DESIGN OF A WOVEN GEOTEXTILE FABRIC BASED ON SISAL FIBERS FOR ENGINEERING APPLICATIONS.

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A RESEARCH REPORT SUBMITTED TO THE DEPARTMENT OF GINNING AND TEXTILE ENGINEERING FOR THE AWARD OF BACHELOR DEGREE IN TEXTILE ENGINEERING OF BUSITEMA UNIVERSITY.

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DECLARATION

I, Tizirihwayo Fredrick, do hereby declare that this research project report is as a result of my own work and is in no way a copy of any proposal that has been submitted anywhere before. Where other work has been quoted, it has been duly referenced.

A research report submitted to the department of ginning and textile engineering for the award of bachelor degree in textile engineering of Busitema University.

Signed: .....

Date: .....

APPROVAL

This research project entitled "Design of a Woven geotextile fabric based on sisal fibers for engineering applications" has been submitted for examination with our approval as supervisors:

Main Supervisor:

Dr. Samuel Baker Kucel

Signature..... Date.....

Co-Supervisor:

Mr. Rwawiire Samson

Signature.....Date.....

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ABSTRACT

This research was a final year project as a requirement for the award of a bachelor degree in Textile engineering Busitema University at the end of the 4 years. Two geotextile fabrics, one as a control and the other for laboratory tests.

Laboratory tests were conducted on a geotextile especially the apparent open size (AOS), permittivity, and strip test for tensile strength, mass per unit area, elongation at break, and all signifies the application of the geotextile in reinforcement as class 3 geotextile.

Most human activities for example agricultural practices and road construction, are not eco-friendly to the environment which leads to climatic changes, resource depletion, global warming through the volume of pollutants they introduce to it.

Strategies that aim at sustainable agriculture and construction of roads is the measure that can mitigate these threats from the environment. One of the measures to mitigate the threats is to use biodegradable and renewable materials. The most important properties of biodegradable geotextiles such as sisal based for soil reinforcement are their high initial tensile strength 846 N, AOS =0.22 mm, permittivity "ψ"=0.002 s^{-1} and other results that shows comparable properties with Jute geotextiles and the geosynthetic based geotextiles as illustrated in tables 4.7.4 and 4.7.4 in appendix of the report.

Widespread use of biodegradable fabrics in ground engineering has not happened due to the limited service life of these fabrics and availability of synthetic fibers, which are superior to vegetable fibers but the overall aim of this design is to demonstrate the potential for the use of sustainable biodegradable sisal based geotextile fabrics over their man-made polymeric counter parts in ground Engineering.

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CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND

Natural fibers such as sisal [Sarsby, 2007], Palm [Bhattacharyya et al. 2009], bagasse [Dinu and saska, 2007], Flax [Rawal and Anandjiwala, 2007], hemp [English, 1995], jute [Ranganathan, 1994] and coir [Subaida et al.2008] have been used for manufacturing geotextiles in recent years because they are inexpensive, bio-degradable and renewable agricultural commodities in contrast to their man-made, petroleum-based alternatives.

Despite the relative advantages of geotextiles based on natural fibers, they find limited use in many engineering projects because of their relatively low tensile strengths and their susceptibility to biological, chemical and physical degradations. In Uganda, the intensity of torrential rainfall and its subsequent destructive influence on human community has become severe and unpredictable due to climate change including global warming. Natural disasters like landslides result from the climate change.

Uganda grows most of the natural fibers but some grow wildly like sisal and jute but these fibers have limited applications. For example sisal fibers are used in making twines, ropes and rugs, etc. The use of the geotextile fabrics in Uganda and E. Africa as a whole has not been so popular both natural and geo-synthetics.

The nature of roads in Uganda is poor both in rural and urban places. Roads in rural areas are not always tarmaced but some places like wet places and swampy areas are always challenging to maintain. More so the roads in the urban areas are tarmaced though not all but still they are affected by the same challenges of developing pot holes with in a few years and always a problem in wet and water logged areas.

Low-cost roads, whether bound or unbound, reinforced or unreinforced are exposed to both short-term and long-term repeated, high and focused loads which can cause premature failure. The major applications of reinforcement during road construction are to strengthen the pavement and embankment, provide an increased working life, reduce deflections, reduce rutting and fatigue cracking and reduce the amount of base materials. Fig 1.1 shows the failure of an embankment. A wide range of ground conditions, require a wide range of reinforcement products as well as the duration of which reinforcement are required during the life cycle of either bound or unbound

REFERENCES

AASHTO, 2000, Geotextile Specification for Highway Applications. AASHTO: M288-00

Dr. K C Yeo, Properties of geotextiles, Castco Testing centre limited, Hong Kong

Murray, R., (1982), "Fabric Reinforcement of Embankments and Cuttings," Proceedings of the 2nd International Conference on Geotextiles, Las Vegas, Aug 1-6, Vol. 3, page 707-713,

Dewey CS (1993), Use of geotextiles in federal land highway projects. Eng. Field Notes.

English BW, (1994), Bio-based Biodegradable Geotextiles. In: Proceeding of the 2nd pacific composite symposium, Vancouver, Canada; page 204–12.

English BW, (1995), Geotextiles: a specific application of bio-fibers. In: Research in industrial application of non-food crops. I Plant fibers: proceedings of a seminar. Copenhagen, Denmark. Lyngby, Denmark: Academy of Technical Sciences; page 70–86.

Prichard M (1999), Vegetable fibre geotextiles. PhD thesis, Bolton Institute.

Sarsby RW (2005), Limited life geotextiles for soil reinforcement. In: International symposium on tsunami reconstruction with geo-synthetics, Bangkok; page 97–108.

Mwasha AP, Sarsby RW (2003), Road improvement in Tanzania using Sisal fibre geotextiles. In: Conference of the Tanzanian development forum, Dar-el-Salaam. Tanzanian Economic and Social Research Foundation;

Mwasha AP, (2008), Using environmentally friendly geotextiles for soil reinforcement: a parametric study.

Mwasha A, (2005), Limited life basal reinforcement for an embankment built on saturated soft clay. PhD thesis, University of Wolver-hampton

(June 1977), United States Department of Agriculture Forest Service, Portland, Oregon Guidelines for Use of Fabrics in Construction and Maintenance of Low Volume Roads.

Perloff, W. H, (1975), Pressure Distribution and Settlement, Chapter 4 in Foundation Engineering Handbook, by Winterkorn and Fang, Van Nostrand Reinhold Company, New York.

Kirby RH. Vegetable fibers. World crops books. London UK: Leonard Hill Ltd; 1963.

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