STABILIZATION OF TEMPORARILY INACTIVE TAILING IMPOUNDMENTS[1]

by

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Abstract. In the arid southwest inactive tailing impoundments dry out rapidly and are subjected to wind erosion. Past techniques involving snow fencing, newsprint mulches with tackifiers, and chemical bonding or crusting agents have proven to be virtually ineffective, or extremely short lived at best. Earth or rock capping, often exceeding 1-2 feet, is extremely effective but is expensive and can prove to be detrimental to re-activating the tailing impoundment. At ASARCO Incorporated's Silver Bell Mine in southern Arizona a relatively new innovative technique was used to place a very thin veneer of crushed rock over the top of two large temporarily inactive tailing impoundments. By utilizing specialized equipment a layer of crushed rock was spread to a depth of -2 inches or less which effectively eliminated all blowing dust from these tailing impoundments. This thin veneer of crushed rock can easily be windrowed to allow for start-up of the mill and the redeposition of tailing on these impoundments.

Control of blowing dust from the Silver Bell tailing impoundments has been an ongoing program from the beginning of the mine's life in 1954. Starting in 1973 an intensive program of tailing revegetation for dust control was initiated. Most of this early work concentrated on the exposed side slopes of the tailing impoundments. These slopes were capped with a rocky soil material and successfully revegetated with the aid of supplemental irrigation. Other revegetation trials conducted on the top of the tailing impoundments were initiated in the mid-1970's and continue to this day. These tests have included direct seeding the tailing with only fertilizers added; mixing organics, such as sewage sludge and livestock manure into the tailing; and planting commercial crops directly in the tailing, such as wine grapes (vitis sp.)and jojoba (simmondsia chinensis). These tests have all demonstrated some degree of control, but have numerous limitations.

With the economic "crash" of the copper market in the mid to late-1980's the Silver Bell Concentrator was temporarily closed. At that time there were two tailing impoundments with vast surface areas that were beginning to be subjected to wind

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erosion. Over time the blowing tailing dust became a significant problem. While our revegetation tests did demonstrate considerable promise for dust control, the vast area of these two tailing impoundments was almost insurmountable. Also the eventual "re-opening" of the concentrator and using the tailing impoundments again at some point in the future had to be considered. Vegetative stabilization would have caused problems with organics in the reclaimed water used in the milling circuits. Our first attempts at dust control therefore involved simple sprinkler irrigation of the perimeter of the impoundments to wet the tailing surface to prevent dusting. We also installed "water cannons" to keep the tailing surfaces wet. These methods proved to be ineffectual due to the size of the tailing areas and the large quantities of water necessary.

Our next attempts to control the blowing dust began in the spring of 1987. In these tests we attempted to control the blowing dust on the surface of one of the tailing impoundments by utilizing rows of planted oleanders (Nerium sp.)and snow fences. Approximately one mile of snow fencing was installed along the eastern perimeter, as well as several 100 foot lengths at various locations across the southwestern portion of the tailing surface. In addition two windrows of some 25-30 oleander bushes were planted and furrow irrigated. Although the snow fencing did "trap" a great deal of blowing tailing sand (creating large sand dunes on each side of the fence), and the oleanders were surviving and growing, this did not significantly stop the blowing dust problems. It would have required many miles of snow fencing and thousands of trees or large shrubs for windrows.

The next techniques we utilized in our attempts to control blowing tailing dust involved two different surface bonding materials. This test was initiated in December, 1988. "Mar Loc" (a polymer bonding chemical), and a newsprint hydromulch with an organic tackifier were hydrosprayed onto the tailing surface. These materials produced a "crust" on the tailing surface. While this test did demonstrate limited control over the blowing tailing dust, it was relatively short lived. The "Mar Loc" was applied at rates ranging from 45 gal. to 131 gal. concentrate/acre. There were three plots with a concentration of 96-gal. "Mar Loc"/acre, one plot at 45 gal., and one plot with a concentration of 131 gal./acre. Two plots were treated with newsprint hydromulch material at 1000 lbs./acre with an organic tackifier at 240 lbs./acre. Within three to four weeks the "Mar Loc" crust began to be undermined, eroded, and "covered" over by blowing tailing sand. The tackified newsprint hydromulch crust was also beginning to show significant signs of deterioration. Within six weeks the effectiveness of the "Mar Loc" had been virtually eliminated and the hydromulch crust was physically peeling off the surface of the tailing due to force of the winds lifting the edge of the crust.

It became evident that to effectively control the blowing tailing dust the tailing surface would have to be covered with rock or soil materials. However, this presented some problems in that to re-activate the tailing impoundment in the future, the rock/soil cap would have to be removed from the tailing surface. If not the layer of soil/rock could cause a perched hydrologic water table on the side of the tailing impoundment and jeopardize the engineered hydrologic integrity and safety of the impoundment. Also, with conventional

earth moving equipment it often required soil/rock materials placed to depths of two or more feet just to support the weight of the equipment on the tailing surface. However, if a very thin veneer of soil/rock could be placed on the surface road graders could be utilized to simply scape the capping material in windrows to re-active the tailing impoundment.

Our final, and most successful, attempt to control the blowing tailing dust at Silver Bell began in August, 1989. ASARCO Incorporated contracted "Terra Contracting Corporation" to crush pit run waste rock and spread this crushed rock to a minimum depth of 2-inches over the surface of one of the tailing impoundments and 1-inch thick on the other tailing impoundment. A specially modified "Terra-Gator" was utilized to spread such a thin veneer of crushed rock on the surfaces of the tailing impoundments. The "Terra-Gator" is a large "balloon" tired piece of agricultural equipment originally designed to spread lime or manure on boggy soils. By its design it exerts very little pressure on the surface and can therefore traverse the tailing surface without getting stuck. These "Terra-Gators" had been specifically modified to handle and spread rock materials.

By September, 1989, the surface of the first tailing impoundment had been litely "skiffed" or covered with less than 1-inch of crushed rock material. Starting in the corner of the tailing impoundment nearest to the prevailing winds a very thin veneer of material was spread perpendicular to the winds. It was immediately evident that the blowing tailing dust had been effectively eliminated. Before applying any additional crushed rock to the surface of this tailing impoundment, cover was started on the surface of the second tailing impoundment to stop any blowing dust as soon as possible. By the end of October, 1989, the surface of the second tailing impoundment was adequately covered with an extremely thin veneer (less than one inch) of crushed rock material much like the first tailing impoundment to prevent any more blowing tailing dust. A second layer of crushed rock material was then placed on the surface of the first tailing impoundment. In the meantime all of the top slopes of the tailing impoundments were being "rip-rapped" with pit-run rock material to prevent any wind erosion from these exposed tailing slopes.

By the end of November, 1989, the second layer of crushed rock material was completed on the surface of the first tailing impoundment. This second layer of rock was spread perpendicular to the first layer. The use of the "balloon" tired "Terra-Gator" equipment prevented any disturbance to the first layer of rock. A second layer of crushed rock was then started on the surface of the second tailing impoundment. In late December, 1989, the outer perimeter of the first tailing surface was hydroseeded with nearly 2300 pounds of seed (approx. 32 acres total). The species seeded included some 300 lbs. of Lehman's lovegrass (Eragrostis lehmanniana), 450 lbs. of bufflegrass (Genchrus ciliare), 450 lbs. of 4-wing saltbush (Atriplex canescens), and some 1080 lbs. of desert saltbush (Atriplex polycarpa). The "rip-rapped" south facing top slope of the second tailing impoundment was also seeded. After hydroseeding, a final thin covering of crushed rock was spread over the surface of the first tailing impoundment, again perpendicular to the previous layer of rock. This brought the total depth of rock to a minimum of two inches as specified. The final spreading of crushed rock over the surfaces of both tailing impoundments was completed by mid-March, 1990.

The total amount of crushed rock used to cover both tailing impoundments amounted to some 150,000 tons. An additional 25,000 tons of crushed rock was "stockpiled" at various strategic locations for any "emergency" covering of tailing in case of erosion or failure of the capping. The total amount of pit-run waste rock material used to rip-rap the upper slopes of the tailing impoundments, and crushed for capping the tailing surface totalled 235,000 tons. Total area of the tailing surfaces capped over with crushed rock and side slopes rip-rapped amounted to some 480 acres.

Without the aid of supplemental irrigation for germination and initial establishment, the revegetation of the seeded areas of the first tailing impoundment has been slow. Although we experienced near "normal" winter and spring rainfall, germination was insignificant until after the summer monsoon rains began in July, 1990. Although germination is very sparse and sporadic, there is sign of the bufflegrass, 4-wing saltbush and some desert saltbush becoming established. As time goes on, and these areas mature, more and more vegetation will become established as these areas slowly revegetate themselves.

From the time the initial thin layer of crushed rock was placed on the top of the tailing impoundments there has been no blowing dust. Even without vegetation, the thin crushed rock covering has been extremely effective in stopping all blowing dust. With the first thin covering of rock it was noticed that the rock fragments lying on the surface of the tailing seemed to be dissipating the erosive energy force from the winds. It should be noted that most of these rock fragments were less then 2-inches in size. To date there has been no sign that any of the thin covering of rock is deteriorating.

At this time there are still no future plans to re-open the Silver Bell Mill.