1. PROJECT SUMMARY

Title: Compatibility of Containment Systems with Mine Waste Liquids
Project I.D.: R/UW-CTP-001S
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Period of Contract: July 1999 - June 2001

Background/Need:
Great interest has arisen in metallic mining at various locations in Wisconsin. Significant concern has developed regarding the potential for environmental impacts of mining, particularly the pollution of groundwater. This concern has arisen due to the poor environmental track record of most mining companies.

Mining's greatest threat to groundwater is pollution from drainage of mine tailings. Tailings are the residue remaining after benefication of the ore. Drainage from tailings may consist of process water present at the time of disposal or acidic water caused by percolate passing through tailings undergoing oxidation. Acidic mine drainage pollution is characterized by a low pH and elevated concentrations of heavy metals affecting both surface and groundwaters.

One method to prevent groundwater contamination is to place tailings in an engineered waste containment facility designed using the principles employed for modern municipal and industrial landfills. Design of an engineered containment system consists of reducing the leakage to a negligible amount so that the only important contaminant transport mechanism is molecular diffusion. Recent studies sponsored by USEPA have shown that modern landfill liners do perform as intended and have very low leakage rates typically less than 30 L/ha-d (1 mm/yr). However, mine tailings are very different than municipal waste and stabilized hazardous waste placed in industrial landfills. Thus the lining systems used for municipal and industrial waste may perform differently when they are exposed to mine drainage. In fact, an extensive review of literature has revealed no case studies regarding the environmental performance of engineered containment facilities for tailings. Therefore, efficiency of the lining systems used for mine waste containment must be assessed in order to make responsible decisions regarding mine waste management.

Objectives:
The main objective of this study is to assess the compatibility of lining system materials and mine waste liquids, with the intent of determining if materials used for lining systems will function as intended when they are exposed to mine waste liquids. The second objective is to predict the lifetime of lining system materials by extrapolating the experimental behavior to site-specific conditions.

Methods:
A variety of lining system materials (geomembrane, geotextile, and geocomposite) are exposed to synthetic acidic mine drainage solution and two control solutions. A modified version of EPA Method 9090 is used for exposure.

Geosynthetic materials are immersed in the chemical environment for a period of 15 months at 20 ^{o}C, 40 ^{o}C and 60 ^{o}C. Three different chemical environments are used for the exposures: Control I (Deionized water), Control II (low pH, no metals solution), and synthetic acidic mine drainage (low pH, high metals solution).

During exposure, samples are periodically taken from the immersion tanks, and physical and engineering properties of geosynthetics are tested to confirm whether the liquids have an adverse effect on engineering properties. The following tests are performed on unexposed and exposed samples: thickness, mass, tear resistance, puncture resistance, tensile strength, elongation at break, modulus of elasticity, melt flow index test, transmissivity test and infrared spectroscopy analysis, which is a special tests used for the detection of degradation in polymer science.

Results and Discussion:
Comparison of exposed and unexposed geomembrane samples of acidic mine drainage set over a period of 6 months suggests that the HDPE geomembrane was slightly deteriorating due to exposure. This deterioration was not easily detectable with puncture and tear test results due to the high standard deviations recorded in these tests. Puncture and tear strength values recorded during the exposure were fluctuating within the high standard deviations of unexposed samples. Melt flow index (MFI) results also suggest a certain amount of degradation of the geomembrane. Test results have still fluctuations mostly within the standard deviation of unexposed samples for geotextiles. This made it difficult to detect any degradation over this short period of exposure. Significant reduction in transmissivity values were observed in geotextile in acidic mine drainage exposure at 60 ^{o}C.

Conclusions/Implications/Recommendations:
Even though exposure and experiments are continuing, following conclusions can be drawn for the first six months of the study: HDPE geomembrane has slightly deteriorated due to acidic mine drainage exposure as it was concluded from wide width test and melt flow index results. This deterioration was not easily detectable with puncture and tear test results due to the high standard deviations recorded in these tests; for geotextile specimens, significant changes physical and engineering properties were not detected due to high variability in the test results of unexposed samples. However, reductions in the transmissivity results were detected for geocomposite (i.e., geonet) specimen.

These results and conclusions will be updated with continuing testing.

Kew Words:
acid mine drainage, groundwater, landfill liners, mining, tailings, chemical compatibility, geosynthetics

Funding: UWS Groundwater Research Program