

Course syllabus

Department of Civil Engineering, Indian Institute of Technology Madras

CE5970 - Barrier Systems for Waste Containment

Credit Distribution: C:9 L:3 T:0 P:0 E:0 O:6 TH:0

Course Type: Theory

Description: This course explores design concepts of barrier systems, which are commonly used for containment of municipal and hazardous solid wastes. Course aims to enable the students to design modern engineered barrier systems. The course also provides an in-depth knowledge pertaining to long-term performance of modern barrier systems.

Course Content: Overview of barrier systems: Re-compacted clayey liners; Geosynthetic composite liners; Components of modern engineered barrier system, Principles of barrier systems design and Geotechnical related design issues. Composition of solid wastes: Composition and characteristics of solid waste; Environmental laws, regulations and assessment. Design of Leachate Collection System: Leachate characteristics; Leachate collection, clogging and mounding; Selection of drainage layer material and thickness, Leachate management and Instrumentation. Fundamentals of Contaminant Transport: Transport of contaminants by advection, diffusion, dispersion phenomena; Chemical mass transfer processes through sorption & desorption, precipitation & dissolution. Testing of Materials: Assessment of physical, chemical, mechanical, endurance, geotechnical, hydraulic and hydrological characteristics of natural geomaterials and geosynthetic materials. Clay Barriers (CBs) and Compatibility: Compacted clay liners, CCLs; Liner specifications; Clay mineralogy and its role in hydraulic performance of CBs; Hydraulic conductivity estimation; Compatibility of CBs with leachate. Geosynthetic Clay Liners (GCLs): Introduction and basic properties; Swelling and hydraulic characteristics; Solute and gas migration; Installation of GCLs; Role of GCLs in composite liners; Equivalency of GCLs and CCLs. Geomembrane Liners (GMs): Physico-mechanical response of GMs; Endurance properties of GMs, Service life estimation by considering ageing of GMs; Leakage through GMs and Installation & seaming of GMs. Design of cover systems: Introduction; Common final cover systems; Infiltration theories; Calculating percolation through cover systems; Erosion assessment; Evaluation of drainage layer capacity; Cover slope stability analysis

Text Books

- Rowe, R. K., Quigley, R. M., Brachman, R. W. I. and Booker, J. R. (2004). "Barrier Systems for Waste Disposal Facilities", Taylor & Francis, London, UK.
- Sharma, H. D. and Reddy, K. R. (2004), "Geoenvironmental Engineering: Site Remediation, Waste Containment and Emerging Waste Management Technologies", John Wiley & Sons, New Jersey, USA.

Reference Books

- Shukla, S. K. (2012), "Handbook of Geosynthetic Engineering", ICE Publishing, London, UK.

- Koerner, R. M. (2012), "Design with Geosynthetics", Xlibris Corporation, USA.
- Fetter, C. W. (2008), "Contaminant Hydrogeology" Waveland Press, Illinois, USA.
- Datta, M., Parida, B.P., Guha, B.K. and Sreekrishnan, T. (1999), "Industrial Solid Waste Management and Landfilling Practice", Narosa Publishers, Delhi.
- Regulations and guidelines developed by USEPA, <http://www.epa.gov/>
- Regulations and guidelines proposed by CPCB, Ministry of Environment & Forest, GOI, <http://www.cpcb.nic.in/>

Prerequisite: NIL