WEDNESDAY, AUGUST 25, 2004, A.M.

SESSION 46: FIFTH UBC-MCGILL INTERNATIONAL SYMPOSIUM ON PARTICLE SIZE ENLARGEMENT IN MINERAL PROCESSING

PELLETIZATION AND BRIQUETTING
Sponsor: Mineral Science and Engineering Section, The Metallurgical Society of CIM
Room: Chedoke C
Chairmen: W. PIETSCH, Compactconsult Inc., Naples, Florida, U.S.A., and
R.T. DEC, K.R. Komarek Briquetting Research Inc., Anniston, Alabamma, U.S.A.

PAPER 46.1 — 8:30
EFFECT OF PARTICULATE CHARACTERISTICS ON THE BALLING AND PROPERTIES OF FLY ASH PELLETS.
D.W. FUERSTENAU, University of California, Berkeley, California, U.S.A.,
A-Z.M. ABOUZEIT, University of Cairo, Giza, Egypt, and
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The use of pulverized coal for electric power generation results in the production of vast amounts of fly ash. One potential use for waste fly ash is the production of pellets for lightweight aggregates. This paper is concerned with the role of the physical and chemical characteristics of two different fly ashes in governing their agglomeration or pelletization behavior and their strength characteristics. In batch balling experiments, fly ash pellet growth was found to be extremely sensitive to the amount of moisture added. One ash (Mohave) exhibits marked pozzolanic activity whereas the other (Jim Bridger) does not. The pozzolanic activity has a very pronounced effect on pellet growth kinetics, moisture requirements, and the effect of various additives on growth kinetics. Slow drying under ambient conditions produces strong pellets from Mohave ash whereas Jim Bridger ash pellets lacking in pozzolanic activity are weak. Rapid drying at high temperatures results in weak pellets because water necessary for hardening is driven out of the pellet. Steam curing enhances pellet strength. Locked-cycle pelletizing experiments exhibit expected oscillation in pellet production rates and attendant fluctuations in pellet green strength.

PAPER 46.2 — 8:55
USE OF PELLETIZATION TO ASSESS THE EFFECT OF PARTICLE-PARTICLE INTERACTIONS ON COAL HANDLEABILITY.
M.E. HOLUSZKO and J.S. LASKOWSKI, University of British Columbia, Vancouver, British Columbia, Canada

Although there is no widely accepted rigorous definition of handleability, the handling coal characteristics often referred to as handleability define whether a coal has the ability to flow unhindered through the processing and transportation systems. The handleability may be severely affected if fine coal particles tend to aggregate. In the pelletization process, the rolling action of the drum is applied to bring the individual particles into proximity with each other so that they can aggregate and form pellets. Because of apparent similarities between these two processes, the pelletization tests are carried out in parallel to the handleability tests in this project, and the pelletization results are used to explain coal handleability properties.

PAPER 46.3 — 9:20
FINE PARTICLE CONTROL TO IMPROVE MINERAL HANDLING.
R.L. JOHNSON, C. STURGESS, E. KOZUB and A. LIEM, Particle Engineering Group, Alberta Research Council, Alberta, Canada

New challenges in mineral processing arise as high-grade ores become less available and the mining industry is forced to exploit lower grade ores. One of the challenges in beneficiating lower grade ores is the liberation of mineral particles while maintaining control over material management. Lower grade ores need fine grinding to free valuable minerals, but finely divided particles can cause severe problems, such as dustiness and flowability, in subsequent stages of material management.

There are at least two approaches that can be taken to resolve this dilemma, both of which relate to particle size enlargement. First, the application of a dust suppressant can be used to control that aspect of material management. The optimal choice of dust suppressant agent depends on effectiveness and cost, both of which can be strongly influenced by the selection of application method. Second, agglomeration—combining small particles into larger units—can reduce dust and improve the flow characteristics of the material at the same time. There are several mechanisms that can be employed to agglomerate mineral materials. Although agglomeration adds a new processing step, it is often cost effective.

This paper describes these two approaches and their respective challenges, as they relate to a mined ore. We report on modified or newly developed procedures for characterizing mineral ores with respect to material management. On the same material, we use agglomeration processing to capture fines within larger particles and show how dustiness and other aspects of material handling are affected. We conclude by discussing their specific application in accordance with the mineral properties and processing needs.

PAPER 46.4 — 9:45

EFFECTS OF RETAINED CALCIUM IONS IN IRON ORE CONCENTRATES ON PELLETIZATION PERFORMANCE.

S.K. KAWATRA, T.C. EISELE, Michigan Technological University, Houghton, Michigan, U.S.A., and
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It was determined by the authors that the water that remains in the filter cake after filtration in iron ore concentrators can contain several hundred times greater concentrations of calcium ions and other cations, due to surface chemical effects carrying the ions along with the water. Filter cake from two plants was analyzed. The water retained in samples of magnetite concentrate filter cake in Plant 1 contained 5088 ppm calcium and 5995 ppm magnesium, while the Plant 2 filter cake contained 231 ppm calcium and 119 ppm magnesium. These levels were dramatically elevated compared to the water that was removed from the concentrate by filtration for recycle to the plants (9 ppm calcium/15 ppm magnesium for Plant 1, and 11.9 ppm calcium/9.3 ppm magnesium in Plant 2). In addition to possible effects on agglomeration performance, the presence of these cations also affected the efficiency of filtration. In order to reduce the effects of these cations on filtration in Plant 2, carbon dioxide was injected into the slurry before it entered the filter press. This was found to increase filtration rates by up to 23.7%. Comparison of the results from the two plants shows that the concentrations of cations present in the filter cake will vary greatly from plant to plant, with correspondingly large variations in their effects on plant operations.

COFFEE BREAK — 10:10 - 10:30

PAPER 46.5 — 10:30

SEGREGATION OF COHESIVE BULK MATERIALS A NEW METHODOLOGY.

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The mining industry routinely processes material with different particle sizes. Coal, nickel ore, copper ore, lignite, shale, and phosphate ore are all examples of materials with wide particle size distributions. It is often assumed that these materials are homogenous and that any particle size distribution has the same chemical activity and composition. It is entirely possible, and quite likely, that chemical composition is a function of particle size distribution. In addition, particle size distributions in ore materials are often responsible for the difference in flow behavior in process equipment. This is evident in coal electrical production facilities. Fine coal may have the same ash content, sulfur content, and BTU value as coarse coal. However, all electrical production facilities know the extreme flow problems that result when attempting to handle wet fine coal. Segregation of these bulk materials is an important issue that must be understood to prevent these cohesive flow problems. Additionally, fertilizers are mixtures of particles with different shape and sizes. These mixtures must remain homogenous to optimize fertilizer performance. Segregation leads to poor product quality. This paper presents a method of measuring the magnitude of sifting segregation occurring in bulk material and the relationship between the strength of the bulk material and the separation tendency. It shows an inverse relationship between the yield strength of the material and the bulk segregation.

PAPER 46.6 — 10:55

FINITE ELEMENT SIMULATION AS A TOOL FOR DESIGN AND OPTIMISATION OF ROLLER PRESS PERFORMANCE.

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R.K. KOMAREK, K.R. Komarek Inc., Elk Grove Village, Illinois, U.S.A.

Current industrial compacting and briquetting practices are largely based on trial-and-error techniques. This paper introduces a two dimensional finite element model of compacting/briquetting process in the roller press. Compared with other modeling techniques used in the past, finite element method offers the most versatile approach because it incorporates adequate information about powder behavior, geometry and frictional conditions and offers predictions for the density distribution, velocity field, stress distribution, roll force, roll torque and other important process variables. More over, when the model includes elasticity, it offers predictions on the internal stress state in the briquet after its exit from the pressing zone. This enables to perform realistic computer experiments which are helpful for establishing the pressing system design, forming cavity geometry and process conditions necessary to produce compacted or briquetted product with the desired properties.

PAPER 46.7 — 11:20

BIOFLOTATION OF SARCHESHMEH COPPER SULPHIDE ORE.

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Y.S.M. TABATABAEI, Biotechnology, Tehran Medical Science University, Tehran, Iran,

A. ESLAMI and Z. MANAFI, Sarcheshmeh R&D Division, Sarcheshmeh, Kerman, Iran

Application of *Acidithiobacillus ferrooxidans* bacteria to flotation of Sarcheshmeh low-grade copper sulphide ore was studied. Sarcheshmeh low-grade ore contains pyrite, which causes some problems in the flotation of copper minerals. In this study, *A. ferrooxidans* was used to change the surface chemistry of pyrite and copper sulphide ores and consequently, their flotation behaviour. In the presence of *A. ferrooxidans* and xanthate as a collector, pyrite was depressed whereas chalcopyrite and other sulphide minerals were unaffected. In addition, the pulp pH remained unchanged. It was shown that the surface chemical properties of the bacteria can be manipulated successfully to achieve the desired effects in a flotation process. The results showed that the recovery of pyrite in the presence of the bio-depressant is 50% lower than when no bacteria were present. At the same time the recovery of chalcopyrite remained unchanged.