Objectives and Design Solutions of a 1000-year Evapotranspiration-Capillary Surface Barrier System[1]

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Abstract: Surface barriers (covers) have been used to isolate mine waste and restore mine lands. The design objectives and hence solutions vary depending on numerous factors such as waste type and hazardousness, hydrogeological conditions, vegetation, climate, and the environmental elements of concern. For radioactive waste sites at the semiarid Hanford Site in southeastern Washington State, a series of objectives was set to meet or exceed Resource Conservation and Recovery Act criteria, function in a semiarid to subhumid climate, limit drainage through the silt to less than 0.5 mm yr^{-1}, limit runoff, minimize erosion, minimize biotic intrusion, have a design life of 1000 years, and be maintenance free. To achieve these objectives, a package of design solutions was developed to

- isolate waste using a multi-component and multi-layered surface barrier system;
- immobilize the underlying contaminants by nearly eliminating drainage;
- manage precipitation and drainage with a store-and-release natural ecological system and by including a capillary break and a coated asphalt concrete layer;
- control wind- and water-induced soil erosion with vegetation and pea gravel;
- inhibit animal, vegetation, and human intrusion with a riprap layer and a coated asphalt concrete layer;
- protect the functional part of the barrier system against damage using side slopes;
- eliminate the impacts of material degradation using only natural stable materials (e.g., soil, sand, and rock);
- reduce gas release from the waste and oxygen ingress into the waste with a coated asphalt concrete layer.

A demonstrative Prototype Hanford Barrier (PHB) was constructed in 1994 and has been tested under stressed and natural conditions for over two decades. PHB performance demonstrated that the barrier satisfied nearly all key objectives. The above solutions can be modified for sites containing other types of wastes, e.g., uranium mill tailings (UMTs), mine tailings or mine lands, and hazardous waste landfills. Depending on the hazardousness of the waste sites, the intrusion prevention layer could be thinned or removed. The coated asphalt concrete layer or a modified version can be used to prevent the release of radon gas from the UMTs or reduce the ingress of water and oxygen into the mine tailings, and hence reduce acid mine drainage generation. The silt loam storage layer probably can also be thinned, depending the maximum allowed drainage rate from the barrier and the minimum thickness needed for normal growth of vegetation.

Additional Key Words: Surface Cover; Mine Land; Reclamation; Tailings; Geotechnical

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