

by incorporating it in the microbial cell or the slime mass around the cell. They will also screen likely sulfate-reducing bacteria that will produce hydrogen sulfide to react with iron in the mine water and precipitate iron sulfide. Consolidation Coal Co., a Conoco subsidiary, will field-test the bacterial process at mine drainage lagoons in West Virginia.

Instead of using bacteria for mine water reactions, MSA Research Corp. has investigated the possibility of attacking bacteria that may contribute to the formation of acid in the first place. *Bacteriophages*—bacteria-specific viruses that dissolve growing bacteria—appear to inhibit bacterial oxidation of pyrite but incompletely. Continuing MSA research aims at developing greater virulence in phages.

Demineralization processes—familiar from work on converting saline to potable water—have been experimentally evaluated for mine water treatment. Westinghouse Electric Corp. has looked at flash distillation, and General Dynamics Corp. has evaluated a reverse osmosis process. In both cases, brackish (intermediate between salt and fresh) water was tested.

SLUDGE DISPOSAL . . . AFT END OF THE PROBLEM

There is still a tough problem down the road after mine drainage treatment of any kind—handling and disposing of the estimated 100 million tons of sludges that could be produced annually in mine drainage neutralization. The disposal problem so far is an operating debit at best, and sometimes a physical burden. No disposal method for the brines produced by demineralization processes is at hand. Handling the sludge from already common lime neutralization processes is a major operation, comparable to handling sanitary sewage and industrial waste effluents. The precipitated material may retain up to 98 percent water. Where settling basins or lagoons are used for dewatering, subsurface drains must be provided and the basins taken out of service periodically for removal of concentrated sludge by dredging, draglining, or bulldozing—or pumping. The solids may be buried without danger of redissolving into underground water, but often suitable landfill area is not readily available.

A process that could reclaim useful products from mine drainage sludge would go far toward easing the economic burden. BCR is investigating the byproduct possibilities, including a substitute material for the limestone used to rockdust underground coal mines.

The review and evaluation of mine drainage research that is being conducted through the joint CIAC-BCR program has revealed many critical subject areas in which more knowledge is needed. We need to know more about the formation of mine water if we are to prevent acid drainage pollution with any consistent measure of effectiveness. We need to know more about the character of mine water if we are to establish parameters for design of treatment processes. We need to know more about the conditions under which mine sealing will be effective. And we need to know how we are to dispose of, or possibly put to beneficial use, the millions of tons of sludge generated by acid water neutralization processes.