AN ADVANCED CONTROL SYSTEM FOR FINE COAL FLOTATION

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ABSTRACT

A model-based flotation control scheme is being implemented to achieve optimal performance in the handling and treatment of fine coal. The control scheme monitors flotation performance through on-line analysis of ash content. Then, based on the economic and metallurgical performance of the circuit, variables such as reagent dosage, pulp density and pulp level are adjusted using model-based control algorithms to compensate for feed variations and other process disturbances. Recent developments in sensor technology are being applied for on-line determination of slurry ash content.

During the fifth quarter of this project, all work was on hold pending the final novation of the contract to Virginia Polytechnic Institute and State University.
INTRODUCTION

Over the past thirty years, process control has spread from the chemical industry into the fields of mineral and coal processing. Process computers, combined with improved instrumentation for monitoring process parameters and performance, have demonstrated improved process control in modern flotation plants. However, the classical methods used in most control strategies have some severe limitations in the control of flotation plants. The nonlinear nature of flotation processes causes single-input, single-output control lines to often battle each other in attempts to achieve single objectives. Other problems experienced in classical control schemes are noisy signals from measuring sensors and the inability to measure certain process variables. Factors related to ore type or process water chemistry, such as liberation characteristics, froth stability and floatability, cannot be measured by conventional sensors.

The purpose of this project is to demonstrate an advanced control system for fine coal flotation. The demonstration is being carried out at the Maple Meadow Coal Preparation Plant owned and operated by Cyprus Amax Coal Company. The objectives of this work are: 1) to identify through sampling, analysis and simulation those variables which can be manipulated in the plant to maintain grades, recoveries and throughput rates at levels set by management; 2) to develop and implement a model-based computer control strategy that continuously adjusts those variables to maximize revenue subject to various metallurgical, economic and environmental constraints; and 3) to employ a video-based optical analyzer for on-line analysis of ash content in fine coal slurries. The following is a summary of work completed during the fifth quarter of this project.
PROJECT TASKS

Task 1 - Project Planning

Subtask 1.1 - Work Plan Preparation: A Draft Project Work Plan has been submitted and reviewed by the DOE COR. The process of revising the Draft Work Plan, per suggestions provided by the DOE COR, is now underway, and the final approved version is scheduled to be in place by March, 1997.

Subtask 1.2 - Project Management and Reporting: The management of this project has now been novated to Virginia Polytechnic Institute and State University. Since the novation process required nearly eight months to complete, there are currently 29 delinquent reports, including this one. The contractors are working diligently to remedy this situation. During the eight-month novation period, no work was conducted by the subcontractor, J.A. Herbst and Associates, and only a small amount of work was carried out by the contractor to complete Subtask 4.1 (Calibration Testing). This work was presented in the Fourth Quarterly Technical Progress Report. All work on this project was on suspended during the fifth quarter.

Task 2 - Sampling and Data Analysis

Subtask 2.1 - Plant Sampling: This subtask has now been completed.

Subtask 2.2 - Data Analysis: This subtask is scheduled to begin in March, 1997, or as soon as funds become available to VPI&SU.

Task 3 - Model Building and Computer Simulation

This task is being carried out by J.A. Herbst and Associates and is scheduled to begin in March, 1997, or as soon as funds become available to VPI&SU.
Task 4 - Sensor Testing

Task 4.1 - Calibration Testing: This subtask has now been completed.

Task 4.2 - Design and Fabrication: Based on the outcome of Subtask 4.2, plans are being made to obtain a six-month lease for a nuclear-based coal slurry analyzer from AMDEL. The AMDEL sensor will now be considered as the primary analysis system for this project. Based on the timetable for this project, the lease is expected to run from 1/1/98 to 6/30/98 for use in conjunction with Task 7 (Operation and Testing). In the meantime, the design of the video-based system will continue to be investigated as a possible back-up system for the nuclear analyzer.

Task 5 - Sample Analysis and Characterization

This task is scheduled to resume in February, 1997, or as soon as funds become available to VPI&SU.

Task 6 - Equipment Procurement and Installation

This task is scheduled to begin in August, 1997.

Task 7 - Operation and Testing

This task is scheduled to begin in January, 1998.

Task 8 - System Evaluation

This task is scheduled to begin in February, 1998.

Task 9 - Decommissioning

This task is scheduled to begin in July, 1998.

Task 10 - Final Report

This task is scheduled to begin in August, 1998.
SUMMARY STATUS AND FUTURE WORK

Following the novation of this contract to Virginia Polytechnic Institute and State University, the project has now resumed and all tasks are on schedule per the new timetable. Twenty-nine delinquent reports are now being prepared and it is expected that nearly all of these reports will be completed within the next two weeks. In addition, plans are now being made to lease a nuclear-based slurry analyzer from AMDEL for the six-month duration of Task 7 (Operation and Testing). Finally, developmental work on the model-based control system is expected to resume in March, or as soon as funds are awarded to VPI&SU so that a subcontract can be issued to J.A. Herbst and Associates.