

# Industrial Technologies Program

## Breakthrough Energy Savings with Waterjet Technology for the Mining Industry

### Waterjet Technology Expected to Reduce Handling and Processing Needs

Mining a valuable mineral requires a number of consecutive steps that begin with the excavation of the ore, followed by transportation to the processing plant and the subsequent grinding and treatment of the mined material in order to concentrate and then recover the valuable mineral content. The conventional extraction technology is relatively non-discriminatory where the mineral and host rock are extracted together and in fragments, in which the two are co-mingled. The separation generally takes place after the ore has been brought to a surface treatment plant and the rock has been reduced in size to ensure liberation of the different constituents of the rock.

However, if the process of extraction breaks down the ore so that the individual constituent grains of the rock are separated and can be segregated at or near the mining machine, potentially with simpler processes, it will reduce the overall volume of material that must then be moved and treated.

Researchers at the University of Missouri – Rolla are attempting to establish a method for disintegrating rock using high-pressure waterjets, and separating the valuable minerals in the vicinity.

Over the past two decades, high-pressure waterjet systems have been developed extensively in the civil construction market. By combining the use of high pressure through very small jet orifices with an associated collection system, UMR is developing a tool that can grow the defining fractures around individual grains that constitute the rock such that the rock is disintegrated into its constituent fragments. This process results in individual mineral grains being liberated. In a number of ores, there is a difference both in size and density of the different constituents, and it is proposed to build on these differences to more easily separate the valuable mineral from the host in a location close to the mining machine.

A number of different benefits can be achieved through this separation technique. First, the amount of material that needs to be transported is expected to be reduced by 95%. Second, the material that will be transported to the surface will be a sized, segregated ore of high grade, requiring very little processing (crushing and grinding). Third, the waste rock left behind can be used to fill mine voids and provide support to the excavation; additionally, this material will not be disposed at a surface mine site, which provides an environmental, energy and economic gain to the process. Finally, the reduction of blast fumes underground will reduce the need for ventilation.

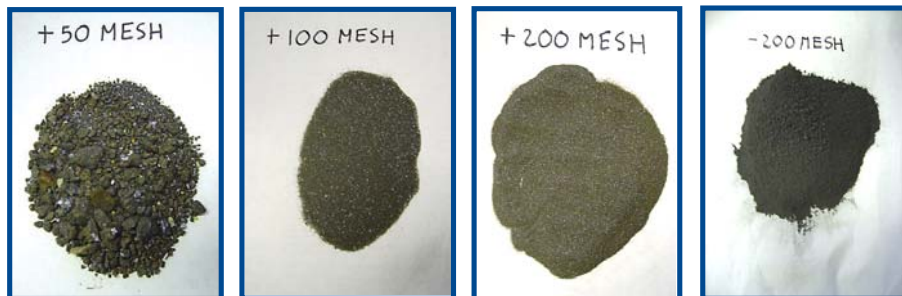


### Benefits for Our Industry and Our Nation

- Reduction in materials handling by 95% through the reduction in transportation of waste rock
- Reduced noise levels due to the elimination of blasting
- Reduction of downstream crushing and grinding
- Lower environmental impact through the increase in product recovery, which will reduce waste disposal at surface mine site

### Applications in Our Nation's Industry

High pressure waterjets have been extensively developed for the civil construction market. This project will focus on validating assumptions for mining of lead ore, however, it is expected that this technology can be applied to other commodities mined in underground mines.



Waterjet degradation of galena ore, product by size fraction: +50 mesh, +100 mesh, +200 mesh, -200 mesh

## Project Description

**Goal:** To demonstrate that the use of high-pressure waterjets to disintegrate mineral ores into discrete grains of the constituents can result in separation of valuable resource from gangue.

A series of tests in which samples of ore are disintegrated under a variety of jet operating conditions will be used to define optimal parameters for ore disintegration. The decision on these optimal conditions will be based on the degree of total liberation achieved by the different components of the ore and the volume of ore that can be mined in a given interval. The specific parameters to be addressed in the initial experiment will include jet pressure, nozzle diameter, and traverse speed of the nozzle over the rock surface.



**Sample of Galena Ore prior to the run**



**Sample after the run, showing the kerf cut by the jet**

In the future, the described technology is expected to be fully automated and remotely controlled. The anticipated adoption rate is 5 mines within a decade.

## Milestones

- Develop a test plan to determine most effective ore disintegration parameters
- Construct a suitable test apparatus
- Perform tests as planned
- Design waterjet mining machine
- Develop a commercialization plan

## Project Partners

CQ, Inc.  
Homer City, PA

EME Homer City Generation L.P.  
Homer City, PA

PBS Coals, Inc.  
Friedens, PA

Alliance Coal LLC  
Oakland, MD

## 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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