Geotextiles: An Innovation Bioengineering Tool

Sreeremya .S
Assistant Professor
Department of Biotechnology
Sree Narayana Guru College, Coimbatore, Tamil Nadu
Corresponding Author's E-mail: *sreeremyasasi@gmail.com*

Abstract

Geotextiles, a novel technology and advancing field in the civil engineering and other fields, offer great potential in varied regions of applications globally. The paper provides an overview of various natural as well as synthetic textile fibres used for application as the geotextiles.

Keywords: - *geotextiles; textiles, fibres, technology, civil engineering*

INTRODUCTION

Geotextiles have been availed very successfully in road construction for over 30 years (Dutta et al., 2008). Their primary function is to separate the sub base from the sub grade resulting in the stronger road construction and building (Nithin et al., 2012). The geotextile perform this function by catering a dense mass of fibers at the interface of the two layers (Fannin et al., 1996).

OVERVIEW GEOTEXTILES

Geotextiles have proven to be among the widest, versatile and cost-effective ground modification materials (Kumar et al., 2012). Their use has expanded sporadically into nearly all areas of civil, geotechnical, environmental, coastal, and hydraulic engineering (Perkins, 2000). They form the main component of the field of geosynthetics, the others being geogrids, geomembranes and geocomposites (Michael et al., 2009).

GEOTEXTILE OVERVIEW

Manufacturing Process

A geotextile is defined as the permeable geosynthetic made of textile materials. Among the different geosynthetic products, geotextiles present the broadest range of properties and can be used for the

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widest variety of transportation applications(Ramaswami et al.,1989). It should be noted that, consistent with the Research Problem Statement, this project will specifically focus on all the applications that apply to pavement design but only for geotextiles (i.e., only one of the various types of geosynthetics) (Rajagopal et all., 2009).Special emphasis will be made in this project regarding the intrigued use of rigorous nomenclature, as inappropriate terminology has often led to confusion. For example, the term "fabric" is often availed to describe a geotextile—in fact; it is in the title of the only DMS focused on geotextiles (Rao et al., 2009). This term is considered inaccurate and is inconsistent with the terminology established by the ASTM. Instead, the appropriate term is geotextile (Rao et al.,2000) . The terminology availed in the guidelines and specifications to result from this project will be rigorously follow the guidelines established by the International Geosynthetics Society (IGS 2000), which are in the agreement with the terminology established by ASTM Committee D35 on Geosynthetics (Giroud et al.,1981).The polymers availed in the manufacture of geotextile fibers include the following, listed in order of decreasing use: polypropylene (≈86%), polyester (≈12%), polyethylene (≈2%), and polyamide (≈1.2%). The most common types of filaments used in the manufacture of geotextiles include monofilament, multifilament, staple filament, and slit-film. If fibers are typically twisted or spun together, they are known as a yarn (Sanyal, 2000). The filaments, fibers, or yarns are formed into geotextiles using either woven or nonwoven methods.

MANUFACTURING ASPECTS OF GEOTEXTILES

Nonwoven geotextiles are manufactured by placing and orienting filaments or fibers onto a conveyor belt, which are subsequently bonded by needle punching or by melt bonding. The nonwoven geotextiles (on the right side of the picture) have multi facetedly and tremendously different engineering properties than the woven geotextiles (Shankar et al., 2012). The type of polymer will also profoundly influence significantly the engineering properties of these products. Common terminology associated with geotextiles includes machine direction, cross machine direction, and selvage (Zornberg et al., 2000). Machine direction also refers to the direction in the plane of the fabric in line with the direction of manufacture. Conversely, cross machine direction typically refers to the direction in the plane of fabric perpendicular to the direction of

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manufacture. The selvage is the finished area on the sides of geotextile width that prevents the yarns from unraveling (Som et al., 1999)

USE OF GEOTEXTILES IN DRAINAGE OF PAVEMENTS AND OUTDOORSSTRUCTURES

Geotextiles are relatively new construction materials that have been on the increase recently specifically in infrastructure applications. This study aims at testing the effectiveness of availing three different types of geotextiles in applications requiring drainage systems and comparing their performance to a control (unprotected) system as well as a traditional drainage method (Zornberg et al.,2006).A brief cost study and research is provided to recommend the pros and cons of each construction material introduced as a function of drainage characteristics.

PROPERTIES

Infrastructure represents the backbone of economic growth and social welfare (Zornberg et al., 2008). It comes as no surprise that infrastructure projects with their materials, design, operation and maintenance receive special attention in both developed and developing countries. Geotextiles are polymeric fabrics which have the ability to typically separate, filter, reinforce protect or drain fluids and/or soil media (Ayres, 1961). When geotextiles function as the draining material, it acts as medium for the movement of liquids or gases. Thus its use has been on the aggrandizeparticularly in infrastructure projects requiring one type or a concoction of the above functions. In loose or gap graded soil, the groundwater flow can migrate soil particle toward the drain; the accumulation of the soil particles overtime can clog the drainage systems. The major purpose of the geotextiles in drains is to filter the soil particles while at the same time garner a smooth medium for the water to flow through. The conflicting nature of filters makes a retention versus permeability a profoundly inevitable trade off that the designer should adjust based on the needs and the environment of the drainage system . For example, if the drainage material has a large volume of voids, the potential clogging risk is much higher, thus the designer should pay a close attention to the retention criteria. On the other hand, if the drainage material has a quiet small volume of voids, one favored criteria would be a controlled permeability of such medium. Consequently, the major concern in selecting the drainage material becomes striking a balance between retention and permeability while maintain good service(Terzaghi et al.,1967).

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While there is an aggrandizing focus on the use of geotextiles in drainage systems as reflected by several studies which were conducted and communicated to the engineering community, there remains lack of understanding on the fundamental basis upon which such geotextiles are selected. In many cases, the selection process of geotextiles as a drainage material is based on an empirical testing and project experiences. There are researches carried out as an attempt to better understand the behavior and performance of specific types of commercially-available geotextiles used in drainage purposes aiming at enhancing the knowledge used towards better selection and utilization(Ko,2003).Geocomposite have tremendous influence to environment (Sreeremya,2018).

EXPERIMENTAL PROGRAM

The experimental program was designed mainly to investigate and assess the overall performance of three different types of geotextiles in models simulating sub-surface road drainage system. The tests weremainly performed on three different weights of non-woven needle-punched geotextiles to investigate the efficiency of using this type of geotextiles in drainage systems. The experimental procedures were majorly applied on five models each has a different layer stratification but all controlled in size, shape, environment and materials. The purpose of these models is typically to imitate sub-surface drainage systems in real life. The experimental procedure is conducted by applying a controlled-volume water discharge on the models to simulate the water drained through the sub-surface drainage system (Kumar et al.,2012). The discharged water is initially poured in a plastic bucket that has a specific openings pattern in all the models to distribute the water over the surface of the model. The following sections will delineate the models and the experimental procedures in details. Geocomposite is another intriguing concept associated with geotextiles (Sreeremya,2018).

TESTS PERFORMED

Time to discharge and water discharge the rate tests: These tests were performed to indicate the overall efficiency of the drainage systems, calculate the discharge change over time, and draw the discharge profile for typically eachmodel in order to evaluate the performance. Microscopic tests: Microscopic tests were mainly performed on the different geotextiles before and after the installation to measure the change in the internal structure as a result of being exposed to the water and

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fines in the above layers. The result of these tests majorly indicates the durability of the geotextiles over time. Geotextiles' weight tests: These tests were performed to measure the increase in weight due to the retention of the fines on the surface of geotextiles. The result of these tests indicates the filtration ability of the each type of the geotextiles (Kumar et al.,2012).

The Basic Properties of Geotextile

- Tensile strength
- Elongation
- Impact strength
- Stress crack resistance
- Heat resistance

Types

- Woven monofilament
- Woven multifilament
- Woven slit-film monofilament
- Woven slit-film multifilament
- Nonwoven continuous filament heat bonded
- Nonwoven continuous filament needle-punched
- Nonwoven staple needle-punched
- Nonwoven resin bonded
- Other woven and nonwoven combinations
- Knitted

Functions

- Separation
- Drainage
- Filtration
- Reinforcement
- Protection

CONCLUSION

Geocomposites are multi-stratified concoctions of geosynthetics. These concoctions cater benefits over individual layers by enhancing functions, aggrandizing interface friction angles and thereby increasing the speed of installation. Geocomposites are basically melange of several fabrics which when implemented under a technique can produce cheap and efficient products.

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