

Water invades almost every mine in the form of rain or snow, surface run-off or underground percolation. Sooner or later it passes through the mine or over or through mined material, becomes mine-drainage, and eventually mingles with other outside waters. Its quality at any time is the net result of the materials dissolved in it and the reaction of each upon the others. When the water comes in contact with acid material in the mine, it leaches the acid from them. If the acid thus picked up is greater than the ability of the water to neutralize it, the water will be acid in character. In this manner, water becomes acid mine-drainage. Thus, *as water passes through the mine, or over or through mined materials, and comes in contact with acids, it dissolves them and becomes their transport agent.*

Generally speaking, the longer water remains in contact with acid materials, the more acid it will pick up and transport.

"ACID-PRODUCING" IN RELATION TO "ACID-NEUTRALIZING" MATERIALS

Not all materials exposed during the mining process are acid-producing. Some have acid-neutralizing properties. *Both acid-producing and acid-neutralizing materials occur in all coal measures*, although the amount and character of each may vary considerably from mine to mine.

All coal measures contain sulfur. It may be organic, sulfate or sulfide sulfur. Only the sulfide sulfur, occurring as the mineral "pyrite," forms acid if exposed to oxidation. Thus, *all coal mines have acid-producing potentials, even though all coal mines do not produce acid mine-drainage.*

Acid-neutralizing materials, or alkalis, occur in almost all earth strata, even those containing acid-producing materials. These alkalis are also present in all coal measures in varying amounts and are exposed by the mining process. So it can be concluded that all coal mines have acid-neutralizing potentials.

Acid and alkali waters react with and neutralize each other. In the case of mine-drainage, the result of this action depends upon the amount of each present. The character of the drainage from any given mine, therefore, depends upon the amounts of acid and alkali that dissolve in the water as it passes through the mine. Even in so-called acid mines, *the exercise of control to decrease the production of acid and increase neutralization by alkali, will have a beneficial effect upon the character of the mine-drainage.*

In no case should the principle of neutralization of acid water be substituted for acid prevention principles.

MEASUREMENTS AND NEUTRALIZATION OF MINE ACIDS

When we see the word "acid," we generally think of a concentrate which will destroy cells and tissue, and we think of an extremely caustic substance when we see the word "alkali." We often forget that fruits, vinegar and carbonated beverages are acids, and that baking soda, limestone and household ammonia are alkalis.

Most matter is either acid or alkaline. Some acid or some alkali does not necessarily mean an unnatural or undesirable condition. Therefore, *control of acid mine-drainage need not require the attainment of completely neutral conditions in all cases.*

Acids and alkalis are opposites which are defined in terms of their ability to act with and neutralize each other. When they are dissolved in water, the water is either acid, alkaline, or neutral. This character, or condition, of water can be indicated by a measurement known as "pH," a term devised by the chemist to indicate the concentration of hydrogen ions in solution in water. When the concentrations of hydrogen and hydroxyl ions are equal, the water is neutral, or pH 7. The greater the hydrogen ion concentration, or the more indication of acid, the lower the pH below 7. The greater the hydroxyl ion concentration, or the more indication of alkaline character, the higher the pH above 7. *The pH measurement is used to indicate the acid or alkaline character of water, and warn of possible extremes.*

In efforts to control the acidity of acid mine-drainage, the amount of neutralization needed to change the acid character cannot be measured by pH, since it is only an indication of the degree of acid or alkaline condition. The terms "acidity" or "alkalinity" are used to define quantity, and, in general, an equal quantity of the opposite character would be necessary to attain a neutral condition. *The determination of the amount of neutralization necessary to control the acid character of a given mine-drainage is a laboratory procedure.*

Dilution may offer a means of ameliorating the pollutional effects of acid mine-drainage. If the added water is alkaline, some degree of neutralization can be expected. Dilution alone will not change the total amount of acid, but it will reduce the concentration, which can result in ameliorating its pollutional effects. The principle of utilizing the assimilative capacity of the stream is involved in the recommendation that acid mine-water be released to streams during periods of high flow. *Dilution to ameliorate the pollutional effects of acid mine-drainage should be practiced whenever feasible.*