Standardization in the field of Geotech

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GEOTECH SECTOR AT A GLANCE

- Geotech segment comprises of technical textiles products used in geotechnical applications pertaining to soil, rock, earth etc. The key products in this sector are woven and non woven geotextiles, geobags, Geo grids, Geocells, Geo tubes etc.
- Geotech market is mainly constituted by woven and non woven geotextiles which make up for 85% of the market. The market for geotextiles have grown at a significant rate of 30% during the last five years.
- The geotech is projected to grow to Rs. 991 crore by 2015-16 at 13% CAGR and further to Rs. 1275 crore by 2017-18

Standardization of Geotech

- Standardization in the field of Geosynthetics has been undertaken by Geosynthetics Sectional Committee, TXD 30 under Textiles Division Council at BIS:
- Scope - **To formulate Indian Standards on terminology, classification and method of test and specification for all types of Geosynthetics (woven and non-woven)**
- Number of standards formulated- 63
- Number of standards under development-07
- Product Standards-12
- Code of practices-08
- Method of tests- 39
- Termonogy-01
- Others-03

IMPORTANT PUBLISHED STANDARDS ON GEOTECH

- **IS 16653 : 2017 Geosynthetics — Needle punched nonwoven geobags for coastal and waterways protection — Specification**
- Specifies requirements for three types of geobags (300/400/600 GSM) made from needle punched non-woven fabric of polyester (PES) or polypropylene (PP), used for coastal and waterways protection applications such as revetments; river training; construction of groynes and artificial reefs; etc, in order to minimize soil erosion and control floods.
- Geobag technology possesses minimal impacts on fish resources and facilitates fishing activities. It facilitates the algal community to grow.
- The technology has been popular worldwide due to its easier installation, cost effectiveness, their technical efficiency and environmental friendliness in comparison to the conventional erosion protection work using cement concrete block, gravel, hard rock, etc.

IS 16653:2017

- One major advantage of geobags is that these small volume units can be used to construct hydraulic and marine structures that require adherence to designed geometrical shape accurately.
- This standard specify the following requirements:

a) **Mechanical properties** to ensure durability like Wide width tensile strength (MD & CD), Elongation %, Seam strength, Abrasion resistance (By loss in strength after abrasion or by simulating abrasion loads caused by movement of rocks in a revetment), Trapezoidal tear strength and CBR puncture resistance and UV stability after 500 h.

b) **Hydraulic properties** like permittivity, water permeability at 100 mm water head and Apparent opening size.

c) **Physical properties** like thickness, mass, dimensional requirements (Small bags- 1.0 X 0.7 m, Large bags- 2.0 X 1.5 m), mass of sand to be filled etc.

d) Prefabrication requirements for geobags like number of stitches, type of thread for stitching etc.

IS 16654:2017

- **IS 16654:2017 Geosynthetics — Polypropylene multifilament woven geobags for coastal and waterways protection — Specification**
- This standard specifies requirements for geobags made from polypropylene (PP) multifilament woven geotextiles, used for coastal and waterways protection applications such as revetments, river training, construction of groynes and artificial reefs, etc in order to minimize soil erosion and control floods. This standards specify two type of geobags of 200 and 300 GSM.
- The survivability/durability of geobags depends upon water pressure, soil condition, type of contents of geobags that is sand or gravels, water *p*H and temperature, etc.
- Woven slit film geotextiles, that is, geotextiles made from yarns of a flat, tape-like character, shall not be used for the manufacture of geobags for permanent erosion control applications.

IS 16352:2015

- **IS 16352:2015 HIGH DENSITY POLYETHYLENE (HDPE) GEOMEMBRANES FOR LINING**
- High density polyethylene geomembranes, are very low permeability synthetic liners used to control fluid or gas migration within soil, rock, earth or any other geotechnical material, as integral part of a manmade product, structure or system. The original use of geomembranes was for the distribution, storage and containment of potable agricultural water supplies. It still remains as an important element of this market, except now it has been broadened to contain a wide variety of liquids.
- Geomembranes have become the design choice as part of a cover system due to a variety of factors such as imperviousness, chemical resistance, inertness to surrounding soils, ease and variety of seaming, mechanical strength and elongation, ease of application and economics, product durability and ageing over the designed life of the containment system.
- Includes Six type of geomembranes having thickness 0.50, 0.75, 1.00, 1.50, 2.00, 2.50 and 3.00 mm.

IS 16090:2013

- **IS 16090:2013 Geo-textiles used as Protection or Cushioning Materials**
- Most solid and hazardous waste landfills, lagoons and reservoirs built today incorporate geo-membranes to contain liquids. Although these low permeability liners have demonstrated excellent performance, they are susceptible to damage when drainage stone or alternate drainage media (such as shredded tires, crushed glass, etc) are placed over them. In addition, geo-membranes are prone to damage from isolated protrusions present in the sub-grade onto which they are deployed.
- This standard specifies requirements for needle punched non-woven geo-textiles used as protection (or cushioning) materials adjacent to (above and/or below) a geo-membrane to protect it from construction and operational damage in typical applications including solid waste landfills and liquid impoundments with varying load, sub-grade and cover sub-grade soil conditions.
- Include 6 types of cushioning materials with GSM of 300, 400, 600, 800, 1000 and 1200.

Geotextiles for separation, erosion control, sub surface drainage and stabilization

- **IS 16391:2015 Geotextiles used in sub-grade separation in pavement structures**
- This standard covers general and performance requirements for geotextiles used to prevent mixing of a sub-grade soil and an aggregate cover material (subbase, base, select embankment, etc) in pavement structures.
- The separation application is appropriate for pavement structures constructed over soils with California Bearing Ratio greater than or equal to three (CBR ≥3) and shear strength greater than approximately 90 kPa. It is appropriate for unsaturated sub-grade soils. The primary function of a geotextile in this application is separation.
- The geotextile separator may provide one or more of the following functions:
- a) A filter to allow water but not soil to pass through it;
- b) A separator to prevent the mixing of the soft soil and the granular material; and
- c) A reinforcement layer to resist the development of rutting.

Geotextiles for separation, erosion control, sub surface drainage and stabilization

- **IS 16392:2015 Geotextiles for permanent erosion control in hard armor systems**
- Soil banks or slopes exposed to constant concentrated flows, currents or waves cannot support vegetation and thus need to be protected from erosion by hard armor systems. These systems include fabric formed revetments, gabions, articulating concrete blocks and riprap. In a hard armor system, water can seep in or out of the bank or slope and gradually carries soil particles with it creating voids causing loss of armor support over time called piping and thus culminates in shifting, rolling or other instability in the armor system.
- Geotextiles with specific hydraulic and soil retention properties to complement the soil needing protection can be used as standard filter layers for hard armor systems as these can be installed with ease on slopes even under water and are cost effective. Depending upon the gradation of the bank soil, either a non-woven or a woven geotextile can be selected and used beneath hard armor system in an erosive environment.

Geotextiles for separation, erosion control, sub surface drainage and stabilization

- **IS 16393:2015 Geotextiles used in subsurface drainage application**
- This standard specifies requirements for two classes of geotextiles used in drainage application such as subgrade dewatering, road base drainage and structure drainage by placing the geotextile against the soil to allow long-term passage of water into a subsurface drain system retaining the *in-situ* soil.
- Class 1 geotextiles are for applications where applied stresses are more severe, that is, very coarse shape angular aggregate is used, compaction is greater than 95 percent of maximum density or depth of trench is greater than 300 mm.
- Class 2 geotextiles are suitable for drainage applications which are less severe, that is, smooth graded surfaces having no sharp angular aggregate, compaction is less than or equal to 95 percent of maximum density.

Geotextiles for separation, erosion control, sub surface drainage and stabilization

- **IS 16362:2015 Geotextiles used in subgrade stabilization in pavement structures**
- This standard covers general and performance requirements for geotextiles used in wet and saturated soil conditions to provide the subgrade stabilization in pavement structures alongwith coincident functions of separation and filtration. In some installations, the geotextile can also provide the functions of reinforcement.
- The stabilization function of geotextile is applicable to pavement structures constructed over soils with a California Bearing Ratio between 1 and 3 ($1 < CBR < 3$), and shear strength between approximately 30 to 90 kPa. The stabilization application is appropriate for subgrade soils which are saturated due to a high ground water table or due to prolonged periods of wet weather.

Important standards formulated on Jute Geotextiles

- **IS 14715(Part 1):2016 Jute Geo-Textiles - Part 1 Strengthening of sub grade in roads**
- Lays down requirements of woven and non-woven jute geotextile (JGT) for strengthening of road sub-grades.
- Selection of jute geotextile (woven) shall be decided principally on CBR (California Bearing Ratio), grain size distribution of soil and the in-situ permeability of sub-grade soil, volume of traffic (denoted by ESAL-Equivalent Single Axle Loading) and the allowable rut-depth.

IS 14715(Part 1):2016

- Jute geotextiles covered under this standard are suitable for strengthening of flexible pavements on weak road sub-grades subjected to relatively low traffic load and intensity. Jute geotextiles control subsidence of a pavement by separating and preventing intermixing of the soft sub-grade and the harder sub-base, migration of soil particles and allows water to permeate across it.
- Jute geo-textiles is of following two types:
- a) Woven jute geo-textile having tensile strength in (MDXCD) of 25 X 25 kN/m.
- b) Non-woven jute geo-textile having tensile strength in (MDXCD) of 4 X 5 kN/m.

IS 14715(Part 1):2016

- **Requirements for Woven Jute Geo-textiles**

Characteristic	Requirement	Tolerance, Percent
Construction	1/1 DW Plain Weave	-
Weight at 20 % moisture regain, g/m^2, *Min*	724	-
Width, cm	As agreed	± 1
Ends × Picks / dm, *Min*	94 × 39	-
Thickness at 2 kPa, mm	1.85	± 10
Tensile strength in MD × CD, kN/m, *Min*	25 × 25	-

IS 14715(Part 1):2016

- **Requirements for Woven Jute Geo-textiles**

Characteristic	Requirement	Tolerance, Percent
Elongation at break in MD × CD, *percent*	10 × 10	± 10
Puncture resistance, kN, *Min*	0.500	-
Burst strength, KPa, *Min*	3500	-
Permittivity at 50mm constant head, sec^{-1}, *Min*	350×10^{-3}	-
Apparent opening size (A. O. S) , O95, *Micron*	150-400	-

IS 14715(Part 1):2016

- **Requirements for Non-Woven Jute Geo-textiles**

Characteristic	Requirement	Tolerance, Percent
Width, cm	150	± 1
Mass, g/m^2	500	± 5
Thickness at 2 kPa, mm	4	± 10
Tensile strength, KN/m, Min: a)Machine Direction b)Cross Machine Direction	 4 5	 - -
Elongation at Break, percent a)Machine direction b)Cross machine direction	 5 6	 ± 15 ± 15

IS 14715(Part 1):2016

- **Requirements for Non-Woven Jute Geo-textiles**

Characteristic	Requirement	Tolerance, Percent
Permittivity at 50mm constant head, sec^{-1}, *Min*	1.94	-
Bursting strength, kPa, *Min*	1750	-
Apparent opening size (A. O. S) , O95, *Micron*	265	± 10

IS 14715(Part 2):2016

- **Jute Geo-Textiles Part 2 Control of bank erosion in rivers and waterways**
- Bank erosion may be controlled effectively either by repulsion of flow away from the affected banks say, by construction of spurs or by providing a durable protection to the affected banks or by a combination of both these measures.
- Repulsion of flow can be effected by construction of suitable flow regulatory measures at appropriate locations. Protection of the banks is done by laying the appropriate woven jute geotextiles (JGT) on the affected bank duly prepared to a stable and undulation-free gradient (within the angle of internal friction of the bank soil) overlain by a layer of granular armour/riprap of adequate weight. Where feasible, suitable vegetation with a deep root system (as in *vetivar grass) may be planted.*

IS 14715(Part 2):2016

- The approach to control bank erosion is to ensure ‘sand tightness’ and the desired permittivity to prevent differential over pressure developing across the fabric. At the same time, it requires to be ensured that JGT shall possesses sufficient strength to withstand installation stresses (survivability of JGT) and retain the design strength up to at least 4 years for tidal rivers with two-way flows and 2 years for one-way flow.
- Use of woven JGT in controlling river bank erosion is recommended as an eco-friendly substitute of the conventional granular filter comprising graded boulders and ballasts of stone, laterite or similar materials of the desired specific gravity.
- JGT on its degradation will nourish the bank soil and improve its hydraulic conductivity, fostering quick growth of vegetation under normal situation.

IS 14715(Part 2):2016

- **Requirements for Treated Woven Jute Geo-textiles**

Characteristic	Requirement	Tolerance, Percent
Construction	1/1 DW Plain Weave	-
Weight at 20 % moisture regain, g/m^2, *Min*	627	-
Width, cm	As agreed	± 1
Ends × Picks / dm, *Min*	85 × 32	-
Thickness at 2 kPa, mm	1.70	± 10
Tensile strength in MD × CD, kN/m, *Min*	20 × 20	-

IS 14715(Part 2):2016

- **Requirements for Treated Woven Jute Geo-textiles**

Characteristic	Requirement	Tolerance, Percent
Elongation at break in MD × CD, *percent*	8 × 8	± 10
Puncture resistance, kN, *Min*	0.400	-
Burst strength, KPa, *Min*	3100	-
Permittivity at 50mm constant head, sec^{-1}, *Min*	350×10^{-3}	-
Apparent opening size (A. O. S) , O95, *Micron*	150-400	-

IS 14715(Part 2):2016

- For river bank protection purpose, the 627 gsm fabric to be treated with suitable additives.
- Width of the fabric shall not be less than 100 cm.
- AOS (O_{95}) is decided on the basis of average particle size distribution of soil and its hydraulic conductivity.

Other Important standards formulated on Geotech

- IS 15869 : 2008 Open weave coir Bhoovastra
- IS 15871 : 2009 Use of coir geotextiles coir Bhoovastra in unpaved Roads – Guidelines
- IS 15872 : 2009 Application of Coir Geotextiles Coir Woven Bhoovastra For Rain Water Erosion Control in Roads Railway Embankments and Hill Slopes – Guidelines
- IS 15909 : 2015 PVC Geomembranes for Lining
- IS 15910 : 2010 Geo-Synthetics for Highways
- IS 16343 : 2015 Guidelines for Installation of Geotexiles as Pavement Fabric
- IS 16344 : 2015 Guidelines for Installation of Geotextile for Permanent Erosion Control in Hard Armor Systems
- IS 16345 : 2015 Guidelines for Installation of Geotextile used in Sub-Grade Separation in Pavement Structures
- IS 16349 : 2015 Guidelines for Installation of Geogrids Used as Reinforcement of Base and Sub-Base Layers in Pavement Structures

Important standards under development on Geotech

- Specification for geo-grids used as reinforcement of base and subbase layers in pavement structures
- Specification for geogrids used as soil reinforcement in mechanically stabilized earth MSE retaining structures
- Geocells
- PVD
- Geosynthetics — Test method for the determination of water discharge capacity for prefabricated vertical drains

THANK YOU

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