2.5Application of geo-synthetics in solid waste management

What are Geosynthetics?

Application of geo-synthetics in Containment and landfill

Application of Geosynthetics in waste management.

Rigid or flexible liners

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What are geosynthetics?

Geosynthetics are polymeric (plastic) man-made products used to solve geotechnical problems in construction projects. They may be planar, strips or three-dimensional structures. The , filtration, drainage, erosion control or containment of liquids.different types of geosynthetics are uniquely designed to deliver varying functions such as stabilisation, reinforcement, separation

filtration, drainage, erosion control or containment of liquids. The purpose of geosynthetics can be derived easily from the word itself. . 'Geo' means earth, in the sense of ground or land, and 'synthetic' means manmade, in the sense of an artificial substance.

Application of geo-synthetics in Containment and landfill

New landfill sites can be lined with layered geosynthetic systems comprising geosynthetic protection, drainage composites and impermeable barriers. Capping of landfill sites will utilise drainage composites and barriers for gas containment and venting. The mining industry uses impermeable membranes to line tailings lagoons, while geogrids and geocomposites may be used to stabilise lagoon capping after use.

Application of Geosynthetics in waste management.

Serving the functions of separation, filtration, drainage, barrier, and protection, the versatile and robust geosynthetics provide optimum results in waste management techniques.

Waste Management with Geosynthetics:

Geosynthetic Type	Function	Description
Nonwoven and woven geotextiles, geocells, and geocomposites	Separation	They are placed between two dissimilar materials retaining the integrity and functionality of both.
Nonwoven and woven geotextiles, geocomposites.	Filtration	They allow the water or gas to flow through but retain the finer particles.
Woven geotextiles, geocomposites, geogrids, and geocells.	Reinforcement	They provide durability and stability in materials lacking tensile capacity.
Nonwoven geotextiles, geomembranes, geocomposite, geonet, and geosynthetic clay liners.	Barrier, hydraulic and gas	Relatively impermeable, they help contain liquids and gases.
Nonwoven geotextiles, geosynthetic clay liners, and geocomposites.	Protection	They act as cushioning during the overlying placement of materials and prevent damage.

Nonwoven geotextiles, geocomposites, geopipe, and geonets.	Drainage	The heavy-duty nature allows the flow of water and leachate.

Landfill Lining Solutions:

With increasing waste volumes and the hazardous nature of the leachate at landfills, groundwater contamination is a high possibility. The geosynthetic clay liners, composites, and geomembranes provide lining systems for protection at municipal solid wastes, bioreactors or nuclear waste landfills, demolition debris, and industrial hazardous waste landfills.

Leachate drainage systems:

The factors such as elongation, chemical resistance, durability, and strength make the geocomposite drains and geonets the perfect and cost-effective alternative to traditional methods for leachate drainage.

Capping systems:

All landfills require an efficient capping system preventing the dispersion of gas that is detrimental to the environment. As capping systems, the geosynthetic clay liners and geocomposite drain provide a distinct advantage. They help in draining, collecting, and conveying gas and runoff, providing robust protection.

Gas collection systems:

Further, in the capping systems, geonets prevent breaches and remove the hazardous gases generated from the decomposition of waste in a landfill, preventing localized areas of high gas pressure in the liners.

Dewatering:

The Geotube dewatering technology uses durable geotextiles with filtration and retention abilities that help abundantly with the dewatering of sediments from site runoff. Wastewater and sludge are pumped into the permeable geotubes, then treated with flocculants, and the moisture drains through the geotextile pores under pressure. It is treated

and returned to native waterways, and the sediments reprocessed.

Rigid or flexible liners

What is a Geosynthetic liner?

Geosynthetic clay liners (GCLs) represent a relatively new technology (developed in 1986) currently gaining acceptance as a barrier system in municipal solid waste landfill applications.

Figure 2.5.1 Geosynthetic liner

GCL technology offers some unique advantages over conventional bottom liners and covers. GCLs, for example, are fast and easy to install, have low hydraulic conductivity (i.e., low permeability), and have the ability to self-repair any rips or holes caused by the swelling properties of the bentonite from which they are made. GCLs are cost effective in regions where clay is not readily available. A GCL liner system is not as thick as a liner system involving the use of compacted clay, enabling engineers to construct landfills that maximize capacity while protecting area ground water.

A GCL is a relatively thin layer of processed clay (typically bentonite) either bonded to a geomembrane or fixed between two sheets of geotextile. A geomembrane is a polymeric sheet material that is impervious to liquid as long as it maintains its integrity. A geotextile is a woven or nonwoven sheet material less impervious to liquid than a geomembrane, but

more resistant to penetration damage. Although the overall configuration of the GCL affects its performance characteristics, the primary performance factors are clay quality, amount of clay used per unit area, and uniformity. Bentonite is an extremely absorbent, granular clay formed from volcanic ash. Bentonite attracts positively charged water particles; thus, it rapidly hydrates when exposed to liquid, such as water or leachate. As the clay hydrates it swells, giving it the ability to "selfheal" holes in the GCL. In laboratory tests on bentonite, researchers demonstrated that a hole up to 75 millimeters in diameter will seal itself, allowing the GCL to retain the properties that make it an effective barrier system.