DENSE MEDIA CYCLONE OPTIMIZATION

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Partition Enterprises

Precision Testing Laboratories

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ABSTRACT

The fieldwork associated with Task 1 (Baseline Assessment) was completed this quarter. Detailed cyclone inspections completed at all but one plant during maintenance shifts. Analysis of the test samples is also currently underway in Task 4 (Sample Analysis). A Draft Recommendation was prepared for the management at each test site in Task 2 (Circuit Modification). All required procurements were completed. Density tracers were manufactured and tested for quality control purposes. Special sampling tools were also purchased and/or fabricated for each plant site. The preliminary experimental data show that the partitioning performance for all seven HMC circuits was generally good. This was attributed to well-maintained cyclones and good operating practices. However, the density tracers detected that most circuits suffered from poor control of media cutpoint. These problems were attributed to poor k-ray calibration and improper manual density measurements. These conclusions will be validated after the analyses of the composite samples have been completed.

Dense Medium Cyclone Optimization (Proposal #60)

- **Principal Investigator:** Gerald Luttrell (Virginia Tech)
- **NETL Project Manager:** David M. Hyman
- **Partners:** Massey Coal Services
Partition Enterprises (Australia)
Precision Testing
- **Total Project Cost:** \$320K
 - DOE Share: \$154K
 - Participant Share: \$166K
- **Project Period:** 12 months
- **Project Start Date:** 14 Dec. 2000

Background

- **Heavy Media Cyclones (HMCs)**
 - Serves as the “workhorse” in the coal preparation industry for removing waste rock from valuable coal
 - In the U.S., HMCs represent an installed capacity of >85,000 ton/hr
 - Problem - Improper operation can result in large losses of recoverable coal to the waste product
 - losses estimated to be more than \$45 million annually

Project Objectives

- To develop a set of three basic engineering tools to improve the efficiency of heavy medium cyclone (HMC) circuits:
 - low cost tracers to rapidly assess HMC performance
 - mathematical process models to predict the influence of changes in operating and design variables on HMC performance
 - model-based expert system to provide operators with a user-friendly interface for evaluating, optimizing, and troubleshooting HMC circuits

Simulations Showing Economic Impact of Improper Density Cutpoints

Photo Library

Photographs of several of the industrial coal preparation plants where the field testing of the heavy media cyclones is being performed.

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Photo Library

Shane Bomar (graduate student) and Chris Wood (Partition Enterprises) preparing for plant sampling and density tracer testing.

Density tracers (32 mm cubes) sorted into groups of 20 each (1.32 to 2.50 SG) just prior to being introduced into the cyclone feed stream.

Photo Library

A bank of parallel coarse coal heavy media cyclones that were sampled in detail and evaluated using the density tracers .

An installation of twin parallel coarse coal heavy media cyclones that were sampled in detail and evaluated using the density tracers .

Photo Library

Inside view of a ceramic-lined heavy media cyclone obtained during the preliminary site inspections (as viewed through the apex).

Examples of sampling tools that were purchased or fabricated for the collection of density tracers and samples of clean coal, refuse and circulating media.

Photo Library

Photograph showing the collection of a sample of circulating media from the underside of the clean coal sieve.

Photograph showing the collection of density tracers from the clean coal drain-and-rinse screens below a bank heavy media cyclones.

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Project Cost Summary

Source	First Year		Second Year		Third Year		Totals	
	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual
Participant	\$166K	---	0	---	0	---	\$166K	---
DOE	\$154K	---	0	---	0	---	\$154K	---
Total	\$320K	---	0	---	0	---	\$320K	---

KEY:

Plan = Planned costs for the full year.

Actual = Actual costs through the reporting period.

Milestones and Status

Project Milestone	Target Date	Status of Proposed Work
1 - Baseline Assessment	Aug. 01	Field Work Completed/Data Analysis Underway
2 - Circuit Modification	Sept. 01	Draft Recommendation in Preparation for Each Plant
3 - Follow-Up Assessment	July/Nov. 01	---
4 - Sample Analysis	Monthly	Size Analyses Completed & Float-Sink Tests Underway
5 - Analysis/Simulation	Monthly	Data Analysis in Progress / Circuit Simulation Underway
6 - Expert System Dev.	Nov. 01	---
7 - Concept Assessment	Dec. 01	---

Key Accomplishments

- **All required procurements completed**
 - Density tracers manufactured and tested for quality control purposes
 - Special sampling tools purchased and/or fabricated for each plant site
- **Baseline Assessment completed**
 - Five different plants visited and evaluated (only four proposed)
 - Seven different cyclone circuits fully examined, sampled and tested (active participation of up to 14 personnel)
 - Detailed cyclone inspections completed at all but one plant during maintenance shifts

Key Accomplishments (continued)

- **Baseline Assessment completed (continued)**
 - In-plant testing procedure:
 - Establish stable operation under required conditions
 - Make multiple manual measurements of the densities of feed, overflow and underflow media
 - Conduct density tracer tests using 32 or 16 mm tracers (as appropriate)
 - Take composite samples of circulating media, feed coal, clean coal, and refuse for later analysis (particle size, float-sink, ash analysis, etc.)
 - Estimate mass flow rates by taking timed samples
 - Record plant operating conditions

Flowsheet for one of the heavy media circuits evaluated in this project .

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Example of Density Tracer Data Obtained During the Preliminary Assessment

Density Tracer Partition Curve

Good News!

- **The partitioning performance for all 7 circuits was generally good.**
 - Attributed to well maintained cyclones and good operating practices.
- **Density tracers detected that most circuits suffered from poor control of media cutpoint.**
 - Problems attributed to poor k-ray calibration and improper manual density measurements.
 - Very important for plants that also have heavy media baths since poor control can have a significant impact on plant profitability.
 - More will be known after the analyses of the composite samples have been completed.

Good News!

- **Other problems identified by tracers...**
 - Plant A: Performance good, but feed distribution problem observed; media readings incorrect.
 - Plant B: Evidence of recoverable coal misplaced to refuse due to overload.
 - Plant C: Recoverable coal misplaced to refuse at low SG cutpoints (overload or surging); media reading incorrect.
 - Plant D: Cyclones suffering from severe overload; media readings incorrect.
 - Plant E: Performance good, but cutpoint lower than expected (probably due to overload)
- **Conclusion - Density tracers very effective in identifying operating problems.**

Project Recognition

- **International Conferences**

- “Optimization of Heavy Media Cyclone Circuits,” Accepted for publication and presentation at the 2002 Annual Meeting of the Society for Mining, Exploration and Metallurgy (SME), Salt Lake City, Utah

- **Short Courses and Workshops**

- “An Introduction to Coal Preparation,” One-Day Short Course, Sponsored by Coal Prep 2001 International Exhibition and Conference, Lexington, KY, April 30, 2001, 66 attendees.
- Operating and Maintenance Standards for Heavy Media Cyclones,” Half-Day Workshop, Sponsored by Massey Coal Services, Chapmanville, WV, February 9, 2001, 18 attendees.
- “Operating and Maintenance Standards for Heavy Media Cyclones,” Half-Day Workshop, Sponsored by Massey Coal Services, Chapmanville, WV, March 9, 2001, 11 attendees.
- “Operating and Maintenance Standards for Heavy Media Cyclones,” Half-Day Workshop, Sponsored by TECO Coal Company, Dunbar, KY, June 12, 2001, 14 attendees.

Project Assessment

(Internal DOE Use Only)

- **Open Issues and/or Problems**
 - None noted
 - All project activities on schedule
 - Spending to date within budget limits
- **Overall Assessment**
 - Off to a good start
 - Findings to date of significant technical and economic importance

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