



# Technology News

From the Bureau of Mines, United States Department of the Interior



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## Abandoned Mine Lands Program TN #4 Repairing Stream Channels To Reduce Water Loss into Underground Mines

### Objective

Control surface stream loss by identifying and selectively sealing water loss zones in stream channels overlying underground mines.

### Approach

Electromagnetic terrain conductivity surveys, coupled with stream gaging, are performed within a stream channel to identify saturated fracture zones associated with loss of stream water. This information is used to target locations for the injection of expandable polyurethane grout. The grout is injected two to three feet beneath the surface of the streambed, across each loss zone, to seal the fractured streambed and restore stream flow across the damaged area.

### How It Works

Multiple zones of infiltration (natural and induced) normally exist in stream channels overlying mined areas, causing water handling and/or acid drainage problems in the mines as well as loss of stream flow. It is typically difficult to accurately locate these loss points. Therefore, conventional methods of stream repair, such as using plastic membranes or clay and rock rip-rapping, are applied to long lengths of a stream channel. The two-step approach developed by the Bureau of Mines first quickly and accurately locates loss zones using electromagnetic

ground conductivity survey and gaging instruments. Conductivity is measured at fixed spacings (typically 25-50 ft depending on the instrument and desired observation depth). Ground conductivity increases when saturated conditions exist at depth. These apparent flow loss zones are confirmed by gaging, to eliminate possible effects due to unobservable metal debris adjacent to or buried in the stream sediment.

The second step consists of grouting designed to contain the stream water within the channel. An expandable polyurethane grout is injected so as to create a shallow and relatively impermeable barrier. Hollow steel rods approximately 3 ft in length and 3/4 in. in diameter, with hardened steel points, are manually driven into the stream sediments at 7-10 ft intervals using a sledge hammer. Where a stream flows over bedrock, a small drill hole serves to emplace the steelrod. The top of each rod has a hardened steel cap to allow mechanical injection of the grout (Figure 1). Several 1/8 in diameter holes are drilled in the side of the rod, near the bottom, providing ports for lateral grout injection. Five gallons of a two-component grout (2.5 gallon of each component) are injected into each grout hole using injection pressures of 400 to 1200 lb/in<sup>2</sup>. Grout is injected at the maximum pressure obtainable until a surface leak developed, whereupon the injection pressure is reduced to 50 lb/in<sup>2</sup> until the leak is sealed by grout curing. The pressure is then slowly increased until another leak occurs or until 5 gallons of grout has been injected. Grouting is repeated, as necessary, until stream flow across the area is restored.

## Results

Field tests were conducted in northwestern Maryland in a section of Staub Run, where it flows over an abandoned underground mine, and in Guyses Run in northern West Virginia, which overlies an active longwall operation. At both sites, terrain conductivity proved to be a simple, inexpensive and accurate way to pinpoint loss zones. At Guyses Run, a conductivity survey conducted before subsidence indicated a fracture zone that was providing ground water to the stream; after subsidence, this zone became the principal area of water loss. This indicates that terrain conductivity may prove to be useful for predicting stream loss zones as well as locating them after subsidence occurs.

Test results from the two sites revealed that grouting resulted in a 95-100% recovery of stream flow, at a cost of \$2.50-\$3.00 per sq ft of stream, approximately half that of clay and riprapping. Accurate pinpointing of loss zones resulted in much greater actual savings. The new stream sealing technique also proved to have other advantages: it was quick and easy, caused very little disturbance to the natural stream, did not require construction of access roads, and should prove to be more permanent, since the grout materials are protected from flood or drought damage by the stream bottom.

Based on the results at Staub Run, the state of Maryland has incorporated the Bureau's technique as part of its abandoned mined land reclamation efforts. Southern Ohio Coal Company's Martinka mine, which cooperated with the Bureau on the Guyses Run test, received an award for outstanding reclamation from the Office of Surface Mining, Reclamation and Enforcement (OSM). The company used this novel stream sealing approach as part of its award-winning reclamation effort.

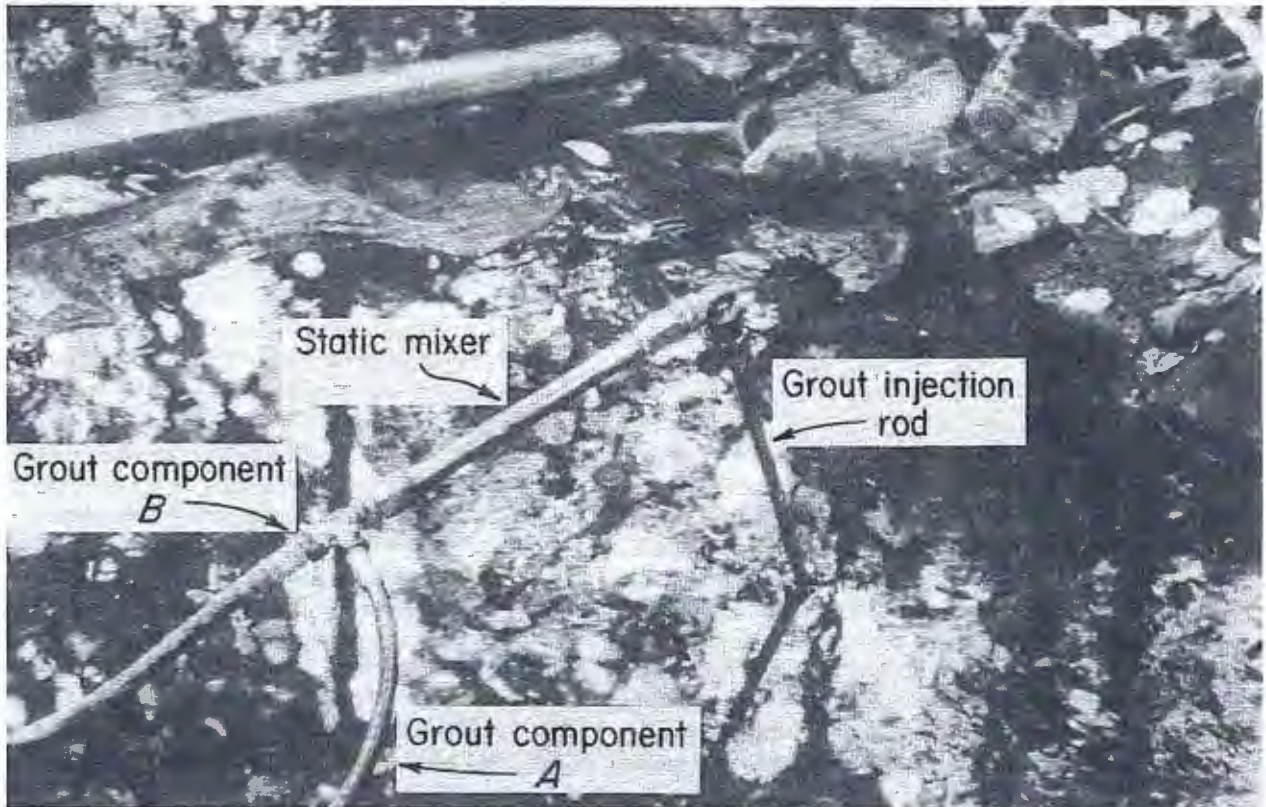
## Patent Status

The U. S. Department of the Interior is not applying for a patent on this technology.

## For More Information

Additional information can be obtained by contacting

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Components of stream sealing technique as it is being used to seal off a fracture zone in a streambed.