

An Indian-Australian research partnership

Project title

Studies on the performance of Geosynthetic Clay Liners of landfill covers subjected to differential settlements

Project number: IMURA0075

Monash University supervisors: A/Professor A. Bouazza

Monash University contact: Email: Malek.Bouazza@eng.monash.edu.au

IITB supervisors: A/Professor B.V.S. Viswanadham

IITB contact: viswam@civil.iitb.ac.in, viswam@iitb.ac.in

Research Academy theme/s

List only the research academy theme/s that is relevant to the project

1. Advanced computational engineering, simulation and manufacture
2. Infrastructure engineering

The research problem

Geosynthetic clay liners (GCLs) are commercially manufactured barrier materials containing approximately 5 kg/m² of sodium based bentonite sandwiched between two geotextiles. GCLs are approximately 6 – 8 mm thick and are manufactured in panels that measure about 5 m in width by 30 m in length. Panels are overlapped without mechanical welding and self-seal at the overlaps when the bentonite hydrates. An important application of GCLs is as a hydraulic barrier in final covers for landfills. Due to on-going biodecomposition, cover systems are prone to differential settlements of varying degree of severity. In the recent findings from a case study indicates that cation exchange combined with dehydration can adversely affect GCLs to the point where they may be no longer effective as hydraulic barriers. Generally, an overlying layer of 0.75 – 1 m thick is being provided to protect GCLs and recent reports also indicate that 0.76 m thick overlying layer is insufficient in protecting GCLs (Meer and Benson, 2007). More research is needed to determine if a thicker surface layer can protect GCLs, and to determine the physical and chemical properties of the surface layer that will minimize potential dangers due to dehydration, cation exchange and differential settlements. In addition, effect of overlaps on the sealing efficiency of containing system need to be verified.

Classically compacted clay liners (CCLs) have been used as hydraulic barriers in canals, retaining basins and other structures with direct or approximate contact with water. Recently, prevalent problems like desiccation cracking, non-availability of suitable clay material, and susceptibility to differential settlements have led to adoption of GCLs ahead of CCLs. The proposed research work has got great relevance to India (especially for mega cities) and Australia, wherein there is a requirement of proper sealing of colossal waste dumping yards.

Project aims

The primary objective of this study is to conduct an in-depth geoenvironmental assessment of GCLs to contain contaminants and protect groundwater resources. To achieve this objective, five different tasks will be conducted: (1) Characterization and Testing of GCLs, (2) laboratory column testing, (3) Hydraulic conductivity testing, (4) centrifuge testing, and (5) numerical modelling. The completed testing program will include four different GCLs.

Expected outcomes

The major outcome will be arrive at the effect of differential settlements, overlaps and overburden on the sealing efficiency of cover systems. Utilization of GCL as a hydraulic barrier solves three problems with one effort, namely (i) Environmental protection; (ii) increased landfill capacities; and (iii) Reduction in the use of natural earthen materials.

Which of the above Theme does this project address?

1, 2

How will the project address the Goals of the above Themes?

The proposed area is an entirely new area and emerging area as far as India is concerned as very limited research has been carried out. In the Indian context, this project is of considerable relevance since colossal amounts of municipal solid waste landfills get accumulated around cities and towns and which are required to be closed with a landfill lining system to safe-guard the environment and to look for other avenues such as reusing of large hectares of area occupied by closed landfills in the future. The problem is all the more acute in and around mega cities. Interestingly, scarcity of suitable earthen materials in urban areas necessitates looking for alternative barriers like GCLs. In a way this study leads to development of guidelines for appropriate sealing of landfills and also helps in safe guarding the environment.