



## **Minnesota's Water and Mine Tailings Program**

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### **Introduction**

Surface mining in Minnesota has been a growing industry in this century. The increasing demand for minerals has created the need for current and new mining operations. The advancement of technology has made surface mining more efficient. These operations benefit Minnesota's economy by providing employment possibilities and increasing communities economic opportunities.

Due to the growing emphasis on Minnesota's natural environment, restrictions and standards have been set by state and federal agencies in order to minimize the impacts mining can have on the people, land, plants, and animals while sustaining economic opportunities. The major impact of surface mining are mine tailings. Mine tailings are any mineral refuse created from a milling operation (Balkema, 1997). These tailings are the composite make-up of all materials left behind due to uneconomical properties. Mine tailings are usually found in long strips along the surface that was stripped. The mine tailings not only create anaesthetic disturbance but contribute to other problems to the environment.

A major problem mine tailings create is due to the lack of anchoring vegetation. Since root systems are not present to hold the soil together a greater potential for soil erosion and surface runoff exists. Runoff from mine tailings can be very acidic causing ground and surface water contamination. The ramifications for mine tailings are not restricted to the runoff stream. In dry seasons with heavy winds dust from the tailings can be significant enough to decrease air quality.

### **Surface Mining Control and Reclamation Act of 1977**

The Surface Mining and Control Act of 1977 (SMCRA of 1977) is a federal law that requires industries to prepare a environmental risk plan prior to mining. The plan includes in depth analysis of potential environmental impacts that could result from the mining details explaining how mine tailings are going to be reclaimed after the operation is complete.

Once the plan is complete, the mining company submits this to the regulatory agency of that particular state. The regulatory agency examines the plan to ensure compliance with all state and federal regulations that fall under the Surface Mining Control and Reclamation Act of 1977. The act requires the operation to achieve a successful reclamation, which is 90 % vegetation cover on the mine tailings within three to five years after mining is complete. If the proposal is accepted, the mining operation is granted a lease from the state regulatory agency if determined portion of land is owned by the state. Private land owned by a mining company or other does not require the issuing of a lease. However, an accepted proposal of environmental risk and reclamation is still required before mining begins. If the mining operation does not successfully reclaim the

mine tailings within this time interval, fines are assessed per acre of unreclaimed land and paid to the state regulatory agency until reclamation is successful (Committee on Disposal of Excess Soil, 1981).

### **State of Minnesota Water and Mine Tailings Program**

The regulatory agency for mining operations in Minnesota falls under the jurisdiction of the Division of Minerals within the Minnesota Department of Natural Resources. The water and mine tailings program was formed in 1980 in order to research new reclamation practices and enforce the federal guidelines outlined in the SMCRA of 1977 (Eger, pers. comm. 1998).

The program's budget is allocated annually by the Minnesota legislature. The Mineral Division submits a request for funding based on that year's expectations of research opportunities and number of proposed leases (Eger, pers. comm. 1998). The Mineral Division receives a variable amounts of Federal grants each year. Another source of funding is generated by the Environmental Cooperative Research Program. This program is run by a collaboration of states working together to formulate new reclamation practices (Eger, pers. comm. 1998).

The mine tailings program works with the mining operations to formulate reclamation practices that will adhere to SMCRA of 1977 standards. If the proposed land to be mined is greater than 160 acres, an EIS is required before the lease is granted. This allows the program to evaluate the operation and ensure the environment will be able to sustain the disturbance and is able to be regenerated back to a natural state. If the proposed area is less than 160 acres, an EIS is not required. However, the mining operation is still required by federal law to reclaim the land meeting standards set by the SMCRA of 1977 under the supervision of the Water and Mine Tailings program (Eger, pers. comm. 1998).

Currently, the mining operations in Minnesota are found in the northern half of the state where taconite, iron ore, peat, and non-ferrous metallic minerals are found. There are approximately 30,000 acres of tailings found in Minnesota, and 8,900 acres have been successfully reclaimed under the supervision of the Water and Mine Tailings Program (LaPakko, pers. comm. 1998).

### **Reclamation Techniques**

Site evaluation is an integral part of the reclamation process. The chemical and physical characteristics of the rock strata above the mineral will help determine the cost and method of reclamation. This includes the soil's pH and the soils physical properties, such as coarse or fine tailings (Camin, 1975).

The variability in chemical and physical properties of mine tailings make each plan and proposal site-specific. However, it has been proven that extensive analysis and execution can result in a reclaimed area that is more productive than was present prior to stripping (Camin, 1975). Due to the increase of permit costs and assumed mining costs related to reclamation policies, some believe reclamation practices having lower costs will be used and increased land productivity potential will be lost. (Camin, 1975).

The following procedures outline existing steps utilized by the program for revegetating mine tailings (American Society for Surface Mining and Reclamation, 1983). Establishment of initial plant communities using available species that are tolerant of drought, low pH, poor soil texture, lack of organic materials and nutrients, and other characteristics of metal extracted tailings begin the reclamation process. The modification of the local plant micro climate is executed to benefit plant establishment.

Once vegetative cover is established, soil invertebrate and microbial communities are needed to decompose naturally occurring organic matter and to assist in the building of soil. Establishment of essential nutrient cycles is required for a lasting productive system.

As the tailings reclamation progresses, a vegetative habitat suitable for wildlife colonization should result if all proceeding steps are successful. Finally, the manipulation of species competition will allow for the establishment of climax communities for the area.

### **Monitoring Program**

The Water and Mine Tailings Program has a three, five, and ten year monitoring requirement that begins after mining is complete. Within three years, the tailings need to exhibit a 90% vegetation cover. The five-year evaluation determines whether there is sufficient progress towards the ten year requirements. After ten years, the tailings are required to exhibit vegetation with natural succession and the ability to sustain wildlife. If these expectations are met, the mining company has filled their obligations and are relieved of all responsibilities (Eger, pers. comm. 1998). If tailings do not meet the Division of Minerals standards, the mining company is assessed fines per acre of unacceptable tailings until requirements are met.

### **Current Research**

Many practices and techniques have been successfully used, but the need for continuing research is still present today. Currently, the Water and Mine Tailings Program is researching different types of organic matter that could be used as mulch for the restoration sites. The research is based on the use of other waste products generated from other industries in Minnesota. The idea is simple: if waste products could be used for mulch, then it would help eliminate the need for their disposal (Eger, 1998).

The waste products under current research include: paper mill waste, dredged materials, and sewer sludge. The major set back for these materials originates from their physical and chemical properties. The Pollution Control Agency has strict guidelines that need to be adhered to before these waste products can be used (Eger, 1998).

Paper mill waste has undergone extensive research because of its abundance in the many mills found in Minnesota. If the paper mill waste was proven to be a viable organic matter for restoration, it could be used instead of disregarded at a dump site. If there is enough demand for this product, a market may be formed, thus increasing the economic well being of Minnesota and increasing job opportunities. A major set back for paper mill waste is the very high

carbon:nitrogen ratio, approximately 200-500:1. In order for this waste to achieve a productive state, many other amendments would need to be added, thus increasing the cost (Eger, 1998).

Dredged material is under extensive research due to the vast amounts of material produced by the Army Corps of Engineers. The Corps dredges Lake Superior in order to allow large barges to transport goods. If the dredged material is able to be used as organic matter, this would help relieve some of the disposal costs associated with the material (Eger, 1998).

Sewer sludge is another waste product under investigation. This material is abundant, and increasing more and more as the population increases. This material could be used with little to no cost to the operation reclaiming the land (Eger, 1998).

## **Critique**

The Division of Minerals is very active in public awareness and education. They provide technical assistance and information about Minnesota minerals to communities where mining exploration occurs ( <http://www.dnr.state.mn.us>). The interaction with the public keeps stakeholders informed on justifications for mining and new techniques being formed. Public awareness helps maintain a good partnership between the citizens and the states regulatory agency.

As stated earlier, the Water and Mine Tailings Program is not only a regulatory agency, but spends considerable amounts of time and money conducting research for new techniques. It seems the majority of research conducted is for the use of other waste products that have little cost to the operation reclaiming the tailings. There has been previous discussion (Camin, 1975) stating with enough analysis and effort, the manipulation of vegetative cover and establishment of productive soil could reclaim the tailings providing a more productive system than was present prior to mining. However, the current research is primarily focused on decreasing costs for the mining companies instead of researching for the benefit of the natural environment and its productivity.

On the reverse side of this argument, the research being conducted will undoubtedly reduce the cost of restoration for the operations. The reduction in costs may be enough encouragement for the operations to reclaim the land in a more efficient manner.

The research being conducted should benefit the stakeholders in general, but they need to find a comfortable median between the economic well being of the state as well as the environmental productivity potential of these tailings.

The ten year monitoring program executed by the Division of Minerals is a indicator of the program's effectiveness. Within the eighteen years of existence, the program has never fined a mining company reclaiming tailings (Knoll, pers. comm. 1998). This fact shows the willingness of the program to work with and aid the mining companies reclamation efforts ensuring the tailings are being reclaimed in a manner that meets Minnesota's reclamation laws.

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Minnesota Department of Natural Resources Home Page.  
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