THE AFFECT OF TAILINGS CHARACTERISTICS ON MINE RECLAMATION AND CLOSURE[1]

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Abstract: Mine tailing properties are so different from other types of mine waste that the reclamation design, criteria for reclamation success and post-closure monitoring require a very different approach from the standard methods used for waste rock and heap leach material. Research has shown that although tailings can be directly revegetated under some conditions, tailings alone are typically a poor growth media due to lack of structure, poor moisture retention characteristics, and lack of fertility and microbiota. Nonetheless, when cover material is used, unless the tailings are highly acidic, plant roots will propogate into the tailings and reduce deep percolation, effectively acting as a evapotranspirative cover. Evidence also suggests that limited oxygen ingress occurs into finer grained tailings and long-term acid generation may be limited to the near surface. These same high moisture retention characteristics can mean that tailings drainage will occur for centuries, depending on the size and construction methods of the impoundment. All of these factors require careful consideration during closure and reclamation design.

Tailings can generally be classified into three textural types corresponding to location within the impoundment: coarse- to fine-grained sands at the dams, sandy silts in perimeter mixed zones, and silt (slimes) in the decant area. The latter two types comprise the majority of tailings. Coarse- to fine-grained sands have poor moisture retention and limited plant available water holding capacity. Silts and sandy silts have high moisture retention but limited permeability, which can reduce infiltration and impede root penetration. Although a number of studies have shown that the addition of organic matter to tailings (such as biosolids and green waste) improves textural properties and fertility, the long-term effects of amendments may be limited. Moreover, for sandy tailings at the impoundment slope areas, limited water availability and high erosion rates make revegetation virtually impossible.

The addition of nominal (one foot or less) amounts of growth media significantly affects the revegetation of non-acid tailings. Primary root growth occurs in the growth media, but rooting extends at depth into the tailings in order to extract moisture during dry periods. Indeed, high moisture retention in the sandy silts and slimes can result in vigorous growth of deep-rooted trees and shrubs after reclamation. Even with thick covers where the roots do not extend into the tailings, the moisture retained in tailings can be wicked via evapotranspirative demand during dry periods.

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The high moisture retention characteristics of most tailings also results in extremely long drainage periods. Model simulations of tailings drainage indicate that the bulk of the tailings solution drains from the dam and mixed zones within a relatively short period of time, but that extremely low rates of drainage occurs from the slimes area for a sustained period. Tailings consolidation due to overburden pressure will increase the rate of drainage, however, many impoundments larger than hundreds of acres may take decades for the majority of drainage to occur and centuries, to completely drain.

The implications of tailings characteristics for reclamation design are: 1) Non-acid tailings can be revegetated with nominal cover and/or amendments; 2) Revegetated tailings/cover systems can serve as highly efficient evapotranspirative covers; 3) Acid tailings can be covered, however, wicking of tailings solution into the cover may occur; 4) Long-term tailings drainage can take decades or more.

Long-term issues needing further study include the relationship between tailings consolidation and long-term drainage rates from tailings impoundments and the long-term effects of salinity on vegetation in both non-acid tailings and covered acid tailing.