Tuesday 3/14/2017

1:15–2:45 p.m.

Geosynthetics in Waste Containment Facilities 1

Chairs: Krishna Reddy, University of Illinois at Chicago; Nazli Yesiller, Global Waste Research Institute / Cal Poly

Performance of Blended Polyolefin Geomembrane in Various Incubation Media Based on Std-OIT
Mohamed Morsy and Kerry Rowe, Queen's University
Blended polyolefin (BPE) is a proprietary blend of polyolefin. There is little independent data on the potential long-term performance of this polymer resin to compare with that of high-density polyethylene and linear low density polyethylene under the same exposure conditions. This paper examines the performance of a BPE geomembrane immersed in incubation solutions relevant to its potential use in heap leach pads, Bayer process, municipal solid waste landfills, water lagoons, and potable water reservoirs. Results presented provide preliminary insight regarding antioxidant depletion as measured by Std-OIT in the immersion fluids and hence with respect to the first stage of the service life of BPE GMBs in these different applications.

Laboratory Study of Geosynthetic Clay Liner Panel Shrinkage Forces and Seam Strength
Robert S. Valorio, CETCO; Julio A.Z. Ferreira and John M. Allen, TRI Environmental; Chris Athanassopoulos, William Rainey Harper College
The purpose of this study was to evaluate the suitability of thermally fusing GCL panels to prevent their separation when left under an exposed geomembrane undergoing cyclic wetting and drying. Small-scale tests were conducted to compare GCL seam shear strength with GCL panel shrinkage forces. GCL shear seam strength was evaluated for seams prepared with a propane torch and specimen widths of 100 mm and 200 mm. A bench-scale test setup was developed to measure shrinkage forces of a GCL sample during wetting and drying cycles. The shrinkage specimen was 300 x 600 mm (CD x MD) and clamped around its perimeter. The 200-mm wide seam strength specimens showed the smallest variability. After 32 cycles, the GCL shrinkage force in the roll cross-machine direction was approximately only 11% of the weakest average measured seam shear strength, suggesting that thermally fusing GCL panels might be a feasible solution to panel separation.

Long-term Performance of HDPE Geomembranes Exposed to High Service Temperature
Andrew Mills, Layfield Group; David Beaumier, SAGEOS
Polyethylene geomembranes typically have poor behaviour when exposed to high temperature. Polyethylene materials soften as the temperature increases and lose their strength completely near 120C. Other research with landfill liners has shown that increasing the service temperature of a polyethylene geomembrane to 85C can reduce the service life of the liner to as little as 3 years through the rapid depletion of antioxidants.

In this paper, the performance of a high temperature resistant geomembrane material was evaluated over a year-long period and compared to other geomembrane materials. The samples were exposed to three different service temperatures and then periodically evaluated for antioxidant retention. An Arrhenius-model was used to project antioxidant depletion. The projected service life of HDPE

geomembranes exposed to high temperatures in these conditions was estimated considering antioxidant depletion as the end-of-life criteria.

Automation of Large-Scale Geotextile and Geomembrane Fabrication

Andrew Mills and Naeem Yassin, Layfield Group

The fabrication of geotextiles and geomembranes offers advantages in deployment speed and quality over field-installed materials. Traditional fabrication methods have joined one strip of material at a time to create extended panels. Recently, the authors have completed the development of a new fabrication machine that joins five strips of material at a time to create fabricated panels for large projects. The new machine is capable of both welding geomembranes and sewing of high strength geotextiles. This machine was specifically designed to address the problems of scale that need to be dealt with in oil sands tailings ponds. This paper will outline the development of this unique machine and present two case histories; one using high strength sewn geotextile, and one using welded geomembrane. The paper also highlights some exciting new equipment technology and innovation developed specifically for meeting the containment needs of larger scale projects.

Comparison of Single and Multi-Layer Interface Strengths for Geosynthetic/Geosynthetic and Soil/Geosynthetic Interfaces

Kris Khilnani, Advanced Earth Sciences Inc.; Timothy D. Stark, University of Illinois at Urbana-Champaign; Taj M. Bahadori, San Joaquin County Dept. of Public Works

This paper presents a unique comparison of single and multi-layer interface shear strength tests for a recently constructed landfill liner system. The comparison includes peak and large displacement combination strength envelopes from single- and multi-layer interface direct shear tests for the same geomembrane (GM)/ drainage geocomposite (GC), geosynthetic clay liner (GCL)/geomembrane, and soil/GCL interfaces. This comparison shows excellent agreement between strength envelopes and critical interfaces derived from single- and multi-layer interface tests for the materials tested. Based on this comparison, it is recommended that multi-layer interface tests be used for composite liner system design and if there is an anomaly with the multi-layer interface test results, single interface tests can be conducted to verify the weakest interface and to clarify the test results. Alternatively, the liner system can be designed using single interface tests and multi-layer interface tests can be used to verify the combination strength envelope derived from the single interface tests as was done in this case.

Numerical Modeling of Shear Response of Composite Liner System with Municipal Solid Waste Degradation in Landfills

Krishna R. Reddy Girish Kumar, and Rajiv Giri, University of Illinois at Chicago

The dynamic coupled hydraulic, biodegradation and mechanical processes in conventional and bioreactor landfills significantly affect the in-plane shear response of the composite bottom and side liner system. Moreover, it is critical to investigate the in-plane shear behavior of the composite liner to maintain the integrity and serviceability of the liner systems. Previous studies on the shear response of composite liner systems have shown the shear response and importance of interface properties by considering only the influence of overburden stresses induced by waste mass in landfills. Till date, there is no study on the interface shear response of composite liner system that incorporates the effects of biodegradation of waste in landfills. In this study, a coupled hydro-bio-mechanical framework was formulated to investigate the in-plane shear response of the composite liner system in both conventional and bioreactor landfills as the MSW degradation progresses. The shear response of

composite liner system was analysed both spatially and temporally in terms of the evolution of shear stresses and shear displacement along the liner interface. It was observed that the changes in the shear strength and stiffness of MSW due to biodegradation had a significant impact on the in-plane shear behavior of the composite liner system considered. In addition, the rate of biodegradation had considerable influence on the induced shear stresses and shear displacements along the liner interface. Overall, this study demonstrates the importance of assessing the in-plane shear response in identifying the stability of composite liner systems considering the influence of coupled processes in MSW landfills.