

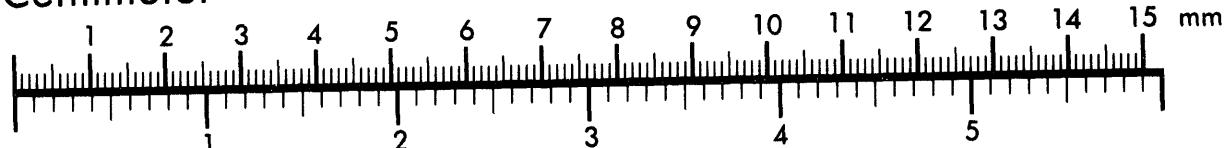


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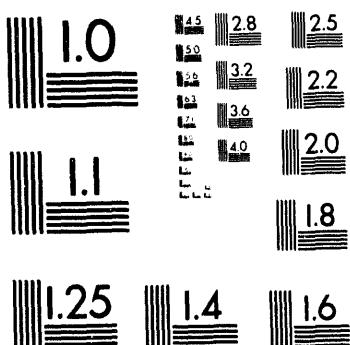
Association for Information and Image Management

1100 Wayne Avenue, Suite 1100
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301/587-8202

Centimeter



Inches



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EXECUTIVE SUMMARY

The objectives of this project are to 1) use surface modification to improve the separation of pyrite and other minerals including trace metals from coal in froth flotation by using dissolved-CO₂, and 2) use chelating agents on clean coal to further reduce the trace metals in clean coal.

In the previous ICCI project, a 2" diameter microbubble flotation column was modified to use for dissolved-CO₂ flotation. For this project, a bench-scale packed column, together with the microbubble column, will be used for dissolved-CO₂ flotation.

A 3" diameter packed column was purchased from GL&V Ontario, Inc. and installed. This column was modified such that the bubbles for the flotation tests were generated by CO₂ dissolved in water under pressure.

The samples of the precleaned and waste Illinois No. 6 coal were obtained from the Ohio Coal Testing and Development (OCTAD) facility. This facility was constructed for a proof-of-concept (POC) coal cleaning plant which was developed under a DOE advanced coal cleaning project. B&W is a subcontractor to ICF Kaiser for this POC testing. Illinois No. 6 was one of the three coals evaluated in the cleaning circuits.

Because only limited samples were able to be obtained from the OCTAD, the Illinois No. 6 waste coal sample obtained from Kerr-McGee Coal Corporation for the previous ICCI project is being used for this project. The Illinois No. 6 coal waste has a top size of 2400 microns. The waste coal was shipped to an outside vendor for grinding. The target top size is 75 microns (200 mesh).

Preliminary flotation tests on Illinois No. 6 waste coal in the 3" diameter packed column were performed. The tests results are being analyzed.

OBJECTIVES

The objectives of the project are to 1) modify the surface of fine/ultrafine Illinois No. 6 precleaned and waste coal to increase the difference in hydrophobicity of coal, pyrite, and mineral matter, 2) use ultrafine bubbles generated by dissolved-CO₂ to enhance the removal of ash, pyrite, and trace metals from coal in froth flotation, and 3) apply chelating agents on the coal from the froth product to further remove trace metals from coal.

INTRODUCTION AND BACKGROUND

In coal flotation, the separation of pyrite and other mineral matter from coal depends on the relative size of the bubbles to the particles and the difference in hydrophobicity (water-repelling) of the surface of mineral matter and of the coal.

For physical fine coal cleaning, fine bubbles have the advantages of 1) greater number of bubbles, 2) more bubble surface area, and 3) longer bubble life time than large bubbles. The result is more contact between bubbles and particles.

In dissolved-CO₂ flotation, ultrafine bubbles with diameters of about 100 to 200 microns can be generated by first dissolving CO₂ in water under pressure prior to flotation and releasing pressure during flotation. The ultrafine bubbles have the potential to improve the separation of pyrite and other mineral matter from coal.

Chemicals can be applied to the coal surface to increase the differences of hydrophobicity between coal and the mineral matter. When coal is more hydrophobic, more bubbles tend to attach the surface. As a result, the coal tends to float. When the mineral matter in coal is more hydrophilic (water-loving), less bubbles tend to attach to the surface. As a result, the mineral matter tends to settle. Therefore, the separation efficiency of mineral matter from coal is improved.

The new amendments to the Federal Clean Air Act have focused attention on air toxics. The trace elements in coal are the potential sources for some of the air toxics. It has been reported that a large portion of trace elements is incorporated with mineral matter in coal. Removal of mineral matter from coal can also reduce the trace elements in coal. Chelating agents can be applied to coal and react with the trace metals to form complexes. Chelates have the potential to further reduce the trace metal contents in coal.

EXPERIMENTAL PROCEDURES

The Illinois No. 6 precleaned and waste coal samples were obtained from the Ohio Coal Testing and Development (OCTAD) facility. This facility was used to evaluate advanced physical fine coal cleaning circuits developed under a DOE project. B&W is a subcontractor to ICF Kaiser for the DOE project. Illinois No. 6 coal was one of the three coals which were evaluated in this facility. The coal samples used in the advanced flotation circuits have a top size of 75 microns (200 mesh).

Because only limited samples were able to be obtained from the OCTAD, the Illinois No. 6 waste coal sample obtained from Kerr-McGee Coal Corporation for the previous ICCI project is being used for this project. The Illinois No. 6 coal waste has a top size of 2400 microns. The waste coal is shipped to an outside vendor for grinding. The target top size for the ground waste coal is 75 microns (200 mesh).

Selected chemicals will be added to the slurry to modify the surface of coal and of mineral matter. The slurries will be subjected to dissolved-CO₂ flotation.

Two types of columns will be used in coal flotation: microbubble and packed column. A bench-scale microbubble column was modified and used in B&W's previous project funded by ICCI/DOE to recover Illinois No. 6 waste coal. A 3" diameter packed column was purchased from GL&V Ontario, Inc. and installed. This column was then modified for dissolved-CO₂ bubble generation.

Preliminary flotation tests on Illinois No. 6 waste coal in the 3" diameter packed column were performed. The formal flotation tests will be performed at different chemical dosages, feed rates, wash water rates, gas pressures, and residence times.

The froth and tail samples from the flotation tests will be analyzed for Btu, pyrite, and mineral matter. Selected samples will be analyzed for major trace metals. The results from the microbubble column and the packed column will be compared.

Selected froth products will be treated with several chelating agents at different conditions. The chelating agents will react with the trace metals in coal to form complexes. The complexes will be removed from coal. The concentration of the trace metals before and after treatment will be compared.

RESULTS AND DISCUSSION

A 3" diameter packed column was purchased from GL&V Ontario, Inc. and installed at the Alliance Research Center. The column was tied in with a pressurized tank for ultrafine bubble generation by dissolved CO₂. Figure 1 is a photograph of the modified packed column.

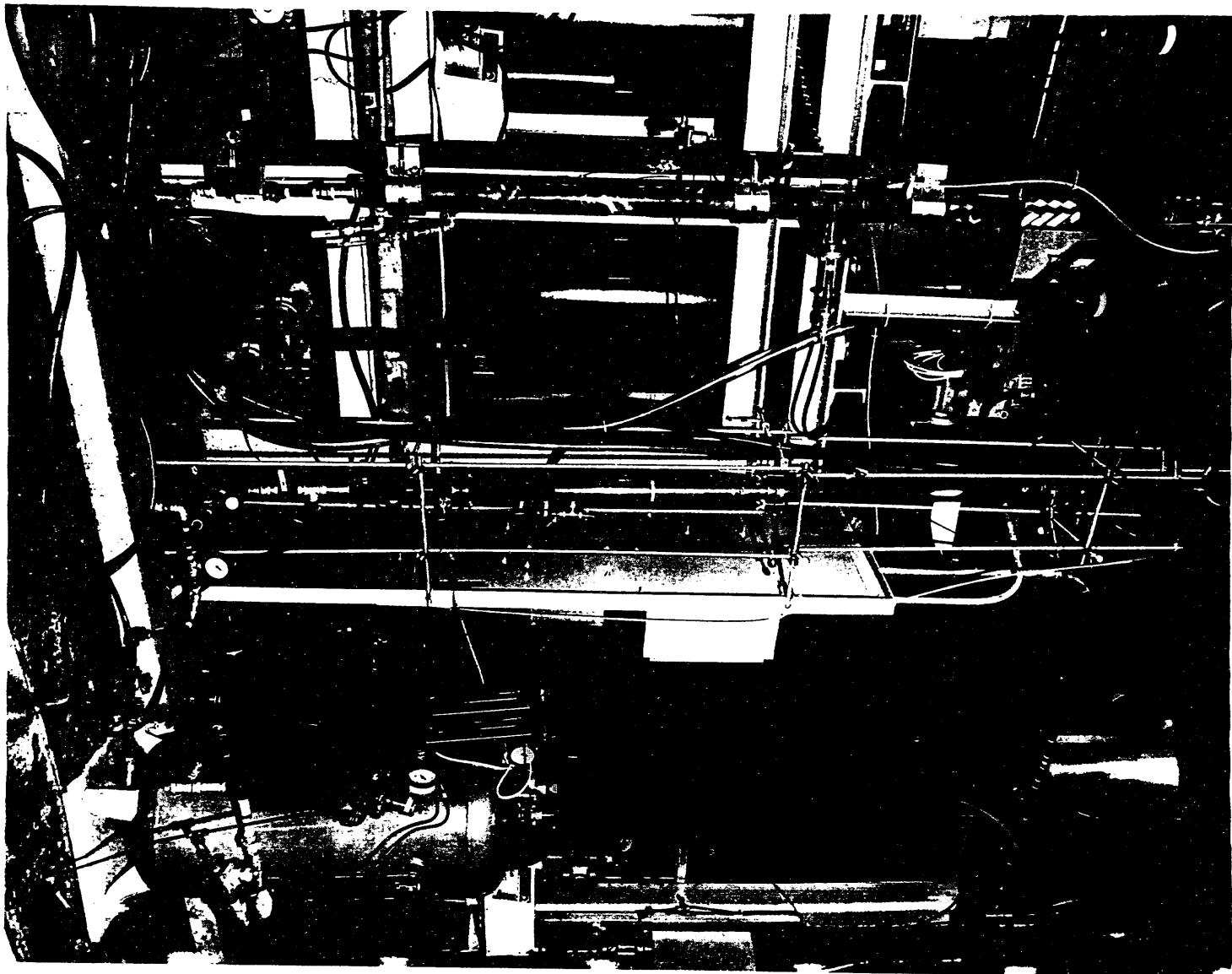
The Illinois No. 6 precleaned and waste coal samples of the proof-of-concept (POC) testings were obtained from the OCTAD facility. Illinois No. 6 waste coal which was obtained from Kerr-McGee Coal Corporation for the previous ICCI project was shipped for grinding. The target top size is 75 microns (200 mesh).

Preliminary dissolved-CO₂ flotation tests were performed in the 3" diameter packed column. Chemical dosages were varied. The froth and tail samples were being analyzed.

CONCLUSION AND RECOMMENDATION

The 3" diameter packed column was installed recently. Preliminary tests have begun. There are no conclusions and recommendations at this point.

Figure 1 Dissolved- CO_2 Flotation Facility



PROJECT MANAGEMENT REPORT
December 1, 1993 thru February 28, 1994

**Project Title: REMOVAL OF PYRITE AND TRACE ELEMENTS FROM
WASTE COAL BY DISSOLVED-CO₂, FLOTATION AND
CHELATING AGENTS**

DOE Grant No.: DE-FC22-92PC92521 (Year 2)
ICCI Project No.: 93-1/5.1B-3P
Principal Investigator: S. Y. Shiao
Babcock & Wilcox Company
Project Manager: Dr. Ken K. Ho, ICCI

COMMENTS

The formal contract was executed on February 8, 1994. Although actual expenses are ahead of projected expenses, the purchase and installation of the 3" diameter flotation column, which was not in the original estimate, will result in fewer expenditures during the next quarter. We estimate that the total project expenses will be within budget.

02/28/94

Projected and Estimated Expenditures by Quarter

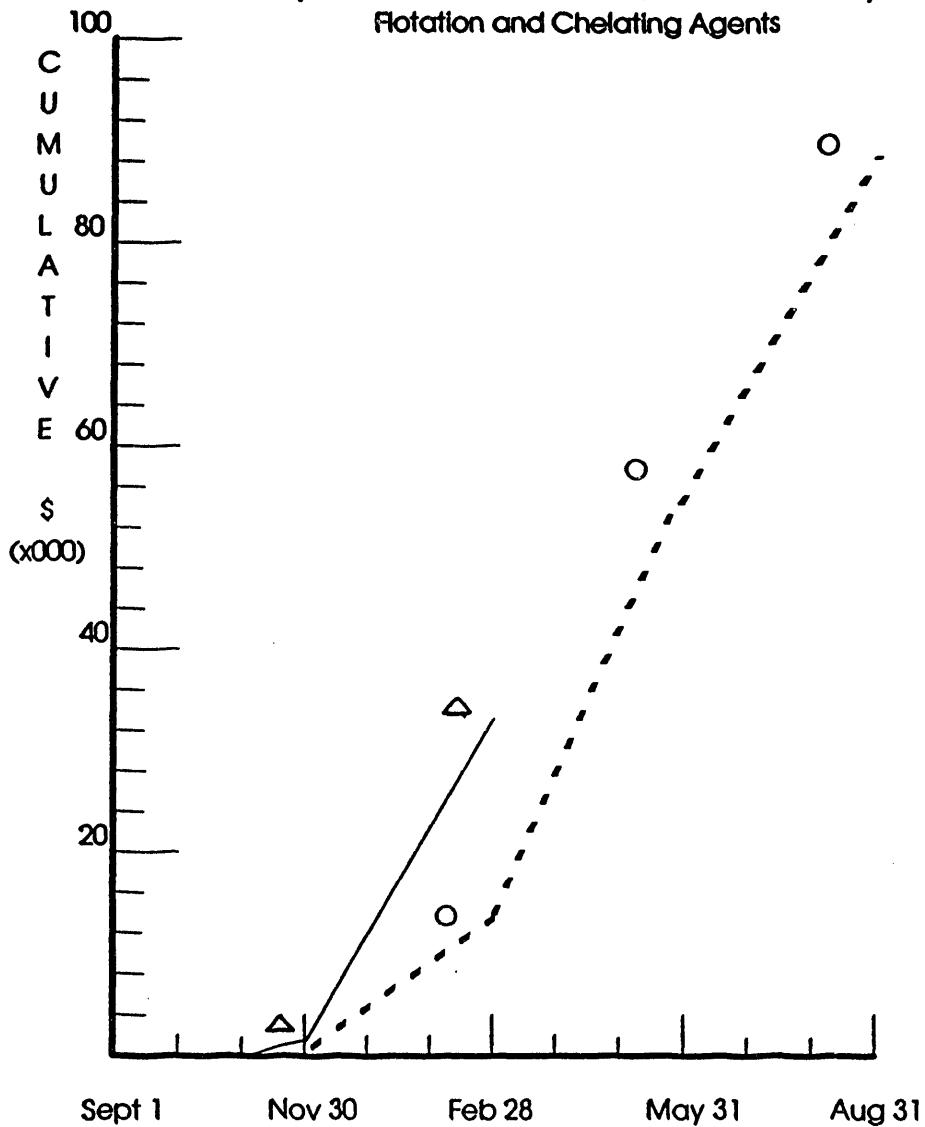
Quarter*	Types of Cost	Direct Labor	Fringe Benefits (General Overhead)	Materials & Supplies	Travel	Major Equipment	Other Direct Costs	Indirect Cost	Total
Sept. 1, 1993 to Nov. 30, 1993	Projected	0	0	0				0	0
	Estimated	252	554	0				202	1008
Sept. 1, 1993 to Feb. 28, 1994	Projected	3251	7152	293				2674	13370
	Estimated	6471	14237	5933				5994	32635
Sept. 1, 1993 to May 31, 1994	Projected	13297	29252	1108				10914	54571
	Estimated								0
Sept. 1, 1993 to Aug. 31, 1994	Projected	21400	47079	1338	806			17656	88279
	Estimated								0

*Cumulative by Quarter

02/28/94

COSTS BY QUARTER

Removal of Pyrite and Trace Elements from Waste Coal by Dissolved-CO₂
Flotation and Chelating Agents



Months and Quarters

○ = Projected Expenditures \$13,370

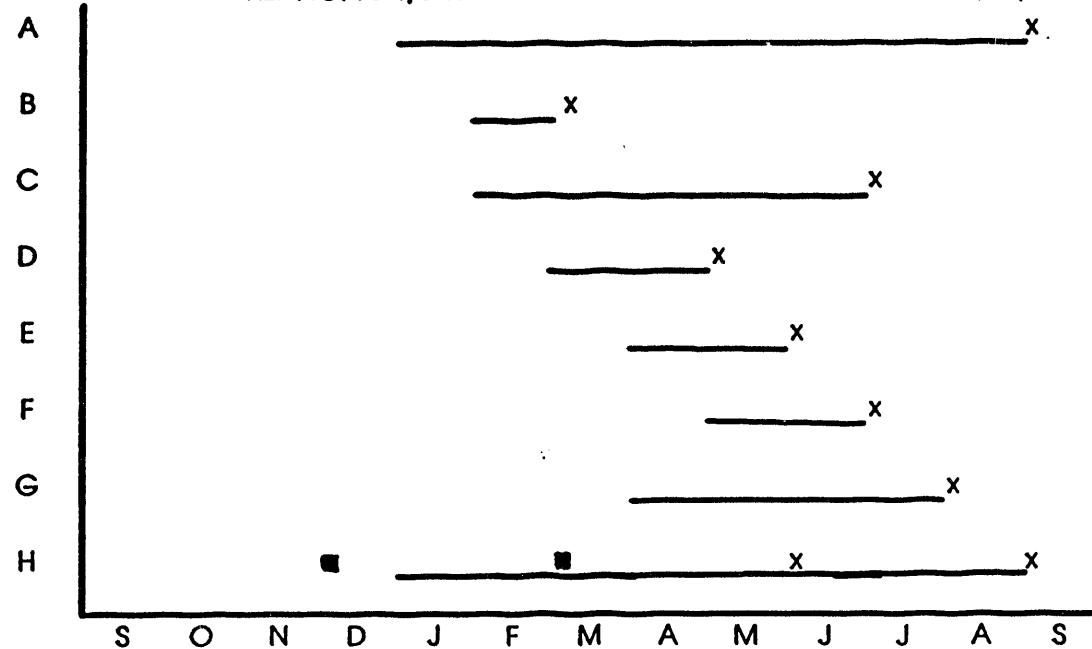
△ = Estimated Actual Expenditures \$32,635

Total Illinois Clean Coal Institute Award \$88,279

SCHEDULE OF PROJECT MILESTONES

REF NO. 93-1/5.1B-3

02/28/94



Begin
Sept. 1
1993

Hypothetical Milestones:

- A. Project Management Activities
- B. Procurement of Waste Coal
- C. Characterization of Waste Coal
- D. Surface Modification
- E. Performing of Flotation Tests
- F. Removal of Trace Metals by Chelating Agents
- G. Data Analysis
- H. Project management reports prepared and submitted

Comments: Work progressing as planned

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