PLANNING AND CONSTRUCTION OF A WASTE ROCK DUMP THROUGH WASTE SORTING TO PREVENT A POTENTIAL ACID ROCK DRAINAGE PROBLEM

by

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Abstract. In order to achieve successful final reclamation, planning must take place before and during the mine life. The large volumes of waste rock created by a surface mine could create a future environmental problem if the storage of this material is not carefully planned.

In order to expose the ore, waste material containing a varying amount of sulfide mineralization must be removed. When waste rock with a high sulfur content is left exposed to the air, it has a potential for creating acid mine drainage. To help prevent a future environmental problem, it was determined that the high sulfide waste would be placed in the core of the waste dump and be totally encapsulated with low sulfide non-acid generating waste. This would help limit oxidation and the infiltration of water to the potentially acid-producing waste. All slope reduction work would then be done in the non-acid generating waste. To accomplish this, the waste from the pit had to be sorted.

Montana Tunnels Mining found a practical correlation between lead and zinc grade and the acid-producing potential.

The waste material is then categorized using lead and zinc assays and placed in the waste dump accordingly.

Introduction

The Montana Tunnels Mine is operated by Montana Tunnels Mining, Inc., a subsidiary of Pegasus Gold Corporation. The mine, located 25 miles south of Helena, Montana, is a large surface gold, silver, lead and zinc mine.

The Montana Tunnels ore body lies in an extinct volcano which was active 50 million years ago. The mineralization is hosted in a diatreme breccia and consists of small veins and disseminated grains of pyrite, galena and sphalerite along with silver minerals and gold. The mine produces 12,000 tons of ore per day and moves 48,000 tons of waste daily.

Mining is done by conventional open pit mining. Large haulage trucks haul ore to the mill where it is ground to a fine sand in autogenous and ball mills. It is then passed on to the flotation cells where chemicals are added. The metals float to the surface and are then filtered and shipped to a smelter for further refining.

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Waste Sorting And Dump Design

In order to expose the ore, waste material must be removed. This waste material contains varying amounts of sulfide mineralization. When waste rock with a high sulfur content is left exposed to the air, it has a potential for creating acid rock drainage.

Montana Tunnels Mining began the waste dump construction using unsorted waste material. Low-grade ore was also stockpiled during these initial years of mining. It was noticed that intermittent surface runoff of this 1.7-million-ton, low-grade stockpile had a decrease in pH from 6.5 to 4.9. Concerned with a possible acid-rock drainage problem, Montana Tunnels Mining began testwork to assess the acid production potential of the waste rock.

This testwork began with 12 static acid-base accounting tests of various waste material samples. In this test, the acid-generating potential of the sulfide minerals is subtracted from neutralizing potential of the waste rock to yield the net neutralizing potential of the waste material (acid-base account). A negative acid-base account number theoretically indicates that the waste material has more acid-producing than neutralizing characteristics and could ultimately produce acid. The results of this preliminary study indicated that the acid-base account of the waste material varied widely from a negative 37 to a positive 84.

To further evaluate the acid-producing potential of the waste material, Montana Tunnels Mining began a sampling program in which composits of each blast pattern were taken. In some areas, individual blast hole samples were collected as well. These samples were analyzed for total sulfur, neutralization potential, acidification potential, lead and zinc. In addition, some samples were analyzed for iron, paste pH and peroxide accelerated pH. Over 350 samples were taken. The results were then collected in a data base for further evaluation.

To help prevent acid rock drainage, it was determined that the high sulfide waste would be placed in the waste dump core and be totally encapsulated with low-sulfur, non-acid generating waste. Oxidation and infiltration of water to the potentially acid producing waste would be limited, thus reducing the potential for acid production. All slope reduction and reclamation work would be done in the non-acid generating waste. To accomplish this, the waste from the pit had to be sorted. The waste is classified into four different categories:

1. Non-acid producing waste material;
2. Potentially acid-producing waste which is encapsulated in non-acid producing waste material;
3. Cap rock material for capping the tailings impoundment and select sulfide dump areas;
4. Armor or rip rap material to be used for the face of the tailing dam and erosion control in diversion ditches.

An easy method of determining the acid-producing potential of the waste had to be found. The majority of the waste from the mine occurs as white diatreme, and the sulfide content cannot readily be determined by eye. Determining the acid-producing potential of the waste rock using the acid-base accounting test requires a lengthy lab test which would slow mine production. The acid-base account was compared with the other data to determine if any correlation existed. All data correlated in some degree. The total sulfur was the best indicator and the pH values more scattered. Montana Tunnels also came up with a fair correlation between lead and zinc grade and the acid-base account. This worked out well since lead and zinc assays are obtained on every blast hole for ore control. As can be seen on the graph in **Figure 1**, as the lead grade of the waste material increases, so does the acid-producing potential. As the lead grade decreases, the acid-producing potential decreases. The correlation between the zinc grade and the acid-producing potential is similar. A cutoff

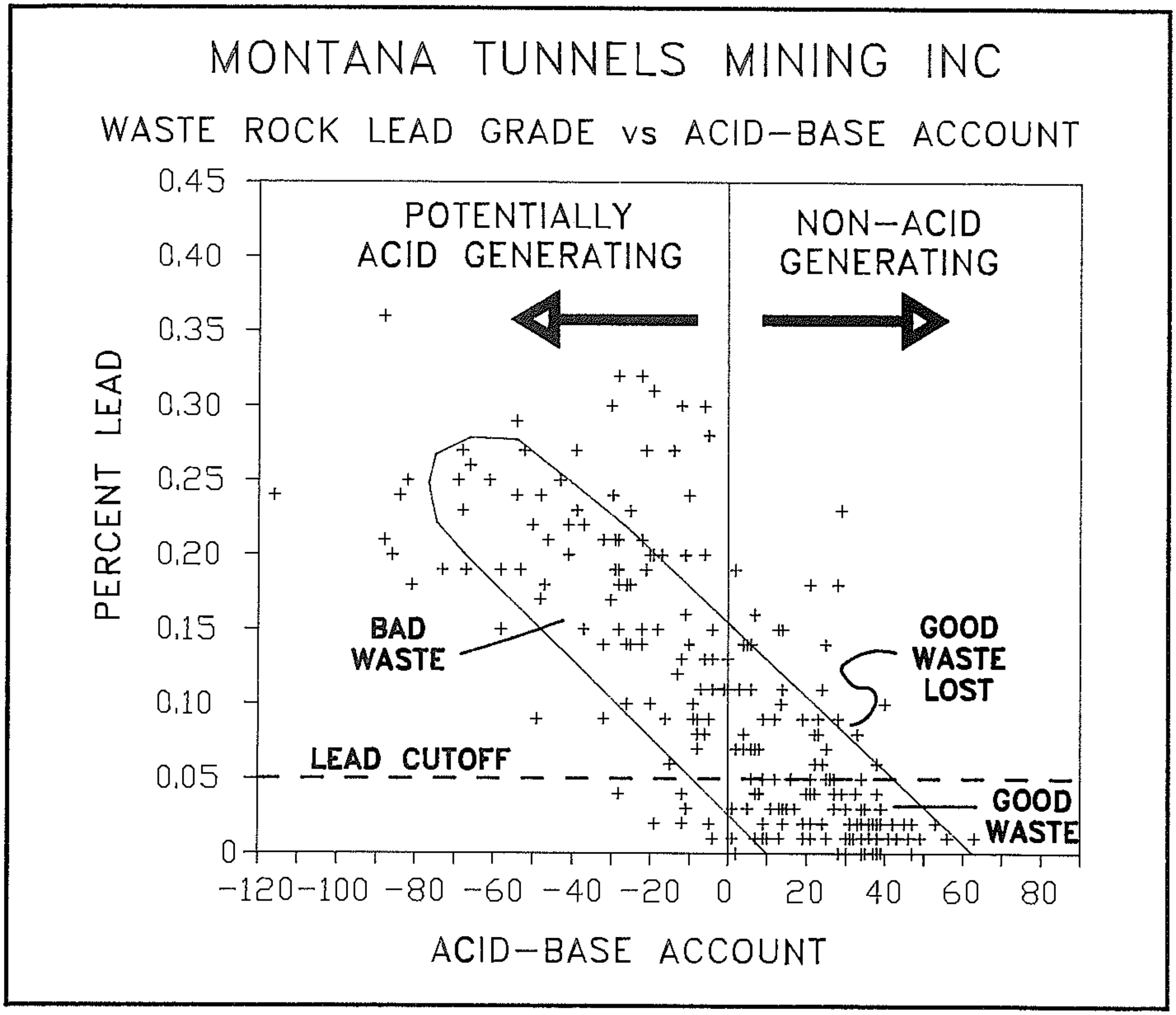

FIGURE 1.

grade of 0.05% lead and 0.1% zinc is used. The waste material must be less than these cutoffs to be considered "good waste." A portion of the waste material falls above the cutoff line but yet is non-acid generating. This waste is handled as potentially acid generating. This helps add a margin of safety to the waste category determinations.

<u>Implementation of Waste Sorting</u>

Waste sorting is integrated with mine production. The rock within the pit is drilled in preparation for blasting. Samples then are taken from cuttings of each blasthole and analyzed for gold, silver, lead and zinc. This assay data is entered in the ore control computer, and the ore control geologist identifies ore areas. While the assay data is still in the computer, the waste material is categorized using the waste criteria cutoffs. A map is plotted showing ore and various waste types. After the rock has been blasted, the ore and waste boundaries are surveyed on the muck pile. This helps guide the material removal. The waste material is then hauled to the designated location in the waste dump.

The dump is built in 50-foot lifts with a diversion ditch and service road every 100

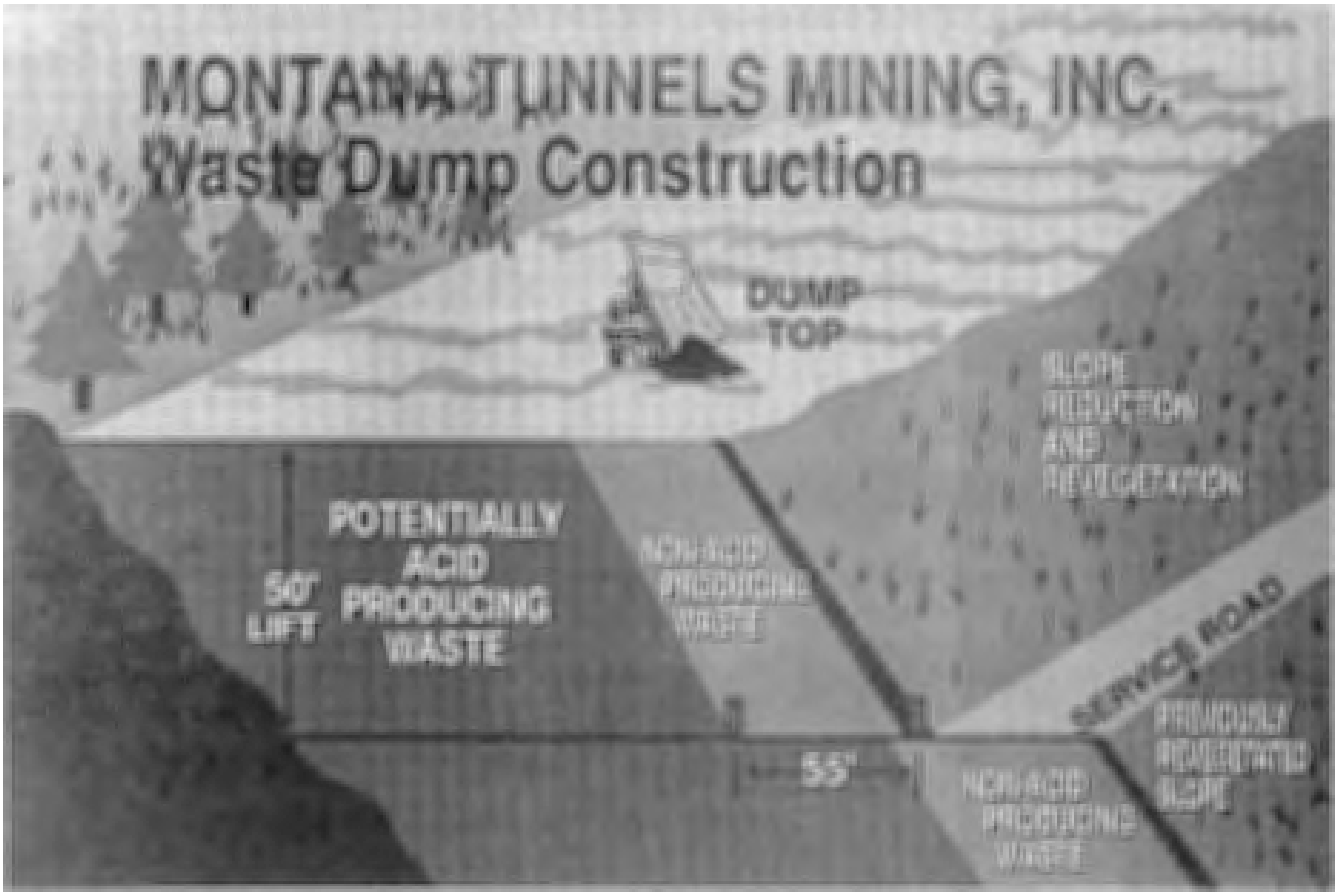

Figure 2

feet in elevation. **Figure 2** shows a cross-section of the waste dump construction. Prior to a new lift construction, the ultimate toes of the potentially acid-producing and non-acid producing waste are marked with survey stakes. The dump is then filled out with the proper waste material to the designated toe stakes. After an area of the dump is filled out, the area is resloped to a 2: to 2.5:1 slope and revegetated. Diversion channels are constructed around the dump to prevent surface waters from infiltrating into the dump. These channels are lined with geotextile fabric and riprapped. Monitoring will be done as construction of the waste dump and concurrent reclamation continue. As areas of the dump are completed, monitor holes will be drilled. Moisture, temperature, and oxygen data will be collected. Vegetation success will also be noted as well as soil chemistry.

Sulfide Dump Reclamation Tests Plots

It is anticipated that due to the distribution of waste in the ore body and our mining schedules, a portion of the potentially acid-generating waste material will not be covered during mining. These areas will have to be capped with non-acid generating waste material from stockpiles to help prevent the higher sulfide waste from producing acid, hindering reclamation. The required thickness of this non-acid generating cap is unknown at this time. In order to plan for the most economical and efficient capping method, Montana Tunnels Mining has constructed a sulfide dump reclamation test plot. The four scenarios shown in **Figure 3** will be tested in the test plot.

The following data will be gathered to determine the effectiveness of the various capping scenarios:

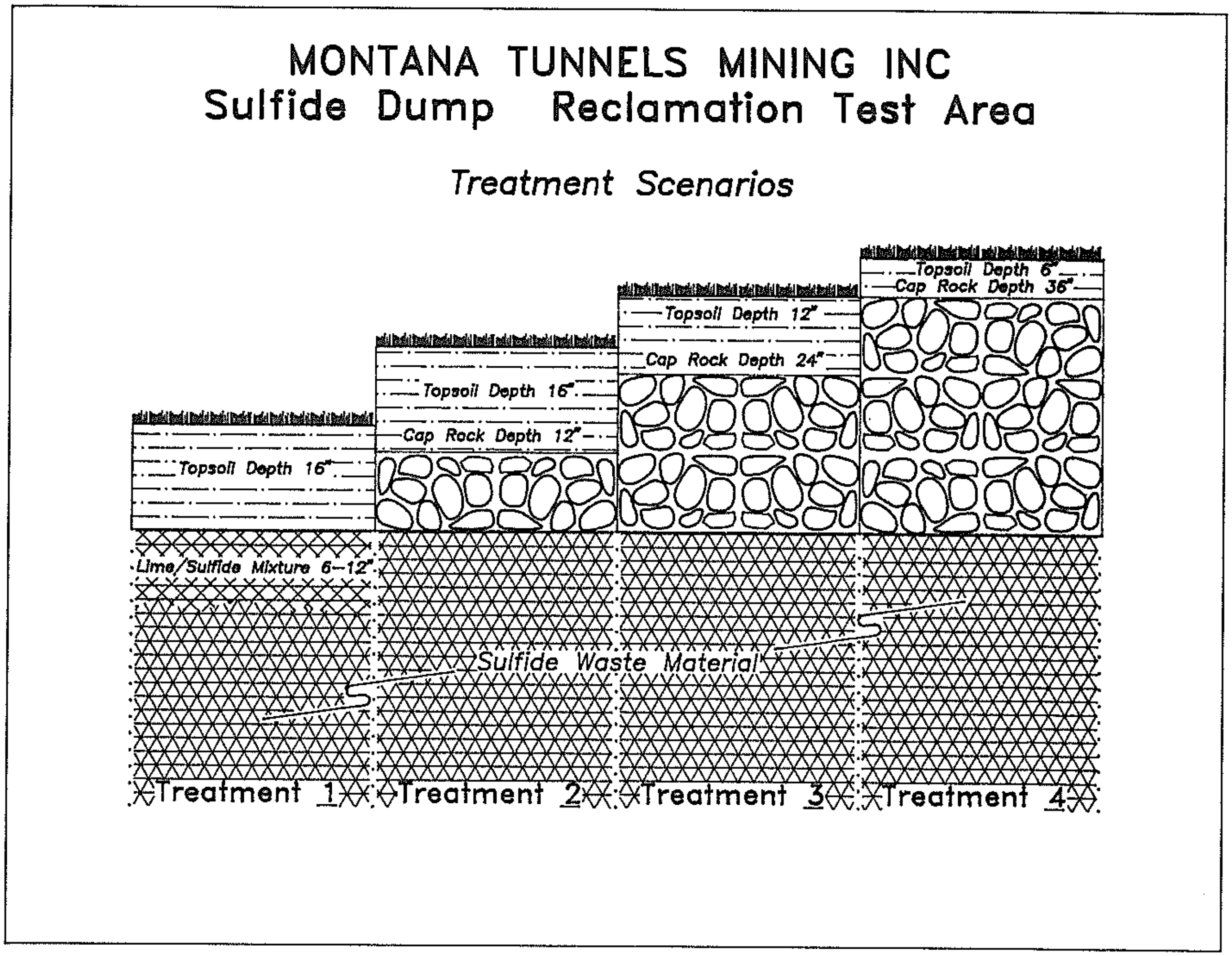

Figure 3

<u>Oxygen Measurements</u>: Oxygen sampling ports at selected depths monitor the ability of the test caps to reduce oxygen infiltration.

<u>Temperature</u>: Temperature probes will detect the heat produced by the oxidation of the sulfide waste material.

<u>Moisture Movement</u>: a neutron probe will be used to track the movement of moisture at various depths in the test plots. Barrel lysimeters buried within each of the test plots will help determine the infiltration rate of water through the different caps. The moisture data collected will be used to calibrate a H.E.L.P. computer model of the various cap scenarios. This computer model will use a computer-generated weather pattern to help determine the effects of precipitation and storm events on water movement within the sulfide waste and cover material. This information, along with other data, will help in the determination of the necessary cap rock and soil depths for effective reclamation.

Conclusion

In order to achieve successful final reclamation, planning must take place before and during the mine life. The large volumes of waste rock created by a surface mine can create a future environmental problem if the storage and reclamation of this material is not carefully planned.