

FINAL TECHNICAL REPORT
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Project Title: **DEMONSTRATION OF ISGS WASHER RETROFIT AT GALATIA
MINE COAL PROCESSING PLANT**

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ABSTRACT

The Inclined Froth Washer (IFW) technology developed at the Illinois State Geological Survey (ISGS) over the past five years with support from the Illinois Clean Coal Institute and the US Department of Energy (DOE) is now licensed by the University of Illinois to Dynamic Separations Inc., a new Champaign-based company formed by MHI Energy Partners, Inc. A previous effort to demonstrate ended prematurely when the host mine discontinued operations. That left the Galatia Mine coal preparation plant as the only operation in Illinois using froth flotation to clean coal fines. The Galatia plant was built with three banks of Denver subaeration froth flotation cells, one of which ceased to be used when the plant converted to spirals in the mid 1990s. With the consent of Galatia management, the purpose of this project was to retrofit part of the idle float cell with IFW attachments and conduct comparison tests with one of the float cells still in use.

The retrofit consisted of removing the froth-skimming paddles, rebuilding three mixing units with new rotors, impellers and motors, and refurbishing the sand and weir gate actuators. The middle unit was capped and four different configurations of the IFW were installed and tested to determine the configuration that provided the best coal cleaning performance. Although test results indicated that one cell did not have the capacity to recover all of the fine coal in the feed, they were positive enough to persuade Galatia management to allow two cells to be equipped with the best IFW configuration and additional testing to be conducted.

Test results indicate an IFW product with ash content between 7.28% and 7.45% and sulfur levels between 0.84% and 0.89%. The ash content of the IFW product was significantly better than the product from the plant's existing cells, which was between 8.26% and 12.66%. Sulfur levels in the IFW cell and the existing cell were almost the same. Having just completed a plant expansion, the Galatia Mine is in need of additional fines processing capacity. Based on the favorable results produced during this project, a recommendation has been given to the plant to convert one of their existing float cells to an IFW system for processing all of the fines and keep the second existing cell available as a backup.

Pages 1-18 contain proprietary information

EXECUTIVE SUMMARY

A number of Illinois coal mines have closed in recent years due to their inability to produce coal that is cleaner and cheaper than their competitors. The desired coal quality is not achievable because some processing methods, particularly those used to clean fine coal, cannot generate a marketable product at a reasonable cost. Both the inefficiency and the high capital and operating costs of existing fine coal cleaning methods are, in part, responsible for this dilemma. Consequently, most coal producers in Illinois recover only the coarse fraction of run-of-mine (ROM) coal. The roughly 25% of the ROM coal that is fine is simply discarded as waste. Not only is this an economic waste of a valuable commodity, but it creates environmental, aesthetic, and safety problems. Money that could be generated from sale of this easily cleaned fine coal is instead spent disposing of it, increasing the cost of production instead of augmenting revenues.

A device that can help existing fine coal processing equipment produce cleaner coal at a faster rate while reducing the number of flotation cells required to process a given tonnage is the Inclined Froth Washer (IFW) developed at the ISGS with financial support from the ICCI. Under optimum conditions the performance of flotation devices equipped with the ISGS washer surpasses the best performance of any ordinary flotation device, as measured by Advanced Flotation Release analysis. The throughput rates of flotation devices to which it is attached can be significantly increased.

The IFW has the potential to eliminate the need for multistage fine coal cleaning systems, to economically enlarge the capacity of existing coal washing plants, and to produce a premium product from material that is currently being rejected. It could reduce the costs of processing fines in coal preparation plants, help processing of fine coal recovery become a more common practice, and enable cleaning plant operators to produce a cleaner coal at less cost. It could also reduce the costs of tailings disposal and reclamation, minimize land disturbance, alleviate environmental hazards, and improve the aesthetic value of the land involved.

The IFW was under development at ISGS laboratories for five years before a field demonstration was attempted in 2002. When the host mine shut down in the middle of that demonstration, it had to be terminated. This mine closure left just one mine in the State of Illinois that utilized froth flotation. This project involved a retrofit of a bank of inactive Denver Froth Flotation Cells at the Galatia Mine. The research team removed the froth-skimming paddles, refurbished the level control system, and rebuilt three mechanical mixing systems by replacing the motors and all of the damaged rotors and impellers. Initially, the retrofit system included a cover or cap on the middle cell combined with a washer mounting system that allowed different IFW configurations to be easily exchanged. Four different IFW configurations were designed, fabricated, installed and tested to determine which configuration best accommodated the specific conditions of the plant.

Single cell tests were completed in June 2005 and results compared with the performance of Galatia's existing conventional froth flotation cells. Results from single cell testing indicate a product with ash content between 7.28% and 7.45% and sulfur levels between 0.84% and 0.89%. The ash content of the IFW product was significantly better than the product from the plant's existing cells, which was between 8.26% and 12.66%. Sulfur levels in the IFW cell and the existing cell were almost the same.

The IFW cell never failed to produce coal, although the single cell was overwhelmed and unable to process all of the feed material. However, favorable results from the single cell tests convinced Galatia management to retrofit two cells with the IFW configuration that performed the best in the single cell test. Because the single cell demonstration relied on natural air suction without forced aeration, it was determined that increasing the intensity of aeration could improve throughput by increasing the probability of collisions between the air bubbles and coal particles. This issue was briefly examined during the two-cell test by installing an air puffer system. The puffer system appeared to improve cell throughput, but it also led to froth surging with potential carry over of contaminants in the product. Testing ended before qualitative results could be obtained.

The project was extended to allow for completion and testing of the two-cell retrofit. Two-cell testing in September 2005 coincided with the start up of a major plant expansion requiring additional fines processing capacity. Based on the success of the demonstration, it was recommended that the plant assume ownership of the installation making it the first commercial use of the IFW technology.

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