufp-239.4	Ufp-9.A	10/02	28.00	.70	8.3	1.46						19.54	.90	59.2	6.37					120sec froth
647	Ufp-239.5	Ufp-9.A	10/02	35.47	.60	11.8	1.78						19.54	.90	59.2	6.37					barren-6min 30sec
648	Ufp-240.1	Ufp-9.A	10/02	30.34	.70	7.3	1.35						17.00	.90	61.2	6.60					15sec froth
649	Ufp-240.2	Ufp-9.A	10/02	15.10	.60	7.5	1.37						17.00	.90	61.2	6.60					30sec froth
650	Ufp-240.3	Ufp-9.A	10/02	24.90	.70	7.8	1.42						17.00	.90	61.2	6.60					60sec froth
651	Ufp-240.4	Ufp-9.A	10/02	33.12	.60	9.0	1.52						17.00	.90	61.2	6.60					120sec froth
652	Ufp-240.5	Ufp-9.A	10/02	38.05	.80	11.8	1.75						17.00	.90	61.2	6.60					barren-6min 15sec
653	Ufp-241.1	Ufp-9.A	10/03	42.10	.90	7.0	1.35	.03	.67	.65			20.44	.90	57.8	6.45	.17	6.27	.01		15sec froth
654	Ufp-241.2	Ufp-9.A	10/03	13.70	.90	7.2	1.34	.02	.66	.66			20.44	.90	57.8	6.45	.17	6.27	.01		30sec froth
655	Ufp-241.3	Ufp-9.A	10/03	21.55	.80	7.4	1.35	.02	.67	.66			20.44	.90	57.8	6.45	.17	6.27	.01		60sec froth
656	Ufp-241.4	Ufp-9.A	10/03	28.59	.80	8.2	1.38	.03	.71	.64			20.44	.90	57.8	6.45	.17	6.27	.01		120sec froth
657	Ufp-241.5	Ufp-9.A	10/03	31.80	.80	11.6	1.62	.03	.97	.62			20.44	.90	57.8	6.45	.17	6.27	.01		barren-6min
658	Ufp-241.11	Ufp-9.A	10/03	40.53	.70	6.9	1.35						20.57	1.10	58.4	6.72					15 SEC FROTH
659	uFP-241.12	Ufp-9.A	10/03	16.33	.70	7.3	1.35						20.57	1.10	58.4	6.72					30sec froth
660	Ufp-241.13	Ufp-9.A	10/03	20.89	.70	7.3	1.37						20.57	1.10	58.4	6.72					60sec froth
661	Ufp-241.14	Ufp-9.A	10/03	26.39	.70	8.2	1.43						20.57	1.10	58.4	6.72					120sec froth

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
662	Ufp-241.15	Ufp-9.A	10/03	33.71	.80	11.7	1.72						20.57	1.10	58.4	6.72					barren-6min
663	Ufp-242.1	Ufp-9.A	10/04	27.36	.80	6.9	1.33						20.54	.90	57.2	6.73					15sec froth
664	Ufp-242.2	Ufp-9.A	10/04	12.66	.90	6.8	1.25						20.54	.90	57.2	6.73					30sec froth
665	Ufp-242.3	Ufp-9.A	10/04	22.41	.70	7.2	1.32						20.54	.90	57.2	6.73					60sec froth
666	Ufp-242.4	Ufp-9.A	10/04	30.65	.70	8.1	1.40						20.54	.90	57.2	6.73					120sec froth
667	Ufp-242.5	Ufp-9.A	10/04	44.44	.80	11.3	1.68						20.54	.90	57.2	6.73					barren-6min 30sec
668	Ufp-243.1	Ufp-9.A	10/04	25.12	.90	7.0	1.29						20.03	1.00	57.8	6.76					15sec froth
669	Ufp-243.2	Ufp-9.A	10/04	14.11	.90	6.9	1.29						20.03	1.00	57.8	6.76					30sec froth
670	Ufp-243.3	Ufp-9.A	10/04	22.61	.80	7.3	1.33						20.03	1.00	57.8	6.76					60sec froth
671	Ufp-243.4	Ufp-9.A	10/04	31.99	.70	8.3	1.43						20.03	1.00	57.8	6.76					120sec froth
672	Ufp-243.5	Ufp-9.A	10/04	44.36	.60	11.1	1.64						20.03	1.00	57.8	6.76					barren-7min
673	Ufp-244.1	Ufp-9.A	10/04	47.11	.90	7.4	1.38	.03	.74	.61			17.33	.90	61.6	6.69	.17	6.75	0.00		15sec froth
674	Ufp-244.2	Ufp-9.A	10/04	19.39	.80	7.6	1.40	.03	.73	.65			17.33	.90	61.6	6.69	.17	6.75	0.00		30sec froth
675	Ufp-244.3	Ufp-9.A	10/04	21.78	.70	7.9	1.43	.03	.75	.65			17.33	.90	61.6	6.69	.17	6.75	0.00		60sec froth
676	Ufp-244.4	Ufp-9.A	10/04	26.64	.80	9.3	1.52	.03	.87	.63			17.33	.90	61.6	6.69	.17	6.75	0.00		120sec froth
677	Ufp-244.5	Ufp-9.A	10/04	25.80	.70	13.0	1.73	.03	1.16	.54			17.33	.90	61.6	6.69	.17	6.75	0.00		barren-5min 30sec
678	Ufp-245.1	Ufp-9.A	10/05	32.42	.60	6.9	1.32						20.72	.80	55.5	6.33					15sec froth
679	Ufp-245.2	Ufp-9.A	10/05	13.27	.60	6.8	1.31						20.72	.80	55.5	6.33					30sec froth
680	Ufp-245.3	Ufp-9.A	10/05	19.65	.60	7.2	1.34						20.72	.80	55.5	6.33					60sec froth
681	Ufp-245.4	Ufp-9.A	10/05	30.88	.60	8.6	1.44						20.72	.80	55.5	6.33					120sec froth
682	Ufp-245.5	Ufp-9.A	10/05	40.88	.60	10.9	1.61						20.72	.80	55.5	6.33					barren-7min 30sec
683	Ufp-245.11	Ufp-9.A	10/09	31.56	.50	7.0	1.32						20.94	.90	56.0	6.27					15sec froth
684	Ufp-245.12	Ufp-9.A	10/09	12.52	.70	7.0	1.30						20.94	.90	56.0	6.27					30sec froth
685	Ufp-245.13	Ufp-9.A	10/09	21.31	.60	7.4	1.38						20.94	.90	56.0	6.27					60sec froth
686	Ufp-245.14	Ufp-9.A	10/09	29.15	.40	8.3	1.45						20.94	.90	56.0	6.27					120sec froth
687	Ufp-245.15	Ufp-9.A	10/09	42.66	.50	10.8	1.63						20.94	.90	56.0	6.27					barren-7min 30sec
688	Ufp-246	Ufp-9.A	10/02	132.78	.80	11.8	1.75						25.75	.90	61.2	6.60					standard test
689	Ufp-247	Ufp-9.A	10/12	130.44	.60	7.0	1.21						27.96	.60	53.3	6.71					
690	Ufp-248	Ufp-9.A	10/15	128.13	.50	6.6	1.18						30.51	.80	50.2	6.23					
691	Ill-238.1	Ill-9.A	10/10	8.97	2.20	5.0	2.79						8.17	1.80	66.1	3.61					15sec froth,0.5min-res. time
692	Ill-238.2	Ill-9.A	10/10	4.37	2.50	4.9	2.79						8.17	1.80	66.1	3.61					30sec froth, 0.5min res time
693	Ill-238.3	Ill-9.A	10/10	8.45	2.20	5.3	2.79						8.17	1.80	66.1	3.61					60sec froth, 0.5min res time
694	Ill-238.4	Ill-9.A	10/10	16.59	2.00	5.5	2.85						8.17	1.80	66.1	3.61					120sec froth, 0.5min res time
695	Ill-238.5	Ill-9.A	10/10	113.87	1.50	7.0	3.02						8.17	1.80	66.1	3.61					barren 9min 30sec
696	Ill-239.1	Ill-9.A	10/11	35.17	2.20	5.6	2.91						7.74	1.60	70.9	3.19					15sec froth
697	Ill-239.2	Ill-9.A	10/11	17.55	2.30	5.6	2.97						7.74	1.60	70.9	3.19					30sec froth
698	Ill-239.3	Ill-9.A	10/11	24.77	2.40	5.8	2.93						7.74	1.60	70.9	3.19					60sec froth
699	Ill-239.4	Ill-9.A	10/11	32.13	2.30	6.2	2.97						7.74	1.60	70.9	3.19					120sec froth

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
700	Ill-239.5	Ill-9.A	10/11	43.52	2.10	8.6	3.14						7.74	1.60	70.9	3.19					barren -9min
701	Ill-240.1	Ill-9.A	10/11	59.19	2.30	6.1	2.92						7.33	1.70	74.3	3.37					15sec froth
702	Ill-240.2	Ill-9.A	10/11	29.46	2.60	6.1	2.90						7.33	1.70	74.3	3.37					30sec froth
703	Ill-240.3	Ill-9.A	10/11	24.47	2.50	6.1	2.98						7.33	1.70	74.3	3.37					60sec froth
704	Ill-240.4	Ill-9.A	10/11	20.76	2.60	6.6	2.94						7.33	1.70	74.3	3.37					120sec froth
705	Ill-240.5	Ill-9.A	10/11	20.58	2.50	9.6	3.20						7.33	1.70	74.3	3.37					barren -8min
706	Ill-241.1	Ill-9.A	10/11	58.51	2.50	6.8	2.95	.04	.73	2.19			6.76	1.60	73.5	3.83	.15	3.68	0.00		15sec froth
707	Ill-241.2	Ill-9.A	10/11	16.62	2.70	6.3	2.97	.03	.74	2.20			6.76	1.60	73.5	3.83	.15	3.68	0.00		30sec froth
708	Ill-241.3	Ill-9.A	10/11	27.83	2.70	6.1	2.94	.03	.73	2.18			6.76	1.60	73.5	3.83	.15	3.68	0.00		60sec froth
709	Ill-241.4	Ill-9.A	10/11	32.28	2.60	6.4	2.97	.03	.74	2.19			6.76	1.60	73.5	3.83	.15	3.68	0.00		120sec froth
710	Ill-241.5	Ill-9.A	10/11	20.24	2.70	8.5	3.16	.04	1.01	2.12			6.76	1.60	73.5	3.83	.15	3.68	0.00		barren -8min
711	Ill-242.1	Ill-9.A	10/11	7.07	3.40	4.8	2.72						7.43	1.90	73.4	3.64					15sec froth, 0.5min res time
712	Ill-242.2	Ill-9.A	10/11	3.48	3.40	4.9	2.70						7.43	1.90	73.4	3.64					30sec froth,0.5min res time
713	Ill-242.3	Ill-9.A	10/11	5.85	3.40	5.3	2.73						7.43	1.90	73.4	3.64					60sec froth, 0.5min res time
714	Ill-242.4	Ill-9.A	10/11	10.85	2.60	5.4	2.79						7.43	1.90	73.4	3.64					120sec froth, 0.5min res time
715	Ill-242.5	Ill-9.A	10/11	127.04	2.00	7.1	3.00						7.43	1.90	73.4	3.64					barren -12min,0.5min res time
716	Ill-243.1	Ill-9.A	10/12	16.17	2.40	5.3	2.79						7.87	1.40	70.9	3.43					15sec froth
717	Ill-243.2	Ill-9.A	10/12	11.27	2.30	5.3	2.81						7.87	1.40	70.9	3.43					30sec froth
718	Ill-243.3	Ill-9.A	10/12	18.00	2.30	5.3	2.81						7.87	1.40	70.9	3.43					60sec froth
719	Ill-243.4	Ill-9.A	10/12	27.30	2.30	5.5	2.83						7.87	1.40	70.9	3.43					120sec froth
720	Ill-243.5	Ill-9.A	10/12	83.91	2.30	7.5	3.06						7.87	1.40	70.9	3.43					barren -9min
721	Ill-244.1	Ill-9.A	10/12	48.73	2.30	6.4	2.92						6.84	1.30	74.5	3.31					15sec froth
722	Ill-244.2	Ill-9.A	10/12	37.85	2.40	6.2	2.92						6.84	1.30	74.5	3.31					30sec froth
723	Ill-244.3	Ill-9.A	10/12	25.34	2.30	6.2	2.95						6.84	1.30	74.5	3.31					60sec froth
724	Ill-244.4	Ill-9.A	10/12	21.84	2.30	6.5	2.97						6.84	1.30	74.5	3.31					120sec froth
725	Ill-244.5	Ill-9.A	10/12	21.08	2.30	8.8	3.14						6.84	1.30	74.5	3.31					barren -8min
726	Ill-245.1	Ill-9.A	10/15	51.18	.80	6.3	2.82						8.68	1.60	63.9	3.94					15sec froth
727	Ill-245.2	Ill-9.A	10/15	31.04	2.40	5.9	2.85						8.68	1.60	63.9	3.94					30sec froth
728	Ill-245.3	Ill-9.A	10/15	22.49	2.40	5.8	2.85						8.68	1.60	63.9	3.94					60sec froth
729	Ill-245.4	Ill-9.A	10/15	18.82	2.50	6.2	2.90						8.68	1.60	63.9	3.94					120sec froth
730	Ill-245.5	Ill-9.A	10/15	29.47	2.40	8.9	3.08						8.68	1.60	63.9	3.94					barren -8min
731	Ill-240.11	Ill-9.A	10/17	61.96	1.40	6.9	2.95						6.99	1.70	72.8	3.65					15sec froth
732	Ill-240.12	Ill-9.A	10/17	28.29	2.90	6.3	2.97						6.99	1.70	72.8	3.65					30sec froth
733	Ill-240.13	Ill-9.A	10/17	26.80	2.90	5.9	2.89						6.99	1.70	72.8	3.65					60sec froth
734	Ill-240.14	Ill-9.A	10/17	16.43	2.80	6.5	2.96						6.99	1.70	72.8	3.65					120sec froth
735	Ill-240.15	Ill-9.A	10/17	24.25	2.80	8.9	3.19						6.99	1.70	72.8	3.65					barren-7min 30sec
736	Ill-244.11	Ill-9.A	10/17	36.97	2.90	6.5	2.91						6.70	1.70	71.0	3.71					15sec froth
737	Ill-244.12	Ill-9.A	10/17	22.70	2.80	6.1	2.92						6.70	1.70	71.0	3.71					30sec froth

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
738	Ill-244.13	Ill-9.A	10/17	23.21	2.90	6.2	2.95						6.70	1.70	71.0	3.71					60sec froth
739	Ill-244.14	Ill-9.A	10/17	27.73	2.90	6.3	3.01						6.70	1.70	71.0	3.71					120sec froth
740	Ill-244.15	Ill-9.A	10/17	39.98	1.20	8.6	3.16						6.70	1.70	71.0	3.71					barren-8min 30sec
741	Ill-246.1	Ill-9.A	10/15	11.35	2.50	4.9	2.72	.03	.50	2.20			8.09	1.20	66.7	3.72	.14	3.24	.35		15sec froth, 0.5min res. time
742	Ill-246.2	Ill-9.A	10/15	6.38	2.40	5.6	2.69	.03	.53	2.14			8.09	1.20	66.7	3.72	.14	3.24	.35		30sec froth,0.5min res. time
743	Ill-246.3	Ill-9.A	10/15	8.49	2.40	5.6	2.72	.03	.53	2.16			8.09	1.20	66.7	3.72	.14	3.24	.35		60sec froth, 0.5min res. time
744	Ill-246.4	Ill-9.A	10/15	14.61	2.40	5.6	2.77	.03	.56	2.18			8.09	1.20	66.7	3.72	.14	3.24	.35		120sec froth,0.5min res. time
745	Ill-246.5	Ill-9.A	10/15	112.45	1.90	7.1	2.98	.04	.79	2.15			8.09	1.20	66.7	3.72	.14	3.24	.35		barren-13min 30sec
746	Ill-247.1	Ill-9.A	10/15	9.18	2.50	5.2	2.76						7.71	1.40	68.9	4.01					15sec froth
747	Ill-247.2	Ill-9.A	10/15	4.28	2.50	5.2	2.76						7.71	1.40	68.9	4.01					30sec froth
748	Ill-247.3	Ill-9.A	10/15	7.30	2.50	5.7	2.85						7.71	1.40	68.9	4.01					60sec froth
749	Ill-247.4	Ill-9.A	10/15	11.28	2.40	6.1	2.84						7.71	1.40	68.9	4.01					120sec froth
750	Ill-247.5	Ill-9.A	10/15	126.00	4.20	7.2	3.06						7.71	1.40	68.9	4.01					barren-14min
751	Ill-248.1	Ill-9.A	10/16	14.33	2.50	5.3	2.80						8.48	1.80	69.4	3.79					15sec froth
752	Ill-248.2	Ill-9.A	10/16	7.66	2.50	5.2	2.81						8.48	1.80	69.4	3.79					30sec froth
753	Ill-248.3	Ill-9.A	10/16	11.43	2.50	5.2	2.85						8.48	1.80	69.4	3.79					60sec froth
754	Ill-248.4	Ill-9.A	10/16	22.13	2.70	5.5	2.88						8.48	1.80	69.4	3.79					120sec froth
755	Ill-248.5	Ill-9.A	10/16	106.89	1.50	7.4	3.07						8.48	1.80	69.4	3.79					barren-10min 30sec
756	Ill-249.1	Ill-9.A	10/16	14.17	2.40	5.3	2.81	.03	.53	2.25			10.99	1.70	73.0	3.71	.14	3.22	.36		15sec froth
757	Ill-249.2	Ill-9.A	10/16	8.64	2.50	5.1	2.80	.03	.53	2.25			10.99	1.70	73.0	3.71	.14	3.22	.36		30sec froth
758	Ill-249.3	Ill-9.A	10/16	11.91	2.50	5.1	2.79	.02	.54	2.22			10.99	1.70	73.0	3.71	.14	3.22	.36		60sec froth
759	Ill-249.4	Ill-9.A	10/16	22.64	2.50	5.4	2.82	.03	.58	2.21			10.99	1.70	73.0	3.71	.14	3.22	.36		120sec froth
760	Ill-249.5	Ill-9.A	10/16	95.46	1.20	7.3	3.06	.04	.83	2.19			10.99	1.70	73.0	3.71	.14	3.22	.36		barren-11min
761	Ill-250	Ill-9.A	10/17	148.83	1.10	5.9	2.91						11.16	1.90	66.6	3.57					
762	Ill-251	Ill-9.A	10/19	155.34	3.50	5.9	2.97						8.73	1.50	74.9	3.09					
763	Ill-252.1	Ill-9.A	10/19	60.38	2.50	5.5	2.86						9.22	1.50	73.1	3.15					15sec froth on second flotation
764	Ill-252.2	Ill-9.A	10/19	33.39	2.50	5.6	2.94						9.22	1.50	73.1	3.15					30sec froth
765	Ill-252.3	Ill-9.A	10/19	22.39	2.50	5.6	2.97						9.22	1.50	73.1	3.15					60sec froth
766	Ill-252.4	Ill-9.A	10/19	21.79	2.40	6.1	3.02						9.22	1.50	73.1	3.15					120sec froth
767	Ill-252.5	Ill-9.A	10/19	15.16	2.40	8.0	3.14						9.22	1.50	73.1	3.15					barren-8min
768	Pit-268	Pit-9.A	10/16	149.64	.70	6.6	3.79						10.17	1.10	60.5	12.94					
769	Pit-269	Pit-9.A	10/16	150.10	.60	6.7	3.82						9.50	1.10	63.4	12.73					
770	Pit-270	Pit-9.A	10/16	149.76	.50	6.4	3.72						10.09	1.00	62.2	13.23					
771	Ufp-249.1	Ufp-9.A	10/18	52.26	.70	6.7	1.24						20.47	.80	62.5	7.17					15sec froth
772	Ufp-249.2	Ufp-9.A	10/18	27.91	.60	6.9	1.28						20.47	.80	62.5	7.17					30sec froth
773	Ufp-249.3	Ufp-9.A	10/18	24.68	.70	7.3	1.33						20.47	.80	62.5	7.17					60sec froth
774	Ufp-249.4	Ufp-9.A	10/18	21.67	.60	8.0	1.41						20.47	.80	62.5	7.17					120sec froth
775	Ufp-249.5	Ufp-9.A	10/18	10.90	.70	10.7	1.69						20.47	.80	62.5	7.17					barren-5min

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
776	Ufp-247.1	Ufp-9.A	10/23	134.08	.70	7.2	1.17						25.05	.90	56.1	6.20					0.14g of lime used fpr pH ajustmen
777	Ufp-250	Ufp-9.A	10/23	135.43	.70	7.2	1.21						23.02	.80	59.3	6.56					no pH ajustment
778	Ufp-251	Ufp-9.A	10/25	126.78	.70	5.9	1.04						31.90	.90	50.1	5.86					
779	Pit-272	Pit-10A	10/30	36.41	1.40	8.3	3.75						3.62	1.30	19.6	6.07					
780	Pit-273	Pit-10A	10/30	37.31	1.40	5.4	3.50	.02	1.13	2.35			2.88	1.00	66.8	11.72					
781	Pit-274	Pit-10A	10/30	38.02	1.40	7.5	3.73						2.12	1.20	43.5	8.63					
782	Pit-271.1	Pit-9.A	10/30	69.58	1.50	6.1	3.54						10.09	1.20	63.4	13.46					15sec froth
783	Pit-271.2	Pit-9.A	10/30	36.60	1.40	6.2	3.59						10.09	1.20	63.4	13.46					30sec froth
784	Pit-271.3	Pit-9.A	10/30	31.22	1.30	6.6	3.63						10.09	1.20	63.4	13.46					60sec froth
785	Pit-271.4	Pit-9.A	10/30	10.81	1.30	7.2	3.81						10.09	1.20	63.4	13.46					120sec froth
786	Pit-271.5	Pit-9.A	10/30	3.25	1.30	7.6	3.84						10.09	1.20	63.4	13.46					barren
787	Ken-29	Ken-1.A	10/29	144.09	1.80	7.7	3.05						17.60	1.00	73.0	15.65					
788	Ken-30	Ken-1.A	10/29	149.44	3.80	7.6	3.20						16.90	1.00	79.2	15.20					
789	Ken-30.1	Ken-1.A	10/29	149.72	4.00	7.3	3.19	.06	1.50	1.63			16.58	.90	78.8	17.51	.22	17.13	.15		
790	Pit-275	Pit-10A	11/02	37.13	1.20	5.7	3.60						2.51	1.10	69.3	12.03					very good separation, grey tailing
791	Pit-276	Pit-10A	11/02	34.85	1.10	4.9	3.28	.02	.91	2.35			4.88	1.00	44.0	9.08	.11	8.21	.76		SLOW SEPARATION, SOME MIDDLINGS
792	Pit-277	Pit-10A	11/02	37.32	1.20	5.8	3.54	.02	1.22	2.30			2.34	1.20	69.6	11.94					VERY GOOD, FAST SEPARATION
793	Ufp-253	Ufp-9.A	10/20	34.84	.60	11.1	1.64						4.37	1.00	44.5	5.40					
794	Ufp-254	Ufp-9.A	10/26	33.46	.50	10.1	1.43						5.93	.90	39.4	5.11					
795	Ufp-256	Ufp-9.A	10/31	34.80	.60	8.0	1.31						4.48	1.20	69.8	7.82					
796	Ufp-256.1	Ufp-9.A	11/01	34.74	.40	7.7	1.35						4.49	1.30	71.7	8.00					
797	Ufp-257	Ufp-9.A	10/31	34.12	.40	7.3	1.24						5.03	1.30	63.0	7.07					
798	Ken-14	Ken-1.A	10/31	37.82	1.30	11.9	4.58						2.17	1.20	77.1	12.95					
799	Ken-15	Ken-1.A	10/31	37.90	1.30	12.6	4.64						1.95	1.20	77.4	11.03					
800	Ken-16	Ken-1.A	10/31	37.52	1.20	11.8	4.52						2.12	1.00	69.1	12.22					
801	Ken-17	Ken-1.A	11/06	33.99	1.30	9.2	3.53						6.71	1.20	41.6	10.42					SMALL AGGLOMERATES
802	Ken-19	Ken-1.A	11/06	31.79	1.30	10.8	4.09						8.71	1.00	30.6	8.16					PASTY PRODUCT
803	Ken-23	Ken-1.A	11/06	139.77	.90	9.8	3.77						19.79	1.10	51.9	10.52					
804	Ken-25	Ken-1.A	11/02	135.06	1.10	11.0	4.25						24.40	1.00	39.0	7.35					
805	Ken-26	Ken-1.A	11/02	147.06	2.40	7.9	3.61						16.29	.90	77.2	13.27					DISTINCT VERY SMALL AGGLOMERATES
806	Ken-27.1	Ken-1.A	11/05	145.78	.50	8.8	3.97						13.49	.90	83.7	11.75					
807	Ken-28	Ken-1.A	11/01	155.02	4.10	10.4	4.36						11.33	.90	75.5	10.49					PASTY PRODUCT
808	Pit-278	Pit-10A	11/06	151.34	1.90	6.6	3.63						9.87	1.10	67.1	11.02					
809	Pit-279	Pit-10A	11/06	37.19	1.10	6.3	3.60						2.51	1.30	64.5	12.05					
810	Pit-279.1	Pit-10A	11/06	37.10	1.10	6.4	3.62						2.54	1.40	64.2	11.76					
811	Pit-280.1	Pit-10A	11/07	118.61	1.30	6.8	3.79						13.78	1.20	45.1	7.55					30sec froth
812	Pit-280.2	Pit-10A	11/07	27.49	1.40	7.3	3.79						13.78	1.20	45.1	7.55					barren-3min 30sec
813	Pit-281.1	Pit-10A	11/07	128.58	1.30	7.2	3.79						9.08	1.10	57.7	8.49					30sec froth

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
814	Pit-281.2	Pit-10A	11/07	22.58	1.30	7.8	3.84						9.08	1.10	57.7	8.49					barren-3min
815	Ken-20	Ken-1.A	11/07	33.70	1.20	6.8	3.07						6.19	.90	59.3	13.22					
816	Ken-21	Ken-1.A		36.26	1.60	7.6	3.48	.02	1.78	1.68			3.84	.70	79.9	13.70					nice round agglomerates
817	Ken-22	Ken-1.A	11/07	35.78	1.40	8.3	3.67						4.18	.90	76.8	13.73					
818	Ken-24	Ken-1.A	11/06	147.30	1.10	10.8	4.29	.03	2.66	1.60			12.72	.90	69.9	11.91	.16	11.63	.12		
819	Ken-27	Ken-1.A	11/01	146.33	1.10	8.8	4.06	.04	2.35	1.67			13.48	.90	84.6	13.22					
820	Pit-274.1	Pit-10A																			
821	Pit-276.1	Pit-10A	11/05	35.91	2.50	5.5	3.28	.02	.90	2.37			4.75	1.00	44.5	9.22					
822	Pit-282	Pit-10A	11/08	148.27	1.20	6.1	3.55	.02	1.30	2.24			11.84	.90	60.2	9.09	.10	9.51	.28		flot. time-3min 30sec
823	Pit-283	Pit-10A	11/08	151.98	1.50	6.6	3.66						8.66	.90	70.4	10.40					flot. time-3min
824	Pit-284.1	Pit-10A	11/13	124.99	1.80	7.1	3.74						9.52	1.20	57.8	8.82					30sec froth
825	Pit-284.2	Pit-10A	11/13	26.40	1.30	8.0	3.89						9.52	1.20	57.8	8.82					barren-3min 20sec
826	Ken-18	Ken-1.A	11/06	34.57	1.30	9.9	3.81	.03	2.05	1.73			5.75	1.10	52.6	12.64	.16	11.89	.59		
827	Pit-1R	Pit-1R	11/05	123.06	1.20	7.9	4.37						35.82	.90	83.7	5.52					
828	Pit-1W	Pit-1W	11/05	150.36	1.20	7.0	4.34						8.54	1.00	70.7	8.02					
829	Pit-2R	Pit-1R	11/06	124.52	1.00	7.7	4.21	.03	1.79	2.39			34.45	1.10	87.2	6.23	.06	5.80	.38		
830	Pit-2R1	Pit-1R	11/06	124.52	1.20	7.0	4.34						34.87	1.20	88.0	5.02					
831	Pit-2W	Pit-1W	11/06	150.21	.90	6.4	4.15	.02	1.63	2.49			8.39	.70	80.6	11.28	.06	11.18	.02		
832	Pit-2W1	Pit-1W	11/07	149.78	1.00	6.2	4.16						9.04	.80	81.1	10.03					
833	Pit-3W	Pit-1W	11/08	37.17	.80	6.1	4.25	.01	1.74	2.50			2.15	.90	76.5	9.22					
834	Pit-3W1	Pit-1W	11/08	36.94	1.10	6.2	4.29						2.05	1.10	75.9	8.61					
835	Pit-3R1	Pit-1R	11/07	29.98	1.00	6.8	4.23						9.45	1.30	83.6	5.50					
836	Pit-3R	Pit-1R	11/07	29.77	.90	6.0	4.00	.02	1.49	2.49			9.74	1.00	82.4	6.71	.06	6.34	.32		
837	Ufp-252	Ufp-9.A	10/26	35.82	.50	10.8	1.54	.03	.95	.56			3.40	1.30	51.9	5.99	.18	5.55	.26		
838	Ufp-255	Ufp-9.A	10/30	35.04	.60	8.1	1.28	.02	.68	.58			4.30	1.30	72.2	8.21	.26	7.78	.16		
839	Ufp-258	Ufp-9.A	11/02	36.40	.50	10.8	1.60						2.90	1.60	59.6	7.10					
840	Ufp-258.1	Ufp-9.A	11/05	36.21	.60	11.7	1.65						2.68	1.60	50.2	6.91					
841	Ufp-259.1	Ufp-9.A	11/09	33.16	.90	5.2	1.09						47.93	1.00	34.9	4.12					30sec froth
842	Ufp-259.2	Ufp-9.A	11/09	77.94	1.00	6.9	1.16						47.93	1.00	34.9	4.12					barren-8min 30sec
843	Ufp-260.1	Ufp-9.A	11/13	66.72	1.00	5.8	1.07						40.02	.80	39.0	4.58					30sec froth
844	Ufp-260.2	Ufp-9.A	11/13	51.92	1.00	7.9	1.24						40.02	.80	39.0	4.58					barren-8min
845	Ufp-260.11	Ufp-9.A	11/13	65.68	.90	5.8	1.10						39.81	.80	39.3	4.60					30sec froth
846	Ufp-260.12	Ufp-9.A	11/13	53.07	.90	8.0	1.27						39.81	.80	39.3	4.60					barren-7min 40sec
847	Pit-285	Pit-10A	11/14	149.12	1.20	6.2	3.69	.02	1.27	2.39			10.58	1.00	63.8	10.70	.17	10.11	.42		flot. time-3min 30sec
848	Pit-286	Pit-10A	11/16	149.72	1.60	7.2	3.95						10.98	1.10	53.0	8.17					FLOT. TIME-3min 30sec
849	Pit-287	Pit-10A	11/16	152.90	1.70	7.6	4.03						7.80	1.10	61.9	9.01					FLOT. TIME-3min 10sec
850	Pit-288	Pit-10A	11/16	153.22	1.60	7.4	4.06						8.59	1.00	60.4	8.81					FLOT. TIME-3min 30sec
851	Ken-32	Ken-2.A	11/16	143.06	1.30	8.2	3.57						18.27	1.10	82.1	11.02					

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
852	Ken-32.1	Ken-2.A	11/16	143.85	1.30	8.2	3.51						17.32	1.10	82.6	10.41					
853	Ken-33	Ken-2.A	11/16	36.18	1.30	8.6	3.63						3.75	1.00	84.2	7.24					
854	Ken-33.1	Ken-2.A	11/16	36.22	1.30	9.0	3.79						3.81	1.10	84.5	7.40					
855	Ken-34.1	Ken-2.A	11/16	52.87	1.60	7.2	3.23						22.41	1.00	67.8	10.81					15sec froth
856	Ken-34.2	Ken-2.A	11/16	24.63	1.20	7.7	3.34						22.41	1.00	67.8	10.81					30sec froth
857	Ken-34.3	Ken-2.A	11/16	34.25	1.50	8.2	3.39						22.41	1.00	67.8	10.81					60sec froth
858	Ken-34.4	Ken-2.A	11/16	27.37	1.30	10.7	3.79						22.41	1.00	67.8	10.81					barren-3min 30sec
859	Ken-35.1	Ken-2.A	11/16	75.18	1.50	9.0	3.44						16.99	1.00	79.5	12.42					15sec froth
860	Ken-35.2	Ken-2.A	11/16	43.83	1.40	9.1	3.51						16.99	1.00	79.5	12.42					30sec froth
861	Ken-35.3	Ken-2.A	11/16	20.62	1.30	9.5	3.68						16.99	1.00	79.5	12.42					60sec froth
862	Ken-35.4	Ken-2.A	11/16	4.85	1.30	10.7	3.95						16.99	1.00	79.5	12.42					barren-2min
863	Ken-36.1	Ken-2.A	11/16	94.03	1.50	8.8	3.55						16.93	.80	77.9	10.99					15sec froth
864	Ken-36.2	Ken-2.A	11/16	32.22	1.40	9.3	3.53						16.93	.80	77.9	10.99					30sec froth
865	Ken-36.3	Ken-2.A	11/16	14.41	1.30	9.3	3.09						16.93	.80	77.9	10.99					60sec froth
866	Ken-36.4	Ken-2.A	11/16	3.78	1.20	10.6	3.81						16.93	.80	77.9	10.99					barren-2min
867	Ufp-261	Ufp-9.A	11/15	124.58	.70	6.8	1.09						34.32	1.00	46.4	5.48					flot. time-9min
868	Ufp-262	Ufp-9.A	11/15	122.70	.70	6.6	1.09	.02	.43	.64			35.98	.90	45.3	5.46	.12	5.14	.20		flot. time-8min 30sec
869	Ufp-263.1	Ufp-9.A	11/16	41.68	.80	5.3	1.06	.02	.39	.65			48.63	.80	34.3	4.36	.09	3.93	.34		30sec froth
870	Ufp-263.2	Ufp-9.A	11/16	67.60	.70	7.2	1.17	.02	.53	.61			48.63	.80	34.3	4.36	.09	3.93	.34		barren-8min 40sec
871	Ufp-264	Ufp-9.A	11/16	109.94	1.00	6.3	1.15						48.89	.80	35.2	4.14					flot.time-8min 30sec
872	Ufp-265	Ufp-9.A	11/16	109.02	.90	6.2	1.11						49.53	.80	34.9	4.05					flot.time-8min 40sec
873	Ufp-266	Ufp-9.A	11/19	117.80	1.10	6.8	1.15	.02	.50	.63			41.01	.90	37.5	4.74	.11	4.03	.61		flot.time-8min 40sec
874	Ken-38.1	Ken-2.A	11/20	136.70	1.50	7.9	3.15						24.26	.80	65.3	11.05					flot.time-2min 30sec
875	Ken-39	Ken-2.A	11/20	144.59	1.20	8.8	3.37						16.08	.70	80.2	11.59					flot.time-2min 15sec
876	Ken-41	Ken-2.A	11/20	143.08	1.20	8.9	3.41						16.86	.70	79.1	11.48					flot. time-2min 30sec
877	Ken-42	Ken-2.A	11/21	142.23	1.30	8.1	3.27						18.48	.70	78.6	12.29					
878	Ken-43	Ken-2.A	11/21	144.14	2.30	7.7	3.42						19.04	.80	82.3	10.79					
879	Pit-289	Pit-10A	11/23	35.15	.90	5.0	3.30						4.61	.80	48.6	10.02					
880	Pit-290	Pit-10A	11/23	32.64	.90	4.9	3.31						7.07	.80	30.7	7.54					
881	Ufp-267	Ufp-9.A	11/22	32.69	.30	6.6	1.16						5.90	.70	55.1	6.60					
882	Ufp-268	Ufp-9.A	11/22	35.22	.30	10.0	1.47	.03	.81	.64			4.62	.70	53.5	6.53	.16	6.00	.37		
883	Ken-35.11	Ken-2.A	11/19	94.05	1.30	8.8	3.52						16.40	.80	80.0	12.40					15sec froth
884	Ken-35.12	Ken-2.A	11/19	38.00	1.30	9.2	3.61						16.40	.80	80.0	12.40					30sec froth
885	Ken-35.13	Ken-2.A	11/19	8.10	1.30	9.4	3.71						16.40	.80	80.0	12.40					60sec froth
886	Ken-35.14	Ken-2.A	11/19	4.69	1.20	10.7	3.97						16.40	.80	80.0	12.40					barren-2min 30sec
887	Ken-37.1	Ken-2.A	11/19	89.99	1.50	8.9	3.61						15.76	.80	82.1	12.00					15sec froth
888	Ken-37.2	Ken-2.A	11/19	43.55	1.60	9.4	3.65						15.76	.80	82.1	12.00					30sec froth
889	Ken-37.3	Ken-2.A	11/19	7.39	1.20	10.1	4.02						15.76	.80	82.1	12.00					60sec froth

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
890	Ken-37.4	Ken-2.A	11/19	4.38	1.10	12.1	4.55						15.76	.80	82.1	12.00					barren-3min
891	Ken-44	Ken-2.A	11/23	33.21	.50	10.6	4.10						5.94	.60	46.1	7.44					
892	Ken-50	Ken-2.A	11/29	142.29	.60	8.5	3.46						17.73	.70	77.5	90					barren flot. time-4min
893	Ken-51	Ken-2.A	11/29	144.52	.70	9.2	3.65						14.96	.70	82.6	9.85					barren flot. time-2min 30sec
894	Ken-52.1	Ken-2.A	11/27	42.55	1.40	7.0	3.16	.01	1.33	1.82			17.59	.80	77.7	11.39					15sec froth
895	Ken-52.2	Ken-2.A	11/27	21.58	1.40	7.1	3.13	.01	1.40	1.72			17.59	.80	77.7	11.39					30sec froth
896	Ken-52.3	Ken-2.A	11/27	32.27	1.50	7.8	3.34	.01	1.57	1.75			17.59	.80	77.7	11.39					60sec froth
897	Ken-52.4	Ken-2.A	11/27	46.19	1.50	10.5	3.92	.02	2.17	1.73			17.59	.80	77.7	11.39					barren-6min
898	Ken-53.1	Ken-2.A	11/27	54.37	1.30	7.2	3.15						17.22	.60	78.9	11.37					15sec froth
899	Ken-53.2	Ken-2.A	11/27	32.45	1.30	7.5	3.15						17.22	.60	78.9	11.37					30sec froth
900	Ken-53.3	Ken-2.A	11/27	27.13	1.30	8.3	3.31						17.22	.60	78.9	11.37					60sec froth
901	Ken-53.4	Ken-2.A	11/27	28.75	1.10	11.1	3.88						17.22	.60	78.9	11.37					barren-5min
902	Ken-54.1	Ken-2.A	11/27	50.56	1.30	7.2	3.08						18.51	.70	76.9	11.48					15sec froth
903	Ken-54.2	Ken-2.A	11/27	27.30	1.30	7.3	3.09						18.51	.70	76.9	11.48					30sec froth
904	Ken-54.3	Ken-2.A	11/27	28.66	1.40	7.9	3.27						18.51	.70	76.9	11.48					60sec froth
905	Ken-54.4	Ken-2.A	11/27	35.49	1.30	10.4	3.84						18.51	.70	76.9	11.48					barren-4min
906	Ken-56	Ken-2.A	11/29	140.78	.50	8.4	3.35						19.45	.70	73.1	11.48					barren flot. time-6min
907	Ken-57	Ken-2.A	11/29	141.70	.70	8.3	3.44						18.19	.60	77.4	10.36					barren flot. time-5min
908	Ken-59	Ken-2.A	11/30	31.28	1.30	7.9	3.24						8.55	.90	50.6	8.90					
909	Ken-60	Ken-2.A	11/30	34.47	1.10	6.9	3.10						5.32	.90	66.0	10.29					
910	Ken-38	Ken-2.A	11/20	139.96	1.10	8.2	3.26	.02	1.58	1.66			20.92	.80	69.8	11.52	.39	11.01	.12		barren flot.time-2min 30sec
911	Ken-40	Ken-2.A	11/20	143.56	1.20	8.7	3.39						17.06	.70	77.5	11.99					barren flot.time-2min 30sec
912	Ken-58	Ken-2.A	11/30	35.41	1.30	13.1	4.04						4.58	1.00	36.4	6.93					
913	Ken-50.1	Ken-2.A	12/03	142.16	1.10	8.5	3.44						18.62	1.00	76.3	10.31					barren flot.time-4min
914	Ken-55.1	Ken-2.A	12/05	91.50	1.80	8.2	3.38						15.69	1.20	82.7	10.63					15sec froth
915	Ken-55.2	Ken-2.A	12/05	24.83	1.60	8.8	3.63						15.69	1.20	82.7	10.63					30sec froth
916	Ken-55.3	Ken-2.A	12/05	21.29	1.50	9.3	3.81						15.69	1.20	82.7	10.63					60sec froth
917	Ken-55.4	Ken-2.A	12/05	8.52	1.70	10.4	4.01						15.69	1.20	82.7	10.63					barren-2min 30sec
918	Ken-48	Ken-2.A	11/27	24.89	1.30	7.1	2.96	.01	1.21	1.74			15.34	1.20	28.4	6.29	.04	5.46	.79		total flot. time for 2flot-1min 40
919	Ken-49	Ken-2.A	11/27	28.44	1.40	5.8	2.89	.01	1.11	1.77			11.55	1.30	37.8	6.74	.05	5.98	.71		total flot.time for 2flot-1min 40s
920	Ken-61	Ken-2.A	11/30	35.12	1.20	8.7	3.48						4.54	.90	73.2	10.74					
921	Ken-62	Ken-2.A	11/30	33.12	1.10	7.0	3.25						6.66	.80	61.0	9.66					
922	Ken-45	Ken-2.A	10/23	34.30	.50	7.9	3.63	.02	1.90	1.71			5.21	.60	75.8	10.27	.08	9.60	.59		
923	Ken-46	Ken-2.A	11/27	139.67	1.40	8.5	3.39						21.42	1.30	67.6	8.94					
924	Ken-46.1	Ken-2.A	11/27	138.90	1.30	8.3	3.35						22.06	1.30	67.0	9.51					
925	Ken-47	Ken-2.A	11/27	136.78	1.30	7.2	3.33						24.11	1.20	69.8	9.20					
926	Ken-47.1	Ken-2.A	11/27	136.83	1.40	7.2	3.34						24.04	1.20	70.0	9.20					
927	Ken-64	Ken-2.A	12/10	34.24	1.30	7.4	3.22						5.75	1.00	69.3	10.61					

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value: Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Tailings Weight, Proximate Analyses & Heating Value: Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Observations
928	Ken-54.11	Ken-2.A	11/27	60.38	2.30	7.1	3.18	.02	1.45	1.72			17.70	.80	77.8	10.85					15sec froth
929	Ken-54.12	Ken-2.A	11/27	28.18	1.30	7.3	3.28	.01	1.53	1.74			17.70	.80	77.8	10.85					30sec froth
930	Ken-54.13	Ken-2.A	11/27	27.93	1.40	8.4	3.49	.01	1.74	1.74			17.70	.80	77.8	10.85					60sec froth
931	Ken-54.14	Ken-2.A	11/27	27.62	1.40	10.9	4.12	.02	2.40	1.70			17.70	.80	77.8	10.85					barren-4min
932	Ken-58.1	Ken-2.A	12/12	35.70	.90	12.9	3.75						4.19	.70	43.9	8.11					
933	Ken-58.2	Ken-2.A	12/12	35.60	.90	12.9	3.86						4.26	.60	38.8	8.71					
934	Ken-63	Ken-2.A	11/30	34.70	1.20	6.9	3.26	.01	1.56	1.69			5.19	1.00	72.8	10.63	.09	10.54	0.00		
935	Ufp-269	Ufp-9.A	12/03	131.41	1.30	7.1	1.10	.02	.50	.59			28.41	1.50	52.4	6.10	.14	6.03	0.00		depressant added to the grinder
936	Ufp-269.1	Ufp-9.A	12/03	131.84	1.20	6.9	1.10						28.03	1.20	50.5	5.97					depressant added to the grinder
937	Ufp-270	Ufp-9.A	12/03	119.17	1.20	6.3	1.01	.03	.40	.59			42.04	1.40	39.6	4.74	.12	4.53	.10		depressant added to the grinder
938	Ufp-271	Ufp-9.A	12/10	115.91	.90	6.4	1.08	.01	.41	.66			43.13	1.10	39.3	4.61	.12	4.43	.07		oxone-to the grinder, lime-to flot
939	Ufp-272	Ufp-9.A	12/11	111.82	.80	6.3	1.11	.02	.46	.63			47.21	.60	36.7	4.33	.11	4.00	.22		oxone-to the grinder, lime-to flot
940	Ufp-272.1	Ufp-9.A	12/12	112.97	.40	6.2	1.09						46.00	.40	37.0	4.35					
941	Ufp-273	Ufp-9.A	12/11	99.80	.80	5.6	1.07	.02	.41	.64			59.14	.50	31.8	3.68	.10	3.33	.25		oxone to the grinder, lime to flot
942	Ufp-274	Ufp-9.A	12/12	109.90	.60	5.9	1.06	.02	.41	.63			48.88	.50	36.1	4.40	.11	4.00	.29		oxone to the grinder, no lime
943	Ufp-275	Ufp-9.A	12/10	31.80	.90	6.0	1.03						7.94	1.30	52.3	6.23					oxone-to the grinder
944	Ufp-275.1	Ufp-9.A	12/10	32.68	.90	6.8	1.09	.02	.48	.59			7.10	1.50	51.8	6.25	.15	6.14	0.00		
945	Ufp-276	Ufp-9.A	12/12	33.50	.60	6.9	1.10						6.30	1.00	57.3	6.76					depressant to the grinder
946	Ufp-276.1	Ufp-9.A	12/12	33.47	.60	7.2	1.14	.02	.50	.61			6.34	1.30	57.8	6.98	.14	6.88	0.00		
947	Ufp-277	Ufp-9.A	12/13	108.40	1.50	5.4	.95						51.64	1.00	35.9	4.48					2-stage,regrinding from 28M to 100
948	Ufp-278	Ufp-9.A	12/14	113.75	.90	6.3	1.01						45.85	.80	36.4	4.19					depressant added to flot. cell
949	Ufp-277.1	Ufp-9.A	12/18	102.30	1.10	5.0	.92						57.24	.60	32.9	4.13					
950	Ufp-280	Ufp-9.A	12/18	104.25	1.00	5.3	.92						55.42	.60	33.6	4.31					2-stage, depressant added to first
951	Ken-67	Ken-2.A	12/18	128.48	1.10	6.8	2.83	.01	1.19	1.62			32.92	.70	57.1	8.76	.10	8.55	.11		depressant added to the grinder
952	Ken-67.1	Ken-2.A	12/18	132.66	1.20	7.1	2.89						28.54	.70	64.3	9.83					
953	Ken-68	Ken-2.A	12/18	128.55	1.20	6.8	2.93						26.23	.90	71.5	10.39					
954	Ken-69	Ken-2.A	12/18	136.33	1.00	7.5	3.07						23.26	.60	68.2	10.66					
955	Ken-70	Ken-2.A	12/18	125.26	1.40	6.4	2.88	.01	1.14	1.73			34.44	.60	51.9	9.03	.08	8.47	.48		depressant-to the grinder,lime-to
956	Ken-65	Ken-2.A	12/13	33.40	.60	6.8	3.03						5.94	1.00	66.6	10.01					1 flotation
957	Ken-66	Ken-2.A	12/13	33.90	.70	8.2	3.15						5.71	1.00	59.6	10.50					1 flotation
958	Ken-72	Ken-2.A	1/04	134.52	1.70	6.8	2.97						26.92	.70	67.4	10.06					
959	Ken-76	Ken-2.A	1/04	110.42	1.60	5.6	2.61						51.36	.80	41.0	7.38					12lb/t oxone
960	Ken-77	Ken-2.A	1/08	131.28	1.10	6.4	2.82	.02	1.15	1.66			29.15	.60	59.8	10.34	.10	9.96	.28		regrinding
961	Ken-78	Ken-2.A	1/08	132.29	.60	6.8	2.87	.02	1.22	1.63			29.38	.60	59.6	9.72					
962	Ken-79	Ken-2.A	1/08	136.95	2.40	6.7	2.95	.03	1.31	1.62			25.98	.60	65.3	9.89					
963	Ken-80	Ken-2.A	1/09	138.19	.90	6.7	3.04						22.01	.50	73.6	10.05					
964	Ufp-279	Ufp-9.A	12/18	110.00	1.10	5.5	.95	.01	.31	.62			49.83	.80	36.3	4.50	.12	4.18	.20		OXONE is split for 2 grindings
965	Ufp-281	Ufp-9.A	12/17	122.51	1.00	6.5	1.11	.02	.46	.63			37.17	.70	42.3	5.12	.14	4.77	.21		

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
966	Ufp-281.1	Ufp-9.A	12/18	123.41	.80	6.4	1.09						36.10	.60	44.2	5.19					
967	Ufp-282	Ufp-9.A	1/07	124.07	1.00	6.4	1.06						35.02	.80	46.1	5.59					
968	Ufp-283	Ufp-9.A	1/07	109.93	1.10	5.9	1.01						51.43	.70	35.8	4.28					
969	Ufp-284	Ufp-9.A	1/08	122.89	1.00	6.1	1.04						38.44	.80	43.0	5.14					
970	Pit-291	Pit-10A	1/08	143.84	.80	5.7	3.43						16.26	.90	48.6	8.89					
971	Pit-292	Pit-10A	1/08	145.87	.80	5.8	3.46						13.67	.80	55.7	10.18					
972	Pit-293	Pit-10A	1/09	137.72	.80	5.7	3.55						21.91	1.20	36.6	6.59					
973	Ken-75	Ken-2.A	1/21	132.64	.90	6.7	2.81						28.96	.40	63.6	9.27					
974	Ken-75	Ken-2.A	1/21	132.64	.90	6.7	2.81						28.96	.40	63.6	9.27					depressant -to the grinder
975	Ken-77.1	Ken-2.A	1/08	133.67	1.90	6.3	2.74						29.74	.50	63.2	10.86					regrinding from 28M to 100M
976	Pit-294	Pit-10A	1/11	35.32	1.50	4.8	3.24						4.47	1.40	46.7	9.55					depressant -to the grinder
977	Pit-295	Pit-10A	1/14	33.54	.90	6.9	3.41	.02	1.15	2.24			6.09	1.20	21.6	5.91	.07	4.26	1.24		depressant to the grinder
978	Pit-295.1	Pit-10A	1/14	33.42	.90	6.8	3.44						6.21	1.10	21.9	5.85					
979	Pit-296	Pit-10A	1/14	144.10	1.20	5.7	3.39						16.49	.90	49.6	9.37					depressant to the grinder
980	Pit-297	Pit-10A	1/15	134.97	1.40	5.7	3.53						25.69	1.00	33.1	6.41					depressant to the grinder
981	Pit-297.1	Pit-10A	1/14	133.07	1.40	5.7	3.59						27.98	.90	31.3	6.45					
982	Pit-306	Pit-10A	1/14	135.75	1.30	5.3	3.37						24.26	1.20	37.6	7.62					REGRINDING FROM 28M TO 100M
983	Pit-306.1	Pit-10A	1/15	138.28	1.80	5.1	3.45						19.50	1.30	38.9	7.32					
984	Pit-298	Pit-10A	1/15	142.44	1.80	6.0	3.59						18.33	1.10	45.1	7.29					depressant to the grinder, no pH a
985	Pit-299	Pit-10A	1/21	144.49	1.60	6.0	3.53	.02	1.22	2.28			16.59	1.00	44.3	7.16	.13	6.17	.86		
986	Pit-299.1	Pit-10A	1/22	144.56	1.60	6.0	3.48						16.50	1.00	43.9	7.26					
987	Pit-300	Pit-10A	1/16	137.86	1.00	5.9	3.56						21.68	.90	23.9	5.60					
988	Pit-301	Pit-10A	1/18	117.09	1.00	5.2	3.43						42.18	.70	36.5	6.57					
989	Pit-302	Pit-10A	1/21	147.95	1.80	5.2	3.37	.02	1.16	2.18			13.67	.90	54.7	9.75	.12	9.04	.59		
990	Pit-305	Pit-10A	1/25	130.18	1.50	4.9	3.32	.02	.95	2.34			27.44	.80	34.3	6.95	.10	5.26	1.59		regrinding from 28M to 100M with d
991	Pit-304	Pit-10A	1/28	129.52	1.50	4.8	3.32						31.45	1.10	31.0	6.34					depressantsplit for 2 grinds
992	Pit-304	Pit-10A	1/28	129.52	1.50	4.8	3.32						31.45	1.10	31.0	6.34					
993	Ken-82	Ken-2.A	1/21	132.12	1.90	6.2	2.63	.02	1.06	1.55			29.71	.90	59.5	11.28	.14	11.01	.13		depressant added to the 2nd grind
994	Ken-83	Ken-2.A	1/22	130.10	1.90	5.9	2.51						33.49	1.00	56.0	9.44					depressant added to the 2nd grind
995	Ufp-286	Ufp-9.A	1/24	107.71	.70	5.9	1.03						48.17	.60	35.5	4.40					0 storage time
996	Ufp-285	Ufp-9.A	1/24	101.83	1.00	5.6	1.01						54.26	.60	33.2	3.90					0 storage time
997	Ufp-287	Ufp-9.A	1/25	109.11	.50	5.6	.99						46.18	.40	36.7	4.11					1 day slurry storage
998	Ufp-288	Ufp-9.A	1/25	109.88	.50	5.8	.98						45.44	.40	36.5	4.60					1 day slurry storage
999	Ufp-289	Ufp-9.A	1/28	108.54	1.00	5.7	1.01						48.04	.70	35.5	4.46					4 days slurry storage
***	UfP-290	Ufp-9.A	1/28	110.13	.90	5.5	1.03						46.66	.60	36.5	4.47					4 days slurry storage
***	Ufp-400	Ufp-10A	2/26	127.50	.80	6.7	1.07						32.11	.90	49.3	5.72					0 storage time
***	Ufp-401	Ufp-10A	2/27	125.75	.50	6.6	1.05						32.51	1.20	51.0	5.77					1 day storage
***	Ufp-402	Ufp-10A	3/01	127.20	.70	6.6	1.01						31.89	.80	50.7	5.88					4 days storage

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
***	Ufp-403	Ufp-10A	3/07	136.73	.90	7.1	1.14						23.88	1.50	54.3	7.31					0 storage time
***	Ufp-404	Ufp-10A	3/06	138.51	1.10	7.3	1.16						23.28	1.40	55.9	7.57					1 day storage
***	Ufp-405	Ufp-10A	3/08	132.17	.40	7.0	1.06						27.01	.90	56.1	65.40					4 days storage
***	Pit-400	Pit-10A	2/26	142.02	.70	5.8	3.53						15.88	.60	45.6	7.60					0 storage time
***	Pit-401	Pit-10A	2/26	143.02	.60	6.0	3.55						15.42	.60	45.5	7.34					1 day storage
***	Pit-402	Pit-10A	3/01	143.72	1.10	6.0	3.52						16.15	.60	45.4	7.90					4 days storage
***	Pit-403	Pit-10A	2/25	148.17	1.20	6.1	3.43						11.30	1.00	62.2	10.80					0 storage time
***	Pit-404	Pit-10A	2/27	147.13	.70	6.0	3.36						11.82	.80	59.7	10.58					1 day storage
***	Pit-405	Pit-10A	3/01	148.87	1.00	6.1	3.43						11.42	1.00	60.2	10.20					4 days storage
***	Pit-406	Pit-10A	3/04	149.20	.90	6.0	3.39						10.83	.90	66.5	11.40					0 storage time
***	Pit-407	Pit-10A	3/05	148.58	1.10	5.1	3.37						11.59	.80	62.4	11.09					1 day storage
***	Pit-408	Pit-10A	3/08	148.51	.90	6.0	3.39						11.48	1.00	61.6	10.90					4 days storage
***	Ken-100	Ken-3.A	2/28	138.22	1.00	7.7	2.97						22.10	.80	74.1	11.29					0 stirage time
***	Ken-101	Ken-3.A	2/28	136.13	1.10	7.2	2.88						23.29	.90	68.1	11.13					1 day storage
***	Ken-102	Ken-3.A	3/01	136.41	1.20	7.1	2.87						23.48	.90	68.4	11.51					4 days stirage
***	Ken-103	Ken-3.A	6/03	138.44	1.90	7.6	2.87						21.70	1.50	66.2	9.11					o storage time
***	Ken-104	Ken-3.A	5/30	139.59	1.30	7.4	2.93						20.34	1.40	68.5	9.16					1 day storage
***	Ken-105	Ken-3.A	5/31	138.78	1.20	7.8	3.10						20.90	.80	76.0	9.50					4 days storage
***	Ken-106	Ken-3.A	5/31	139.27	1.80	13.0	3.47						20.58	1.50	41.5	5.04					0 storage time
***	Ken-107	Ken-3.A	6/03	138.62	1.90	6.5	2.64						20.19	1.30	33.5	4.80					1 day storage
***	Ken-108	Ken-3.A	5/30	138.85	1.30	6.1	2.59						20.41	1.30	39.2	5.15					4 days storage
***	Ufp-304	Ufp-11	3/25	111.41	.90	5.6	1.01						48.15	.90	34.5	4.45					Standard test
***	Ufp-305	Ufp-11	3/25	127.02	.60	6.8	1.20						32.68	.90	42.9	5.03					Tailings refloated with addition o
***	Ufp-306	Ufp-11	3/26	132.73	.95	7.2	1.15						27.24	1.10	47.4	6.10					Tailings reground and refloated wi
***	Ufp-317	Ufp-11	6/04	115.31	1.10	6.4	.91						45.27	1.80	49.2	6.57					Tails screened,+150um fraction reg
***	Pit-410	Pit-10A																			
***	Ufp-310	Ufp-11	4/02	105.40	1.10	5.3	.98						55.02	1.40	31.0	4.33					STRAIGHT OIL
***	Ufp-308	Ufp-11	3/28	105.75	1.10	5.1	.97						54.89	1.40	31.6	4.25					EMULSIFIED OIL
***	Ufp-311	Ufp-11	4/04	71.80	1.20	4.4	.94						88.47	1.10	22.0	2.81					STRAIGHT OIL
***	Ufp-309	Ufp-11	4/04	81.40	1.10	4.6	.95						82.72	1.10	22.8	3.03					EMULSIFIED OIL
***	Pit-313	Pit-11	4/03	141.83	1.80	6.0	3.74						18.43	1.30	39.3	7.47					STRAIGHT OIL
***	Pit-315	Pit-11	4/03	141.35	1.90	6.0	3.69						18.35	1.30	39.6	7.60					EMULSIFIED OIL
***	Pit-316	Pit-11	4/03	87.26	1.80	4.7	3.53						73.18	1.40	16.3	4.91					STRAIGHT OIL
***	Pit-314	Pit-11	4/03	103.08	1.80	5.0	3.58						57.48	1.40	18.4	5.11					EMULSIFIED OIL
***	Ken-90	Ken-3.A	4/04	130.95	1.20	6.6	2.63						29.14	.90	56.7	9.79					EMULSIFIED OIL
***	Ken-91	Ken-3.A	4/05	127.48	.90	6.1	2.57						32.39	1.20	50.0	8.32					STRAIGHT OIL
***	Ken-92	Ken-3.A	4/04	112.41	1.00	5.6	2.62						47.40	1.20	41.2	8.09					EMULSIFIED OIL
***	Ken-93	Ken-3.A	4/09	111.26	.90	5.8	2.61						48.15	1.20	40.9	7.83					STRAIGHT OIL

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
***	Ufp-316	Ufp-11	6/05	115.52	1.10	4.7	.84						44.39	1.20	26.9	3.35					
***	Ufp-316.1	Ufp-11	4/11	115.60	1.00	5.7	.99						44.47	1.40	36.1	4.63					
***	Pit-321	Pit-11	4/12	145.99	1.30	5.7	3.34						13.31	1.20	57.0	10.83					
***	Pit-321.1.	Pit-11	4/12	146.25	1.30	5.6	3.31						13.27	1.20	57.6	11.04					
***	Ken-98	Ken-3.A	4/12	132.72	1.20	6.7	2.83						26.66	1.30	64.4	10.33					
***	Ken-98.1	Ken-3.A	4/12	133.67	1.20	6.7	2.83						26.18	1.30	66.7	10.54					
***	Ufp-317.1	Ufp-11	4/15	111.15	1.10	5.4	.89						45.27	1.21	33.8	4.49					
***	Pit-317	Pit-11	4/11	36.01	1.50	5.4	3.33						3.85	1.30	50.4	10.06					Straight oil
***	Pit-318	Pit-11	4/24	35.90	1.30	4.8	3.14						3.78	1.20	56.4	11.23					Emulsified oil
***	Pit-319	Pit-11	4/11	37.05	1.60	9.7	3.92						2.87	2.30	12.1	4.76					Straight oil
***	Pit-320	Pit-11	4/24	37.44	1.40	9.1	3.77						2.51	1.40	17.4	6.07					Emulsified oil
***	Ken-94	Ken-3.A	4/10	34.90	1.30	10.2	3.32						4.59	1.30	49.5	8.11					Emulsified oil
***	Ken-95	Ken-3.A	4/24	34.51	1.50	12.4	3.42						5.45	1.50	32.9	6.29					Straight oil
***	Ken-96	Ken-3.A	4/10	30.50	1.00	15.3	4.00						9.04	1.10	18.4	4.24					Straight oil
***	Ken-97	Ken-3.A	4/24	30.20	1.10	14.1	3.77						9.94	1.50	17.2	3.87					Emulsified oil
***	Ufp-312	Ufp-11	4/11	32.72	1.00	5.7	.98						7.22	1.50	51.5	6.47					Straight oil
***	Ufp-314	Ufp-11	4/25	33.10	.90	6.4	1.06						6.57	1.40	51.7	6.55					Emulsified oil
***	Ufp-313	Ufp-11	4/11	36.71	1.10	13.6	1.84						3.11	1.50	21.3	3.43					Straight oil
***	Ufp-315	Ufp-11	4/24	37.99	1.00	13.2	1.83						1.74	1.60	37.0	5.56					Emulsified oil
***	Pit-307	Pit-10A	6/03	152.40	1.40	6.4	3.63						15.60	1.20	41.8	6.61					0 OXIDATION TIME
***	Pit-307.1	Pit-10A	3/06	129.98	1.40	6.2	3.60						15.60	1.20	41.8	6.61					30 SEC FROTH
***	Pit-307.2	Pit-10A	3/06	13.42	1.50	7.2	3.76						15.60	1.20	41.8	6.61					60 SEC FROTH
***	Pit-307.3	Pit-10A	6/03	7.68	1.40	8.3	3.89						15.60	1.20	41.8	6.61					120 SEC FROTH
***	Pit-307.4	Pit-10A	6/03	1.72	1.10	10.1	4.14						15.60	1.20	41.8	6.61					BARREN
***	Pit-308	Pit-10A	6/03	151.24	1.50	6.9	3.55						9.01	1.20	59.8	10.01					0 OXID TIME
***	Pit-308.1	Pit-10A	6/03	125.68	1.50	6.5	3.49						9.01	1.20	59.8	10.01					30 SEC FROTH
***	Pit-308.2	Pit-10A	6/03	15.59	1.50	7.9	3.68						9.01	1.20	59.8	10.01					60 SEC FROTH
***	Pit-308.3	Pit-10A	6/03	8.45	1.40	10.2	4.03						9.01	1.20	59.8	10.01					120 SEC FROTH
***	Pit-308.4	Pit-10A	6/03	1.52	1.00	13.1	4.29						9.01	1.20	59.8	10.01					BARREN
***	Pit-309	Pit-10A	3/27	153.25	2.00	7.1	3.67						13.04	1.50	44.9	7.53					14 DAYS OF OXIDATION
***	Pit-309.1	Pit-10A	3/27	131.53	2.00	6.8	3.63						13.04	1.50	44.9	7.53					30 SEC FROTH
***	Pit-309.2	Pit-10A	3/27	12.41	1.70	7.9	3.81						13.04	1.50	44.9	7.53					60 SEC FROTH
***	Pit-309.3	Pit-10A	3/27	7.41	1.70	8.8	3.99						13.04	1.50	44.9	7.53					120 SEC FROTH
***	Pit-309.4	Pit-10A	3/27	1.90	1.70	11.9	4.37						13.04	1.50	44.9	7.53					BARREN
***	Pit-310	Pit-10A	3/27	153.67	1.50	7.0	3.58						9.87	1.40	57.8	10.04					14 DAYS
***	Pit-310.1	Pit-10A	3/27	131.14	1.50	6.7	3.53						9.87	1.40	57.8	10.04					30 SEC FROTH
***	Pit-310.2	Pit-10A	3/27	15.09	1.80	8.1	3.80						9.87	1.40	57.8	10.04					60 SEC FROTH
***	Pit-310.3	Pit-10A	3/27	5.82	1.70	10.1	4.06						9.87	1.40	57.8	10.04					120 SEC FROTH

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
***	Pit-310.4	Pit-10A	3/27	1.62	1.70	11.0	4.09						9.87	1.40	57.8	10.04					BARREN
***	Pit-311	Pit-10A	4/24	137.04	1.40	6.4	3.57						33.09	1.00	23.1	5.38					49 DAYS
***	Pit-311.1	Pit-10A	4/24	98.81	1.40	6.2	3.54						33.09	1.00	23.1	5.38					30 SEC FROTH
***	Pit-311.2	Pit-10A	4/24	20.42	1.30	6.7	3.63						33.09	1.00	23.1	5.38					60 SEC FROTH
***	Pit-311.3	Pit-10A	4/24	11.61	1.30	6.9	3.65						33.09	1.00	23.1	5.38					120 SEC FROTH
***	Pit-311.4	Pit-10A	4/24	6.20	1.20	7.9	3.81						33.09	1.00	23.1	5.38					BARREN
***	Pit-312	Pit-10A	4/24	147.30	1.40	6.4	3.48						17.74	1.10	37.6	7.59					49 DAYS
***	Pit-312.1	Pit-10A	4/24	113.59	1.40	6.0	3.43						17.74	1.10	37.6	7.59					30 SEC FROTH
***	Pit-312.1	Pit-10A	4/24	22.38	1.40	6.0	3.43						17.74	1.10	37.6	7.59					60 SEC FROTH
***	Pit-312.3	Pit-10A	4/24	9.00	1.20	8.5	3.72						17.74	1.10	37.6	7.59					120 SEC FROTH
***	Pit-312.4	Pit-10A	4/24	2.33	1.20	8.9	3.71						17.74	1.10	37.6	7.59					BARREN
***	Ken-84	Ken-2.A	3/01	147.66	2.90	8.8	3.16						19.28	1.20	71.1	11.53					0 OXID TIME
***	Ken-84.1	Ken-2.A	3/01	124.79	3.20	8.2	3.06						19.28	1.20	71.1	11.53					30 SEC FROTH
***	Ken-84.2	Ken-2.A	3/01	14.77	1.40	10.5	3.49						19.28	1.20	71.1	11.53					60 SEC FROTH
***	Ken-84.3	Ken-2.A	3/01	8.10	1.40	14.1	4.08						19.28	1.20	71.1	11.53					BARREN
***	Ken-85	Ken-2.A	3/01	154.21	8.20	8.4	3.08						18.67	1.20	70.9	10.42					0 OXOD TIME
***	Ken-85.1	Ken-2.A	3/01	114.62	10.50	7.6	2.93						18.67	1.20	70.9	10.42					30 SEC FROTH
***	Ken-85.2	Ken-2.A	3/01	26.62	1.50	9.8	3.41						18.67	1.20	70.9	10.42					60 SEC FROTH
***	Ken-85.3	Ken-2.A	3/01	12.97	1.50	11.6	3.66						18.67	1.20	70.9	10.42					BARREN
***	Ken-86	Ken-2.A	3/25	141.70	1.50	8.3	3.01						22.50	1.40	65.8	11.06					14 DAYS
***	Ken-86.1	Ken-2.A	3/25	125.46	1.50	8.0	2.96						22.50	1.40	65.8	11.06					30 SEC FROTH
***	Ken-86.2	Ken-2.A	3/25	10.01	1.60	9.6	3.23						22.50	1.40	65.8	11.06					60 SEC FROTH
***	Ken-86.3	Ken-2.A	3/25	6.23	1.60	11.7	3.64						22.50	1.40	65.8	11.06					BARREN
***	Ken-87	Ken-2.A	3/25	148.47	3.20	8.4	3.15						19.16	1.50	73.0	10.76					14 DAYS
***	Ken-87.1	Ken-2.A	3/25	124.52	3.50	8.0	3.08						19.16	1.50	73.0	10.76					30 SEC FROTH
***	Ken-87.2	Ken-2.A	3/25	13.90	1.60	9.7	3.30						19.16	1.50	73.0	10.76					60 SEC FROTH
***	Ken-87.3	Ken-2.A	3/25	10.05	1.60	12.3	3.77						19.16	1.50	73.0	10.76					BARREN
***	Ken-88	Ken-2.A	3/25	126.81	1.30	7.7	2.94						37.66	1.00	43.7	7.77					49 DAYS
***	Ken-88.1	Ken-2.A	3/25	106.42	1.30	7.5	2.90						37.66	1.00	43.7	7.77					30 SEC FROTH
***	Ken-88.2	Ken-2.A	3/25	13.40	1.20	8.6	3.05						37.66	1.00	43.7	7.77					60 sec froth
***	Ken-88.3	Ken-2.A		6.99									37.66								barren
***	Ken-89	Ken-2.A	3/25	136.49	1.20	7.9	3.05						27.68	1.00	55.3	9.41					49 DAYS
***	Ken-89.1	Ken-2.A	3/25	104.25	1.30	7.4	2.99						27.68	1.00	55.3	9.41					30 SEC FROTH
***	Ken-89.2	Ken-2.A	3/25	21.35	1.20	8.9	3.15						27.68	1.00	55.3	9.41					60 SEC FROTH
***	Ken-89.3	Ken-2.A	3/25	10.89	1.10	10.8	3.47						27.68	1.00	55.3	9.41					BARREN
***	Ken-99W	Ken-2.W	4/30	147.38	1.40	6.5	2.52						13.91	1.10	34.9	4.36					WASHED COAL
***	Ken-100W	Ken-2.W	4/30	149.61	1.60	6.2	2.51						12.46	1.10	41.3	4.62					WASHED COAL
***	Ken-101W	Ken-2.W	4/30	154.60	2.90	6.1	2.49						10.45	.90	50.2	4.98					WASHED COAL

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
***	Ken-103	Ken-4.R	6/03	126.24	1.90	7.6	2.87						37.20	1.50	66.2	9.11					
***	Ken-104	Ken-4.R	5/30	124.46	1.30	7.4	2.93						37.07	1.40	68.5	9.16					
***	Ken-105	Ken-4.R	5/31	129.86	1.20	7.8	3.10						31.16	.80	76.0	9.50					
***	Ken-107	Ken-4.W	6/03	146.57	1.90	6.5	2.64						16.70	1.30	33.5	4.80					
***	Ken-108	Ken-4.W	5/30	145.56	1.30	6.1	2.59						14.98	1.30	39.2	5.15					
***	Ken-109	Ken-4.W	5/31	149.30	1.30	5.9	2.56						11.33	1.20	52.7	6.20					
***	Ken-106	Ken-4.R	5/31	34.34	1.80	13.0	3.47						6.24	1.50	41.5	5.04					
***	Ken-110	Ken-4.W	5/30	37.56	1.90	6.1	2.72						3.07	1.70	52.8	6.83					
***	Ufp-316	Ufp-11	6/05	92.59	1.10	4.7	.84						68.23	1.20	26.9	3.35					Diesel/water em.1:20
***	Pit-416	Pit-11	6/03	110.48	2.10	4.9	3.30						51.25	1.80	20.0	5.02					Diesel/water em.1:20
***	Ken-111	Ken-3.A	6/03	130.86	2.00	6.7	2.53						30.88	1.80	53.3	8.96					Diesel/water em.1:20
***	Ufp-317	Ufp-11	6/04	33.02	1.10	6.4	.91						6.88	1.80	49.2	6.57					Heptane/water em. 1:10
***	Pit-417	Pit-11	6/05	35.50	1.80	9.2	3.70						4.87	2.10	13.0	4.18					Heptane/water em. 1:10
***	Ken-112	Ken-3.A	6/06	34.76	1.60	11.3	3.34						5.23	2.00	37.9	6.74					Heptane/water em. 1:10
***	Ufp-318	Ufp-11	5/09	114.92	1.40	5.9	.89						46.38	1.80	36.0	4.59					slurry pH=11
***	Ufp-319	Ufp-11	5/09	125.08	1.30	6.4	.96						36.52	1.90	43.0	5.16					slurry pH=11
***	Pit-418	Pit-11	5/09	109.47	1.70	5.1	3.39						50.99	1.40	20.7	5.27					slurry pH=11
***	Pit-419	Pit-11	5/10	143.56	2.80	5.7	3.31						20.74	1.70	42.3	8.31					slurry pH=11
***	Ken-113	Ken-3.A	5/10	118.50	1.60	6.2	2.59						42.38	1.20	46.3	8.34					slurry pH=11
***	Ken-114	Ken-3.A	5/10	131.91	1.60	6.7	2.65						28.18	1.40	61.3	10.12					slurry pH=11
***	Ken-116	Ken-3.A	6/24	136.18	1.40	6.9	2.68						24.94	1.30	62.8	10.53					
***	Ken-117	Ken-3.A	6/24	119.10	1.40	6.2	2.57						42.02	1.20	43.1	8.11					UNEMULS. OIL
***	Pit-420	Pit-11	6/25	107.01	2.10	5.0	3.37						54.57	1.80	21.6	5.04					UNEMULS. OIL
***	Ufp-320	Ufp-11	6/25	80.82	1.20	4.4	.96						79.59	1.00	23.0	3.27					UNEMULS. OIL
***	Ken-118	Ken-3.A	6/25	114.55	2.10	6.6	2.68						49.03	1.80	40.4	7.41					pH adjusted in flot. cell
***	Pit-421	Pit-11	6/26	84.50	1.30	5.3	3.49						77.75	1.20	17.2	4.53					pH adjusted in flot. cell
***	Ufp-321	Ufp-11	6/26	102.11	.90	5.4	.99						60.12	1.20	31.4	3.97					pH adjusted in flot. cell
***	Ufp-322	Ufp-12R	6/26	134.78	1.50	8.7	1.16						26.77	1.80	51.4	6.88					
***	Ufp-323	Ufp-12R	6/26	138.99	.90	8.6	1.24						23.75	2.00	55.8	7.17					
***	Ufp-324	Ufp-12R	6/26	140.38	1.80	8.7	1.27						22.53	1.70	58.7	7.53					
***	Ufp-325	Ufp-12W	6/27	144.41	.90	8.3	.98						16.35	2.20	40.8	4.58					
***	Ufp-326	Ufp-12W	6/27	147.11	.90	7.9	.94						14.61	2.40	47.3	5.23					
***	Ufp-327	Ufp-12W	6/27	147.60	1.10	7.8	.94						14.94	2.30	47.7	5.40					
***	Ufp-328	Ufp-12H	6/27	136.53	1.50	8.7	1.15						26.79	1.70	51.5	6.43					
***	Ufp-329	Ufp-12H	6/27	139.24	1.10	8.7	1.15						22.73	1.90	57.6	7.03					
***	Ufp-330	Ufp-12H	6/27	140.18	1.20	8.8	1.18						21.93	1.90	59.3	7.32					
***	Ufp-331	Ufp-12R	6/27	34.71	.70	8.9	1.15						4.69	1.30	62.8	8.44					
***	Ufp-332	Ufp-12W	6/27	37.32	.80	8.2	.92						2.46	.60	56.0	6.72					

Table A1-6 (Continued)

CLEAN COAL AND TAILINGS ANALYSIS

Ser No	Lab ID	Coal & Samp No	Clean Coal Weight, Proximate Analyses & Heating Value									Tailings Weight, Proximate Analyses & Heating Value									Observations
			Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	Date	Wt (g)	Moist	Ash%	TS%	SS%	PS%	OS%	Btu/lb	
***	Ufp-333	Ufp-12H	6/27	36.16	.90	8.9	1.14						4.57	1.30	65.6	8.29					

Table A1-7

BATCH TEST RESULTS

TEST ID	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR % OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR % OIL	LOW SHEAR MIN	PYRITE DEP	SEPARATION TECHNIQUE	FR-1 LB/T	FR-2 LB/T	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	TS REJ	PS REJ
00001	Ill-1	Ill-1	28M	20	Diesel	10.00	2000		0.00	16		Flot/Flot			8.6	4.13	1.74	73.3	14.60	86.27	96.47	95.50	34.57	52.75
00002	Ill-2	Ill-1	28M	20	Diesel	6.00	2000		0.00	16		Flot/Flot			8.2	4.10	1.70	65.9	14.57	83.90	94.27	93.30	36.82	55.11
00003	Ill-3	Ill-1	28M	20	Diesel	3.00	2000		0.00			2-Flot/None		.13	8.2	3.99	1.59	60.0	12.68	82.75	92.95	91.99	39.35	58.54
00004	Ill-4	Ill-1	28M	20	Diesel	.50	2000		0.00			2-Flot/None	.31	.19	9.0	4.15	1.77	53.5	11.39	79.94	88.91	88.06	39.07	55.39
00005	Ill-5	Ill-1	200M	20	Diesel	10.00	2000		0.00	16		Flot/Flot			7.8	4.17	1.76	76.4	13.34	86.69	97.76	96.73	33.58	51.87
00006	Ill-6	Ill-1	200M	20	Diesel	6.00	2000		0.00	16		Flot/Flot			7.7	4.21	1.80	73.4	13.55	84.49	95.38	94.36	34.64	52.08
00007	Ill-7-R	Ill-1	200M	20	Diesel	3.00	2000		0.00			2-Flot/None	.05	.10	7.1	3.76	1.33	56.1	12.24	79.43	90.37	89.36	45.17	66.74
00008	Ill-8-R	Ill-1	200M	20	Diesel	.50	2000		0.00			2-Flot/None	.15	.15	7.8	3.83	1.42	53.0	10.76	80.15	90.41	89.45	43.63	64.16
00009	Pitt-1	Pit-1	28M	20	Diesel	10.00	2000		0.00	16		Flot/Flot			7.2	3.61	2.38	58.3	11.59	87.79	93.84	93.11	26.73	31.38
00010	Pitt-1R	Pit-1	28M	20	Diesel	10.00	2000		0.00	16		Flot/Flot			7.3	3.69	2.46	60.2	10.53	88.01	93.96	93.25	24.89	28.83
00011	Pitt-2	Pit-1	28M	20	Diesel	6.00	2000		0.00	16		Flot/Flot			6.6	3.37	2.13	52.9	11.91	83.90	90.38	89.60	34.63	41.27
00012	Pitt-3	Pit-1	28M	20	Diesel	3.00	2000		0.00			2-Flot/None			5.9	3.11	1.87	44.9	9.76	91.30	99.10	98.16	34.23	43.96
00013	Pitt-4	Pit-1	28M	20	Diesel	.50	2000		0.00			2-Flot/None	.19	.13	5.9	3.11	1.87	35.8	8.65	77.89	84.56	83.76	43.89	52.20
00014	Pitt-5	Pit-1	200M	20	Diesel	10.00	2000		0.00	16		Flot/Flot			5.6	2.87	1.62	64.5	14.89	88.36	96.30	95.35	41.36	53.01
00015	Pitt-6	Pit-1	200M	20	Diesel	5.86	2000		0.00	16		Flot/Flot			5.7	2.82	1.57	64.1	15.43	87.83	95.53	94.61	42.64	54.55
00016	Pitt-7	Pit-1	200M	20	Diesel	3.00	2000		0.00			2-Flot/None			5.5	2.74	1.49	57.7	14.73	88.50	96.52	95.56	43.85	56.63
00017	Pitt-8	Pit-1	200M	20	Diesel	.50	2000		0.00			2-Flot/None		.10	4.9	2.35	1.09	41.5	11.73	79.96	87.85	86.91	56.47	71.26
00018	UPF-1	Ufp-1	28M	20	Diesel	10.00	2000		0.00	16		Flot/Flot			10.7	2.22	1.49	76.6	5.41	93.81	95.90	95.63	12.03	11.63
00019	UPF-2	Ufp-1	28M	20	Diesel	6.00	2000		0.00	16		Flot/Flot			9.7	1.90	1.16	69.3	7.70	92.29	95.59	95.17	25.91	32.24
00020	UPF-3	Ufp-1	28M	20	Diesel	3.00	2000		0.00			2-Flot/None			8.4	1.52	.77	61.7	9.99	89.77	94.49	93.89	42.30	56.26
00021	UPF-4	Ufp-1	28M	20	Diesel	.50	2000		0.00			2-Flot/None	.13	.19	8.9	1.67	.92	65.2	9.79	91.64	95.82	95.29	35.33	46.44
00022	UPF-5	Ufp-1	200M	20	Diesel	10.00	2000		0.00	16		Flot/Flot			9.3	1.60	.85	74.3	13.32	92.50	96.30	95.82	37.73	50.28
00023	UPF-6	Ufp-1	200M	20	Diesel	6.00	2000		0.00	16		Flot/Flot			8.5	1.33	.58	73.0	13.71	93.80	98.52	97.92	47.24	65.51
00024	UPF-7	Ufp-1	200M	20	Diesel	3.00	2000		0.00			2-Flot/None			8.2	1.42	.67	70.3	12.95	94.21	99.42	98.76	43.45	60.21
00025	UPF-8	Ufp-1	200M	20	Diesel	.50	2000		0.00			2-Flot/None		.06	7.4	1.33	.57	66.9	11.73	90.72	96.64	95.89	49.01	67.25
00026	Ill-9	Ill-1	28M	20	Maya	10.00	2000		0.00	16		Flot/Flot			10.8	4.96	2.63	80.3	11.49	90.38	98.45	97.65	17.53	24.99
00027	Ill-10	Ill-1	28M	20	Maya	6.19	2000		0.00	16		Flot/Flot			9.7	4.42	2.06	71.9	13.67	87.01	95.99	95.13	29.30	43.45
00028	Ill-11	Ill-1	28M	20	Maya	3.47	2000		0.00			2-Flot/None	.05	.10	8.9	4.70	2.32	61.6	12.93	83.35	92.87	91.97	28.01	39.09
00029	Ill-12	Ill-1	28M	20	Maya	.53	2000		0.00			2-Flot/None	.30	.30	9.4	4.12	1.75	48.7	11.20	79.35	87.81	87.00	39.92	56.14
00030	Ill-13	Ill-1	200M	20	Maya	10.00	2000		0.00	16		Flot/Flot			9.9	4.50	2.14	76.2	11.49	86.87	95.61	94.77	28.19	41.31
00031	Ill-14	Ill-1	200M	20	Maya	6.00	2000		0.00	16		Flot/Flot	.10	.05	8.8	4.05	1.67	78.0	14.09	86.50	96.40	95.46	35.57	54.43
00032	Ill-15	Ill-1	200M	20	Maya	3.00	2000		0.00			2-Flot/None	.35	.20	9.1	4.18	1.81	77.9	12.59	87.20	96.85	95.92	32.93	50.22
00033	Ill-15R	Ill-1	200M	20	Maya	3.00	2000		0.00			2-Flot/None	.35	.20	9.3	4.18	1.82	80.0	12.40	88.31	97.85	96.93	32.07	49.44
00034	Ill-16	Ill-1	200M	20	Maya	.56	2000		0.00			2-Flot/None	.60	.60	8.4	3.89	1.50	73.0	13.69	85.37	95.59	94.62	39.00	59.74
00035	Pitt-9	Pit-1	28M	20	Maya	10.00	2000		0.00	16		Flot/Flot			9.4	4.08	2.88	72.0	7.84	95.86	99.78	99.31	9.54	9.33
00036	Pitt-10	Pit-1	28M	20	Maya	5.86	2000		0.00	16		Flot/Flot			8.5	4.02	2.80	60.9	7.45	93.88	98.75	98.17	12.74	13.45
00037	Pitt-11	Pit-1	28M	20	Maya	2.98	2000		0.00			2-Flot/None		.10	6.9	3.39	2.16	39.1	7.96	83.17	89.19	88.47	34.65	40.87
00038	Pitt-12	Pit-1	28M	20	Maya	.48	2000		0.00			2-Flot/None	.20	.15	6.3	3.14	1.90	26.1	7.16	70.78	76.46	75.78	48.53	55.74

Table A1-7 (Continued)

BATCH TEST RESULTS

TEST ID	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR % OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR % OIL	LOW SHEAR MIN	PYRITE DEP	SEPARATION TECHNIQUE	FR-1 LB/T	FR-2 LB/T	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	TS REJ	PS REJ
00039	Pitt-13	Pit-1	200M	20	Maya	10.00	2000		0.00	16		Flot/Flot			8.4	3.46	2.25	70.4	12.84	94.39	99.42	98.82	24.42	30.27
00040	Pitt-14	Pit-1	200M	20	Maya	6.00	2000		0.00	16		Flot/Flot			7.5	3.20	1.98	65.9	12.57	91.54	97.51	96.79	32.13	40.45
00041	Pitt-15	Pit-1	200M	20	Maya	3.00	2000		0.00			2-Flot/None	.10	.10	7.0	2.88	1.65	64.7	14.97	89.88	96.26	95.50	39.99	51.12
00042	Pitt-16	Pit-1	200M	20	Maya	.50	2000		0.00			2-Flot/None	.20	.30	5.9	2.61	1.36	58.5	14.79	86.54	93.94	93.05	47.72	61.17
00043	UDF-9	Ufp-1	28M	20	Maya	10.00	2000		0.00	16		Flot/Flot			12.0	2.30	1.58	73.8	6.07	97.38	97.91	97.84	5.40	2.68
00044	UDF-10	Ufp-1	28M	20	Maya	6.00	2000		0.00	16		Flot/Flot			11.0	2.17	1.43	69.9	6.30	96.73	98.50	98.27	11.63	12.22
00045	UDF-11	Ufp-1	28M	20	Maya	3.06	2000		0.00			2-Flot/None			9.2	1.89	1.14	62.0	8.30	92.34	96.17	95.69	26.46	33.31
00046	UDF-12	Ufp-1	28M	20	Maya	.50	2000		0.00			2-Flot/None	.10	.05	8.9	1.70	.95	62.0	9.77	91.75	95.90	95.37	34.24	44.84
00047	UDF-13	Ufp-1	200M	20	Maya	10.00	2000		0.00	16		Flot/Flot			10.0	1.71	.97	72.4	12.92	93.78	96.78	96.40	32.15	42.17
00048	UDF-14	Ufp-1	200M	20	Maya	6.00	2000		0.00	16		Flot/Flot	.05	.05	9.1	1.53	.79	67.9	11.67	92.66	96.62	96.12	40.05	53.90
00049	UDF-15	Ufp-1	200M	20	Maya	3.00	2000		0.00			2-Flot/None	.10	.05	8.7	1.54	.79	73.0	11.80	92.19	96.63	96.07	40.10	53.96
00050	UDF-16	Ufp-1	200M	20	Maya	.50	2000		0.00			2-Flot/None	.20	.28	8.0	1.47	.71	70.2	10.76	91.51	96.74	96.08	43.33	58.80
00051	Ill-17	Ill-1	28M	20	M1/D1	10.00	2000		0.00	16		Flot/Flot			9.7	4.63	2.27	75.0	13.39	87.94	97.02	96.14	25.11	36.96
00052	Ill-18	Ill-1	28M	20	M1/D1	6.00	2000		0.00	16		Flot/Flot			9.1	4.36	1.99	73.4	14.16	87.01	96.63	95.71	30.21	45.40
00053	Ill-19	Ill-1	28M	20	M1/D1	3.06	2000		0.00			2-Flot/None			8.6	4.01	1.62	64.9	13.31	85.85	95.98	95.02	36.70	56.08
00054	Ill-20	Ill-1	28M	20	M1/D1	.56	2000		0.00			2-Flot/None	.20	.25	9.3	3.81	1.45	55.0	11.56	82.69	91.62	90.77	42.04	62.33
00055	Ill-20R	Ill-1	28M	20	M1/D1	.52	2000		0.00			2-Flot/None	.45		9.8	4.50	2.14	61.7	12.29	85.08	93.71	92.87	29.70	42.60
00056	Ill-21	Ill-1	200M	20	M1/D1	10.00	2000		0.00	16		Flot/Flot			8.3	4.51	2.11	79.9	12.49	86.72	97.25	96.25	28.16	42.27
00057	Ill-22	Ill-1	200M	20	M1/D1	6.00	2000		0.00	16		Flot/Flot			8.3	4.40	2.00	77.4	12.91	86.30	96.78	95.79	30.27	45.57
00058	Ill-23	Ill-1	200M	20	M1/D1	3.00	2000		0.00			2-Flot/None			8.5	4.23	1.84	74.0	14.13	86.82	97.19	96.21	32.41	49.53
00059	Ill-23R	Ill-1	200M	20	M1/D1	3.17	2000		0.00			2-Flot/None			8.4	3.78	1.38	71.0	13.28	84.94	95.20	94.23	41.02	62.94
00060	Ill-24	Ill-1	200M	20	M1/D1	.56	2000		0.00			2-Flot/None	.20	.25	8.2	3.84	1.45	67.9	13.04	84.19	94.50	93.53	40.52	61.61
00061	Pitt-17	Pit-1	28M	20	M1/D1	9.98	2000		0.00	16		Flot/Flot			8.0	3.95	2.73	71.6	9.33	93.91	99.41	98.75	14.21	15.75
00062	Pitt-18	Pit-1	28M	20	M1/D1	6.06	2000		0.00	16		Flot/Flot			7.6	3.78	2.55	64.9	9.95	92.65	98.58	97.86	19.03	22.27
00063	Pitt-19	Pit-1	28M	20	M1/D1	3.04	2000		0.00			2-Flot/None			6.8	3.43	2.20	53.2	11.38	87.43	93.93	93.15	30.51	36.77
00064	Pitt-20	Pit-1	28M	20	M1/D1	.61	2000		0.00			2-Flot/None		.10	5.0	2.60	1.35	29.5	8.18	71.33	78.26	77.43	56.99	68.40
00065	Pitt-21	Pit-1	200M	20	M1/D1	10.08	2000		0.00	16		Flot/Flot			7.3	3.21	1.98	72.7	15.21	92.79	99.10	98.34	31.08	39.55
00066	Pitt-22	Pit-1	200M	20	M1/D1	5.99	2000		0.00	16		Flot/Flot			6.9	3.02	1.79	66.8	14.96	91.07	97.74	96.94	36.37	46.54
00067	Pitt-23	Pit-1	200M	20	M1/D1	3.05	2000		0.00			2-Flot/None			6.6	2.81	1.57	61.4	14.63	88.88	95.71	94.89	42.27	54.13
00068	Pitt-23R	Pit-1	200M	20	M1/D1	2.99	2000		0.00			2-Flot/None			6.7	2.82	1.58	61.2	12.61	89.25	96.00	95.19	41.81	53.59
00069	Pitt-24	Pit-1	200M	20	M1/D1	.53	2000		0.00			2-Flot/None		.10	5.3	2.38	1.13	48.1	13.43	82.85	90.58	89.65	54.26	69.17
00070	UPF-17	Ufp-1	28M	20	M1/D1	10.00	2000		0.00	16		Flot/Flot			10.7	1.99	1.26	69.3	6.32	97.03	99.19	98.92	18.48	22.81
00071	UPF-18	Ufp-1	28M	20	M1/D1	6.00	2000		0.00	16		Flot/Flot			10.5	2.02	1.28	71.8	8.13	95.41	97.74	97.44	18.66	22.41
00072	UPF-19	Ufp-1	28M	20	M1/D1	3.00	2000		0.00			2-Flot/None			9.6	1.87	1.12	66.2	9.11	93.72	97.14	96.71	26.14	33.29
00073	UPF-20	Ufp-1	28M	20	M1/D1	.50	2000		0.00			2-Flot/None		.10	7.7	1.45	.69	52.5	8.42	88.92	94.37	93.68	45.46	60.91
00074	UPF-21	Ufp-1	200M	20	M1/D1	10.00	2000		0.00	16		Flot/Flot			10.2	1.60	.86	74.5	18.07	97.40	100.23	99.87	34.42	47.16
00075	UPF-22	Ufp-1	200M	20	M1/D1	6.00	2000		0.00	16		Flot/Flot			9.7	1.56	.82	74.6	16.53	95.22	98.56	98.14	37.35	50.77
00076	UPF-23	Ufp-1	200M	20	M1/D1	3.00	2000		0.00			2-Flot/None	.10	.05	9.1	1.52	.78	72.3	13.66	96.70	100.87	100.34	37.84	52.50

Table A1-7 (Continued)

BATCH TEST RESULTS

TEST ID	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR % OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR % OIL	LOW SHEAR MIN	PYRITE DEP	SEPARATION TECHNIQUE	FR-1 LB/T	FR-2 LB/T	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	TS REJ	PS REJ
00077	UPF-24	Ufp-1	200M	20	M1/D1	.50	2000		0.00			2-Flot/None	.10	.05	7.5	1.31	.55	64.4	11.30	90.39	96.17	95.43	49.91	68.39
00078	Ill-25	Ill-3	28M	20	F4/D1	10.00	2000		0.00	16		Flot/Flot			11.4	4.37	2.06	81.9	6.39	87.06	97.03	95.97	20.38	28.09
00079	Ill-26	Ill-3	28M	20	F4/D1	6.00	2000		0.00	16		Flot/Flot			10.4	4.33	1.99	72.5	7.33	84.26	95.03	93.90	23.67	32.66
00080	Ill-27	Ill-3	28M	20	F4/D1	3.00	2000		0.00			2-Flot/None		.05	9.3	3.73	1.37	68.8	8.90	82.96	94.76	93.55	35.22	54.53
00081	Ill-28	Ill-3	28M	20	F4/D1	.50	2000		0.00			2-Flot/None	.25	.03	9.1	3.59	1.22	35.7	6.16	63.10	72.24	71.31	52.63	69.20
00082	Ill-29	Ill-3	200M	20	F4/D1	.52	2000		0.00			2-Flot/None	.40	.30	8.7	3.63	1.25	71.4	8.65	82.73	95.17	93.90	37.20	58.62
00083	Ill-30	Ill-3	200M	20	F4/D1	3.00	2000		0.00			2-Flot/None	.20	.15	9.4	3.78	1.42	83.2	8.56	87.66	100.02	98.74	30.61	50.06
00084	Ill-31	Ill-3	200M	20	F4/D1	6.12	2000		0.00	16		Flot/Flot			8.9	3.99	1.61	80.1	7.45	85.23	97.80	96.52	28.90	44.90
00085	Ill-32	Ill-3	200M	20	F4/D1	10.00	2000		0.00	16		Flot/Flot			9.2	3.90	1.53	80.1	7.18	86.32	98.73	97.45	29.60	47.03
00086	Pitt-25	Pit-3	28M	20	F4/D1	9.61	2000		0.00	16		Flot/Flot			9.5	4.12	2.92	76.7	5.85	96.52	100.42	99.95	12.50	12.89
00087	Pitt-26	Pit-3	28M	20	F4/D1	6.23	2000		0.00	16		Flot/Flot			8.8	3.94	2.73	70.2	6.91	93.39	98.04	97.48	18.95	21.07
00088	Pitt-27	Pit-3	28M	20	F4/D1	3.11	2000		0.00			2-Flot/None		.20	7.8	3.48	2.26	45.7	8.60	88.18	93.72	93.05	32.48	38.48
00089	Pitt-28	Pit-3	28M	20	F4/D1	.58	2000		0.00			2-Flot/None	.15	.15	6.2	3.01	1.76	36.0	8.88	79.1[illegible]	85.74	84.95	47.59	56.80
00090	Pitt-29	Pit-3	200M	20	F4/D1	9.96	2000		0.00	16		Flot/Flot			8.7	3.83	2.63	76.8	6.28	94.73	99.58	98.99	20.01	23.10
00091	Pitt-30	Pit-3	200M	20	F4/D1	6.03	2000		0.00	16		Flot/Flot			8.4	3.60	2.39	73.2	9.44	93.27	98.31	97.70	25.97	31.00
00092	Pitt-31	Pit-3	200M	20	F4/D1	2.98	2000		0.00			2-Flot/None			7.3	3.13	1.90	70.5	14.94	92.10	98.50	97.73	36.55	45.87
00093	Pitt-32	Pit-3	200M	20	F4/D1	.62	2000		0.00			2-Flot/None	.20	.10	6.5	2.87	1.64	47.9	12.03	82.30	88.80	88.02	47.89	58.31
00094	UPF-25	Ufp-3	28M	20	F4/D1	9.99	2000		0.00	16		Flot/Flot			10.7	2.24	1.50	71.8	7.17	96.67	98.83	98.56	10.61	9.72
00095	UPF-26	Ufp-3	28M	20	F4/D1	5.99	2000		0.00	16		Flot/Flot			10.5	2.52	1.78	70.4	9.86	95.63	97.98	97.68	.49	-5.90
00096	UPF-27	Ufp-3	28M	20	F4/D1	3.00	2000		0.00			2-Flot/None		.05	9.6	2.21	1.46	66.3	7.15	94.59	98.06	97.61	13.69	13.93
00097	UPF-28	Ufp-3	28M	20	F4/D1	.50	2000		0.00			2-Flot/None	.10	.05	6.7	1.76	.99	42.6	7.57	83.98	90.22	89.43	38.93	48.21
00098	UPF-28R	Ufp-3	28M	20	F4/D1	.50	2000		0.00			2-Flot/None	.10	.05	6.6	1.70	.93	40.3	7.70	82.81	89.06	88.27	41.84	52.08
00099	UPF-29	Ufp-3	200M	20	F4/D1	3.00	2000		0.00			2-Flot/None			8.0	1.90	1.14	73.2	12.13	93.50	98.92	98.23	26.51	33.49
00100	UPF-30	Ufp-3	200M	20	F4/D1	.50	2000		0.00			2-Flot/None	.05	.10	7.2	1.60	.84	67.1	12.96	91.28	97.45	96.67	39.68	52.59
00101	UPF-31	Ufp-3	200M	20	F4/D1	9.99	2000		0.00	16		Flot/Flot			10.5	2.48	1.75	80.2	2.45	98.28	100.76	100.44	-.87	-6.70
00102	UPF-32	Ufp-3	200M	20	F4/D1	5.99	2000		0.00	16		Flot/Flot			9.7	2.35	1.61	78.1	6.13	95.75	99.15	98.72	6.94	4.27
00103	Ill-33	Ill-3	200M	20	Hexane	10.00	2000		0.00			Flot/None			8.1	3.29	.89	27.0	5.16	46.45	53.84	53.10	68.03	83.39
00104	Ill-33R	Ill-3	200M	20	Hexane	10.00	2000		0.00			Flot/None	.60		9.4	3.53	1.16	57.3	7.91	79.31	90.52	89.37	41.43	62.93
00105	Ill-34	Ill-3	200M	20	Hexane	6.00	2000		0.00			Flot/None			7.8	3.08	.67	23.1	5.10	30.87	35.90	35.40	80.11	91.67
00106	Ill-34R	Ill-3	200M	20	Hexane	6.00	2000		0.00			Flot/None	.60		10.4	3.63	1.29	51.1	7.45	78.59	88.63	87.58	40.32	59.28
00107	Ill-35	Ill-3	200M	20	Hexane	3.00	2000		0.00			Flot/None	.60		8.4	3.52	1.13	38.6	6.47	67.31	77.74	76.69	50.43	69.51
00108	Ill-35R	Ill-3	200M	20	Hexane	3.00	2000		0.00			Flot/None			7.7	3.25	.84	22.7	5.12	32.95	38.37	37.83	77.60	88.89
00109	Ill-36	Ill-3	200M	20	Hexane	.50	2000		0.00			Flot/None	1.20		11.2	3.66	1.34	46.4	8.04	78.58	87.76	86.79	39.83	57.68
00110	Ill-37	Ill-3	28M	20	Hexane	10.00	2000		0.00			Flot/None			6.5	3.16	.72	28.5	5.25	46.81	55.27	54.44	69.05	86.49
00111	Ill-37R	Ill-3	28M	20	Hexane	10.00	2000		0.00			Flot/None	.50		9.7	3.21	.85	39.9	7.52	69.57	79.13	78.14	53.28	76.20
00112	Ill-38	Ill-3	28M	20	Hexane	6.00	2000		0.00			Flot/None			6.4	2.84	.40	24.4	4.71	33.91	40.08	39.47	79.86	94.61
00113	Ill-38R	Ill-3	28M	20	Hexane	6.00	2000		0.00			Flot/None	.60		9.4	3.10	.73	34.2	6.16	63.55	72.54	71.62	58.78	81.26
00114	Ill-39	Ill-3	28M	20	Hexane	3.00	2000		0.00			Flot/None			6.3	2.56	.11	19.2	4.76	10.95	12.96	12.76	94.13	99.50

Table A1-7 (Continued)

BATCH TEST RESULTS

TEST ID	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR % OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR % OIL	LOW SHEAR MIN	PYRITE DEP	SEPARATION TECHNIQUE	FR-1 LB/T	FR-2 LB/T	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	TS REJ	PS REJ
00115	Ill-39R	Ill-3	28M	20	Hexane	3.00	2000		0.00			Flot/None	.60		9.3	3.07	.70	25.2	6.41	47.99	54.84	54.14	69.18	86.48
00116	Ill-40	Ill-3	28M	20	Hexane	.50	2000		0.00			Flot/None	1.20		11.4	2.98	.67	19.8	4.67	36.60	40.77	40.33	77.19	90.21
00117	Pitt-33	Pit-3	200M	20	Hexane	9.99	2000		0.00			Flot/None			5.6	2.55	1.30	32.9	8.96	75.43	82.30	81.47	57.63	69.65
00118	Pitt-33-1	Pit-3	200M	20	Hexane	9.99	2000		0.00			Flot/None	.35		6.4	2.72	1.48	44.9	11.61	84.23	91.02	90.21	49.53	61.40
00119	Pitt-34	Pit-3	200M	20	Hexane	5.99	2000		0.00			Flot/None			6.3	2.75	1.51	24.2	7.26	67.87	73.43	72.77	58.89	68.30
00120	Pitt-34-1	Pit-3	200M	20	Hexane	5.99	2000		0.00			Flot/None	.40		7.8	2.96	1.74	58.3	15.01	90.80	96.47	95.79	40.80	51.14
00121	Pitt-35	Pit-3	200M	20	Hexane	3.00	2000		0.00			Flot/None			8.0	2.74	1.52	13.3	4.71	23.21	24.60	24.43	85.99	89.07
00122	Pitt-35-1	Pit-3	200M	20	Hexane	3.00	2000		0.00			Flot/None	.50		7.3	2.97	1.74	56.4	14.55	91.07	97.35	96.59	40.42	50.89
00123	Pitt-36	Pit-3	200M	20	Hexane	.50	2000		0.00			Flot/None			7.6	2.55	1.33	12.2	3.92	2.43	2.59	2.57	98.63	99.00
00124	Pitt-36-1	Pit-3	200M	20	Hexane	.50	2000		0.00			Flot/None	.70		7.9	2.97	1.75	67.4	17.14	91.27	96.85	96.18	40.29	50.56
00125	Pitt-37	Pit-3	28M	20	Hexane	9.99	2000		0.00			Flot/None			5.9	2.64	1.40	29.0	7.80	71.74	77.99	77.24	58.28	69.05
00126	Pitt-37-1	Pit-3	28M	20	Hexane	9.99	2000		0.00			Flot/None	.20		6.3	2.66	1.42	31.4	8.29	74.50	80.60	79.87	56.35	67.28
00127	Pitt-38	Pit-3	28M	20	Hexane	5.99	2000		0.00			Flot/None			5.5	2.63	1.38	23.2	6.39	61.51	67.19	66.51	64.37	73.75
00128	Pitt-38-1	Pit-3	28M	20	Hexane	5.99	2000		0.00			Flot/None	.30		6.3	2.77	1.53	28.3	8.28	71.97	77.86	77.16	56.09	65.94
00129	Pitt-39	Pit-3	28M	20	Hexane	3.00	2000		0.00			Flot/None			6.1	2.66	1.42	15.3	4.70	35.83	38.86	38.50	79.01	84.29
00130	Pitt-39-1	Pit-3	28M	20	Hexane	3.00	2000		0.00			Flot/None	.40		7.3	2.86	1.63	23.0	6.47	67.51	72.16	71.60	57.47	65.89
00131	Pitt-40	Pit-3	28M	20	Hexane	.50	2000		0.00			Flot/None			7.0	2.53	1.30	12.9	4.34	5.54	5.94	5.90	96.91	97.77
00132	Pitt-40-1	Pit-3	28M	20	Hexane	.50	2000		0.00			Flot/None	.70		7.9	2.99	1.77	20.3	6.10	64.31	68.24	67.76	57.65	64.77
00133	UPF-33	Ufp-3	200M	20	Hexane	9.99	2000		0.00			2-Flot/None			6.9	1.63	.86	41.2	7.52	84.47	90.55	89.78	43.10	54.65
00134	UPF-33-1	Ufp-3	200M	20	Hexane	9.99	2000		0.00			Flot/None			7.9	1.75	.99	55.6	8.99	91.13	96.50	95.82	34.10	43.81
00135	UPF-33-2	Ufp-3	200M	20	Hexane	9.99	2000		0.00			2-Flot/None		.30	7.6	1.59	.83	64.9	10.43	91.51	97.25	96.52	39.88	52.82
00136	UPF-34	Ufp-3	200M	20	Hexane	5.99	2000		0.00			Flot/None			7.3	1.59	.83	40.0	7.45	85.87	91.60	90.87	43.58	55.86
00137	UPF-34-1	Ufp-3	200M	20	Hexane	5.99	2000		0.00			2-Flot/None	.15	.30	7.0	1.42	.65	52.9	10.05	86.80	92.92	92.15	49.07	64.68
00138	UPF-35-1	Ufp-3	200M	20	Hexane	3.00	2000		0.00			Flot/None			7.6	1.58	.82	23.1	4.75	71.84	76.35	75.78	53.09	63.41
00139	UPF-36	Ufp-3	200M	20	Hexane	.50	2000		0.00			Flot/None			6.2	1.31	.54	25.2	5.28	65.04	70.31	69.65	64.79	78.25
00140	UPF-36-1	Ufp-3	200M	20	Hexane	.50	2000		0.00			Flot/None	.30		8.2	1.69	.93	70.6	13.95	92.98	98.09	97.44	35.07	46.00
00141	UPF-37	Ufp-3	28M	20	Hexane	9.99	2000		0.00			Flot/None	.10		9.5	2.15	1.41	55.0	5.72	94.19	97.76	97.31	16.32	17.74
00142	UPF-37-1	Ufp-3	28M	20	Hexane	9.99	2000		0.00			Flot/None			9.3	2.07	1.32	49.4	6.50	93.08	96.85	96.37	20.38	23.44
00143	UPF-38	Ufp-3	28M	20	Hexane	5.99	2000		0.00			Flot/None			8.1	1.85	1.09	35.8	5.99	81.77	86.37	85.79	37.49	44.42
00144	UPF-38-1	Ufp-3	28M	20	Hexane	5.99	2000		0.00			Flot/None	.10		8.6	1.88	1.13	41.5	6.96	89.48	93.93	93.36	30.49	37.28
00145	UPF-39	Ufp-3	28M	20	Hexane	3.00	2000		0.00			Flot/None			6.7	1.44	.67	21.0	4.18	62.52	67.18	66.59	62.80	73.88
00146	UPF-40	Ufp-3	28M	20	Hexane	.50	2000		0.00			Flot/None			5.1	1.17	.39	12.7	2.52	12.67	13.87	13.72	93.88	96.94
00147	Ill-41	Ill-5	28M	20	Maya	9.96	2000		0.00	16	Calgon	Flot/Flot			11.2	4.56	2.24	75.1	10.40	88.97	95.89	95.22	21.04	25.07
00148	Ill-42	Ill-5	28M	20	Maya	9.96	2000		0.00	16	KFeCN-CaOH	Flot/Flot			11.8	4.79	2.49	82.8	9.96	90.68	96.96	96.34	15.50	15.31
00149	Ill-43	Ill-5	200M	20	Maya	9.96	2000		0.00	16	Calgon	Flot/Flot			10.0	4.53	2.18	82.3	7.65	89.30	97.64	96.84	21.31	26.92
00150	Ill-44	Ill-5	200M	20	Maya	9.96	2000		0.00	16	KFeCN-CaOH	Flot/Flot			9.3	3.99	1.62	73.8	10.64	86.04	94.80	93.97	33.28	47.69
00151	Ill-45	Ill-5	200M	20	Maya	.50	2000		0.00		Calgon	2-Flot/None	.60	.60	8.5	3.92	1.53	60.9	10.35	84.87	94.42	93.53	35.31	51.25
00152	Ill-46	Ill-5	200M	20	Maya	.59	2000		0.00		KFeCN-CaOH	2-Flot/None	.60	.60	8.4	3.73	1.34	57.3	9.98	82.90	92.33	91.45	39.90	58.41

Table A1-7 (Continued)

BATCH TEST RESULTS

TEST ID	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR % OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR % OIL	LOW SHEAR MIN	PYRITE DEP	SEPARATION TECHNIQUE	FR-1 LB/T	FR-2 LB/T	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	TS REJ	PS REJ
00153	Ill-47	Ill-5	28M	20	M1/D1	10.02	2000		0.00	16	Calgon	Flot/Flot			10.0	4.03	1.68	73.9	11.43	88.82	97.09	96.30	30.44	44.12
00154	Ill-48	Ill-5	28M	20	M1/D1	9.87	2000		0.00	16	KFeCN-CaOH	Flot/Flot			10.3	4.13	1.79	79.4	12.21	89.00	96.94	96.17	28.48	40.22
00155	Ill-49	Ill-5	200M	20	M1/D1	10.08	2000		0.00	16	Calgon	Flot/Flot			9.2	4.39	2.02	80.6	9.48	89.55	98.88	98.00	23.54	32.18
00156	Ill-50	Ill-5	200M	20	M1/D1	9.99	2000		0.00	16	KFeCN-CaOH	Flot/Flot			9.1	4.17	1.80	83.0	11.54	87.65	96.91	96.04	28.81	40.75
00157	Ill-51	Ill-5	28M	20	F4/D1	9.95	2000		0.00	16	Calgon	Flot/Flot			10.9	4.42	2.09	78.9	11.75	90.35	97.69	96.97	22.33	29.00
00158	Ill-52	Ill-5	28M	20	F4/D1	9.91	2000		0.00	16	KFeCN-CaOH	Flot/Flot			11.1	4.33	2.01	83.1	12.73	90.86	97.99	97.29	23.44	31.41
00159	Ill-53	Ill-5	200M	20	M1/D1	.68	2000		0.00		Calgon	2-Flot/None	.30	.20	8.8	3.97	1.59	72.6	11.70	85.56	94.84	93.97	33.84	48.78
00160	Ill-54	Ill-5	200M	20	M1/D1	.50	2000		0.00		KFeCN-CaOH	2-Flot/None	.40	.20	8.5	3.93	1.54	68.0	10.89	84.54	94.06	93.17	35.31	50.96
00161	Ill-55	Ill-5	200M	20	F4/D1	9.96	2000		0.00	16	Calgon	Flot/Flot			9.8	4.27	1.92	79.5	9.70	88.96	97.45	96.63	26.10	36.00
00162	Ill-56	Ill-5	200M	20	F4/D1	9.96	2000		0.00	16	KFeCN-CaOH	Flot/Flot			9.7	4.23	1.87	84.7	10.40	89.36	98.00	97.18	26.52	37.25
00163	Ill-57	Ill-5	200M	20	F4/D1	.50	2000		0.00		Calgon	2-Flot/None	.50	.40	8.5	3.92	1.53	68.1	11.79	85.69	95.33	94.43	34.66	50.73
00164	Ill-58	Ill-5	200M	20	F4/D1	.50	2000		0.00		KFeCN-CaOH	2-Flot/None	.60	.50	8.6	3.95	1.56	68.7	11.58	86.51	96.13	95.22	33.53	49.19
00165	Pitt-41	Pit-5	28M	20	F4/D1	10.03	2000		0.00	16	Calgon	Flot/Flot			9.9	4.11	2.92	80.1	6.31	97.05	99.37	99.09	5.05	2.46
00166	Pitt-42	Pit-5	28M	20	F4/D1	10.03	2000		0.00	16	KFeCN-CaOH	Flot/Flot			8.5	3.75	2.54	79.5	9.93	96.17	100.31	99.81	14.19	15.97
00167	Pitt-43	Pit-5	200M	20	F4/D1	9.91	2000		0.00	16	Calgon	Flot/Flot			9.6	3.69	2.50	73.7	6.07	95.92	98.62	98.30	15.70	17.55
00168	Pitt-44	Pit-5	200M	20	F4/D1	9.96	2000		0.00	16	KFeCN-CaOH	Flot/Flot			7.8	3.52	2.30	78.3	9.83	92.68	97.43	96.87	22.26	26.47
00169	Pitt-45	Pit-5	28M	20	M1/D1	9.97	2000		0.00	16	Calgon	Flot/Flot			8.7	3.83	2.63	74.0	7.43	96.15	99.98	99.52	12.25	13.04
00170	Pitt-46	Pit-5	28M	20	M1/D1	10.07	2000		0.00	16	KFeCN-CaOH	Flot/Flot			7.5	3.33	2.11	73.7	11.49	93.49	98.69	98.07	25.79	32.06
00171	Pitt-47	Pit-5	200M	20	M1/D1	10.13	2000		0.00	16	Calgon	Flot/Flot			8.5	3.77	2.56	78.5	6.91	96.01	100.08	99.59	13.81	15.34
00172	Pitt-48	Pit-5	200M	20	M1/D1	10.01	2000		0.00	16	KFeCN-CaOH	Flot/Flot			7.0	3.20	1.97	79.6	13.27	94.28	100.16	99.46	28.19	36.09
00173	UPF-41	Ufp-5	200M	20	F4/D1	10.00	2000		0.00	16	Calgon	Flot/Flot			11.9	2.05	1.32	80.7	4.45	98.29	99.64	99.46	11.44	11.34
00174	UPF-42	Ufp-5	200M	20	F4/D1	10.00	2000		0.00	16	KFeCN-CaOH	Flot/Flot			10.0	1.63	.89	76.9	11.20	96.76	100.52	100.04	30.59	41.33
00175	UPF-43	Ufp-5	28M	20	F4/D1	10.00	2000		0.00	16	Calgon	Flot/Flot			11.9	2.01	1.29	75.2	7.66	97.66	99.00	98.83	13.39	14.05
00176	UPF-44	Ufp-5	28M	20	F4/D1	10.00	2000		0.00	16	KFeCN-CaOH	Flot/Flot			11.1	1.84	1.11	74.7	7.75	96.26	98.52	98.23	21.88	26.92
00177	UPF-45	Ufp-5	28M	20	Maya	10.00	2000		0.00	16	Calgon	Flot/Flot			12.2	2.10	1.37	75.7	7.42	97.48	98.37	98.26	9.96	8.45
00178	UPF-46	Ufp-5	28M	20	Maya	10.00	2000		0.00	16	KFeCN-CaOH	Flot/Flot			11.7	2.01	1.28	75.5	6.68	97.08	98.65	98.45	14.07	14.92
00179	UPF-47	Ufp-5	200M	20	Maya	10.00	2000		0.00	16	Calgon	Flot/Flot			12.0	2.10	1.37	76.9	6.54	97.55	98.72	98.57	9.92	8.53
00180	UPF-48	Ufp-5	200M	20	Maya	10.00	2000		0.00	16	KFeCN-CaOH	Flot/Flot			10.2	1.69	.95	75.1	11.40	90.88	94.15	93.73	32.24	40.80
00181	UPF-49	Ufp-5	28M	20	M1/D1	10.00	2000		0.00	16	Calgon	Flot/Flot			11.2	1.98	1.25	74.7	5.99	97.93	100.10	99.82	14.55	16.33
00182	UPF-50	Ufp-5	28M	20	M1/D1	10.00	2000		0.00	16	KFeCN-CaOH	Flot/Flot			10.7	1.83	1.10	74.0	7.04	97.08	99.90	99.53	21.53	27.03
00183	UPF-51	Ufp-5	200M	20	M1/D1	10.00	2000		0.00	16	Calgon	Flot/Flot			11.4	1.98	1.25	77.7	5.89	98.06	99.96	99.72	14.43	16.09
00184	UPF-52	Ufp-5	200M	20	M1/D1	10.00	2000		0.00	16	KFeCN-CaOH	Flot/Flot			10.6	1.67	.93	77.5	13.13	96.63	99.57	99.19	28.97	38.40
00185	UPF-AL1	Ufp-5	28M	20	Diesel	3.01	2000		0.00			2-Flot/None			8.6	1.58	.83	58.5	8.69	90.32	95.46	94.80	36.97	48.66
00186	UPF-AL2	Ufp-5	28M	20	Diesel	3.01	2000		0.00			2-Flot/None			8.5	1.53	.78	60.6	8.27	90.37	95.63	94.96	38.95	51.80
00187	UPF-AL3	Ufp-5	28M	20	Diesel	3.01	2000		0.00			2-Flot/None			8.5	1.55	.80	60.8	8.56	90.75	96.04	95.36	37.89	50.35
00188	UPF-AL4	Ufp-5	28M	20	Diesel	3.01	2000		0.00			2-Flot/None			8.6	1.53	.78	59.8	8.41	91.10	96.29	95.63	38.45	51.36
00189	UPF-ET1	Ufp-5	28M	20	Diesel	3.06	2000		0.00			2-Flot/None			8.5	1.58	.83	57.4	7.87	90.35	95.61	94.94	36.94	48.68
00190	UPF-ET2	Ufp-5	28M	20	Diesel	3.11	2000		0.00			2-Flot/None			8.5	1.59	.84	59.1	7.84	90.32	95.58	94.90	36.56	48.06

Table A1-7 (Continued)

BATCH TEST RESULTS

TEST ID	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR % OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR % OIL	LOW SHEAR MIN	PYRITE DEP	SEPARATION TECHNIQUE	FR-1 LB/T	FR-2 LB/T	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	TS REJ	PS REJ
00191	UPF-ET3	Ufp-5	28M	20	Diesel	3.03	2000		0.00			2-Flot/None			8.5	1.58	.83	58.1	8.43	89.82	95.06	94.39	37.31	48.99
00192	UPF-ET4	Ufp-5	28M	20	Diesel	3.05	2000		0.00			2-Flot/None			8.4	1.52	.77	56.3	8.01	89.98	95.34	94.65	39.60	52.67
00193	UPF-WG1	Ufp-5	28M	20	Diesel	3.08	2000		0.00			2-Flot/None			8.5	1.49	.74	60.8	8.92	91.97	97.33	96.64	39.49	53.46
00194	UPF-WG2	Ufp-5	28M	20	Diesel	3.03	2000		0.00			2-Flot/None			8.7	1.57	.82	58.5	8.26	90.74	95.78	95.14	37.08	48.99
00195	ILL-59	Ill-5	28M	20	F4/D1	10.00	2000		0.00	16		Flot/Flot			11.6	4.69	2.38	74.6	9.36	88.69	95.13	94.50	19.11	20.77
00196	ILL-60	Ill-5	28M	20	M1/D1	10.50	2000		0.00	16		Flot/Flot			10.4	4.63	2.29	65.8	10.18	87.69	95.46	94.72	21.08	24.74
00197	ILL-61	Ill-5	28M	20	Maya	10.00	2000		0.00	16		Flot/Flot			12.0	4.88	2.58	67.8	9.97	87.96	93.80	93.22	16.56	14.79
00198	ILL-62	Ill-5	200M	20	F4/D1	10.00	2000		0.00	16		Flot/Flot			9.5	4.35	1.98	76.1	9.46	88.16	96.94	96.10	25.44	34.29
00199	ILL-63	Ill-5	200M	20	M1/D1	10.00	2000		0.00	16		Flot/Flot			9.2	4.38	2.01	78.9	9.17	87.50	96.62	95.76	25.49	34.11
00200	ILL-64	Ill-5	200M	20	Maya	9.94	2000		0.00	16		Flot/Flot			10.4	4.82	2.48	76.3	6.54	84.97	92.42	91.70	20.28	20.76
00201	ILL-65	Ill-5	200M	20	F4/D1	.50	2000		0.00	16		Flot/Flot	.40	.30	8.5	3.79	1.40	68.4	11.70	85.30	94.89	94.00	37.12	55.13
00202	ILL-66	Ill-5	200M	20	M1/D1	.62	2000		0.00	16		Flot/Flot	.20	.25	8.2	3.77	1.38	70.3	12.05	85.41	95.35	94.43	37.30	55.83
00203	Pitt-49	Pit-5	28M	20	M1/D1	9.99	2000		0.00	16		Flot/Flot			9.0	3.88	2.68	79.4	5.08	96.37	99.82	99.41	10.85	10.99
00204	Pitt-50	Pit-5	28M	20	M1/D1	10.09	2000		0.00	16		Flot/Flot			8.6	3.88	2.68	83.9	6.20	96.38	100.33	99.86	10.86	11.18
00205	Pitt-51	Pit-5	28M	20	F4/D1	9.91	2000		0.00	16		Flot/Flot			9.7	4.08	2.88	79.6	4.77	96.57	99.15	98.84	6.29	4.15
00206	Pitt-52	Pit-5	200M	20	F4/D1	10.01	2000		0.00	16		Flot/Flot			9.1	4.00	2.80	81.5	5.53	95.38	98.70	98.31	9.09	7.99
00207	UFP-53	Ufp-5	200M	20	M1/D1	10.00	2000		0.00	16		Flot/Flot			11.6	2.13	1.40	80.2	5.99	98.15	99.79	99.58	8.05	6.14
00208	UFP-54	Ufp-5	200M	20	F4/D1	10.00	2000		0.00	16		Flot/Flot			11.9	2.05	1.32	80.9	4.68	98.00	99.34	99.17	11.71	11.60
00209	UFP-55	Ufp-5	200M	20	Maya	10.00	2000		0.00	16		Flot/Flot			11.8	2.03	1.31	76.4	4.17	97.47	98.92	98.73	12.79	13.06
00210	UFP-56	Ufp-5	28M	20	M1/D1	10.00	2000		0.00	16		Flot/Flot			11.7	2.06	1.34	73.3	5.90	97.70	99.20	99.00	11.15	10.66
00211	UFP-57	Ufp-5	28M	20	F4/D1	10.00	2000		0.00	16		Flot/Flot			11.9	2.06	1.33	72.7	8.16	97.33	98.66	98.49	11.85	11.49
00212	UFP-58	Ufp-5	28M	20	Maya	10.00	2000		0.00	16		Flot/Flot			12.3	1.99	1.27	77.3	5.99	97.18	97.93	97.83	14.86	15.83
00213	Pitt-57	Pit-5	28M	20	Hexane	30.00	2000		0.00			Flot/None			6.1	2.83	1.59	33.4	8.49	79.05	84.84	84.15	46.74	56.77
00214	Pitt-58	Pit-5	28M	20	Hexane	30.00	2000		0.00			Scr-290/None			8.6	3.42	2.21	23.6	6.80	81.21	84.55	84.15	33.87	38.16
00215	Pitt-59	Pit-5	200M	20	Hexane	30.00	2000		0.00			Flot/None			5.1	2.46	1.20	50.3	13.01	84.23	91.49	90.63	50.67	65.05
00216	Pitt-60	Pit-5	200M	20	Hexane	30.00	2000		0.00			Scr-106/None			8.3	3.29	2.08	51.6	11.79	90.46	94.54	94.05	29.14	35.29
00217	Pitt-61	Pit-5	28M	5	M1/D1	.10	2000		0.00			Flot/None	.25		5.7	2.69	1.44	16.6	4.90	45.42	48.98	48.56	70.92	77.45
00218	Pitt-62	Pit-5	200M	5	M1/D1	.10	2000		0.00			Flot/None	.30		6.3	2.45	1.21	17.5	5.41	51.32	54.95	54.52	70.08	78.62
00219	Pitt-63	Pit-5	28M	10	M1/D1	.10	2000		0.00			Flot/None	.20		6.3	2.79	1.55	18.0	5.03	45.38	48.59	48.21	69.86	75.78
00220	Pitt-64	Pit-5	200M	10	M1/D1	.10	2000		0.00			Flot/None	.25		5.9	2.43	1.18	22.1	6.54	65.95	70.95	70.36	61.86	73.10
00221	Pitt-65	Pit-5	28M	20	M1/D1	.10	2000		0.00			Flot/None	.15		6.3	2.77	1.53	15.0	5.14	45.40	48.61	48.23	70.07	76.08
00222	Pitt-66	Pit-5	200M	20	M1/D1	.10	2000		0.00			Flot/None	.15		5.9	2.41	1.16	21.8	6.18	65.34	70.30	69.71	62.52	73.80
00223	Pitt-67	Pit-5	28M	5	M1/D1	.20	2000		0.00			Flot/None	.20		5.6	2.55	1.30	67.3	13.02	71.31	77.00	76.32	56.73	68.08
00224	Pitt-68	Pit-5	200M	5	M1/D1	.20	2000		0.00			Flot/None	.25		5.2	2.31	1.05	29.8	8.85	75.82	82.25	81.49	58.33	72.47
00225	Pitt-69	Pit-5	28M	10	M1/D1	.21	2000		0.00			Flot/None	.15		6.6	3.03	1.79	23.9	6.23	70.93	75.67	75.11	48.85	56.19
00226	Pitt-70	Pit-5	200M	10	M1/D1	.20	2000		0.00			Flot/None	.25		5.9	2.48	1.23	39.4	10.90	81.59	87.78	87.05	51.86	65.34
00227	Pitt-71	Pit-5	28M	20	M1/D1	.20	2000		0.00			Flot/None	.15		6.7	3.06	1.82	26.2	6.35	74.08	78.94	78.36	46.05	53.44
00228	Pitt-72	Pit-5	200M	20	M1/D1	.20	2000		0.00			Flot/None	.15		6.7	2.75	1.51	61.4	15.25	89.99	95.89	95.18	41.11	53.07

Table A1-7 (Continued)

BATCH TEST RESULTS

TEST ID	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR % OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR % OIL	LOW SHEAR MIN	PYRITE DEP	SEPARATION TECHNIQUE	FR-1 LB/T	FR-2 LB/T	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	TS REJ	PS REJ
00229	Pitt-73	Pit-5	28M	5	M1/D1	.30	2000		0.00			Flot/None	.05		5.7	2.69	1.44	44.4	10.03	78.01	84.12	83.40	50.09	61.31
00230	Pitt-74	Pit-5	200M	5	M1/D1	.30	2000		0.00			Flot/None	.05		5.0	2.28	1.02	43.7	11.22	82.72	89.95	89.09	55.15	70.93
00231	Pitt-75	Pit-5	200M	10	M1/D1	.30	2000		0.00			Flot/None	.05		5.5	2.34	1.09	43.8	9.59	84.17	90.99	90.18	53.16	68.48
00232	Pitt-76	Pit-5	28M	10	M1/D1	.30	2000		0.00			Flot/None			5.9	2.82	1.57	36.2	9.85	79.69	85.73	85.02	46.54	56.83
00233	Pitt-77	Pit-5	28M	20	M1/D1	.30	2000		0.00			Flot/None			6.2	2.89	1.65	34.8	8.05	80.25	86.03	85.34	44.82	54.47
00234	Pitt-78	Pit-5	200M	20	M1/D1	.30	2000		0.00			Flot/None	.05		6.3	2.66	1.42	52.9	13.10	87.30	93.47	92.74	44.76	57.36
00235	Pitt-79	Pit-5	28M	20	M1/D1	.59	2000		0.00			2-Flot/None	.20		6.5	3.03	1.79	36.3	8.42	81.91	87.48	86.82	40.99	49.52
00236	Pit-80	Pit-5	28M	20	M1/D1	.54	2000		0.00			Scr-106/None			9.6	3.20	2.00	14.4	4.49	55.88	57.45	57.26	57.47	61.48
00237	Pitt-85	Pit-5	200M	20	M1/D1	.50	2000		0.00			2-Flot/None	.20		5.7	2.53	1.28	72.4	18.62	89.48	96.49	95.66	46.19	60.60
00238	Pitt-86	Pit-5	200M	20	M1/D1	.52	2000		0.00			Scr-106/None			11.7	2.57	1.40	11.2	3.87	1.05	1.05	1.05	99.36	99.50
00239	Pitt-83	Pit-5	28M	20	M1/D1	10.00	2000		0.00	16		Flot/Flot			8.8	3.68	2.47	79.6	4.57	96.64	100.35	99.91	15.38	17.74
00240	Pit-84	Pit-5	28M	20	M1/D1	10.00	2000		0.00			Scr-106/None			9.0	3.46	2.26	58.0	9.35	93.58	96.93	96.53	22.91	27.28
00241	Pitt-81	Pit-5	200M	20	M1/D1	10.00	2000		0.00	16		Flot/Flot			8.5	3.43	2.22	82.5	6.07	95.71	99.76	99.28	21.88	26.88
00242	Pitt-82	Pit-5	200M	20	M1/D1	10.06	2000		0.00			Scr-106/None			6.0	2.60	1.35	11.9	3.83	6.11	6.56	6.51	96.23	97.16
00243	Pitt-3R	Pit-1	28M	20	Diesel	3.00	2000		0.00			2-Flot/None			5.7	2.98	1.73	41.1	9.09	79.63	86.64	85.80	45.04	54.60
00244	Pitt-4R	Pit-1	28M	20	Diesel	.31	2000		0.00			2-Flot/None	.19	.13	5.8	2.96	1.72	35.3	8.12	76.65	83.31	82.51	47.46	56.79
00245	Pitt-15R	Pit-1	200M	20	Maya	3.04	2000		0.00			2-Flot/None			6.7	2.89	1.66	61.0	14.47	89.97	96.71	95.90	39.74	50.92
00246	UPF-1R	Ufp-1	28M	20	Diesel	10.00	2000		0.00	16		Flot/Flot			10.7	2.14	1.41	75.4	5.33	94.55	96.65	96.38	14.63	15.87
00247	UPF-4R	Ufp-1	28M	20	Diesel	.50	2000		0.00			2-Flot/None	.12	.15	8.2	1.55	.80	59.4	9.99	89.82	94.74	94.11	41.17	54.67
00248	UPF-11R	Ufp-1	28M	20	Maya	3.00	2000		0.00			2-Flot/None		.05	9.4	1.95	1.20	61.3	8.34	92.58	96.18	95.72	23.82	29.36
00249	UPF-15R	Ufp-1	200M	20	Maya	3.00	2000		0.00			2-Flot/None	.10	.05	8.3	1.48	.72	71.8	12.23	93.86	98.89	98.25	41.46	57.00
00250	UPF-20R	Ufp-1	28M	20	M1/D1	.50	2000		0.00			2-Flot/None		.10	7.6	1.40	.64	55.2	8.91	88.95	94.51	93.81	47.32	63.76
00251	Ill-67	Ill-5	200M	20	Maya	.50	2000		0.00			2-Flot/None	.60	.60	7.6	3.67	1.25	62.7	12.47	82.51	92.76	91.82	41.14	61.12
00252	Pit-87	Pit-6	28M	20	M1/D1	6.03	2000		0.00			Scr-106/None			9.1	3.50	2.30	33.1	6.99	85.36	88.33	87.97	21.58	16.30
00253	Pit-87-1	Pit-6	28M	20	M1/D1	6.06	2000		0.00			Scr-106/None			8.6	3.56	2.35	24.5	5.95	81.85	85.24	84.83	23.49	17.84
00254	Pit-94	Pit-6	28M	20	M1/D1	4.00	2000		0.00			Scr-106/None			8.9	3.22	2.01	14.6	4.72	57.51	59.64	59.38	51.46	50.64
00255	Pit-90	Pit-6	28M	20	M1/D1	.99	2000		0.00			Scr-106/None			9.0	3.45	2.25	14.8	4.53	51.69	53.54	53.32	53.12	50.33
00256	Pit-91	Pit-6	28M	20	M1/D1	6.06	2000		0.00	16		Scr-106/Scr-106			8.4	3.33	2.11	28.8	6.55	85.86	89.63	89.18	25.05	22.54
00257	Pit-91-1	Pit-6	28M	20	M1/D1	6.05	2000		0.00	16		Scr-106/Scr-106			8.8	3.26	2.06	26.4	6.57	84.35	87.61	87.22	27.72	25.91
00258	Pit-92	Pit-6	28M	20	M1/D1	1.01	2000		0.00	16		Scr-106/Scr-106			8.6	3.12	1.91	14.8	4.58	54.52	56.75	56.48	55.30	55.45
00259	Pit-96	Pit-6	200M	20	Diesel	1.00	2000		0.00			Scr-45/None			7.9	3.18	1.97	14.4	4.36	39.71	41.69	41.46	66.82	66.69
00260	Pit-97	Pit-6	200M	20	Diesel	1.00	2000	M3/D2	5.00	16		Scr-45/Scr-45			7.4	2.93	1.70	14.7	4.41	42.62	45.06	44.77	67.26	69.05
00261	Pit-97-1	Pit-6	200M	20	Diesel	1.00	2000	M3/D2	5.00	16		Scr-45/Scr-45			7.4	2.92	1.69	14.5	4.35	44.52	47.06	46.75	65.92	67.87
00262	Pit-120	Pit-6	200M	20	Heptane	30.00	9000		0.00			Phase/None			7.4	4.20	2.97	82.8	1.39	93.10	98.37	97.74	-2.63	-18.20
00263	Pit-121	Pit-6	200M	20	Heptane	20.00	9000		0.00			Phase/None			7.4	3.83	2.60	81.8	4.78	92.37	97.60	96.98	7.15	-2.69
00264	Pit-121-1	Pit-6	200M	20	Heptane	20.00	9000		0.00			Phase/None			7.5	4.01	2.79	80.4	2.80	92.54	97.66	97.05	2.61	-10.04
00265	Pit-122	Pit-6	200M	20	Heptane	10.00	9000		0.00			Phase/None			6.6	3.17	1.93	29.5	5.53	80.79	86.19	85.55	32.78	33.31
00266	Pit-124	Pit-6	200M	5	Heptane	30.04	9000		0.00			Phase/None			5.0	2.87	1.61	70.6	12.37	88.38	96.11	95.19	33.43	39.15

Table A1-7 (Continued)

BATCH TEST RESULTS

TEST ID	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR % OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR % OIL	LOW SHEAR MIN	PYRITE DEP	SEPARATION TECHNIQUE	FR-1 LB/T	FR-2 LB/T	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	TS REJ	PS REJ
00267	Pit-124-1	Pit-6	200M	5	Heptane	30.04	9000		0.00			Phase/None			5.5	3.03	1.78	70.9	10.14	87.96	95.09	94.24	30.05	33.19
00268	Pit-125	Pit-6	200M	5	Heptane	20.02	9000		0.00			Phase/None			4.7	2.67	1.41	47.3	9.63	81.99	89.47	88.59	42.54	50.69
00269	Pit-126	Pit-6	200M	5	Heptane	10.01	9000		0.00			Phase/None			3.8	2.22	.95	18.6	5.20	48.89	53.92	53.32	71.51	80.23
00270	Pit-88	Pit-6	200M	20	M1/D1	6.00	2000		0.00			Scr-45/None			7.3	3.17	1.95	20.9	5.47	57.59	60.95	60.55	52.05	52.19
00271	Pit-88-1	Pit-6	200M	20	M1/D1	6.00	2000		0.00			Scr-45/None			7.1	2.69	1.46	16.3	4.86	53.53	56.80	56.41	62.19	66.60
00272	Pit-89	Pit-6	200M	20	M1/D1	1.00	2000		0.00			Scr-45/None			7.6	2.97	1.75	13.2	4.24	33.12	34.90	34.69	74.15	75.25
00273	Pit-93	Pit-6	200M	20	M1/D1	6.00	2000		0.00	16		Scr-45/Scr-45			6.5	2.73	1.50	17.2	5.06	49.29	52.63	52.23	64.65	68.53
00274	Pit-93-1	Pit-6	200M	20	M1/D1	6.00	2000		0.00	16		Scr-45/Scr-45			6.9	2.75	1.52	17.2	4.99	54.89	58.38	57.97	60.34	64.38
00275	Pit-98	Pit-6	200M	20	Diesel	1.00	2000	M3/D2	5.00	16		None/Scr-45			10.7	3.60	2.42	55.3	4.74	97.60	98.94	98.78	7.71	-.88
00276	Pit-98-1	Pit-6	200M	20	Diesel	1.00	2000	M3/D2	5.00	16		None/Scr-45			10.7	3.50	2.32	63.5	4.68	98.23	99.58	99.42	9.75	2.75
00277	Pit-99	Pit-6	200M	20	Diesel	2.00	2000	M3/D1	4.00	16		None/Scr-45			10.7	3.66	2.48	62.3	3.92	98.16	99.52	99.35	5.59	-4.04
00278	Pit-99-1	Pit-6	200M	20	Diesel	2.00	2000	M3/D1	4.00	16		None/Scr-45			10.7	3.64	2.46	58.2	4.01	98.21	99.56	99.40	6.07	-3.23
00279	Pit-100	Pit-6	200M	20	Diesel	3.00	2000	Maya	3.00	16		None/Scr-45			11.0	3.75	2.57	67.4	3.81	98.17	99.14	99.02	3.47	-7.65
00280	Pit-100-1	Pit-6	200M	20	Diesel	3.00	2000	Maya	3.00	16		None/Scr-45			11.0	3.73	2.55	61.6	4.28	98.24	99.21	99.09	3.93	-6.86
00281	Pit-123	Pit-6	200M	20	Heptane	20.00	9000	Maya	6.00	16		Phase/Scr-600			7.1	4.05	2.83	80.1	3.25	92.43	98.07	97.40	1.63	-11.44
00282	Pit-127	Pit-6	200M	5	Heptane	30.04	9000	Maya	6.01	16		Phase/Scr-600			4.9	2.63	1.37	69.9	12.52	88.33	96.19	95.26	39.03	48.31
00283	Pit-94	Pit-6	200M	20	Diesel	1.00	2000		0.00			Flot/None			6.4	2.85	1.62	52.8	11.49	88.63	94.78	94.05	33.62	38.89
00284	Pit-95	Pit-6	200M	20	Diesel	1.00	2000	M3/D2	5.00	16		Flot/Flot			6.1	2.78	1.54	54.6	11.74	89.00	95.48	94.71	34.99	41.46
00285	Pit-95-1	Pit-6	200M	20	Diesel	1.00	2000	M3/D2	5.00	16		Flot/Flot			6.0	2.77	1.53	47.5	10.51	87.77	94.28	93.51	36.12	42.70
00286	Pit-106	Pit-6	200M	20	Heptane	30.00	2000	Maya	6.00	16		Phase/Scr-600			5.5	2.70	1.45	60.7	11.26	87.63	94.73	93.89	37.82	45.65
00287	Pit-106-1	Pit-6	200M	20	Heptane	30.00	2000	Maya	6.00	16		Phase/Scr-600			6.3	3.33	2.09	62.4	7.49	90.36	96.72	95.96	21.09	19.47
00288	Pit-108	Pit-6	200M	5	Heptane	30.04	2000	Maya	6.01	16		Phase/Scr-45			3.6	2.07	.79	44.5	10.41	81.06	89.56	88.56	56.03	72.61
00289	Pit-101	Pit-6	200M	20	Heptane	30.00	2000		0.00			Phase/None			6.4	3.26	2.02	71.0	8.59	90.58	96.88	96.13	22.49	21.84
00290	Pit-101-1	Pit-6	200M	20	Heptane	30.00	2000		0.00			Phase/None			5.2	2.58	1.33	58.9	11.47	88.41	95.92	95.03	40.13	49.97
00291	Pit-102	Pit-6	200M	20	Heptane	20.00	2000		0.00			Phase/None			4.1	2.19	.92	17.0	4.57	44.03	48.39	47.87	74.69	82.69
00292	Pit-103	Pit-6	200M	20	Heptane	40.00	2000		0.00			Phase/None			5.6	2.81	1.56	68.0	11.39	89.41	96.54	95.70	34.06	40.43
00293	Pit-104	Pit-6	200M	5	Heptane	30.04	2000		0.00			Phase/None			3.7	2.03	.76	44.5	10.45	80.84	89.26	88.27	56.93	73.92
00294	Pit-104-1	Pit-6	200M	5	Heptane	30.04	2000		0.00			Phase/None			3.7	1.96	.69	37.8	9.71	76.62	84.60	83.66	60.58	77.57
00295	Pit-105	Pit-6	200M	5	Heptane	40.05	2000		0.00			Phase/None			4.4	2.29	1.03	58.5	12.70	85.63	93.77	92.81	48.53	62.53
00296	Pit-107	Pit-6	200M	5	Heptane	20.02	2000		0.00			Phase/None			3.7	2.00	.73	21.9	5.64	58.24	64.31	63.59	69.43	81.95
00297	Pit-110	Pit-6	200M	20	Heptane	20.13	9000		0.00			Scr-106/None			7.9	3.70	2.48	78.6	3.85	95.22	100.00	99.43	7.53	-.85
00298	Pit-110-1	Pit-6	200M	20	Heptane	20.13	9000		0.00			Scr-106/None			7.1	3.62	2.39	78.7	4.73	93.87	99.55	98.87	10.81	4.21
00299	Pit-111	Pit-6	200M	5	Heptane	20.02	9000		0.00			Scr-106/None			6.3	2.67	1.43	58.4	11.95	90.50	96.90	96.14	36.58	44.75
00300	Pit-111-1	Pit-6	200M	5	Heptane	20.02	9000		0.00			Scr-106/None			5.0	2.60	1.34	67.1	12.24	87.32	94.95	94.05	40.41	49.95
00301	Pit-112	Pit-6	200M	5	Heptane	10.00	9000		0.00			Scr-106/None			4.3	2.25	.98	65.0	13.80	87.13	95.53	94.54	48.55	63.41
00302	Pit-112-1	Pit-6	200M	5	Heptane	10.00	9000		0.00			Scr-106/None			4.5	2.29	1.03	63.1	13.45	87.49	95.70	94.73	47.42	61.67
00303	Pit-109	Pit-6	200M	20	Heptane	20.00	2000		0.00			Scr-106/None			5.0	2.49	1.23	62.1	13.30	87.41	95.05	94.15	42.88	54.00
00304	Pit-109-1	Pit-6	200M	20	Heptane	20.00	2000		0.00			Scr-106/None			5.0	2.47	1.21	58.3	12.85	86.42	93.98	93.08	43.97	55.25

Table A1-7 (Continued)

BATCH TEST RESULTS

TEST ID	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR % OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR % OIL	LOW SHEAR MIN	PYRITE DEP	SEPARATION TECHNIQUE	FR-1 LB/T	FR-2 LB/T	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	TS REJ	PS REJ
00305	Pit-128	Pit-6	200M	20	Heptane	30.00	2000		0.00			Scr-106/None			8.2	3.09	1.88	62.4	12.61	92.04	96.31	95.80	25.35	26.33
00306	Pit-129	Pit-6	200M	5	Heptane	20.02	2000		0.00			Scr-106/None			3.7	1.88	.61	54.5	13.21	83.61	92.32	91.29	58.74	78.37
00307	Pit-129-1	Pit-6	200M	5	Heptane	20.02	2000		0.00			Scr-106/None			3.9	2.02	.75	56.1	13.58	84.09	92.63	91.62	55.42	73.13
00308	Pit-130	Pit-6	200M	5	Heptane	30.04	2000		0.00			Scr-106/None			3.8	2.04	.77	59.7	13.56	85.10	93.85	92.81	54.44	72.13
00309	Pit-131	Pit-6	200M	20	Heptane	20.13	9000	Maya	6.13	16		Scr106/Scr-425			6.8	3.68	2.45	78.0	3.87	93.14	99.19	98.47	10.06	2.79
00310	Pit-131-1	Pit-6	200M	20	Heptane	20.13	9000	Maya	6.09	16		Scr106/Scr-425			6.8	3.39	2.16	68.6	4.28	92.73	98.76	98.04	17.52	14.71
00311	Pit-132	Pit-6	200M	5	Heptane	20.25	9000	Maya	6.02	16		Scr106/Scr-75			4.6	2.46	1.20	61.5	12.58	87.87	96.03	95.06	43.21	55.00
00312	Pit-133	Pit-6	200M	20	Heptane	30.00	2000	Maya	6.00	16		Scr106/Scr-600			5.2	2.71	1.46	66.3	12.39	88.24	95.74	94.85	37.16	45.05
00313	Pit-134	Pit-6	200M	5	Heptane	30.04	2000	Maya	6.01	16		Scr-106/Scr-45			4.5	2.18	.92	62.5	14.08	85.80	93.89	92.93	50.86	66.37
00314	Pit-134-1	Pit-6	200M	5	Heptane	30.04	2000	Maya	6.01	16		Scr-106/Scr-45			4.1	2.09	.82	65.1	14.70	86.32	94.92	93.90	52.69	69.84
00315	Pit-113	Pit-6	28M	20	Diesel	6.00	2000		0.00	16		Scr-106/Scr-106			7.7	2.82	1.60	37.9	8.82	85.42	89.98	89.43	36.74	41.68
00316	Pit-114	Pit-6	28M	20	Diesel	4.00	2000		0.00	16		Scr-106/Scr-106			8.4	3.04	1.82	16.5	4.81	60.65	63.27	62.96	51.68	52.79
00317	Pit-115	Pit-6	28M	20	HD4/D1	6.06	2000		0.00	16		Scr-106/Scr-106			10.7	3.51	2.33	49.7	7.07	98.06	99.48	99.31	9.74	2.70
00318	Pit-116	Pit-6	28M	20	HD4/D1	4.06	2000		0.00	16		Scr-106/Scr-106			9.5	3.43	2.24	18.2	5.05	76.08	78.33	78.06	31.43	27.37
00319	Pit-116-1	Pit-6	28M	20	HD4/D1	4.00	2000		0.00	16		Scr-106/Scr-106			9.3	3.20	2.00	17.8	4.98	76.53	78.99	78.70	35.66	34.57
00320	Pit-117	Pit-6	200M	20	Diesel	6.00	2000		0.00	16		Scr-45/Scr-45			6.8	3.01	1.78	38.7	7.66	84.77	90.27	89.62	32.96	35.63
00321	Pit-117-1	Pit-6	200M	20	Diesel	6.00	2000		0.00	16		Scr-45/Scr-45			6.3	2.83	1.59	52.5	10.52	87.35	93.48	92.75	35.08	40.62
00322	Pit-118	Pit-6	200M	20	Diesel	4.00	2000		0.00	16		Scr-45/Scr-45			6.7	2.69	1.46	17.0	4.63	52.46	55.88	55.48	62.91	67.31
00323	Pit-135	Pit-6	200M	20	Heptane	20.13	2000	Maya	5.99	16		None/Scr-300			7.9	3.69	2.47	77.8	2.81	94.10	98.83	98.27	8.81	.67
00324	Pit-136	Pit-6	200M	20	Heptane	20.13	9000	Maya	6.17	16		None/Scr-300			7.2	3.77	2.54	39.8	3.44	89.47	94.80	94.17	11.41	2.85
00325	Pit-137	Pit-6	200M	5	Heptane	20.00	9000	Maya	6.65	16		None/Scr-75			5.0	2.41	1.15	56.6	12.59	88.05	95.74	94.83	44.34	56.73
00326	Pit-137-1	Pit-6	200M	5	Heptane	20.00	9000	Maya	6.00	16		None/Scr-75			4.9	2.23	.98	51.0	12.59	86.53	94.22	93.31	49.25	63.94
00327	Pit-138	Pit-6	200M	5	Heptane	10.00	9000	Maya	5.95	16		None/Scr-75			5.5	2.33	1.08	33.5	8.37	81.31	87.89	87.11	50.27	62.52
00328	Pit-139	Pit-6	200M	5	Heptane	20.00	2000	Maya	6.00	16		None/Scr-75			7.2	2.93	1.71	40.7	8.78	89.27	94.60	93.97	31.26	35.02
00329	Pit-139-1	Pit-6	200M	5	Heptane	20.00	2000	Maya	6.17	16		None/Scr-75			7.4	2.73	1.51	41.2	10.05	89.84	94.96	94.35	35.54	42.18
00330	UFP-73	Ufp-6	28M	20	M1/D1	6.00	2000		0.00	16		Scr-106/Scr-106			12.2	1.91	1.19	34.6	4.72	98.36	99.44	99.30	18.38	15.73
00331	UFP-74	Ufp-6	28M	20	Diesel	6.00	2000		0.00	16		Scr-106/Scr-106			11.5	1.82	1.09	50.7	6.33	95.53	97.42	97.18	24.37	24.59
00332	UFP-69	Ufp-6	200M	20	M1/D1	6.00	2000		0.00	16		Scr-45/Scr-45			10.0	1.66	.92	21.5	3.18	76.99	80.01	79.62	44.38	48.77
00333	UFP-70	Ufp-6	200M	20	M1/D1	4.00	2000		0.00	16		Scr-45/Scr-45			9.0	1.41	.66	17.3	2.82	55.95	58.87	58.50	65.71	73.28
00334	UFP-71	Ufp-6	200M	20	Diesel	6.00	2000		0.00	16		Scr-45/Scr-45			9.3	1.62	.87	30.4	4.49	83.15	87.25	86.73	41.50	47.64
00335	UFP-71-1	Ufp-6	200M	20	Diesel	6.00	2000		0.00	16		Scr-45/Scr-45			9.1	1.54	.79	25.0	3.58	79.38	83.50	82.97	46.96	54.78
00336	UFP-72	Ufp-6	200M	20	Diesel	4.00	2000		0.00	16		Scr-45/Scr-45			8.9	1.36	.61	16.7	2.81	48.08	50.68	50.35	71.65	78.94
00337	UFP-65	Ufp-6	200M	5	Heptane	20.00	2000		0.00			Scr-106/None			8.9	1.73	.98	75.5	7.80	93.18	98.22	97.57	29.91	34.00
00338	UFP-66	Ufp-6	200M	5	Heptane	30.00	2000		0.00			Scr-106/None			8.7	1.65	.90	73.9	8.36	93.23	98.52	97.84	33.12	39.46
00339	UFP-66-1	Ufp-6	200M	5	Heptane	30.00	2000		0.00			Scr-106/None			8.6	1.68	.93	72.3	8.09	93.38	98.80	98.10	31.79	37.40
00340	Ill-72	Ill-6	200M	5	Heptane	20.00	2000		0.00			Scr-106/None			12.7	4.32	2.04	23.1	5.40	74.16	79.83	79.24	38.15	41.50
00341	Ill-72-1	Ill-6	200M	5	Heptane	20.00	2000		0.00			Scr-106/None			12.9	4.25	1.98	16.9	4.81	75.41	80.98	80.39	38.13	42.40
00342	Ill-73	Ill-6	200M	5	Heptane	30.00	2000		0.00			Scr-106/None			13.7	4.21	1.96	20.0	5.05	75.29	80.03	79.53	38.81	43.05

Table A1-7 (Continued)

BATCH TEST RESULTS

TEST ID	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR % OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR % OIL	LOW SHEAR MIN	PYRITE DEP	SEPARATION TECHNIQUE	FR-1 LB/T	FR-2 LB/T	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	TS REJ	PS REJ
00343	Ill-74	Ill-6	28M	20	M1/D1	5.99	2000		0.00	16		Scr-106/Scr-106			11.9	4.62	2.32	51.1	5.76	85.36	92.76	92.00	23.84	23.36
00344	Ill-74-1	Ill-6	28M	20	M1/D1	5.99	2000		0.00	16		Scr-106/Scr-106			11.3	4.57	2.25	43.5	5.21	82.11	89.92	89.12	27.55	28.42
00345	Ill-75	Ill-6	28M	20	Diesel	5.93	2000		0.00	16		Scr-106/Scr-106			11.1	4.27	1.95	36.9	5.15	78.27	85.95	85.17	35.53	41.13
00346	Ill-76	Ill-6	200M	20	Diesel	6.06	2000		0.00	16		Scr-45/Scr-45			9.9	4.13	1.77	51.3	6.34	84.42	94.08	93.12	32.74	42.11
00347	Ill-76-1	Ill-6	200M	20	Diesel	5.99	2000		0.00	16		Scr-45/Scr-45			10.2	4.02	1.68	51.0	6.38	81.72	90.74	89.84	36.52	46.97
00348	Ill-77	Ill-6	200M	20	Diesel	4.00	2000		0.00	16		Scr-45/Scr-45			9.3	4.11	1.74	26.5	5.21	60.76	68.18	67.45	51.77	59.05
00349	Ill-78	Ill-6	200M	20	M1/D1	6.00	2000		0.00	16		Scr-45/Scr-45			8.9	3.99	1.61	51.1	7.58	80.21	90.39	89.39	38.22	50.01
00350	Ill-79	Ill-6	200M	20	M1/D1	4.00	2000		0.00	16		Scr-45/Scr-45			8.6	3.84	1.46	35.1	6.16	68.76	77.78	76.90	48.99	61.27
00351	Pit-121-2	Pit-6	200M	20	Heptane	20.00	9000		0.00			Phase/None			7.1	3.69	2.46	80.7	3.36	93.29	98.93	98.26	9.65	2.02
00352	Pit-1%D	Pit-7	200M	20	Diesel	1.00	2000		0.00			2-Flot/None	.10		5.6	2.61	1.36	55.8	12.36	87.69	95.04	94.16	43.97	54.10
00353	Pit-D-1	Pit-7	200M	20	Diesel	1.00	2000		0.00			2-Flot/None			5.2	2.51	1.26	55.0	12.54	86.76	94.49	93.57	46.68	58.09
00354	Pit-D-2	Pit-7	200M	20	Diesel	1.00	2000		0.00			2-Flot/None			5.3	2.49	1.24	58.5	13.37	87.62	95.31	94.39	46.59	58.31
00355	Pit-Du-1	Pit-7	200M	20	M1/D1	1.00	2000		0.00			2-Flot/None			5.4	2.68	1.43	59.7	12.35	88.01	95.61	94.70	42.29	51.71
00356	Pit-Du-2	Pit-7	200M	20	M1/D1	1.00	2000		0.00			2-Flot/None			5.4	2.63	1.38	60.5	12.97	87.90	95.48	94.57	43.45	53.47
0236a	Pit-80	Pit-5	28M	20	M1/D1	.54	2000		0.00			Scr-212/None			10.3	3.07	1.88	12.4	4.12	33.80	34.45	34.37	75.32	78.11
0236b	Pit-80	Pit-5	28M	20	M1/D1	.54	2000		0.00			Scr-300/None			13.2	3.36	2.21	11.4	3.83	15.57	15.29	15.32	87.55	88.15
0236c	Pit-80	Pit-5	28M	20	M1/D1	.54	2000		0.00			Scr-425/None			16.9	3.85	2.75	11.2	3.75	8.44	7.89	7.95	92.26	92.00
0236d	Pit-80	Pit-5	28M	20	M1/D1	.54	2000		0.00			Scr-600/None			22.5	4.68	3.65	11.2	3.72	4.40	3.79	3.87	95.10	94.46
0240a	Pit-84	Pit-5	28M	20	M1/D1	10.00	2000		0.00			Scr-212/None			8.4	3.30	2.09	20.3	5.08	73.34	76.54	76.16	42.32	47.16
0240b	Pit-84	Pit-5	28M	20	M1/D1	10.00	2000		0.00			Scr-300/None			8.4	3.29	2.08	17.8	4.71	66.09	68.98	68.64	48.18	52.61
0240c	Pit-84	Pit-5	28M	20	M1/D1	10.00	2000		0.00			Scr-425/None			14.1	3.29	2.15	11.3	3.78	5.43	5.27	5.29	95.75	95.98
0240d	Pit-84	Pit-5	28M	20	M1/D1	10.00	2000		0.00			Scr-600/None			18.1	3.83	2.74	11.3	3.76	2.06	1.90	1.92	98.12	98.05
0252a	Pit-87	Pit-6	28M	20	M1/D1	6.03	2000		0.00			Scr-212/None			8.4	3.24	2.03	15.0	4.54	50.58	52.80	52.54	56.93	56.13
0252b	Pit-87	Pit-6	28M	20	M1/D1	6.03	2000		0.00			Scr-300/None			9.0	3.16	1.96	12.2	4.04	20.98	21.74	21.65	82.58	82.46
0252c	Pit-87	Pit-6	28M	20	M1/D1	6.03	2000		0.00			Scr-425/None			9.8	3.18	1.99	11.6	3.93	10.39	10.66	10.63	91.32	91.17
0252d	Pit-87	Pit-6	28M	20	M1/D1	6.03	2000		0.00			Scr-600/None			10.8	3.46	2.28	11.5	3.87	4.82	4.87	4.87	95.63	95.31
0253a	Pit-87-1	Pit-6	28M	20	M1/D1	6.06	2000		0.00			Scr-300/None			9.0	3.30	2.09	11.8	4.14	23.15	23.99	23.89	79.97	79.33
0253b	Pit-87-1	Pit-6	28M	20	M1/D1	6.06	2000		0.00			Scr-600/None			10.3	3.54	2.35	11.1	3.96	5.55	5.65	5.64	94.84	94.42
0254a	Pit-94	Pit-6	28M	20	M1/D1	4.00	2000		0.00			Scr-300/None			8.8	2.85	1.64	12.0	4.10	21.58	22.40	22.30	83.86	84.86
0254b	Pit-94	Pit-6	28M	20	M1/D1	4.00	2000		0.00			Scr-600/None			12.3	3.28	2.12	11.2	3.84	3.29	3.27	3.28	97.17	97.02
0255a	Pit-90	Pit-6	28M	20	M1/D1	.99	2000		0.00			Scr-212/None			9.3	3.21	2.01	12.6	4.24	27.10	27.96	27.86	77.14	76.70
0270a	Pit-88	Pit-6	200M	20	M1/D1	6.00	2000		0.00			Scr-74/None			7.3	2.51	1.28	13.3	4.25	7.43	7.86	7.81	95.11	95.94
0270b	Pit-88	Pit-6	200M	20	M1/D1	6.00	2000		0.00			Scr-106/None			9.3	2.73	1.53	12.9	4.13	1.42	1.47	1.46	98.98	99.07
0271a	Pit-88-1	Pit-6	200M	20	M1/D1	6.00	2000		0.00			Scr-74/None			8.0	2.24	1.02	11.5	3.79	7.27	7.63	7.59	95.72	96.82
0271b	Pit-88-1	Pit-6	200M	20	M1/D1	6.00	2000		0.00			Scr-106/None			9.4	2.19	.99	11.2	3.70	1.62	1.67	1.66	99.07	99.31

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
357	Pit-200	P-8.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.8	3.83	1.53	55.4	9.62	93.7	97.6	97.1	36.9	15.3	28.9	26.4	
358	Pit-201	P-8.A	28	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.6	4.03	1.73	55.5	10.15	93.1	97.2	96.7	39.0	11.5	20.4	17.5	23.5
359	Pit-201.1	P-8.A	28	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.6	3.70	1.40	53.6	10.21	92.6	96.7	96.2	39.3	19.1	36.0	33.7	
360	Pit-202	P-8.A	200	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.1	3.75	1.44	71.0	13.00	94.3	99.0	98.5	43.0	16.5	33.0	30.6	
361	Pit-203	P-8.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.2	3.72	1.41	72.3	13.39	94.2	98.8	98.3	42.0	17.3	34.4	32.0	28.8
362	Pit-204	P-8.A	28	5	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.4	3.80	1.49	37.8	8.86	89.6	93.8	93.3	43.2	19.6	33.8	31.4	
363	Pit-205	P-8.A	28	5	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.3	3.75	1.44	42.5	10.33	89.7	94.0	93.5	43.9	20.6	36.1	33.8	30.4
364	Pit-206	P-8.A	200	5	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.3	3.46	1.13	56.7	12.38	91.7	97.2	96.5	51.9	25.1	49.0	47.1	
365	Pit-207	P-8.A	200	5	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.2	3.40	1.06	62.1	14.13	93.2	98.9	98.3	51.9	25.2	51.0	49.3	44.0
366	Pit-207.1	P-8.A	200	5	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.3	3.39	1.05	62.2	13.73	91.8	97.3	96.7	51.7	26.6	52.1	50.4	
367	Ufp-200	U-8.A	200	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.7	1.33	.73	63.7	8.39	87.8	95.6	94.6	52.9	46.9	60.8	58.0	
368	Ufp-201	U-8.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		8.4	1.52	.93	66.6	8.28	89.2	96.4	95.4	47.7	38.2	49.5	45.8	47.8
369	Ufp-202	U-8.A	200	5	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.9	1.25	.65	61.9	8.54	85.5	94.0	92.9	58.9	51.4	66.3	63.9	65.2
370	Ufp-203	U-8.A	200	5	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.7	1.36	.76	67.2	8.39	89.0	97.0	96.0	52.2	44.8	58.5	55.6	57.3
371	Ufp-203.1	U-8.A	200	5	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.5	1.11	.51	66.4	8.54	88.7	96.9	95.8	53.6	55.2	72.4	70.4	
372	Ufp-204	U-8.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.6	1.03	.43	32.4	4.22	67.4	75.3	74.3	73.7	68.2	82.5	81.2	80.1
373	Ill-200	I-8.A	28	20	Diesel	1.0	2000		0.0		2-F	.1	.1		Non	0.0		6.1	2.90	.69	38.5	3.56	86.8	91.5	91.2	49.9	18.1	38.1	34.0	
374	Ill-201	I-8.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.3	2.85	.62	26.2	3.59	75.9	80.7	80.4	61.9	29.6	51.3	48.1	
375	Ill-202	I-8.A	28	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.8	2.98	.79	62.1	3.45	93.7	97.9	97.6	39.5	9.0	23.5	18.4	
376	Ill-202.1	I-8.A	28	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.0	3.01	.82	68.2	4.02	93.3	97.3	97.0	38.0	8.5	20.5	15.2	
377	Ill-203	I-8.A	28	5	Diesel	4.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.6	2.87	.65	32.4	3.76	85.5	90.7	90.4	55.1	20.0	42.5	38.7	29.4
378	Ill-204	I-8.A	28	5	M1/D1	4.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.2	2.99	.81	47.3	3.97	92.9	96.7	96.4	37.1	9.4	22.2	17.0	
379	Ill-204.1	I-8.A	28	5	M1/D1	4.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.1	3.06	.87	49.6	4.39	93.8	97.8	97.5	37.4	6.6	15.6	10.1	
380	Ill-205	I-8.A	200	20	Diesel	1.0	2000		0.0		2-F	.1	.1		Non	0.0		5.6	2.88	.66	60.1	3.99	91.6	97.1	96.8	51.4	14.1	37.7	33.5	24.0
381	Ill-206	I-8.A	200	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.6	2.85	.63	44.4	3.88	88.6	93.9	93.5	53.1	17.8	42.5	38.7	
382	Ill-207	I-8.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.1	3.06	.85	73.5	3.38	93.3	98.3	98.0	45.9	6.9	17.6	12.2	11.9
383	Ill-208	I-8.A	200	5	Diesel	4.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.1	2.95	.72	64.4	3.85	92.7	98.9	98.5	55.8	10.8	31.0	26.5	
384	Ill-208.1	I-8.A	200	5	Diesel	4.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.1	2.97	.74	61.5	4.31	92.3	98.5	98.1	56.0	10.6	29.4	24.7	
385	Ill-209	I-8.A	200	5	M1/D1	4.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.7	3.13	.91	59.7	2.92	93.2	98.6	98.2	49.5	5.1	12.3	6.5	20.9
386	Ufp-204.1	U-8.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.6	1.02	.42	32.4	4.09	67.1	75.0	74.0	73.8	68.6	82.9	81.7	
387	Ufp-205	U-8.A	28	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.7	1.32	.72	40.6	4.80	76.8	84.7	83.7	64.1	53.8	66.4	64.0	
388	Ufp-206	U-8.A	28	5	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.9	1.01	.41	34.7	4.73	71.6	79.7	78.7	70.6	66.9	82.2	80.9	
389	Ufp-207	U-8.A	28	5	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.5	1.23	.63	48.6	7.07	83.5	91.2	90.2	56.3	53.2	67.8	65.5	
390	Ill-210	I-8.A	28	5	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.2	2.88	.65	18.7	3.59	71.1	75.7	75.3	65.0	33.4	52.4	49.2	52.1
391	Ill-211	I-8.A	28	5	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.3	2.91	.71	45.5	4.02	90.6	95.2	94.9	45.8	14.1	33.8	29.4	
392	Ill-212	I-8.A	200	5	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.0	2.85	.61	28.3	4.00	82.1	87.7	87.3	61.1	23.8	47.9	44.4	
393	Ill-213	I-8.A	200	5	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.6	2.91	.69	62.9	3.90	93.3	98.9	98.5	50.4	11.6	33.4	29.0	
394	Ill-213.1	I-8.A	200	5	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.6	2.92	.70	61.3	3.42	92.7	98.3	97.9	50.7	11.8	32.8	28.4	

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	LOW SHEAR MIN	MICROAGG MET	MICROAGG FR-1	MICROAGG FR-2	MICROAGG SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
395	Pit-208	P-8.A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		5.7	3.73	1.40	70.7	14.10	93.0	98.2	97.6	47.5	18.2	35.5	33.1	
396	Pit-208.1	P-8.A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		5.6	3.80	1.47	72.3	13.19	93.1	98.4	97.8	48.4	16.5	32.3	29.8	
397	Pit-209	P-8.A	200	5	Heptane	20.0	2000	Maya	5.4	16	Scr	0.0	0.0	106	Scr	0.0	106	5.4	3.69	1.35	70.5	13.45	94.3	99.8	99.2	49.4	18.0	36.8	34.6	44.2
398	Pit-209.1	P-8.A	200	5	Heptane	20.0	2000	Maya	6.1	16	Scr	0.0	0.0	106	Scr	0.0	106	5.5	3.82	1.49	65.6	12.76	94.5	99.9	99.3	48.2	14.9	30.5	28.0	
399	Pit-210	P-8.A	200	5	Heptane	20.0	14000	Maya	6.4	16	Scr	0.0	0.0	106	Scr	0.0	106	5.9	3.86	1.54	69.0	10.60	94.8	99.9	99.3	45.0	13.6	27.8	25.2	
400	Pit-211	P-8.A	200	5	Heptane	20.0	14000	Maya	6.1	16	Non	0.0	0.0		Scr	0.0	106	5.8	3.92	1.60	77.5	10.79	94.9	100.0	99.4	45.0	12.3	25.0	22.4	32.6
401	Pit-211.1	P-8.A	200	5	Heptane	20.0	14000	Maya	6.0	16	Non	0.0	0.0		Scr	0.0	106	6.2	3.69	1.37	67.1	10.26	96.0	100.8	100.2	41.5	16.5	34.9	32.6	
402	Pit-212	P-8.A	200	5	Heptane	20.0	2000	Maya	6.0	16	Non	0.0	0.0		Scr	0.0	106	6.1	3.62	1.31	74.9	13.96	96.5	101.4	100.8	42.2	17.5	37.7	35.4	
403	Pit-212.1	P-8.A	200	5	Heptane	20.0	2000	Maya	6.0	16	Non	0.0	0.0		Scr	0.0	106	6.3	3.79	1.48	47.2	7.55	94.3	98.9	98.4	41.6	15.7	31.1	28.7	
404	Ill-214	I-8.A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		8.4	2.95	.79	9.4	3.26	89.7	92.1	91.9	28.9	13.8	26.2	21.4	13.9
405	Ill-214.1	I-8.A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		8.0	2.94	.78	11.8	3.53	89.2	92.0	91.8	32.6	14.5	28.4	23.7	
406	Ill-215	I-8.A	200	5	Heptane	20.0	2000	Maya	6.0	16	Scr	0.0	0.0	106	Scr	0.0	106	5.8	3.15	.93	21.4	3.08	77.3	81.8	81.5	58.0	20.8	25.8	20.8	29.1
407	Ill-216	I-8.A	200	5	Heptane	20.0	14000	Maya	6.0	16	Scr	0.0	0.0	106	Scr	0.0	106	5.3	3.04	.81	52.1	3.70	87.3	92.9	92.5	56.1	13.5	26.7	21.8	
408	Ill-216.1	I-8.A	200	5	Heptane	20.0	14000	Maya	6.0	16	Scr	0.0	0.0	106	Scr	0.0	106	5.1	3.04	.81	45.8	3.84	86.0	91.7	91.3	58.5	14.8	28.2	23.4	
409	Ill-217	I-8.A	200	5	Heptane	20.0	2000	Maya	6.0	16	Non	0.0	0.0		Scr	0.0	106	6.1	3.24	1.03	79.6	1.86	92.4	97.5	97.1	47.0	2.4	1.3	-5.2	
410	Ill-218	I-8.A	200	5	Heptane	20.0	14000	Maya	6.0	16	Non	0.0	0.0		Scr	0.0	106	5.7	3.20	.98	81.4	1.82	89.9	95.3	94.9	52.1	6.3	8.9	2.9	
411	Ill-219	I-8.A	28	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	150	Non	0.0		8.0	3.05	.89	18.5	3.54	83.7	86.4	86.2	36.8	16.8	23.3	18.2	
412	Ill-220	I-8.A	28	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		8.4	3.06	.90	27.6	3.80	90.7	93.1	92.9	28.1	9.6	15.1	9.5	
413	Ill-221	I-8.A	200	5	Heptane	20.0	14000		0.0		Scr	0.0	0.0	106	Non	0.0		6.8	2.97	.78	44.9	3.45	94.7	99.1	98.8	39.2	8.4	23.8	18.8	
414	Pit-213	P-8.A	28	20	Heptane	30.0	2000		0.0		Scr	0.0	0.0	600	Non	0.0		7.8	4.17	1.89	70.8	5.73	96.3	99.1	98.8	25.6	5.3	9.7	6.5	
415	Pit-214	P-8.A	28	20	Heptane	20.0	2000		0.0		Scr	0.0	0.0	600	Non	0.0		7.7	4.07	1.79	69.3	6.25	96.1	99.0	98.6	26.8	7.8	14.8	11.8	
416	Pit-215	P-8.A	28	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	425	Non	0.0		6.9	4.06	1.76	32.0	8.04	89.0	92.6	92.2	39.2	14.8	22.4	19.6	
417	Pit-216	P-8.A	28	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	212	Non	0.0		7.2	4.20	1.91	46.8	10.28	94.0	97.4	97.0	33.0	6.9	11.2	8.0	
418	Ufp-208	U-8.A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		8.2	1.56	.97	73.2	8.37	90.4	98.0	97.0	48.5	35.6	46.5	42.7	
419	Ufp-208.1	U-8.A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		8.5	1.47	.88	71.9	7.68	90.1	97.2	96.3	46.8	39.5	51.6	48.1	
420	Ufp-209	U-8.A	200	5	Heptane	20.0	2000	Maya	6.0	16	Scr	0.0	0.0	106	Scr	0.0	106	8.4	1.73	1.14	72.4	7.99	89.5	96.7	95.8	47.7	29.4	37.8	33.3	
421	Ufp-209.1	U-8.A	200	5	Heptane	20.0	2000	Maya	6.0	16	Scr	0.0	0.0	106	Scr	0.0	106	8.6	1.61	1.02	73.1	7.67	89.7	96.7	95.8	46.3	33.9	43.9	39.9	
422	Ufp-210	U-8.A	200	5	Heptane	20.0	14000	Maya	6.0	16	Scr	0.0	0.0	106	Scr	0.0	106	9.6	1.78	1.20	78.7	7.75	92.0	98.0	97.2	38.9	25.1	32.6	27.7	
423	Ufp-211	U-8.A	200	5	Heptane	20.0	2000	Maya	6.0	16	Non	0.0	0.0		Scr	0.0	106	9.9	2.23	1.65	75.8	3.98	91.9	97.5	96.8	37.0	6.2	7.2	.5	
424	Ufp-212	U-8.A	200	5	Heptane	20.0	14000	Maya	6.0	16	Non	0.0	0.0		Scr	0.0	106	10.8	2.09	1.51	77.5	3.69	93.5	98.0	97.4	29.8	10.9	13.6	7.4	
425	Ufp-213	U-8.A	28	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	425	Non	0.0		10.0	1.73	1.15	34.9	4.53	83.2	88.1	87.5	42.2	34.3	41.6	37.4	
426	Ufp-214	U-8.A	28	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	212	Non	0.0		10.5	1.82	1.24	49.4	5.91	89.6	94.2	93.6	34.7	25.6	32.0	27.1	
427	Ufp-215	U-8.A	28	20	Diesel	1.0	2000		0.0		2-F	.1	.1		Non	0.0		6.3	1.23	.62	32.0	4.47	68.6	76.0	75.1	69.9	61.6	74.0	72.1	
428	Ufp-216	U-8.A	28	20	M1/D1	1.0	2000		0.0		2-F	.1	.1		Non	0.0		7.1	1.40	.80	41.3	5.45	78.9	86.6	85.6	60.9	49.6	61.5	58.7	
429	Ufp-217	U-8.A	28	5	Diesel	1.0	2000		0.0		2-F	.1	.1		Non	0.0		5.8	1.04	.44	32.9	4.78	69.2	77.2	76.1	72.0	67.0	81.5	80.2	
430	Ufp-218	U-8.A	200	5	Heptane	20.0	14000		0.0		Scr	0.0	0.0	106	Non	0.0		10.3	1.94	1.36	76.1	7.24	92.3	97.4	96.8	34.0	18.2	23.2	17.7	
431	Pit-217	P-8.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.2	3.85	1.54	70.0	13.20	94.0	98.6	98.1	42.1	14.5	28.4	25.9	29.9
432	Pit-217.1	P-8.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.5	3.85	1.55	75.6	12.14	94.6	98.9	98.4	38.9	14.0	27.7	25.1	

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	LOW SHEAR MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
433	Pit-218	P-8.A	200	5	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.6	3.60	1.27	43.9	8.27	93.6	98.8	98.2	48.0	20.5	41.1	39.0	
434	Pit-218.1	P-8.A	200	5	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.2	3.51	1.17	74.9	2.93	92.5	98.2	97.6	52.2	23.4	46.3	44.4	
435	Pit-219	P-8.A	200	10	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.7	3.74	1.42	69.2	13.21	93.9	99.0	98.4	46.9	17.2	34.3	31.9	
436	Pit-219.1	P-8.A	200	10	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.8	3.70	1.38	70.1	13.99	93.7	98.8	98.2	46.0	18.2	36.1	33.8	
437	Pit-220	P-8.A	200	10	M1/D1	.9	2000		0.0		2-F	0.0	0.0		Non	0.0		5.4	3.57	1.24	61.1	12.62	93.5	99.0	98.4	49.9	21.2	42.7	40.7	
438	Pit-220.1	P-8.A	200	10	M1/D1	1.1	2000		0.0		2-F	0.0	0.0		Non	0.0		5.4	3.51	1.18	56.2	13.42	93.0	98.5	97.8	50.1	23.0	45.9	43.9	
439	Pit-220.2	P-8.A	200	10	M1/D1	1.1	2000		0.0		2-F	0.0	0.0		Non	0.0		5.5	3.46	1.13	56.2	13.77	90.9	96.1	95.5	50.3	25.8	49.2	47.4	
440	Pit-220.3	P-8.A	200	10	M1/D1	.9	2000		0.0		2-F	0.0	0.0		Non	0.0		5.5	3.48	1.15	62.9	13.87	92.0	97.3	96.6	49.8	24.5	47.7	45.8	
441	Pit-221	P-8.A	200	10	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.3	3.87	1.56	72.6	12.61	94.7	99.2	98.7	40.8	13.5	26.9	24.3	27.0
442	Pit-221.1	P-8.A	200	10	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.2	3.73	1.42	74.1	13.77	94.2	98.8	98.3	42.0	17.1	33.9	31.6	
443	Pit-222	P-8.A	200	5	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.7	3.71	1.39	68.6	13.02	95.0	100.2	99.6	46.2	16.8	34.9	32.6	
444	Pit-222.1	P-8.A	200	5	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.7	3.67	1.34	70.8	13.79	93.4	98.5	97.9	47.2	19.2	37.9	35.7	
445	Pit-223	P-8.A	200	20	M1/D1	1.1	2000		0.0		2-F	0.0	0.0		Non	0.0		5.8	3.63	1.31	56.7	12.09	90.2	95.1	94.5	48.0	22.8	41.7	39.6	
446	Pit-223.1	P-8.A	200	20	M1/D1	1.1	2000		0.0		2-F	0.0	0.0		Non	0.0		6.1	3.70	1.38	71.1	13.51	93.7	98.4	97.8	43.3	18.2	35.8	33.5	
447	Pit-224	P-8.A	200	20	M1/D1	.9	2000		0.0		2-F	0.0	0.0		Non	0.0		5.5	3.57	1.24	52.2	12.39	90.0	95.2	94.6	50.9	24.2	44.8	42.8	
448	Pit-224.1	P-8.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.7	3.55	1.22	60.2	13.81	92.3	97.4	96.8	47.8	22.7	44.1	42.1	
449	Pit-225	P-8.A	200	20	M1/D1	.9	2000		0.0		2-F	0.0	0.0		Non	0.0		5.6	3.55	1.22	53.2	12.99	93.3	98.6	98.0	48.1	21.8	43.5	41.5	
450	Pit-225.1	P-8.A	200	20	M1/D1	.8	2000		0.0		2-F	0.0	0.0		Non	0.0		5.8	3.61	1.29	60.8	13.61	92.9	97.9	97.3	46.5	20.8	40.8	38.6	
451	Pit-226	P-8.A	200	20	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.2	4.00	1.68	67.2	9.67	93.6	98.1	97.6	42.6	11.7	22.0	19.2	
452	Pit-227	P-8.A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.1	3.89	1.57	77.6	11.63	94.9	99.7	99.2	42.7	12.9	26.1	23.5	
453	Pit-228	P-8.A	200	20	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		18.4	3.85	1.84	9.8	4.20	.3	.2	.2	99.5	99.8	99.8	99.8	
454	Pit-229	P-8.A	200	5	Heptane	20.0	14000		0.0		Scr	0.0	0.0	106	Non	0.0		6.3	4.07	1.76	78.6	9.69	95.1	99.6	99.1	40.7	8.7	17.3	14.4	
455	Pit-230	P-8.A	200	20	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.8	4.25	1.95	83.9	7.43	95.8	99.8	99.3	35.5	4.0	7.6	4.3	
456	Ill-222	I-8.A	200	5	Heptane	10.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		8.4	2.99	.83	10.5	3.00	80.8	82.9	82.8	36.0	21.3	30.2	25.6	33.2
457	Ill-223	I-8.A	200	5	Heptane	30.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		8.5	2.95	.80	9.5	3.20	90.1	92.4	92.2	27.7	13.4	25.7	20.8	18.5
458	Ill-224	I-8.A	200	5	Heptane	150.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.6	2.96	.76	37.5	3.54	90.9	95.3	95.0	43.4	12.3	28.3	23.5	27.8
459	Pit-231	P-8.A	200	5	Heptane	10.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		5.3	3.47	1.13	54.4	11.89	91.5	97.0	96.4	52.0	25.1	48.7	46.9	
460	Pit-232	P-8.A	200	5	Heptane	30.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.1	3.67	1.35	76.5	14.11	94.4	99.2	98.6	43.0	18.2	36.8	34.5	
461	Pit-233	P-8.A	200	5	Heptane	150.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.4	3.81	1.50	54.4	10.28	93.1	97.5	97.0	41.0	16.3	30.9	28.4	
462	Ufp-219	U-8.A	200	5	Heptane	10.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		7.5	1.25	.65	56.7	7.71	86.7	94.8	93.7	54.8	50.5	65.4	62.9	64.3
463	Ufp-220	U-8.A	200	5	Heptane	30.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		8.3	1.50	.91	72.6	8.41	90.7	98.2	97.2	47.7	37.8	49.6	46.0	48.4
464	Ufp-221	U-8.A	200	5	Heptane	150.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		8.6	1.54	.95	68.9	8.34	92.5	99.7	98.8	44.7	34.9	46.3	42.4	44.3
465	Ill-231	I-8.A	200	20	Heptane	50.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		9.6	3.07	.94	22.1	3.52	96.5	97.7	97.6	12.6	3.5	5.9	-.4	
466	Ill-232	I-8.A	200	20	Heptane	100.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		9.9	3.09	.97	14.1	3.42	96.7	97.5	97.5	9.7	2.6	2.9	-3.5	
467	Ill-233	I-8.A	200	20	Heptane	150.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		9.9	3.00	.88	18.9	3.64	93.7	94.5	94.5	12.5	8.4	14.7	9.0	18.3
468	Ill-235	I-8.A	200	5	Heptane	6.0	2000		0.0		Flo	.5	0.0		Non	0.0		6.7	2.79	.59	11.0	3.18	43.4	45.4	45.3	72.6	60.6	73.3	71.5	
469	Ill-236	I-8.A	28	5	Diesel	2.0	2000		0.0		2-F	0.0	0.0		Non	0.0		4.9	2.82	.58	16.3	3.56	64.5	68.9	68.6	70.0	40.9	61.4	58.8	
470	Ill-236.1	I-8.A	28	5	Diesel	2.0	2000		0.0		2-F	0.0	0.0		Non	0.0		4.9	2.85	.61	16.3	3.52	65.8	70.3	70.0	69.4	39.0	58.5	55.8	

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	LOW SHEAR MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
471	Ill-237	I-8.A	200	5	Diesel	2.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.9	2.75	.56	40.4	4.10	89.0	93.0	92.7	41.7	20.4	48.8	45.4	
472	Pit-234	P-8.A	200	20	Heptane	50.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		7.0	4.13	1.83	81.5	8.63	95.5	99.2	98.8	33.8	7.0	13.3	10.2	14.9
473	Pit-235	P-8.A	200	20	Heptane	100.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		7.7	4.14	1.86	78.1	7.17	96.5	99.4	99.0	26.5	5.8	11.1	8.0	
474	Pit-236	P-8.A	200	20	Heptane	150.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		7.5	4.18	1.90	74.2	7.76	96.3	99.4	99.1	28.5	5.1	9.6	6.4	
475	Pit-237	P-8.A	200	15	Heptane	50.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.8	4.07	1.77	76.9	9.65	95.0	99.0	98.5	36.0	8.8	16.8	13.8	15.3
476	Pit-238	P-8.A	200	15	Heptane	100.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.5	3.95	1.64	71.4	11.65	94.4	98.6	98.1	39.3	12.1	23.3	20.6	
477	Pit-239	P-8.A	200	15	Heptane	150.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.7	3.90	1.60	72.8	11.98	94.3	98.3	97.8	37.5	13.3	25.5	22.8	
478	Pit-240	P-8.A	200	10	Heptane	50.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.3	3.81	1.50	73.0	12.77	94.3	98.8	98.2	41.2	15.3	30.2	27.7	
479	Pit-241	P-8.A	200	10	Heptane	100.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.3	3.84	1.53	70.2	12.38	94.2	98.7	98.2	41.2	14.7	28.8	26.2	
480	Pit-242	P-8.A	200	10	Heptane	150.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.3	3.74	1.43	68.7	12.38	93.7	98.2	97.7	41.5	17.3	33.8	31.4	
481	Pit-243	P-8.A	200	5	Heptane	6.0	2000		0.0		2-F	0.0	0.0		Non	0.0		4.1	3.15	.78	12.7	4.84	40.0	43.0	42.6	83.8	70.3	84.5	84.0	
482	Pit-243.1	P-8.A	200	5	Heptane	6.0	2000		0.0		2-F	0.0	0.0		Non	0.0		4.2	3.10	.74	13.5	4.91	44.0	47.2	46.9	81.7	67.8	84.0	83.4	
483	Ufp-222	U-8.A	200	5	Heptane	6.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.4	.99	.38	21.6	3.10	43.2	48.4	47.7	83.8	80.5	90.0	89.2	91.0
484	Ufp-222.1	U-8.A	200	5	Heptane	6.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.5	.99	.38	21.8	3.11	44.1	49.3	48.6	83.2	80.1	89.7	89.0	
485	Ufp-223	U-8.A	28	5	Diesel	2.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.0	1.20	.60	41.7	6.04	79.2	87.2	86.1	61.7	56.6	71.0	68.9	
486	Ufp-223.1	U-8.A	28	5	Diesel	2.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.7	1.07	.47	36.3	5.33	73.5	81.2	80.2	66.0	64.1	79.0	77.5	
487	Ufp-224	U-8.A	200	10	Heptane	50.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		8.9	1.67	1.08	72.1	7.04	91.5	98.2	97.3	43.5	30.3	39.5	35.2	
488	Ufp-225	U-8.A	200	10	Heptane	100.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		8.9	1.70	1.11	69.9	7.25	90.5	97.2	96.3	44.1	29.8	38.5	34.1	
489	Ufp-225.1	U-8.A	200	10	Heptane	100.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		9.0	1.69	1.10	69.9	7.23	89.9	96.5	95.6	43.8	30.6	39.4	35.0	
490	Ufp-227	U-8.A	200	15	Heptane	50.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		10.3	1.93	1.35	72.7	5.90	94.8	100.1	99.4	32.2	16.4	21.7	16.1	
491	Ufp-226	U-8.A	200	10	Heptane	150.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		9.3	1.73	1.15	69.9	7.22	90.3	96.5	95.7	41.7	28.7	36.9	32.3	30.9
492	Ufp-228	U-8.A	200	15	Heptane	100.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		9.2	1.65	1.07	70.0	7.41	91.7	98.1	97.3	41.4	30.9	40.4	36.1	
493	Ufp-229	U-8.A	200	15	Heptane	150.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		9.3	1.76	1.18	67.2	6.17	90.4	96.6	95.8	41.6	27.3	35.1	30.4	
494	Ufp-230	U-8.A	200	20	Heptane	50.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		10.2	1.99	1.41	72.1	5.86	92.5	97.7	97.1	34.5	15.9	20.3	14.6	
495	Ill-225	I-8.A	200	10	Heptane	50.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.3	2.83	.63	14.5	3.22	60.5	63.7	63.4	64.0	44.2	60.8	58.2	
496	Ill-226	I-8.A	200	10	Heptane	100.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		7.2	2.92	.74	13.6	3.21	72.0	74.9	74.7	51.1	31.5	45.1	41.5	
497	Ill-227	I-8.A	200	10	Heptane	150.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		5.1	2.78	.55	16.3	3.36	55.8	59.5	59.2	73.2	49.5	68.4	66.3	70.5
498	Ill-228	I-8.A	200	15	Heptane	50.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		8.2	3.04	.88	18.2	3.25	84.5	87.0	86.8	34.6	16.3	23.0	17.9	
499	Ill-229	I-8.A	200	15	Heptane	100.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		7.7	2.96	.79	18.6	3.35	78.3	81.0	80.8	43.1	24.5	36.2	31.9	
500	Ill-230	I-8.A	200	15	Heptane	150.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		7.6	2.93	.76	19.8	3.42	80.3	83.2	83.0	42.4	23.4	37.2	33.1	41.6
501	Ill-234	I-8.A	200	5	Heptane	6.0	2000		0.0		Flo	0.0	0.0		Non	0.0		0.0	0.00	-2.35	10.6	3.07	0.0	0.0	0.0	100.0	100.0	100.0	100.0	
502	Pit-237.1	P-8.A	200	15	Heptane	50.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.8	3.87	1.57	78.3	10.13	96.2	100.2	99.7	35.2	12.2	25.3	22.6	
503	Pit-240.1	P-8.A	200	10	Heptane	50.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.2	3.65	1.33	75.0	12.03	93.8	98.4	97.9	42.4	19.2	38.0	35.8	
504	Ill-227.1	I-8.A	200	10	Heptane	150.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		5.4	2.72	.49	15.8	3.35	57.2	60.7	60.5	70.9	49.4	70.8	68.8	
505	Ill-228.1	I-8.A	200	15	Heptane	50.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		7.5	2.94	.76	16.0	3.20	74.3	77.0	76.8	47.5	28.9	41.3	37.4	
506	Ufp-230.1	U-8.A	200	20	Heptane	50.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		10.0	1.97	1.39	68.0	5.51	92.9	98.4	97.7	35.5	16.5	21.2	15.5	
507	Ufp-231	U-8.A	200	20	Heptane	100.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		10.6	2.01	1.43	73.7	5.21	92.4	97.2	96.5	32.0	15.2	19.1	13.3	
508	Ufp-232	U-8.A	200	20	Heptane	150.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		11.9	2.02	1.45	70.6	2.57	95.1	98.3	97.9	21.4	12.3	15.7	9.6	

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CH REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
509	Ken-1	K-1.A	28	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.9	3.41	1.63	72.6	17.32	88.4	97.4	96.3	54.8	37.5	54.9	53.9	55.4
510	Ken-2	K-1.A	28	20	M1/D1	1.5	2000		0.0		2-F	0.0	0.0		Non	0.0		6.5	3.07	1.26	70.0	16.10	86.4	96.8	95.5	63.6	45.1	66.0	65.2	64.4
511	Ken-3	K-1.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		8.2	3.44	1.67	73.6	15.82	88.9	97.6	96.5	52.9	36.6	53.6	52.6	
512	Ken-3.1	K-1.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		8.3	3.51	1.74	75.4	15.72	89.7	98.4	97.3	51.9	34.8	51.2	50.1	
513	Ken-4	K-1.A	28	20	Diesel	1.5	2000		0.0		2-F	0.0	0.0		Non	0.0		6.6	3.13	1.32	73.6	15.19	89.2	99.9	98.6	61.9	42.3	63.2	62.4	
514	Ken-5	K-1.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.8	3.57	1.79	72.9	13.68	88.6	97.7	96.6	55.3	34.5	50.4	49.3	
515	Ken-6	K-1.A	200	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		8.4	3.70	1.93	77.0	13.23	91.4	100.2	99.1	50.4	29.9	44.7	43.5	
516	Ken-7	K-1.A	28	20	Diesel	1.5	2000		0.0		2-F	0.0	0.0		Non	0.0		6.6	3.04	1.23	68.5	17.67	86.4	96.7	95.5	63.1	45.7	66.8	66.1	66.2
517	Ken-8	K-1.A	28	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.1	3.03	1.23	63.7	13.85	84.8	94.4	93.2	61.0	46.8	67.3	66.5	
518	Ken-9	K-1.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.9	3.23	1.45	73.8	16.79	88.1	97.2	96.1	55.0	41.0	60.0	59.1	
519	Ken-10	K-1.A	28	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.5	3.15	1.36	66.9	15.66	85.5	94.6	93.5	58.5	44.2	63.6	62.8	
520	Ken-11	K-1.A	28	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.0	3.00	1.20	65.5	15.61	83.8	93.4	92.2	62.0	47.9	68.5	67.8	67.9
521	Ken-12	K-1.A	28	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.2	3.07	1.27	66.6	16.06	85.5	95.1	93.9	60.1	45.6	65.9	65.1	
522	Pit-244	P-9.A	28	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.7	4.08	1.81	39.6	7.22	92.1	95.3	94.9	32.3	15.9	26.5	21.2	
523	Pit-245	P-9.A	28	20	M1/D1	1.5	2000		0.0		Flo	0.0	0.0		Non	0.0		6.6	3.80	1.49	42.2	9.27	89.8	94.2	93.7	43.3	23.7	40.7	36.5	34.2
524	Pit-245.1	P-9.A	28	20	M1/D1	1.5	2000		0.0		Flo	0.0	0.0		Non	0.0		6.4	3.74	1.43	53.6	10.27	93.7	98.5	98.0	42.5	21.6	40.8	36.6	35.8
525	Pit-246	P-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.9	4.23	1.96	52.1	6.13	94.3	97.4	97.0	28.8	10.7	18.2	12.4	
526	Pit-246.1	P-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		8.3	4.15	1.89	57.8	7.21	95.2	97.9	97.5	24.5	11.5	20.4	14.7	6.4
527	Pit-248	P-9.A	28	20	M1/D1	1.5	2000		0.0		2-F	0.0	0.0		Non	0.0		6.5	3.76	1.45	42.6	8.72	89.7	94.2	93.7	44.2	24.6	42.4	38.3	
528	Pit-249	P-9.A	28	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.9	4.30	2.03	32.1	6.59	92.1	95.1	94.7	30.5	11.4	17.3	11.4	
529	Pit-250	P-9.A	28	20	M1/D1	1.5	2000		0.0		2-F	0.0	0.0		Non	0.0		6.5	3.74	1.43	36.2	8.19	88.9	93.4	92.9	44.7	25.6	43.7	39.7	33.6
530	Pit-250.1	P-9.A	28	20	M1/D1	1.5	2000		0.0		2-F	0.0	0.0		Non	0.0		6.7	3.74	1.44	36.1	8.33	88.9	93.1	92.6	43.1	25.7	43.6	39.5	
531	Pit-251	P-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		8.4	4.21	1.95	51.2	5.02	97.2	99.7	99.4	22.1	8.4	16.1	10.1	
532	Pit-251.1	P-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		8.3	4.22	1.96	47.8	5.34	96.4	99.0	98.7	23.6	8.9	16.4	10.5	
533	Pit-253	P-9.A	28	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.1	3.92	1.63	47.9	8.80	93.6	97.6	97.1	36.3	17.9	32.5	27.7	
534	Pit-254	P-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.5	3.73	1.42	69.8	12.96	95.3	100.1	99.6	40.8	20.4	39.9	35.7	
535	Pit-255.1	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.2	3.77	1.46	61.8	12.06	46.5	49.0	48.7	72.5	60.8	70.0	67.9	
536	Pit-255.2	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.8	3.90	1.60	61.8	12.06	17.5	18.3	18.2	88.7	84.7	87.6	86.7	
537	Pit-255.3	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.3	4.02	1.74	61.8	12.06	13.1	13.6	13.5	90.9	88.2	90.0	89.3	
538	Pit-255.4	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.4	4.18	1.92	61.8	12.06	10.7	11.0	10.9	91.4	90.0	90.9	90.3	
539	Pit-255.5	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		9.1	4.30	2.06	61.8	12.06	5.6	5.7	5.7	95.1	94.6	94.9	94.5	
540	Pit-258.1	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.0	3.79	1.50	69.6	13.08	53.4	55.8	55.5	64.3	54.7	64.6	62.1	
541	Pit-258.2	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.2	3.89	1.60	69.6	13.08	21.6	22.5	22.4	85.1	81.2	84.7	83.6	
542	Pit-258.3	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.2	3.85	1.56	69.6	13.08	13.9	14.5	14.4	90.5	88.0	90.4	89.7	
543	Pit-258.4	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.2	4.04	1.78	69.6	13.08	3.8	3.9	3.9	97.0	96.6	97.0	96.8	
544	Pit-258.5	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		9.3	4.35	2.12	69.6	13.08	1.9	1.9	1.9	98.3	98.1	98.2	98.1	
545	Pit-259.1	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		5.9	3.47	1.15	64.6	14.67	20.4	21.5	21.4	88.5	84.2	89.6	88.9	88.8
546	Pit-259.2	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.2	3.59	1.28	64.6	14.67	12.8	13.5	13.4	92.4	89.7	92.8	92.3	92.4

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	LOW SHEAR MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
547	Pit-259.3	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.8	3.71	1.41	64.6	14.67	21.3	22.3	22.2	86.1	82.3	86.7	85.7	85.7
548	Pit-259.4	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.5	3.92	1.64	64.6	14.67	23.5	24.4	24.3	83.1	79.3	82.9	81.7	81.8
549	Pit-259.5	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.9	4.17	1.93	64.6	14.67	15.6	15.9	15.9	86.7	85.4	86.7	85.7	84.9
550	Pit-254.1	P-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.4	3.74	1.43	69.2	13.14	95.2	100.1	99.5	41.8	20.3	39.7	35.4	34.9
552	Pit-A	P-9.A	200	20	M1/D1	1.3	2000		0.0		2-F	0.0	0.0		Non	0.0		5.4	3.45	1.11	60.6	11.29	90.7	96.5	95.9	53.2	30.0	55.3	52.1	
553	Pit-B	P-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.0	3.40	1.06	46.9	9.35	88.3	94.4	93.7	57.8	32.8	58.7	55.8	
554	Pit-C	P-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		4.9	3.33	.98	41.7	9.22	86.2	92.2	91.5	59.7	35.8	62.5	59.8	
555	Pit-D	P-9.A	200	20	M1/D1	.8	2000		0.0		2-F	0.0	0.0		Non	0.0		5.2	3.37	1.03	48.9	10.15	87.0	92.8	92.1	56.8	34.4	60.3	57.4	
556	Pit-E	P-9.A	200	20	M1/D1	.5	2000		0.0		2-F	0.0	0.0		Non	0.0		6.5	3.72	1.41	49.4	9.09	91.6	96.4	95.9	43.1	23.7	42.8	38.8	
557	Ken-13	K-1.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.7	2.73	.90	60.7	14.74	81.8	92.6	91.3	69.8	53.7	76.8	76.3	
558	Pit-256.1	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.9	3.85	1.56	68.7	11.97	57.5	60.1	59.8	62.1	50.5	60.5	57.7	
559	Pit-256.2	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.5	4.05	1.77	68.7	11.97	15.0	15.6	15.5	89.2	86.4	88.2	87.4	
560	Pit-256.3	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.8	3.95	1.68	68.7	11.97	15.4	15.9	15.9	88.5	86.4	88.6	87.8	
561	Pit-256.4	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.3	4.14	1.88	68.7	11.97	5.3	5.5	5.5	95.8	95.1	95.6	95.2	
562	Pit-256.5	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		9.5	4.34	2.11	68.7	11.97	1.8	1.8	1.8	98.3	98.2	98.3	98.2	
563	Pit-257.1	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.9	3.74	1.44	68.2	11.96	49.5	51.7	51.5	67.4	58.6	68.4	66.1	
564	Pit-257.2	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.4	3.93	1.65	68.2	11.96	27.3	28.4	28.2	80.7	76.0	80.1	78.7	
565	Pit-257.3	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.0	4.04	1.77	68.2	11.96	12.1	12.5	12.5	90.7	89.0	90.5	89.8	
566	Pit-257.4	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.4	4.16	1.90	68.2	11.96	3.8	3.9	3.9	96.9	96.4	96.8	96.6	
567	Pit-257.5	P-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		9.4	4.21	1.98	68.2	11.96	.9	1.0	1.0	99.2	99.1	99.2	99.1	
568	Pit-260.1	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		6.7	3.71	1.41	67.1	12.00	51.0	53.4	53.2	67.4	57.6	68.2	65.9	
569	Pit-260.2	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.2	3.88	1.59	67.1	12.00	21.7	22.6	22.4	85.1	81.2	84.7	83.7	
570	Pit-260.3	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.9	4.02	1.75	67.1	12.00	12.7	13.1	13.1	90.4	88.5	90.1	89.4	
571	Pit-260.4	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		8.9	4.20	1.96	67.1	12.00	6.7	6.9	6.9	94.3	93.7	94.2	93.7	
572	Pit-260.5	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		10.0	4.45	2.23	67.1	12.00	2.1	2.1	2.1	98.0	97.9	97.9	97.8	
573	Pit-260.1	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		6.6	3.70	1.40	66.3	12.60	39.9	41.9	41.7	74.8	66.9	75.3	73.6	
574	Pit-260.1	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		6.8	3.80	1.50	66.3	12.60	27.2	28.5	28.3	82.3	76.8	81.9	80.6	
575	Pit-260.1	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.6	4.03	1.75	66.3	12.60	14.2	14.7	14.6	89.7	87.2	89.0	88.2	
576	Pit-260.1	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		8.4	4.25	1.99	66.3	12.60	9.3	9.6	9.5	92.5	91.1	91.8	91.2	
577	Pit-260.1	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		9.7	5.50	3.27	66.3	12.60	3.6	3.7	3.7	96.6	95.5	94.7	94.4	
578	Pit-261.1	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		6.9	3.59	1.29	69.4	13.69	57.8	60.4	60.1	61.9	53.6	66.9	64.6	
579	Pit-261.2	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.7	3.78	1.50	69.4	13.69	22.2	22.9	22.8	83.7	81.3	85.3	84.2	
580	Pit-261.3	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.7	3.94	1.67	69.4	13.69	9.2	9.5	9.5	93.2	91.9	93.2	92.7	
581	Pit-261.4	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		8.6	4.19	1.94	69.4	13.69	4.2	4.3	4.3	96.6	96.1	96.4	96.1	
582	Pit-261.5	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		10.1	4.36	2.15	69.4	13.69	1.4	1.4	1.4	98.7	98.7	98.7	98.6	
583	Pit-262.1	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		6.9	3.79	1.50	70.3	12.27	60.3	63.1	62.7	60.2	48.8	60.1	57.3	
584	Pit-262.2	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.4	3.93	1.65	70.3	12.27	18.3	19.0	18.9	87.1	83.9	85.7	85.7	
585	Pit-262.3	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.9	4.02	1.75	70.3	12.27	11.4	11.8	11.7	91.4	89.7	91.2	90.5	

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	LOW SHEAR MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
586	Pit-262.4	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		9.5	4.16	1.93	70.3	12.27	3.6	3.6	3.6	96.8	96.7	97.0	96.7	
587	Pit-262.5	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		9.9	4.44	2.22	70.3	12.27	1.2	1.2	1.2	98.9	98.8	98.8	98.7	
588	Pit-263.1	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		6.9	3.68	1.38	70.1	12.98	56.8	59.3	59.0	62.6	53.3	65.2	62.8	
589	Pit-263.2	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.3	3.88	1.60	70.1	12.98	24.2	25.2	25.1	83.1	79.0	82.9	81.7	
590	Pit-263.3	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.9	4.09	1.82	70.1	12.98	8.8	9.0	9.0	93.4	92.0	92.9	92.4	
591	Pit-263.4	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		8.8	4.31	2.06	70.1	12.98	3.8	3.9	3.9	96.8	96.3	96.5	96.3	
592	Pit-263.5	P-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		9.8	4.26	2.04	70.1	12.98	1.2	1.2	1.2	98.8	98.8	98.9	98.8	
593	Pit-264.1	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		6.2	3.54	1.23	62.9	12.15	30.1	31.8	31.6	82.2	76.1	83.6	82.5	
594	Pit-264.2	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		6.3	3.68	1.37	62.9	12.15	17.0	17.9	17.8	89.8	86.0	89.7	89.0	
595	Pit-264.3	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		6.9	3.75	1.45	62.9	12.15	18.9	19.8	19.7	87.5	84.1	87.8	87.0	
596	Pit-264.4	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.8	3.97	1.70	62.9	12.15	17.7	18.3	18.2	86.8	84.3	86.7	85.8	
597	Pit-264.5	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		9.5	4.27	2.04	62.9	12.15	9.8	9.9	9.9	91.1	90.6	91.2	90.5	
598	Pit-265.1	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		6.5	3.69	1.38	68.1	13.01	41.5	43.6	43.4	74.2	65.7	74.6	72.8	
599	Pit-265.2	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		6.8	3.79	1.49	68.1	13.01	18.0	18.9	18.8	88.3	84.7	88.1	87.3	
600	Pit-265.3	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.3	3.93	1.65	68.1	13.01	18.6	19.4	19.3	87.0	83.6	86.5	85.5	
601	Pit-265.4	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		8.5	4.18	1.93	68.1	13.01	11.5	11.8	11.8	90.7	89.2	90.2	89.5	
602	Pit-265.5	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		10.3	4.56	2.35	68.1	13.01	4.5	4.5	4.5	95.5	95.4	95.3	95.0	
603	Pit-266.1	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		6.7	3.71	1.41	64.5	12.66	52.2	54.7	54.4	66.6	56.7	67.5	65.2	
604	Pit-266.2	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.1	3.81	1.52	64.5	12.66	20.7	21.6	21.5	86.0	82.4	86.1	85.1	
605	Pit-266.3	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.7	3.90	1.63	64.5	12.66	10.7	11.0	11.0	92.2	90.7	92.3	91.8	
606	Pit-266.4	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		8.5	4.13	1.88	64.5	12.66	7.3	7.5	7.5	94.1	93.2	93.9	93.5	
607	Pit-266.5	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		9.9	4.20	1.98	64.5	12.66	3.0	3.0	3.0	97.2	97.2	97.4	97.2	
608	Pit-267.1	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		6.9	3.80	1.51	68.2	12.44	54.0	56.4	56.1	64.4	54.1	64.1	61.5	
609	Pit-267.2	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.1	3.86	1.57	68.2	12.44	23.8	24.8	24.7	83.9	79.4	83.5	82.3	
610	Pit-267.3	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.6	3.98	1.70	68.2	12.44	11.2	11.6	11.6	91.9	90.0	91.6	91.0	
611	Pit-267.4	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		8.4	4.19	1.93	68.2	12.44	4.1	4.3	4.2	96.7	96.1	96.5	96.2	
612	Pit-267.5	P-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		9.4	4.26	2.03	68.2	12.44	1.6	1.6	1.6	98.6	98.5	98.6	98.5	
613	Ufp-233.1	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.8	1.46	.86	59.2	6.36	38.6	42.5	42.0	80.1	75.7	81.2	79.1	
614	Ufp-233.2	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		8.6	1.55	.96	59.2	6.36	18.9	20.6	20.3	89.3	87.4	89.8	88.6	
615	Ufp-233.3	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		9.2	1.60	1.01	59.2	6.36	14.8	16.0	15.8	91.0	89.8	91.6	90.6	
616	Ufp-233.4	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		10.9	1.79	1.22	59.2	6.36	5.8	6.2	6.1	95.8	95.5	96.0	95.6	
617	Ufp-233.5	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		11.4	1.71	1.14	59.2	6.36	7.5	7.9	7.8	94.4	94.5	95.2	94.7	
618	Ufp-234.1	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.1	1.45	.86	57.9	5.93	37.0	40.6	40.1	80.2	76.9	82.1	80.1	
619	Ufp-234.2	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.3	1.51	.92	57.9	5.93	17.6	19.2	19.0	90.4	88.6	90.9	89.9	
620	Ufp-234.3	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		9.0	1.56	.97	57.9	5.93	13.7	14.9	14.7	91.8	90.8	92.5	91.6	
621	Ufp-234.4	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		10.2	1.69	1.11	57.9	5.93	10.0	10.7	10.6	93.2	92.7	93.7	93.0	
622	Ufp-234.5	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		10.9	1.68	1.11	57.9	5.93	7.4	7.9	7.8	94.6	94.6	95.4	94.8	
623	Ufp-235.1	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.3	1.39	.79	46.3	5.06	29.1	32.2	31.8	86.0	82.6	87.0	85.6	

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	LOW SHEAR MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
624	Ufp-235.2	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.6	1.37	.77	46.3	5.06	10.7	11.8	11.7	94.6	93.7	95.3	94.8	
625	Ufp-235.3	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.8	1.39	.79	46.3	5.06	10.7	11.8	11.7	94.5	93.6	95.2	94.6	
626	Ufp-235.4	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.4	1.44	.85	46.3	5.06	13.6	14.8	14.6	92.5	91.6	93.5	92.8	
627	Ufp-235.5	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		9.4	1.49	.90	46.3	5.06	16.4	17.7	17.5	89.8	89.5	91.6	90.7	
628	Ufp-236.1	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.3	1.30	.70	62.4	7.01	39.5	43.7	43.1	81.0	77.9	84.4	82.7	84.1
629	Ufp-236.2	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.0	1.37	.77	62.4	7.01	17.3	19.0	18.8	90.8	89.8	92.4	91.6	92.5
630	Ufp-236.3	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.9	1.46	.87	62.4	7.01	14.3	15.6	15.4	91.6	91.0	93.0	92.2	93.0
631	Ufp-236.4	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		10.5	1.57	.99	62.4	7.01	9.1	9.7	9.6	93.7	93.8	94.9	94.3	94.9
632	Ufp-236.5	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		16.1	2.05	1.51	62.4	7.01	7.0	6.9	6.9	92.6	93.8	94.0	93.4	93.9
633	Ufp-237.1	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.6	1.37	.77	60.5	6.76	25.3	27.9	27.5	87.3	85.1	89.0	87.8	
634	Ufp-237.2	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.5	1.35	.75	60.5	6.76	9.8	10.9	10.7	95.1	94.3	95.8	95.4	
635	Ufp-237.3	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		8.2	1.45	.86	60.5	6.76	16.4	17.9	17.7	91.1	89.8	92.1	91.2	
636	Ufp-237.4	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		9.3	1.51	.92	60.5	6.76	15.7	16.9	16.8	90.4	89.8	91.8	90.9	
637	Ufp-237.5	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		12.5	1.76	1.20	60.5	6.76	19.7	20.4	20.3	83.9	85.1	86.8	85.3	
638	Ufp-238.1	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.1	1.26	.66	59.1	6.92	26.0	28.8	28.5	87.8	85.9	90.4	89.3	
639	Ufp-238.2	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.2	1.27	.67	59.1	6.92	11.0	12.2	12.0	94.8	94.0	95.9	95.4	
640	Ufp-238.3	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.7	1.32	.72	59.1	6.92	14.5	16.0	15.8	92.6	91.8	94.1	93.4	
641	Ufp-238.4	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		9.0	1.37	.78	59.1	6.92	17.6	19.1	18.9	89.5	89.6	92.2	91.4	
642	Ufp-238.5	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		12.4	1.71	1.14	59.1	6.92	16.6	17.3	17.2	86.5	87.7	89.3	88.1	
643	Ufp-239.1	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.0	1.33	.73	59.3	6.37	20.3	22.6	22.3	90.6	88.4	91.6	90.7	
644	Ufp-239.2	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.1	1.34	.74	59.3	6.37	11.6	12.9	12.7	94.6	93.3	95.2	94.6	
645	Ufp-239.3	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.6	1.40	.80	59.3	6.37	14.4	15.9	15.7	92.8	91.3	93.5	92.7	
646	Ufp-239.4	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.3	1.45	.86	59.3	6.37	17.3	18.9	18.7	90.5	89.2	91.6	90.7	
647	Ufp-239.5	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		11.9	1.77	1.20	59.3	6.37	21.9	22.9	22.8	82.9	83.3	85.1	83.5	
648	Ufp-240.1	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.3	1.34	.74	61.3	6.60	18.7	20.7	20.5	91.0	89.2	92.2	91.3	
649	Ufp-240.2	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.5	1.36	.76	61.3	6.60	9.3	10.3	10.2	95.4	94.5	96.0	95.5	
650	Ufp-240.3	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.8	1.41	.81	61.3	6.60	15.4	16.9	16.7	92.1	90.7	92.9	92.1	
651	Ufp-240.4	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		9.0	1.51	.92	61.3	6.60	20.5	22.2	22.0	87.8	86.7	89.4	88.1	
652	Ufp-240.5	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		11.9	1.74	1.17	61.3	6.60	23.5	24.6	24.4	81.7	82.4	84.5	82.7	
653	Ufp-241.1	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.0	1.34	.74	57.9	6.45	26.0	28.8	28.5	88.0	85.0	89.2	88.0	89.0
654	Ufp-241.2	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.2	1.33	.73	57.9	6.45	8.4	9.4	9.2	96.0	95.2	96.5	96.1	96.5
655	Ufp-241.3	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.4	1.34	.74	57.9	6.45	13.3	14.7	14.5	93.5	92.3	94.4	93.8	94.4
656	Ufp-241.4	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		8.2	1.37	.78	57.9	6.45	17.6	19.3	19.1	90.4	89.6	92.3	91.4	92.1
657	Ufp-241.5	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		11.7	1.61	1.04	57.9	6.45	19.6	20.6	20.5	85.0	86.4	88.5	87.2	88.0
658	Ufp-241.1	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		6.9	1.34	.74	58.5	6.73	25.0	27.9	27.5	88.6	85.6	89.6	88.4	
659	uFP-241.1	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.3	1.34	.74	58.5	6.73	10.1	11.2	11.0	95.1	94.2	95.8	95.3	
660	Ufp-241.1	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.3	1.36	.76	58.5	6.73	12.9	14.3	14.1	93.8	92.5	94.5	93.8	
661	Ufp-241.1	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		8.2	1.42	.83	58.5	6.73	16.3	17.8	17.6	91.2	90.0	92.4	91.5	

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	LOW SHEAR MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
662	Ulp-241.1	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		11.8	1.71	1.14	58.5	6.73	20.8	21.8	21.7	83.9	84.7	86.6	85.1	
663	Ulp-242.1	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.9	1.32	.72	57.3	6.74	16.9	18.8	18.5	92.3	90.4	93.2	92.4	
664	Ulp-242.2	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.8	1.24	.64	57.3	6.74	7.8	8.7	8.6	96.5	95.8	97.2	96.9	
665	Ulp-242.3	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.2	1.31	.71	57.3	6.74	13.8	15.3	15.1	93.4	92.2	94.5	93.8	
666	Ulp-242.4	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.1	1.39	.80	57.3	6.74	18.9	20.8	20.5	89.9	88.7	91.5	90.5	
667	Ulp-242.5	U-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		11.3	1.67	1.10	57.3	6.74	27.4	28.9	28.7	79.5	80.3	83.0	81.1	
668	Ulp-243.1	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.0	1.28	.68	57.9	6.77	15.5	17.2	17.0	92.8	91.5	94.1	93.4	
669	Ulp-243.2	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		6.9	1.28	.68	57.9	6.77	8.7	9.7	9.5	96.0	95.2	96.7	96.3	
670	Ulp-243.3	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.3	1.32	.72	57.9	6.77	14.0	15.4	15.2	93.3	92.1	94.3	93.7	
671	Ulp-243.4	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		8.3	1.42	.83	57.9	6.77	19.8	21.6	21.4	89.2	87.9	90.8	89.7	
672	Ulp-243.5	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		11.1	1.63	1.06	57.9	6.77	27.4	28.9	28.7	79.9	80.7	83.7	81.9	
673	Ulp-244.1	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.4	1.37	.77	61.7	6.69	29.0	32.1	31.7	85.8	82.9	87.4	85.9	86.5
674	Ulp-244.2	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.6	1.39	.79	61.7	6.69	12.0	13.2	13.0	94.0	92.8	94.7	94.1	94.5
675	Ulp-244.3	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.9	1.42	82	61.7	6.69	13.5	14.8	14.6	93.0	91.8	93.7	93.0	93.6
676	Ulp-244.4	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		9.3	1.51	.92	61.7	6.69	16.4	17.8	17.6	89.9	89.3	91.4	90.5	91.0
677	Ulp-244.5	U-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		13.1	1.72	1.16	61.7	6.69	15.9	16.4	16.3	86.3	88.2	89.6	88.4	88.3
678	Ulp-245.1	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		6.9	1.31	.71	55.6	6.33	20.0	22.3	22.0	90.9	88.7	92.0	91.1	
679	Ulp-245.2	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		6.8	1.30	.70	55.6	6.33	8.2	9.1	9.0	96.3	95.4	96.8	96.4	
680	Ulp-245.3	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.2	1.33	.73	55.6	6.33	12.2	13.5	13.3	94.2	93.0	95.0	94.4	
681	Ulp-245.4	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		8.6	1.43	.84	55.6	6.33	19.1	20.8	20.6	89.1	88.2	91.0	89.9	
682	Ulp-245.5	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		10.9	1.60	1.03	55.6	6.33	25.3	26.7	26.6	81.8	82.6	85.4	83.7	
683	Ulp-245.1	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.0	1.31	.71	56.1	6.27	19.5	21.7	21.4	91.0	89.0	92.2	91.3	
684	Ulp-245.1	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.0	1.29	.69	56.1	6.27	7.7	8.6	8.5	96.4	95.7	97.0	96.7	
685	Ulp-245.1	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.4	1.37	.77	56.1	6.27	13.2	14.6	14.4	93.6	92.2	94.3	93.6	
686	Ulp-245.1	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		8.3	1.44	.85	56.1	6.27	18.1	19.7	19.5	90.1	88.8	91.4	90.4	
687	Ulp-245.1	U-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		10.8	1.62	1.04	56.1	6.27	26.4	28.0	27.8	81.1	81.6	84.4	82.7	
688	Ulp-246	U-9.A	200	20	M1/D1	1.0	2400		0.0		2-F	0.0	0.0		Non	0.0		11.9	1.74	1.17	61.3	6.60	82.0	85.7	85.2	36.1	38.5	45.9	39.7	
689	Ulp-247	U-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.0	1.20	.60	53.4	6.72	80.7	89.6	88.4	62.7	58.4	72.8	69.8	
690	Ulp-248	U-9.A	200	20	M1/D1	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		6.6	1.17	.56	50.3	6.23	79.3	88.5	87.3	65.4	60.1	74.7	71.9	
691	Ill-238.1	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		5.0	2.79	.56	66.3	3.61	5.4	5.8	5.8	97.5	95.3	97.3	97.1	
692	Ill-238.2	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		4.9	2.79	.55	66.3	3.61	2.6	2.8	2.8	98.8	97.7	98.7	98.6	
693	Ill-238.3	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		5.3	2.79	.56	66.3	3.61	5.1	5.5	5.5	97.5	95.5	97.4	97.2	
694	Ill-238.4	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		5.5	2.85	.63	66.3	3.61	10.1	10.7	10.7	94.9	91.0	94.3	93.9	
695	Ill-238.5	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		7.0	3.02	.83	66.3	3.61	69.7	72.9	72.7	55.0	34.2	47.4	43.8	
696	Ill-239.1	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		5.6	2.91	.69	71.0	3.19	21.4	22.7	22.6	89.0	80.6	86.6	85.7	
697	Ill-239.2	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		5.6	2.92	.70	71.0	3.19	10.6	11.3	11.3	94.5	90.3	93.2	92.8	
698	Ill-239.3	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		5.8	2.93	.72	71.0	3.19	15.0	15.9	15.9	92.0	86.3	90.3	89.6	
699	Ill-239.4	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		6.2	2.97	.76	71.0	3.19	19.5	20.6	20.5	88.8	81.9	86.5	85.6	

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	LOW SHEAR MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
700	LL-239.5	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		8.7	3.14	.99	71.0	3.19	26.5	27.2	27.1	79.0	74.0	76.2	74.6	
701	LL-240.1	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		6.1	2.92	.71	74.4	3.37	35.9	38.0	37.8	79.8	67.2	76.8	75.3	
702	LL-240.2	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		6.1	2.90	.69	74.4	3.37	17.8	18.8	18.8	90.0	83.9	88.8	88.1	
703	LL-240.3	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		6.1	2.98	.77	74.4	3.37	14.8	15.7	15.6	91.7	86.2	89.6	88.9	
704	LL-240.4	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		6.6	2.94	.74	74.4	3.37	12.6	13.2	13.2	92.3	88.5	91.5	91.0	
705	LL-240.5	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		9.7	3.20	1.08	74.4	3.37	12.5	12.7	12.6	89.0	87.5	87.8	87.0	
706	LL-241.1	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		6.8	2.95	.76	73.6	3.83	35.4	37.2	37.0	77.8	67.3	75.6	74.0	74.8
707	LL-241.2	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		6.3	2.97	.77	73.6	3.83	10.0	10.6	10.6	94.2	90.7	93.0	92.5	92.8
708	LL-241.3	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		6.1	2.94	.73	73.6	3.83	16.8	17.8	17.7	90.5	84.5	88.8	88.1	88.0
709	LL-241.4	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		6.4	2.97	.77	73.6	3.83	19.5	20.6	20.5	88.5	81.9	86.4	85.5	85.9
710	LL-241.5	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		8.6	3.16	1.01	73.6	3.83	12.2	12.6	12.6	90.4	87.9	88.8	88.0	88.0
711	LL-242.1	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		4.8	2.72	.48	73.5	3.64	4.2	4.6	4.5	98.1	96.4	98.2	98.0	
712	LL-242.2	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		4.9	2.70	.46	73.5	3.64	2.1	2.2	2.2	99.1	98.2	99.1	99.1	
713	LL-242.3	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		5.3	2.73	.50	73.5	3.64	3.5	3.7	3.7	98.3	97.0	98.4	98.3	
714	LL-242.4	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		5.4	2.79	.56	73.5	3.64	6.6	7.0	7.0	96.7	94.3	96.6	96.4	
715	LL-242.5	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.1	3.00	.82	73.5	3.64	77.3	80.8	80.6	49.3	27.5	42.8	38.9	
716	LL-243.1	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		5.3	2.79	.56	71.0	3.43	9.6	10.5	10.4	95.2	91.5	95.0	94.7	
717	LL-243.2	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		5.3	2.81	.58	71.0	3.43	6.8	7.3	7.3	96.7	94.0	96.4	96.1	
718	LL-243.3	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		5.3	2.81	.58	71.0	3.43	10.9	11.7	11.6	94.7	90.4	94.2	93.8	
719	LL-243.4	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		5.5	2.83	.61	71.0	3.43	16.6	17.6	17.6	91.6	85.4	90.9	90.3	
720	LL-243.5	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.5	3.06	.89	71.0	3.43	50.9	53.0	52.8	64.7	51.3	59.1	56.4	
721	LL-244.1	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.4	2.92	.72	74.6	3.31	29.6	31.2	31.0	82.5	73.0	80.7	79.4	
722	LL-244.2	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.2	2.92	.71	74.6	3.31	22.9	24.2	24.1	86.9	79.1	85.1	84.1	
723	LL-244.3	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.2	2.95	.74	74.6	3.31	15.4	16.2	16.2	91.2	85.8	89.6	88.9	
724	LL-244.4	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.5	2.97	.77	74.6	3.31	13.3	13.9	13.9	92.0	87.7	90.7	90.1	
725	LL-244.5	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.9	3.14	1.00	74.6	3.31	12.8	13.1	13.1	89.6	87.4	88.4	87.7	
726	LL-245.1	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.3	2.82	.62	64.1	3.94	31.5	33.3	33.1	81.7	72.2	82.4	81.2	
727	LL-245.2	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		5.9	2.85	.64	64.1	3.94	18.8	19.9	19.9	89.8	83.2	89.1	88.4	
728	LL-245.3	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		5.8	2.85	.63	64.1	3.94	13.6	14.5	14.4	92.7	87.9	92.2	91.6	
729	LL-245.4	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.2	2.90	.69	64.1	3.94	11.4	12.0	12.0	93.5	89.7	92.8	92.3	
730	LL-245.5	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		9.0	3.08	.94	64.1	3.94	17.9	18.3	18.3	85.3	82.8	84.8	83.8	
731	LL-240.1	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		6.9	2.95	.76	72.9	3.65	37.9	39.8	39.6	75.8	65.0	73.8	72.1	
732	LL-240.1	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		6.3	2.97	.77	72.9	3.65	17.1	18.0	17.9	90.1	84.2	88.1	87.3	
733	LL-240.1	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		5.9	2.89	.68	72.9	3.65	16.2	17.1	17.1	91.2	85.4	90.1	89.4	
734	LL-240.1	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		6.5	2.96	.76	72.9	3.65	9.9	10.4	10.4	94.0	90.8	93.2	92.7	
735	LL-240.1	I-9.A	200	20	M1/D1	1.0	2400		0.0		Flo	0.0	0.0		Non	0.0		9.0	3.19	1.05	72.9	3.65	14.6	15.0	15.0	88.0	85.4	86.1	85.1	
736	LL-244.1	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.5	2.91	.71	71.1	3.71	22.3	23.5	23.4	86.6	79.7	85.6	84.7	
737	LL-244.1	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.1	2.92	.71	71.1	3.71	13.7	14.5	14.4	92.3	87.5	91.2	90.6	

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	LOW SHEAR MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
738	Ill-244.1	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.2	2.95	.74	71.1	3.71	14.0	14.8	14.7	92.0	87.1	90.6	89.9	
739	Ill-244.1	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.3	3.01	.81	71.1	3.71	16.7	17.6	17.6	90.3	84.3	87.8	86.9	
740	Ill-244.1	I-9.A	200	20	M1/D1	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.7	3.16	1.01	71.1	3.71	24.5	25.2	25.2	80.5	75.8	77.5	76.0	
741	Ill-246.1	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		4.9	2.72	.48	66.9	3.72	6.9	7.4	7.3	96.9	94.2	97.0	96.8	96.7
742	Ill-246.2	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		5.6	2.69	.47	66.9	3.72	3.9	4.1	4.1	98.0	96.8	98.4	98.2	98.0
743	Ill-246.3	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		5.6	2.72	.50	66.9	3.72	5.1	5.5	5.4	97.3	95.6	97.7	97.5	97.3
744	Ill-246.4	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		5.6	2.77	.55	66.9	3.72	8.9	9.4	9.4	95.4	92.3	95.6	95.3	95.2
745	Ill-246.5	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.1	2.98	.80	66.9	3.72	68.5	71.6	71.4	55.1	36.2	50.6	47.2	47.3
746	Ill-247.1	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		5.2	2.76	.53	69.0	4.01	5.6	5.9	5.9	97.3	95.2	97.3	97.2	
747	Ill-247.2	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		5.2	2.76	.53	69.0	4.01	2.6	2.8	2.8	98.8	97.8	98.8	98.7	
748	Ill-247.3	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		5.7	2.85	.63	69.0	4.01	4.4	4.7	4.7	97.7	96.1	97.5	97.3	
749	Ill-247.4	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		6.1	2.84	.63	69.0	4.01	6.8	7.2	7.2	96.1	93.9	96.1	95.8	
750	Ill-247.5	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.2	3.06	.88	69.0	4.01	75.0	78.3	78.0	50.2	28.3	40.3	36.2	
751	Ill-248.1	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		5.3	2.80	.57	69.5	3.79	8.7	9.3	9.2	95.8	92.4	95.5	95.2	
752	Ill-248.2	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		5.2	2.81	.58	69.5	3.79	4.6	5.0	4.9	97.8	95.9	97.6	97.4	
753	Ill-248.3	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		5.2	2.85	.62	69.5	3.79	6.9	7.4	7.4	96.7	93.8	96.1	95.8	
754	Ill-248.4	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		5.5	2.88	.66	69.5	3.79	13.4	14.2	14.2	93.2	88.0	92.0	91.5	
755	Ill-248.5	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.4	3.07	.89	69.5	3.79	65.4	68.1	67.9	55.3	37.2	47.0	43.5	
756	Ill-249.1	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		5.3	2.81	.58	73.1	3.71	8.6	9.2	9.1	95.8	92.5	95.5	95.2	95.6
757	Ill-249.2	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		5.1	2.80	.57	73.1	3.71	5.2	5.6	5.6	97.5	95.4	97.3	97.1	97.3
758	Ill-249.3	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		5.1	2.79	.56	73.1	3.71	7.2	7.7	7.7	96.6	93.7	96.4	96.1	96.2
759	Ill-249.4	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		5.4	2.82	.59	73.1	3.71	13.7	14.6	14.5	93.2	87.9	92.6	92.1	92.3
760	Ill-249.5	I-9.A	200	20	M1/D1	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.3	3.06	.88	73.1	3.71	58.6	61.1	60.9	60.5	44.0	53.2	50.1	52.7
761	Ill-250	I-9.A	200	20	M1/D1	1.0	2400		0.0		2-F	0.0	0.0		Non	0.0		5.9	2.91	.70	66.8	3.57	91.4	96.9	96.5	50.2	16.9	42.2	38.3	
762	Ill-251	I-9.A	200	20	M1/D1	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		5.9	2.97	.76	75.0	3.09	93.1	98.7	98.3	49.3	13.6	36.1	31.8	
763	Ill-252.1	I-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.5	2.86	.64	73.2	3.15	36.6	38.9	38.8	81.4	67.3	78.9	77.5	
764	Ill-252.2	I-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.6	2.94	.72	73.2	3.15	20.2	21.5	21.4	89.5	81.4	86.8	85.9	
765	Ill-252.3	I-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.6	2.97	.75	73.2	3.15	13.6	14.4	14.4	93.0	87.4	90.8	90.2	
766	Ill-252.4	I-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.1	3.02	.81	73.2	3.15	13.2	14.0	13.9	92.6	87.5	90.3	89.6	
767	Ill-252.5	I-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		8.1	3.14	.98	73.2	3.15	9.2	9.5	9.5	93.2	91.0	91.9	91.3	
768	Pit-268	P-9.A	200	20	M1/D1	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		6.6	3.78	1.48	60.6	12.95	92.6	97.2	96.6	41.6	21.6	39.5	35.2	
769	Pit-269	P-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.7	3.81	1.51	63.5	12.74	93.0	97.4	96.9	40.5	20.7	37.9	33.5	
770	Pit-270	P-9.A	200	20	M1/D1	1.0	2400		0.0		2-F	0.0	0.0		Non	0.0		6.4	3.71	1.40	62.3	13.24	92.9	97.7	97.1	43.2	22.9	42.4	38.3	
771	Ufp-249.1	U-9.A	200	20	M1/D1	1.0	2400		0.0		2-F	0.0	0.0		Non	0.0		6.7	1.23	.63	62.6	7.18	32.3	36.0	35.5	85.7	82.9	88.6	87.3	
772	Ufp-249.2	U-9.A	200	20	M1/D1	1.0	2400		0.0		2-F	0.0	0.0		Non	0.0		6.9	1.27	.67	62.6	7.18	17.3	19.2	18.9	92.1	90.6	93.5	92.8	
773	Ufp-249.3	U-9.A	200	20	M1/D1	1.0	2400		0.0		2-F	0.0	0.0		Non	0.0		7.3	1.32	.72	62.6	7.18	15.2	16.9	16.7	92.6	91.3	93.8	93.1	
774	Ufp-249.4	U-9.A	200	20	M1/D1	1.0	2400		0.0		2-F	0.0	0.0		Non	0.0		8.0	1.40	.81	62.6	7.18	13.4	14.7	14.5	92.9	91.9	93.9	93.2	
775	Ufp-249.5	U-9.A	200	20	M1/D1	1.0	2400		0.0		2-F	0.0	0.0		Non	0.0		10.7	1.68	1.10	62.6	7.18	6.7	7.1	7.1	95.2	95.1	95.8	95.3	

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	LOW SHEAR MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
776	Ufp-247.1	U-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.2	1.16	.56	56.2	6.20	82.8	91.8	90.6	60.6	58.7	73.9	71.0	
777	Ufp-250	U-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.2	1.20	.60	59.4	6.56	83.7	92.7	91.5	60.2	56.9	71.8	68.6	
778	Ufp-251	U-9.A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.9	1.04	.44	50.2	5.87	78.4	88.2	86.9	69.5	64.7	80.6	78.4	
779	Pit-272	P-10A	200	5	Heptane	20.0	1600		0.0		Scr	0.0	0.0	106	Non	0.0		8.3	3.75	1.69	19.6	6.07	89.8	92.2	91.9	28.3	19.2	29.6	27.2	
780	Pit-273	P-10A	200	5	Heptane	20.0	1600		0.0		Scr	0.0	0.0	106	Non	0.0		5.4	3.50	1.38	66.8	11.72	92.1	97.9	97.2	52.2	22.7	41.3	39.3	50.2
781	Pit-274	P-10A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		7.5	3.73	1.65	43.5	8.63	93.8	97.2	96.8	32.3	16.1	28.1	25.7	
782	Pit-271.1	P-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.1	3.53	1.21	63.5	13.47	42.7	45.1	44.8	75.1	66.3	77.1	75.4	
783	Pit-271.2	P-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.2	3.58	1.27	63.5	13.47	22.5	23.7	23.6	86.7	82.0	87.4	86.5	
784	Pit-271.3	P-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.6	3.62	1.32	63.5	13.47	19.2	20.1	20.0	87.9	84.4	88.8	88.0	
785	Pit-271.4	P-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.2	3.80	1.51	63.5	13.47	6.6	6.9	6.9	95.4	94.3	95.6	95.2	
786	Pit-271.5	P-9.A	200	20	M1/D1	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.6	3.83	1.55	63.5	13.47	2.0	2.1	2.1	98.5	98.3	98.6	98.5	
787	Ken-29	K-1.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.7	3.05	1.27	73.0	15.66	88.3	97.6	96.5	56.1	44.2	65.0	64.2	
788	Ken-30	K-1.A	200	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.6	3.20	1.41	79.2	15.20	89.7	99.3	98.1	55.9	40.5	60.3	59.4	
789	Ken-30.1	K-1.A	200	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.3	3.19	1.40	78.8	17.52	89.7	99.6	98.4	57.7	40.7	60.7	59.8	56.8
790	Pit-275	P-10A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		5.7	3.60	1.48	69.3	12.03	91.8	97.2	96.6	49.7	20.7	36.9	34.8	
791	Pit-276	P-10A	200	5	Heptane	20.0	2400		0.0		Scr	0.0	0.0	106	Non	0.0		4.9	3.28	1.15	44.0	9.08	86.2	92.2	91.5	59.4	32.2	54.2	52.7	62.4
792	Pit-277	P-10A	200	5	Heptane	20.0	2400		0.0		Scr	0.0	0.0	106	Non	0.0		5.8	3.54	1.43	69.6	11.94	92.3	97.6	97.0	48.5	21.7	39.1	37.0	46.1
793	Ufp-253	U-9.A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		11.1	1.64	1.07	44.5	5.40	86.6	91.4	90.8	36.8	38.8	47.9	42.0	
794	Ufp-254	U-9.A	200	5	Heptane	20.0	1600		0.0		Scr	0.0	0.0	106	Non	0.0		10.1	1.43	.85	39.4	5.11	83.2	89.0	88.2	44.7	48.7	60.1	55.6	
795	Ufp-256	U-9.A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		8.0	1.31	.72	69.8	7.82	86.5	94.9	93.8	54.5	51.2	65.0	61.1	
796	Ufp-256.1	U-9.A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		7.7	1.35	.76	71.7	8.00	86.5	95.3	94.2	56.2	49.7	63.2	59.0	
797	Ufp-257	U-9.A	200	5	Heptane	20.0	1600		0.0		Scr	0.0	0.0	106	Non	0.0		7.3	1.24	.64	63.0	7.07	85.0	94.1	92.9	59.2	54.6	69.2	65.7	
798	Ken-14	K-1.A	28	5	Heptane	10.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		11.9	4.58	2.87	77.1	12.95	93.3	97.9	97.3	28.3	11.5	16.0	14.1	
799	Ken-15	K-1.A	28	5	Heptane	30.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		12.6	4.64	2.95	77.4	11.03	93.5	97.2	96.7	24.0	10.2	13.7	11.8	
800	Ken-16	K-1.A	28	5	Heptane	150.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		11.8	4.52	2.81	69.1	12.22	92.7	97.3	96.7	29.4	13.3	18.4	16.6	
801	Ken-17	K-1.A	28	5	Heptane	10.0	2000		0.0		Scr	0.0	0.0	400	Non	0.0		9.2	3.53	1.77	41.6	10.42	83.9	91.0	90.1	50.2	38.7	53.5	52.4	
802	Ken-19	K-1.A	28	5	Heptane	150.0	2000		0.0		Scr	0.0	0.0	400	Non	0.0		10.8	4.09	2.36	30.6	8.16	78.4	83.4	82.8	45.3	33.6	42.0	40.7	
803	Ken-23	K-1.A	28	20	Heptane	10.0	2000		0.0		Scr	0.0	0.0	600	Non	0.0		9.8	3.77	2.02	51.9	10.52	86.6	93.2	92.4	45.3	32.4	45.2	43.9	
804	Ken-25	K-1.A	28	20	Heptane	150.0	2000		0.0		Scr	0.0	0.0	600	Non	0.0		11.0	4.25	2.52	39.0	7.35	83.5	88.6	87.9	40.8	26.5	34.0	32.5	
805	Ken-26	K-1.A	200	20	Heptane	10.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		7.9	3.61	1.82	77.2	13.27	89.7	98.9	97.8	54.3	33.0	48.7	47.6	
806	Ken-27.1	K-1.A	200	20	Heptane	30.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		8.8	3.97	2.20	83.7	11.75	90.7	98.8	97.8	48.5	25.5	37.5	36.1	
807	Ken-28	K-1.A	200	20	Heptane	150.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		10.4	4.36	2.62	75.5	10.49	92.9	99.3	98.5	37.7	16.1	23.6	21.9	
808	Pit-278	P-10A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.6	3.63	1.54	67.1	11.02	92.8	97.3	96.7	41.1	19.1	33.9	31.7	
809	Pit-279	P-10A	100	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.3	3.60	1.50	64.5	12.05	92.0	96.8	96.3	44.2	20.5	36.2	34.0	
810	Pit-279.1	P-10A	100	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.4	3.62	1.52	64.2	11.76	91.8	96.5	95.9	43.5	20.3	35.4	33.2	
811	Pit-280.1	P-10A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.8	3.79	1.70	45.1	7.55	73.2	76.5	76.1	52.1	33.4	42.3	40.4	
812	Pit-280.2	P-10A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.3	3.79	1.71	45.1	7.55	16.9	17.6	17.5	88.1	84.6	86.6	86.1	
813	Pit-281.1	P-10A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.2	3.79	1.71	57.7	8.49	79.3	82.5	82.2	45.0	27.8	37.1	35.0	

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	MIN	MICROAGG MET	MICROAGG FR-1	MICROAGG FR-2	MICROAGG SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
814	Pit-281.2	P-10A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.8	3.84	1.77	57.7	8.49	13.9	14.4	14.3	89.5	87.2	88.6	88.2	
815	Ken-20	K-1.A	200	5	Heptane	10.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.8	3.07	1.26	59.3	13.22	83.4	93.2	92.0	63.4	47.0	67.0	66.2	
816	Ken-21	K-1.A	200	5	Heptane	30.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		7.6	3.48	1.69	79.9	13.70	89.2	98.7	97.5	56.3	35.7	52.8	51.7	49.1
817	Ken-22	K-1.A	200	5	Heptane	150.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		8.3	3.67	1.89	76.8	13.73	88.2	96.8	95.7	52.8	33.0	47.7	46.5	
818	Ken-24	K-1.A	28	20	Heptane	30.0	2000		0.0		Scr	0.0	0.0	600	Non	0.0		10.8	4.29	2.56	69.9	11.91	91.0	96.8	96.1	36.6	19.1	27.0	25.3	22.4
819	Ken-27	K-1.A	200	20	Heptane	30.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		8.8	4.06	2.29	84.6	13.22	90.4	98.6	97.6	48.6	24.0	35.0	33.6	31.9
820	Pit-274.1	P-10A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		0.0	0.00	-2.24	0.0	0.00	0.0	0.0	0.0	100.0	100.0	100.0	100.0	
821	Pit-276.1	P-10A	200	5	Heptane	20.0	2400		0.0		Scr	0.0	0.0	106	Non	0.0		5.5	3.28	1.16	44.5	9.22	87.6	93.0	92.4	53.7	31.1	52.9	51.4	62.3
822	Pit-282	P-10A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.1	3.55	1.45	60.2	9.89	91.6	96.5	96.0	46.2	22.0	38.7	36.6	43.0
823	Pit-283	P-10A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.6	3.66	1.57	70.4	10.40	93.6	98.1	97.5	40.6	17.8	32.1	29.8	
824	Pit-284.1	P-10A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.1	3.74	1.66	57.8	8.82	76.7	79.9	79.5	47.6	31.1	41.1	39.1	
825	Pit-284.2	P-10A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		8.0	3.89	1.83	57.8	8.82	16.3	16.8	16.7	87.5	84.8	86.2	85.7	
826	Ken-18	K-1.A	28	5	Heptane	30.0	2000		0.0		Scr	0.0	0.0	400	Non	0.0		9.9	3.81	2.06	52.6	12.64	85.3	91.7	91.0	45.5	32.7	44.9	43.6	44.0
827	Pit-1R	P-1R	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.9	4.37	2.01	83.7	5.52	75.9	95.1	92.4	75.3	32.9	49.2	48.5	
828	Pit-1W	P-1W	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.0	4.34	2.09	70.7	8.02	92.8	97.4	96.8	40.4	16.6	27.4	16.8	
829	Pit-2R	P-1R	200	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.7	4.21	1.85	87.2	6.23	77.0	96.6	93.8	75.6	34.5	52.7	52.1	53.6
830	Pit-2R1	P-1R	200	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.0	4.34	1.96	88.0	5.02	76.8	97.3	94.4	77.9	32.6	50.0	49.3	
831	Pit-2W	P-1W	200	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.4	4.15	1.88	80.6	11.28	93.0	98.3	97.6	45.4	20.1	34.4	24.8	34.9
832	Pit-2W1	P-1W	200	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.2	4.16	1.89	81.1	10.03	92.6	98.1	97.5	47.3	20.2	34.5	24.9	
833	Pit-3W	P-1W	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.1	4.25	1.97	76.5	9.22	92.2	97.8	97.1	48.4	18.9	31.9	21.9	31.2
834	Pit-3W1	P-1W	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.2	4.29	2.02	75.9	8.61	91.3	96.8	96.2	48.0	18.9	31.0	21.0	
835	Pit-3R1	P-1R	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.8	4.23	1.84	83.6	5.50	74.2	94.2	91.3	79.2	36.6	54.6	54.0	
836	Pit-3R	P-1R	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.0	4.00	1.59	82.4	6.71	73.8	94.5	91.6	81.8	40.4	61.0	60.5	63.0
837	Ufp-252	U-9.A	200	5	Heptane	20.0	2400		0.0		Scr	0.0	0.0	106	Non	0.0		10.8	1.54	.97	51.9	5.99	89.1	94.4	93.7	36.7	40.8	51.5	46.0	46.9
838	Ufp-255	U-9.A	200	5	Heptane	20.0	2400		0.0		Scr	0.0	0.0	106	Non	0.0		8.1	1.28	.69	72.2	8.21	87.1	95.5	94.4	53.6	52.0	66.2	62.4	62.8
839	Ufp-258	U-9.A	100	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		10.8	1.60	1.03	59.6	7.10	90.6	96.0	95.3	35.7	37.6	47.6	41.7	
840	Ufp-258.1	U-9.A	100	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		11.7	1.65	1.08	50.2	6.91	90.0	94.3	93.7	30.7	36.0	45.1	38.9	
841	Ufp-259.1	U-9.A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		5.2	1.09	.48	35.0	4.13	20.5	23.2	22.9	93.0	90.4	94.4	93.8	
842	Ufp-259.2	U-9.A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.9	1.16	.57	35.0	4.13	48.0	53.4	52.7	78.1	75.9	84.7	83.0	
843	Ufp-260.1	U-9.A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		5.8	1.07	.47	39.1	4.59	41.1	46.3	45.7	84.2	81.0	89.2	87.9	
844	Ufp-260.2	U-9.A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.9	1.25	.65	39.1	4.59	32.0	35.2	34.7	83.3	82.8	88.2	86.9	
845	Ufp-260.1	U-9.A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		5.8	1.10	.50	39.4	4.61	40.5	45.7	45.0	84.5	80.7	88.6	87.3	
846	Ufp-260.1	U-9.A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.0	1.28	.68	39.4	4.61	32.7	35.9	35.5	82.7	82.0	87.4	86.0	
847	Pit-285	P-10A	100	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		6.2	3.69	1.59	63.8	10.70	92.1	97.0	96.4	45.0	18.4	32.2	30.0	44.0
848	Pit-286	P-10A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.2	3.95	1.87	53.0	8.17	92.1	95.8	95.4	36.2	12.7	20.2	17.5	
849	Pit-287	P-10A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.6	4.03	1.96	61.9	9.01	94.0	97.3	96.9	31.3	9.1	14.7	11.9	
850	Pit-288	P-10A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.4	4.06	1.99	60.4	8.81	94.2	97.8	97.4	32.9	8.2	13.3	10.4	
851	Ken-32	K-2.A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		8.2	3.57	2.03	82.1	11.02	88.1	98.7	97.3	57.2	27.6	39.4	38.8	

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	LOW SHEAR MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
852	Ken-32.1	K-2.A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		8.2	3.51	1.97	82.6	10.41	88.6	99.2	97.9	56.9	28.4	40.9	40.3	
853	Ken-33	K-2.A	100	5	Heptane	30.0	2000		0.0		Scr	0.0	0.0	212	Non	0.0		8.6	3.63	2.09	84.2	7.24	89.3	99.5	98.2	54.6	25.5	36.7	36.1	
854	Ken-33.1	K-2.A	100	5	Heptane	30.0	2000		0.0		Scr	0.0	0.0	212	Non	0.0		9.0	3.79	2.26	84.5	7.40	89.4	99.1	97.9	52.4	22.1	31.6	30.9	
855	Ken-34.1	K-2.A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.2	3.23	1.67	67.8	10.82	32.5	36.8	36.3	86.1	75.9	81.6	81.4	
856	Ken-34.2	K-2.A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.7	3.34	1.79	67.8	10.82	15.2	17.1	16.9	93.1	88.3	90.8	90.7	
857	Ken-34.3	K-2.A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		8.2	3.39	1.85	67.8	10.82	21.1	23.6	23.3	89.8	83.6	86.8	86.7	
858	Ken-34.4	K-2.A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		10.7	3.79	2.29	67.8	10.82	16.9	18.3	18.1	89.3	85.3	86.9	86.8	
859	Ken-35.1	K-2.A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		9.0	3.44	1.91	79.5	12.42	46.2	51.2	50.6	75.4	63.4	70.0	69.7	
860	Ken-35.2	K-2.A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		9.1	3.51	1.98	79.5	12.42	27.0	29.9	29.5	85.5	78.2	81.9	81.7	
861	Ken-35.3	K-2.A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		9.5	3.68	2.16	79.5	12.42	12.7	14.0	13.8	92.8	89.2	90.7	90.6	
862	Ken-35.4	K-2.A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		10.7	3.96	2.45	79.5	12.42	3.0	3.2	3.2	98.1	97.3	97.5	97.5	
863	Ken-36.1	K-2.A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.8	3.55	2.02	77.9	10.99	57.8	64.2	63.4	69.9	52.8	60.4	60.0	
864	Ken-36.2	K-2.A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		9.3	3.53	2.01	77.9	10.99	19.8	21.9	21.6	89.1	83.9	86.5	86.4	
865	Ken-36.3	K-2.A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		9.3	3.09	1.57	77.9	10.99	8.9	9.8	9.7	95.1	93.7	95.3	95.2	
866	Ken-36.4	K-2.A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		10.6	3.81	2.31	77.9	10.99	2.3	2.5	2.5	98.5	98.0	98.2	98.2	
867	Ufp-261	U-9.A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.8	1.09	.49	46.5	5.49	77.0	85.8	84.6	65.4	63.7	78.5	76.1	
868	Ufp-262	U-9.A	100	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		6.6	1.09	.49	45.4	5.47	75.8	84.7	83.5	66.9	64.2	78.9	76.5	79.5
869	Ufp-263.1	U-9.A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		5.3	1.06	.45	34.4	4.37	25.7	29.2	28.7	91.0	88.2	93.4	92.7	93.7
870	Ufp-263.2	U-9.A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.2	1.17	.58	34.4	4.37	41.8	46.3	45.7	80.1	78.8	86.4	84.9	86.0
871	Ufp-264	U-9.A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.3	1.15	.55	35.3	4.15	67.7	75.9	74.8	71.8	66.3	78.9	76.6	
872	Ufp-265	U-9.A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		6.2	1.11	.51	35.0	4.06	67.2	75.4	74.4	72.5	67.7	80.6	78.5	
873	Ufp-266	U-9.A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.8	1.15	.55	37.6	4.75	72.5	80.8	79.7	67.4	63.9	77.3	74.8	77.2
874	Ken-38.1	K-2.A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.9	3.15	1.60	65.3	11.06	84.0	94.4	93.1	60.7	39.1	54.3	53.9	
875	Ken-39	K-2.A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		8.8	3.37	1.84	80.2	11.59	89.2	99.1	97.8	53.5	30.8	44.4	43.9	
876	Ken-41	K-2.A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.9	3.41	1.88	79.1	11.48	88.2	97.9	96.7	53.5	30.7	43.8	43.2	
877	Ken-42	K-2.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		8.1	3.27	1.73	78.6	12.29	87.6	98.2	96.9	57.9	34.0	48.7	48.2	
878	Ken-43	K-2.A	200	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.7	3.42	1.87	82.3	10.79	87.9	99.0	97.6	59.9	30.8	44.3	43.7	
879	Pit-289	P-10A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		5.0	3.30	1.17	48.6	10.02	87.2	93.1	92.4	58.1	31.0	52.8	51.3	
880	Pit-290	P-10A	200	5	Heptane	20.0	1600		0.0		Scr	0.0	0.0	106	Non	0.0		4.9	3.31	1.18	30.7	7.54	80.9	86.6	85.9	61.9	35.7	55.9	54.4	
881	Ufp-267	U-9.A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.6	1.16	.56	55.1	6.60	81.5	91.0	89.8	64.6	59.3	74.3	71.4	
882	Ufp-268	U-9.A	200	5	Heptane	20.0	1600		0.0		Scr	0.0	0.0	106	Non	0.0		10.0	1.47	.89	53.5	6.53	87.8	94.0	93.2	42.2	44.4	55.9	51.0	55.4
883	Ken-35.11	K-2.A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		8.8	3.52	1.99	80.0	12.40	57.9	64.4	63.6	69.8	53.1	60.9	60.5	
884	Ken-35.12	K-2.A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		9.2	3.61	2.09	80.0	12.40	23.4	25.9	25.6	87.2	80.5	83.5	83.3	
885	Ken-35.13	K-2.A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		9.4	3.71	2.19	80.0	12.40	5.0	5.5	5.4	97.2	95.7	96.3	96.3	
886	Ken-35.14	K-2.A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		10.7	3.98	2.47	80.0	12.40	2.9	3.1	3.1	98.2	97.4	97.6	97.6	
887	Ken-37.1	K-2.A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.9	3.61	2.08	82.1	12.00	55.3	61.4	60.6	70.8	54.0	61.0	60.6	
888	Ken-37.2	K-2.A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		9.4	3.65	2.13	82.1	12.00	26.7	29.5	29.2	85.1	77.5	80.7	80.5	
889	Ken-37.3	K-2.A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		10.1	4.03	2.51	82.1	12.00	4.6	5.0	4.9	97.3	95.8	96.1	96.1	

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
890	Ken-37.4	K-2.A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		12.1	4.56	3.08	82.1	12.00	2.7	2.9	2.9	98.1	97.2	97.2	97.2	
891	Ken-44	K-2.A	28	5	Heptane	10.0	2000		0.0		Scr	0.0	0.0	425	Non	0.0		10.6	4.10	2.59	46.1	7.44	82.6	89.8	88.9	48.2	22.1	27.4	26.6	
892	Ken-50	K-2.A	200	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.5	3.46	1.92	77.5	10.90	88.3	98.5	97.2	55.5	29.7	42.4	41.9	
893	Ken-51	K-2.A	200	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		9.2	3.65	2.13	82.6	9.85	89.6	99.0	97.9	51.2	24.7	35.5	34.8	
894	Ken-52.1	K-2.A	200	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.0	3.16	1.60	77.7	11.39	26.2	29.7	29.3	89.1	81.0	85.8	85.7	88.1
895	Ken-52.2	K-2.A	200	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.1	3.13	1.57	77.7	11.39	13.3	15.1	14.8	94.4	90.4	92.9	92.9	93.6
896	Ken-52.3	K-2.A	200	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.8	3.34	1.79	77.7	11.39	19.8	22.3	22.0	90.8	84.7	88.0	87.8	89.3
897	Ken-52.4	K-2.A	200	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		10.5	3.93	2.42	77.7	11.39	28.4	30.9	30.6	82.3	74.4	76.7	76.5	78.9
898	Ken-53.1	K-2.A	200	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.2	3.15	1.59	78.9	11.37	33.5	38.0	37.4	85.7	75.7	81.9	81.8	
899	Ken-53.2	K-2.A	200	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		7.5	3.15	1.60	78.9	11.37	20.0	22.6	22.2	91.1	85.5	89.2	89.1	
900	Ken-53.3	K-2.A	200	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		8.3	3.31	1.77	78.9	11.37	16.7	18.7	18.4	91.8	87.3	90.0	89.9	
901	Ken-53.4	K-2.A	200	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		11.1	3.88	2.39	78.9	11.37	17.7	19.2	19.0	88.3	84.1	85.6	85.5	
902	Ken-54.1	K-2.A	200	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.2	3.08	1.52	76.9	11.48	31.1	35.3	34.8	86.7	77.9	83.9	83.8	
903	Ken-54.2	K-2.A	200	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.3	3.09	1.53	76.9	11.48	16.8	19.0	18.8	92.7	88.0	91.3	91.2	
904	Ken-54.3	K-2.A	200	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.9	3.27	1.72	76.9	11.48	17.6	19.8	19.5	91.7	86.7	89.7	89.6	
905	Ken-54.4	K-2.A	200	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		10.4	3.84	2.34	76.9	11.48	21.9	23.8	23.6	86.5	80.7	82.7	82.5	
906	Ken-56	K-2.A	200	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		8.4	3.35	1.81	73.1	11.48	87.4	97.6	96.4	56.5	32.6	46.3	45.8	
907	Ken-57	K-2.A	200	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		8.3	3.44	1.90	77.4	10.36	87.8	98.2	96.9	56.8	30.5	43.4	42.9	
908	Ken-59	K-2.A	200	5	Heptane	10.0	1600		0.0		Scr	0.0	0.0	106	Non	0.0		7.9	3.24	1.69	50.6	8.90	77.2	86.7	85.5	63.9	42.5	55.8	55.4	
909	Ken-60	K-2.A	200	5	Heptane	10.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.9	3.10	1.53	66.0	10.29	85.2	96.9	95.5	65.2	39.3	55.8	55.3	
910	Ken-38	K-2.A	28	20	Diesel	1.0	1600		0.0		Flo	0.0	0.0		Non	0.0		8.2	3.26	1.72	69.8	11.53	86.4	96.7	95.4	58.0	35.2	49.7	49.2	53.2
911	Ken-40	K-2.A	28	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.7	3.39	1.86	77.5	11.99	88.5	98.5	97.3	54.4	30.9	44.3	43.7	
912	Ken-58	K-2.A	200	5	Heptane	10.0	1600		0.0		Scr	0.0	0.0	106	Non	0.0		13.1	4.04	2.58	36.4	6.93	87.4	92.0	91.4	32.3	18.8	23.7	22.9	
913	Ken-50.1	K-2.A	200	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.5	3.44	1.90	76.3	10.31	87.8	97.9	96.6	55.8	30.5	43.4	42.8	
914	Ken-55.1	K-2.A	200	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.2	3.38	1.84	82.7	10.63	56.1	62.8	61.9	72.8	56.4	65.1	64.7	
915	Ken-55.2	K-2.A	200	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.8	3.63	2.10	82.7	10.63	15.3	16.9	16.7	92.0	87.3	89.2	89.0	
916	Ken-55.3	K-2.A	200	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		9.3	3.81	2.29	82.7	10.63	13.1	14.5	14.3	92.8	88.5	89.9	89.7	
917	Ken-55.4	K-2.A	200	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		10.4	4.02	2.51	82.7	10.63	5.2	5.7	5.6	96.8	95.2	95.6	95.5	
918	Ken-48	K-2.A	28	5	Heptane	10.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.1	2.96	1.39	28.4	6.29	61.4	69.7	68.7	74.2	58.2	71.0	70.7	74.5
919	Ken-49	K-2.A	200	5	Heptane	10.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.8	2.89	1.30	37.8	6.74	70.1	80.8	79.5	75.9	53.4	69.0	68.7	73.3
920	Ken-61	K-2.A	200	5	Heptane	10.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		8.7	3.48	1.94	73.2	10.74	86.8	96.5	95.3	55.3	30.6	42.9	42.3	
921	Ken-62	K-2.A	200	5	Heptane	10.0	2400		0.0		Scr	0.0	0.0	106	Non	0.0		7.0	3.25	1.68	61.0	9.66	81.9	93.0	91.7	66.1	38.8	53.3	52.8	
922	Ken-45	K-2.A	200	5	Heptane	10.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		7.9	3.63	2.08	75.8	10.27	85.3	95.9	94.6	60.1	28.8	39.9	39.3	44.5
922	Pit-1A	P-8.A	200	5	Heptane	30.0	10000		0.0		Scr	0.0	0.0	150	Non	0.0		5.8	3.63	1.30	89.3	0.00	88.5	93.3	92.7	49.2	24.2	42.9	40.8	
923	Ken-46	K-2.A	28	20	Heptane	10.0	2000		0.0		2-F	0.0	0.0		Non	0.0		8.5	3.39	1.85	67.6	8.94	86.1	96.0	94.8	56.7	32.9	46.1	45.5	
923	Pit-2A	P-8.A	200	15	Heptane	30.0	10000		0.0		Scr	0.0	0.0	150	Non	0.0		6.5	3.93	1.62	77.0	0.00	89.5	93.6	93.1	42.4	17.0	28.2	25.6	
924	Ken-46.1	K-2.A	28	5	Heptane	10.0	2000		0.0		2-F	0.0	0.0		Non	0.0		8.3	3.35	1.81	67.0	9.51	85.7	95.8	94.6	57.9	34.0	47.6	47.0	
924	Pit-3A	P-8.A	200	5	Heptane	50.0	10000		0.0		Scr	0.0	0.0	150	Non	0.0		5.6	3.56	1.23	69.4	0.00	86.2	91.0	90.5	52.2	27.7	47.6	45.7	

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	LOW SHEAR MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
925	Ken-47	K-2.A	200	20	Heptane	10.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.2	3.33	1.77	69.8	9.20	84.4	95.6	94.2	64.1	35.4	49.5	49.0	
926	Ken-47.1	K-2.A	200	20	Heptane	10.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.2	3.34	1.78	70.0	9.20	84.3	95.6	94.2	64.1	35.3	49.2	48.7	
927	Ken-64	K-2.A	100	5	Heptane	10.0	2000		0.0		Scr	0.0	0.0	150	Non	0.0		7.4	3.22	1.66	69.3	10.61	84.5	95.5	94.2	63.0	37.5	52.5	52.0	
928	Ken-54.11	K-2.A	200	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.1	3.18	1.62	77.8	10.85	36.8	41.8	41.2	84.5	73.0	79.8	79.6	81.7
929	Ken-54.12	K-2.A	200	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		7.3	3.28	1.72	77.8	10.85	17.4	19.6	19.4	92.5	86.9	89.9	89.8	90.9
930	Ken-54.13	K-2.A	200	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.4	3.49	1.95	77.8	10.85	17.2	19.2	18.9	91.4	86.2	88.6	88.5	89.7
931	Ken-54.14	K-2.A	200	20	Diesel	1.0	2000		0.0		Flo	0.0	0.0		Non	0.0		10.9	4.13	2.62	77.8	10.85	17.0	18.4	18.2	89.0	83.9	84.9	84.7	86.0
932	Ken-58.1	K-2.A	200	5	Heptane	10.0	1600		0.0		Scr	0.0	0.0	106	Non	0.0		12.9	3.75	2.28	43.9	8.11	88.5	93.3	92.7	32.5	23.7	31.6	30.9	
933	Ken-58.2	K-2.A	200	5	Heptane	10.0	1600		0.0		Scr	0.0	0.0	106	Non	0.0		12.9	3.86	2.39	38.8	8.71	88.2	93.1	92.4	32.7	21.7	28.5	27.7	
934	Ken-63	K-2.A	200	5	Heptane	10.0	2400		0.0		Scr	0.0	0.0	106	Non	0.0		6.9	3.26	1.69	72.8	10.63	85.7	97.5	96.0	65.0	35.8	50.9	50.3	54.2
935	Ufp-269	U-9.A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.1	1.10	.47	52.5	6.11	80.7	89.0	88.4	62.1	61.6	78.2	75.7	74.0
936	Ufp-269.1	U-9.A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.9	1.10	.47	50.6	5.98	81.1	89.6	89.0	63.0	61.4	78.2	75.7	
937	Ufp-270	U-9.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.3	1.01	.37	39.7	4.75	73.3	81.5	81.0	69.5	68.0	84.3	82.5	81.1
938	Ufp-271	U-9.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.4	1.08	.44	39.4	4.62	71.5	79.5	78.9	69.8	66.6	81.7	79.6	81.1
939	Ufp-272	U-9.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.3	1.11	.47	36.8	4.34	69.0	76.8	76.3	71.3	66.8	81.2	79.0	79.6
940	Ufp-272.1	U-9.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.2	1.09	.45	37.1	4.36	70.0	78.0	77.4	71.3	67.0	81.8	79.7	
941	Ufp-273	U-9.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.6	1.07	.43	31.9	3.69	61.6	69.1	68.6	77.2	71.5	84.8	83.1	83.7
942	Ufp-274	U-9.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.9	1.06	.42	36.2	4.41	68.0	76.0	75.4	73.5	68.8	83.6	81.7	82.1
943	Ufp-275	U-9.A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.0	1.03	.39	52.3	6.23	78.8	88.0	87.3	68.9	65.0	82.5	80.5	
944	Ufp-275.1	U-9.A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.8	1.09	.45	51.8	6.25	81.0	89.6	89.0	63.8	62.0	78.9	76.5	75.1
945	Ufp-276	U-9.A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.9	1.10	.46	57.3	6.76	83.3	92.0	91.4	62.2	60.5	77.8	75.3	
946	Ufp-276.1	U-9.A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		7.2	1.14	.51	57.8	6.98	83.2	91.6	91.0	60.6	59.1	75.9	73.1	73.3
947	Ufp-277	U-9.A	28	20	Diesel	1.5	2000		0.0		2-F	0.0	0.0		Non	0.0		5.4	.96	.31	36.0	4.50	66.3	74.5	74.0	76.3	72.7	88.2	86.9	
948	Ufp-278	U-9.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.3	1.01	.37	36.5	4.20	70.2	78.1	77.5	70.8	69.3	84.9	83.2	
949	Ufp-277.1	U-9.A	28	20	Diesel	1.5	2000		0.0		2-F	0.0	0.0		Non	0.0		5.0	.93	.28	33.0	4.15	62.8	70.9	70.4	79.2	74.9	90.0	88.9	
950	Ufp-280	U-9.A	28	20	Diesel	1.5	2000		0.0		2-F	0.0	0.0		Non	0.0		5.3	.93	.28	33.7	4.33	64.1	72.1	71.6	77.5	74.4	89.8	88.6	
951	Ken-67	K-2.A	28	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		6.8	2.83	1.26	57.1	8.77	79.3	89.3	88.9	68.0	48.3	66.0	65.7	67.6
952	Ken-67.1	K-2.A	28	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		7.1	2.89	1.33	64.3	9.84	81.8	91.8	91.4	65.6	45.6	63.1	62.8	
953	Ken-68	K-2.A	200	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		6.8	2.93	1.36	71.5	10.39	79.3	89.3	88.9	68.1	46.5	63.3	63.0	
954	Ken-69	K-2.A	28	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		7.5	3.07	1.52	68.2	10.66	84.2	94.2	93.8	62.6	40.5	56.7	56.3	
955	Ken-70	K-2.A	28	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		6.4	2.88	1.31	51.9	9.04	77.1	87.2	86.8	70.8	48.9	65.8	65.5	69.9
956	Ken-65	K-2.A	200	5	Heptane	10.0	2000		0.0		Flo	0.0	0.0		Non	0.0		6.8	3.03	1.46	66.6	10.01	83.0	93.5	93.1	66.6	42.2	58.9	58.5	
957	Ken-66	K-2.A	28	5	Heptane	10.0	2000		0.0		Flo	0.0	0.0		Non	0.0		8.2	3.15	1.60	59.6	10.50	84.2	93.4	93.0	59.2	39.1	54.3	53.8	
958	Ken-72	K-2.A	200	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		6.8	2.97	1.40	67.4	10.06	82.5	93.0	92.6	66.7	43.6	60.7	60.3	
959	Ken-76	K-2.A	28	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		5.6	2.61	1.02	41.0	7.39	67.8	77.4	77.0	77.5	59.3	76.5	76.2	
960	Ken-77	K-2.A	28	20	Diesel	1.5	1600		0.0		2-F	0.0	0.0		Non	0.0		6.4	2.83	1.25	59.9	10.35	81.0	91.6	91.2	69.3	47.4	65.7	65.4	68.0
961	Ken-78	K-2.A	28	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		6.8	2.87	1.30	59.6	9.73	82.1	92.4	92.0	66.9	45.8	63.7	63.4	65.7
962	Ken-79	K-2.A	100	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		6.7	2.95	1.38	65.3	9.89	83.4	94.1	93.7	66.9	43.3	60.9	60.5	62.5

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	LOW SHEAR MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
963	Ken-80	K-2.A	200	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		6.7	3.04	1.47	73.6	10.05	85.5	96.4	96.0	66.1	40.2	57.3	56.9	
964	Ufp-279	U-9.A	28	20	Diesel	1.5	2000		0.0		2-F	0.0	0.0		Non	0.0		5.5	.96	.31	36.5	4.52	67.6	75.8	75.3	75.4	72.2	88.0	86.6	86.5
965	Ufp-281	U-9.A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.5	1.11	.48	42.4	5.13	75.5	83.8	83.2	67.6	63.7	79.4	77.0	77.6
966	Ufp-281.1	U-9.A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.4	1.09	.45	44.3	5.20	76.2	84.7	84.1	67.8	64.1	80.1	77.8	
967	Ufp-282	U-9.A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.4	1.06	.42	46.2	5.60	76.5	85.0	84.4	67.7	64.9	81.4	79.2	
968	Ufp-283	U-9.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.9	1.01	.37	35.9	4.29	67.7	75.6	75.1	73.6	70.4	85.6	83.9	
969	Ufp-284	U-9.A	100	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		6.1	1.04	.40	43.1	5.15	75.7	84.4	83.8	69.5	65.9	82.5	80.5	
970	Pit-291	P-10A	100	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		5.7	3.43	1.11	48.6	8.89	89.2	95.4	93.9	51.1	26.6	49.6	47.7	
971	Pit-292	P-10A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.8	3.46	1.14	55.7	10.18	90.5	96.6	95.1	4[illegible].5	24.9	47.4	45.5	
972	Pit-293	P-10A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.7	3.55	1.23	36.6	6.59	85.4	91.4	89.9	53.2	27.2	46.5	44.5	
973	Ken-71	K-2.A	200	5	Heptane	10.0	2000		0.0		Scr	0.0	0.0	150	Non	0.0		9.9	3.40	1.88	62.3	9.62	89.3	97.2	96.9	47.7	30.2	43.0	42.4	44.6
973	Ken-75	K-2.A	200	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		6.7	2.81	1.24	63.6	9.27	82.0	92.5	92.1	67.4	46.9	65.5	65.1	
974	Ken-75	K-2.A	200	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		6.7	2.81	1.24	63.6	9.27	82.0	92.5	92.1	67.4	46.9	65.5	65.1	
975	Ken-77.1	K-2.A	28	20	Diesel	1.5	1600		0.0		2-F	0.0	0.0		Non	0.0		6.3	2.75	1.17	63.3	10.87	81.8	92.6	92.2	69.4	48.4	67.6	67.3	
976	Pit-294	P-10A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		4.8	3.24	.89	46.7	9.55	87.1	94.3	92.5	59.8	32.4	60.4	58.9	
977	Pit-295	P-10A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.9	3.41	1.11	21.6	5.91	83.2	87.5	86.4	44.8	32.0	52.7	51.0	49.4
978	Pit-295.1	P-10A	200	5	Heptane	20.0	2000		0.0		Scr	0.0	0.0	106	Non	0.0		6.8	3.44	1.14	21.9	5.85	82.9	87.3	86.2	45.8	31.6	51.7	49.9	
979	Pit-296	P-10A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.7	3.39	1.07	49.6	9.37	89.0	95.2	93.7	51.2	27.6	51.5	49.7	
980	Pit-297	P-10A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.7	3.53	1.21	33.1	6.41	83.2	89.0	87.5	54.4	29.5	48.8	46.9	
981	Pit-297.1	P-10A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.7	3.59	1.27	31.3	6.45	82.0	87.7	86.3	55.0	29.3	47.0	45.0	
982	Pit-306	P-10A	28	20	Diesel	1.5	2000		0.0		2-F	0.0	0.0		Non	0.0		5.3	3.37	1.04	37.6	7.62	83.8	90.1	88.5	57.3	32.3	55.7	54.0	
983	Pit-306.1	P-10A	28	20	Diesel	1.5	2000		0.0		2-F	0.0	0.0		Non	0.0		5.1	3.45	1.11	38.9	7.32	84.9	91.6	89.9	58.3	29.7	51.8	50.0	
984	Pit-298	P-10A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.0	3.59	1.28	45.1	7.29	87.4	93.2	91.7	49.5	24.7	43.1	41.0	
985	Pit-299	P-10A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.0	3.53	1.22	44.3	7.16	88.9	94.7	93.2	48.7	24.7	44.9	42.9	42.6
986	Pit-299.1	P-10A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.0	3.48	1.16	43.9	7.26	88.9	94.7	93.3	48.7	25.7	47.2	45.2	
987	Pit-300	P-10A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.9	3.56	1.24	23.9	5.60	85.3	91.0	89.6	51.6	27.1	45.9	43.9	
988	Pit-301	P-10A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.2	3.43	1.10	36.5	6.57	72.5	78.1	76.7	63.7	40.3	59.5	58.0	
989	Pit-302	P-10A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.2	3.37	1.04	54.7	9.75	90.8	97.8	96.1	54.6	26.5	52.0	50.3	44.2
990	Pit-305	P-10A	28	20	Diesel	1.5	2000		0.0		2-F	0.0	0.0		Non	0.0		4.9	3.32	.98	34.3	6.96	80.1	86.7	85.0	62.2	36.1	60.0	58.5	59.7
991	Ken-73	K-2.A	200	5	Heptane	10.0	2000		0.0		Scr	0.0	0.0	150	Non	0.0		11.9	3.48	2.00	32.5	6.44	85.2	90.6	90.4	40.0	31.8	42.3	41.7	39.6
991	Pit-304	P-10A	28	20	Diesel	1.5	2000		0.0		2-F	0.0	0.0		Non	0.0		4.8	3.32	.98	31.0	6.35	79.7	86.4	84.7	63.2	36.5	60.3	58.8	
992	Ken-74	K-2.A	200	5	Heptane	10.0	2000		0.0		Scr	0.0	0.0	150	Non	0.0		16.3	4.18	2.77	25.8	6.19	95.1	95.9	95.8	8.3	8.6	10.7	9.8	12.4
992	Pit-304	P-10A	28	20	Diesel	1.5	2000		0.0		2-F	0.0	0.0		Non	0.0		4.3	3.32	.98	31.0	6.35	79.7	86.4	84.7	63.2	36.5	60.3	58.8	
993	Ken-82	K-2.A	28	20	Diesel	1.5	1600		0.0		2-F	0.0	0.0		Non	0.0		6.2	2.64	1.06	59.6	11.29	80.8	91.6	91.2	70.3	51.0	71.1	70.8	70.6
994	Ken-83	K-2.A	28	20	Diesel	1.5	1600		0.0		2-F	0.0	0.0		Non	0.0		5.9	2.52	.93	56.1	9.45	79.6	90.5	90.1	72.2	54.0	74.9	74.6	
995	Ufp-286	U-9.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.9	1.03	.39	35.6	4.41	67.8	75.8	75.2	73.6	69.8	84.8	83.0	
996	Ufp-285	U-9.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.6	1.01	.37	33.3	3.91	63.9	71.6	71.1	76.4	72.1	86.5	84.9	
997	Ufp-287	U-9.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.6	.99	.35	36.8	4.12	68.8	77.2	76.6	74.5	70.5	86.2	84.6	

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
998	Ufp-288	U-9.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.8	.98	.34	36.6	4.61	69.3	77.5	77.0	73.4	70.6	86.5	84.9	
999	Ufp-289	U-9.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.7	1.01	.37	35.6	4.47	68.1	76.3	75.7	74.4	70.2	85.5	83.9	
***	UfP-290	U-9.A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.5	1.03	.39	36.6	4.48	69.2	77.7	77.1	74.9	69.2	84.6	82.8	
***	Ufp-400	U-10A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.7	1.07	.48	49.4	5.73	78.8	88.0	87.3	66.4	62.2	77.9	75.9	
***	Ufp-401	U-10A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.6	1.05	.46	51.1	5.78	78.0	87.1	86.5	67.3	63.3	79.1	77.2	
***	Ufp-402	U-10A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.6	1.01	.42	50.8	5.89	78.7	88.0	87.3	67.0	64.4	80.8	79.0	
***	Ufp-403	U-10A	200	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.1	1.14	.55	54.4	7.32	84.4	93.8	93.1	61.9	56.9	72.7	70.3	
***	Ufp-404	U-10A	200	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.3	1.16	.57	56.0	7.58	85.4	94.6	93.9	60.4	55.6	71.4	68.8	
***	Ufp-405	U-10A	200	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		7.0	1.06	.47	56.2	65.53	82.0	91.3	90.6	63.5	61.0	77.4	75.4	
***	Pit-400	P-10A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.8	3.53	1.21	45.6	7.60	88.2	94.2	92.7	50.8	25.3	45.6	43.6	
***	Pit-401	P-10A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.0	3.55	1.24	45.5	7.34	88.9	94.7	93.2	48.7	24.3	44.0	41.9	
***	Pit-402	P-10A	28	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.0	3.52	1.21	45.4	7.90	88.9	94.7	93.2	48.7	24.9	45.4	43.4	
***	Pit-403	P-10A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.1	3.43	1.12	62.2	10.80	91.5	97.4	95.9	46.3	24.7	47.8	45.9	
***	Pit-404	P-10A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.0	3.36	1.04	59.7	10.58	91.3	97.3	95.8	47.3	26.3	51.3	49.5	
***	Pit-405	P-10A	100	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.1	3.43	1.12	60.2	10.20	92.1	98.0	96.5	45.9	24.2	47.5	45.5	
***	Pit-406	P-10A	200	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.0	3.39	1.07	66.5	11.40	92.4	98.5	97.0	46.6	24.8	49.3	47.4	
***	Pit-407	P-10A	200	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		5.1	3.37	1.03	62.4	11.09	91.9	99.1	97.3	54.9	25.7	51.6	49.8	
***	Pit-408	P-10A	200	20	Diesel	1.0	2000		0.0		2-F	0.0	0.0		Non	0.0		6.0	3.39	1.07	61.6	10.90	92.0	98.0	96.5	46.9	25.1	49.6	47.7	
***	Ken-100	K-3.A	28	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		7.7	2.97	1.35	74.1	11.29	85.4	94.6	94.3	59.8	42.0	60.3	59.7	
***	Ken-101	K-3.A	28	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		7.2	2.88	1.25	68.1	11.14	84.0	93.6	93.3	63.1	44.7	63.8	63.2	
***	Ken-102	K-3.A	28	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		7.1	2.87	1.24	68.4	11.52	84.1	93.8	93.5	63.5	44.8	64.1	63.5	
***	Ken-103	K-3.A	100	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		7.2	2.96	1.33	74.2	11.40	85.5	95.3	94.9	62.4	42.1	60.8	60.1	
***	Ken-104	K-3.A	100	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		7.3	2.97	1.34	76.0	11.34	86.2	95.9	95.5	61.6	41.5	60.2	59.5	
***	Ken-105	K-3.A	100	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		7.2	2.95	1.32	73.3	11.08	85.5	95.3	94.9	62.4	42.3	61.2	60.5	
***	Ken-106	K-3.A	200	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		7.1	3.05	1.42	77.8	11.40	85.8	95.7	95.3	62.8	40.2	58.1	57.4	
***	Ken-107	K-3.A	200	20	Diesel	1.0	1600		0.0		2-F	0.0	0.0		Non	0.0		7.2	3.06	1.43	78.3	11.07	85.7	95.4	95.1	62.3	40.1	57.8	57.1	
***	Ken-108	K-3.A	200	20	Diesel	1.0	1600				2-F				Non			7.1	3.04	1.41	78.9	10.68	85.9	95.8	95.4	62.8	40.3	58.4	57.6	
***	Ufp-304	U-11	28	20	Diesel	1.0	2000				2-F				Non			5.6	1.01	.31	34.6	4.46	68.7	76.2	75.7	73.0	68.0	86.2	84.7	
***	Ufp-305	U-11	28	20	Diesel	1.1	2000				2-F				Non			6.8	1.21	.51	43.0	5.04	78.6	85.9	85.4	62.5	56.6	74.0	71.2	
***	Ufp-306	U-11	28	20	Diesel	1.1	2000				2-F				Non			7.2	1.16	.46	47.5	6.12	81.8	89.1	88.5	58.6	56.7	75.4	72.8	
***	Ufp-317	U-11	28	20	Diesel	1.1	2000				2-F				Non			5.6	.92	.22	35.8	4.72	70.9	78.6	78.1	72.1	70.0	89.9	88.8	
***	Ufp-310	U-11	28	20	Diesel	1.0	2000				2-F				Non			5.3	.98	.28	31.1	4.34	64.9	72.2	71.7	75.9	70.7	88.3	87.1	
***	Ufp-308	U-11	28	20	Diesel	1.0	2000				2-F				Non			5.1	.97	.27	31.7	4.26	65.1	72.6	72.1	76.7	70.9	88.8	87.6	
***	Ufp-311	U-11	28	20	Diesel	1.0	1000				2-F				Non			4.4	.94	.23	22.1	2.82	44.2	49.6	49.2	86.4	80.9	93.4	92.7	
***	Ufp-309	U-11	28	20	Diesel	1.0	1000				2-F				Non			4.6	.95	.24	22.9	3.04	50.1	56.2	55.8	83.8	78.1	92.1	91.3	
***	Pit-313	P-11	28	20	Diesel	1.0	2000				2-F				Non			6.0	3.74	1.33	39.3	7.47	87.0	92.0	90.7	47.2	23.4	40.5	37.0	
***	Pit-315	P-11	28	20	Diesel	1.0	2000				2-F				Non			6.0	3.69	1.28	39.6	7.60	86.6	91.6	90.3	47.5	24.8	43.0	39.6	
***	Pit-316	P-11	28	20	Diesel	1.0	1000				2-F				Non			4.7	3.53	1.09	16.3	4.91	53.5	57.6	56.6	74.6	55.5	70.1	68.3	

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
***	Pit-314	P-11	28	20	Diesel	1.0	1000				2-F				Non			5.0	3.58	1.15	18.4	5.11	63.2	67.8	66.6	68.0	46.7	62.8	60.6	
***	Ken-90	K-3.A	28	20	Diesel	1.0	1600				2-F				Non			6.6	2.63	.99	56.7	9.80	80.8	90.6	90.2	67.5	51.4	72.5	72.0	
***	Ken-91	K-3.A	28	20	Diesel	1.0	1600				2-F				Non			6.1	2.57	.92	50.0	8.33	78.9	88.9	88.6	70.6	53.7	75.0	74.6	
***	Ken-92	K-3.A	28	20	Diesel	1.0	1000				2-F				Non			5.6	2.62	.96	41.2	8.10	69.5	78.7	78.4	76.3	58.4	77.0	76.6	
***	Ken-93	K-3.A	28	20	Diesel	1.0	1000				2-F				Non			5.8	2.61	.96	40.9	7.84	68.8	77.8	77.5	75.6	58.9	77.4	77.0	
***	Ufp-316	U-11	200	20	Diesel	1.0	2000				2-F				Non			5.8	.99	.29	35.9	4.57	71.2	78.7	78.2	71.0	67.5	86.6	85.1	
***	Ufp-316.1	U-11	200	20	Diesel	1.0	2000				2-F				Non			5.7	.99	.29	36.2	4.64	71.2	78.9	78.4	71.5	67.5	86.6	85.1	
***	Pit-321	P-11	200	20	Diesel	1.0	2000				2-F				Non			5.7	3.34	.93	57.0	10.83	90.0	95.6	94.2	48.1	29.2	57.3	54.8	
***	Pit-321.1	P-11	200	20	Diesel	1.0	2000				2-F				Non			5.6	3.31	.89	57.6	11.04	90.1	95.9	94.4	49.0	29.7	58.7	56.3	
***	Ken-98	K-3.A	200	20	Diesel	1.0	1600				2-F				Non			6.7	2.83	1.19	64.4	10.34	81.8	91.7	91.3	66.5	47.0	66.4	65.8	
***	Ken-98.1	K-3.A	200	20	Diesel	1.0	1600				2-F				Non			6.7	2.83	1.19	66.7	10.55	82.4	92.3	92.0	66.3	46.7	66.2	65.6	
***	Ufp-317.1	U-11	28	20	Diesel	1.1	2000				2-F				Non			5.4	.89	.19	33.9	4.50	68.4	76.0	75.5	74.2	72.0	91.7	90.8	
***	Pit-317	P-11	200	5	Heptane	20.0	2000				Scr			106	Non			5.4	3.33	.90	50.4	10.06	88.7	94.6	93.1	51.6	30.5	58.9	56.4	
***	Pit-318	P-11	200	5	Heptane	20.0	2000				Scr			106	Non			4.8	3.14	.70	56.4	11.23	88.6	95.3	93.6	57.1	34.6	68.2	66.3	
***	Pit-319	P-11	200	5	Heptane	20.0	1000				Scr			106	Non			9.7	3.92	1.60	12.1	4.76	91.1	91.4	91.3	10.7	15.9	25.0	20.5	
***	Pit-320	P-11	200	5	Heptane	20.0	1000				Scr			106	Non			9.1	3.77	1.44	17.4	6.07	92.3	93.4	93.1	15.2	18.1	31.9	27.8	
***	Ken-94	K-3.A	200	5	Heptane	20.0	2000				Scr			106	Non			10.2	3.32	1.74	49.5	8.11	86.1	92.8	92.5	46.4	34.7	48.5	47.6	
***	Ken-95	K-3.A	200	5	Heptane	20.0	2000				Scr			106	Non			12.4	3.42	1.88	32.9	6.29	85.0	89.3	89.0	35.8	33.7	45.1	44.2	
***	Ken-96	K-3.A	200	5	Heptane	20.0	1000				Scr			106	Non			15.3	4.00	2.51	18.4	4.24	75.5	76.5	76.5	29.6	31.1	34.9	33.7	
***	Ken-97	K-3.A	200	5	Heptane	20.0	1000				Scr			106	Non			14.1	3.77	2.26	17.2	3.87	74.7	76.8	76.7	35.8	35.7	42.0	41.0	
***	Ufp-312	U-11	200	5	Heptane	20.0	2000				Scr			106	Non			5.7	.98	.28	51.5	6.47	81.0	89.7	89.1	67.7	63.6	85.5	83.9	
***	Ufp-314	U-11	200	5	Heptane	20.0	2000				Scr			106	Non			6.4	1.06	.36	51.7	6.55	82.0	90.1	89.6	63.3	60.1	80.8	78.7	
***	Ufp-313	U-11	200	5	Heptane	20.0	1000				Scr			106	Non			13.6	1.84	1.19	21.3	3.43	90.8	91.6	91.5	13.7	23.4	29.6	22.0	
***	Ufp-315	U-11	200	5	Heptane	20.0	1000				Scr			106	Non			13.2	1.83	1.18	37.0	5.56	94.0	95.3	95.2	13.2	21.1	27.8	20.1	
***	Pit-307	P-10A	28	20	Diesel	1.0	2000				2-F				Non			6.4	3.63	1.32	41.8	6.61	93.9	99.5	98.1	42.1	18.2	36.5	34.2	
***	Pit-307.1	P-10A	28	20	Diesel	1.0	2000				2-F				Non			6.2	3.60	1.29	41.8	6.61	80.1	85.1	83.9	52.2	30.8	47.3	45.3	
***	Pit-307.2	P-10A	28	20	Diesel	1.0	2000				2-F				Non			7.2	3.76	1.47	41.8	6.61	8.3	8.7	8.6	94.3	92.5	93.8	93.6	
***	Pit-307.3	P-10A	28	20	Diesel	1.0	2000				2-F				Non			8.3	3.89	1.63	41.8	6.61	4.7	4.9	4.8	96.2	95.6	96.1	95.9	
***	Pit-307.4	P-10A	28	20	Diesel	1.0	2000				2-F				Non			10.1	4.14	1.93	41.8	6.61	1.1	1.1	1.1	99.0	98.9	99.0	98.9	
***	Pit-308	P-10A	100	20	Diesel	1.0	2000				2-F				Non			6.9	3.55	1.26	59.8	10.01	93.1	98.0	96.8	38.2	20.7	40.3	38.1	
***	Pit-308.1	P-10A	100	20	Diesel	1.0	2000				2-F				Non			6.5	3.49	1.19	59.8	10.01	77.4	81.9	80.8	51.6	35.2	53.1	51.4	
***	Pit-308.2	P-10A	100	20	Diesel	1.0	2000				2-F				Non			7.9	3.68	1.41	59.8	10.01	9.6	10.0	9.9	92.7	91.5	93.1	92.8	
***	Pit-308.3	P-10A	100	20	Diesel	1.0	2000				2-F				Non			10.2	4.03	1.82	59.8	10.01	5.2	5.2	5.2	94.9	95.0	95.2	95.0	
***	Pit-308.4	P-10A	100	20	Diesel	1.0	2000				2-F				Non			13.1	4.29	2.15	59.8	10.01	.9	.9	.9	98.8	99.0	99.0	98.9	
***	Pit-309	P-10A	28	20	Diesel	1.0	2000				2-F				Non			7.1	3.67	1.38	44.9	7.53	93.9	98.5	97.3	35.9	17.3	33.8	31.4	
***	Pit-309.1	P-10A	28	20	Diesel	1.0	2000				2-F				Non			6.8	3.63	1.33	44.9	7.53	80.6	84.9	83.8	47.3	29.8	45.1	43.1	
***	Pit-309.2	P-10A	28	20	Diesel	1.0	2000				2-F				Non			7.9	3.81	1.54	44.9	7.53	7.6	7.9	7.8	94.2	93.0	94.0	93.8	
***	Pit-309.3	P-10A	28	20	Diesel	1.0	2000				2-F				Non			8.8	3.99	1.74	44.9	7.53	4.6	4.7	4.6	96.1	95.6	95.9	95.8	

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	LOW SHEAR MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
***	Pit-309.4	P-10A	28	20	Diesel	1.0	2000				2-F				Non			11.9	4.37	2.20	44.9	7.53	1.2	1.1	1.1	98.7	98.8	98.7	98.6	
***	Pit-310	P-10A	100	20	Diesel	1.0	2000				2-F				Non			7.0	3.58	1.29	57.8	10.04	94.6	99.4	98.2	36.3	18.7	37.8	35.4	
***	Pit-310.1	P-10A	100	20	Diesel	1.0	2000				2-F				Non			6.7	3.53	1.23	57.8	10.04	80.7	85.2	84.1	47.9	31.6	49.2	47.4	
***	Pit-310.2	P-10A	100	20	Diesel	1.0	2000				2-F				Non			8.1	3.80	1.54	57.8	10.04	9.3	9.6	9.5	92.8	91.6	92.7	92.5	
***	Pit-310.3	P-10A	100	20	Diesel	1.0	2000				2-F				Non			10.1	4.06	1.85	57.8	10.04	3.6	3.6	3.6	96.5	96.5	96.6	96.5	
***	Pit-310.4	P-10A	100	20	Diesel	1.0	2000				2-F				Non			11.0	4.09	1.90	57.8	10.04	1.0	1.0	1.0	98.9	99.0	99.0	99.0	
***	Pit-311	P-10A	28	20	Diesel	1.0	2000				2-F				Non			6.4	3.57	1.26	23.1	5.38	84.5	89.5	88.2	48.0	27.6	45.5	43.5	
***	Pit-311.1	P-10A	28	20	Diesel	1.0	2000				2-F				Non			6.2	3.54	1.23	23.1	5.38	60.9	64.7	63.8	63.7	48.3	61.8	60.4	
***	Pit-311.2	P-10A	28	20	Diesel	1.0	2000				2-F				Non			6.7	3.63	1.33	23.1	5.38	12.6	13.3	13.1	91.9	89.0	91.4	91.1	
***	Pit-311.3	P-10A	28	20	Diesel	1.0	2000				2-F				Non			6.9	3.65	1.36	23.1	5.38	7.2	7.5	7.4	95.2	93.7	95.0	94.9	
***	Pit-311.4	P-10A	28	20	Diesel	1.0	2000				2-F				Non			7.9	3.81	1.54	23.1	5.38	3.8	4.0	3.9	97.1	96.5	97.0	96.9	
***	Pit-312	P-10A	100	20	Diesel	1.0	2000				2-F				Non			6.4	3.48	1.17	37.6	7.59	90.8	96.2	94.8	44.1	24.2	45.6	43.6	
***	Pit-312.1	P-10A	100	20	Diesel	1.0	2000				2-F				Non			6.0	3.43	1.11	37.6	7.59	13.8	14.7	14.5	92.0	88.6	92.2	91.9	
***	Oit-312.2	P-10A	100	20	Diesel	1.0	2000				2-F				Non			7.2	3.60	1.31	37.6	7.59	13.8	14.5	14.3	90.4	88.1	90.7	90.4	
***	Pit-312.1	P-10A	100	20	Diesel	1.0	2000				2-F				Non			6.0	3.43	1.11	37.6	7.59	70.0	74.6	73.4	59.6	42.4	60.2	58.7	
***	Pit-312.3	P-10A	100	20	Diesel	1.0	2000				2-F				Non			8.5	3.72	1.47	37.6	7.59	5.6	5.7	5.7	95.5	95.0	95.8	95.7	
***	Pit-312.4	P-10A	100	20	Diesel	1.0	2000				2-F				Non			8.9	3.71	1.47	37.6	7.59	1.4	1.5	1.5	98.8	98.7	98.9	98.9	
***	Ken-84	K-2.A	100	20	Diesel	1.0	1600				2-F				Non			8.8	3.16	1.63	71.1	11.53	89.8	98.9	98.5	53.2	34.7	50.5	50.0	
***	Ken-84.1	K-2.A	100	20	Diesel	1.0	1600				2-F				Non			8.2	3.06	1.52	71.1	11.53	75.6	83.9	83.5	63.3	46.7	61.1	60.7	
***	Ken-84.2	K-2.A	100	20	Diesel	1.0	1600				2-F				Non			10.5	3.49	1.99	71.1	11.53	9.1	9.9	9.8	94.3	92.7	93.9	93.8	
***	Ken-84.3	K-2.A	100	20	Diesel	1.0	1600				2-F				Non			14.1	4.09	2.64	71.1	11.53	5.0	5.2	5.2	95.8	95.3	95.5	95.5	
***	Ken-85	K-2.A	28	20	Diesel	1.0	1600				2-F				Non			8.4	3.08	1.54	70.9	10.42	88.6	98.1	97.7	55.9	37.2	53.7	53.2	
***	Ken-85.1	K-2.A	28	20	Diesel	1.0	1600				2-F				Non			7.6	2.93	1.38	70.9	10.42	64.2	71.7	71.4	71.1	56.7	70.0	69.7	
***	Ken-85.2	K-2.A	28	20	Diesel	1.0	1600				2-F				Non			9.8	3.41	1.90	70.9	10.42	16.4	17.9	17.8	90.5	87.1	89.5	89.3	
***	Ken-85.3	K-2.A	28	20	Diesel	1.0	1600				2-F				Non			11.6	3.66	2.18	70.9	10.42	8.0	8.5	8.5	94.5	93.3	94.1	94.0	
***	Ken-86	K-2.A	28	20	Diesel	1.0	1600				2-F				Non			8.3	3.01	1.47	65.8	11.07	87.4	96.8	96.4	57.0	39.5	56.5	56.0	
***	Ken-86.1	K-2.A	28	20	Diesel	1.0	1600				2-F				Non			8.0	2.96	1.41	65.8	11.07	77.4	86.0	85.6	63.3	47.3	62.9	62.5	
***	Ken-86.2	K-2.A	28	20	Diesel	1.0	1600				2-F				Non			9.6	3.23	1.71	65.8	11.07	6.2	6.7	6.7	96.5	95.4	96.4	96.4	
***	Ken-86.3	K-2.A	28	20	Diesel	1.0	1600				2-F				Non			11.7	3.64	2.16	65.8	11.07	3.8	4.1	4.1	97.3	96.8	97.2	97.2	
***	Ken-87	K-2.A	100	20	Diesel	1.0	1600				2-F				Non			8.4	3.15	1.61	73.0	10.76	90.0	99.6	99.2	55.2	34.8	50.9	50.4	
***	Ken-87.1	K-2.A	100	20	Diesel	1.0	1600				2-F				Non			8.0	3.08	1.53	73.0	10.76	76.4	85.0	84.6	63.8	45.8	60.2	59.8	
***	Ken-87.2	K-2.A	100	20	Diesel	1.0	1600				2-F				Non			9.7	3.30	1.78	73.0	10.76	8.6	9.3	9.3	95.1	93.5	94.8	94.8	
***	Ken-87.3	K-2.A	100	20	Diesel	1.0	1600				2-F				Non			12.3	3.77	2.30	73.0	10.76	6.2	6.6	6.5	95.5	94.6	95.2	95.1	
***	Ken-88	K-2.A	28	20	Diesel	1.0	1600				2-F				Non			7.7	2.94	1.39	43.7	7.78	78.4	87.4	87.0	64.2	47.0	63.1	62.7	
***	Ken-88.1	K-2.A	28	20	Diesel	1.0	1600				2-F				Non			7.5	2.90	1.35	43.7	7.78	65.8	73.5	73.2	70.8	56.1	70.0	69.7	
***	Ken-88.2	K-2.A	28	20	Diesel	1.0	1600				2-F				Non			8.6	3.05	1.51	43.7	7.78	8.3	9.2	9.1	95.8	94.2	95.7	95.7	
***	kEN-88.3	K-3.M	28	20	Diesel	1.0	1600				2-F				Non			9.9	3.30	1.67	43.7	7.78	4.2	4.6	4.6	97.6	96.9	97.6	97.6	
***	Ken-89	K-2.A	100	20	Diesel	1.0	1600				2-F				Non			7.9	3.05	1.50	55.3	9.42	84.4	94.0	93.6	60.5	40.7	57.0	56.6	

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	LOW SHEAR MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
***	Ken-89.1	K-2.A	100	20	Diesel	1.0	1600				2-F				Non			7.4	2.99	1.43	55.3	9.42	64.4	72.1	71.8	71.8	55.7	68.7	68.4	
***	Ken-89.2	K-2.A	100	20	Diesel	1.0	1600				2-F				Non			8.9	3.15	1.62	55.3	9.42	13.2	14.5	14.5	93.0	90.4	92.7	92.7	
***	Ken-89.3	K-2.A	100	20	Diesel	1.0	1600				2-F				Non			10.8	3.47	1.97	55.3	9.42	6.7	7.3	7.2	95.7	94.6	95.5	95.4	
***	Ken-99W	K-2.W	28	20	Diesel	1.0	1600				2-F				Non			6.5	2.52	.94	34.9	4.36	90.7	93.4	93.4	35.9	16.2	28.6	27.3	
***	Ken-100W	K-2.W	100	20	Diesel	1.0	1600				2-F				Non			6.2	2.51	.92	41.3	4.62	91.9	94.9	94.9	38.0	15.4	28.8	27.6	
***	Ken-101W	K-2.W	200	20	Diesel	1.0	1600				2-F				Non			6.1	2.49	.90	50.2	4.98	93.7	96.9	96.9	37.8	14.5	29.1	27.9	
***	Ken-103	K-4.R	28	20	Diesel	1.0	1600				2-F				Non			7.6	2.87	1.47	66.2	9.11	77.3	92.1	91.2	72.9	51.6	66.6	65.5	
***	Ken-99WR	K-2.A	28	20	Diesel	1.0	1600				2-F				Non			6.5	2.52	.95	34.9	4.36	91.1	103.0	102.5	64.9	47.1	70.7	70.4	
***	Ken-100WR	K-2.A	100	20	Diesel	1.0	1600				2-F				Non			6.2	2.51	.93	41.3	4.62	92.3	104.7	104.2	66.1	46.7	70.8	70.5	
***	Ken-104	K-4.R	100	20	Diesel	1.0	1600				2-F				Non			7.4	2.93	1.53	68.5	9.16	76.7	91.5	90.7	73.8	51.0	65.6	64.4	
***	Ken-101WR	K-2.A	200	20	Diesel	1.0	1600				2-F				Non			6.1	2.49	.91	50.2	4.98	94.2	106.8	106.4	66.0	46.0	70.9	70.6	
***	Ken-105	K-4.R	200	20	Diesel	1.0	1600				2-F				Non			7.8	3.10	1.70	76.0	9.50	80.1	95.2	94.3	71.2	45.8	59.9	58.5	
***	Ken-102W	K-2.W	200	5	Heptane	10.0	2000				Scr			106	Non			5.5	2.47	.87	29.9	4.37	87.3	90.9	90.9	47.8	21.0	36.4	35.3	
***	Ken-107	K-4.W	28	20	Diesel	1.0	1600				2-F				Non			6.5	2.64	.98	33.5	4.80	89.7	92.7	92.7	38.5	19.1	33.4	30.2	
***	Ken-108	K-4.W	100	20	Diesel	1.0	1600				2-F				Non			6.1	2.59	.92	39.2	5.15	89.7	93.0	93.0	42.4	20.7	37.3	34.3	
***	Ken-109	K-4.W	200	20	Diesel	1.0	1600				2-F				Non			5.9	2.56	.89	52.7	6.20	92.0	95.6	95.6	42.8	19.6	38.0	35.1	
***	Ken-106	K-4.R	200	5	Heptane	10.0	2000				2-F				Non			13.0	3.47	2.15	41.5	5.04	84.3	94.4	93.6	49.5	36.3	46.8	45.0	
***	Ken-110	K-4.W	200	5	Heptane	10.0	2000				Scr			106	Non			6.1	2.72	1.05	52.8	6.83	92.0	95.5	95.5	40.9	14.6	26.8	23.4	
***	Ufp-316	U-11	28	20	Diesel	1.0	1000				2-F				Non			4.7	.84	.13	27.0	3.36	57.0	63.8	63.4	81.2	77.9	95.1	94.6	
***	Pit-416	P-11	28	20	Diesel	1.0	1000				2-F				Non			4.9	3.30	.86	20.0	5.02	67.5	72.5	71.3	66.5	47.5	70.1	68.3	
***	Ken-111	K-3.A	28	20	Diesel	1.0	1000				2-F				Non			6.7	2.53	.89	53.3	8.97	80.0	89.7	89.3	67.3	53.7	75.4	75.0	
***	Ufp-317	U-11	200	5	Heptane	20.0	1000				2-F				Non			6.4	.91	.21	49.2	6.57	81.7	89.8	89.3	63.4	65.9	88.8	87.6	
***	Pit-417	P-11	200	5	Heptane	20.0	1000				Scr			106	Non			9.2	3.70	1.37	13.0	4.18	87.1	88.0	87.8	19.0	24.1	38.7	35.0	
***	Ken-112	K-3.A	200	5	Heptane	20.0	1000				Scr			106	Non			11.3	3.34	1.78	37.9	6.74	85.5	91.0	90.7	41.1	34.8	47.7	46.8	
***	Ufp-318	U-11	28	20	Diesel	1.0	2000				2-F				Non			5.9	.89	.19	36.1	4.60	70.5	77.9	77.4	70.8	71.1	91.2	90.3	
***	Ufp-319	U-11	100	20	Diesel	1.0	2000				2-F				Non			6.4	.96	.27	43.1	5.17	76.8	84.4	83.9	65.5	66.0	86.8	85.3	
***	Pit-418	P-11	28	20	Diesel	1.0	2000				2-F				Non			5.1	3.39	.96	20.7	5.27	67.2	72.0	70.8	65.4	46.4	66.9	64.9	
***	Pit-419	P-11	100	20	Diesel	1.0	2000				2-F				Non			5.7	3.31	.90	42.3	8.31	87.1	92.5	91.2	49.8	32.1	60.0	57.6	
***	Ken-113	K-3.A	28	20	Diesel	1.0	2000				2-F				Non			6.2	2.59	.94	46.3	8.35	72.7	81.9	81.6	72.5	57.0	76.4	76.0	
***	Ken-114	K-3.A	100	20	Diesel	1.0	2000				2-F				Non			6.7	2.65	1.01	61.3	10.13	80.9	90.7	90.3	66.9	51.0	71.8	71.3	
***	Ken-116	K-3.A	100	20	Diesel	1.0	1600				2-F				Non			6.9	2.68	1.05	62.8	10.54	83.8	93.7	93.3	64.7	48.7	69.9	69.3	
***	Ken-117	K-3.A	28	20	Diesel	1.0	1000				2-F				Non			6.2	2.57	.92	43.1	8.12	73.3	82.5	82.2	72.3	56.9	76.7	76.3	
***	Pit-420	P-11	28	20	Diesel	1.0	1000				2-F				Non			5.0	3.37	.94	21.6	5.04	65.4	70.2	69.0	66.9	48.1	68.6	66.7	
***	Ufp-320	U-11	28	20	Diesel	1.0	1000				2-F				Non			4.4	.96	.25	23.1	3.28	49.7	55.8	55.4	84.6	78.0	91.9	91.1	
***	Ken-118	K-3.A	28	20	Diesel	1.0	1600				2-F	.1			Non			6.6	2.68	1.04	40.4	7.42	70.0	78.5	78.2	71.8	57.1	75.0	74.5	
***	Pit-421	P-11	28	20	Diesel	1.0	2000				2-F	.2			Non			5.3	3.49	1.07	17.2	4.53	52.1	55.6	54.7	72.1	57.2	71.6	69.9	
***	Ufp-321	U-11	28	20	Diesel	1.0	2000				2-F	.2			Non			5.4	.99	.29	31.5	3.98	63.0	70.0	69.5	76.1	71.3	88.2	87.0	
***	Ufp-322	U-12R	28	20	Diesel	1.0	2000				2-F				Non			8.7	1.16	.58	51.5	6.89	82.6	90.6	90.0	55.4	57.8	72.8	71.1	

Table A1-7 (Continued)

BATCH TEST RESULTS

SER NO	LAB ID	COAL & NO	TOP SIZE	% SOL	HIGH SHEAR OIL	HIGH SHEAR %OIL	HIGH SHEAR RPM	LOW SHEAR OIL	LOW SHEAR %OIL	LOW SHEAR MIN	MICROAGG REC MET	MICROAGG REC FR-1	MICROAGG REC FR-2	MICROAGG REC SCR	PROD REC MET	PROD REC FR	PROD REC SCR	CLEAN COAL A %	CLEAN COAL TS %	CLEAN COAL PS %	TAILINGS A %	TAILINGS TS %	CC Y %	BTU REC %	CM REC %	ASH REJ	TS REJ	IS REJ	PS REJ COMP	PS REJ ACT
***	Ufp-323	U-12R	100	20	Diesel	1.0	2000				2-F				Non			8.6	1.25	.66	55.9	7.18	85.7	94.1	93.5	54.3	53.2	67.8	65.9	
***	Ufp-324	U-12R	200	20	Diesel	1.0	2000				2-F				Non			8.7	1.28	.69	58.8	7.54	85.8	94.1	93.4	53.7	52.0	66.3	64.3	
***	Ufp-325	U-12W	28	20	Diesel	1.0	2000				2-F				Non			8.3	.98	.43	40.9	4.59	89.0	92.7	92.5	37.2	36.5	54.7	51.2	
***	Ufp-326	U-12W	100	20	Diesel	1.0	2000				2-F				Non			7.9	.94	.39	47.4	5.24	90.7	94.9	94.6	39.1	38.0	58.4	55.2	
***	Ufp-327	U-12W	200	20	Diesel	1.0	2000				2-F				Non			7.8	.94	.39	47.8	5.41	90.8	95.2	94.9	39.8	37.9	58.4	55.2	
***	Ufp-328	U-12H	28	20	Diesel	1.0	2000				2-F				Non			8.7	1.15	.58	51.6	6.44	83.7	91.9	91.3	55.1	56.5	71.4	70.0	
***	Ufp-329	U-12H	100	20	Diesel	1.0	2000				2-F				Non			8.7	1.15	.58	57.7	7.04	85.7	94.1	93.5	54.1	55.4	70.7	69.3	
***	Ufp-330	U-12H	200	20	Diesel	1.0	2000				2-F				Non			8.8	1.18	.61	59.4	7.33	86.2	94.6	93.9	53.3	54.0	69.0	67.5	
***	Ufp-331	U-12R	200	5	Heptane	20.0	2000				Scr			106	Non			8.9	1.15	.56	62.8	8.44	86.2	94.3	93.7	52.7	56.5	72.3	70.6	
***	Ufp-332	U-12W	200	5	Heptane	20.0	2000				Scr			106	Non			8.2	.92	.37	56.0	6.72	92.5	96.6	96.3	35.7	38.3	59.9	56.8	
***	Ufp-333	U-12H	200	5	Heptane	20.0	2000				Scr			106	Non			8.9	1.14	.56	65.6	8.29	89.5	98.1	97.4	51.1	54.0	70.2	68.7	

APPENDIX 2

CPRU TEST PROGRAM

APPENDIX 2

Table of Contents | Page

Table A2-1	Calibration of Ball Mill Screw Feeder with Different Hopper Loadings	A2-1
Table A2-2	Ball Milling/Grinding Calibration for CPRU Tests	A2-2
Figure A2-1	Calibration of Ball Mill Screw Feeder with Different Hopper Loadings	A2-3
Table A2-3	Calibration of Oil Pump with Diesel	A2-4
Figure A2-2	Calibration of Oil Pump with Diesel	A2-5
Table A2-4	Calibration of Denver Flotation Cell Air Flow System	A2-6
Figure A2-3	Calibration of Denver Flotation Cell Air Flow System	A2-7
Table A2-5	Calibration of Second Stage Flotation Air Flow System	A2-8
Figure A2-4	Calibration of Second Stage Flotation Air Flow System	A2-9
Table A2-6	Experimental Conditions for Runs 1 to 37 (Diesel and Heptane Runs Inclusive)	A2-10
Table A2-7	Calculated Feed Properties	A2-22
Table A2-8	Calculated Flotation Product Properties	A2-25
Table A2-9	Calculated Second Stage Flotation Product Properties	A2-26
Table A2-10	Calculated Screen Product Properties (Heptane Based)	A2-29

Table A2-1

CALIBRATION OF BALL MILL SCREW FEEDER WITH DIFFERENT HOPPER LOADINGS

Control Setting %	8kg Illinois #6(50x0) Coal Feed Rate, g/m at Different Elapsed Times				15 kg Illinois #6(50x0) Coal Feed Rate, g/m at Different Elapsed Times			
	2 min	5min	8min	Average	2 min	5 min	8min	Average
15	26.41	25.83	25.97	26.07	26.40	26.37	26.35	26.37
20	38.03	38.16	38.15	38.11	38.05	37.94	37.93	37.97
25	50.27	50.32	50.29	50.29	50.25	50.04	50.27	50.19
30	62.21	62.45	62.48	62.39	62.20	62,22	62.21	62.21
35	74.45	74.51	74.65	74.54	74.15	74.16	74.18	74.14
40	87.31	86.95	86.76	87.01	86.90	87.04	87.09	84.01
45	99.00	98.72	98.73	98.82	98.65	98.60	98.53	98.59
50	111.35	110.90	110.81	111.02	111.30	110.58	110.56	110.81
55	122.90	122.88	123.15	122.98	121.90	122.59	122.64	122.38
60	136.00	135.56	135.53	135.70	134.58	134.80	135.04	134.81
65	148.60	148.26	148.04	148.30	147.10	147.60	147.75	147.48
70	160.30	160.46	160.53	160.43	159.40	160.78	160.84	160.34

Table A2-2

BALL MILLING: GRINDING CALIBRATION
FOR CPRU TESTS

Coal	Test Conditions: Coal Feed Rate Kg/min	Test Conditions: Water Feed Rate Kg/min	Grinding Residence Time min:sec	Recycle Size Fraction mesh/micron	Analysis of Product Size: Slurry Concentration kg coal/kg slurry	Analysis of Product Size: Wt% +28 mesh	Analysis of Product Size: Wt% -200 mesh	Analysis of Product Size: d_{50} microns
			Objective:	28 mesh x 0, d_{50} = 125 ± 5 microns				
III	0.96	1.15	11:12	No recycle	0.44	4.8	55.0	
III	2.48	2.89	5:58	No recycle	0.44	28.1	28.4	120
PII	2.45	5.88	3:15	16/1180	0.29	10.8	30.8	152
PII	1.96	4.73	3:58	16/1180	0.27	6.1	39.0	107
UFP	0.93	1.13	10:50	No recycle	0.44	0.8	70.6	
UFP	2.56	2.70	6:18	No recycle	0.46	7.5	46.1	80
UFP	3.14	3.18	5:30	28/600	0.46	0.0	46.6	86
UFP	3.18	6.04	2:33	16/1180	0.38	5.9	36.5	121
			Objective:	200 mesh x 0, d_{50} = 25 ± 5 microns				
UFP	0.30	0.71	25:50	100/150	0.30	-	91.9	20
PII	0.25	0.56	33:18	100/150	0.31	-	91.8	21

Figure A2-1

CALIBRATION OF BALL MILL SCREW FEEDER
WITH DIFFERENT HOPPER LOADINGS

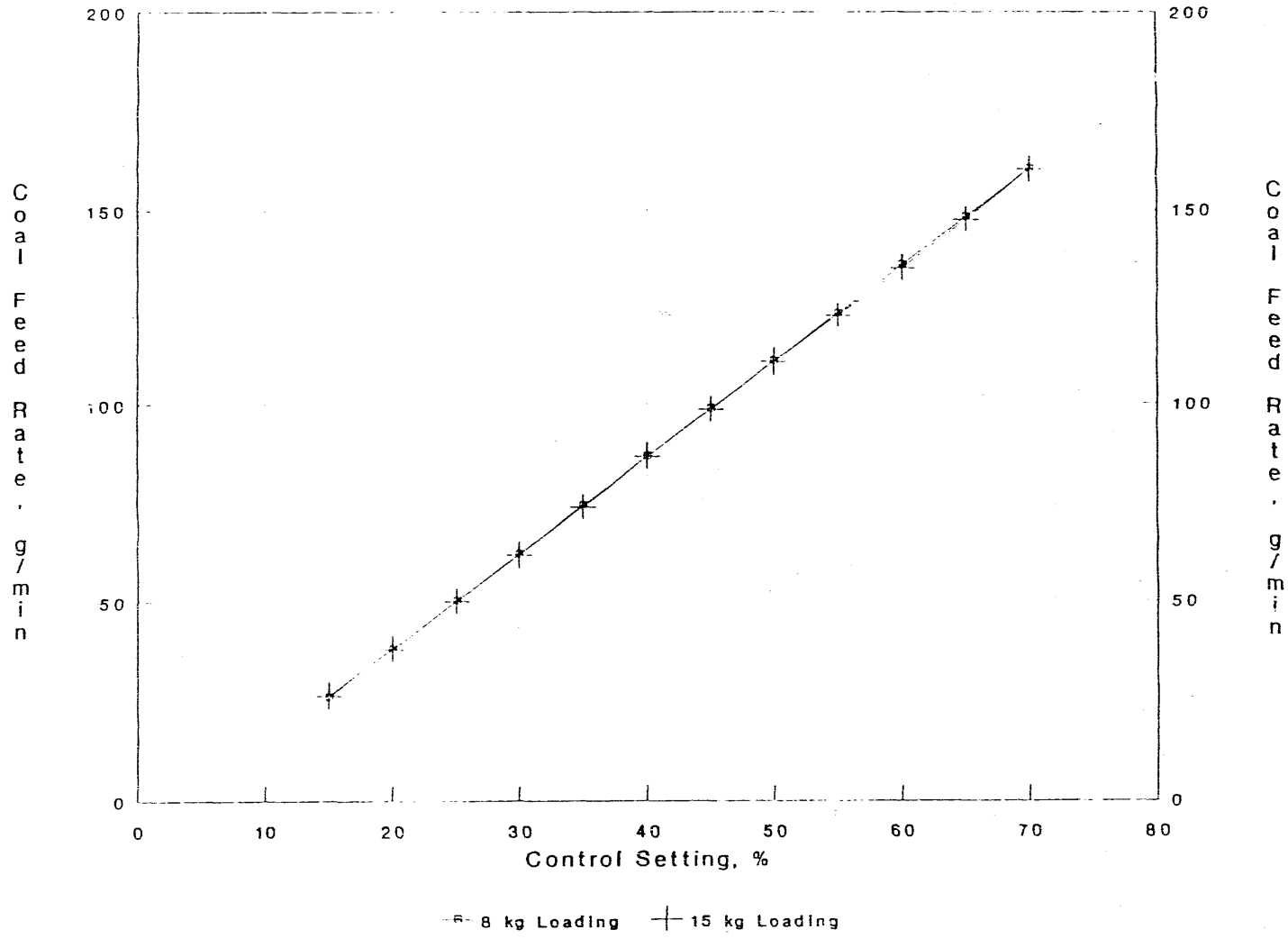


Table A2-3

CALIBRATION OF OIL PUMP WITH DIESEL

Control Setting, %	Balance Method, g/min	Weighing Method, g/min
10	1.550	1.560
20	3.250	3.220
30	4.900	4.890
40	6.500	6.490
50	8.055	8.005
60	9.700	9.660
70	11.300	11.270
80	13.100	13.010

Figure A2-2

CALIBRATION OF OIL PUMP WITH DIESEL

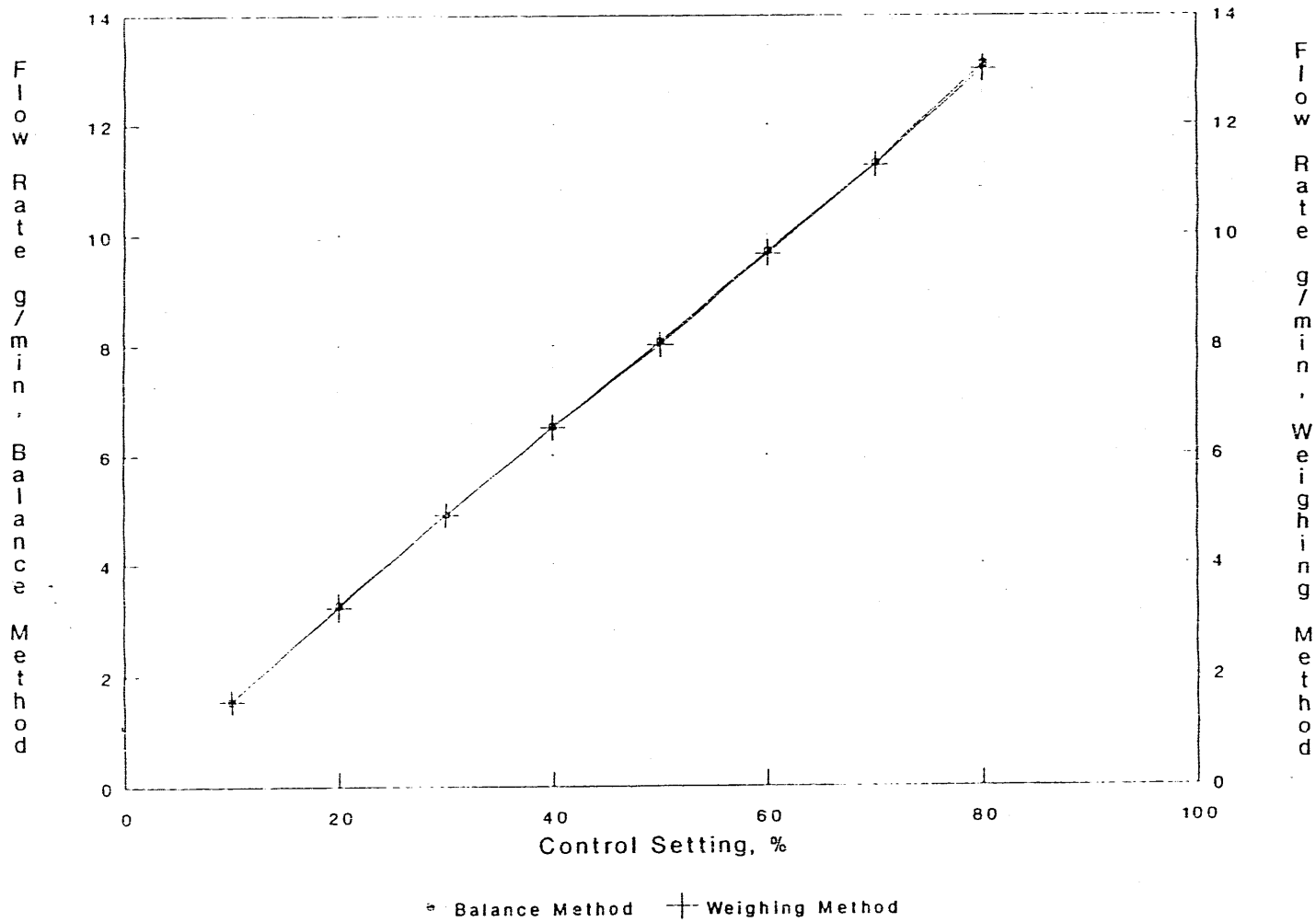


Table A2-4

CALIBRATION OF DENVER FLOTATION CELL
AIR FLOW SYSTEM

Cell R.P.M	Air Flow Rate, l/min
900	0.65
1100	5.04
1200	7.20
1300	8.77
1400	10.00
1500	10.84

Figure A2-3

CALIBRATION OF DENVER FLOTATION CELL
AIR FLOW SYSTEM

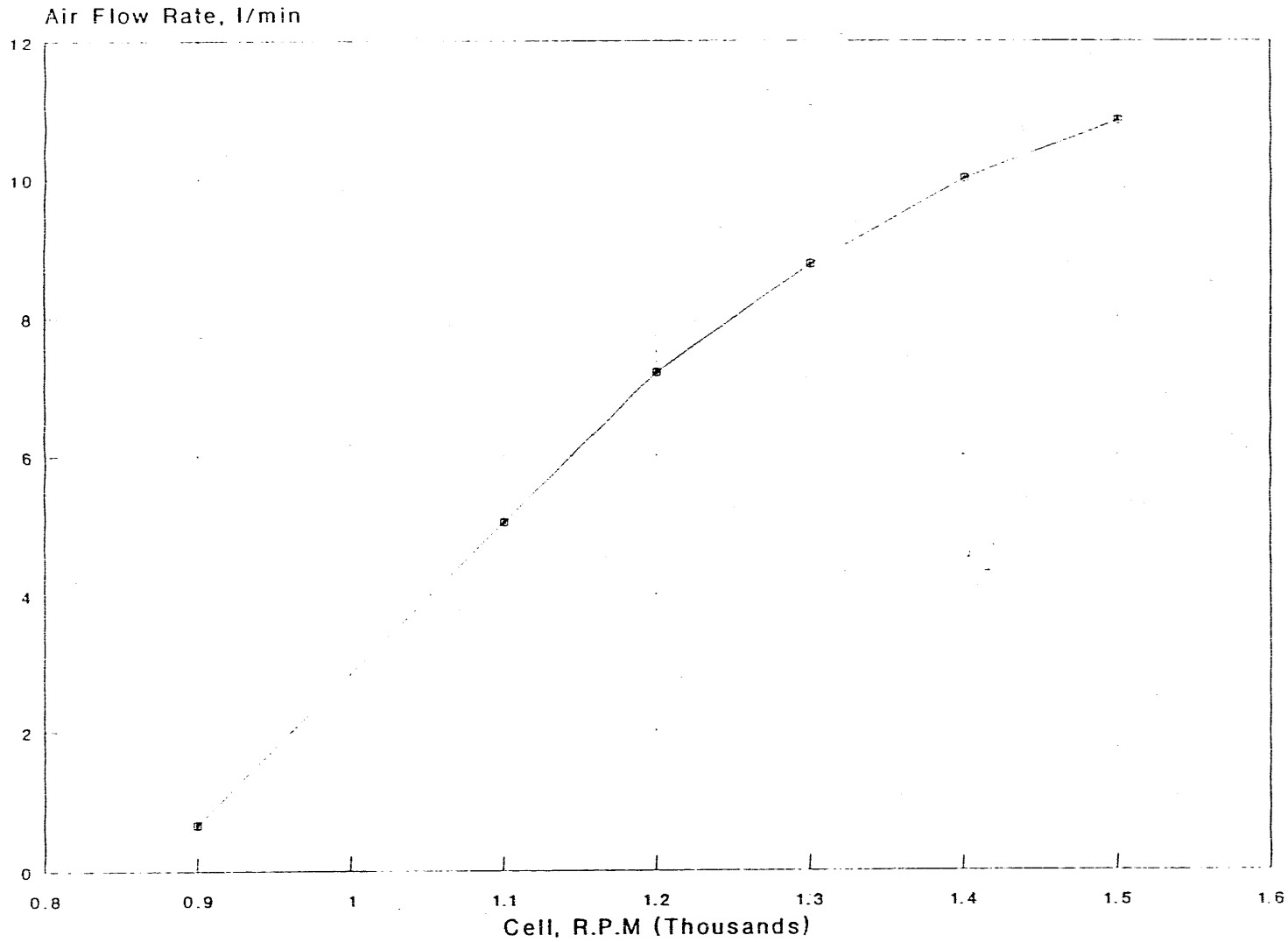


Table A2-5

CALIBRATION OF SECOND STAGE FLOTATION CELL
AIR FLOW SYSTEM

Cell R.P.M	Air Flow Rate, l/min
1100	1.38
1200	3.47
1300	5.56
1400	7.80
1500	10.1

Figure A2-4

CALIBRATION OF SECOND STAGE FLOTATION CELL
AIR FLOW SYSTEM

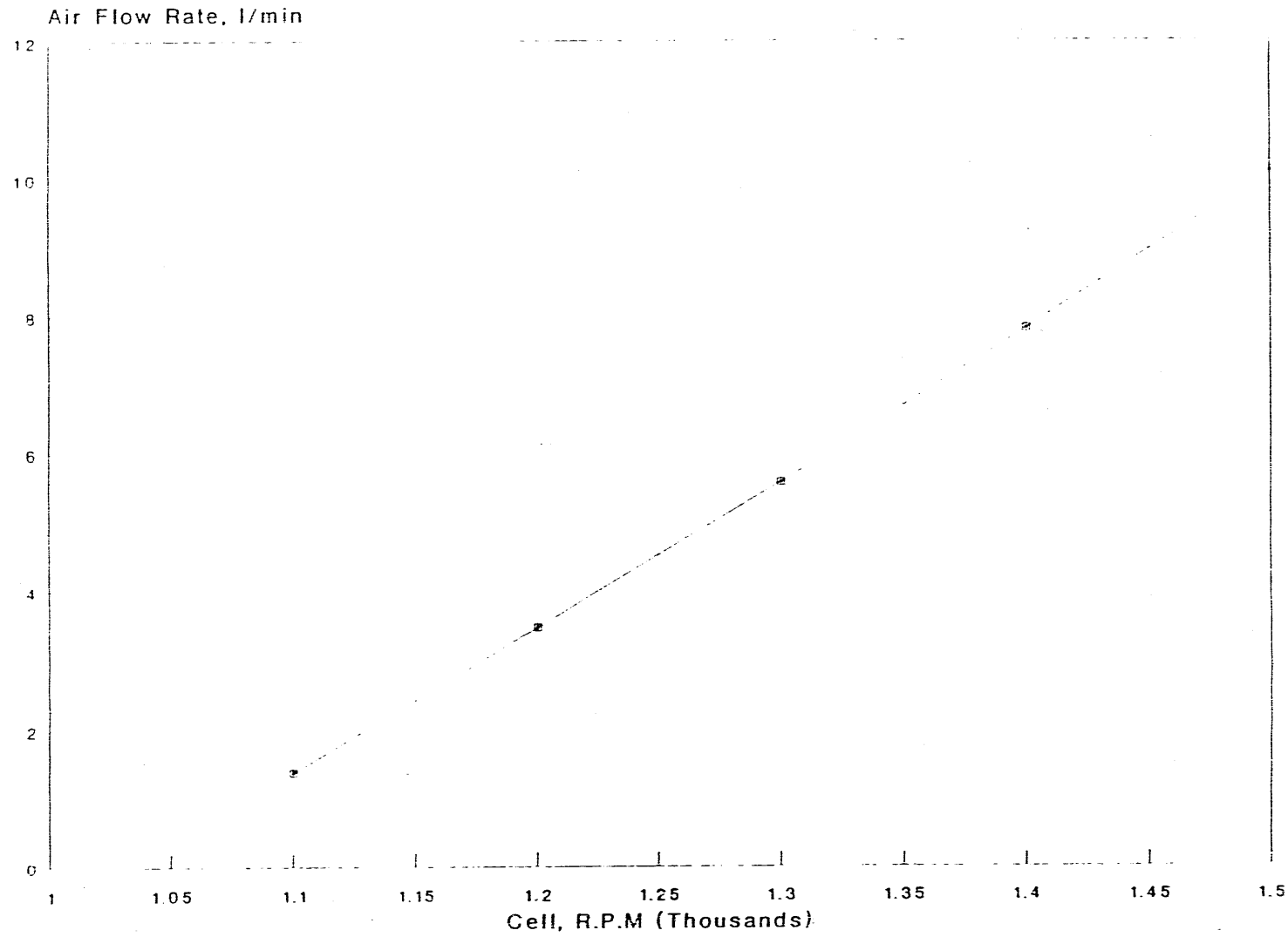


Table A2-6

EXPERIMENTAL CONDITIONS FOR RUNS 2 TO 37
(DIESEL AND HEPTANE RUNS INCLUSIVE)

Run #	Set point	Date	Coal	Proc Config B	HS	F/PS	CT H2O g/m	High Shear Tank #1 Oil	gm/min	rpm	Size	Torque	High Shear #2 rpm	Oil g/m	Size	Torque	High Shear Sreen mesh	Water g/m	Vibr	Flotation Tank #1 Water g/m	Air l/m	Imp rpm
1	1	11/27/90	UFP	N	1	FP	90.00	DIESEL	.42	2000	900.00									560.00	5.00	1100
1	2	11/27/90	UFP	N	1	FP	90.00	DIESEL	.93	2000	900.00									560.00		1100
1	3	11/27/90	UFP	N	1	FP	90.00	DIESEL	1.45	2000	900.00									560.00		1100
1	4	11/27/90	UFP	N	1	FP	90.00	DIESEL	.68	2000	900.00									560.00		1100
1	5	11/27/90	UFP	N	1	FP	90.00	DIESEL	.42	2000	900.00	8.50								560.00		1100
1	6	11/27/90	UFP	N	1	FP	90.00	DIESEL	.42	2000	900.00	8.50								560.00		1100
1	7	11/27/90	UFP	N	1	FP	90.00	DIESEL	.42	2000	900.00	8.50								560.00		1100
3	1	1/21/91	UFP	n	1	FP	77.00	DIESEL	.56	2000	900.00	6.90								540.00	5.00	1100
3	2a	1/21/91	UFP	n	1	FP	77.00	DIESEL	.46	2000	900.00	6.20								540.00	5.00	1100
3	2b	1/21/91	UFP	n	1	FP	77.00	DIESEL	.50	2000	900.00	6.20								540.00	5.00	1100
3	3a	1/21/91	UFP	n	1	FP	77.00	DIESEL	.49	2000	900.00									155.00	5.00	1100
3	3b	1/21/91	UFP	n	1	FP	77.00	DIESEL	.49	2000	900.00									155.00	5.00	1100
3	4	1/21/91	UFP	n	1	FP	77.00	DIESEL	.45	2000	900.00									155.00	5.00	1100
3	5	1/21/91	UFP	n	1	FP	77.00	DIESEL	.64	2000	900.00	5.80			******					155.00	5.00	1100
3	6	1/21/91	UFP	n	1	FP	77.00	DIESEL	.64	2000	900.00	5.80								155.00	5.00	1100
3	7	1/21/91	UFP	n	1	FP	77.00	DIESEL	.69	2000	900.00									540.00	5.00	1100
4	1	1/22/91	UFP	n	1	FP	77.00	DIESEL	.65	2000	900.00	5.50								540.00	5.00	1100
4	2a	1/22/91	UFP	n	1	FP	77.00	DIESEL	.65	2000	900.00									540.00	5.00	1100
4	2b	1/22/91	UFP	n	1	FP	77.00	DIESEL	.65	2000	900.00									540.00	5.00	1100
4	3-A	1/22/91	UFP		1	FP	77.00	DSL	.46	2000	900.00									540.00	5.00	1100
4	3b	1/22/91	UFP	n	1	FP	77.00	DIESEL	.46	2000	900.00									540.00	5.00	1100
4	4	1/22/91	UFP	n	1	FP	77.00	DIESEL	.46	2000	900.00									540.00	5.00	1100
4	5a	1/22/91	UFP	n	1	FP	77.00	DIESEL	.56	2000	900.00									280.00	5.00	1100
4	5b	1/22/91	UFP	n	1	FP	77.00	DIESEL	.56	2000	900.00									280.00	5.00	1100
5	1	1/28/91	UFP	n	1	FP	77.00	DIESEL	.45	2000	900.00	7.40								540.00	5.00	1100
5	2a	1/28/91	UFP	n	1	FP	77.00	DIESEL	.47	2000	900.00	7.40								540.00	5.00	1100
5	2b	1/28/91	UFP	n	1	FP	77.00	DIESEL	.46	2000	900.00	7.40								540.00	5.00	1100
5	3a	1/28/91	UFP	n	1	FP	77.00	DIESEL	.47	2000	900.00	7.30								155.00	5.00	1100
5	3b	1/28/91	UFP	n	1	FP	77.00	DIESEL	.45	2000	900.00	7.40								155.00	5.00	1100

Table A2-6 (Continued)

EXPERIMENTAL CONDITIONS FOR RUNS 2 TO 37
(DIESEL AND HEPTANE RUNS INCLUSIVE)

Run #	Set Point	FL#1 Frother Type	& Rate mg/m	Flotation Tank #2 Water g/m	Air l/m	Imp rpm	Frother Type&	Rate mg/min	Low Shear Rate rpm	Water g/m	Binder Type &	Rate g/m	Screen Size	Water	Vibr	Comments
													mesh			
1	1			590.00	1.40	1100							mesh			
1	2			590.00		1100							mesh			
1	3			590.00		1100							mesh			
1	4			590.00		1100							mesh			
1	5	MIBC	2.400	590.00		1100							mesh			
1	6	MIBC	5.200	590.00		1100							mesh			
1	7	MIBC	8.600	590.00		1100							mesh			
3	1	MIBC	2.300	456.00	5.40	1100							mesh			
3	2a	MIBC	6.900	456.00	5.40	1100							mesh			
3	2b	MIBC	6.900	456.00	5.40	1100							mesh			
3	3a	MIBC	6.900	156.00	5.40	1100							mesh			
3	3b	MIBC	6.900	156.00	5.40	1100							mesh			
3	4	MIBC	2.300	156.00	5.40	1100							mesh			
3	5	MIBC	2.300	156.00	5.40	1100							mesh			
3	6	MIBC	6.900	156.00	5.40	1100							mesh			
3	7	MIBC	6.900	456.00	5.40	1100							mesh			
4	1	MIBC	2.300	456.00	5.40	1100							mesh			
4	2a	MIBC	0.000	456.00	5.40	1100							mesh			
4	2b	MIBC	0.000	456.00	5.40	1100							mesh			
4	3-A	MIBC		456.00	5.40	1100							mesh			
4	3b	MIBC	0.000	456.00	5.40	1100							mesh			
4	4	MIBC	2.300	456.00	5.40	1100							mesh			
4	5a	MIBC	4.400	256.00	5.40	1100							mesh			
4	5b	MIBC	0.000	256.00	5.40	1100							mesh			
5	1	MIBC	2.300	456.00	5.40	1100							mesh			
5	2a	MIBC	6.900	456.00	5.40	1100							mesh			
5	2b	MIBC	6.900	456.00	5.40	1100							mesh			
5	3a	MIBC	6.900	156.00	5.40	1100							mesh			
5	3b	MIBC	6.900	156.00	5.40	1100							mesh			

Table A2-6 (Continued)

EXPERIMENTAL CONDITIONS FOR RUNS 2 TO 37 (DIESEL AND HEPTANE RUNS INCLUSIVE)

Run #	Set point	Date	Coal	Proc Config B	HS	F/PS	CT H2O g/m	High Shear Tank #1 Oil	gm/min	rpm	Size	Torque	High Shear #2 rpm	Oil g/m	Size	Torque	High Shear Sreen mesh	Water g/m	Vibr	Flotation Tank #1 Water g/m	Air l/m	Imp rpm
5	4	1/28/91	UFP	n	1	FP	77.00	DIESEL	.46	2000	900.00	7.40								155.00	5.00	1100
5	5	1/28/91	UFP	n	1	FP	77.00	DIESEL	.67	2000	900.00	7.30								155.00	5.00	1100
6	1A	1/30/91	UFP	N	1	FP	77.00	DIESEL	.68	2000	900.00	7.90								155.00	5.00	1100
6	1B	1/30/91	UFP	N	1	FP	77.00	DIESEL	.70	2000	900.00	7.90								155.00	5.00	1100
6	2	1/30/91	UFP	N	1	FP	77.00	DIESEL	.68	2000	900.00	7.30								540.00	5.00	1100
6	3	1/30/91	UFP	N	1	FP	77.00	DIESEL	.68	2000	900.00	7.40								540.00	5.00	1100
7	1A	2/04/91	UFP	N	1	FP	77.00	DIESEL	.72	2000	900.00	7.00								540.00	5.00	1100
7	1B	2/04/91	UFP	N	1	FP	77.00	DIESEL	.72	2000	900.00	6.70								540.00	5.00	1100
7	2A	2/04/91	UFP	N	1	FP	77.00	DIESEL	.46	2000	900.00	6.70								540.00	5.00	1100
7	2B	2/04/91	UFP	N	1	FP	77.00	DIESEL	.46	2000	900.00	7.00								540.00	5.00	1100
8	1	2/06/91	UFP	n	1	FP	77.00	DIESEL	.56	2000	900.00	7.60								280.00	5.00	1100
8	2	2/06/91	UFP	n	1	FP	77.00	DIESEL	.61	2000	900.00	7.50								280.00	5.00	1100
8	3	2/06/91	UFP	n	1	FP	77.00	DIESEL	.44	2000	900.00	7.50								540.00	5.00	1100
9	1-ud	3/14/91	ufp	n	s	fp	70.00	diesel	.72	2000	130.00		2000	0.00	130.00					600.00	5.00	1100
9	2-ud	3/14/91	ufp	n	s	fp	70.00	diesel	.72	2000	130.00		2000		130.00					600.00	5.00	1100
9	3-ud	3/14/91	ufp	n	s	fp	70.00	diesel	.72	2000	130.00		2000		130.00					600.00	5.00	1100
9	4-ud	3/14/91	ufp	n	s	fp	70.00	diesel	.72	2000	130.00		2000		130.00					600.00	5.00	1100
10	1-ud	3/19/91	ufp	n	s	fp	134.00	diesel	.79	2000	345.00		2000		345.00					938.00	5.00	1100
10	2-ud	3/19/91	ufp	n	s	fp	134.00	diesel	.79	2000	345.00		2000		345.00					938.00	5.00	1100
10	3-ud	3/19/91	ufp	n	s	fp	134.00	diesel	.79	2000	345.00		2000		345.00					938.00	5.00	1100
10	4-ud		ufp	n	s	fp	134.00	diesel	.79	2000	345.00		2000		345.00					938.00	5.00	1100
11	1-ud	3/19/91	ufp	n	1	fp	134.00	diesel	.77	2000	345.00									945.00	5.00	1100
11	2-ud	3/19/91	ufp	n	1	fp	134.00	diesel	.75	2000	345.00									940.00	5.00	1100
11	3-ud	3/19/91	ufp	n	1	fp	134.00	diesel	.88	2000	345.00									940.00	5.00	1100
12	1-ud	3/21/91	ufp	n	s	fp	151.00	diesel	.81	2000	815.00		2000		815.00					******	5.00	1100
12	2-ud	3/21/91	ufp	n	s	fp	151.00	diesel	.81	2000	815.00		2000		815.00					******	5.00	1100
12	3-ud	3/21/91	ufp	n	s	fp	134.00	diesel	.81	2000	815.00		2000		815.00					******	5.00	1100
12	4-ud	3/21/91	ufp	n	s	fp	151.00	diesel	.81	2000	815.00		2000		815.00					******	5.00	1100
12	5-ud	3/21/91	ufp	n	s	fp	151.00	diesel	.81	2000	815.00		2000		815.00					******	5.00	1100
12	6-ud	3/21/91	ufp	n	s	fp	151.00	diesel	.81	2000	815.00		2000		815.00					******	5.00	1100
12	7-ud	3/21/91	ufp	n	s	fp	151.00	diesel	.81	2000	815.00		2000		815.00					******	5.00	1100

Table A2-6 (Continued)

EXPERIMENTAL CONDITIONS FOR RUNS 2 TO 37
(DIESEL AND HEPTANE RUNS INCLUSIVE)

Run #	Set Point	FL#1 Frother Type & Rate mg/m	Flotation Tank #2 Water g/m	Air l/m	Imp rpm	Frother Type& Rate mg/min	Low Shear Rate rpm	Water g/m	Binder Type & Rate g/m	Screen Size	Water	Vibr	Comments
5	4	MIBC 2.300	156.00	5.40	1100					mesh			
5	5	MIBC 2.300	156.00	5.40	1100					mesh			
6	1A	MIBC 6.900	156.00	5.40	1100					mesh			D40=.125 MM, FROTH
6	1B	MIBC 6.900	156.00	5.40	1100					mesh			
6	2	MIBC 6.900	456.00	5.40	1100					mesh			
6	3	MIBC 2.300	456.00	5.40	1100					mesh			
7	1A	MIBC 0.000	456.00	5.40	1100					mesh			
7	1B	MIBC 0.000	456.00	5.40	1100					mesh			
7	2A	MIBC 0.000	456.00	5.40	1100					mesh			
7	2B	MIBC 0.000	456.00	5.40	1100					mesh			
8	1	MIBC 4.600	256.00	5.40	1100					mesh			
8	2	MIBC 4.600	256.00	5.40	1100					mesh			
8	3	MIBC 2.300	456.00	5.40	1100					mesh			
9	1-ud	mibc 0.000	900.00	5.40	1100					mesh			
9	2-ud	mibc 4.600	900.00	5.40	1100					mesh			
9	3-ud	mibc 8.000	900.00	5.40	1100					mesh			
9	4-ud	mibc 12.000	900.00	5.40	1100					mesh			
10	1-ud	mibc	950.00	5.40	1100					mesh			
10	2-ud	mibc 4.000	950.00	5.40	1100					mesh			
10	3-ud	mibc 8.000	950.00	5.40	1100					mesh			
10	4-ud	mibc 12.000	950.00	5.40	1100					mesh			
11	1-ud	mibc	950.00	5.40	1100					mesh			
11	2-ud	mibc 4.000	950.00	5.40	1100					mesh			
11	3-ud	mibc 12.000	950.00	5.40	1100					mesh			
12	1-ud	mibc 4.500	******	5.40	1100					mesh			
12	2-ud	mibc 5.700	******	5.40	1100					mesh			
12	3-ud	mibc 10.500	******	5.40	1100					mesh			
12	4-ud	mibc 13.500	******	5.40	1100					mesh			
12	5-ud	mibc 9.000	******	5.40	1100					mesh			
12	6-ud	mibc 4.500	******	5.40	1100					mesh			
12	7-ud	mibc	******	5.40	1100					mesh			

Table A2-6 (Continued)

EXPERIMENTAL CONDITIONS FOR RUNS 2 TO 37 (DIESEL AND HEPTANE RUNS INCLUSIVE)

Run #	Set point	Date	Coal	Proc Config B	HS	F/PS	CT H2O g/m	High Shear Tank #1 Oil	gm/min	rpm	Size	Torque	High Shear #2 rpm	Oil g/m	Size	Torque	High Shear Sreen mesh	Water g/m	Vibr	Flotation Tank #1 Water g/m	Air l/m	Imp rpm
13	1-KD	3/27/91	KEN	N	S	PS	165.00	diesel	.83	2000	815.00		2000		815.00					975.00	5.00	1100
13	2-KD	3/27/91	KEN	N	S	PS	165.00	diesel	.97	2000	815.00		2000		815.00					975.00	5.00	1100
13	3-KD	3/27/91	KEN	N	S	PS	165.00	diesel	.94	2000	815.00		2000		815.00					975.00	5.00	1100
13	4-KD	3/27/91	KEN	N	S	PS	165.00	diesel	.97	2000	815.00		2000		815.00					975.00	5.00	1100
13	5-KD	3/27/91	KEN	N	S	PS	165.00	diesel	.84	2000	815.00		2000		815.00					975.00	5.00	1100
14	1-KD	4/03/91	KEN	N	S	PS	135.00	diesel	.93	2000	815.00		2000		815.00					930.00	5.00	1100
14	2-KD	4/03/91	KEN	N	S	PS	135.00	diesel	.83	2000	345.00		2000		345.00					930.00	5.00	1100
14	3-KD	4/03/91	KEN	N	S	PS	135.00	diesel	.83	2000	130.00		2000		130.00					930.00	5.00	1100
14	4-KD	4/03/91	KEN	N	S	PS	135.00	diesel	.75	2000	815.00		2000		815.00					486.00	5.00	1100
14	5-KD	4/03/91	KEN	N	S	PS	135.00	diesel	.76	2000	345.00		2000		345.00					486.00	5.00	1100
14	6-KD	4/03/91	KEN	N	S	PS	135.00	diesel	.82	2000	130.00		2000		130.00					486.00	5.00	1100
15	1-KD	4/11/91	KEN	N	S	PS	134.00	diesel	.79	2000	815.00		2000		815.00					930.00	5.00	1100
15	2-KD	4/11/91	KEN	N	S	PS	134.00	diesel	.80	2000	345.00		2000		345.00					930.00	5.00	1100
15	3-KD	4/11/91	KEN	N	S	PS	134.00	diesel	.80	2000	130.00		2000		130.00					930.00	5.00	1100
15	4-KD	4/11/91	KEN	N	S	PS	134.00	diesel	.80	2000	815.00		2000		815.00					468.00	5.00	1100
15	5-KD	4/11/91	KEN	N	S	PS	134.00	diesel	.80	2000	345.00		2000		345.00					468.00	5.00	1100
15	6-KD	4/11/91	KEN	N	S	PS	134.00	diesel	.80	2000	130.00		2000		130.00					468.00	5.00	1100
16	1-UH	2/25/91	UFP	n	1	n	600.00	heptane	3.90	2000	900.00											
16	2-UH	2/25/91	UFP	n	1	n	164.00	heptane	6.30	2000	900.00											
17	1-UH	3/05/91	UFP	n	1	n	600.00	heptane	13.00	2000	900.00											
18	1-UH	3/06/91	UFP	n	1	n	600.00	heptane	13.00	2000	900.00											
19	1-UH	3/06/91	UFP	n	1	n	155.00	heptane	13.00	2000	900.00											
20	1-KD	4/25/91	KEN		S	FP	80.00	DSL	.80	2000	815.00		2000		815.00					810.00	5.00	1100
20	2-KD	4/25/91	KEN		S	fp	80.00	DSL	.67	2000	815.00		2000		815.00					810.00	5.00	1100
20	3-KD	4/25/91	KEN		S	FP	80.00	DSL	.84	2000	815.00		2000		815.00					810.00	5.00	1100
20	4-KD	4/25/91	KEN		S	FP	80.00	DSL	.70	2000	815.00		2000		815.00					810.00	5.00	1100
21	5-KD	5/22/91	KEN		1	FP	140.00	Diesel	1.16	2000	815.00									980.00	5.00	1100
21	6-KD	5/22/91	KEN		1	FP	140.00	Diesel	.95	2000	815.00									980.00	5.00	1100
21	7-KD	5/22/91	KEN		1	FP	140.00	Diesel	1.17	2000	815.00									980.00	5.00	1100
21	8-KD	5/22/91	KEN		1	FP	140.00	Diesel	.91	2000	815.00									980.00	5.00	1100
22	10-KD	5/01/91	KEN		S	FP	140.00	Diesel	.85	2000	815.00		2000		815.00					980.00	5.00	1100

Table A2-6 (Continued)

EXPERIMENTAL CONDITIONS FOR RUNS 2 TO 37 (DIESEL AND HEPTANE RUNS INCLUSIVE)

Run #	Set Point	FL#1 Frother Type &	Rate mg/m	Flotation Tank #2 Water g/m	Air l/m	Imp rpm	Frother Type&	Rate mg/min	Low Shear Rate rpm	Water g/m	Binder Type &	Rate g/m	Screen Size	Water	Vibr	Comments
13	1-KD	MIBC	2.700	880.00	5.40	1100							mesh			Kentucky #9
13	2-KD	MIBC	5.700	975.00	5.40	1100							mesh			
13	3-KD	MIBC	9.200	975.00	5.40	1100							mesh			
13	4-KD	MIBC	10.700	975.00	5.40	1100							mesh			
13	5-KD	MIBC	5.700	975.00	5.40	1100							mesh			
14	1-KD			885.00	5.40	1100							mesh			
14	2-KD			930.00	5.40	1100							mesh			
14	3-KD			880.00	5.40	1100							mesh			
14	4-KD			880.00	5.40	1100							mesh			
14	5-KD			700.00	5.40	1100							mesh			
14	6-KD			930.00	5.40	1100							mesh			
15	1-KD			930.00	5.40	1100							mesh			
15	2-KD			930.00	5.40	1100							mesh			
15	3-KD			930.00	5.40	1100							mesh			
15	4-KD			930.00	5.40	1100							mesh			
15	5-KD			930.00	5.40	1100							mesh			
15	6-KD			930.00	5.40	1100							mesh			
16	1-UH												120mesh		y	
16	2-UH												120mesh		y	
17	1-UH												120mesh		y	
18	1-UH												120mesh		y	
19	1-UH												120mesh		y	
20	1-KD	MIBC	5.700	900.00	5.40	1100							mesh			
20	2-KD	MIBC	5.700	900.00	5.40	1100							mesh			
20	3-KD	MIBC		900.00	5.40	1100							mesh			
20	4-KD	MIBC		900.00	5.40	1100							mesh			
21	5-KD	MIBC	7.800	980.00	5.40	1100							mesh			
21	6-KD	MIBC	7.800	980.00	5.40	1100							mesh			
21	7-KD	MIBC		980.00	5.40	1100							mesh			
21	8-KD	MIBC		980.00	5.40	1100							mesh			
22	10-KD	MIBC	6.700	980.00	5.40	1100							mesh			

Table A2-6 (Continued)

EXPERIMENTAL CONDITIONS FOR RUNS 2 TO 37 (DIESEL AND HEPTANE RUNS INCLUSIVE)

	Set			Proc Config		CT H2O	High Shear Tank #1					High Shear #2				High Shear Sreen			Flotation Tank #1		
Run #	point	Date	Coal	B HS	F/PS	g/m	Oil	gm/min	rpm	Size	Torque	rpm	Oil g/m	Size	Torque	mesh	Water g/m	Vibr	Water g/m	Air l/m	Imp rpm
22	11-KD	5/01/91	KEN	S	FP	140.00	Diesel	1.07	2000	815.00		2000		815.00					980.00	5.00	1100
22	12-KD	5/01/91	KEN	S	FP	140.00	Diesel	.83	2000	815.00		2000		815.00					980.00	5.00	1100
22	9-KD	5/01/91	KEN	S	FP	140.00	Diesel	1.03	2000	815.00		2000		815.00					980.00	5.00	1100
23	13-KD	5/01/91	KEN	1	FP	150.00	Diesel	1.04	2000	815.00									980.00	5.00	1100
23	14-KD	5/19/89	KEN	1	FP	150.00	Diesel	.85	2000	815.00									980.00	5.00	1100
23	15-KD	5/01/91	KEN	1	FP	150.00	Diesel	1.05	2000	815.00									980.00	5.00	1100
23	16-KD	5/01/91	KEN	1	FP	150.00	Diesel	.84	2000	815.00									980.00	5.00	1100
24	17-KD	5/23/91	KEN	S	FP	197.00	Diesel	1.08	2000	815.00		2000		815.00					980.00	5.00	1100
24	18-KD	5/23/91	KEN	S	FP	197.00	Diesel	1.05	2000	815.00									980.00	5.00	1100
24	19-KD	5/23/91	KEN	S	FP	197.00	Diesel	.82	2000	815.00		2000		815.00					980.00	5.00	1100
24	20-KD	5/23/91	KEN	S	FP	197.00	Diesel	.80	2000	815.00		2000		815.00					515.00	5.00	1100
24	21-KD	5/23/91	KEN	S	FP	197.00	Diesel	.82	2000	815.00		2000		815.00					515.00	5.00	1100
25	22-KD	5/06/91	KEN	S	FP	150.00	Diesel	1.06	2000	815.00		2000		815.00					980.00	5.00	1100
25	23-KD	5/06/91	KEN	S	FP	150.00	Diesel	1.06	2000	815.00		2000		815.00					980.00	5.00	1100
25	24-KD	5/06/91	KEN	S	FP	150.00	Diesel	.87	2000	815.00		2000		815.00						5.00	1100
26	1-PD	6/07/91	PIT	S	FP	85.00	Diesel	.54	2000	815.00		2000		345.00					595.00	5.00	1100
26	2-PD	6/07/91	PIT	S	FP	85.00	Diesel	.55	2000	815.00		2000		345.00					595.00	5.00	1100
26	3-PD	6/07/91	PIT	S	FP	85.00	Diesel	.55	2000	815.00		2000		345.00					595.00	5.00	1100
26	4-PD	6/07/91	PIT	S	FP	85.00	Diesel	.64	2000	815.00		2000		345.00					595.00	5.00	1100
26	5-PD	6/07/91	PIT	S	FP	85.00	Diesel	.62	2000	815.00		2000		345.00					595.00	5.00	110
26	6-PD	6/07/91	PIT	S	FP	85.00	Diesel	.65	2000	815.00		2000		345.00					595.00	5.00	1100
27	1-PD	6/04/91	PIT	S	FP	85.00	DSL	.50	2000	815.00		2000		345.00					595.00	5.00	1100
27	2-PD	6/04/91	PIT	S	FP	85.00	DSL	.49	2000	815.00		2000		345.00					595.00	5.00	1100
27	3-PD	6/04/91	PIT	S	PD	85.00	DSL	.50	2000	815.00		2000		345.00					595.00	5.00	1100
27	4-PD	6/04/91	PIT	S	FP	85.00	DSL	.61	2000	815.00		2000		345.00					595.00	5.00	1100
27	5-PD	6/04/91	PIT	S	FP	85.00	DSL	.61	2000	815.00		2000		345.00					595.00	5.00	1100
27	6-PD	6/04/91	PIT	S	FP	85.00	DSL	.61	2000	815.00		2000		345.00					595.00	5.00	1100
28	1-KD	6/17/91	KEN	S	FP	85.00	Diesel	.55	2000	815.00		2000		345.00					595.00	5.00	1100
28	2-KD	6/17/91	KEN	S	FP	85.00	Diesel	.55	2000	815.00		2000		345.00					595.00	5.00	1100
28	3-KD	6/17/91	KEN	S	FP	85.00	Diesel	.64	2000	815.00		2000		345.00					595.00	5.00	1100
29	1-KD	6/18/91	KEN	S	FP	85.00	Diesel	.52	2000	815.00		2000		345.00					595.00	5.00	1100

Table A2-6 (Continued)

EXPERIMENTAL CONDITIONS FOR RUNS 2 TO 37 (DIESEL AND HEPTANE RUNS INCLUSIVE)

Run #	Set Point	FL#1 Type	Frother & Rate mg/m	Flotation Tank #2 Water g/m	Air l/m	Imp rpm	Frother Type&	Rate mg/min	Low Shear Rate rpm	Water g/m	Binder Type &	Rate g/m	Screen Size	Water	Vibr	Comments
22	11-KD	MIBC		980.00	5.40	1100							mesh			
22	12-KD	MIBC		980.00	5.40	1100							mesh			
22	9-KD	MIBC	6.700	980.00	5.40	1100							mesh			
23	13-KD	MIBC	6.500	980.00	5.40	1100							mesh			
23	14-KD	MIBc	6.700	980.00	5.40	1100							mesh			
23	15-KD	MIBC		980.00	5.40	1100							mesh			
23	16-KD	MIBC		980.00	5.40	1100							mesh			
24	17-KD	MIBC	3.400	980.00	5.40	1100							mesh			
24	18-KD	MIBC	3.400	980.00	5.40	1100							mesh			
24	19-KD	MIBC	3.400	980.00	5.40	1100							mesh			
24	20-KD	MIBC	3.400	980.00	5.40	1100							mesh			
24	21-KD	MIBC	3.400	980.00	5.40	1100							mesh			
25	22-KD	MIBC	3.400	980.00	5.40	1100							mesh			
25	23-KD	MIBC		980.00	5.40	1100							mesh			
25	24-KD	MIBC	3.400	980.00	5.40	1100							mesh			
26	1-PD	MIBC	0.000	770.00	5.40	1100							mesh			
26	2-PD	MIBC	2.600	770.00	5.40	1100							mesh			
26	3-PD	MIBC	5.400	770.00	5.40	1100							mesh			
26	4-PD	MIBC		770.00	5.4[illegible]	1100							mesh			
26	5-PD	MIBC	2.800	770.00	5.40	1100							mesh			
26	6-PD	MIBC	5.600	770.00	5.40	1100							mesh			
27	1-PD	MIBC	0.000	770.00	5.40	1100							mesh			
27	2-PD	MIBC	2.500	770.00	5.40	1100							mesh			
27	3-PD	MIBC	5.000	770.00	5.40	1100							mesh			
27	4-PD	MIBC	0.000	770.00	5.40	1100							mesh			
27	5-PD	MIBC	2.600	770.00	5.40	1100							mesh			
27	6-PD	MIBC	5.000	770.00	5.40	1100							mesh			Feed sample # 1 not
28	1-KD	MIBC		770.00	5.40	1100							mesh			
28	2-KD	MIBC	2.600	770.00	5.40	1100							mesh			
28	3-KD	MIBC		770.00	5.40	1100							mesh			
29	1-KD	MIBC		770.00	5.40	1100							mesh			

Table A2-6 (Continued)

EXPERIMENTAL CONDITIONS FOR RUNS 2 TO 37
(DIESEL AND HEPTANE RUNS INCLUSIVE)

	Set			Proc Config		CT H2O	High Shear Tank #1					High Shear #2				High Shear Sreen			Flotation Tank #1		
Run #	point	Date	Coal	B HS	F/PS	g/m	Oil	gm/min	rpm	Size	Torque	rpm	Oil g/m	Size	Torque	mesh	Water g/m	Vibr	Water g/m	Air l/m	Imp rpm
29	2-KD	6/18/91	KEN	S	FP	85.00	Diesel	.52	2000	815.00		2000		345.00					595.00	5.00	1100
29	3-KD	6/18/91	KEN	S	FP	85.00	Diesel	.61	2000	815.00		2000		345.00					595.00	5.00	1100
30	1-UD	6/12/91	UFP	S	FP	85.00	Diesel	.43	2000	815.00		2000		345.00					595.00	5.00	1100
30	2-UD	6/12/91	UFP	S	FP	85.00	Diesel	.44	2000	815.00		2000		345.00					395.00	5.00	1100
30	3-UD	6/12/91	UFP	S	FP	85.00	Diesel	.54	2000	815.00		2000		345.00					595.00	5.00	1100
31	1-UD	6/12/91	UFP	S	FP	51.00	Diesel	.52	2000	815.00		2000		345.00					595.00	5.00	1100
31	2-UD	6/12/91	UFP	F	FP	51.00	Diesel	.53	2000	815.00		2000		345.00					595.00	5.00	1100
31	3-UD	6/12/91	UFP	S	FP	51.00	Diesel	.65	2000	815.00		2000		345.00					595.00	5.00	1100
34	1-PH	6/10/91	PIT	1		762.30	HEPTANE	5.13	2000	******											
34	2-PH	6/10/91	PIT	1		327.00	HEPTANE	5.19	2000	******											
34	3-PH	6/10/91	PIT	1		838.00	HEPTANE	10.44	2000	******											
34	4-PH	6/10/91	PIT	1		337.60	HEPTANE	10.28	2000	******											
34	5-PH	6/10/91	PIT	1		337.60	HEPTANE	10.28	2000	******											
34	6-PH	6/10/91	PIT	1		142.36	HEPTANE	5.01	2000	******											
35	1-UH	6/04/91	UFP	1		358.00	Heptane	8.99	2000	******											
35	2-UH	6/04/91	UFP	1		357.30	Heptane	17.40	2000	******											
36	1-UH	6/04/91	UFP	1		819.50	Heptane	6.32	2000	******											
36	10-UH	6/06/91	UFP	1		317.00	HEPTANE	10.60	2000	******											
36	11-UH	6/06/91	UFP	1		317.00	HEPTANE	15.60	2000	******											
36	12-UH	6/07/91	UFP	1		334.90	HEPTANE	5.20	2000	******											
36	13-UH	6/07/91	UFP	1		334.00	HEPTANE	10.50	2000	******											
36	14-UH	6/07/91	UFP	1		140.80	HEPTANE	5.14	2000	******											
36	15-UH	6/07/91	UFP	1		140.00	HEPTANE	10.50	2000	******											
36	2-UH	6/04/91	UFP	1		779.41	Heptane	10.10	2000	******											
36	3-UH	6/04/91	UFP	1		316.80	Heptane	5.30	2000	******											
36	4-UH	6/04/91	UFP	1		317.00	Heptane	10.20	2000	******											
36	5-UH	6/05/91	UFP	1		138.66	HEPTANE	5.17	2000	******											
36	6-UH	6/05/91	UFP	1		137.60	HEPTANE	7.30	2000	******											
36	7-UH	6/05/91	UFP	1		806.00	HEPTANE	15.30	2000	******											
36	8-UH	6/06/91	UFP	1		329.00	HEPTANE	15.00	2000	******											
36	9-UH	6/06/91	UFP	1		332.00	HEPTANE	5.36	2000	******											

Table A2-6 (Continued)

EXPERIMENTAL CONDITIONS FOR RUNS 2 TO 37 (DIESEL AND HEPTANE RUNS INCLUSIVE)

Run #	Set Point	FL#1 Frother Type &	Rate mg/m	Flotation Tank #2 Water g/m	Air l/m	Imp rpm	Frother Type&	Rate mg/min	Low Shear Rate rpm	Water g/m	Binder Type &	Rate g/m	Screen Size	Water	Vibr	Comments
29	2-KD	MIBC	2.600	770.00	5.40	1100							mesh			
29	3-KD	MIBC		770.00	5.40	1100							mesh			
30	1-UD	MIBC		770.00	5.40	1100							mesh			
30	2-UD	MIBC	2.300	770.00	5.40	1100							mesh			
30	3-UD	MIBC		770.00	5.40	1100							mesh			
31	1-UD	MIBC		770.00	5.40	1100							mesh			
31	2-UD	MIBC	2.600	770.00	5.40	1100							mesh			
31	3-UD	MIBC		770.00	5.40	1100							mesh			
34	1-PH												125mesh	0.00	Y	
34	2-PH												125mesh	527.00	Y	
34	3-PH												125mesh	527.00	Y	
34	4-PH												125mesh	337.60	Y	
34	5-PH												125mesh	0.00	Y	
34	6-PH												125mesh	718.20	Y	
35	1-UH												125mesh	0.00	Y	Sieve Bend followed
35	2-UH												125mesh	0.00	Y	
36	1-UH												125mesh	0.00	Y	
36	10-UH												125mesh	528.00	Y	
36	11-UH												125mesh	528.00	Y	
36	12-UH												125mesh	528.00	Y	
36	13-UH												125mesh	528.00	Y	
36	14-UH												125mesh	704.00	Y	
36	15-UH												125mesh	704.00	Y	SIEVE BEND FOLLOWED
36	2-UH												125mesh	0.00	Y	
36	3-UH												125mesh	0.00	Y	
36	4-UH												125mesh	0.00	Y	
36	5-UH												125mesh	0.00	Y	
36	6-UH												125mesh	0.00	Y	
36	7-UH												125mesh	0.00	Y	
36	8-UH												125mesh	0.00	Y	
36	9-UH												125mesh	0.00	Y	

Table A2-6 (Continued)

EXPERIMENTAL CONDITIONS FOR RUNS 2 TO 37
(DIESEL AND HEPTANE RUNS INCLUSIVE)

Run #	Set point	Date	Coal	Proc Config B	Proc Config HS	Proc Config F/PS	CT H2O g/m	High Shear Tank #1 Oil	High Shear Tank #1 gm/min	High Shear Tank #1 rpm	High Shear Tank #1 Size	High Shear Tank #1 Torque	High Shear #2 rpm	High Shear #2 Oil g/m	High Shear #2 Size	High Shear #2 Torque	High Shear Sreen mesh	High Shear Sreen Water g/m	High Shear Sreen Vibr	Flotation Tank #1 Water g/m	Flotation Tank #1 Air l/m	Flotation Tank #1 Imp rpm
37	1-KH	6/11/91	KEN	1			824.00	HEPTANE	5.03	2000	******											
37	2-KH	6/11/91	KEN	1			331.00	HEPTANE	5.35	2000	******											
37	3-KH	6/11/91	KEN	1			140.00	HEPTANE	10.33	2000	******											
37	4-KH	6/11/91	KEN	1			341.00	HEPTANE	5.36	2000	******											
37	5-KH	6/13/91	KEN	1			341.50	HEPTANE	10.85	2000	******											
37	6-KH	6/13/91	KEN	1			344.00	HEPTANE	10.81	2000	******											
37	7-KH	6/13/91	KEN	1			348.00	HEPTANE	10.82	2000	******											
37	8-KH	6/13/91	KEN	1			348.00	HEPTANE	5.48	2000	******											
37	9-KH	6/13/91	KEN	1			845.00	HEPTANE	10.50	2000	******											

Table A2-6 (Continued)

EXPERIMENTAL CONDITIONS FOR RUNS 2 TO 37
(DIESEL AND HEPTANE RUNS INCLUSIVE)

Run #	Set Point	FL#1 Frother Type & Rate mg/m	Flotation Tank #2 Water g/m	Air l/m	Imp rpm	Frother Type& Rate mg/min	Low Shear Rate rpm	Water g/m	Binder Type & Rate g/m	Screen Size	Water	Vibr	Comments
37	1-KH									125mesh	0.00	Y	
37	2-KH									125mesh	345.00	Y	
37	3-KH									125mesh	696.00	Y	
37	4-KH									125mesh	278.00	Y	
37	5-KH									125mesh	278.00	Y	
37	6-KH									125mesh	504.00	Y	
37	7-KH									125mesh	0.00	Y	
37	8-KH									125mesh	0.00	Y	
37	9-KH									125mesh	0.00	Y	

Table A2-7

CALCULATED FEED PROPERTIES

Run #	Setpoint	Flow gm/min	Moist	Ash%	TS%	SC%	Dry Rate	Calc PS%	Calc Btu-lb	HS Oil Conc.
1	1	147.93	.50	14.70	2.16	35	51.23	1.61	12861	.82
1	2	150.18	.40	14.30	2.05	34	51.41	1.50	12927	1.81
1	3	149.58	.40	14.30	1.94	34	50.71	1.39	12927	2.86
1	4	149.28	.30	14.80	2.33	34	50.80	1.78	12845	1.34
1	5	148.44	.35	14.45	2.03	33	49.61	1.48	12902	.85
1	6	147.55	.40	14.10	1.92	33	48.28	1.37	1296[illegible]	.87
1	7	146.83	.40	14.10	2.03	32	47.03	1.48	12960	.89
3	1	158.30	.40	15.80	1.91	28	44.29	1.37	12679	1.26
3	2a	158.80	1.00	16.00	2.12	29	45.64	1.58	12646	1.01
3	2b	158.80	1.00	16.00	2.12	29	45.64	1.58	12646	1.10
3	3a	158.70	1.10	15.80	1.93	29	46.53	1.39	12679	1.05
3	3b	158.70	1.10	15.80	1.93	29	46.53	1.39	12679	1.05
3	4	151.35	.90	16.70	1.93	28	42.47	1.40	12529	1.06
3	5	151.35	1.00	15.10	1.93	28	41.82	1.39	12795	1.53
3	6	150.30	.30	15.10	1.78	27	41.29	1.24	12795	1.55
3	7	151.00	.40	15.20	1.81	27	41.49	1.27	12778	1.66
4	1	159.80	.70	15.50	2.02	29	45.91	1.48	12729	1.42
4	2a	159.80	.70	15.50	2.02	29	45.91	1.48	12729	1.42
4	2b	159.80	.70	15.50	2.02	29	45.91	1.48	12729	1.42
4	3-A	160.37	.50	1.98	1.98	29	45.80	1.35	14902	1.00
4	3b	160.37	.50	15.40	1.98	29	46.03	1.44	12745	1.00
4	4	160.39	.40	15.30	1.99	28	45.68	1.45	12762	1.01
4	5a	157.70	.50	15.60	2.00	29	44.96	1.46	12712	1.25
4	5b	156.63	.60	15.50	1.93	28	44.47	1.39	12729	1.26
5	1	155.10	.90	15.60	2.19	30	46.89	1.65	12712	.96
5	2a	156.10	.60	15.60	2.18	30	46.99	1.64	12712	1.00
5	2b	156.10	.60	15.60	2.18	30	46.99	1.64	12712	.98
5	3a	154.00	.60	15.40	2.12	30	45.65	1.58	12745	1.03
5	3b	154.00	.60	15.40	2.12	30	45.65	1.58	12745	.99
5	4	156.50	.60	15.10	1.96	30	46.23	1.42	12795	1.00
5	5	158.30	.60	14.80	2.07	29	46.21	1.52	12845	1.45
6	1A	156.90	.80	14.60	1.91	29	45.92	1.36	12878	1.48
6	1B	156.90	.80	14.60	1.91	29	45.92	1.36	12878	1.52
6	2	157.40	.60	14.20	1.92	29	45.65	1.37	12944	1.49
6	3	157.10	.40	14.20	1.99	27	43.09	1.44	12944	1.58
7	1A	160.90	.50	15.70	1.77	31	49.62	1.23	12695	1.45
7	1B	160.90	.50	15.70	1.77	31	49.62	1.23	12695	1.45
7	2A	161.20	.60	15.70	1.92	30	48.15	1.38	12695	.96
7	2B	161.20	.60	15.70	1.92	30	48.10	1.38	12695	.96
8	1	162.30	.60	16.20	1.89	28	45.74	1.35	12612	1.22
8	2	161.90	1.30	16.40	2.03	28	45.45	1.49	12579	1.34
8	3	162.50	.70	16.30	2.00	28	44.93	1.46	12596	.98
9	1-ud	296.65	.50	16.30	2.17	24	71.73	1.63	12596	1.00
9	2-ud	296.65	.50	16.30	2.17	24	71.73	1.63	12596	1.00
9	3-ud	296.65	.50	16.30	2.17	24	71.73	1.63	12596	1.00
9	4-ud	296.65	.50	16.30	2.17	24	71.73	1.63	12596	1.00
10	1-ud	268.40	.90	17.20	2.81	30	79.53	2.28	12446	.99
10	2-ud	268.40	.90	17.20	2.81	30	79.53	2.28	12446	.99
10	3-ud	268.40	.90	17.20	2.81	30	79.53	2.28	12446	.99
10	4-ud	268.40	.90	17.20	2.81	30	79.53	2.28	12446	.99
11	1-ud	280.00	.90	17.20	2.81	30	82.97	2.28	12446	.93
11	2-ud	280.00	.90	17.20	2.81	30	82.97	2.28	12446	.90
11	3-ud	280.00	.90	17.20	2.81	30	82.97	2.28	12446	1.06
12	1-ud	297.80	1.00	14.80	2.05	30	88.60	1.50	12845	.91
12	2-ud	297.80	1.00	14.80	2.05	30	88.60	1.50	12845	.91
12	3-ud	297.60	1.00	14.80	2.05	30	88.60	1.50	12845	.91
12	4-ud	297.60	1.00	14.80	2.05	30	88.60	1.50	12845	.91
12	5-ud	297.80	1.00	14.80	2.05	30	88.60	1.50	12845	.91
12	6-ud	297.80	1.00	14.80	2.05	30	88.60	1.50	12845	.91
12	7-ud	297.80	1.00	14.80	2.05	30	88.60	1.50	12845	.91

Table A2-7 (Continued)

CALCULATED FEED PROPERTIES

Run #	Setpoint	Flow gm/min	Moist	Ash%	TS%	SC%	Dry Rate	Calc PS%	Calc Btu-lb	HS Oil Conc.
13	1-KD	322.38	1.10	17.40	3.87	27	86.08	2.41	12054	.96
13	2-KD	320.00	1.10	17.40	3.87	27	85.45	2.41	12054	1.14
13	3-KD	325.55	1.10	17.40	3.87	27	86.93	2.41	12054	1.08
13	4-KD	327.79	1.10	17.40	3.87	27	87.53	2.41	12054	1.11
13	5-KD	325.99	1.10	17.40	3.87	27	87.05	2.41	12054	.96
14	1-KD	245.00	1.10	16.07	3.66	31	75.11	2.17	12261	1.24
14	2-KD	239.20	1.10	16.07	3.66	31	73.33	2.17	12261	1.13
14	3-KD	267.70	1.10	16.07	3.66	31	82.08	2.17	12261	1.01
14	4-KD	246.60	1.10	16.07	3.66	31	75.61	2.17	12261	.99
14	5-KD	239.20	1.10	16.07	3.68	31	73.33	2.19	12261	1.04
14	6-KD	279.70	1.10	16.07	3.66	31	85.76	2.17	12261	.96
15	1-KD	273.00	1.20	18.15	3.93	28	76.87	2.48	11936	1.03
15	2-KD	273.00	1.20	18.15	3.93	28	76.87	2.48	11936	1.04
15	3-KD	273.00	1.20	18.15	3.93	28	76.87	2.48	11936	1.04
15	4-KD	273.00	1.20	18.15	3.93	28	76.87	2.48	11936	1.04
15	5-KD	273.00	1.20	18.15	3.93	28	76.87	2.48	11936	1.04
15	6-KD	273.00	1.20	18.15	3.93	28	76.87	2.48	11936	1.04
16	1-UH	154.40	0.00	15.80	1.98	30	46.32	1.44	12679	8.42
16	2-UH	154.40	0.00	15.80	1.98	30	46.32	1.44	12679	13.60
17	1-UH	152.00	0.00	15.80	1.98	30	45.60	1.44	12679	28.51
18	1-UH	152.00	0.00	15.80	1.98	30	45.60	1.44	12679	28.51
19	1-UH	152.00	0.00	15.80	1.98	30	45.60	1.44	12679	28.51
20	1-KD	282.29	1.00	17.20	3.95	23	65.76	2.48	12085	1.22
20	2-KD	282.29	1.00	17.20	3.95	23	65.76	2.48	12085	1.02
20	3-KD	282.29	1.00	17.20	3.95	23	65.76	2.48	12085	1.28
20	4-KD	282.29	1.00	17.20	3.95	23	65.76	2.48	12085	1.06
21	5-KD	281.60	1.30	18.00	3.95	37	104.42	2.50	11960	1.11
21	6-KD	281.60	1.30	18.00	3.95	37	104.42	2.50	11960	.91
21	7-KD	281.60	1.30	18.00	3.95	37	104.42	2.50	11960	1.12
21	8-KD	281.60	1.30	18.00	3.95	37	104.42	2.50	11960	.87
22	10-KD	287.57	1.40	18.80	4.44	29	82.69	3.00	11834	1.03
22	11-KD	287.57	1.40	18.80	4.44	29	82.69	3.00	11834	1.29
22	12-KD	287.57	1.40	18.80	4.44	29	82.69	3.00	11834	1.00
22	9-KD	287.57	1.40	18.80	4.44	29	82.69	3.00	11834	1.25
23	13-KD	277.00	1.30	19.40	4.66	30	82.02	3.23	11739	1.27
23	14-KD	277.00	1.30	19.40	4.66	30	82.02	3.23	11739	1.04
23	15-KD	277.00	1.30	19.40	4.66	30	82.02	3.23	11739	1.28
23	16-KD	277.00	1.30	19.40	4.66	30	82.02	3.23	11739	1.02
24	17-KD	227.18	1.50	17.93	3.76	36	82.52	2.31	11971	1.31
24	18-KD	227.18	1.50	17.93	3.76	36	82.52	2.31	11971	1.27
24	19-KD	227.18	1.50	17.93	3.76	36	82.52	2.31	11971	.99
24	20-KD	227.18	1.50	17.93	3.76	36	82.52	2.31	11971	.97
24	21-KD	227.18	1.50	17.93	3.76	36	82.52	2.31	11971	.99
25	22-KD	277.00	1.10	19.00	4.30	30	82.19	2.87	11802	1.29
25	23-KD	277.00	1.10	19.00	4.30	30	82.19	2.87	11802	1.29
25	24-KD	277.00	1.10	19.00	4.30	30	82.19	2.87	11802	1.06
26	1-PD	171.26	1.80	9.20	3.77	31	52.85	1.53	13345	1.02
26	2-PD	171.26	1.80	9.20	3.77	31	52.85	1.53	13345	1.04
26	3-PD	171.26	1.80	9.20	3.77	31	52.85	1.53	13345	1.04
26	4-PD	171.26	1.80	9.20	3.77	31	52.85	1.53	13345	1.21
26	5-PD	171.26	1.80	9.20	3.77	31	52.85	1.53	13345	1.17
26	6-PD	171.26	1.80	9.20	3.77	31	52.85	1.53	13345	1.23
27	1-PD	169.22	1.60	10.30	3.95	29	48.69	1.73	13131	1.03
27	2-PD	169.22	1.60	10.30	3.95	29	48.69	1.73	13131	1.01
27	3-PD	169.22	1.60	10.30	3.95	29	48.69	1.73	13131	1.03
27	4-PD	169.22	1.60	10.30	3.95	29	48.69	1.73	13131	1.25
27	5-PD	169.22	1.60	10.30	3.95	29	48.69	1.73	13131	1.25
27	6-PD	169.22	1.60	10.30	3.95	29	48.69	1.73	13131	1.25
28	1-KD	170.00	1.40	18.20	4.00	30	50.79	2.55	11928	1.08
28	2-KD	170.00	1.40	18.20	4.00	30	50.79	2.55	11928	1.08

Table A2-7 (Continued)

CALCULATED FEED PROPERTIES

Run #	Setpoint	Flow gm/min	Moist	Ash%	TS%	SC%	Dry Rate	Calc PS%	Calc Btu-lb	HS Oil Conc.
28	3-KD	170.00	1.40	18.20	4.00	30	50.79	2.55	11928	1.26
29	1-KD	172.40	1.50	18.50	4.12	29	50.78	2.68	11881	1.02
29	2-KD	172.40	1.50	18.50	4.12	29	50.78	2.68	11881	1.02
29	3-KD	172.40	1.50	18.50	4.12	29	50.78	2.68	11881	1.20
30	1-UD	167.00	1.60	13.80	1.77	26	42.68	1.22	13009	1.01
30	2-UD	167.00	1.60	13.80	1.77	26	42.68	1.22	13009	1.03
30	3-UD	167.00	1.60	13.60	1.77	26	42.68	1.22	13042	1.27
31	1-UD	204.00	1.40	15.80	2.01	25	50.09	1.47	12679	1.04
31	2-UD	204.00	1.40	15.80	2.01	25	50.09	1.47	12679	1.06
31	3-UD	204.00	1.40	15.80	2.01	25	50.09	1.47	12679	1.30
34	1-PH	265.00	1.10	10.40	3.80	21	55.78	1.59	13112	9.20
34	2-PH	270.80	1.20	10.50	3.80	21	57.01	1.59	13092	9.10
34	3-PH	270.80	1.10	10.50	3.80	21	57.07	1.59	13092	18.29
34	4-PH	273.00	1.10	10.40	3.80	21	57.56	1.59	13112	17.86
34	5-PH	273.20	1.10	10.50	3.70	21	57.56	1.49	13092	17.86
34	6-PH	273.60	1.10	10.40	3.80	21	57.66	1.59	13112	8.69
35	1-UH	269.80	.80	15.30	2.10	27	73.90	1.56	12762	12.16
35	2-UH	209.70	.80	15.30	2.10	35	73.80	1.56	12762	23.58
36	1-UH	196.05	.80	15.30	2.10	27	53.37	1.56	12762	11.84
36	10-UH	263.00	.80	15.30	2.10	21	56.15	1.56	12762	18.88
36	11-UH	261.50	.80	15.30	2.10	21	56.15	1.56	12762	27.78
36	12-UH	258.00	.80	15.30	2.10	22	56.15	1.56	12762	9.26
36	13-UH	263.80	.80	15.30	2.10	21	56.15	1.56	12762	18.70
36	14-UH	263.80	.80	15.30	2.10	21	56.15	1.56	12762	9.15
36	15-UH	263.90	.80	15.30	2.10	21	56.15	1.56	12762	18.70
36	2-UH	196.05	.80	15.30	2.10	27	52.28	1.56	12762	19.32
36	3-UH	197.00	.80	15.30	2.10	28	56.05	1.56	12762	9.46
36	4-UH	200.00	.80	15.30	2.10	28	56.05	1.56	12762	18.20
36	5-UH	206.59	.80	15.30	2.10	27	56.15	1.56	12762	9.21
36	6-UH	266.00	.80	15.30	2.10	21	56.15	1.56	12762	13.00
36	7-UH	263.00	.80	15.30	2.10	21	56.15	1.56	12762	27.25
36	8-UH	260.00	.80	15.30	2.10	22	56.15	1.56	12762	26.72
36	9-UH	259.60	.80	15.30	2.10	22	56.15	1.56	12762	9.55
37	1-KH	270.00	.90	18.00	4.00	22	58.57	2.55	11960	8.59
37	2-KH	268.72	.90	18.00	4.00	21	57.38	2.55	11960	9.32
37	3-KH	268.00	.90	18.00	4.00	22	58.17	2.55	11960	17.76
37	4-KH	261.50	.80	18.30	4.04	22	57.83	2.59	11912	9.27
37	5-KH	265.14	.90	18.00	4.02	22	57.97	2.57	11960	18.72
37	6-KH	245.00	.90	17.40	3.94	22	53.41	2.48	12054	20.24
37	7-KH	261.00	.90	18.00	4.00	22	56.88	2.55	11960	19.02
37	8-KH	261.16	.90	18.00	4.00	22	56.98	2.55	11960	9.62
37	9-KH	259.70	.90	18.00	4.00	22	56.59	2.55	11960	18.56

Table A2-8

CALCULATED FLOTATION PRODUCT PROPERTIES

Run #	Set point	Sample	Yield	Btu	CmRec	Calc PS%	Ash Rej	TS Rej	PS Rej	TS Red	PS Red	SC%
1	1	1	0.00	0	0.00	.73	*****	*****	*****	43.15	57.75	0.0
1	1	2	74.25	81	80.17	.70	60.10	55.66	67.77	44.69	59.80	28.4
1	1	3	74.79	81	80.93	.68	60.83	56.03	68.53	45.66	61.11	28.7
20	1-KD	1	93.27	100	99.58	1.83	37.09	19.95	31.47	19.61	31.18	11.9
20	2-KD	1	93.15	99	98.89	1.86	34.47	19.35	30.10	18.44	29.32	10.6
20	3-KD	1	92.51	100	99.99	1.68	43.53	23.65	37.60	23.65	37.60	16.4
20	4-KD	1	91.79	100	99.99	1.50	47.70	27.96	44.45	27.96	44.45	16.0
21	5-KD	1	90.33	98	97.49	1.91	42.29	20.42	30.82	18.37	29.04	20.8
21	6-KD	1	85.71	94	93.13	1.77	48.10	27.31	39.18	21.95	34.70	37.2
21	7-KD	1	87.22	95	94.99	1.61	48.15	29.56	43.82	25.84	40.85	25.0
21	8-KD	1	83.90	92	91.99	1.45	52.92	35.43	51.35	29.80	47.11	22.4
22	10-KD	1	86.51	94	93.65	1.92	44.32	32.20	44.56	27.60	40.80	14.7
22	11-KD	1	85.31	93	92.66	1.92	46.46	33.14	45.48	27.84	41.17	13.3
22	12-KD	1	83.60	92	91.22	1.76	49.31	37.30	50.95	31.26	46.23	13.5
22	9-KD	1	85.98	94	93.50	1.83	46.49	34.35	47.68	29.79	44.05	14.5
23	13-KD	1	87.95	96	95.04	1.89	41.52	35.27	48.64	31.89	45.96	12.3
23	14-KD	1	89.89	98	97.80	2.04	43.01	30.75	43.35	29.20	42.08	16.4
23	15-KD	1	89.76	100	99.12	1.80	49.10	34.89	49.90	34.31	49.45	16.4
23	16-KD	1	87.07	97	96.80	1.69	51.81	38.69	54.35	36.66	52.84	16.0
24	17-KD	1	90.55	99	98.41	1.69	45.46	21.25	33.63	19.98	32.56	19.9
24	18-KD	1	89.28	97	96.93	1.72	45.72	21.64	33.33	19.16	31.22	20.1
24	19-KD	1	89.60	97	96.95	1.82	44.03	19.22	29.39	16.67	27.17	31.5
24	20-KD	1	88.50	97	96.30	1.74	47.19	21.86	33.28	18.85	30.72	20.9
24	21-KD	1	87.70	95	95.00	1.75	45.71	22.56	33.62	18.49	30.12	22.3
25	22-KD	1	92.17	100	99.79	1.99	40.33	24.12	36.08	23.96	35.95	14.8
25	23-KD	1	91.51	100	99.08	2.02	40.76	24.02	35.58	23.32	34.98	14.5
25	24-KD	1	92.11	100	99.84	1.96	40.86	24.81	37.15	24.69	37.05	16.6
26	1-PD	1	91.60	94	93.32	1.24	25.32	14.47	25.91	8.35	20.61	13.5
26	2-PD	2	97.92	100	99.43	1.37	16.98	5.20	11.99	4.65	11.49	15.5
26	3-PD	3	96.93	100	98.96	1.43	23.09	4.35	9.22	3.35	8.27	24.6
26	4-PD	4	95.29	98	97.18	1.37	23.35	7.49	14.35	4.80	11.86	13.5
26	5-PD	5	95.66	97	96.82	1.40	15.78	6.88	12.30	3.82	9.42	13.0
26	6-PD	6	97.03	99	98.84	1.32	20.90	7.35	16.44	6.26	15.46	18.0
27	1-PD	1	94.45	97	96.35	1.37	22.05	13.20	25.40	9.91	22.57	10.4
27	2-PD	2	94.60	98	97.03	1.50	26.52	9.71	18.31	6.94	15.81	21.6
27	3-PD	3	94.66	97	96.56	1.48	21.88	10.37	19.23	7.18	16.35	14.8
27	4-PD	4	92.57	96	94.94	1.32	28.10	15.87	29.68	11.39	25.93	13.2
27	5-PD	5	92.63	96	95.11	1.40	28.95	13.94	25.49	9.51	21.66	17.3
27	6-PD	6	93.66	97	96.06	1.48	27.25	11.08	20.21	7.44	16.94	21.8
28	1-KD	1	78.91	85	84.99	1.69	48.40	35.88	47.73	24.56	38.49	13.6
28	2-KD	2	89.55	97	96.88	1.73	43.42	26.12	39.17	23.75	37.22	22.9
28	3-KD	3	89.06	97	96.79	1.59	45.68	29.64	44.64	27.31	42.80	18.8
29	1-KD	1	85.56	95	94.38	1.56	53.29	34.59	50.19	30.69	47.22	21.6
29	2-KD	2	88.10	96	95.56	2.05	44.76	22.80	32.70	19.22	29.57	16.4
29	3-KD	3	85.27	95	94.27	1.56	54.37	34.81	50.47	30.84	47.46	23.2
30	1-UD	1	92.69	99	98.61	.78	44.25	28.25	40.42	27.24	39.58	27.5
30	2-UD	2	95.00	98	98.20	1.11	24.96	9.83	13.46	8.17	11.88	28.2
30	3-UD	3	91.84	98	97.69	.80	45.30	27.88	39.49	26.17	38.06	27.2
31	1-UD	1	64.13	70	70.00	.63	67.12	61.07	72.45	44.39	60.65	27.1
31	2-UD	2	93.65	98	97.65	1.10	27.69	22.66	30.10	20.80	28.42	18.7
31	3-UD	3	81.27	88	87.16	.72	50.10	47.44	60.11	39.69	54.23	17.3

Table A2-9

CALCULATED SECOND STAGE FLOTATION PRODUCT PROPERTIES

Run #	Set point	Sample	Yield	Btu	CmRec	Calc PS%	Ash Rej	TS Rej	PS Rej	TS Red	PS Red	SC%
1	1	1	70.58	77	76.95	.56	66.39	62.09	75.30	50.74	67.91	38.3
1	1	2	68.57	75	74.68	.61	66.88	61.91	74.28	48.99	65.56	23.8
1	1	3	71.35	78	77.96	.57	66.99	61.35	74.65	50.42	67.48	25.1
1	1	4	71.02	78	77.68	.54	67.63	62.52	76.11	51.75	69.25	18.4
1	1	5	70.70	78	77.41	.53	68.26	63.02	76.69	52.22	69.88	18.4
1	1	6	67.74	75	74.25	.55	70.05	63.93	76.85	51.43	68.82	20.8
1	1	7	68.06	75	74.61	.49	69.90	65.65	79.27	53.96	72.21	21.4
1	1	8	67.79	75	74.31	.52	70.02	64.85	78.09	52.70	70.52	20.2
1	2	1	85.40	93	92.58	.70	57.60	46.26	60.45	41.95	57.27	23.6
1	3	1	87.33	94	93.74	.71	51.15	41.48	55.37	37.58	52.39	28.5
1	4	1	72.13	79	78.73	.53	65.88	65.02	78.39	55.57	72.55	27.9
1	5	1	73.73	81	80.06	.50	63.77	60.41	75.36	50.55	69.22	26.6
1	6	1	78.47	85	84.59	.50	58.82	55.45	71.52	47.34	66.33	25.2
1	7	1	84.33	91	90.12	.58	50.96	51.28	66.70	45.94	63.05	23.7
3	1	1	73.08	80	79.33	.64	60.22	53.32	66.15	41.16	57.33	10.4
3	2a	2	73.57	80	79.18	.74	55.86	54.19	65.53	42.14	56.46	21.5
3	2b	3	80.83	87	86.89	.77	51.00	48.53	60.56	40.76	54.61	21.6
3	3a	4	85.15	89	88.80	1.06	34.25	28.52	35.23	19.50	27.06	18.2
3	3b	5	83.36	87	86.72	1.03	34.58	31.33	38.32	20.81	28.88	18.3
3	4	6	93.65	101	100.62	.79	41.12	34.01	47.22	34.42	47.55	23.1
3	5	7	86.57	92	91.36	.80	40.38	38.55	50.27	32.74	45.57	23.4
3	6	8	84.56	88	87.55	1.01	32.24	25.42	31.11	14.81	21.31	16.9
3	7	9	91.47	97	96.86	.76	38.62	32.79	45.49	30.61	43.72	20.1
4	1	1	86.20	94	93.44	.60	53.29	49.22	64.82	45.66	62.35	18.9
4	2a	2	67.54	74	73.78	.52	66.45	62.89	76.29	49.69	67.86	22.1
4	2b	3	62.47	69	68.23	.52	68.97	65.67	78.07	49.69	67.86	22.7
4	3-A	4	60.73	57	57.56	.49	*****	66.87	78.21	42.45	62.13	23.1
4	3b	5	59.34	66	65.23	.44	73.03	68.83	81.65	52.22	71.87	15.2
4	4	6	71.34	78	77.40	.55	62.23	59.13	72.81	47.20	64.87	19.2
4	5a	7	83.70	88	87.87	.90	38.83	38.48	48.23	29.98	41.08	19.2
4	5b	8	87.49	92	91.53	.85	34.52	35.63	46.20	29.67	41.22	17.3
5	1	1	52.32	58	57.84	.60	77.53	71.33	80.88	50.43	66.94	28.4
5	2a	2	90.11	97	96.83	.85	46.28	40.89	53.32	38.96	51.79	19.6
5	2b	3	92.98	101	99.92	.86	44.57	38.58	51.26	38.53	51.23	19.8
5	3a	4	95.38	100	99.78	1.10	28.77	24.86	33.32	24.70	33.17	22.8
5	3b	5	96.56	100	100.10	1.29	22.88	15.74	21.17	15.82	21.25	23.2
5	4	6	94.06	100	99.93	.83	38.96	32.34	44.71	32.29	44.67	28.3
5	5	7	94.66	100	99.44	.95	32.84	30.49	41.19	30.10	40.86	21.8
6	1A	1	89.49	94	93.58	.92	34.42	30.19	39.72	25.40	35.58	23.2
6	1B	2	88.34	93	92.58	.89	36.47	32.47	42.52	27.06	37.91	24.3
6	2	3	77.23	83	82.55	.60	54.86	52.13	66.02	42.01	58.84	25.1
6	3	4	64.38	70	69.86	.51	68.72	64.09	77.03	48.59	67.11	16.4
7	1A	1	65.96	72	71.60	.60	64.29	55.65	67.60	38.06	54.75	9.4
7	1B	2	65.89	72	71.83	.53	66.00	58.30	71.52	41.96	60.35	9.3
7	2A	3	47.00	53	52.13	.42	80.54	75.03	85.65	52.10	72.46	28.4
7	2B	4	45.92	51	50.98	.38	81.28	76.56	87.33	54.03	75.15	28.6
8	1	1	88.13	92	91.71	1.01	30.37	26.79	34.12	20.17	28.16	15.6
8	2	2	79.65	84	83.84	.97	41.72	39.97	48.49	28.40	38.56	21.9
8	3	3	64.71	72	71.28	.54	69.03	63.44	76.14	48.71	66.53	20.5
9	1-ud	1	36.55	42	41.22	.38	87.44	83.49	91.60	59.96	79.61	24.1
9	2-ud	2	56.01	63	62.37	.48	76.63	72.12	83.43	55.30	73.43	23.6
9	3-ud	3	70.62	78	77.45	.60	64.48	61.27	73.97	50.00	66.39	28.4
9	4-ud	4	87.02	93	92.74	.98	42.34	37.84	47.87	32.98	43.78	37.6
10	1-ud	1	60.16	68	67.57	.57	75.52	74.95	84.83	62.93	77.56	28.9
10	2-ud	2	67.43	76	75.33	.67	70.60	69.76	80.24	59.86	73.78	27.8
10	3-ud	3	81.56	90	89.54	.88	56.85	57.62	68.59	52.67	64.91	23.1
10	4-ud	4	97.51	106	105.40	1.14	40.47	40.66	51.37	43.70	53.86	20.5
11	1-ud	1	47.55	54	53.64	.57	81.75	80.20	88.07	63.09	77.75	18.1
11	2-ud	2	64.01	72	71.27	.66	70.97	71.53	81.47	60.05	74.01	26.4
11	3-ud	3	76.36	85	84.48	.69	62.71	65.22	76.77	58.82	72.50	16.6

Table A2-9 (Continued)

CALCULATED SECOND STAGE FLOTATION PRODUCT PROPERTIES

Run #	Set point	Sample	Yield	Btu	CmRec	Calc PS%	Ash Rej	TS Rej	PS Rej	TS Red	PS Red	SC%
12	1-ud	1	36.25	39	39.22	.51	80.90	80.55	87.72	50.42	68.68	7.2
12	2-ud	2	52.42	57	56.54	.60	71.31	69.57	79.04	46.18	62.92	10.2
12	3-ud	3	77.77	83	82.79	.80	51.13	47.64	58.68	36.76	50.09	14.8
12	4-ud	4	85.44	91	90.55	.98	44.00	34.98	44.24	28.20	38.42	20.7
12	5-ud	5	73.81	80	79.19	.73	57.11	52.83	64.43	40.43	55.08	26.0
12	6-ud	6	59.65	66	65.18	.50	72.19	67.99	80.02	50.89	69.34	28.7
12	7-ud	7	39.74	44	43.89	.43	84.16	80.03	88.70	54.51	74.26	16.9
13	1-KD	1	64.16	72	71.54	1.44	70.87	49.10	61.64	28.85	46.37	26.1
13	2-KD	1	80.75	89	88.96	1.64	58.23	32.19	45.03	23.77	38.21	24.8
13	3-KD	3	85.79	94	93.48	1.73	50.69	26.40	38.47	21.27	34.18	19.1
13	4-KD	4	92.23	99	98.93	1.90	39.57	17.30	27.16	16.41	26.37	14.2
13	5-KD	5	88.51	97	96.33	1.79	48.63	22.70	34.25	19.75	31.75	15.7
14	1-KD	1	82.33	89	88.97	1.67	52.36	26.22	36.60	17.07	28.73	22.0
14	2-KD	2	90.21	97	96.84	1.70	44.43	18.91	29.67	16.26	27.38	12.2
14	3-KD	3	67.48	74	74.21	1.23	67.67	47.27	61.95	28.94	48.72	27.4
14	4-KD	4	74.15	81	81.10	1.45	62.16	37.80	50.72	23.31	39.24	30.8
14	5-KD	5	74.61	82	81.52	1.34	61.46	39.98	54.54	26.38	44.24	29.5
14	6-KD	6	68.98	75	75.12	1.38	63.09	43.46	56.15	24.73	41.63	23.3
15	1-KD	1	71.58	81	80.10	1.47	66.87	43.72	57.63	29.74	47.11	18.3
15	2-KD	2	73.95	83	82.84	1.40	66.18	43.18	58.37	31.41	49.75	17.2
15	3-KD	3	72.93	84	83.58	1.03	75.09	50.08	69.73	40.27	63.79	15.9
15	4-KD	4	77.69	88	87.51	1.38	66.61	40.50	56.85	32.01	50.70	23.3
15	5-KD	5	77.39	87	86.52	1.45	63.76	39.54	54.76	30.12	47.71	21.3
15	6-KD	6	77.04	87	86.78	1.22	66.89	44.13	62.18	35.62	56.42	20.7
20	1-KD	2	84.49	93	92.96	1.52	56.28	33.05	48.39	27.98	44.48	20.3
20	2-KD	2	86.34	96	95.62	1.39	58.34	34.21	51.80	31.19	49.59	25.6
20	3-KD	2	86.65	97	96.18	1.44	59.19	32.65	49.66	29.97	47.66	26.3
20	4-KD	2	87.07	97	96.85	1.32	60.01	34.97	53.74	32.86	52.24	29.2
21	5-KD	2	85.03	95	94.47	1.50	57.96	33.05	49.04	29.13	46.05	26.3
21	6-KD	2	72.30	81	80.68	1.47	65.86	43.44	57.45	29.89	47.26	27.9
21	7-KD	2	72.53	82	81.20	1.36	66.96	45.28	60.66	32.61	51.55	26.8
21	8-KD	2	71.37	81	80.86	1.18	71.85	49.05	66.42	36.98	58.47	26.8
22	10-KD	2	76.94	87	86.42	1.47	63.98	46.62	62.44	38.24	56.54	22.4
22	11-KD	2	80.65	91	90.78	1.52	63.11	42.97	59.12	37.17	54.96	22.0
22	12-KD	2	72.53	83	82.09	1.39	68.75	50.66	66.34	39.90	59.00	22.3
22	9-KD	2	83.10	94	93.34	1.46	61.10	42.54	59.71	38.44	56.84	17.7
23	13-KD	2	80.00	91	90.12	1.55	62.06	45.75	61.58	39.81	57.37	21.8
23	14-KD	2	85.94	97	96.39	1.74	57.47	38.41	53.76	36.10	52.02	20.6
23	15-KD	2	88.60	101	100.80	1.44	62.09	41.82	60.63	42.28	60.94	21.4
23	16-KD	2	80.37	92	91.54	1.44	66.03	47.22	64.33	42.35	61.03	23.1
24	17-KD	2	87.10	97	96.68	1.47	56.77	28.65	44.60	26.20	42.70	22.1
24	18-KD	2	87.85	98	97.62	1.48	56.88	27.80	43.81	26.05	42.44	21.7
24	19-KD	2	74.46	83	82.66	1.51	63.04	38.21	51.35	25.25	41.14	26.6
24	20-KD	2	84.72	95	94.24	1.48	58.89	30.15	45.51	25.89	42.19	27.1
24	21-KD	2	81.71	92	91.10	1.41	61.26	34.15	50.05	27.72	45.17	26.8
25	22-KD	2	86.24	97	96.46	1.70	57.34	33.82	48.96	31.39	47.09	22.3
25	23-KD	2	86.14	97	96.56	1.66	58.29	34.49	50.03	32.16	48.25	22.2
25	24-KD	2	83.93	95	94.60	1.55	61.57	38.13	54.50	34.60	51.90	22.1
26	1-PD	1	90.63	94	93.53	1.17	37.94	16.34	30.83	10.55	26.04	22.4
26	2-PD	2	92.76	96	95.11	1.30	30.43	11.43	21.02	6.87	16.95	16.7
26	3-PD	3	92.50	96	95.04	1.25	32.64	12.90	24.57	8.36	20.63	25.6
26	4-PD	4	95.22	99	98.15	1.23	33.76	10.59	23.43	8.91	21.99	17.7
26	5-PD	5	94.60	98	97.10	1.31	30.08	9.41	18.98	6.71	16.56	15.9
26	6-PD	6	90.80	94	93.10	1.32	31.90	12.81	21.49	6.35	15.68	13.2
27	1-PD	1	86.19	91	90.03	1.08	47.28	26.03	46.55	17.84	40.63	22.4
27	2-PD	2	84.87	90	88.46	1.13	46.44	26.09	44.68	16.45	37.47	25.7
27	3-PD	3	90.05	94	93.16	1.22	37.05	19.98	36.77	14.11	32.13	22.6
27	4-PD	4	84.50	89	87.98	1.27	45.86	23.42	37.98	12.96	29.51	25.9
27	5-PD	5	86.98	92	90.47	1.21	43.42	22.71	39.55	14.57	33.18	23.9
27	6-PD	6	85.53	90	88.96	1.10	44.36	26.38	45.98	17.25	39.28	23.6

Table A2-9 (Continued)

CALCULATED SECOND STAGE FLOTATION PRODUCT PROPERTIES

Run #	Set point	Sample	Yield	Btu	CmRec	Calc PS%	Ash Rej	TS Rej	PS Rej	TS Red	PS Red	SC%
28	1-KD	1	73.93	82	82.07	1.37	62.63	44.92	60.23	32.88	51.54	18.3
28	2-KD	2	83.79	93	92.40	1.51	54.88	34.85	50.31	29.49	46.22	21.2
28	3-KD	3	87.80	98	97.36	1.34	55.13	35.24	53.74	33.49	52.48	21.2
29	1-KD	1	72.69	82	81.70	1.27	66.99	49.01	65.55	37.59	57.84	20.8
29	2-KD	2	83.03	93	92.30	1.51	57.81	37.32	53.28	32.10	49.39	12.0
29	3-KD	3	80.14	91	90.17	1.31	64.05	43.01	60.88	36.79	56.62	20.2
30	1-UD	1	70.75	77	76.41	.68	64.63	48.84	60.27	33.04	48.01	15.3
30	2-UD	2	85.02	91	90.15	.79	47.01	34.19	45.21	27.00	39.23	11.7
30	3-UD	3	84.56	91	91.02	.62	56.48	41.72	56.59	35.97	52.31	19.1
31	1-UD	1	48.63	55	54.23	.39	81.22	76.05	87.14	55.83	76.29	25.1
31	2-UD	2	85.52	92	91.91	.76	48.58	42.99	55.78	37.97	51.88	14.3
31	3-UD	3	70.67	78	77.55	.48	66.01	62.38	77.01	51.49	70.35	12.8

Table A2-10

CALCULATED SCREEN PRODUCT PROPERTIES
(Heptane Based)

Run #	Set point	Sample	Yield	Btu	CmRec	Calc PS%	Ash Rej	TS Rej	PS Rej	TS Red	PS Red	CS%
16	1-UH	1	68.83	76	75.37	.74	66.02	53.76	64.66	38.66	53.11	29.94
16	1-UH	2	72.18	80	79.04	.71	64.37	52.61	64.44	40.04	55.01	32.56
16	1-UH	3	61.59	68	67.37	.73	69.20	58.94	68.78	39.05	53.65	31.76
16	2-UH	1	76.08	83	82.58	.89	58.59	43.52	53.28	31.61	43.42	23.18
16	2-UH	2	84.87	92	91.73	.94	51.65	34.85	44.78	28.97	39.80	19.57
17	1-UH	1	83.25	90	89.38	1.16	49.42	26.84	32.91	18.15	24.93	15.51
17	1-UH	2	91.13	99	97.95	1.07	45.20	24.06	32.28	22.47	30.87	16.96
17	1-UH	3	87.26	94	93.89	1.06	48.09	27.73	35.81	23.02	31.63	16.19
17	1-UH	4	83.99	91	90.27	1.06	49.50	30.43	38.18	22.94	31.51	15.33
17	1-UH	5	83.99	91	90.27	1.02	49.50	32.13	40.51	24.82	34.10	15.18
18	1-UH	1	77.01	83	82.77	1.11	53.70	34.27	40.64	20.59	28.29	22.73
18	1-UH	2	77.04	83	82.90	1.08	54.17	35.41	42.26	22.08	30.34	22.99
18	1-UH	3	83.54	90	89.59	1.10	48.71	29.12	36.12	20.88	28.69	24.80
18	1-UH	4	84.99	92	91.35	1.10	48.90	27.88	35.08	21.06	28.93	18.91
19	1-UH	1	91.96	99	98.07	.94	40.64	29.87	40.32	28.49	39.15	19.24
19	1-UH	2	92.02	99	98.03	1.11	40.01	21.92	29.38	20.35	27.97	14.48
19	1-UH	3	90.26	97	96.05	1.18	40.59	20.23	26.31	16.94	23.28	21.43
34	1-PH	1	67.09	71	70.38	.62	61.29	48.09	73.86	26.25	62.87	17.78
34	2-PH	2	71.45	77	75.28	.75	61.21	42.09	66.25	23.07	55.17	15.67
34	3-PH	3	61.87	67	65.60	.71	69.95	50.34	72.52	24.30	58.11	14.38
34	4-PH	4	75.24	81	79.27	.77	59.49	38.62	63.57	22.57	54.04	16.69
34	5-PH	5	79.90	85	83.47	.89	50.54	30.90	52.23	17.21	42.76	21.67
34	6-PH	6	67.03	71	70.25	.78	60.68	45.32	67.02	22.16	53.06	14.14
35	1-UH	1	64.35	70	69.52	.43	64.25	68.74	82.06	55.04	74.19	20.76
35	2-UH	2	86.92	94	93.07	.60	47.17	51.16	66.55	47.53	64.06	29.03
36	1-UH	1	68.35	75	74.41	.37	65.15	68.75	83.77	58.00	78.19	17.09
36	10-UH	10	70.60	77	76.93	.57	64.47	61.00	74.20	49.31	66.47	11.13
36	11-UH	11	71.80	79	78.50	.47	65.27	63.76	78.46	53.82	72.56	16.26
36	12-UH	12	65.97	73	72.35	.52	69.39	65.13	78.17	51.81	69.84	22.92
36	13-UH	13	87.81	95	94.86	.72	51.22	45.22	59.17	42.26	56.96	18.70
36	14-UH	14	72.23	79	78.63	.62	63.18	58.38	71.26	47.07	63.45	20.02
36	15-UH	15	85.06	92	91.59	.84	51.08	42.48	54.34	37.20	50.14	18.98
36	2-UH	2	61.92	68	67.40	.25	68.43	75.23	90.07	63.25	85.26	19.42
36	3-UH	3	79.73	86	85.94	.72	54.67	50.65	63.38	42.57	57.38	25.62
36	4-UH	4	92.93	100	99.18	.88	41.69	35.39	47.42	34.86	46.99	26.62
36	5-UH	5	91.87	98	97.19	.99	37.55	31.75	41.82	29.78	40.14	23.24
36	6-UH	6	75.09	81	80.32	.80	53.87	50.66	61.43	38.57	51.98	22.86
36	7-UH	7	88.78	96	95.80	.68	50.10	46.73	61.53	44.40	59.85	14.00
36	8-UH	8	86.75	94	93.61	.75	51.24	45.06	58.51	41.31	55.68	18.52
36	9-UH	9	64.25	70	69.78	.56	66.41	64.82	76.86	49.58	66.84	17.44
37	1-KH	1	62.61	71	70.93	1.12	75.31	56.80	72.59	39.10	61.36	20.24
37	2-KH	2	63.73	73	72.20	1.12	74.86	56.03	72.10	39.10	61.36	20.96
37	3-KH	3	77.43	88	87.35	1.29	67.74	43.28	60.72	35.06	55.03	22.83
37	4-KH	4	69.30	79	78.54	1.15	71.98	52.14	69.25	39.07	60.85	25.81
37	5-KH	5	79.57	89	88.88	1.45	62.87	39.24	55.12	31.64	49.51	21.74
37	6-KH	6	51.95	59	58.80	1.00	80.59	65.06	79.14	40.58	64.53	16.55
37	7-KH	7	57.26	65	64.45	1.09	75.51	61.06	75.59	39.59	62.13	18.73
37	8-KH	8	51.01	57	57.17	1.17	77.05	64.29	76.52	37.54	58.92	19.45
37	9-KH	9	52.24	60	59.44	.97	80.55	65.78	80.15	42.43	66.60	16.68

END

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