Industrial Technologies Program

Improving Energy Efficiency in SAG Mills

Pilot-Scale SAG Mill Facility Will Help to Optimize Charge Motion and Slurry Flow in Plant-Scale SAG Mills - Reducing Energy Consumption

The U.S. mining industry operates approximately 80 semi-autogenous grinding mills (SAG) throughout the United States. Both mine and mill site variables determine SAG mill performance, i.e. capacity and grind-size. In many operations these variables affect production capacity seemingly at random. Methods to increase capacity, decrease energy consumption and prolong lifter and liner life are needed.

The variable interaction involved in slurry transportation should first be understood. This begins with the motion of the charge (rocks and balls) in SAG mills, which creates a field of breakage. If the ore is sufficiently ground, the slurry leaves through the slots in the grate. Next, the pulp lifter transports the slurry into the trunnion discharge. The energy input to the mill results in charge motion, field of breakage and slurry transport. However, the interaction between these variables is poorly understood in the industry.

Researchers from the University of Utah are developing a pilot-scale SAG mill facility that will imitate a full-scale operation. It will have sensors for on-line mill load, power, flow and other measurements. This research will lead to an understanding of the individual effect of design and operating variables on power draft.

Researchers will mimic the operation of participating mine sites. From this baseline operation, the pilot mill will be operated at a variety of conditions until the most energy-efficient regimen in the operation is discovered. A model linking all of the variables will be developed. This model will be able to predict the best operating condition under which energy per ton of ore ground is minimized for a particular shell lifter, grate open area and pulp lifter combination.

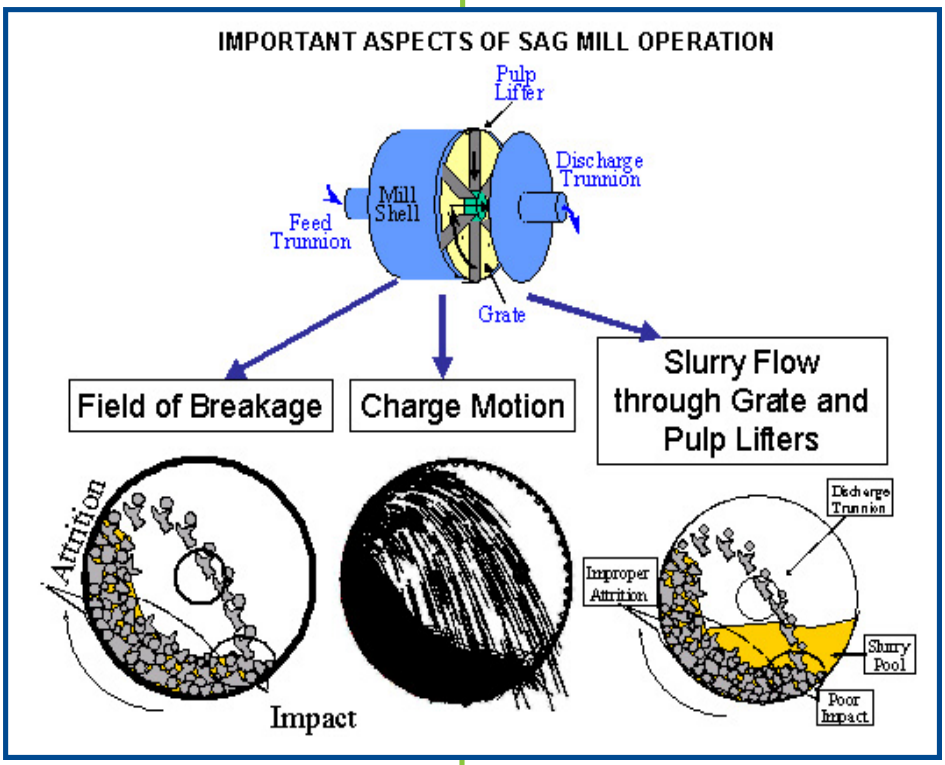
Researchers will seek to use computer modeling, especially process modeling of SAG mills, as an online tool to process ore more efficiently. A more accurate process model will provide plant operators with the instantaneous operating status of the mill so that they can make intelligent decisions. The proposed project seeks to implement one new individual process model within two years. Such a model can be integrated with the other models, for example, crusher model and ball mill model, to integrate the overall mill system model within 10 years as outlined in the Mineral Processing Technology Roadmap.

Benefits for Our Industry and Our Nation

- *Reduces energy consumption by as much as 15-20% in SAG Mills.*
- *Reduces equipment wear.*
- *Reduces operation costs.*

Applications in Our Nation's Industry

This model will serve the mining industry as a standard against which they can compare their operations and, hence, fine-tune their operations to the energy-efficient conditions predicted by the model.



Project Description

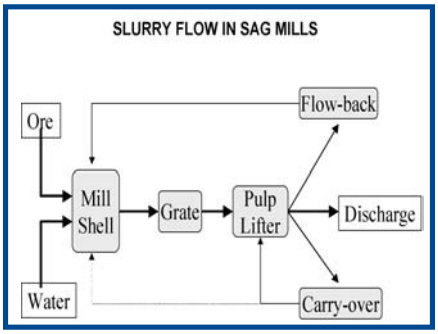
Goal: To develop an integrated process model to enable the SAG mills to operate with high-energy efficiency.

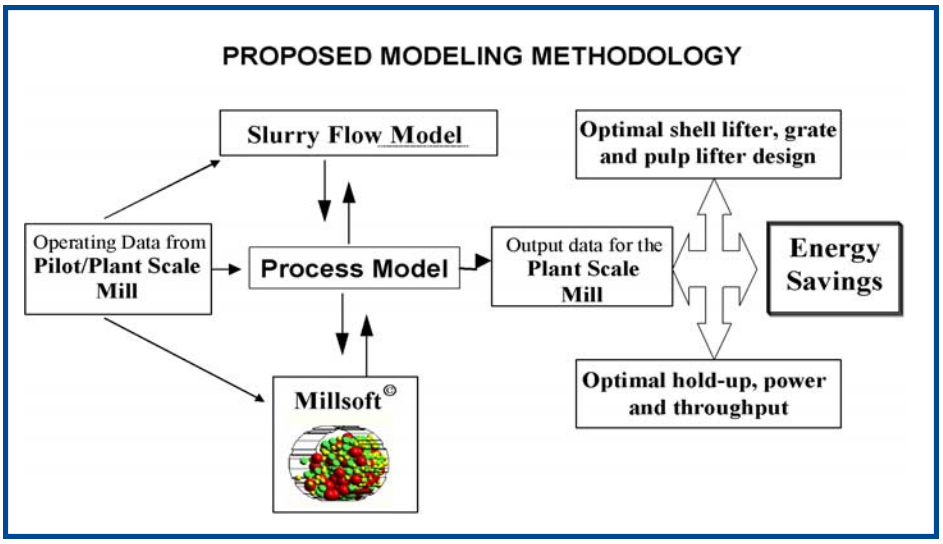
There are two sub-objectives. The first is to study the effect of individual variables such as charge filling, shell lifter configuration and design of discharge grate and pulp lifter on power draft of the mill by isolating the effect that one has on another. The second sub-objective is to conduct plant surveys at Kennecott Utah Copper Corporation and Cortez Gold Mines around the plant-scale SAG mills. This will be done in order to collect the operational data necessary to simulate in the pilot mill. The result will optimize the performance of SAG mills and increase its energy efficiency.

The pilot mill will be operated with sample ore/slurry from participating mine sites. Considering the operating conditions, optimal shell lifter, grate and pulp lifter designs will be suggested for achieving maximum energy benefit. The two participating mine sites will be persuaded to operate the mill under these conditions, providing that no major equipment modifications are required. The derived energy efficient operating scheme will be packaged into a model linking all the variables.

Milestones

- Design and construct a pilot-scale SAG mill facility with on-line power, load and flow measurement instrumentation. Scats or pebbles will be collected from KCC Copperton and Cortez Gold operations.
- Design and construct three sets of shell lifters, grates and pulp lifters. This will be followed by a series of experiments and tests on the pilot mill.
- Conduct data analysis to delineate the effect of each variable on the energy efficiency and construction of a model, which will link these factors.
- Record the operating parameters of Copperton operations and Cortez operations during a site visit. Have the pilot-scale mimic the full-scale operations. Next, a simulation model will be built so that other mine sites can optimize their operations on-line.





Project Partners

University of Utah
Salt Lake City, UT

Kennecott Utah Copper Corporation
Magna, UT

Cortez Gold Mines
Crescent Valley, NV

Process Engineering Resources, Inc.
Salt Lake City, UT

Outokumpu Technology, Inc.
Centennial, CO

Weir Rubber Engineering
Salt Lake City, UT

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

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Energy Efficiency and Renewable Energy

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