

Geo Solutions for Civil and Geotechnical Engineering

Geotech

Textile products have also offered inventive engineering solutions for several applications in civil and geotechnical engineering and for infrastructure in water resources projects. Geotech materials are permeable and have been designed for uses such as soil reinforcement, separation, filtration, drainage and erosion control. Products in Geotech segment are used in nonwoven, woven and knitted forms in roads, railway tracks, embankments, waterworks etc.

Geocell used as Approach slab in Western railways, Mumbai project



Application of Geocell for Reservoir lining

(Image courtesy: Strata Geosystems (India) Pvt. Ltd., Mumbai)

Major products in Geotech segment are Geotextiles, Geomembranes, Geonets, Geogrids, Geostrips, Geocomposites, Geotextile tubes, Geomats, etc. Brief introduction of the Geotech products as follows:

1. Geotextiles

Geotextiles are permeable material fabricated like a blanket from synthetic yarns or fibres. There are three main types of geotextiles: woven, nonwoven and knitted type. Most of the woven and nonwoven geotextiles are manufactured from yarns and fibres such as polypropylene, polyester, polyethylene and polyamide. A few geotextiles are produced from natural fibres such as jute due to its biodegradable nature. Such geotextiles are mostly used in erosion control applications. The major applications of Geotextiles are in roads and highways for reinforcement, separation, drainage/filtration, containment and erosion control.

2. Geomembranes

Geomembranes are generally low permeable membrane liner or barrier which are available in large custom panels or rolled goods that can be field seamed to regulate fluid (liquid or gas) migration in a system. These are produced from various types of polymers (e.g. LLDPE, HDPE, PVC, CSPE, EPDM and PPE) as well as layered fibre glass and bitumen-impregnated geotextile. The most common use of geomembranes is the containment of hazardous and urban waste and their leachates.

3. Geonets, Geogrids and Geostrips

Geonets and geogrids are the terms for geosynthetic materials of rigid type that are fabricated in the form of a regular mesh with relatively large voids in the material. Geostrips are fabricated in the form of strips. Geonets and geogrids are produced by different methods (e.g. extrusion, bonding, and interlacing) from polymeric materials.

Geonets and geogrids are typically used to provide reinforcement of soil structure beneath civil construction or roads by distributing the load over a broader area. Geonets/geogrids are of two types: biaxial and uniaxial. Biaxial geonets and geogrids are used in roadways, where they are used to stabilise or to reinforce the base materials. Uniaxial geogrids are mainly used to reinforce the soil mass in a steepened slope or segmental retaining wall and to a small extent as a wrapping to confine the aggregate in the wire forms of welded wire faced steepened slopes. Geonets are being used in railway construction on account of their ability to act as filters, separators, and facilitators in channelising water through lateral drainage. In addition, they are used for the reinforcement of rail tracks for stress reduction, thus ensuring long-term efficient performance. Roads and highways, railroads, airports use geogrids to reinforce runway and embankments. Geonets and Geogrids are typically fabricated from high-density polyethylene (HDPE), polypropylene, polyester or fiberglass yarn. To provide the geogrid with dimensional stability during handling and installation, the yarns may be coated with PVC, bitumen, or latex.





4. Geocomposites

Geocomposites are those materials which are made of two components viz. geofabric and geonet. These consist of a combination of geotextiles, geonets, geogrids, and/or geomembranes. It is the desired characteristics of the end-product which determines the mix of geocomposite materials and manufacturing methods. Geosynthetic clay liners or GCLs, which are fabricated with a bentonite clay layer either sandwiched between two layers of geotextile or else bonded to a geomembrane or single layer of geotextile are also considered as Geocomposites. The hydrated GCLs are mostly used in landfill liner applications in combination with a conventional geomembrane. The most common type of geocomposite is drainage geocomposites which consist of a three-dimensional core layer through which fluid or gas flows, with geotextiles attached to one or both sides to filter out soils and other particulates that could impede the fluid flow through the drainage core and thus provide stability to the soil by providing friction for shear stability on slopes.

5. Geotextile tubes

Geotextile tubes are among the most commonly used and most economical choice for dewatering a large site, water reservoir or waste water treatment plant. Dewatering tubes remove and control sludge or sediment from a water flow and are a very good alternative to mechanical methods used for dewatering. Geotextile tubes are made of robust woven geotextile material (using specially engineered woven and composite fabrics) and involve the fabrication of close-ended tubular containers attached with filling ports at regularly spaced intervals. The technology involves the fabrication of large containers made of specially engineered textiles, which are filled with dredged sediments or sand on-site. Geotextile tubes are environmentally friendly because the decanted water can be recycled as also the water that is placed into storm drainages or water tables. The large-size Geotextile tubes with high strength and durability can act as effective sludge tubes for heavy containment requirements. Geotextile tube systems are often used for coastal and marine construction for erosion control on the shores, land reclamation, island creation, wetlands creation, construction platforms, revetments, dykes, and offshore structures.

6. Geomats

Geomat is a flexible material, an alternative to massive concrete, stone or asphalt constructions. Due to open surface and strip hardness Geomat can be easily filled with soil all over its area and depth and it encourages root germination, quick vegetation of slopes and thus guarantees erosion control. With right choice of the material and observation of assembling technique erosion damages can be eliminated even on difficult areas and steep slopes. Geomats are used mainly for controlling soil erosion especially on slopes to offer resistance to rain induced erosion. Geomats may also be used as a protection against erosion for canal and river banks.

Synthetic Geomats are usually made of synthetic material filaments (typically polyamide and polypropylene but not always) tangled together to form a high deformable layer of 10-20 mm thickness, featuring very high porosity (greater than 90% on average). Natural fibre based Geomats are commonly made from Jute and Coir fibres.

7. Geocells

Geocell is a thin-walled cell that, when filled with soil, sand or gravel, enhances the load bearing capability of soft subgrade much better than compacted soil alone. Geocells are usually interconnected to form a honeycomb shape which provides reinforcement through cellular confinement and prevent sub-optimal soil from getting eroded. Geocells have been constructed from a variety of materials, including fibreglass and aluminum. However, high density polyethylene (HDPE) is becoming immensely popular as a suitable material for Geocells.



Geocell for Load support application

8. Market size of Geotech

The global market size of Technical Textiles is expected to grow from US\$ 217.80 Bn (2019-20) to US\$ 278.84 Bn at a CAGR of 5.06% during the period of 2020-25. India is now emerging as a key player in Technical Textiles industry contributing to a market size of Rs. 1,22,943 Crores (US\$ 18,879.45 Million) in 2019-20 and expected to grow Rs. 182,742.15 Crores (US\$ 28,062.37 Million) in 2024-25 (*Reference: Baseline Study 2020 by IIT Delhi- “Technical Textile Industry in India: Opportunities and Challenges”*).

Geotech is fast growing Technical Textiles segment with estimated market size of Rs. 2050 crores in year 2019-20 and expected to grow Rs. 4483 Crores in year 2024-25. In Geotech, Geotextiles form the biggest portion of the domestic market at a share of 37.32% and Geonets, Geogrids and Geostrips at 25.12% have the second largest share. Globally, Geotextiles have the biggest market share at approximately 43% and Geomembranes at nearly 28% have the next largest share.

Table 1: Geotech - World and India Market Size 2019-20 (*Reference: Baseline Study 2020 by IIT Delhi- “Technical Textile Industry in India: Opportunities and Challenges”*)

Product Name	World (US\$ Million)	India (Rs. Crores)	India's Share (%)
Geotextiles	3184	765	3.69
Geomembranes	2105	290	2.12
Geonets, Geogrids and Geostrips	1305	515	6.06
Geocomposites	350	268	11.76
Geotextile tubes	205	61	4.57
Geomats	196	55	4.31
Others	100	96	14.74
Total	7445	2050	4.23

9. Major indigenous manufacturers of Geotech

- 1) Strata Geosystems (India) Pvt. Ltd., Mumbai
- 2) Techfab India Ltd., Mumbai
- 3) Maccaferri Environmental Sol. Pvt Ltd, Pune
- 4) Terram Geosynthetics Pvt Ltd, Ahmedabad
- 5) Maruti Rub-Plast Pvt. Ltd., Delhi
- 6) Geosys India, Ltd., Noida