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CONF-770821--2

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Proceedings of the Electron Microscopy

Society of America

G. W. Bailey, Editor

Published by Claitor's Press

Baton Rouge, La.

1977

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EVALUATION OF PYRITE PARTICLE SIZE, SHAPE AND DISTRIBUTION FACTORS FOR COAL
CHANNEL SAMPLES

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The recognition of the importance of different mixtures of macerals and minerals in affecting coal conversion liquefaction and gasification processes is broadly acknowledged. The details of these interrelations between physical and chemical characteristics and the behavior of the coal lithotypes are not known. The present scanning electron microscope investigation^{1,2} is concerned with developing certain microstructural and microchemical data to enhance our understanding of the nature of coal as related to various methods of beneficiation, desulfurization and processing.

Complete channel samples have been obtained from Iowa mines and prepared for detailed SEM analysis on a micrometer size basis. The findings offer insight into the presence and distribution of pyrite (the primary sulfur bearing phase in the coal) as well as suggest the application of innovative techniques to remove this material from coal prior to combustion of the coal at a power plant. The distribution of pyrite (in weight percent) among three forms in the Mich mine, for example, is 69.7% single crystals (micrometer and colloidal size single crystals), 12.3% framboids (various size agglomerations of single crystals; the agglomerations are generally of a size of 10 to 50 μ m in diameter), and 18.0% other pyrite forms (larger pyrite masses). Figures 1a and 1b show examples of these forms.

The proportion of pyrite in various size ranges offers an insight into the difficulties in pyrite removal by conventional techniques as well as considerations for establishing the degree of confidence in precision and accuracy of sulfur determinations in coal by conventional chemical analytical techniques. Data for the Mich mine are presented in Figure 1c. Two items are of primary interest: 1) the size (particle diameter) below which 50% of the pyrite is present in the seam. . . 12 μ m diameter, and 2) the amount of pyrite present which could pass through a 200 mesh sieve. . . 75%. From these data, it is not surprising that the Mich mine coal would be difficult to clean with so much pyrite being present in a very small size range. The amount of pyrite present of a size of 76 μ m or less in diameter is of direct practical interest. Most utilities in the U.S. crush coal to -200 mesh size just prior to combustion. Thus, the significance of this information relates to the potential for additional sulfur removal at a power plant after final coal crushing. There may be a very important potential present to decrease the coal sulfur content by removal of the very fine sulfur bearing phases (predominately pyrite) at this stage.

This work is supported at Iowa State University by the Engineering Research Institute and the Ames Laboratory under contract to the U.S. Energy Research and Development Administration under contract number W-7405-ENG-82.

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(a)

(b)

(c)

Fig. 1a SEM view of fresh fracture surface. Two forms of pyrite are seen in this field:: Individual crystals and framboids.

Fig. 1b SEM view of fresh fracture surface. The third form of pyrite ("other" pyrite) is massive material consisting of intimate intergrowths of pyrite crystals.

Fig. 1c Proportionation of pyrite for the various size ranges observed for the Mich mine. Lower Mich seam, 60.7 cm thick. Percentage of pyrite less than a particular size. For example, 75% of the pyrite is less than 76 μm in diameter (i.e., 200 mesh).