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Objectives of BIS

- Harmonious development of standardization, marking and quality certification.
- To provide new thrust to standardization and quality control.
- To evolve a national strategy for according recognition to standards and integrating them with growth and development of production and exports.

The Indian Standards are formulated keeping in view national priorities, programmes for industrial development, technological needs, export promotion, consumer welfare, health, safety, etc. So far over 17000 standards have been formulated in different technology areas.

Open weave Coir Bhoovastra

Open weave Coir Bhoovastra (CBV) are permeable coir fabrics made from coir fibre extracted from coconut husk either by natural retting or by mechanical process. The open weave CBV are used for stabilization of soil through vegetation against erosion of landscape and soil slopes as well as protection of river bank, canal bank road and railway embankment and reinforcement of mud of stream against erosion and other applications involving separation and filtration. Open weave CBV control the soil erosion by acting as a ground cover or mulch. They are good insulators, resistant to dampness and moths and bio-degradable. Open weave CBV have been found to be ideal geotextile for situation where land is sloppy which may lead to rilling and gulling. The Open weave CBV initially hold the ground for seeds and seedling and provide a mechanical support against water action, help the germination of seeds for better growth of the plants conserving moisture and add organic matter in the soil after degradation.

Coir Bhoovastra has four Indian Standards published by Bureau of Indian Standards besides the constructional details for mesh mattings used as coir geotextiles.

1. IS 15869:2008 Textiles-Open Weave Coir Bhoovastra-Specifications

2. IS: 15868(Part 1 to 6): 2008 Natural Fibre Geo textiles (Jute Geo textiles and Coir Bhoovastra)-Method of Test

3. IS 15871:2009 Use of Coir Geo textiles (Coir Bhoovastra) in Unpaved Roads-Guidelines

These standards were published by the Bureau of Indian Standards after the draft was finalized by the Geosynthetics Sectional Committee and approved by the Textile Division Council.

4. Application of Coir Geo textiles (Coir Woven Bhoovastra) for Rain Water Erosion Control in Roads, railway Embankments and Hill Slopes-Guidelines

1. IS 15869:2008 Textiles-Open Weave Coir Bhoovastra-Specifications

This standard prescribes constructional details and other requirements of open weave Coir Bhoovastra (CBV) of three different grades used in prevention of erosion of soil and reinforcement of paved and unpaved roads.

An open weave CBV is woven fabrics of two treadles weave in construction made from coir yarn in which the warp and weft strands are positioned at a distance to get a mesh (net) effect of 1", 3/4" and 1/2" square. The open weave CBV shall have the following grades based on the mass.

a) Grade I- 400g/m^2
b) Grade II-700gm/m^2
c) Grade-III 900gm/m^2

Grade I- 400g/m^2

Grade II-700gm/m^2

Grade-III 900gm/m^2

The Coir Bhoovastra shall have the following requirements.

Sl.No.	Characteristic	Grade			Method of test
1	Mass/Unit Area, g/m^2 Min	400	700	900	IS 15868(Part 1 to 6)
2	Width, cm, Min	100 or as required	100 or as required	100 or as required	IS 12503(Part 1 to 6)
3	Length, m	50 or as required	50 or as required	50 or as required	IS 12503 (Part 1 to 6)
4	Thickness at 20 kPa, mm, Min	6.5	6.5	6.5	IS 15868 (Part 1 to 6)
5	Ends (warp)	180	150	210	IS 12503 (Part 1 to 6)
6	Picks (weft)	160	160	250	
7	Break Load, Dry (kN/m), Min a) Machine Direction b) Cross machine Direction	7.0 4.0	8.5 8.0	15.0 8.0	IS 13162 (Part5)
8	Break Load, wet (kN/m), Min a) Machine Direction b) Cross machine Direction	3.0 2.0	7.0 4.5	12.5 5.0	IS 13162 (Part5)
9	Peak Load, Dry (kN/m), Min a) Machine Direction b) Cross machine Direction	7.5 4.0	9.0 8.0	18.0 9.0	IS 13162 (Part5)
10	Peak Load, wet (kN/m), Min a) Machine Direction b) Cross machine Direction	3.0 2.0	8.5 5.5	15.0 6.0	IS 13162 (Part5)
11	Trapezoidal tearing strength (kN) at 25 mm gauge length, Min a) Machine Direction b) Cross machine Direction	0.18 0.15	0.35 0.30	0.50 0.35	
12	Mesh size, mm, Max	20.0x16.75	7.50x7.30	4.2x5.1	IS 15868 (Part 1 to 6)

The fabric shall be marked and packed with roll number, grade, length, source of manufacturer, month and year of packing, gross mass and number of pieces.

2. IS: 15868(Part 1 to 6): 2008 Natural Fibre Geotextiles (Jute Geotextile and Coir Bhoovastra)-Method of Test

This standard specifies the different methods for the determination of the different quality parameters of all natural fibre geotextiles for identification purposes and for use in technical data sheets. These methods are applicable to all natural fibre geotextiles such as coir bhoovastra, jute geotextile and erosion control blankets.

2.1. Determination of Mass per unit Area

This standard explains a method to determine the mass per unit area of all natural geotextile. The mass per unit area is calculated by weighing small square specimens of known dimensions. Ten specimens of 100cm^2 are cut from the material in such way that they are representative of the material to be tested. The area and weight of the specimens are determined to an accuracy of 0.5 and 0.1 % respectively. The mass per unit area of each specimen is calculated using the equation

$$p = (m \times 10^6) / a$$

Where

p = mass/unit area in g/m^2
m = mass of the specimen in, g
a = the area of the specimen in mm^2

The average mass per unit area is calculated.

2.2. Determination of Thickness

This standard describes a method for the determination of the thickness of geotextiles at specified pressures. The distances between a reference plate on which the specimen rests and a parallel presser-foot applying the given pressure to the specimen is define as the thickness of the geotextiles. A thickness tester apparatus capable of exerting a pressure of 2kPa is used. Test specimen shall be cut from the material from positions evenly distributed over the full width and length of the sample. The specimen is placed between the surfaces of the reference plate and pressure foot of the thickness tester. The presser-foot is load gentle over the specimen by applying a pressure of 2±0.01 kPa. The gauge reading is noted after 30 seconds. Remove the pressure and the specimen. The procedure is repeated for at least ten specimens. The average of all the readings is reported as the thickness of the geotextile. The thickness is expressed in mm to an accuracy of 1% for geotextiles thickness over 0.05mm and to the nearest 0.001mm for thickness not exceeding 0.05mm.

2.3. Determination of Percentage of Swell

This standard prescribes method for determination of the percentage of swell in water of geo textiles after it has been immersed in water for 24 hours. Ten specimens of size 100mmx100mm are used for the test. The thickness of each specimens is noted on thickness tester and recorded as the initial thickness t_i to the nearest 0.01mm. Now place the specimen between the two No.17 gauge wire mesh screens that have been soaked in water for a minimum of one hour .The screen corners are connected loosely to hold the test specimen in place. The test specimen is immersed in deionized water for 24 hours. After the soaking period, the specimen is removed from the assembly after allowing the water to drain of. The thickness of the drain specimen is measured as t_f. The percentage thickness change or swell is calculated as,

$$\textit{Percentage thickness change} = 100(t_f - t_i) / t_i$$

The procedure is repeated for 10 specimens.

2.4. .Determination of Water Absorption Capacity

This standard describes the method for determination of the water absorption capacity of geotextiles. A galvanized screen and pans are used for this method. Three specimens measuring 200mm x 200mm are prepared and weight the nearest 0.1g. Each specimen is placed on a tared 230mm x 230mm galvanized wire screen. Another tared screen having similar dimension is placed over the specimen. Now both screen and specimen is placed in a 76mm deep pan containing water at about 75mm deep. The specimen is allowed to soak for 24 hours. After the soaking period the specimen and the screens are allowed to drain for 10 minute and then weighed to the nearest 0.1g. The amount of water held by the specimen is calculated by subtracting the sum of the weights of the weighing pan, screens and dry specimens from the total weight.

The absorptive capacity is a ratio of the water held by the specimen to the weight of the original dry specimen.

2.5. Determination of Smouldering Resistance

This standard measures the smouldering resistance, which is the distance between an extinguished cigarette and maximum smoulder travel. This is of great concern since degradable erosion control materials are susceptible to flammability cause by cigarettes. A fan capable of providing 50 ft /min air velocity, a fire resistant square box having two holes of three inches diameter on opposite walls and a cigarette are used for determination of volume smouldering resistance. The fan is installed in one hole and the opposite hole acts as a vent. Three samples of diameter 300mm x 300mm are cut from across the roll to ensure representative specimen of the test material. The test specimen is placed on the base of the fire resistant square box. The fan speed is set to a velocity of 50ft/min across the center of the sample. A freshly lit cigarette is placed in the center of the specimen in a lengthwise direction with the direction of air. The cigarette is allowed to burn completely until it extinguishes. Upon extinguishments of the cigarette, measure the maximum distance in mm of specimen smoulder from the cigarette ashes. The procedure is repeated for two additional test specimens.

2.6. Determination of mesh size of coir geotextiles by overhead projector method

This standard specifies method to determine the mesh size by projecting the geotextile through an overhead projector (OHP). A sample of known dimension (20cmx 20cm) is placed on the OHP. The image is made to project on a screen and focused till a clear image is obtained. The length and breadth of the projected image are measured. The dimension of the projected meshes in both directions is also noted. Five sets of readings

may be obtained .The meshes may be chosen randomly so as to include all the mesh sizes. The mesh size is calculated as given below.

Length of the specimen	*= Ls*
Length of the projected sample	*= Lp*
Projected length of mesh	*= Sp*
Actual length of mesh, La	*= (Ls x Sp)/Lp*
Width of the specimen	*= Ws*
Width of the projected sample	*= Wp*
Projected width of mesh	*= Sp*
Actual width of mesh, Wa	*= (Ws x Sp)/Wp*
Mesh size	***= La x Wa***

The mesh sizes are measured in mm.

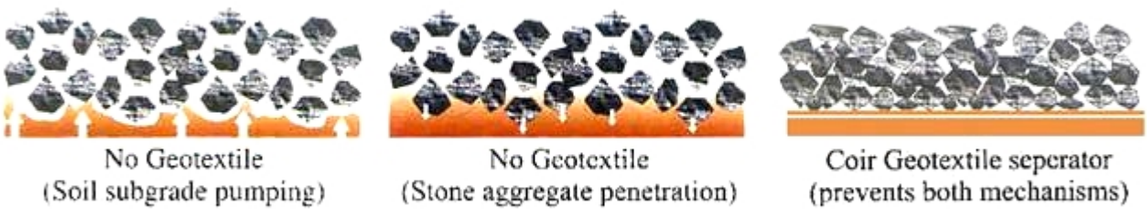
3. IS 15871:2009 Use of Coir Geo textiles (Coir Bhoovastra) in Unpaved Roads- Guidelines

This standard prescribes the guidelines of coir woven bhoovastra suitable for application in unpaved roads including the selection of coir woven bhoovastra and installed methods.

In order to perform beneficially in road stabilisation applications, the coir woven bhoovastra must not only be properly designed, it must be properly installed. Coir bhoovastra damaged during placement or installed in a highly wrinkled condition will not perform. The main functions of the coir bhoovastra in unpaved road application are separation, filtration, drainage and reinforcement.

A. Separation

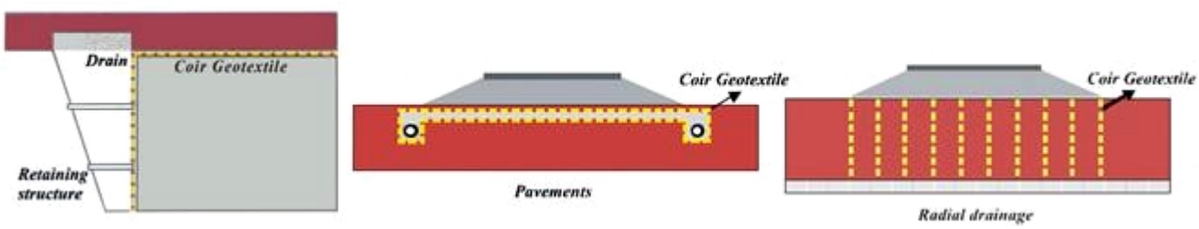
This is the principle function of coir woven bhoovastra when placed beneath the aggregate layer of an unpaved road. The coir woven bhoovastra prevents intermixing of aggregate and underlying subgrade soil. In the absence of a geotextile there is loss of aggregate thickness and intermixing of finer grained material reduces load bearing capacity.



This separation and confinement plus additional strength gained by frictional interlock between the aggregate and coir woven bhoovastra, helps to maintain the reduced stress on the subgrade thereby increasing load bearing capacity of structural section.

B. Filtration / Drainage

The coir woven bhoovastra may also function as a filtration and drainage capacity in the presence of wet or saturated soils. Under dynamic high load pore pressure create soil slurry that pumps upward against the fabric. The coir woven bhoovastra acts as a filter. It screens out fines from contaminating the aggregate layer while allowing water to drain freely through the aggregate or through the plain of the coir woven bhoovastra.

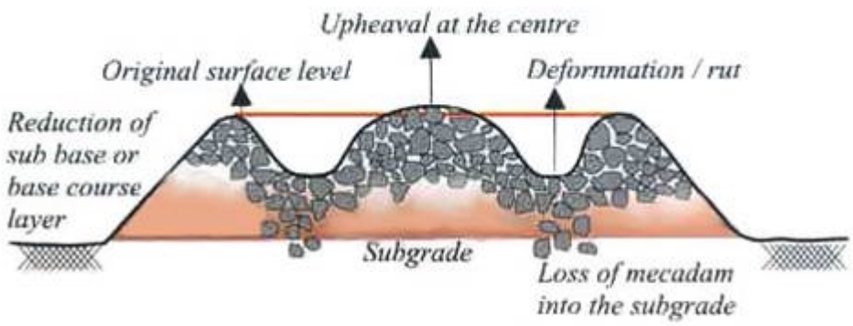


Coir Geotextile applications as drains and filters

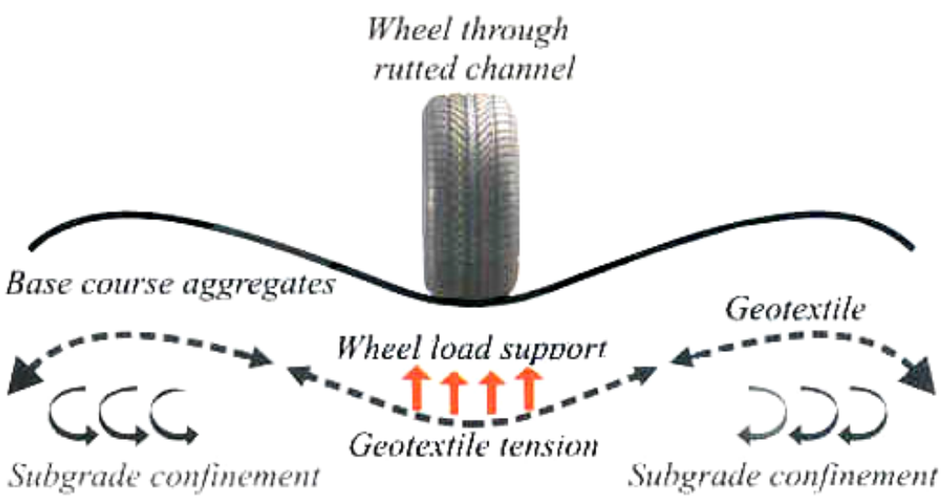
C. Reinforcement

The two principle mechanisms of the coir woven bhoovastra is to confine and restrain movements of the granular, structural layer and the so called membrane effect whereby a fabric that develops high tensile strength under load can induce a vertical stress upward. This aids the granular layer to support vehicular loading while reducing the magnitude of stress imposed upon subgrade. Coir woven bhoovastra will ensure that no intermixing takes place at this level and the effective depth of the pavement remains intact.

Reinforcement function of a coir geotextile



Typical unpaved road illustrating rut formation and loss of macadam into the subgrade soil



Load supported by coir geotextile through tensioned membrane action

Installation

The coir woven bhoovastra can effectively be used as a feasible material to soil stabilisation techniques in road construction. The use of coir woven bhoovastra varieties acts as an interface between the sub grade and the sub base increases the strength of the pavement and prevents intermingling of the soil and the granular sub base and improves drainage.

The rural unpaved roads are leveled, clearing of all foreign materials including uprooting of any vegetation if present. The area leveled with earth and rolled for compaction to the optimum moisture content. To facilitate easy unrolling on the surface of the sub-grade to be treated, the coir geotextiles, which come in rolls of 1m width, is spread directly over the leveled sub grade, ensuring that the coir geo textiles should touch the sub grade surface at all points.

Laying of coir bhoovastra at Kuttiyadi

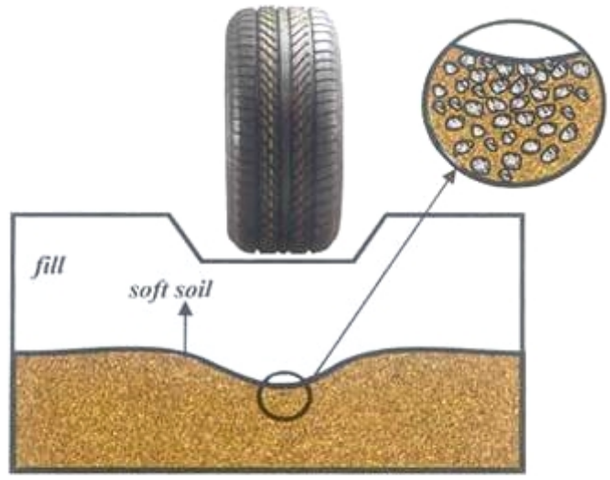
The edge of the coir geotextiles should be folded back. The coir geotextiles should be folded back or cut and overlapped in the direction of the turn on application in curve. The granular (local sand) material spread over coir geo textiles for15 cm thick to prevent puncture / damage due to rolling of the upper sub base/ base layer and rolled with a light or medium roller. Again spread the second layer of coir geotextile and spread the local sand over it 15cm thick and rolled. In the case of clayey sub-grades, a cushion layer of 10 cm thick sand is laid before spreading the coir geo textiles or coir geo textiles layers can be increased to 3 or 4 depending on condition of the soil.

Under the weight of the base layer and the compactive effect, the sub-grade loses water draining out through the coir geo textiles and gains in strength. Due to the inherent tensile strength, the coir geo textiles acts as a support membrane and reduces localised distress to the road surface by redistributing traffic loads over a wider area of the road surface. The coir geotextiles can be used for reinforcement for short duration on temporary roads and on rural roads where traffic intensity is less.

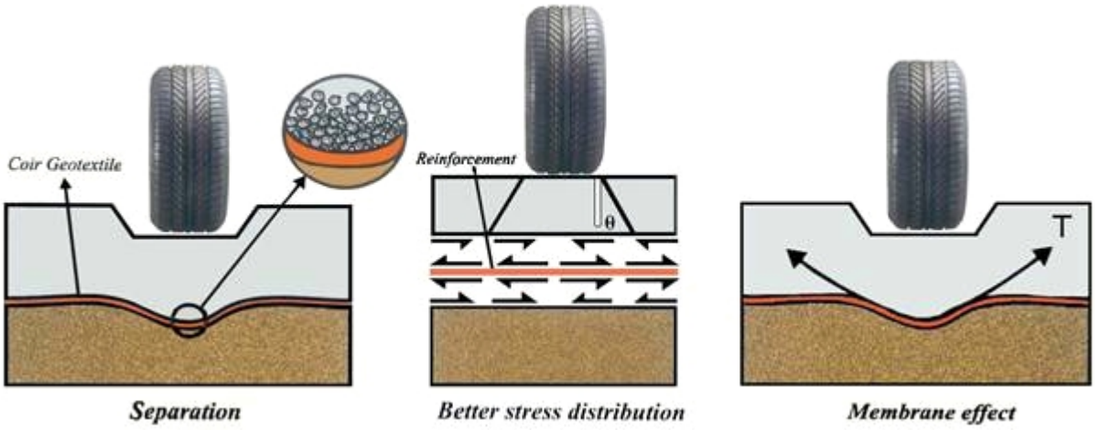
Installation of coir bhoovastra at Thaneermukkom

Once the coir geotextiles is placed on the weak sub grade, the sub grade stiffens and becomes stronger on consolidation within about a year or so under the action of the granular sub base surcharge, self-weight of pavement, construction rolling and traffic loads. The coir geotextiles immensely help in this rapid sub grade strengthening process in combination with the drainage layer above it. With time, the sub grade becomes less and less dependent on the fabric for its stability and therefore, the long-term durability aspect of coir should not deter its use as a geotextiles for various applications in road construction.

The coir geo textiles condition should be assessed for any constructional / installation damages before covering. Torn / damaged portions may be covered by pieces of coir geo textiles and the extent of overlap will be such as to cover the damaged / torn portion fully plus at least 75mm beyond, on all sides.



Typical degradation mechanism in unreinforced unpaved roads in soft soils



Influence of coir geotextile reinforcement on unpaved road behavior

4. Application of Coir Geo textiles (Coir Woven Bhoovastra) for Rain Water Erosion Control in Roads, Railway Embankments and Hill Slopes-Guidelines

This standard prescribes the code for guidelines of woven coir bhoovastra suitable for application in slopes of road and railway embankments and also in hill slopes including the selection of woven coir bhoovastra and installation methods.

Open weave coir bhoovastra made out of coir is used for this application. By the use of these coir bhoovastra the exposed soil surface road, railway embankments and hill slopes are protected from the impact of rain drops and surface wind, which may cause surface runoff.

Protection of Rail Embankment (Konkan)

Protection of Road Embankment (IIM(K) – Kozhilode)

The sides, top and bottom of coir geo textiles are anchored into clean trenches of 300mm deep and 150mm width, free from mud / soil slurry at the sides and the bottom Lay the coir geo textiles in rolls on the prepared surface firmly in the direction of water flow. The rolls are to be rolled down the slope and to cut at the end. The coir geo textiles should be laid loosely and evenly without stitch.

The open mesh coir geo textiles are laid side by side by overlapping of 150mm while end to end overlapping of two coir geo textiles is 200mm. The overlapping edges are fixed with the ground with the help of either 150mm long. U-shaped nails or 220mm long J shaped hooks made of 3 mm iron or steel wire.

The U shaped nails or J shaped hooks should be driven at intervals of 500 – 750mm; along sides and overlapping sections at a distance of 300-500mm. Wooden bamboo pegs may also be used for fixing the coir geo textiles. The hooks must be at the same level with the ground for smooth water flow over the joint to the next fabric.

Protection of Hill Slope (Kallar)

Protection of Hill Slopes (Itanagar)

Secure the top and bottom ends of the coir geo textiles into slots about 300mm deep, dug into the slope for the purpose. Fill in the slots with soil and tamp it flush with the soil surface. Peg down the coir geo textiles using U/J shaped or wooden pegs driven at intervals of 500-750mm, along sides and overlapping sections at a distance of 300-500 mm.

Do second seeding of grass at 10g per sq.metre after the coir geo textiles is in place. Finally, tamp the coir geo textiles flush with the soil surface. Care should be taken to ensure that no aggregate stays between coir geo textiles and the base soil either at the bottom sides.

Irrigate the treated slope as required to promote the growth of vegetation. Care must be taken to protect the treated site from trampling by human and cattle till vegetation comes up fully.

Close monitoring should be carried out for at least two-season cycle. Displacement of coir geo textiles, if any, is to be noted and watched without disturbing it initially. Fresh coir geo textiles pieces duly stapled on all sides may overlap torn portions.

The following table indicates the plants and grass used for soil conservation

Sl.No.	**Botanical Name**	**Suited for**
i)	Avicennia officinnalis	Shrub suitable for marshy places
ii)	Rhizophora mucrunata	Shrub suitable for marshy places
iii)	Cyperus exaltatus	Grass suitable for highway slopes
iv)	Acrostichuim aureum	Shrub suitable for dam sites
v)	Adiantum spices	Shrub suitable for dam sites
vi)	cyanodon dactylon	For light sandy soils
vii)	Cenehurs ciliaries	For most types of soils
viii)	Eragrostic curuvla	For protecting terraces and channels
ix)	Dianthum annulatum	Sandy light soil
x)	Pennisetum pedicellaltum	Sandy loam soil
xi)	Both rochola glabra	For red semi arid soil
xii)	Stylosanthis gracilis	For light soils with low moisture

The standards on Coir Bhoovastra focused on providing useful information on the performance of potential geotextiles used on unpaved roads, in order to sell them into the road construction industry. The purpose of the performance evaluations was to determine which fabrics would best perform the required functions of reinforcement, stabilization, and separation. With the standards on Coir Bhoovastra providing design and installation procedures, natural coir geotextiles perform even better and longer.