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STUDY ON THE EFFECTIVENESS OF COIR FIBRE GEO-TEXTILE FOR EROSION CONTROL UNDER THE DYNAMIC APPROACH

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ABSTRACT

This paper presents the effectiveness of coir geotextiles for erosion control. In the context of sustainable slope management, coir is a cheap and locally available material that can be used to strengthen traditional earthen bunds or protect the banks of river from erosion. Particularly in developing countries, where coir is abundantly available and textiles can be produced by small-scale industry, this is an attractive alternative for conventional methods.

INTRODUCTION

The study of this research is to find out that the using of natural fiber geotextile which is coir is very effective for erosion controls and in landscape design. As soil erosion is one of the most serious problems facing mankind today, there are many ways to prevent the situation from happen. The experts always seeking for the ecological way which will not harming the mankind and the environment. In recent years, new applications for coir have increasingly become available to cater the erosion problems. These include in particular their use as geo-textiles as reinforcement, and are part of a general trend of employing plant fibers in more environmentally friendly materials and components. With rapid pace of economic

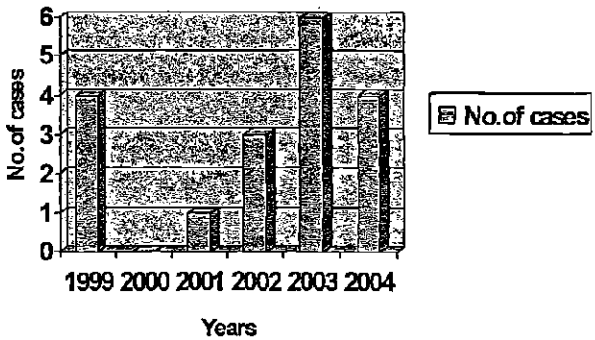
development in Malaysia, highland areas are increasingly under great pressure to be developed. In addition, inadequate understanding of environment and incompatible development on hilly or slopes have made soil erosion and land slides frequent occurrences in the highland areas sometimes with fatal consequences. This matter should seriously taken into account as it will cause many harm to human being and before it become worse to save. The example of the landslides case at Km65, Jalan Gua Musang-Kuala Krai that was held in Kelantan on 15 of December 2007 is the results of untreated erosion. (News Straits Times, 2007). The unexpected tragedy happen when Malaysians were busy on preparing the celebration of Aidilfitri Eve and waiting for the end of the fasting month. The landslides occur due to the heavy rain that washes away the soil particle and the water runoff caused the land movement. Moreover, the steep slopes are not hold by proper vegetation or any erosion control blanket and prone to eroded. Wherever the earth is denuded of vegetation, some sort of covering has to be provided to prevent soil erosion due to rain or wind and to play this important role coir geotextile is the best material. Coir fibre is obtained from the Outer layer of the fruit of Coconut tree (Cocos Nucifera L). This outer layer is called the coconut husk. The husk (exocarp) of the coconut consists of a smooth waterproof outer skin (epicarp) and fibrous zone (mesocarp). Coir Geo textiles are a range of woven open mesh fabrics made from 100% natural and biodegradable coir netting installed on the surface to hold seed and soil intact during the establishment of vegetative cover. When it biodegrade it add organic nutrients to the soil. Hence, in age of growing environmental awareness, coir fiber geotextiles should be the best material for erosion control as it is eco friendly, biodegradable and non-polluting.

Source: Pusat Penyelidikan Tanah Runtuh Negara (2005)

AIM

The aim of this study is to find out that the using of natural fiber geotextile from coir is effective for sustainable landscape construction.

Fig.1 Landslide Events in Malaysia



OBJECTIVES

1. To study on the effectiveness of natural fiber geotextile(coir fibre geotextile) for erosion controls
2. To identify the current and potential use of natural fiber geotextile that will minimize erosions.
3. To study on the role and importance of coir geotextextile in landscape design.

MATERIALS AND METHODS

Case Studies:

The site survey was conducted to find out the effectiveness of coir fiber and its application for erosion control under the dynamic approach in Malaysia. Six case studies were randomly selected to prove the effectiveness of using coir as an erosion control material. The case studies deal with the construction on hill slope

and riverbank protection located at Maran, MRSM Bentong, UPSI Tanjung Malim, Sg. Paroi, Sg. Pinji, and Sg. Klang. All of the cases studies areas are under the supervision of MTS Fibromat (M) Sdn.Bhd. which conducted and supply the materials.

MTS Fibromat (M) Sdn.Bhd is the one which supply the coir geotextile for all the cases studies areas. It is an established company with a long history and experience in the manufacturing of erosion control products which meets the international standards. It is also the pioneer and leader in the production of erosion control products in Asia and being actively involved in a few international bodies such as International Erosion Control Association (IECA), Erosion Control Technology Council (ECTC) and International Association of Hydroseeding Professional (IAHP). To make the study clearer, the study also involved the other methods such as preliminary and theoretical studies, observation, photograph analysis, and professional interviews.

Installation techniques:

Fig. 2 Technique of installation

The method of installation of all case studies areas are similar as referred to MTS (M) Fibromat Sdn. Bhd. They have their own technique which is very successful and approved by Ministry of Energy, Water and Communications. The methods covered from the planning stage until the implementation of works at the selected area.

The selected area must be hydroseeded as soon as they are exposed. Hydroseeding is grass planting process. The process is fast, effective and economical. The process begins by mixing mulch, seed, fertilizer and water in the tank of a hydroseeding machine. The mixed material is then pumped from the tank and sprayed onto the ground. The material is often referred to as slurry.

Once applied to soil, the material enhances initial growth by providing a micro environment beneficial to seed germination. Mostly seeds used are signal grass *(Brachiaria decumbens)*, narrow-leafed carpet grass *(Axonopus affinis)*, Bermuda grass *(Cynodon dactylon)*, Guinea/Hamil grass *(Brachiaria ruziziensis)* and Elephant grass *(Pennisetum purpureum)*. It is also important to make sure precipitation does not wash seeds down the slope.

The methods of hydroseeding are by shooting the slurry in the form of raindrops and uniformed. This is to ensure even spreads of slurry on soil surface. The watering process can start on the next day and repeating daily on the initial stage to ensure the germination of seeds. Proper watering is very important to make sure the seeds get sufficient water and well grow.

The slope area was cleared from any unwanted materials before sprayed with the mixture of seed, fertilizer, mulch and water in the process of hydro-seeding. The slope area fully covered with the blanket and inspections have to be made to ensure that all part of the slope is covered to avoid the soil movement. **(Refer to figure 2).**

Experimental Method:

Material:

Coir has been used in this experiment. The coir geotextile was cut into two sample which is A and B.

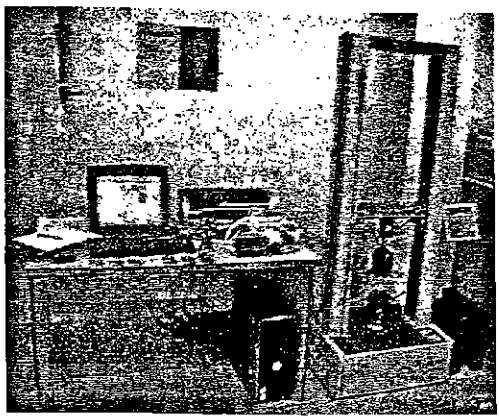
Fig. 3 Sample A

Fig. 4 Sample B

Sample	Width (mm)	Gauge Length (mm)	Area (mm^2)
A	49.280	49.320	196.29
B	52.290	49.320	209.16

The experiment was conducted by using the Universal Tensile Machine (UTM).The tensile test is used to derive the mechanical properties of coir. Using the data generated from a tensile test a stress-strain curve can be plotted, which characterizes a material's mechanical performance. The test is used to directly or indirectly measure the most important material properties such as yield strength and tensile strength. In this test, a prepared material sample

Fig. 5 Experimental equipment (Universal Tensile Machine)



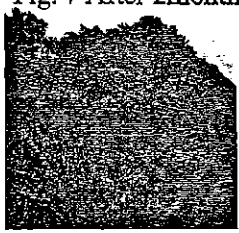
(i.e., a specimen) is axially loaded in tension, and it is pulled until it fractures. The applied axial loads and the corresponding deformation of the sample are measured. The stresses and strains are then calculated from these values.

RESULT AND DISCUSSION

Maran,Pahang (Karak Highway)

Fig. 6 After 3 weeks

Fig. 7 After 2months



The slope at the highway is not stable enough and may leads to any unexpected incident to the highway users. The area was a bare slope without any cover or

vegetation to hold the soil. After three weeks of installation, the seeds were successfully germinated and grass was growing from the slope area. (Refer to figure 6).

After two months the slope was well treated by the growth of vegetation to hold the soil. (Refer to figure 7). In terms of effectiveness, the coir geotextile had shown the positive result through the stages of installation until the grass growth. Before the installation, the slope was bare and unfertile for vegetation. Vegetation alone will not very successful to grow due to rainfalls that will wash away the soil and hard wind but coir geotextile hold the soil and help the seeds to germinate.

The coir geotextile still remain at the slope after two months. As it is biodegradable, the material will degrade through the period of time and mix up with the living things under the soil. The polypropylene netting still can be seen as it is photodegradable. Before the installation the slope looks very bare and unattractive. But after certain time of period, the area looks green and brings the sense of calmness to the user's eyes that access the highway. After the slope was very stable and not prone to any erosion problem, the area can be turn into beautiful plan composition like the arrangement of colourful and fragrance shrubs.

Klang River

Fig. 8 before the installation

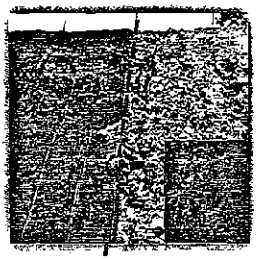


Fig. 9 after two weeks

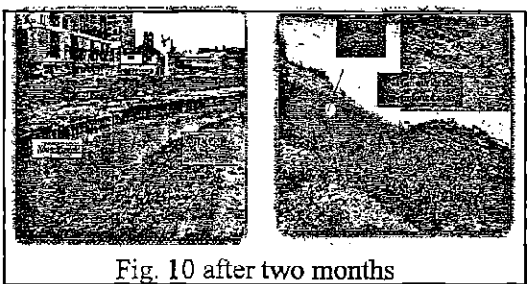


Fig. 10 after two months

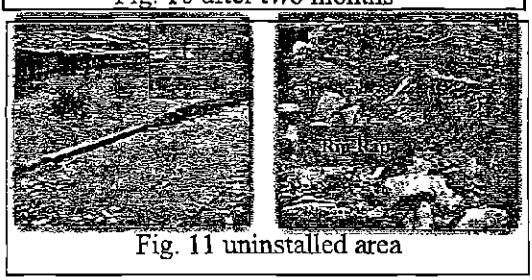


Fig. 11 uninstalled area

The erosion problems at Klang River lead to sedimentation. The river became shallow and prone to flood during heavy rain. The TRM or coir geotextile was installed at part of the slope and the other part was left bare.

(Refer to figure 9) After two weeks, the covered area was growth with grasses while the bare land was still prone to erosion. After two months the grasses were grown and covered the area while nothing grow for the non-reinforced areas. It shows that the type of soil need turf reinforce mat to allow the vegetation growth. (Refer to figure 10). The photograph shows that heavy erosion happen when the area just protected with riprap. The area was soaking in the water and still facing erosion problem. (Refer to figure 11)). The other portion of the Klang River bank that protected with rip-raping technique seems not very successful to control the erosion as compared to the Coir Geotextile. The area with coir geotextile started to be covered with vegetation while the other side with riprap, the stones were scattered and start to roll onto the reinforced section. The rip-raping technique is not effective enough to solve the problem. (Refer to figure 11)

The Experiment

Table 1: Mechanical properties in the tensile direction

sample	Strain at maximum [%]	Load at maximum (N)	Tensile strength [MPa]
A	25.410	712.280	3.6287
B	23.195	662.320	3.1666

Figure 13. Sample A

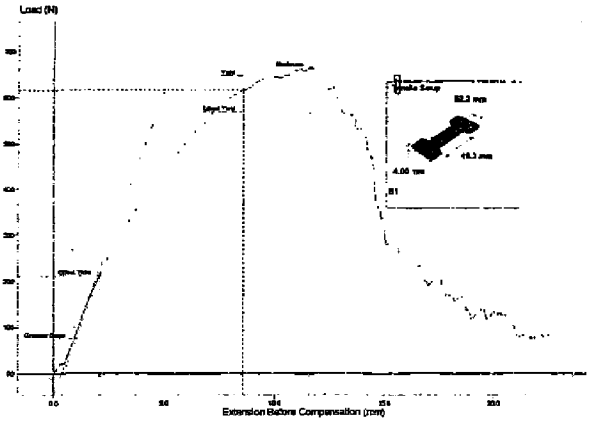
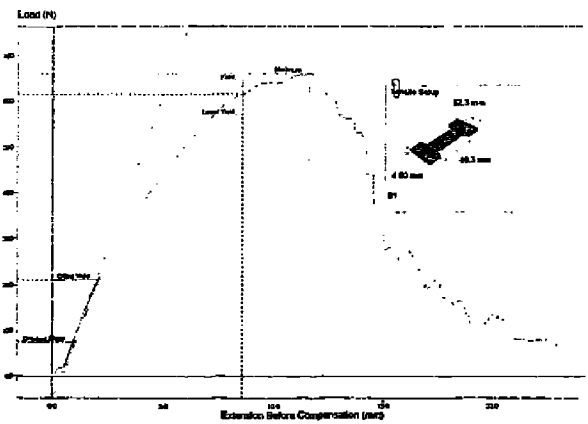


Figure 13. Sample B



CONCLUSION

All of the cases studies have clearly shown the effectiveness of coir geotextiles to stabilize the slopes and the steeply sloping banks of river. The community was very enthusiastic about the effectiveness of the coir, particularly in combination with a local grass variety. The coir with grass appeared to be the most effective to prevent erosion, to retain moisture and nutrients and to facilitate grass growth. Moreover the slope with grass was productive in providing fodder. The degradation of the natural fibres over time did not result in any loss of effectiveness. On the contrary, the fibre contributed to the natural fertility of the soil after the vegetation cover was well established and the geotextile was no longer needed for slope stability. The relative cheapness of the material and the potential for producing and laying the matting with local labour makes the use of coir geotextiles a very attractive option for sustainable development scenarios in slopes management.

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