Mine Tailing Stabilization

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The Environmental Restoration Design team has proposed a remediation scheme for a superfund site that is located at an elevation of 9000 feet in Tererro, New Mexico. It is a 130-year-old mining area covering 18.5 square miles of a watershed that drains along the site to a river. The pile of mine tailings is leaching heavy metals into the groundwater and surface water through the mechanism of acid mine drainage. Eliminating heavy metal contamination is essential because the stream that drains from the tailing site is used for irrigation, recreation and public water supply.

Table 1 compares the concentrations of heavy metals in the groundwater adjacent to the pile with regulatory levels. Note that the concentrations of lead and cadmium exceed EPA primary drinking water quality standards (CFR 141.62) [1].

Table 1: Metal Concentrations in Down-gradient Groundwater

Metal	C.U.R.E. Analysis (mg/L)	National Primary Drinking Water Regulations (mg/L)	National Secondary Drinking Water Regulations (mg/L)	New Mexico Groundwater Regulations (mg/L)
Pb	**0.04**	**0.015**	**None**	**0.05**
Fe	0.12	None	0.3	1
Cd	**0.13**	**0.005**	**None**	**0.01**
Mn	1.84	None	0.05	0.2
Zn	2.83	None	5	10
As	0.02	0.05	None	0.1
Cu	0.08	1.3	1	1

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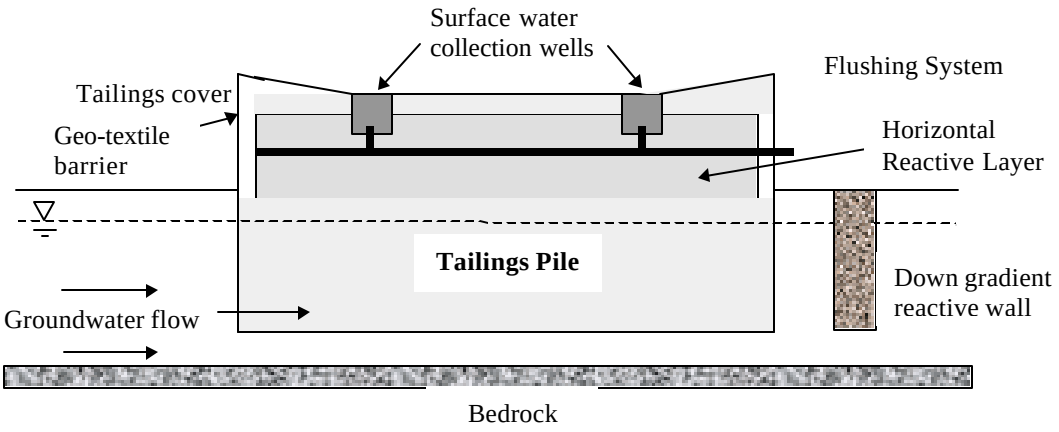
In response to the contamination problem C.U.R.E. has developed a comprehensive remediation process that is technically innovative, cost-effective, within the parameters defined by the local community, and in compliance with all applicable regulations. To address the critical issues and constraints associated with the mine tailings pile, we are proposing a multi-facet remediation process. Our design incorporates technologies to remediate the contaminated groundwater and prevent additional surface water contamination. The main components of the design (Figure 1) are a permeable reactive wall down-gradient of the tailings pile, a horizontal reactive layer in the pile, a surface runoff collection system, and a concrete trench for the stream flowing adjacent to the pile. The chosen remediation process (Figure 1) satisfies all relevant requirements and provides a practical solution.

Figure 1



The down-gradient treatment wall, composed of limestone and activated alumina, intercepts the groundwater plume and ensures regulatory compliance by removing metals through precipitation and adsorption. The combination of these two mechanisms helps address the uncertainty factor associated with the non-homogeneity of the tailing pile. To avoid long-term expense associated with regular replacement of worn out reactive media, we have designed a horizontal reactive layer containing potash (K_2CO_3) and wood-chips to neutralize the tailings and create an anaerobic environment in the pile. Eliminating the available oxygen in the pile stops the acid-generating and metabolic activity of microorganisms, such as *Thiobacillus ferrooxidans* [2]. We will be using biosolids to create such an environment. Direct contact of the adjacent streambed with the tailing pile will be prevented by diverting the stream through a concrete channel for the entire length of the pile.

The viability of these remediation processes was verified through extensive bench scale testing. Column experiments representative of the down-gradient treatment wall indicated that limestone raises the pH of contaminated groundwater from 3.18 to 7.45 and precipitate all the metals of concern except lead to concentrations well below regulatory standards. Activated alumina reduced the lead concentrations from 189µg/L to 1.5µg/L, which is below the legal maximum of 15µg/L. The anticipated neutralizing capability of the horizontal reactive layer was confirmed by a column experiment containing potash and tailings where the potash raised the pH from 2 to 6.8. An organic mixture primarily composed of biosolids provides an oxygen consumption rate that is capable of maintaining an anaerobic environment inside the tailing pile.

Reference:

[1] WWW EPA code of Federal Regulations, Title 40. Environmental Protection Agency. 2-19-99 <http://earth.epa.gov/epacfr40/chapt-I,info/>

[2] WWW Thiobacillus ferrooxidans. Acid Mine Drainage. 2-1-99 <http://www.mines.edu/fs_home/jhoran/ch126/thiobaci.html>