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Geo textiles and its application

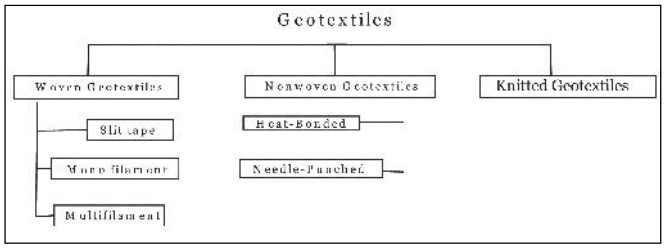
Sangeeta Sharma[1] and Aastha Khatri[2]

[1]Department of Textiles and Apparel Designing, Maharana Pratap University of Agriculture and Technnology, Udaipur (Rajasthan) India

[2]Department of Home Science Extension and Communication Management, Maharana Pratap University of Agriculture and Technnology, Udaipur (Rajasthan) India

As its name suggests Geo textiles refers to textiles related to earth or soil. When any permeable material used with rock, soil or earth it is termed as Geo textiles. The basic function of this technology is to prevent soil erosion to strengthening heavy concrete structures. This technology has not yet gained much attention in India, but is widely used in many countries for construction of bridges, roads, railway tracks to improve its strength. Many researchers have view that this technology is not newly developed but is in use from past thousands of years.

Classification of Geo textiles : On the basis of construction of geo textiles, it can be classified as woven and non-woven.



Geo textiles are generally made up of woven, non-woven and knitted type of fabrics.

Non-woven geo textile : The arrangement of fibers in case of non-woven geo textiles is either tilting or randomly patterned in a sheet. It has special application for controlled water flow in addition to stabilization of soil. It is widely used filtration processes, roads, asphalt pavement overlays, and erosion control. Nonwoven fabrics can range in thickness from a thin, lightweight material (4 oz./s.y.) to a fairly thick felt-type material (over 16 oz./s.y.). They are typically used for drainage purposes, such as in gravel under drains. General types of wovens are-heat-bonded and needle-punched.

Woven geo textile : Woven geo textile is made of two sets of parallel threads or strands systematically interweaved to form a thin and flat fabric. The strands used are either slit film which are flat or monofilament that are round. The pattern of weavings depends on where its application. When high strength property is needed, woven geo textiles is the best option. General types of woven are- slit tape, monofilament, multifilament.

"Slit tape" fabric has a flat tape-like strand produced by slitting and weaving a solid sheet of extruded film. These fabrics are the cheapest woven and are typically used in road stabilization/separation applications. A general price range would be 10 to 20 cents per square foot.

"Monofilament" fabric has strands which are like individual fishing lines. It is much higher quality than the slit-tapes and is correspondingly more expensive (generally 20 to 30 cents per square foot). Monofilaments are typically used for erosion control and drainage purposes.

"Multifilament" consists of many fine continuous filaments that are held together by twisting or intermingling the strands. Generally, multifilament fabrics are not commonly used for routine.

Knitted geo-textiles used Knitted bags for protection of dam's riverbank etc. Warp knitted fabric of Kevlar yarns used in automobile and marine application. It is also used with foundations, soil, rock, earth or any other related material as an integral part of human man made project, structure or system projects.

Geosynthetics : As the geo textiles is gaining application day by day, researchers are making efforts to expand and improve its scope of utility. One of the outcomes of such efforts is Geo synthetics. Natural fibers are realized insufficient to meet the tougher demands. Thus, new composites with varying properties are now being introduced which has more durability then natural fiber based geo textiles. It includes geo textiles, geonets, Geo membranes, geo grids, geo composites, etc. All of these have various civil engineering applications like separation, reinforcement, protection, filtration, drainage, and moisture barriers.

Geo textiles: These are either woven or non-woven. Woven geo textiles are produced by the interweaving of yarns. Non-woven geo textiles are needle punched, heat bonded, and chemically bonded.

Geo grids: Geo grids are meshes, form of a regular pattern of tensile elements. Geo grids are stiffer than geo textiles.

The tensile strength can prevent the degree of differential loads by spreading the load over a broader area of soil. In this way geo grids are used to strengthen fill materials in geotechnical applications. Most of all polymetric materials can be used to produce geo grids through process of interlacing, extrusion or bonding.

Geo membranes: These are basically impervious sheets produced from polymeric materials. Geo membranes cannot be manufactured from woven methods as it leaves voids which make it permeable. Geo membranes are produced from Pp, polyvinyl chloride (PVC), HOPE and PE. Each material gives different property to it, like PVC geo membranes are much flexible while Pp geo membranes are subjected to ultra violet (UV) radiations.

Geo composites: These are formed of combination of geo textiles, geo grids or geo membranes.

Applications :

– Geo Textiles in Road Industry

In the road industry there are four primary uses for geo textiles:

– Separation
– Drainage
– Filtration
– Reinforcement.

Separation or stabilization: The geotextile is used to permanently separate two distinct layers of soil in a roadway. The classic example is where a road is to be built across a poorly drained, fine-grained soil (clay or silt) and a geo textile is laid down prior to placing gravel. This keeps the soft, underlying soil from working its way up into the expensive gravel and it keeps the gravel form punching down into the soft soil. The full gravel thickness remains intact and provides full support for many years. Typically, woven and nonwoven geo textiles are used in this application. If a woven product is used, it should be at least 4 oz./sq. yd. and could be a "slit-tape" or monofilament" type for *routine, non-critical* situations. If a nonwoven product is used, it should be at least 8 oz./ sq. yd. for survivability during construction.

Drainage : The geo textile acts as a filter through which water passes while it restricts fine-grained soil from entering into coarse-grained soil (sand or gravel). An example is in an under drain where gravel-filled trenches lined with a geo textile fabric are constructed along the edges of roads. The fabric allows water to drain into the trench, while it permanently separates the different soil materials. The gravel remains clean and cannot "plug up" with fine material. Not only can it be used in roadways, but also under parking lots, walls, athletic fields, lawns, tennis courts, and other areas. Normally, nonwoven fabrics are used because of their small pore size (opening size) and high flow capacity. They should be at least 4 oz./sq. yd. If installation stresses are more severe such as where sharp angular aggregate is in contact with the fabric, or a heavy degree of compaction is required, then a heavier nonwoven with a minimum of 8 oz./sq. yd. should be used. Woven fabrics can be used but they should be of the "monofilament" variety. "Slit-tape" woven should not be used for drainage applications because of their poor capacity to pass water.

Erosion control: A layer of heavy stones or broken rocks (riprap) is commonly used to provide erosion protection for stream banks, culverts, ditches, stream channels, shorelines, and bridge structures. A geo textile placed between the rock layer and the underlying soil surface provides anchorage of the underlying soil and protects it from erosion and wave attack Two key properties are important for proper erosion control. It must have sufficient capacity to pass water, especially if water is coming from behind the fabric. Second, the geo textile must be able to retain the finer soil particles under the fabric. Typical geo textiles used for erosion control are medium weight (8 oz./sq. yd.) nonwoven fabrics or "monofilament" woven fabrics. In some instances where the riprap is rounded or the fabric is protected by a this sand cushion before the riprap is placed, a lighter weight fabric (4 oz./sq. yd.) could be used, if care is exercised during riprap placement.

Reinforcement: In some areas, construction is proposed in "soft" areas where the foundation soils are too weak to support a road or structure. Without sufficient reinforcement, the foundation cannot "hold up" the structure and it fails at considerable expense. When this condition exists, usually a soils engineer is needed to design the facility and the underlying geo textile and/or geo grid.

Geo textiles in pavement repair: A major contributor to roadway deterioration is water beneath a pavement which softens sub-grade soil which destroys pavement structural capacity. A pavement with a base which becomes saturated as little as 10% of the time will only have 50% of the life of a pavement where water is kept out of the base. Most of this water enters through cracks and pores in the pavement surface Paving fabrics and repair membranes are engineered to reduce water infiltration and reflective cracking, thereby saving on costly repaving cycles. They have been proven to extend the life of highways, city streets, parking lots, and airport runways and taxiways. These kind of geo-textiles are used in new asphalt pavements, beneath overlays of rigid and

flexible pavements, and beneath chip-seal pavements. A needle punched, nonwoven polypropylene paving fabric which provides a moisture barrier over the full width of the paving surface when combined with an asphalt cement tack coats sub-grade. It helps in extending pavement life while reducing maintenance costs.

Geo textiles in retaining walls: Retaining walls help to maximize their land use. However, building a concrete gravity or crib wall is often impractical because of their high construction cost. Geo textiles are used for a wide assortment of reinforcement applications, including embankments over soft soils, levees and retaining walls. Geo textiles are well-suited to construction of walls with timber, precast panel and segmental block facing. In fact a geo textile retaining wall can be built for less than half the cost of a conventional wall. Woven geo textiles offer other significant advantages over conventional methods, such as simplified installation and construction, and the ability to use on-site backfill material. Polypropylene geo textiles cost approximately half the amount of polyester and polyethylene geo grids, and they require considerably less labor to install.

Geo textiles subsurface drainage: Geo textiles have replaced graded soil filters for drainage of virtually all structures, including groundwater intercept systems, pavements, building foundations, dams and walls. Compared to conventional soil filters, geo textiles offer advantages by providing a consistent and continuous filter, reduced excavation, reduced environmental impact, simplified, higher quality construction and a substantial reduction in material costs. Both woven and nonwoven geo textiles perform well when draining stable, coarse-grained soils. Nonwovens are generally used when the retention of fine soil particles is critical to the performance of the drainage system. Geo textile strength properties are selected to ensure that the geo textile survives construction and remains intact to perform as a filter.

Geo textiles erosion control: Geo textiles have replaced graded granular filters used beneath riprap or other armor materials in revetments. Applications include drainage channels, shorelines, and bridge and pier scour protection systems. Without a geo textile filter, wave action and water movement erode sub-grade soils from beneath the riprap or armor. Degradation of the sub-grade negates the benefit of the riprap or armor, resulting in extensive repair and replacement. The selection of geo textiles for permanent erosion control is similar to subsurface drainage. However, permanent erosion control applications usually require higher geo textile strength properties. The geo textile must survive placement of possibly very large, angular riprap, plus be able to endure severe wave action.

Geo textiles waste containment: Waste containment and environmental cleanup projects demand geo textiles with uncompromising physical properties and consistent product quality. In environmental applications, geo textiles must retain these critical properties while exposed to harsh chemical environments.

Waste containment fabrics serves in a variety of environmental applications, including filtration of fluid and gas collection systems, protection of geo membrane liners, waste daily covers and reinforcement. Geo textiles are specified for municipal waste and hazardous waste landfills, heap leach pads, sewage treatment lagoons, as well as waste containment ponds and other surface impoundments.

Geo textiles railroad stabilization: Maintaining track bed geometry is critical for efficient railroad operation. Sub-grde pumping into the overlying ballast can create an uneven track bed, resulting in delayed arrivals and even derailments. Geo textiles perform multiple functions in railroad applications. Nonwoven fabrics are used to stabilize both new and rehabilitated tracks. They prevent contamination of new ballast with underlying fine-grained soils and provide a mechanism for lateral water drainage. Using nonwoven geo textiles beneath track beds ensures that the ballast can sustain the loads for which it was designed. These geo textiles are used in all track applications, including switches, turnouts and grade crossings. High-strength woven geo textiles can also be used to reinforce weak sub-grade soils and reduce required embankment fill materials.

Selection of Geo textiles : Selection will depend on the actual soil and hydraulic conditions, the following general considerations seem appropriate for the soil conditions given:

Graded gravels and coarse sands : Very open monofilament or multifilament woven may be required to permit high rates of flow and a low risk of blinding.

Sands and gravels with less than 20% fines (very "dirty" or silty sand and gravel) : Open monofilament wovens and needle punched nonwovens with large openings are preferable to reduce the risk of blinding. For thin heat-bonded nonwoven geo textiles and thick needle punched nonwoven geo textiles, filtration tests should be performed.

Soils with 20% to 60% fines (silt or silty sand) : Filtration tests should be performed on all fabric types.

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