Industrial Technologies Program

Reducing Energy Consumption for Water Pumping at Quarries

Geophysical Techniques and a New Hybrid Grout can Greatly Decrease Energy Use at Quarries

Limestone is an abundant natural resource found throughout the United States. The mining of limestone and subsequent products is critical to a number of industries. The presence of large water-filled voids makes mining difficult and can have environmental impacts on surface topography, surface water and groundwater systems. Limestone is typically mined by open pit quarrying operations. Open pit quarrying of carbonates often results in the infiltration of large volumes of groundwater, which can rapidly fill the quarry pit. Quarry operators must pump this water from the active pit in order to continue mining operations. Although this water can often be recycled and used for road watering to reduce dust during crushing operations, pumping represents a significant cost and consumption of energy.

The draining of aquifers into the quarry pits generates ancillary problems, which also consumes energy and incurs additional costs. The draining of near-surface water-filled voids into the quarry pit generates sink holes. These sink holes can periodically impact highways, civil structures, buried utility lines, agricultural operations and surface streams.

Recently, by using novel geophysical and polyurethane grouting techniques, remediation efforts by the U.S. Department of Energy, along with the National Energy Technology Laboratory, have been successful in restoring flow in disrupted surface streams after mining-induced fractures have altered the flow. Geophysical techniques help identify contaminated surface and ground waters, as well as locate underground mines and cavities. The limestone quarry industry has not previously employed geophysical techniques to map groundwater pathways.

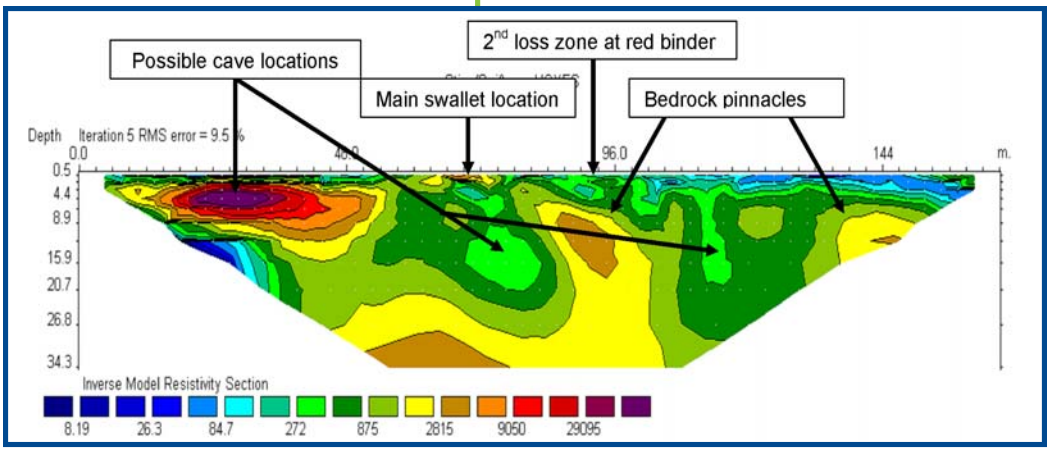
Using various geophysical techniques, this project will locate major groundwater pathways around the perimeter of mine pits. The National Energy Technology Laboratory will also create an economical hybrid grout material. This material will be comprised of low-cost coal combustion products, along with other materials such as expandable polyurethane grouts to fill, seal and stabilize these pathways.

Benefits for Our Industry and Our Nation

- *Reduces energy consumption for pumping water.*
- *Minimizes hydrologically-related hazards.*
- *Provides a beneficial use for coal combustion products.*

Applications in Our Nation's Industry

This project has the potential to greatly reduce energy consumption related to the mining operations at various quarries via new geophysical techniques. The economical grout hybrid will not only be able to save money at limestone quarries to fill cavities, but also have applications in the coal mining industry to seal streams at their bed.



Pseudosection developed by inverting data from resistivity survey. The data was collected along a traverse that intersected Hoyes Run at the known stream loss zone.

Project Description

Goal: To reduce energy consumption at quarries in the form of dewatering costs by applying geophysical techniques to locate groundwater pathways, and developing an economical hybrid grout material to stabilize the pathways.

The Karst areas will be delineated using geophysical techniques. Stream loss zones will be located and targeted to receive grout containing coal combustion products (CCP). As a result, the project will reduce energy costs for pumping, minimize environmental impact of streams, help prevent sinkhole collapse and provide a beneficial use for CCP.

Milestones

- Locate the major karstic features or groundwater pathways around the perimeter of the mine pit that allow groundwater flows to enter the pit, using various geophysical techniques.
- Create an economical hybrid grout material, using low-cost coal combustion products coupled with other grouts and/or waste materials, to fill, seal and stabilize identified cavities/voids, in a curtain-like manner.
- Conduct three case studies of the energy/cost expenditures for water pumping and addressing ancillary problems. Also conduct one case study on implementing the unique geophysical and grouting approaches at a limestone quarry.

Burkholder Paving Quarry - Ephrata, PA

Project Partners

National Energy Technology Laboratory
Pittsburgh, PA

Maryland Power Plant Research Program
Annapolis, MD

SubTechnical, Inc.
Mars, PA

Martin Limestone, Inc.
Blue Ball, PA

Keystone Lime Co., Inc.
Pelham, AL

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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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