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Use of Geotextile Pavement in Road Construction In India

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Abstract: Geotextiles are generally used for straining and separation in road constructions, to prevent relocation and intermingling of materials, thus allowing free movement of water.Geotextiles act as a soupy mass between the two consecutive layers of soil. The geotextiles network should be enough stable such that no difficulty would arise during carrying, installation, and repair work in future. It is commonly divided into two categories: Woven and Nonwoven geotextiles. The functions performed by geotextiles are: drainage, sealing, filtration, separation, and reinforcement. The properties of geotextiles like, elongation, tensile strength, diffusive permeability, flexibility, etc are predominantly affected by its molecular weight. Polyamide, Polypropylene, Polyester, Polyethylene are the four main raw used in the fabrication of geotextiles.After 2005, The World Bank made geotextiles use mandatory in infrastructures funded by it," says Aditya Agarwaal, CEO of Jeevan Product which resulted in growing awareness about use of geotextiles.

Keywords: geotextiles, separation, transmissivity, nonwoven geotextiles, woven geotextiles

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I. INTRODUCTION

The prefix of geotextile, geo is related to earth and the textile word is used for fabric .The American Society of Agricultural Engineers (ASAE) explains a geotextile as a artificial and fabric material provided in between the soil sub grade, in the construction of retaining wall ,etc to amplify mobilization of water and decelerate soil movement, because of the membrane ,which behaves as separation and strengthening material. A geotextile should compose of a steady system that resists its respective structure during grasping, positioning and service period Geotextile cloth, agricultural synthetic and geosynthesis are the other ingredients can be used for same purpose. The foremost purpose of geotextile is to disintegrate sub base from the sub grade, results into a durable and reinforced pavement .This is done by providing a stiff mass between the two layers of soil sub grade. By increasing the molecular weight tensile strength, impact strength, heat resistance, stress, crack resistance elongation would be increased. By contracting the molecular weight we would get increased impact strength, decreased processability, and decreased stress crack resistance. With more and and crystallinity we would get increase in stiffness, increase in heat resistance, increase in tensile strength, increase in modulus, increase in chemical resistance, decrease in diffusive permeability, decrease in elongation or strain at failure, decrease in flexibility, decrease in impact strength and decrease in stress crack resistance. Based on their structure and the manufacturing technique, geotextiles can be predominantly classified into woven and nonwoven. Woven geotextiles are manufactured by the interlacement of warp and weft filament, which may be of gyrate as shown in fig.1.1 and installation of geotextiles in fig 1.2, multifilament, fibrillated or of slit film. Nonwoven geotextiles are manufactured through a process of mechanical interlocking or thermal bonding of fibers.

Fig 1.1 Gyrates

Fig 1.2 Installation of geotextiles

II. LITRATURE REVIEW

Ajjarapu Sreerama Rao," JUTE GEOTEXTILE APPLICATION IN KAKINADA PORT AREA", studied on the applications of geotextiles situated at Kakinada on the eastern coast of India. The type of soil at Kakinada town consists of soft clay about 8.5m in thick, followed by 3.0m thick sandy silt, which is underlain by a 6.0m in thick clayey silt layer. Variation of water tables varies between 0.2m to 1.0m. Construction of road was found very tedious due to the liquid limit of 78% and natural content of 75% of soft clay. This difficulty was overcome by using geotextiles. Quantities like void ratio, water content, compression index, dry density and CBR have been examined before and after providing jute geotextiles. Values of water content, void ratio and compression index falled down, while dry density and CBR went up due to the laying of jute geotextiles. After the lapse of 7 years, an unpaved road laid on the reinforced soil is still giving good service over there.

Choudhury et al "APPLICATION OF JUTE GEOTEXTILE IN RURAL ROAD CONSTRUCTION UNDER PMGSY" studied about the design and application of woven Jute Geotextile in a rural road in the West Bengal under PMGSY programme. It was concluded by lots of engineers that jute fibre easily get degrade when used in road pavement. It does not have such amount of potential to act as improver of sub-grade. The main reason of the engineers against its use in roads the property of biodegradability of the jute fabric. The studies carried over there and the result obtained that the soil naturally gets consolidated due to impact of dynamic loading which results in the separation of sub-grade from sub-grade which can be controlled by application of jute textile. The property of low spreading of jute fibre maximizes the bearing capacity of sub-grade due to membrane impact. The geotextiles life is of 2 to 3 years without doing any further maintenance. It is found that geotextles is low in cost, easy availability and environment friendly, thus it should be used in a large scale.

Sanyal et al "JUTE GEOTEXT1LE IN HILL SLOPE MANAGEMENT - CASE STUDIES IN SIKKIM AND MEGHALAYA" researched on the usage of geotextiles at the border roads in the hilly areas of Sikkim prone to sliding of land .Landslides generally occur due to the natural movement and the movement of rock, debris and earth. Treatment like management of upstream and the downstream side slope had done with Jute Geotextile overlain by suitable vegetation. The slide zone exists at Shillong, Meghalaya , Tripura are treated with jute geotextiles and good results has been obtained.

Bhagwan et al "JUTE GEOTEXTILE FOR ROAD APPLICATIONS - FIELD TRIALS BY CRRI" researched on the shortcomings in soils and thereby found methods for the improvements. Geotextiles plays important role such as fastening up the construction, giving better performance of the structures and reducing the cost of maintenance. Except these, there exists vast range of works in which application of geotextiles in retaining structures, drainage, traffic structures and so on.. Jute is biodegradable and lignocelluloses natural fiber but there are certain places where degradation in the applications of jute fibre does not create any problem. Various experiments carried out at different places in India, has shown that the jute geotextiles play a vital role in various applications in highway engineering.

III. FUNCTIONS OF GEOTEXTILES

Geotextiles basically performs six identical functions; separation, filtration, drainage, reinforcement, sealing and protection, and also can execute one or more than one task at a time.

3.1. Separation: The instigation of a malleable pervious fiber placed between dissimilar soil sub grade such that the behavior of both the sub grade materials would remain undamaged, is termed as separation. The basic of separation in geotextile is to prevent the intermixing of two adjacent soils. For example, fine sub grade soil can be separated from the aggregates of the base course by separation. The geotextile holds the drainage and the strength of the aggregate material. The results of separation is shown in figure 3.1

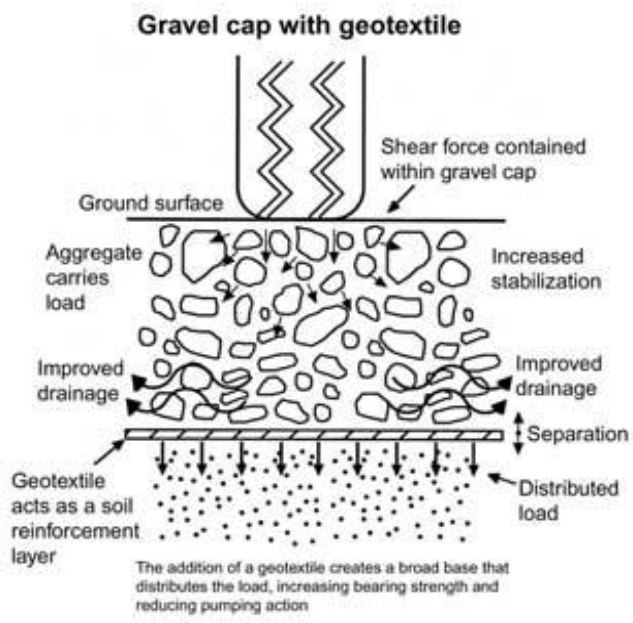

Fig 3.1 Effects of Separation by geotextile

3.2. Filtration: The equilibrium geotextile-to-soil system that it permits the sufficient amount of liquid flow with a restricted soil loss over the stratum of the geotextile during a service lifetime accordant with the implementation under deliberation is termed as filtration. To be successfully complete this situation the geotextile must fulfill the two conditions; the filter's pore size must be small enough so as to retain fine soil particles above it while the geotextile should permit relatively smooth flow of water into the drainage media and example is shown in figure 3.2

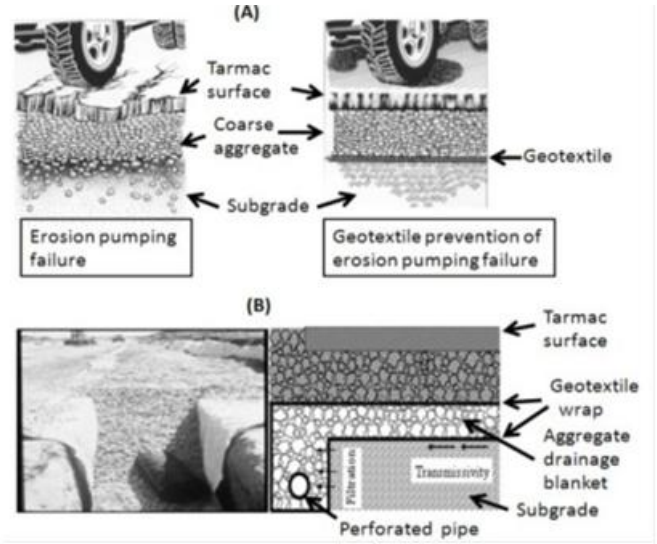

Fig 3.2 filtration and transmissivity

3.3. Transmissivity: Transmissivity is described as the potential of broad nonwoven geotextile whose three-dimensional structure imparts a route for flow of water through geotextile. Figure 3.2 also shows the Transmissivity .In this process the geotextile stimulate a slanting flow resulting in the dissipation of the kinetic energy of the capillary rise of ground water.

3.4. Reinforcement: Reinforcement is the coordinated advancement in the total structural strength generated by the addition of a geotextile into a soil. This is formed essentially by the following three mechanisms: first, the lateral restraint through interfacial friction between geotextile and soil/aggregat1e. Second, focuses on the capacity of bearing surface failure plane to develop further shear strength surface. And third, membrane support of the wheel loads.

3.5. Sealing Function: This function is basically performed by a nonwoven geotextile when abundant with asphalt or some other synthetic mixes executing it relatively imperious to in-plane and cross plane flow. Liquid blockades in paved road reclamations are definitive application of geotextile. It is shown in Figure 3.3. In this, firstly an asphalt tack coat is applied on the existing pavement after that nonwoven geotextile is placed on this. Water is absorbed by the asphalt results into formation of water proofing covering, which minimizes vertical water flow into the pavement structure.

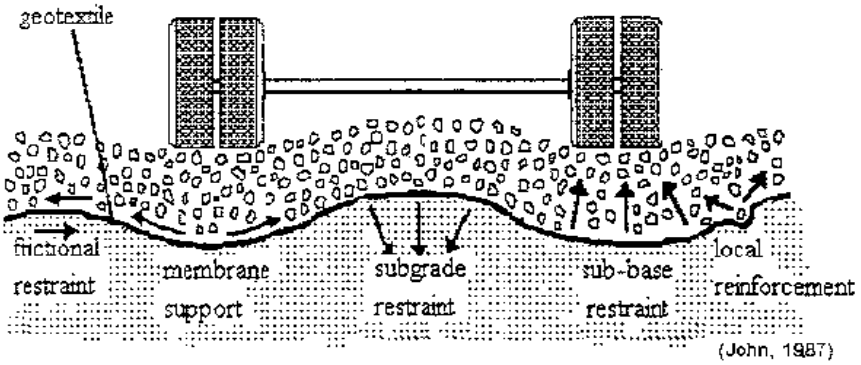

Fig 3.3 sealing function by geotextiles

IV. CLASSIFICATION OF GEOTEXTILES

The immense majority of geotextiles are made from polyester or polypropylene formed into fabrics as follows:

4.1 Woven monofilament: Woven monofilament geotextiles, also termed as Filtration Geotextiles which are manufactured from extruded polypropylene monofilaments woven to create a dimensionally stable, extremely porous, geotextile. It is found that they have superior resistance to soil and biological choking and allow water to pass freely while preventing befoul of base material and increasing tensile elements to soil.

4.2. Woven multifilament: Woven multifilaments are made up of separate multifilament yarns woventogether into a firm fabric structure by a combination of hydraulic and mechanical properties. These product series has extremely good resistance to biological and chemical environment normally found in soils. They are durable against ultraviolet radiation. They are applicable for, Sub grade stabilization, area stabilization, basal reinforcement of embankments on poor ground. Working platforms & Load transfer platforms, reinforced soil slopes and walls.

4.3. Woven slit-film monofilament: Woven slit-films are basically made by weaving flat fragments, which are further made by first slitting a plastic sheet; and monofilaments, which amalgamateround strands which are extruded. They are generally used for applications where filtration requirements are less vital .They are constructed over a soft and loose soil by providing division and stabilization where both strength and filtration are concern, like in shoreline rip rap.

4.4. Woven slit-film multifilament: Woven silt film multifilament yarn consists of many continuous filaments or strands. They tend to be more flexible than a monofilament yarn. Due to its higher tensile modulus at low strains, it delivers instant support and load distribution in temperature subgrade conditions. They hugely prevent unlike material from intermixing and therefore increasing the life of paved as well as unpaved roads. They can be used in applications like, Separation under driveways and streets, parking, roadways, airport runways, paving blocks, etc.

4.5. Nonwoven continuous filament needle-punched: Nonwoven continuous filament needle punched has a unique property of waterproofing, provides stress relief, and reduces reflective cracking functions in paved roads. They are primarily designed for the countries having extreme weather conditions. This product has undergone a number of years of testing and enhancement to provide the best overall adaptation. The high melt temperature of polyester cinch that the geotextile properties should not be affected by the usage of hot bitumen or asphalt.

4.6. Nonwoven continuous filament heat bonded: In a continuous filament nonwoven filament, a portion of the filaments are significantly, randomly deposited, and another portion of the filaments are cross-linked polymerized materials which act as a bonding agent for the fabric. The fabric is made by process which has been termed "spunbond fabrics". While using the thermoplastic materials, such as the polypropylenes, the web of continuous filaments may be mould with heat and pressure to bond the continuous filament web i.e., called as nonwoven continuous filament head bounded.

4.7. Nonwoven staple needle-punched: Non-woven staple needle-punched geotextiles are made from polypropylene fibres that are matted together by a needle-punching process. They may be made in short lengths (staple fibres are the short length fibres) and their hardiness is gained by interlinking. They have remarkable

water flow rates and are generally applicable for straining of soil fine for drainage reasons counting as a wrapping for porous pipe, trench drains, for erosion control, and combined with three-dimensional construction to establish prefabricated drains. Needle- punched geotextiles are also mostly used with geo-membranes to provide a protective buffer. Needle-punched staple non-woven has primary functions; filtration, separation, protection, drainage; Secondary functions: reinforcement.

4.8. Knitted geotextile: Knitted geosynthetics are manufactured using the process which is adopted from the textiles clothing industry which is also known as knitting. Interlocking various series of loops of yarn together is done in this process. All the knitted geotextiles are made using the knitting method in addition with some other method of geosynthetics manufacture, like weaving.

V. GEOTEXTILES CONSCIOUSNESS IN INDIA

As the demand and the application of geotextiles are becoming more prominent, there are certain manufacturers of geotextiles believed that attention could be improved within India which is a very big challenge for the growth of geotextile. Jeevan Products is one of the sound and famous company which has been manufacturing non-woven geotextiles in India since 2000." But the main problem arising is whether or not the current particularization will be suitable for the climate and the shortage of items for geotextile is seen to be major impulsion. “Some particular have been laid down but still confusion as to whether those will be successful and suitable for Indian soil and weather conditions," says Agarwaal. Due to the different geographical and climatic weather conditions it might be possible that the Amercian and European specifications won't work in Indian climatic conditions and existing soil strata. For this certain hit and trials are going on different soil stratas in India. Since India faces a high level of soil loss each year due to its monsoon seasons, so geotextiles are progressively being implemented for restricting the problems of soil erosion on embankments and hillsides.

VI. CONCLUSION

To protect the aggregate layer from shrinking into the soil, geotextiles are being used in the form of separator between the aggregate layer and subsoil World Bank has made the use of geotextile as compulsary in all infrastructures outsourced by it. From the above studies it is clear that, it is a time to take a big step towards the use of geotextiles in Indian road construction. Geotextiles are an emphatic and economic method of fixing the most geotechnical problems in roads. The designer engineer should be well aware of the problems arising while construction of roads and should use comparatively new techniques for solving the problem. Engineer should be well cognizant of the properties and capabilities of geotextile material. Despite having huddles, the profits for implementing geotextiles are well known. If all the industries would collaborate we would definitely gain the practical specifications so the potential of geotextiles can be obtained.

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