Industrial Technologies Program

Novel Binders and Methods for Agglomeration of Ore

A Functional Binder for Acidic Environments that Will Increase Metal Recovery and Improve the Binder/Ore Mixing Process

Currently, heap-leaching operations are plagued by poor permeability of the heap, which leads to uneven distribution of the leaching solution, unleached zones in the heap, and low metal recovery. This poor permeability is caused by excessive amounts of fine particles clogging the spaces between larger ore particles. By agglomerating ores, individual ore particles will be held together in coarse, porous masses with the use of a binder. In addition to benefits for heap leaching, agglomeration is a critical factor in the success of the Iron Ore Industry. This process requires the formation of strong agglomerates of coal, iron oxide, and flux without heat treatment, and at a minimal cost.

Unfortunately, there are no known agglomeration binders that will work satisfactorily in the acidic environment encountered in many heap-leaching operations, and few binders that will produce high strengths without sintering. Alkaline binders, for instance, are destroyed by acid attack, and are thus completely unsuitable for use in acidic leaching heaps. Other binders are synthetic polymer compounds, but many of these binders also perform poorly in acidic environments. In most cases their synthesis costs are so high that they are impractical. As a result, operators of acidic heap-leach facilities cannot take full advantage of the agglomeration technique.

Because of problems with effectiveness or cost, all binders that have been evaluated to date for use in acidic heap leaching have either performed poorly, or proved to be too expensive for commercial use. Furthermore, mixing problems in all types of heap leaching operations has led to significantly more binder usage than necessary. The large quantity of ore that must be handled in heap-leaching operations requires that the binder must be kept to low dosages to be economical.

Researchers will select the binders to be studied in this project based on theoretical considerations, with particular emphasis on low-cost reagents or industrial wastes/byproducts that are expected to be particularly acid-resistant. The use of advanced compressive shear mixing technology will further reduce binder cost by ensuring that the binder is used with the greatest possible efficiency. Michigan Technological University, along with their project partners, will focus on developing a more broadly usable binder and a more efficient binder/ore mixing method that will benefit all heap-leaching operations that use agglomeration. The project will improve energy efficiency by increasing metal recovery during heap leaching, reducing the quantity of ore that must be handled and prepared to produce a given amount of metal.

Another result of the project will be the decreased land area required for leaching pads due to the increased processing efficiency, which not only reduces cost, but also simplifies design to prevent spills and groundwater contamination. Boosting the use of heap leaching will also generate lower emissions than are currently generated by conventional smelting techniques. The binders developed are expected to benefit the agglomeration of feed pellets for use in the Iron Nugget process, which will make it possible to implement this process as a high-efficiency, environmentally-sound replacement for blast furnace technology.

Benefits for Our Industry and Our Nation

- *Improves process efficiency by augmenting metal recovery rates relative to unagglomerated processes by 53%.*
- *Increases energy efficiency by increasing recovery rates without increasing energy consumption.*
- *Reduces environmental impact caused by high material handling and preparation costs.*
- *Replaces conventional techniques with the adoption of high-efficiency, environmentally-sound processes.*

Applications in Our Nation's Industry

This technology will increase metal recovery and improve energy efficiency in heap-leaching operations. Also by making use of byproducts, waste disposal costs will be reduced in other industries. It will also simplify the adoption of advanced direct iron-making processes to replace the existing blast furnace technology.

Project Description

Goal: To develop an effective, low-cost agglomeration binder that can be used in acidic heap-leaching operations, and to maximize the effectiveness of the binder using an improved binder/ore mixing process.

The overall technology transfer strategy is to use the industrial partnerships in this project to commercialize the technology outside of Michigan Technological University (MTU).

Milestones

- To determine size distribution and composition by the sampling and characterization of unagglomerated heap-leach feeds.
- Perform binder characterization and testing.
- Develop improved mixing procedures to increase binder effectiveness.
- Optimize binder dosage and pretreatment, and evaluate leaching rates and metal recovery, in preparation for on-site studies by the industrial sponsors.
- Perform economic analysis of developed agglomeration binders.

Columns for simulating heap leaching.

Project Partners

Michigan Technological University
Houghton, MI

Phelps Dodge Inc.
Morenci, AZ

Newmont Gold Co.
Denver, CO

Northshore Mining Co.
Silver Bay, MN

Southern Peru Copper Co.
Phoenix, AZ

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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