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A Review on Geo-Textile in Transportation Applications

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ABSTRACT

Geotextiles, a recently developed field in civil engineering and other sectors, have a wide range of potential uses around the world. Modern pavement design and maintenance methods heavily rely on geotextiles. Its use in transportation applications has increased dramatically across the board. For building infrastructure such as roads, harbors, and many other things, geotextiles are the perfect material. They have a promising future because of their multifaceted traits.

The article includes a summary of several natural and synthetic textile fibers used to make geotextiles.

Keywords: Geotextiles, maintenance methods and infrastructure.

I. INTRODUCTION

One of the world's largest road networks is found in India. The current roadways are structurally unsound because of the traffic's quick expansion. Construction criteria are not met by conventional design and construction methods. Researchers are compelled to look for alternatives employing subpar materials and creative design techniques in order to get beyond these limitations. For many geo-engineering applications, it is a burning work to identify an alternate solution of geo-materials that have good strength and deformation parameters. Several by-products or waste materials, such as fly ash, fibre, rice husk ash, geo-synthetic materials, such as geo-textile, geo-grid, geo-membrane, geo-mats, and geo-webs, as well as recycled tyre materials, are being investigated by several researchers.

For more than 30 years, geotextiles have been utilised with great success in the building of roads. Their main job is to divide the sub base from the sub grade, which makes the road building stronger. This task is accomplished by the geotextile, which creates a dense mass of fibres at the boundary between the two layers.

In this paper, the types of fibres suitable for use as geotextiles have been mentioned along with their basic characteristics, functions, and applications in various areas.

II. CHARACTERISTICS OF GEOTEXTILES

The characteristics of geotextiles are broadly classified as:

1. Physical properties:

a) Specific gravity
b) Weight
c) Thickness
d) Stiffness
e) Density

2. Mechanical properties:

a) Tensile strength
b) Compatibility
c) Flexibility
d) Frictional resistance
e) Tenacity
f) Tearing strength
g) Drapability
h) Bursting strength

3. Hydraulic properties:

a) Porosity
b) Permeability
c) Turbidity / soil retention
d) Filtration length
e) Transitivity
f) Permittivity

III. TYPES OF GEOTEXTILES

Geotextiles are classified into two types. They are:

1. Based on fibre geotextiles:

In this type, it is sub-divided into two types. They are:

a) Natural fibres:

Natural fibres are derived from mineral, animal, and plant sources. These fibres are widely accessible and come in a great amount. The natural fibres have some qualities that can aid in the creation of geotextiles. They have high modulus, low breaking extension, low elasticity, high strength, and high strength. The creep ability of yarn and fabrics made from natural fibres is minimal when used. Mineral fibres are brittle and not very flexible; thus, they cannot be used to construct geotextiles for industrial purposes. The important natural fibres which are used in making geotextiles that is our jute, sisal, flax, hemp, abaca, ramie, and coir. Because they are made of natural fibres, geotextiles are biodegradable. Thus, these textile items are primarily employed for transient purposes. Hence, natural fibres have low cost, robustness, strength, durability, availability, high drapeability, and biodegradability as advantages for making geotextiles.

b) Man-made fibres:

The synthetic or man –made fibres are used for geotextiles are called geosynthetics. The distinction between geotextiles and geosynthetics is that the former is made from both natural and synthetic fibres, whereas the latter are entirely made from synthetic fibres. As a result, it is claimed that all geotextiles are not all geosynthetics and vice versa. These four polymeric families—polypropylene, polyester, polyamide, and polyethylene—are acknowledged as the basic components of geosynthetic materials. The following is a discussion of the functional properties used by polymeric materials to create geotextiles:

Polypropylene:

On account of its low cost, good tensile qualities, and chemical inertness, polypropylene is the most commonly utilised polymer for the production of geotextiles. Due of its low density, polypropylene is inexpensive per volume. Polypropylene's drawbacks include its extreme sensitivity to UV rays and high temperature. It has weak mineral resistance and creep. Polypropylene should be used under suitable installation and environmental conditions as shown in below figure.

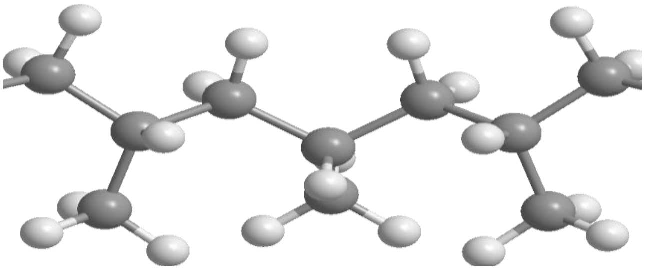

Fig-1: Molecular structure of polypropylene

Polyester:

Because of its outstanding creep resistance and tenacity properties, polyester is utilised to make geotextiles. It is useful whenever high stresses and bluff temperatures necessitate the use of geotextiles. Polyester's drawback is hydraulic deterioration in soils with pH levels above 10. Polyester fabric is quite inexpensive and is made from PET chips or polymers. Here is a list of polyester's molecular building blocks.

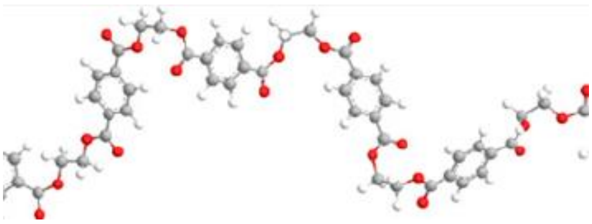

Fig-2: Molecular structure of polyester

Polyamide:

Polyamide is necessary for the creation of conventional geotextiles. Nylon 6 and Nylon 6:6 is used to make it. Choice of polymers depend on strength, creep behaviour, fabric structure & finishing parameters. Protein is not appropriate for it; only synthetic polyamide, not natural polyamide like silk, is used for it. Here is a list of the molecular structures of nylon 6 and nylon 6:6.

Fig-3: Molecular structure of Nylon 6.6

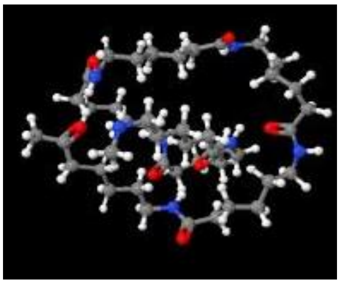

Fig-4: Molecular structure of Nylon 6

Polyethylene:

When using only woven coated geotextiles, polyethylene is employed. Its minimum thermal expansion and contraction, extra-strong tear and puncture resistance, and other advantages make it useful. It offers excellent heat seaming resistance and is UV resistant. Here is a list of polyethylene's molecular building blocks.

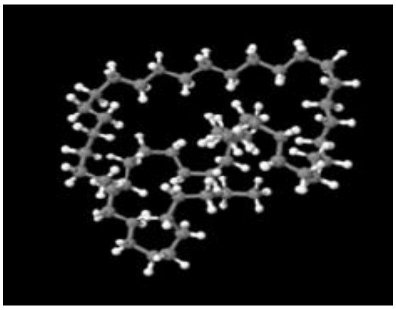

Fig-5: Molecular structure of Polyethylene

2. **Based on fabric geotextiles:**

It is sub divided into three types. They are:

i. **Woven geotextiles:**

Geotextiles that have been woven using a number of threads to create a planar structure are known as woven materials (both warp and weft). It exhibits robust mechanical qualities. It is separated into two categories: polypropylene-based woven geotextile straps and monofilament polyester fabrics. Its main functions are reinforcement, separation, and filtration

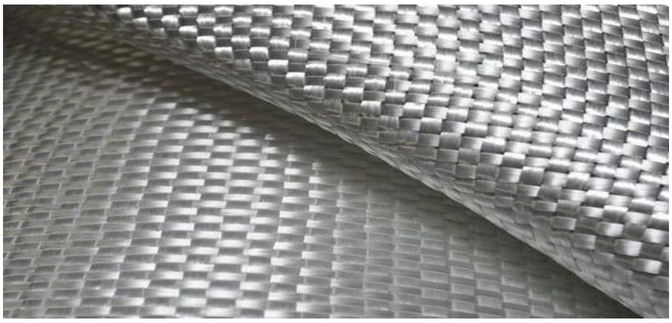

Fig-6: Woven geotextiles

ii. Non-woven geotextiles:

Non-woven geotextiles are made from bonding materials together. Chemicals, heat, needle piercing, and other techniques are used to do it. They are primarily constructed of synthetic fibres. They are applied in filtering and separation processes. They can protect interior and external penetrations with geomembrane lining solutions. Nonwoven geotextiles are the finest choice when it comes to pulling water. Non-woven geotextiles are used only 5% cases according to its application as shown in below:

Fig-7: non-woven geotextile

iii. Knitted geotextiles:

Knitted geotextiles are used only 25% cases. Because to its light weight, knitted geotextile is becoming more and more popular despite its low demand. Because of this, handling and transportation costs are simpler. The demand of knitted geotextile is increasing in our Asian subcontinent as shown in below:

Fig-8: Knitted geotextiles

IV. FUNCTIONS OF GEOTEXTILES

Depending on the application, the geotextile performs one or more of these functions simultaneously.

1. Separation:

For the integrity and functionality of both materials to remain intact or enhance, separation is defined as "the introduction of a flexible porous cloth inserted between dissimilar materials." Separation in transportation applications describes how the geotextile works to keep two nearby soils from interacting with one another. For instance, the geotextile maintains the drainage and strength properties of the aggregate material by separating fine subgrade soil from the aggregates of the base course. Figure shows how separation has an impact.

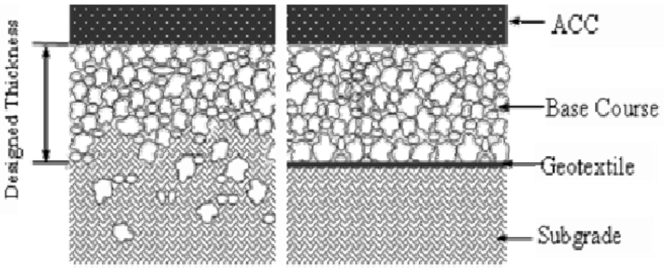

Fig-9: Separation

2. Filtration:

According to its definition, it is "the equilibrium geotextile-to-soil system that permits sufficient liquid flow with negligible soil loss across the plane of the geotextile throughout a service lifetime compatible with the application under consideration." Fabrics used in filtration can be either woven or non-woven, allowing water to pass through while trapping soil particles.

The primary characteristics of geotextiles that are involved in filtration action are porosity and permeability.

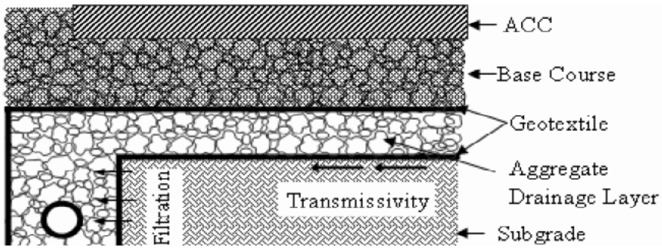

Fig-10: filtration function

3. Drainage:

This is a reference to a thick nonwoven geotextile's capacity to allow water to flow across its plane due to its three-dimensional structure. The geotextile's transmissivity function is also shown in Figure 6. Here, the geotextile encourages lateral flow, dissipating the kinetic energy of the ground water capillary rise.

4. Reinforcement:

The insertion of a geotextile into a soil result in a synergistic enhancement in the overall system strength, which was principally established through the following three mechanisms:

- Lateral constraint induced by geotextile-soil/aggregate interfacial friction
- forcing the possible failure plane of the bearing surface to develop at a different surface with higher shear strength;
- membrane-type support for the wheel loads

The tensile strength of the geosynthetic material used in this process significantly increases the structural stability of the soil. This idea is comparable to using steel to reinforce concrete.

5. Sealing function:

When a non-woven geotextile is impregnated with asphalt or other polymeric mixtures, it serves this purpose and becomes comparatively impermeable to both cross-plane and in-plane flow. Figure illustrates the traditional use of a geotextile as a liquid barrier in surfaced road restoration.

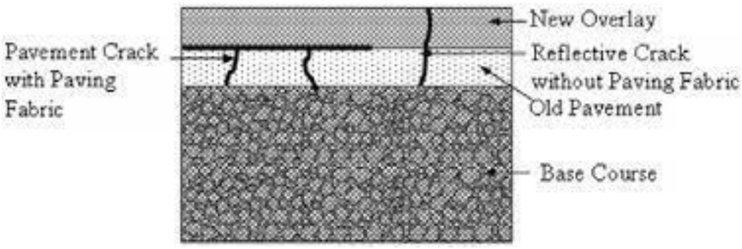

Fig-11: Sealing function

V. CONCLUSION

Textiles are used to safeguard our motherland as well as to dress the human body. It is important to spread knowledge about the use of geotextiles among the public. Geotextiles are useful tools that civil engineers can use to solve a wide range of geotechnical issues. Further studies in this area are required in order to fully explore geotextile's potential.

VI. REFERENCES

[1]. ASTM (1994), Annual Books of ASTM Standards, American Society Testing and Materials, Philadelphia, Pennsylvania. Volume 4.08 (1), Soil and Rock, Volume 4. No. (8), Soil and Rock, Geosynthetics, Volume 7, No. 1, Textiles.

[2]. Abdullah, A. B. M., A Hand book of Geotextiles Particularly natural geotextiles from jute and other vegetable fibers, FAO-2000.

[3]. Gregory, R. N., Barry, C. R., Geotextiles in Transportation Applications, Featured Short Course, 1998.

[4]. Rankilor, P. R., Membranes in Ground Engineering, John Wiley and Sons, New York, 1981.

[5]. Koerner, R. M., Designing with Geosynthetics, Third edition, Prentice Hall, 1993.

[6]. Ayres, D. J., “The Treatment of Unstable Slopes and Railway Track formation”, The Journal of the Society of Engineers, Vol. 52, No. 4 (Oct./Dec), 1961.

[7]. Terzaghi, K. and Peck, R. B., “Soil Mechanics in Engineering Practice”, John Wiley & Sons, New York, 1967.

[8]. Ko, F.K., “Nanofiber Technology: Bridging the Gap between Nano and Macro World”, in NATO ASI on Nanoengineered Nanofibrous Materials, Anatalia, Turkey, Kluwer Academic Publishers, 2003.

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