

DESIGN PROPOSAL FOR TRANSPORTING TAILINGS AND RECOVERING COPPER

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ABSTRACT

In response to the WERC Environmental Design Contest 1998, Southeastern New Mexico Recovery Corporation (SENMR) designed a comprehensive process for the recovery of mine tailings. This process includes the recovery of copper oxides, and the safe transportation of the tailings to a new lined impoundment. SENMR has also developed a comprehensive cost and profit estimate for this process.

The process will take place in basically two phases. In the first phase, all construction needs are met. These include construction of various machinery platforms, process, and recovery pipeline. Perhaps the most impressive part of the construction is the projected timetable. All construction will take place in a one-month time, excluding unforeseen difficulties.

In the second phase, all process needs are met. It will begin by moving the tailings into the specially lined tank. There sulfuric acid will be added to leach the copper from the tailings in a large agitation mixer. The slurry will then be pumped to the first of two centrifuges for separation. The pregnant solution will be shipped to the electrowinning plant for refining. The tailings will then be placed back into the agitation mixer. Here the tailings are mixed with water and lime and pumped to the second centrifuge. Separation takes place, the recovered water is shipped back for reuse, and the tailings are placed in the lined containment pit. The whole process takes place in 280 working days.

Accountability is an important issue in promoting our best company image and dedication to the spirit of making New Mexico a better place to live and work. Accurate assessments of our procedures in monitoring legal, health, and environmental safety measures will provide ongoing data for reporting to all applicable agencies and regulators ensuring that we are practicing good stewardship and promoting sound environmental practices.

Not only is the SENMR plan plausible, it is economically feasible as well. The SENMR plan takes seemingly unusable tailings, and turns them into a multi-million dollar enterprise. The whole process costs around 2.8 million dollars. However, total income from copper sales is estimated at 5 million dollars. Therefore, as this proposal is reviewed SENMR's plan calls for a profit margin of around 2.2 million dollars.

The good points of SENMR's tailing recovery plan far outweigh the bad points. It is simple, environmentally responsible, and an economically feasible plan.

INTRODUCTION

This document outlines a process developed by SENMR to solve the WERC #1 tailings transportation problem. The principle objective is to design a system for tailing recovery, in a manner that will allow for slurry transport. SENMR will also consider the economic feasibility of recovering semi-precious metals from the tailings. The WERC #1 document also calls for SENMR to treat the slurry until it reaches a safe storage pH of seven to nine. The final objective is to design a system to recover the water from the slurry for reuse in the transport and treatment system. In order to complete the project successfully, certain environmental, social, safety, and economic issues must be addressed.

PROCESS OPTION REVIEW

After careful consideration of all available process options, SENMR has chosen the following three processes as the most feasible for review.

Scenario 1

This scenario involves tailing transfer, without copper recovery. This process begins with the transport of tailing, by the use of a front-end loader, to an agitation mixer. There the tailings are mixed to slurry, fifty percent of which will be water. After being mixed to proper consistency, they will be transported by pipeline to a centrifuge machine. There the water will be recovered and sent back to the agitation mixer for reuse. The tailings will be removed from the centrifuge machine by use of a front-end loader and placed in the lined pit that is provided by WERC. This is the simplest of all options listed. Its environmental impact is low and waste production is almost non-existent.

Scenario 2

Scenario 2 differs from Scenario 1 by the fact that extractive metallurgy will be used. The process begins with the leaching of the tailings using concentrated sulfuric acid. They are then rinsed with water to ensure that the optimum amount of copper is removed. The copper rich solution is then recovered and shipped to the electrowinning plant for refining. The tailings are placed in an agitation mixer where water and lime are added to control the pH level. Once this is accomplished, the slurry is pumped to the centrifuge machine. Here the water is separated and pumped back. The tailings are removed by the method mentioned earlier, and placed in the lined pit. This process effectively recovers over eighty percent of the copper oxide. Due to high construction cost and time inefficiency of the leaching process, this method is not feasible. Its environmental impact is extraordinarily high due to the dangers of exposed sulfuric acid.

Scenario 3

Like Scenario 2, Scenario 3 uses extracted metal energy to remove copper from the tailings. This process begins by placing the tailings into the agitation mixer. Here the tailings are mixed with a solution of concentrated sulfuric acid and water to the proper consistency. They are then pumped to the centrifuge machine for separation. The copper solution is then piped to the electrowinning plant for refining. After being refined, it is sold to market. The leftover tailings are placed back into the agitation mixer with lime. They under go the above mentioned slurry process. Scenario 3 is a time efficient and effective method for removing the copper. Special consideration must be placed on preparing the centrifuge machine, due to the

corrosive nature of considerations must be made for the agitation mixer as well. Environmental impact is greatly reduced from that of Scenario 2, as sulfuric acid is handled more responsibly.

A continuation of process three was also considered. In-order to recover copper sulfide ore the tailings would have to be sent through flotation and to a smelter after the removal of copper oxide. In-order to do flotation the tailings would have to be ground an additional time. This continuation process has been ruled out, because it would be too complicated and not cost effective.

PROCESS SELECTION AND DESIGN

Phase I

SENMR has selected process three as the most feasible approach. It is both environmentally and economically sound. Below are the complete systematically outline of the process proposed.

Step 1: This step involves the construction of the process zone. Construction will begin by pouring concrete platforms on which the two agitation mixers will be located. These platforms will be designed to prevent any accidental hazardous spills occurring during the mixing process. A thirty-inch levy of concrete around the work area will be constructed. The two agitation mixers will then be installed. Next, a concrete platform on which the centrifuge machine will rest will be constructed. This platform will have to be specifically designed to handle the stress produced by the centrifuge machine. The centrifuge machine will then be installed. Finally, installation of the pumping units will be pumping the slurry and copper solutions to their destinations.

Step 2: This step will involve the construction of pipeline. This step will begin with the digging of ditches required for burying the pipe. Next, the pipe will be laid in the ditch. Measurements will be conducted to assure proper length and fit. The line will then be connected to the pumping systems and pressure checked. Finally, the line will be buried. The same process will be used for the returning water recovery line.

Step 3: This step will involve the construction of the recovery zone. Another platform, identical to the one constructed in the process zone, will need to be constructed. The centrifuge machine will then be installed. Pumping units will also be installed for pumping the recovered water back to the process zone.

Phase 1's completion timetable is expected to be around one month. A lofty goal, which we believe can be accomplished. By using three different construction crews for the three different types. Contractors will be employed to complete the construction phase.

Phase II

This phase will involve the process selection of our proposal.

Step 1: The tailings will be moved into the agitation mixer number 1, where they will be mixed with a solution of concentrated sulfuric acid and water. This solution will be approximately thirty percent acid and seventy percent water. The solution will then be mixed to the proper slurry consistency to insure acid leaching of the copper oxide; this will take approximately one hour according to our bench scale model. It will then be pumped to the centrifuge machine for separation. After this is accomplished, the copper solution will be pumped to the electrowinning facility, as the tailings are being moved back into the agitation mixer number two.

Step 2: This step involves mixing the tailings with limewater. The lime will assure that pH of seven to nine is reached. The tailings will then be pumped to the second centrifuge machine for separation.

Step 3: Once separated, the water will be pumped back for reuse. The tailings will then be moved by front-end loader to the lined tailing impoundment.

Phase two's timetable is roughly 280 working days. We realize that adjustments may occur due to weather conditions and expected down time. However, we feel our process will easily meet the time limit of twenty-four months.

Figure 1. Flowing diagram of copper recovery-tailing transportation.

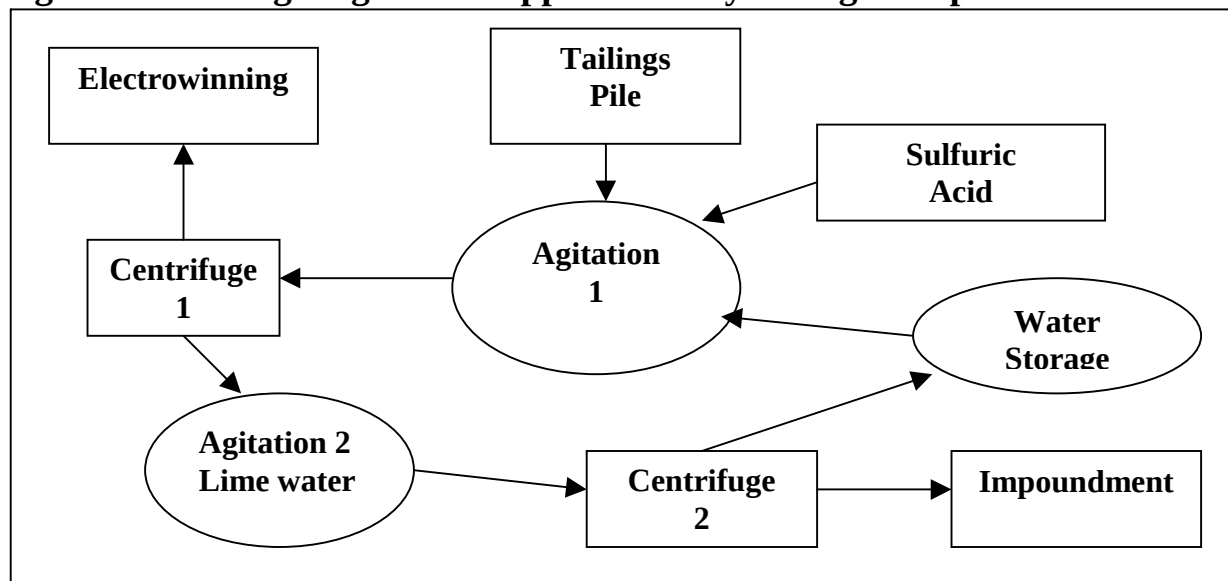


Table I. Time Schedule

Item	Total to Move
Project Length (280 working days)	488,810,913 lbs.
Per Day	1,745,753 lbs.
Per Hour (8 hr. day)	218,219 lbs.

Table II. Amount of tailings and copper present

Item	Amount Present	Amount Present (lbs.)
Tailings	100,000 cubic yards	488,810,913 lbs.
Copper	Avg.3.62% of total mass	17,694,955 lbs.
Copper Oxide	55% of 3.62%	9,732,225 lbs.
Copper from Oxide	79.9% of 9,732,225lbs.	7,776,047 lbs.
Recoverable Copper	82% of 7,776,047 lbs.	6,376,358 lbs.

ECONOMICS

In an effort to be simplistic, all economic factors affecting SENMR's proposed plan are included in the following table.

Table III. Economics-Income-Expenditure Statement

CATEGORY	ITEM	COST PER ITEM	TOTAL
Income	Copper	\$.80 per lb.	\$ 5,101,086
Expenditure	Construction	N/A	\$ 870,000
Expenditure	Labor	N/A	\$ 372,520
Expenditure	Machinery, etc.	N/A	\$ 989,340
Expenditure	Electrowinning	N/A	\$ 800,000
Expenditure	Community Relations	N/A	\$ 875
Total Expenditures	N/A	N/A	\$ 3,032,735
Total Profit	N/A	N/A	\$ 2,068,351

ENVIRONMENTAL AND SAFETY PROPOSAL

In the production of copper, there is the reality of human impact on the global environment from the extraction, transportation, and utilization of energy and mineral resources. In order for modern industry to shoulder the responsibility of environmental safety, they must consider all rules and regulations governing the environment that apply directly or indirectly to their industry. Our Environmental Safety and Health Plan (ES&H) will cover the areas of tailing transfer, copper recovery, and tailing storage.

Handling and transfer of both treated and untreated tailings is a major environmental concern in our proposed plan. To ensure the utmost environmental safety, SENMR will meet the environmental challenges associated with the transfer of tailings with the newest, most innovative environment protection techniques available. Due to the potential hazard that sulfuric acid poses to both the environmental and human factors involved with our process, The Resource Conservation and Recovery Act and its Hazardous and Solid Waste Amendments will be strictly adhered too. The act covers most aspects of the handling and transfer of sulfuric acid. The act also calls for the strict monitoring of worker exposure to hazardous and toxic waste, and by products. When applicable, SENMR will follow the Toxic Substance Control Act for proper use, storage, handling, and disposal of these substances. According to OSHA, all chemicals produced or imported will be evaluated, and information concerning their hazards will be made available to all employees. This information will include, but not be limited to; container labeling and warning forms, material safety data sheets (MSDS), and proper employee training in the handling of these substance.

Copper recovery will pose the greatest environmental risk in SENMR's proposal. Due to the dangers involved with heavy equipment and corrosive chemicals, protective clothing, headgear, eyeglasses, facemasks, and instructions for proper use and care will be provided to every employee and any incoming personnel. The company will employ an electronic liability reduction module focused on liability connected with company due diligence, property, and risk reduction. Required regulatory reports and filings will be coordinated through the main business office. These will stress four areas of liability assessment: property liability; property and environment; scientific environmental assessment; and site remediation. This information is relevant for bank and legal audit processes on the sale, lease, transfer, or acquisition of a property. Documentation required for cost recovery and complete and accurate tracking of property during various development phases of the mine and compliance to health, safety, and environmental standards at Chino mines will be valuable marketing tool.

Regulations for the Clean Air Act and Clean Water Act will be strictly adhered to promote worker and surrounding community safety. Protective clothing, headgear, eyeglasses, facemasks, and instructions for the proper use and care will be provided to every employee and any incoming personnel. Our policy, as directed by OSHA of 1970, to protect our employees from any recognizable hazard, protect them with a safe and secure workplace, and protect them from any chemical or airborne hazard. This will include the prevention of any dust-related illness from airborne contaminants known as nuisance and/or breathable dust will be managed with the use of prevailing wind management and sprinklers when necessary. Dust sampling data and other compliance data will be provided as outlined by the Mine Safety and Health Administration in an effort to reduce work related lung diseases. In adherence to the Emergency Planning and Community Right to Know Act and our goal of community- wide involvement, local input and cooperation in the design of an Emergency Response plan is needed. This is necessary to insure the best possible response to any accident or injury on the job. SENMR will take proper action on mitigating or modifying procedures in the area of human health, as mandated by the Comprehensive Environmental Response, Compensation, and liability Act (CERCLA). SENMR will also employ the use of an electronic liability reduction module focused on liability connected with company diligence, property, and risk reduction. It will focus on three main areas; property liability, scientific environmental assessment, and site remediation. This information will be necessary for legal auditing processes on the sale, lease, or transfer of property.

COMMUNITY RELATIONS

In the early days of the Chino Mines, technology was limited. Due to inefficient recovery techniques, large amounts of copper was left in the waste tailings. Today, however, technology allows the extraction of the forgotten copper. Southeastern New Mexico Recovery has developed a plan that will efficiently move the tailings and produce a profit. We will safely extract the copper from the tailings then pump the tailings in a slurry mixture to the new lined pit. Most of the water used to pump the slurry to the new pit will be recovered and later reused. The tailings will be stored safely at the new site. They will no longer be an environmental hazard to the community. This process from start of construction to finish of tailing storage will take approximately 320 working days.

Water quality is the most important aspect of the project. However, one very important fact to remember is that these tailings have been sitting here for decades allowing rainwater to

run through them. Since the water is not already polluted, it suggests that the tailings and chemicals in them are not water-soluble. To insure that our company does not cause any further problems we propose installing two test wells to monitor ground water conditions.

Dust should not be a great problem since these tailings hold water very well. Just the moisture in the atmosphere and left over moisture from rain is enough to keep dust to a minimum. The mixing system will be set down wind to make use of the prevailing wind direction. This will blow any dust produced away from the community. If dust does become a problem, a light misting system will be used when moving the tailings. This will help keep the dust down.

Another consideration is noise pollution, due to the closeness of the community. Several things to reduce this problem will be looked at. First, we will only use heavy machinery from 7:30 a.m. to 4:30 p.m. Noise reduction mufflers will also be used.

To insure the safety of the children, a fence will be built around the project sight. We will also hold community safety lectures. Tours of the project to assure all interested parties that everything is being done properly.

Our project also brings with it several positive aspects for the community. Many jobs will be created and filled from the local community. The local economy will be enhanced. Another good point to keep in mind is when these tailings are gone you will no longer have this problem in your backyard.

Once again, we assure the community that all environmental regulations will be followed and you community will be impacted as little as possible.

CONCLUSION

The process outlined throughout this paper is immediately and directly applicable to WERC 1's tailings problem. Meeting the design challenges given by WERC, Southeastern New Mexico Recovery has created an effective and efficient copper recovery and tailings transportation process. SENMR has provided a cost-effective method of copper recovery. SENMR has not only paid for all processes used; we have made a substantial profit. The tailings have been moved using innovative new processes to solve old problems. SENMR has handled potentially hazardous chemicals in an environmentally responsible way. SENMR has employed the newest resources in technology to reduce water loss and dust pollution.