Final Project Report – Lumina Caserones Mine Demonstration.

Introduction

Earthbind 100 was used for a trial demonstration on an unpaved access road located on the Lumina Caserones Mine. The Caserones Mine is an open pit copper and molybdenum mine located approximately 162 kilometers southeast of Copiapo in the Atacama region of Chile.

The objective of the trial was to demonstrate how Earthbind 100 can successfully mitigate fugitive dust on an active mine access or haul road. The trial road was approximately 1 kilometer long by 8 to 12 meters wide. The project took place during the fourth week of July, 2014. The demonstration included the first phase of a mine haul road dust control procedure: the Base Coarse Application Phase. The Maintenance Phase is scheduled shortly after the Base Coarse Application Phase is completed.

Project Procedure

Swayne Walther (EnviRoad, LLC – Director of Field Operations) and Ricardo Maldonado (Global Stabilization – Regional Sales Director) supervised Andreas Perez Alarcon (INDAK - Project Manager) and Jose Campos Valdes (INDAK - Mine Work Administrator) how to apply Earthbind 100 for the Base Coarse Application Phase. INDAK personnel and equipment were used for demonstration. Prior to the trial, excessive loose material was removed from the surface of the road. The Base Coarse Application Phase began on the afternoon of July 23, 2014. All application procedures were discussed and approved by Bruce Coulthard prior to, and discussed by telephone during the demonstration.

Trial road prior to application

Example of the compacted surface of the road

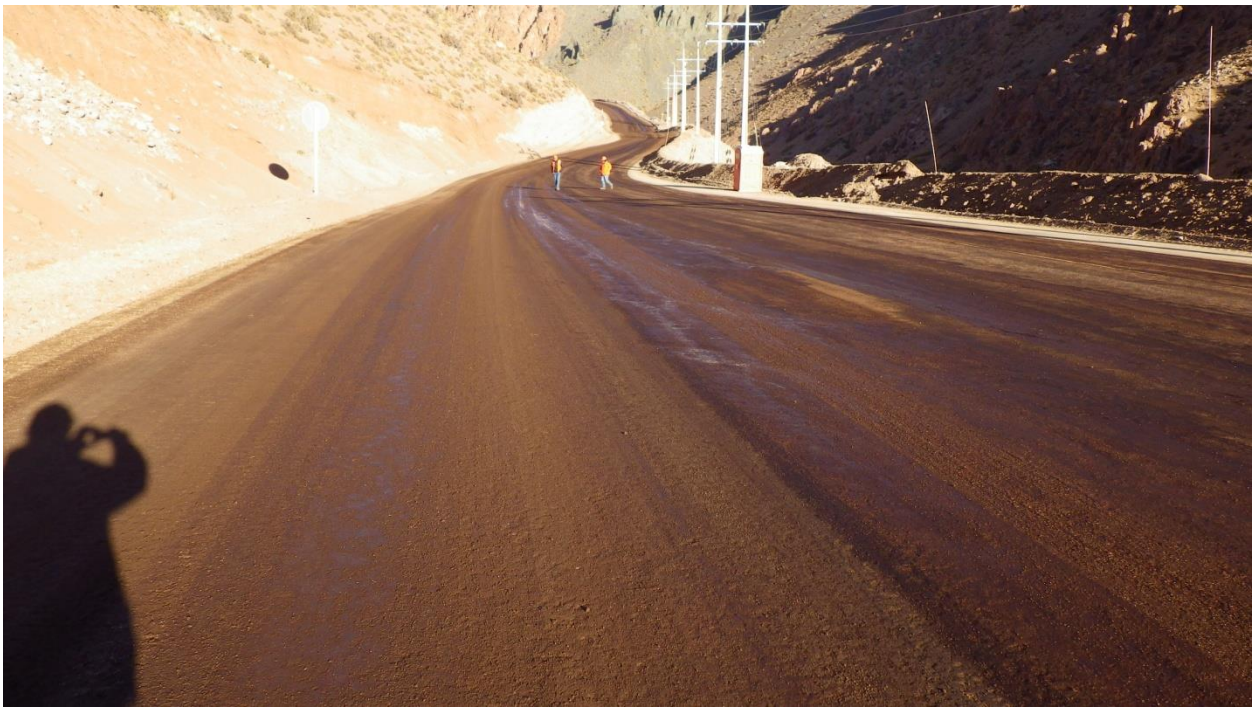
Based on the road area, approximately 5,000-liters (1,320-gallons) of Earthbind 100 concentrate (four, 1,250-liter totes) was required for the Base Coarse Application Phase. The Base Coarse Phase was done in four segments. Each segment consisted of one complete tote mixed with water in the applicator truck.

The applicator used for the demonstration was a pressurized water truck with a 20,000-liter (5,300-gallon) capacity. New spray jets were attached onto the spray bar to ensure a fan shaped spray pattern. Before the first application, we determined that the speed of the water truck to achieve the optimum application rate for the Earthbind solution was approximately 20 km/hour. The rate was based on a solution applied at a rate that is heavy enough to wet the surface of the road and soak in properly without ponding up or excessively running down the road.

Example of the application rate that was chosen

Example of how well the Earthbind 100 solution soaked into the compacted surface

The application of the first tote (first segment), was done using a 10:1 solution (10 parts water to 1 part Earthbind concentrate) and applied at a speed of approximately 20 km/hour. This solution concentration was chosen due to the very hard surface and the high traffic. The application went well. The first tote of Earthbind was applied on July 23.



The road section after the first totes was applied (first segment)

The second tote was applied on the morning of July 24. However, because of magnesium chloride crystals precipitating on top of the road surface due to the additional moisture used to apply a 12:1 solution, we decided to apply the second tote of Earthbind 100 using a 6:1 solution instead. The heavier concentration was chosen to minimize the amount of water applied to the road and to seal the surface to form a barrier so keep magnesium chloride crystals from migrating to the surface of the road as the Earthbind solution cures.

The trial road section covered with magnesium chloride crystals

The left side of the road completed with the second tote of Earthbind. Note that the magnesium chloride crystals covered with the Earthbind solution.

The third and forth totes were applied on July 25 and July 27. The Base Coarse Phase was complete on July 27.

The trial road section completed.

Challenges

Overall, initially the demonstration project went very well. INDAK personnel were very professional, enthusiastic, and capable. Also, equipment supplied by INDAK was superior.

Following are challenges that we encountered and solved during the demonstration:

1) Very hard road surface that minimized product penetration;
2) Sections of relatively steep gradients that caused some of the Earthbind solution to run down hill;

3) Moist road surface. It appeared that the trial section was inadvertently watered (to control dust) prior to the first application of the Earthbind solution. This initial moisture probably minimized the Earthbind solution soaking into the hard surface.
4) Very high traffic counts and relatively high speed of the traffic. The traffic count was estimated to be at least 200 trucks per hour. The high traffic caused us to lose a percentage of uncured Earthbind that was picked up by the tires. Also, it appears that some of the applied Earthbind was "picked up" by traffic during the "tacky" phase (the short period of time when the Earthbind solution goes from a wet phase to the cured phase). This can be solved with proper planning of traffic to allow for drying time.
5) Relatively cold temperatures that prolonged loading the Earthbind concentrate into the water truck due to a higher viscosity;
6) Relatively cold temperatures that minimized the mixing efficiency of the totes;
7) Winter conditions that minimized the cure time of the Earthbind solution;
8) Topography of the road sides (mountains on both sides of the road) that minimized exposure to the sun that affected cure time; and
9) Excessive magnesium chloride concentrations in the road material. We unexpectedly had a challenge with anhydrous magnesium chloride precipitating to the surface of the road due to the extra moisture that was applied using the initial 10:1 solution. Therefore as the Earthbind solution evaporated from the surface of the road, the magnesium chloride also "wicked" up to the surface of the road since magnesium chloride normally follows moisture. For example, as the Earthbind solution was drying on the surface of the road it also caused the magnesium chloride to be wicked up due to the evaporation process. In addition, freezing temperatures caused the hydrous magnesium chloride to turn into anhydrous magnesium chloride and precipitate on the surface of the road. This resulted in the road covered with a thin layer of dusty salt crystals. The precipitation occurred because the solubility of magnesium chloride decreases with colder temperatures. The high concentrations of magnesium chloride probably would not be an issue if the trial was done in warmer temperatures.

<u>Recommendations</u>

I recommend that the Maintenance Phase begin soon. The Maintenance Phase is done to lightly treat dust that is generated from the road by the high traffic counts, run-on dust, and blow-on dust. Also since there are untreated soil berms along both sides of the road, it is expected that this will be a major source of dust. Here dust will be picked up from the berms by the vortices trailing behind moving traffic. This dust will most likely settle on top of the surface of the treated road.

A maintenance application can be applied using anywhere from a 20:1 to a 100:1 solution. The maintenance application is done to keep the treated road dust free. The timing of the

maintenance application depends upon how fast new dust is deposited on the road surface. Therefore a maintenance application can be done once every two weeks, once a week, once every other day, or every day. A heavier solution (e.g., 20:1) should maximize time between maintenance applications, whereas a lighter solution (e.g., 100:1) may need to be done more often. For the initial application, I recommend using a 50:1 solution and applied to the road whenever deposited dust becomes an issue.

Conclusions

Based on feedback that I received from Bruce Coulthard President of Global Stabilization and sources involved with the demonstration project, our conclusion is that the recommendations that were made to complete the Lumina Caserones Mine Demonstration successfully was not followed. It appears that as little as 0.05 to 0.1-gallons of Earthbind concentrate was used on the demonstration section. This means that no maintenance applications were performed. Also, the Earthbind intended to complete the demonstration and maintenance was used on another additional section. How much extra road (square meters) and how much Earthbind product (liters concentrate) was used on the additional section was not ascertained. It is safe for me to assert that instructions that I gave to the key personnel involved with the project was not followed. Our instructions were crucial to the success of the project especially due to the extremely heavy mine traffic and the nature of the compacted road.

EarthBind Products have been used for over 18 years in the mining industry with a zero failure rate when application and maintenance protocols are followed.