TITLE: DEVELOPMENT OF AN ON-LINE COAL WASHABILITY ANALYZER

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ABSTRACT

OBJECTIVE

The primary objective of the proposed research program is to develop a CT-based, on-line coal washability analyzer. A secondary objective will be to demonstrate the capabilities of the analyzer by comparing efficiency data from traditional float-sink tests conducted at three preparation plant sites with efficiency data generated by the washability analyzer. The scope of the proposed research program involves several tasks including (i) the acquisition and preparation of test samples for use in testing and calibrating the analyzer, (ii) the development of appropriate hardware and software necessary to adapt a CT analyzer for use in determining coal washability, (iii) the testing and modification of the analyzer using well-characterized coal samples, (iv) the evaluation of the analyzer's performance under simulated plant conditions, and (v) an evaluation of the technical and economic feasibility of implementing the CT-based washability analyzer on a commercial basis. Researchers from the University of Utah and Terra Tek Inc. will perform tasks related to the development, calibration and testing the analyzer, while technical personnel from Virginia Tech and selected coal companies will provide the required coal samples, evaluate the industrial capabilities of the analyzer, and promote system commercialization.

WORK DONE AND CONCLUSIONS

- The response time will be significantly reduced if a large CT sampling interval can still provide accurate information for coal washability analysis. Base on early studies, it is expected that the 3-dimensional information can be estimated from sectioned 2-dimensional data with a suitable transformation kernel. In this regard, the second approach involves the development of

transformation kernel and algorithms for coal washability information based on non-continuous 2-D images in order to reduce the total response time. In contrast to the approach for the 3-D mass density analysis reported previously, algorithms such as the polygonal approximation and the classification of concavities based on polygons are implemented to enhance the robustness of the algorithm for the separation of particles in contact. Transformation kernel for the link between 2-D x-ray CT image data and 3-D reality (washability curve) were established to facilitate the separation and classification the density distribution of the coal particle bed.

- The algorithm for the 2-D mass density distribution analysis has been implemented. Test results for multiple size/single density and single size/multiple density samples show that the algorithm works in a promising way.
- Excellent progress has been made on the project and it is expected that the cycle time for the CT scanner and the amount of sample required to achieve a given level of accuracy can be established.
- Characteristics of the washability based on ash content of the particle population has been initiated. Preliminary results indicate that the ash content of coal particles can be estimated once the relationship between ash content and specific gravity is established.
- The feed to a coal preparation plant may be subject to significant variations in terms of size, quality and mineralogical association. Factors responsible for these variations include fluctuations in seam characteristics, modifications in mining practices and changes in the mix of coal entering the plant from multiple sections and/or mines. These disturbances make it difficult for plant operations to maintain a consistent coal quality and to maximize clean coal production. In order to examine the extent of these variations, samples were collected from the feed stream to an industrial coal preparation plant and subjected to washability (float-sink) analyses. The plant samples were taken daily and then combined to prepare a composite feed sample at the end of each four-week period. This procedure was continued for a period of about 13 months. Each sample was sized at 6.35 mm (1/4 inch) and 1 mm (16 mesh). Due to the large amounts of material involved, a two-point float-sink procedure was used for each size fraction. This allowed three specific gravity fractions (i.e., float 1.35, 1.35 x 1.65 and sink 1.65) to be produced for each of the two coarser size fractions (i.e., plus 6.35 mm and 6.35 x 1 mm). Since the proposed CT unit is currently not capable of analyzing the minus 1 mm fraction, this size class was not evaluated as part of this study. In summary, field data have been collected to evaluate the variability in washability that may be expected for a typical feed to a coal preparation plant. These data show that large variations in washability do occur and suggest that large financial benefits may be derived through the application of a washability-based control system.

ARTICLES, PRESENTATIONS, STUDENTS

ARTICLES: J.D. Miller and C.L. Lin, "Characterization of Mineral Particle Populations by X-Ray CT", Conference Proceedings *Frontiers in Industrial Process Tomography II*, Engineering Foundation, April 8-12, 1997, Delft Technical University, Delft, Netherlands, p. 9-14.

J.D. Miller and C.L. Lin, "Computed Tomographic Techniques for the Analysis of Multiphase Mineral Processing Systems", *XX International Mineral Processing Congress*, Aachen, Germany, Vol. 1, p.151-161, 1997.

PRESENTATIONS: J.D. Miller and C.L. Lin, "Review of Tomographic Techniques for the Analysis of Multiphase Systems", for presentation at NSF Workshop in South Africa, June, 1997.

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