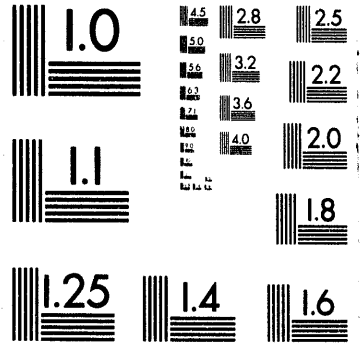
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3
7.1
8.0
9.0

1 of 1

DOE/PC/92205--T4

BENCH-SCALE TESTING OF THE MULTI-GRAVITY SEPARATOR IN COMBINATION WITH MICROCEL

Contract No: DE-AC22-92PC92205
Fourth Quarterly Report

Reporting Period:
July 1, 1993 to September 30, 1993

Prime Contractor:

Center for Coal and Minerals Processing
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061-0258

Subcontractors:

Carpco, Inc.
Roberts & Schaefer Company
Consolidation Coal Company
Kerr-McGee Coal Corporation

Prepared for:

Pittsburgh Energy Technology Center
U.S. Department of Energy
P.O. Box 10940
Pittsburgh, Pennsylvania 15236

Date Submitted: December 6, 1993

Contracting Officer's Representative: Carl Maronde

TABLE OF CONTENTS

1.0 Abstract

Work this quarter included equipment installation, shakedown testing, and the beginning of the detailed testing program. With the exception of ongoing *Task 4 - Sample Characterization*, Tasks 1 through 8 are now complete. *Task 10 - Detailed Testing* and *Task 12 - Sample Analysis* began this quarter and will consume all available time during the 5th quarter.

Installation and testing of the process equipment, mechanical systems, as well as the electrical systems were completed. The shakedown process uncovered several necessary modifications to the circuit which were subsequently completed. Most of the changes concerned piping and valving modifications which allowed for better material flow and sampling. The circuit was operated with coal to determine the time for each unit to reach steady state.

The following table summarizes the status of major project tasks:

MAJOR TASKS	STATUS
Task 1 - Project Planning	Complete
Task 2 - CPPRF Modifications	Complete
Task 3 - Sample Acquisition	Complete
Task 4 - Sample Characterization	Ongoing
Task 5 - Flowsheet Development and Engineering Design	Complete
Task 6 - Procurement and Fabrication	Complete
Task 7 - Process Module Installation	Complete
Task 8 - Shakedown Testing	Complete
Task 9 - MGS Scale-Up	Ongoing
Task 10 - Detailed Testing	Ongoing
Task 11 - Decommissioning	Planned
Task 12 - Sample Analysis	Ongoing
Task 13 - Final Report	Planned

2.0 Project Objectives

The primary objective of the proposed work is to design, install, and operate an advanced fine coal processing circuit combining the Microcel™ and Multi-Gravity-Separator (MGS) technologies. Both of these processes have specific advantages as stand-alone units. For example, the Microcel column effectively removes ash-bearing mineral matter, while the MGS efficiently removes coal-pyrite composites. By combining both unit operations into a

single processing circuit, synergistic advantages can be gained. As a result, this circuit arrangement has the potential to improve coal quality beyond that achieved using the individual technologies.

In addition to the primary objective, secondary objectives of the proposed test program include:

- *Circuit Optimization:* The performance of each unit operation, individually and combined, will be optimized by conducting parametric studies as a function of key operating variables. The goal of this work is to maximize the rejections of pyritic sulfur and ash while maintaining a high energy recovery.

- *Process Variability:* The steady-state performance of the optimized processing circuit will be studied (i) by conducting several long-duration test runs over a period of several days and (ii) by testing coal samples from other sources specified by the participating coal companies.

- *Process Evaluation:* Detailed technical and economic evaluations will be conducted to examine the feasibility of the proposed concept for fine coal cleaning on an industrial scale. This evaluation will include a projected cost-benefit analysis and a review of all test data, engineering analyses, scale-up procedures, and process deficiencies.

The test work is being conducted at the Pittsburgh Energy Technology Center's Coal Preparation Process Research Facility (CPPRF) located in Pittsburgh, Pennsylvania. The CPPRF is a state-of-the-art pilot-scale facility for coal preparation research and testing. The Emerging Technology (ET) section of the pilot plant will be used for testing the combined Microcel and MGS circuit. The ET area, and subsequently installed mezzanine, is adjacent to the pilot plant and was established for testing new and emerging technologies in coal preparation. This facility is ideally suited for pilot-scale test work due to the availability of all necessary ancillary facilities (i.e., bulk solids handling, preparation, and waste disposal). In addition, the necessary environmental, safety and health aspects related to the handling and disposal of waste are already in place.

3.0 Project Task Updates

The status of ongoing tasks as well as those that are now complete are mentioned herein. However, subsequent quarterly reports will not discuss any of the tasks that are listed as complete in this report.

3.1 Task 1.0 - Project Planning

Project planning has been successfully completed and the project testing is now underway. The current project reporting requirements indicate that the final report for the project is due on January 28, 1994. The test work, however, will not be completed until just prior to that date. To allow sufficient time for CCMP to submit both the draft final and final report, a no-cost time extension request was submitted and approval is expected soon.

3.2 Task 2.0 - CPPRF Modifications

All work was completed on the CPPRF Modifications including the following design modifications:

- Installation of a concrete pad and approach ramp to allow trucks to dump directly into the raw coal receiving hopper.
- Removal of the existing raw coal feed system.
- Installation of a receiving hopper and 18-inch screw conveyor for feeding raw coal to the existing crushing circuit.

This work will be summarized in the final *ET Area Modification Report* being prepared by R & S.

3.3 Task 3.0 - Sample Acquisition

The Pittsburgh No. 8 sample from Consolidation Coal Company and the Illinois No. 6 sample from Kerr-McGee Coal Corporation are both in the storage yard and ready for daily delivery to the CPPRF for testing. Although it was originally estimated that 50 tons of each seam would be necessary for testing, 75 tons of each were actually obtained. The extra amount is to allow the CPPRF to run at full feed for initial grind size testing. Extra material is also necessary to allow for an upset in which all units must again reach steady state. This task is thus complete.

3.4 Task 4.0 - Sample Characterization

3.4.1 *Subtask 4.1 - Preliminary Characterization*

Utilizing a hammermill, -28 mesh and -65 mesh samples were produced independently. The size-by-size sulfur and ash analyses for each of the two seams and each of the two feed sizes were given in the *Second Quarterly Report*.

3.1 Task 1.0 - Project Planning

Project planning has been successfully completed and the project testing is now underway. The current project reporting requirements indicate that the final report for the project is due on January 28, 1994. The test work, however, will not be completed until just prior to that date. To allow sufficient time for CCMP to submit both the draft final and final report, a no-cost time extension request was submitted and approval is expected soon.

3.2 Task 2.0 - CPPRF Modifications

All work was completed on the CPPRF Modifications including the following design modifications:

- Installation of a concrete pad and approach ramp to allow trucks to dump directly into the raw coal receiving hopper.
- Removal of the existing raw coal feed system.
- Installation of a receiving hopper and 18-inch screw conveyor for feeding raw coal to the existing crushing circuit.

This work will be summarized in the final *ET Area Modification Report* being prepared by R & S.

3.3 Task 3.0 - Sample Acquisition

The Pittsburgh No. 8 sample from Consolidation Coal Company and the Illinois No. 6 sample from Kerr-McGee Coal Corporation are both in the storage yard and ready for daily delivery to the CPPRF for testing. Although it was originally estimated that 50 tons of each seam would be necessary for testing, 75 tons of each were actually obtained. The extra amount is to allow the CPPRF to run at full feed for initial grind size testing. Extra material is also necessary to allow for an upset in which all units must again reach steady state. This task is thus complete.

3.4 Task 4.0 - Sample Characterization

3.4.1 *Subtask 4.1 - Preliminary Characterization*

Utilizing a hammermill, -28 mesh and -65 mesh samples were produced independently. The size-by-size sulfur and ash analyses for each of the two seams and each of the two feed sizes were given in the *Second Quarterly Report*.

3.4.2 *Subtask 4.2 - Washability Characterization*

Extensive work involving high-G centrifuge washabilities has indicated that this procedure is extremely unreliable for fine particle sizes. Results obtained indicate that the washability gives performance poorer than those obtained with flotation release analysis. For pyritic rejection, this is considered highly unlikely if not impossible. For these reasons the fine coal washability work has been discontinued and will be substituted with image analysis by Scanning Electron Microscope Image Processing System (SEM). The SEM can give a particle composition analysis by area resulting in the percent of carbonaceous material, mineral matter, and pyrite. An equivalent washability by density can then be calculated [Adel et al, 1991]. Some preliminary results on the Illinois No. 6 coal are presented in the Appendix, while the remainder will be included in the *Preliminary Characterization Topical Report.* This preliminary data indicates that the most of the pyrite which can be liberated is liberated at a relatively coarse size, while the remaining pyrite is finely disseminated and cannot be liberated even at a -400 mesh grind size.

3.4.3 *Subtask 4.3 - Release Analysis Characterization*

Release analysis results for both coals were presented in the Second Quarterly Report and will be included in the *Preliminary Characterization Topical Report* along with a complete summary of all the characterization data..

3.5 Task 5.0 - Flowsheet Development and Engineering Design

Flowsheets and engineering design and layout have been presented in previous quarterly reports and are complete.

3.6 Task 6.0 - Procurement and Fabrication

3.6.1 *Procurement and Fabrication*

All procurement of process equipment and fabrication was completed on schedule during this quarter.

3.7 Task 7.0 - Process Module Installation

All processing equipment has been installed and is fully operational.

3.8 Task 8.0 - Shakedown Testing

Shakedown testing was completed by the first week of September. Motors were checked for proper configuration, controls and rotation. Pneumatic instrumentation lines were pressure tested and checked for proper configuration. Leak tests were conducted on all process water and slurry lines. All items were corrected and repaired as identified.

The Process Module was installed as a functional industrial unit with proper conduit and wiring installed. Motor disconnects and start/stop buttons are permanently labeled. Panel displays were checked and calibrated. Pump speeds were adjusted for proper flow.

After all units and controls were operated successfully with water, shakedown testing with coal slurry began. Magnetic flowmeters, proportional valves, and nuclear density gauges were all checked and calibrated with coal slurry flow. The Microcel™ flotation column was tested for wash water addition rate, level control system, air hold-up measurement, bubble generation, reagent addition, and air and feed slurry volume control. The MGS unit was tested for wash water addition, feed rate control, drum speed control, and shaking amplitude. The ancillary systems such as waste sump pump, foam breaker pump, and feed sump recirculation systems were also checked and modified as necessary.

3.9 Task 9.0 - MGS Scale-Up

3.9.1 *Subtask 9.1 - Development of Scale-Up Criteria*

Development of a process model for the MGS requires identification of the operating parameters which affect performance. A series of tests were conducted at the CCMP to identify these parameters and the relevant operating parameters were identified in the 3rd Quarterly Report. This work will continue as more data becomes available from the detailed testing.

3.9.2 *Subtask 9.2 - Scale-Up Validation*

After completion of the detailed testing, the criteria required for scale-up modeling will be reviewed and quantified to the extent possible.

3.10 Task 10.0 - Detailed Testing

Testing began in September on *Subtask 10.1 - Microcel Test* and *Subtask 10.2 - MGS Test* for the Pittsburgh No. 8 seam coal. After some minor operational delays the circuit performed well and the testing was on schedule through September 30. The independent testing will be completed by the first week of October. Results of the initial tests will be available for the next quarterly report.

3.11 Task 12.0 - Sample Analysis

Sample analysis is being conducted as required on the initial testing. Samples are being analyzed initially for % solids, ash, total sulfur, and pyritic sulfur. Selected samples will be further analyzed for heating value, sizing, and washability analysis.

REFERENCES

Adel, G.T., Wang, D. and Yoon, R.H., 1991. *Proceedings, Eighth Annual International Pittsburgh Coal Conference*, October 14-18, 1991, Pittsburgh, PA, 204-209.

APPENDIX

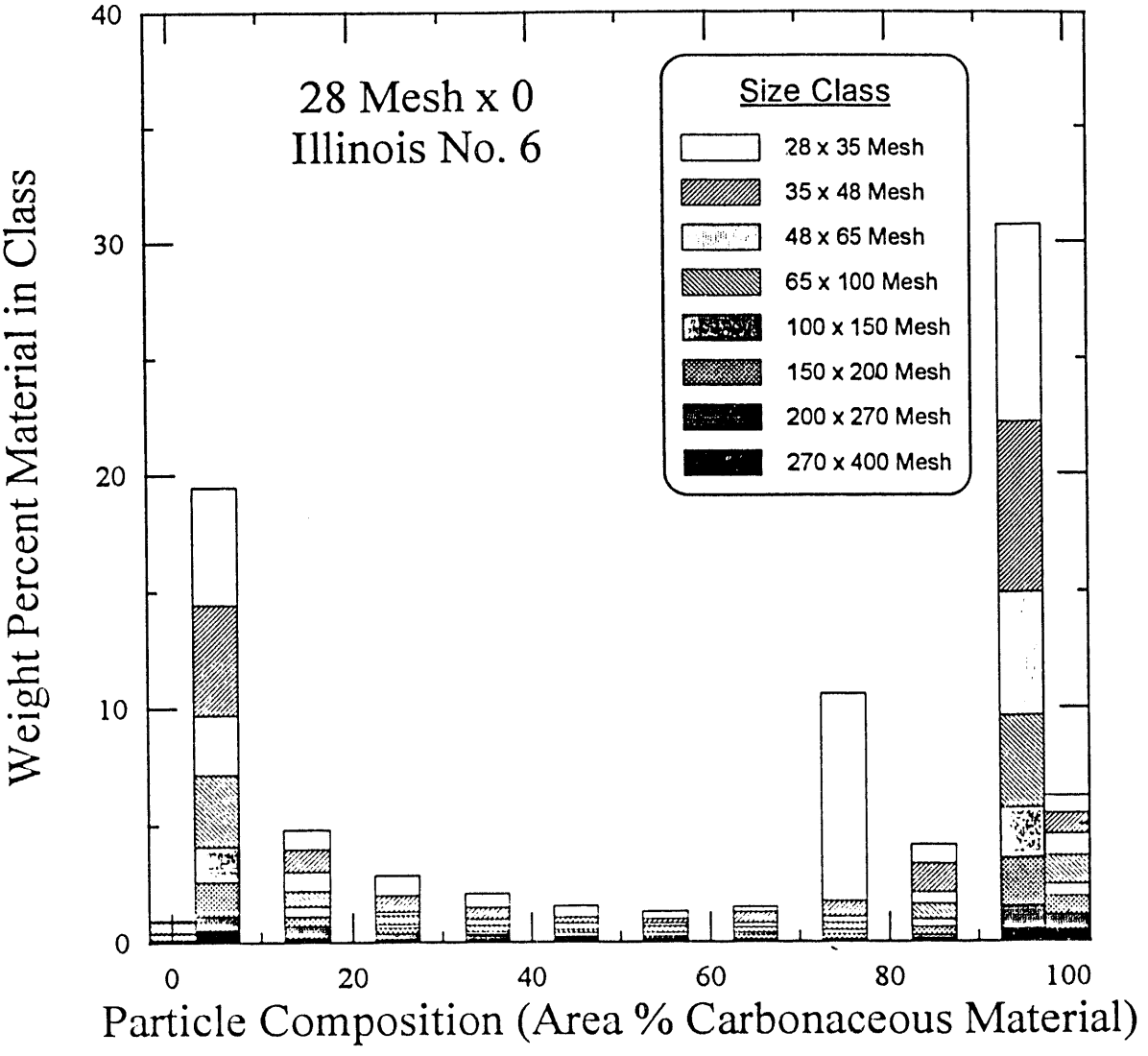

Figure 1. Weight percent material present as a function of particle composition (based on area % carbonaceous material) for -28 mesh Illinois No. 6 coal.

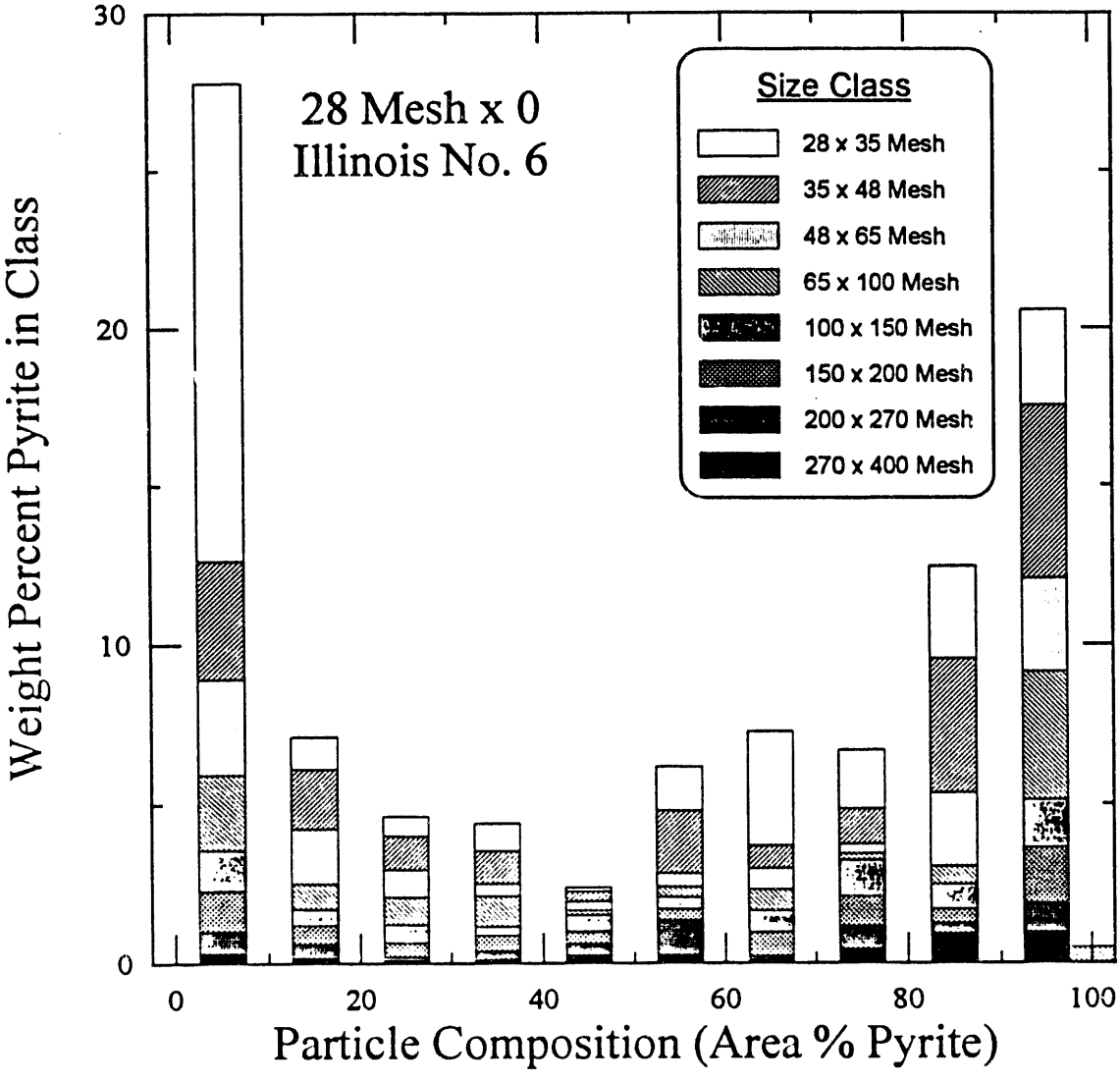

Figure 2. Weight percent pyrite present as a function of particle composition (area % pyrite) for -28 mesh Illinois No. 6 coal.

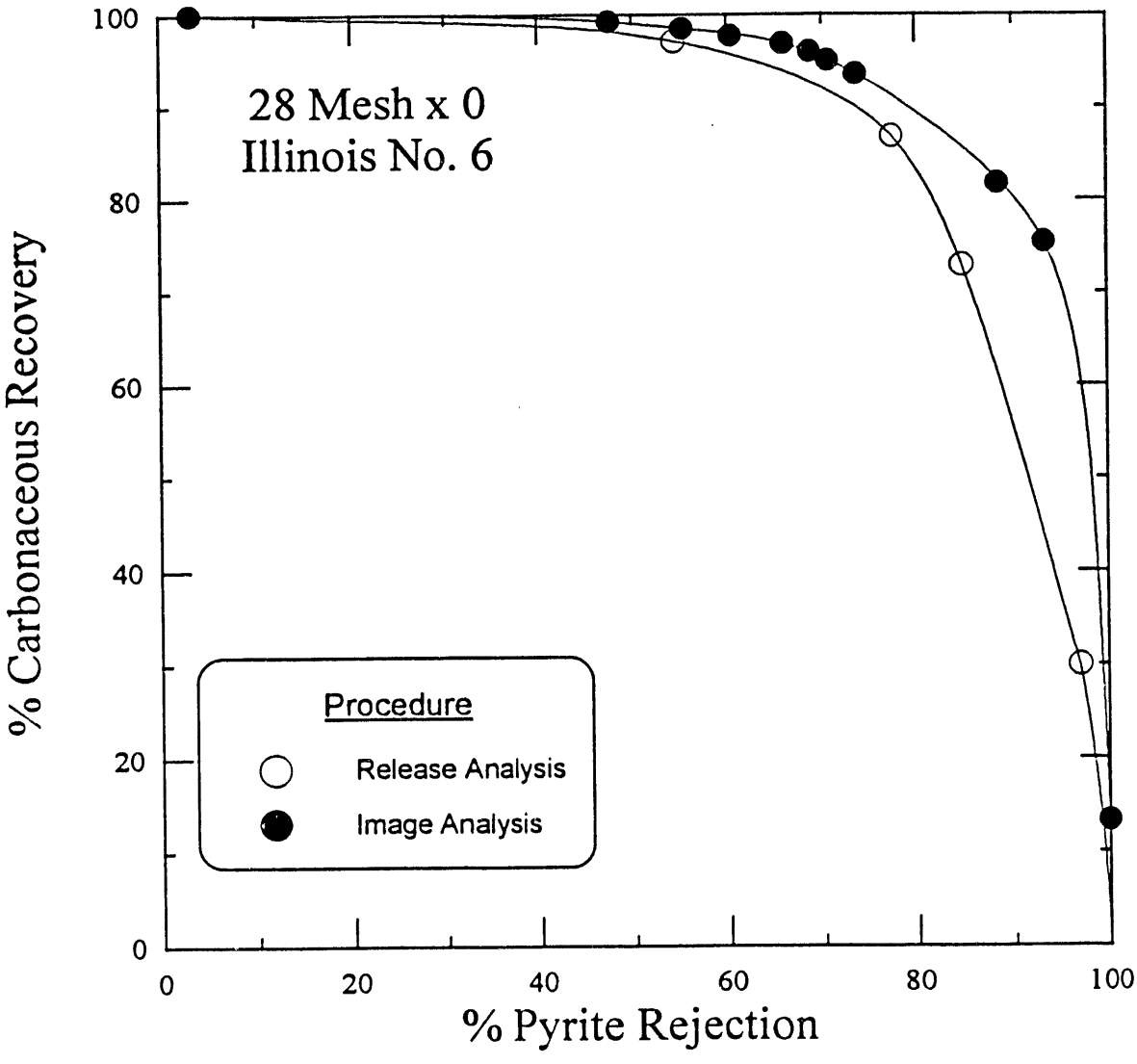

Figure 3. Comparison of release analysis and image analysis separation curves for pyrite obtained on -28 mesh Illinois No. 6 coal. (note: -400 mesh size fraction missing)

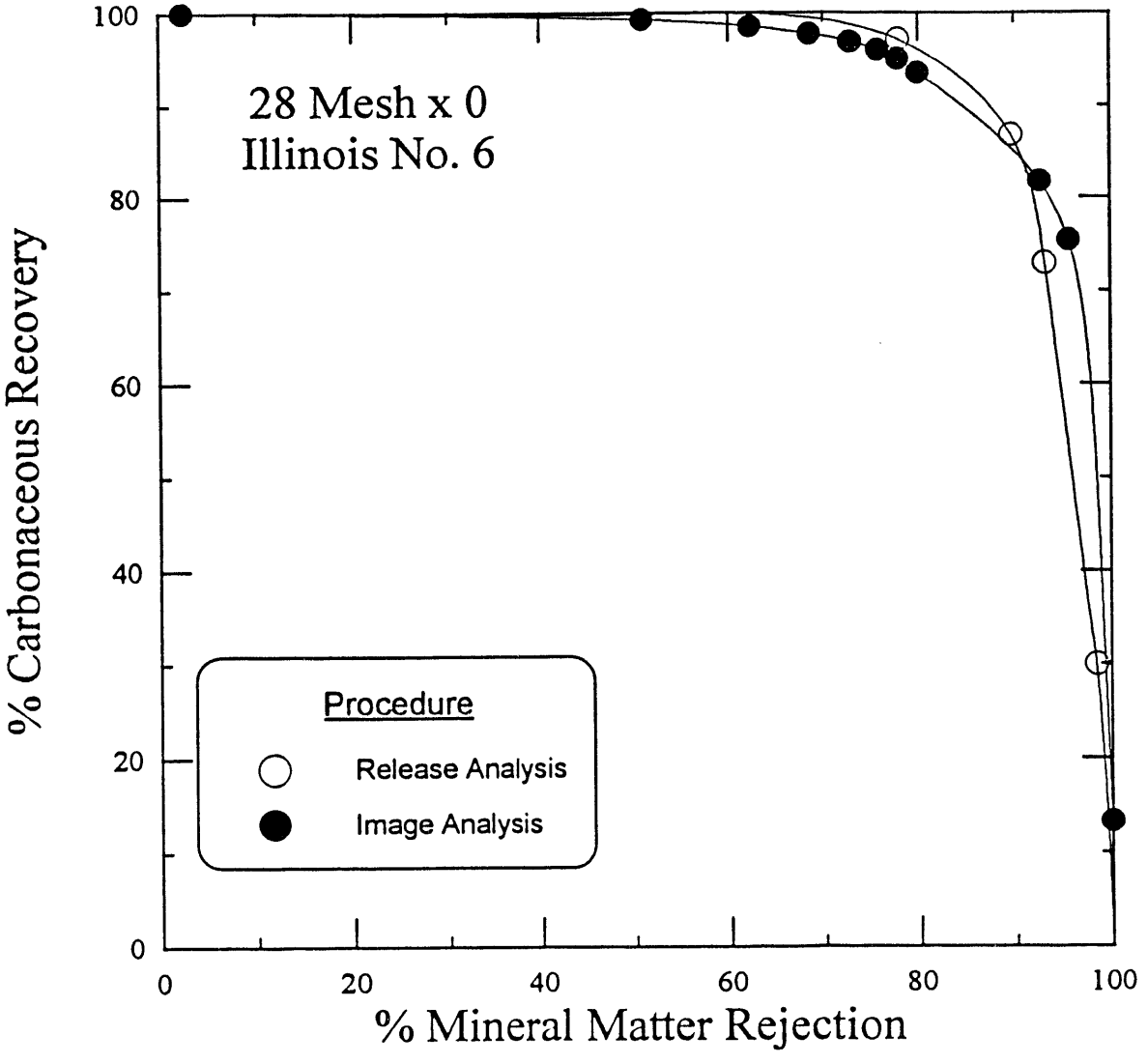

Figure 4. Comparison of release analysis and image analysis separation curves for mineral matter obtained using -28 mesh Illinois No. 6 coal. (note: -400 mesh size fraction missing)

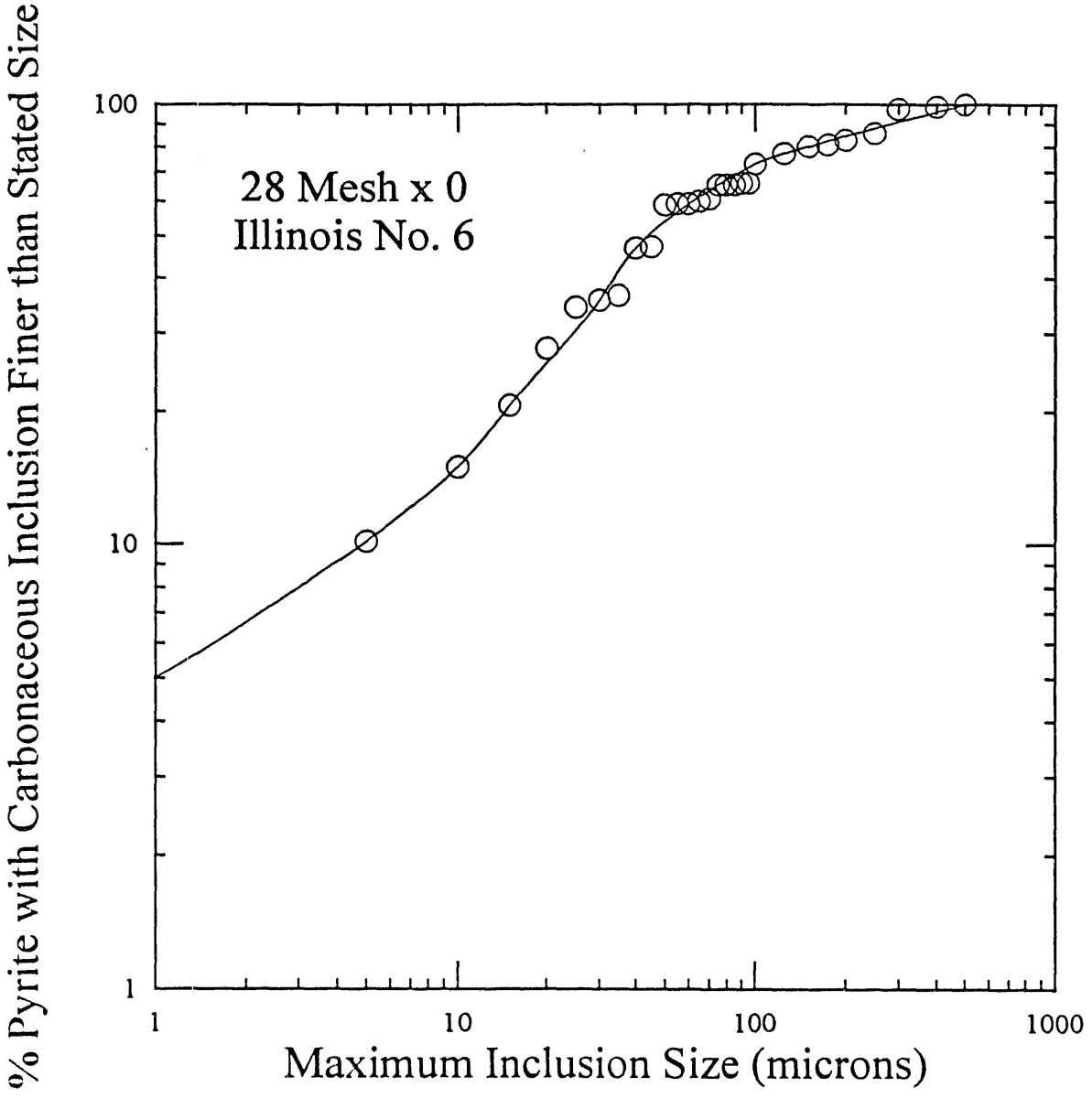

Figure 5. Weight percent pyrite containing carbonaceous inclusions finer than a given size obtained for -28 mesh Illinois No. 6 coal.

DATE
FILMED
5/13/94
END