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GEOSYNTHESIS AS SMART CONSTRUCTION MATERIAL

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Abstract-This study was primarily concerned with the use of geotextile, a geosynthetic membrane to strengthen the foundation of a flexible pavement. Three soil samples were collected from FUTA environs and all of the samples underwent primary soil tests such as natural moisture content, sieve analysis, compaction and California bearing ratio (CBR) test to determine the geotechnical properties of the samples. In carrying out the project, a flexible pavement model using tested soil samples was constructed with the geotextile material incorporated.
Geotextile material design and selection should be based on sound engineering principles as they will serve the long-term interest of both user and industry. The use of geotextiles should be incorporated into the construction of roads as they are economical in reducing the stress of 'borrowing to fill', enhance strength of the sub-grade and increase service life of the roadway.

I INTRODUCTION

1.0 PREAMBLE -

Geosynthetics have been defined by the American Society for Testing and Materials (ASTM) Committee D35 on geosynthetics as planar products manufactured from polymeric materials used with soil, rock, earth, or other geotechnical engineering related material as an integral part of a man-made project, structure or system. Geosynthetics is the term used to describe a range of polymeric products used for Civil Engineering construction works. The term is generally regarded to encompass eight main products categories. They include geotextiles, geonets, geomembrane, geosynthetic clay liners, geofoam, geocells and geocomposite.The most popular geosynthetics used are the geotextiles and geomembrane. A geogrid is a polymeric structure, unidirectional or bidirectional, in the form of manufactured sheet, consisting of a regular network of integrally connected elements which may be linked by extrusion, bonding, and whose openings are larger than the constituents and are used in geotechnical, environmental, hydraulic and transportation engineering applications.

A geonet is a polymeric structure in the form of manufactured sheet, consisting of a regular network integrally connected overlapping ribs, whose openings are usually larger thanits constituents.A geocomposite is an assembled polymeric material in the form of manufactured sheet orstrips, consisting of at least, one geosynthetic among the components, used in geotechnical environmental and transportational engineering applications.

Aim: The aim of this research work is to assess the different types of geosynthetics available and to evaluate the effectiveness of the geotextile in road construction and maintenance.

1.1 Objectives:

- To classify the available geosynthetics in the country.
- To determine the constituent material used in producing the geotextile, one of the geosynthetic materials.
- To incorporate the geotextile in some collected soil materials and assess performance
- To analyse the results and make appropriate recommendations for optimal use.

1.2 HYPOTHESIS-

H0: Geotextiles is not among the most versatile and cost-effective ground modification and soil stabilizing materials in the construction industry.

H1: Geotextiles is among the most versatile and cost-effective ground modification and soil stabilizing materials in the construction industry.

II METHODOLOGY

The designed methodology is based on previous years of research and experience in geotextile filtration design.

The approach presents a logical progression through four steps.

Step 1: Defining the Application Filter Requirements

Step 2: Defining Boundary Conditions

Step 3: Determining the Soil Retention Requirements

Geotextile filters are used between the soil and drainage or armoring medium. Typical drainage media include natural materials such as gravel and sand, as well as geosynthetic materials such as geonets and cuspated drainage cores. Armoring material is often riprap or concrete blocks.Often, an armoring system includes a sand bedding layer beneath the surface armor. The armoring system can be considered to act as a "drain" for water seeping from the protected slope.

2.1 Sample Collection:-

The materials that were used for this investigation are clayey, organic and lateritic soils. For the laboratory tests, three soil samples were collected. Organic soil and clayey soil were gotten from Apatapiti layout, Akure and Laterite gotten from Akure-Lagos Expressway opposite FUTA North Gate. The materials were gotten in polythene to prevent loss of moisture to the atmosphere. Analysis was carried out in order to ascertain the physical and engineering properties of the samples.

2.2 Laboratory Test :-

Tests implemented or performed on natural clayey, organic and lateritic soils collected for this project include particle size distribution, grain size analysis, moisture content, Atterberg limits and California Bearing ratio tests (CBR) in order to assess their geotechnical properties

2.2.1 Soil Particle-Size Distribution

The natural soil samples were crushed respectively and 500grams of each sample was measured.

The sieves were arranged in decreasing order of hole size and the soil samples retained on each sieve was weighed to determine the individual weight. Thereafter, the soil was placed in an array of sieves in the manual shaker and shaken for 15minutes. The sieves were then weighed independently along with the soil retained. The percentage retained in each sieve was determined after which the distribution curves were plotted.

The particle-size distribution of the soil to be protected should be determined using test method ASTM D 422. The grain size distribution curve is used to determine parameters necessary for the selection of numerical retention criteria.

2.2.2 Soil Atterberg Limits

The test was carried out on natural soil samples in order to classify into standard groups and these limits include: liquid, plastic and shrinkage limits.

Some useful information obtained from knowledge of these limits are:

1. It enables to identify and classify the soil.
2. Shear strength of soil can be inferred from these properties.
3. Results of the liquid limit can be useful in assessment of the settlement of soil.

For fine-grained soils, the plasticity index (PI) should be determined using the Atterberg Limits test procedure BS 1377-2.

(i) **Liquid limit**

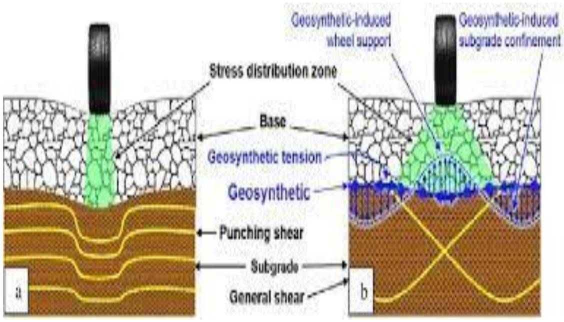
The liquid limit of a soil is defined as the moisture content of which the soil passes from plastic to liquid state as determined in accordance with the standard procedure, BS 1371, London, 1961. This procedure consists of a portion of air-dried soil, which was pulverized in order to make it pass through sieve 425um. 250grams of the soil passing was mixed with water to form a thick, homogenous paste. The paste was placed in a casagrande cup and levelled parallel to the base of the cup. The paste was divided into two halves using the grooving tool and blows were given to the paste till it closed in. small samples of the paste were collected into containers and oven-dried for 24hrs. Other pastes were collected by varying the moisture content of the paste for the three samples.

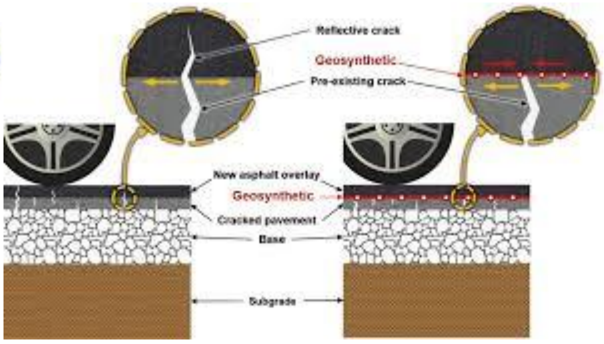
The relationship between moisture content and the number of blows were plotted and the best straight line between these points was drawn. The moisture content corresponding to 25blows on the graph was taken as the liquid limit.

(ii) Plastic limit

The plastic limit of a soil is defined as the moisture content at which the soil becomes too dry to be in the plastic condition or the minimum water content at which a soil can be rolled into threads of 3mm diameter between the palm of the hand. The soil thread at plastic limit crumbles under the rolling action. At this stage, moisture was added again and the average value of the moisture content was taken as the plastic limit of the soil.

The numerical value between the liquid and the plastic limits of the soil is known as the plasticity index. This is a measure of how much water a soil can absorb before dissolving into a solution. The higher the value, the more plastic and weak the material is. Plastic soil containing clay has PI of 10 to 50 or more.





(iii) Shrinkage limit

Shrinkage due to drying is significant in clays, but less in silt and sands. These tests enable the shrinkage limit of clay to be determined i.e the moisture content below which clay ceases to shrink. They also quantify the amount of shrinkage likely to be experienced by soils in terms of the shrinkage ratio, volumetric shrinkage and linear shrinkage.

III.CONCLUSION

3.0 CONCLUSION -

From the above analysis taken on both soil sample and material it is of economic benefit to introduce the use of geotextiles in road construction as it reduces the act of “borrowing to fill” when the in-situ soil can easily be enhanced by use of geosynthetics. Geotextiles are effective tools in the hands of the civil engineer that have proved to solve a myriad of geotechnical problems. With the availability of variety of products with differing characteristics, the design engineer needs to be aware of not only the application possibilities but also more specifically the reason why he is using the geotextile and the governing geotextile functional properties to satisfy these functions. Design and selection of geotextiles based on sound engineering principles will serve the long-term interest of both the user and the industry.

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