

Unique Geosynthetic Liner System for Uranium Mill Tailings Disposal

The White Mesa Mill is the only actively operating uranium and vanadium mill in the United States. The mill processes ores using an acid leach process to extract uranium, and in some cases, vanadium from the ore. Process liquids are acidic with a pH between 1 and 2.

The liner system for cells 4A and 4B was designed to provide a cell for disposal of byproducts from onsite processing operations while protecting the groundwater beneath the site. The liner system was designed to meet the Best Available Technology requirements of the UAC R 317-6, which requires the facility to be designed to achieve the maximum reduction of a pollutant achievable by available processes and methods.

The primary liner consists of a smooth 1.5 mm (60-mil) thick HDPE geomembrane. An HDPE geomembrane was selected due to its high resistance to chemical degradation and ability to withstand acidic environments.

The leak detection system (LDS) underlies the primary liner and is designed to collect potential leakage through the primary liner and convey the liquid to the sump for manual detection through monitoring of sump levels. The LDS consists of a 300 mil thick geonet and network of gravel trenches throughout the bottom of cell 4B.

The primary purpose of the secondary liner is to provide a flow barrier so that potential leakage through the primary liner will collect on top of the secondary liner, then flow through to the LDS sump for removal. The secondary liner also provides an added hydraulic barrier against leakage to the subsurface soils and groundwater. The secondary liner consists of a composite liner that is comprised of a 1.5 mm thick HDPE geomembrane overlying a GCL.

Although the GCL is used as an element of the secondary composite liner system and is not expected to be in contact with process liquids (i.e. the process liquids have to migrate through defects, if any, in the primary liner and then build up enough head to drive the process liquids through the secondary liner into the GCL), a testing program was devised to demonstrate that a GCL would exhibit low hydraulic conductivity when permeated with a low pH liquid similar to the process liquids anticipated to be contained by the liner system. Testing consisted of permeating GCL samples with varying degrees of initial moisture content. Moisture contents varied from 50% to 140% and each sample was then permeated with a liquid pH of 1.0 (pH was established using hydrochloric acid) under a normal stress of 5 psi in accordance with ASTM D 6766, Scenario 1. The Action Leakage Rate (ALR) at 50% moisture was expected to be more than 150 years for the first pore volume of permeant, which is well beyond the time the cell will be drained of free liquids. Based on this analysis, the regulatory agency agreed that a minimum moisture content of 50% should be achieved in the GCL installed for this project.

Since the start of filling of Cell 4A, the liner has performed well with minimal leakage detected in the leak detection system (significantly below the ALR).

References:

Corcoran, G.T., Roberts, H.R. (2010) "Unique Geosynthetic Liner System for Uranium Mill Tailings Disposal", Tailings and Mine Waste Conference 2010 proceedings.