

Surface Mine Revegetation and acid Mine Drainage

by

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Introduction

Revegetation of surface mines in West Virginia is no longer much problem. It has been said by many people in the state that "we can at most any surface mine green." Indeed, this is probably true be - revegetation technology has rapidly advanced during the past 10 years.

The biggest reclamation problem in the state is the control of acid mine drainage (AMD). Technology in this area has not advanced as rapidly as revegetation because the problems are more complex.

Therefore, it is time for an integrated thorough study of the (AMD) problem. Thus, the Acid Mine Drainage Technical Advisory Committee (AMDTAC) was formed. This committee will study AMD in West Virginia and evaluate some innovative, unique approaches to controlling or eliminating it. Everyone is concerned about the problem, and many people (coal mine operators, consultants, regulatory personnel, university and government scientists, and environmental groups) are cooperating in an effort to achieve a common goal.

With this increased concern for and emphasis on AMD we must not overlook or forget the importance of the other facets of reclamation, particularly revegetation. My position and function on the committee is to make certain that new techniques of controlling AMD will not adversely affect vegetation establishment and growth arid soil development on mined lands.

Much of the adverse impact that surface coal mining has had and which orphan land continues to have upon water resources is related to failure to properly revegetate the mined area. Many factors need to be considered to ensure proper revegetation: site characteristics, including climate and slope length, gradient and aspect; soil properties within the plant rooting zone; amendments to be applied; plant species to be planted; seedbed preparation and planting technique. Revegetation is an integral part of controlling pollution of water resources by acid and/or sediment, and all of these factors must be considered for success.

Effects of Vegetation on Soil Properties

If a coal mine operator were approached and asked what he considered to be the greatest effect of revegetating mined lands, he might say that a vegetative cover that meets the

requirements of the regulatory authority will help get part of his reclamation bond released. Bond release is certainly important to those people whose livelihood depends upon coal production. However, vegetation is very important to accelerating soil development and decreasing stream pollution.

Most of the beneficial effects of vegetation are related to organic matter additions to the soil. Organic matter improves soil structure, aeration and water relations. Soils with adequate amounts of organic matter will hold more plant available water than soils with low amounts of organic matter. Organic matter will increase the cation exchange capacity of the surface soil which means that the soil will hold more nutrients in the root zone of the plants. In addition to increased nutrient supply, the soil will tend to "chelate" or hold aluminum and other metal ions so that they are less detrimental to plants.

As soil structure and aeration improve, bulk density decreases benefiting root proliferation. Infiltration of water will increase and erosion will decrease. Decreased erosion is brought about by several factors. First, the vegetation protects the soil from the dispersing effects of raindrop impact. Second, vegetation slows the movement of water over the surface. Third, infiltration of water is increased so run off is decreased. Fourth, the roots mechanically hold the soil in place, and fifth, the organic matter stabilizes soil aggregates so that they are less erosive.

Another effect of vegetation and organic matter upon soils is an increased carbon dioxide (CO_2) content. Carbon dioxide is produced by respiration of plants and by decomposition of organic matter in the presence of air. Therefore, the CO_2 content of soil is higher than the atmosphere, generally 10 to 25 times as great. Any increase of CO_2 in water causes limestone (CaCO_3) to be more soluble, so it will neutralize more acid.

Addition of organic matter to minesoils to increase the CO_2 content of percolating water has been considered. However, more research will be needed before actual effects of increased organic matter are understood.

Relationships of Vegetation to AMD

Inadequate vegetation establishment could add to the problems of AMD. Likewise, some of the techniques used to control AMD could adversely affect vegetation establishment. Therefore, plans for total reclamation must be integrated so that one aspect is not slighted to benefit another.

Current technology calls for compaction of materials to hydrologically isolate the acid-producing materials. When this procedure is used, the operator must be very careful so that the soil material within the plant root zone is not compacted to the point when it severely restricts root growth. Compacted soils will decrease seed germination and seedling growth, increasing the potential for erosion. Other factors that adversely affect vegetation establishment, and thus increase the chances for erosion, are improper fertility levels, poor seedbed preparation, inadequate mulching and poor timing of seeding.

Anything that decreases the amount of vegetation on a site will increase the erosion hazard. Erosion not only removes soil particles, fertilizer and seed from the site, but it could increase

the acid potential of a mine. If gullies are allowed to form, it is possible that the soil will erode deeply enough for some of the acid producing materials to be exposed. Once these materials are exposed it may be impossible to stop the accelerated acid production.

Rooting depth of plants is a very important factor that must be considered when planning for, reclamation of potentially acid producing sites. This concern should be considered from two aspects. First, if deep rooted plants, such as some of the forage legumes, are to be used the highly compacted zone should not be close enough to the surface to affect the growth of these plants. Some roots of black locust, alfalfa and other species have been known to grow to depths of 8 to 10 feet or more. Second, if roots eventually grow through some of the compacted materials, channels for water movement into and out of the acid producing materials could be developed.

Drastic measures such as covering a mine site with a plastic (PVC) sheet could have the same affect on root growth as a compacted soil zone. The effects of both compacted soil and other sealants on plant growth need more study.

Chemical properties of the "topsoil" or soil material that is placed within the rooting zone of plants affect both the plant growth and the quality of the percolating water. Therefore, it is imperative that the best material from the site be placed at the surface. At some mines, the original soil will be the best material. At other sites better material may be located within the overburden. Laboratory analyses such as acid-base accounting and nutrient determinations should be used on all potential "topsoiling" materials.

Proposed Studies

Based upon the previous information, there are several studies within the AMDTAC program for which I will be the primary investigator.

1. Evaluation of the effects of mining on topsoil properties.

Before proper evaluation of any new techniques can be made, we must know how current mining practices are affecting soil properties. This study will be conducted on a small (20 acres) site that has been completely isolated from the rest of a large mine, therefore making evaluation of any treatment very easy. This study may be expanded to include other sites if time and money are available.

2. Evaluation of alternative "topsoil" materials.

Sites where some of the overburden materials show a potential for being good "topsoil" materials will be chosen. Vegetation establishment on original soil used as "topsoil" will be compared to establishment on some of the overburden materials.

3. Effects of surface or near surface sealants on soil properties and plant growth.

Some of the soil sealants, such as the plastic (PVC) sheet, show promise for reducing infiltration of water into a backfill thus reducing seepage and AMD. However, the affects on water movement and other properties of the soil covering the sheet have not been well

documented. A site where the PVC covering has been used will be monitored. Other sites will be evaluated if sealants are used.

These three studies will be initiated and conducted within the next three years. I expect that these studies and the studies of the other scientists will indicate other research that should be initiated during the original three-year project or in the future.