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A Practical Experiment for Protecting River Banks From Erosion By Using Geotextile

تجربة معملية توضح تأثير استخدام القماش لحماية الجسور

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الملخص:

اجريت هذه الدراسة للتعرف على مشكلة انجراف التربة باستخدام منسوجات الاغراض الجيولوجية (geotextile) في شواطئ الانهار.

ثلاثة انواع من الخامات استخدمت في هذا العمل وهي البولستر، القطن والكناف. تم قياس مواصفات كل عينة وايضاً قوة الشد قبل وبعد التجارب . نفذت التجارب باستخدام نموذج معملي صمم خصيصاً لهذا العمل لتمثيل العوامل الحقيقية التي تسبب انجراف التربة في نهر النيل.

اظهرت النتائج ان الحل لهذه المشكلة تم التوصل اليه بنجاح باستخدام المنسوجات لحماية شاطيء النهر من ظاهرة انجراف التربة كما وجد ان البولستر هو الافضل لحماية شواطئ الانهار من انجراف التربة .

ABSTRACT:

This study was conducted for illustrating the problem of soil erosion on river banks by using geotextile.Three geotextile materials have been used in this work, namely are polyester, cotton and kenaf.The specifications of each fabric have been measured as well as the tensile strenghth of each sample before and after the experimental work.

All experiments have been executed using a prototype designed especially for this work .The prototype was used as a simulator for the bank of the River Nile to study the real factors causing the erosion of the soil.The results obtained showed that a good solution for this problem could be achieved successfully through using geotextile for the protection of the soil of the river banks from being eroded. Polyester armour was found to be the best.

1.0 INTRODUCTION:

The term of "geotextile" is composed of two words geo which means earth and textile which means fabric. Fabrics were used in or near the ground to enhance the grounds characteristics. Such applications are often closely associated with geotechnical engineering.[2]

The effective control of destructive erosion in shorelines and riverbanks are always posting a difficult problem. This stems from the need of an outer protective layer to absorb the energy of wave and current and an inner protective layer to prevent the erosion of the bank's soil.[3]

These problems could be solved properly by using a geotextile filter to be installed on the exposed surface of the bank. The selection of geotextiles used in shoreline erosion control should consider filtration mechanisms.

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2.0 MATERIALS AND METHODS:

2.1 The prototype:

A prototype is designed specially for this work.This prototype was made of stainless steel because of the direct contact with water. The dimensions of the prototype are shown in figure (1). A layer of 5 cm of natural clay is added on the bottom of the prototype . As well two layers each 11 cm wide are added to both sides of the prototype.

The prototype is used in this work as a simulator for the river where three fabrics were used to study the effects of the geotextile as a protection material for soil erosion.

The results obtained are recorded in tables and plotted in the figures shown in the text.

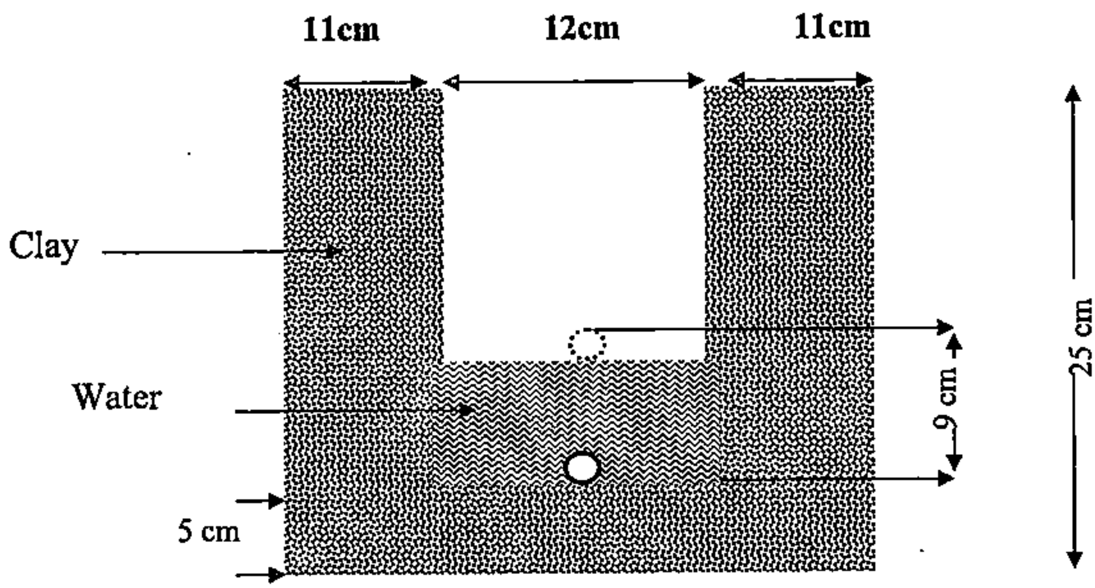

Figure (1)

A side view of the prototype to show the inlet and outlet tubes

2-2 Geotextile:

To solve the problem of the erosion in river banks, three types of geotextiles were used in this work, namley, polyester, cotton and kenaf.

2.2.1 Geotextile out of Polyester fibres:

Polyester is derived from petroleum derivatives through the melt-spun process to give the polyester fiber.[1]

The moisture absorption of the thermoplastic polyester fibre is very low and its resistance to abrasion is very high. The fibers do not extend easily at low loads and consequently polyester fiber is not used in stockings.

Polyester fiber is used in lightweight sheet fabric such as voids. The specifications of the fabric used are as follows:

Warp density = 27 ends/cm
Warp count = 36.5 Tex
Weft density = 14 picks/cm
Weft count = 38.5 Tex

2.2.1 Geotextile out of Cotton fibres:

All cotton fibers exhibit good moisture absorption, good wet and tensile strength and resistance to abrasion. So, they withstand frequent laundering even at high temperatures with minimum shrinkage.[1]

The specifications of the cotton fabric used in this experiment are as follows:

Warp density = 18 ends/cm

Warp count = 44.4 Tex

Weft density = 15 picks/cm

Weft count = 37.4 Tex

2.2.3 Geotextile out of Kenaf (Gunea Hemp) fibres:

It is one of the varieties of the Hibiscus canabinus plant. It is a tall plant, about 3m high and 25 mm in diameter. The plant grows nearly in all tropical and semi- tropical countries.The fiber is found inside the stem of the plant. It must pass through retting process and other subsequent manufacturing operations.[1]

Kenaf is harsh and stiff and it is not

The specifications of the fabric used in this experiment are as follows:

Warp density = 7 ends/cm

Warp count = $\frac{422.75}{2}$ Tex (plied)

Weft density = 3 picks/cm

Weft count = 500.75 Tex

3.0 Determination of the amount of the eroded soil:

3.1 Without using geotextile:

A quantity of clay was added to the bottom and against the sides of prototype as shown in figure (2). A quantity of water was injected through the opening. Water is discharged through the outlet opening in a rate less than the injection rate for keeping the water level unchanged. A filter was fixed before the outlet to measure the quantity of the eroded clay. The experiment was carried out for three hours.This experiment was carried out without using geotextile as a protection material.

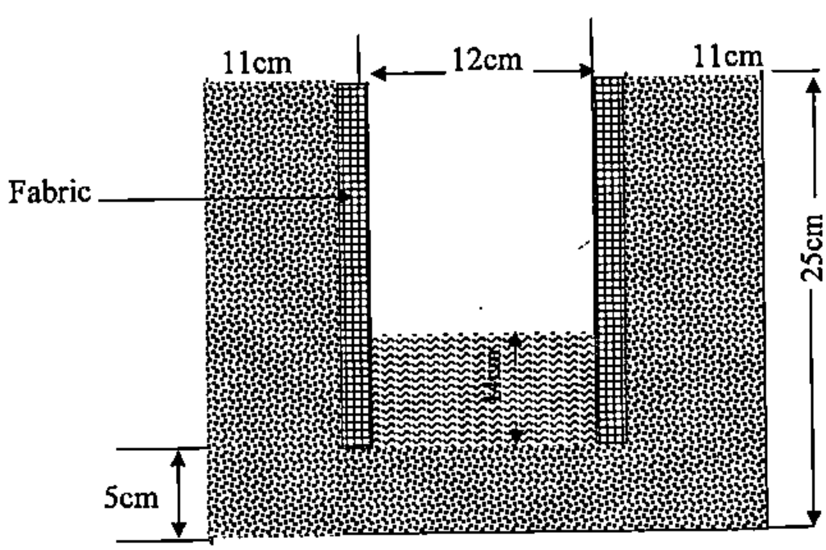

Figure (2)

Cross-section of the prototype where the piece of fabric was installed

This experiment indicates that the eroded soil is so great. Around 73 simulator through a short time gives a scary indication about the real amounts grams of clay have been eroded through only three hours. This eroded amount of clay in the of eroded clay in the real conditions (see Fig (3)).

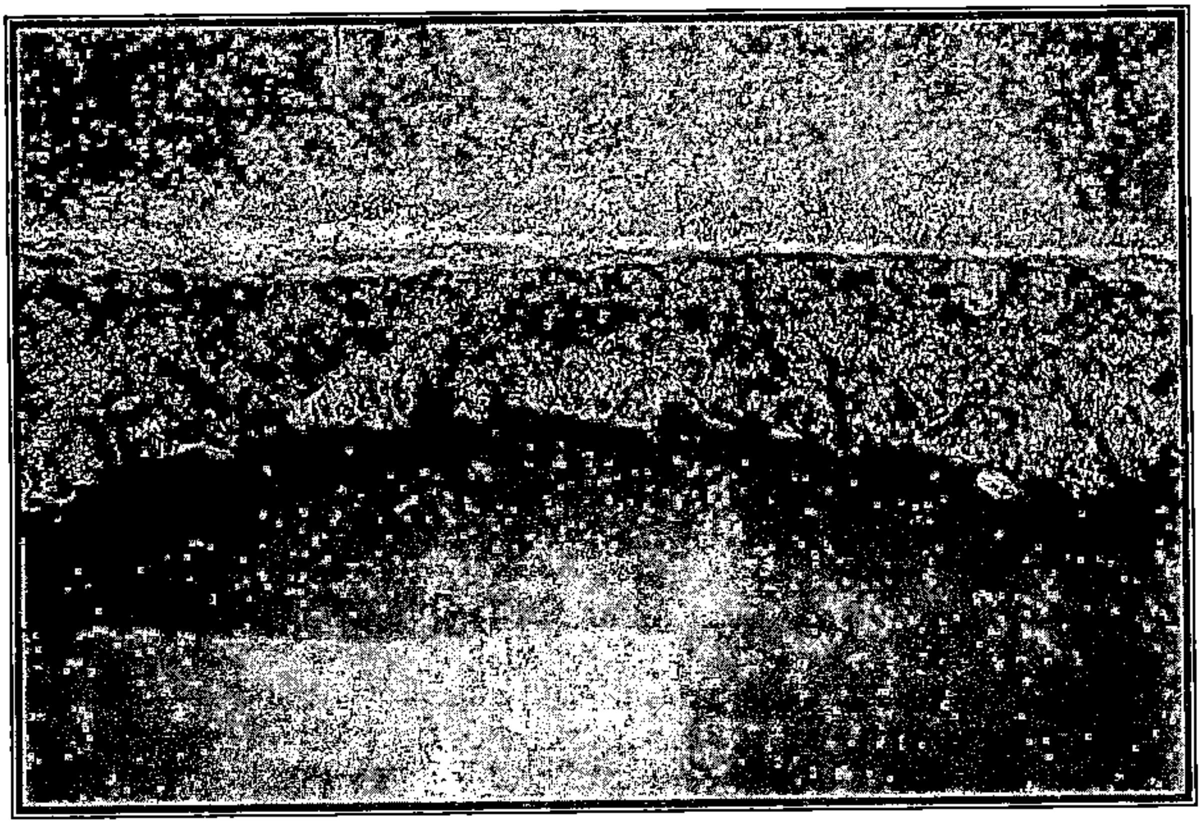

Figure (3)
Erosion without fabric

3.2Results of the effect of using geotextile on the amount of the eroded soil:

3.2.1Results of Polyester geotextile:

Pieces of polyester fabrics were laid as shown in the Figure (2) while some of stones were placed on top of the fabric (riprap). A quantity of water was injected and the rate of discharge was less than the rate of injection. The water level is kept constant. A filter was fixed before the discharge opening to measure the quantity of the eroded clay.This experiment as well took three hours.

The eroded clay was taken from the filter, dried and weighed. The weight of the eroded clay was found 2.8 grams. There is a significant drop in the weight of the eroded clay when the polyester fabric was used as an armour with small stones used as a riprap. This showed that polyester armour worked perfectly as a soil erosion protector as shown in Fig (4).

Figure (4)
Using polyester armour

3.2.2Results of Cotton geotextile:

In the second experiment a piece of cotton fabric and some stones were laid as described before. A quantity of water was injected and the rate of discharge was kept less than the rate of injection so that the water level is kept constant. A filter was fixed before the discharge opening to measure the quantity of eroded clay. This experiment as well took three hours.

The same procedures were followed in this experiment. The eroded clay was taken from the filter then dried and weighed.The weight was found 5.2 grams. As well there is a significant drop in the weight of the eroded clay when a cotton fabric was used as an armour when compared with the weight gained without an armour. The weight of the eroded clay when a cotton fabric was used as an armour was 85% greater than that when the polyester armour was used. See Figure (5).

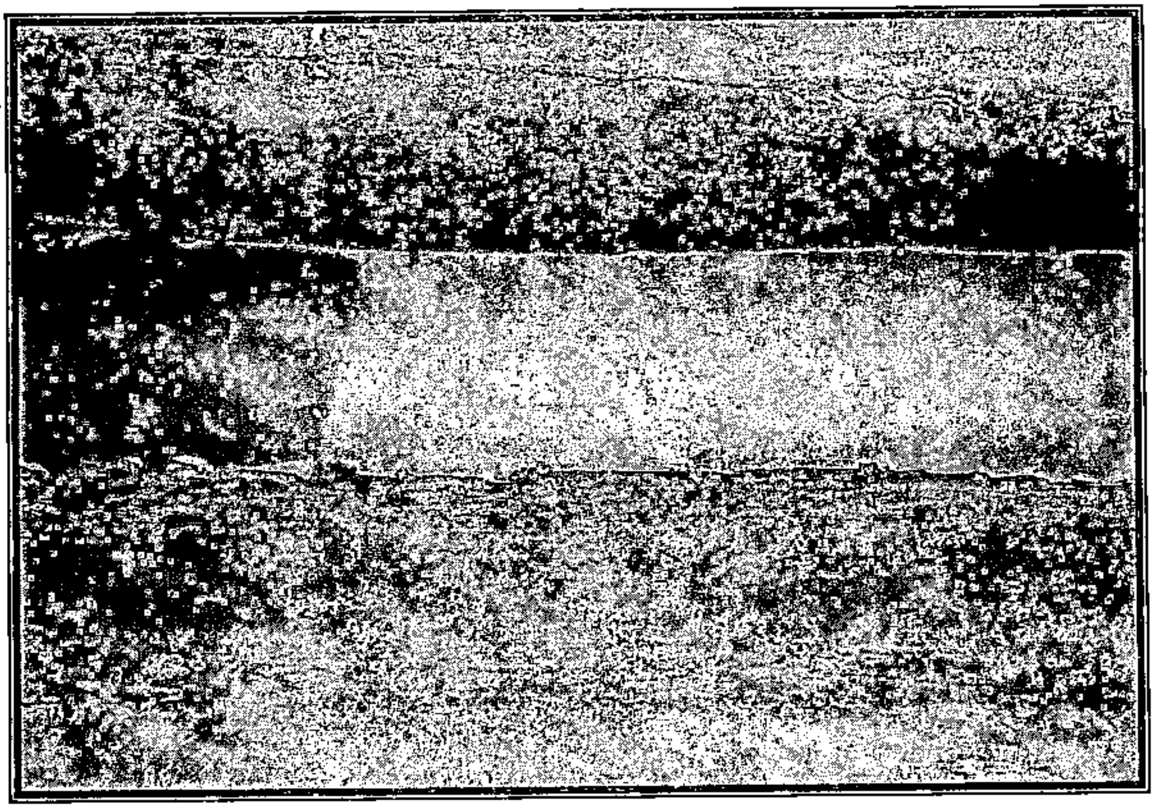

Figure (5)
The erosion of the soil when using cotton armour

3.2.3Results of Kenaf geotextile:

To study the effect of Kenaf as an armour, a piece of kenaf fabric with some stones were laid and a quantity of water was injected. The rate of discharge was maintained less than the rate of injection so that the water level is kept constant. A filter was fixed before the discharge opening to measure the quantity of the eroded clay. This experiment as well took three hours.

The weight of the eroded clay was found 7.4 grams when a kenaf fabric was used as an armour. Again the significant drop in the weight of the eroded clay was maintained when the kenaf fabric was used as an armour when compared with the unprotected soil. The weight of the eroded clay when a kenaf armour was used was 40% greater than that when a cotton armour was applied. See Figure (6).

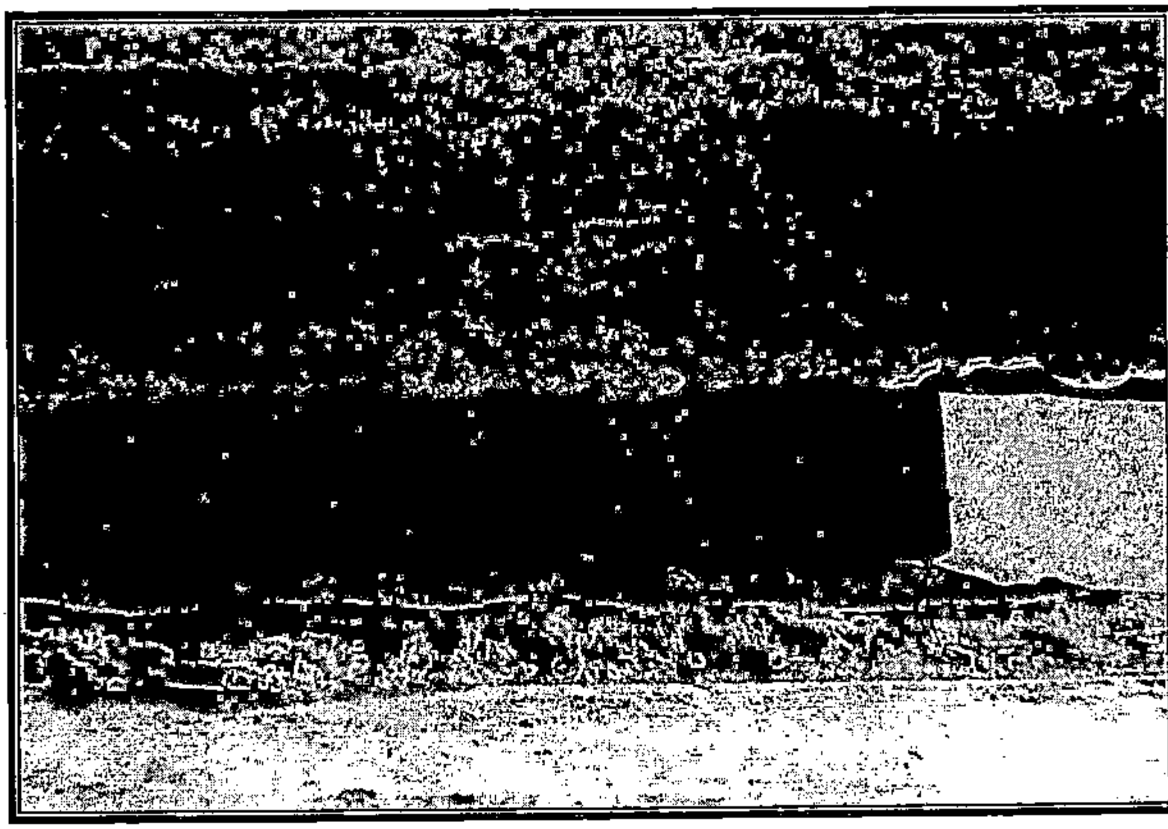

Figure (6)
Using kenaf armour

4.0 Determination of breaking strength of tested fabrics:

The test was made to study the behavior of the fabrics when exposed to water. The breaking tenacities for the dry and wet fabrics were measured. It was found that the breaking tenacity for the polyester fabric remained unchanged under both dry and wet conditions. It was reasoned that the polyester fabric absorbed nill water. For both cotton and kenaf fabrics, it was noticed that the breaking tenacities of wet fabrics are greater than that for dry ones. The absorbed water played a significant role in the orientation of cotton and kenaf fibers thus making them stronger than when they were dry.

This experiment answered the question of the behaviour of these fabrics when being immersed into the water. The water increased the strength of these fabrics. The results were recorded in table (1) and plotted as histograms in Figure (7).

Table (1)
Strength of fabrics(dry and wet) for a specimen of 5 cm width

Fabrics		Breaking Force FH (CN)	Breaking Tenacity RH (CN/Tex)	Breaking Elongation EH
Polyester	Dry	1300	30	16.5
	Wet	1300	30	16.6
Cotton	Dry	650	15.3	7
	Wet	715	16.83	7.7
Kenaf	Dry	975	23	10.5
	Wet	1072	25	11.6

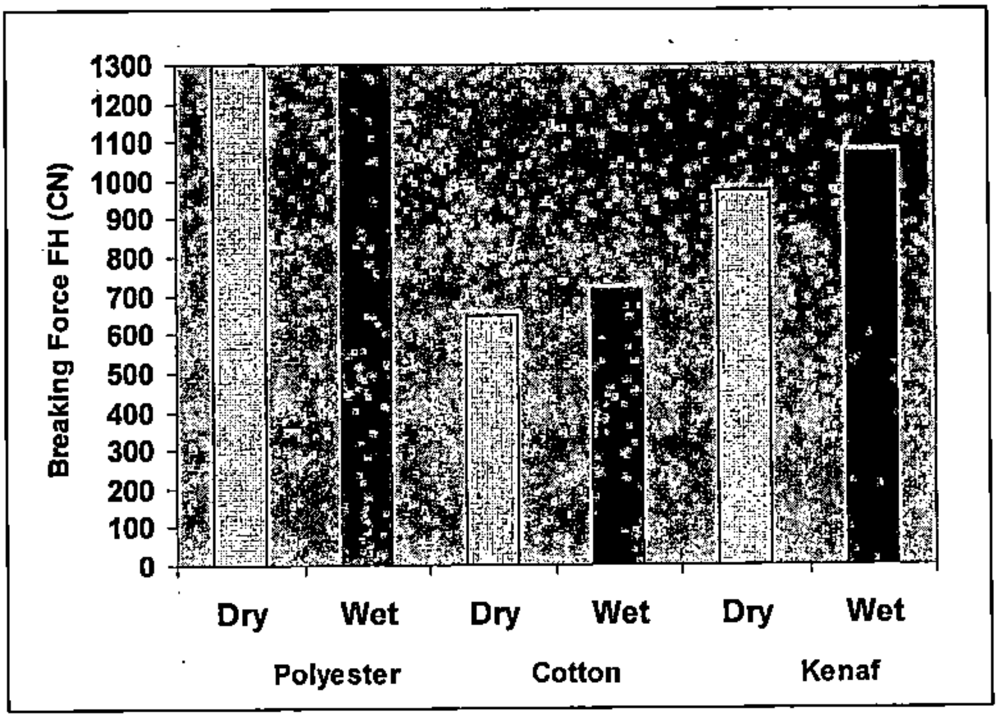

Figure (7)
Showing the breaking strength of the dry and wet specimens

5.0 RESULTS AND DISCUSSIONS:

It was obvious from Figure (8) that the polyester armour worked perfectly as a soil erosion protector. Cotton and kenaf armours came second and third respectively. The reason is simple knowing that the property of water absorption of the polyester fabric is very weak, therefore it prevented the direct contact between the water and the soil.The water current got little chances to contact directly the soil and so got little chances to erode it.

Therefore the absorption has a direct effect on erosion. As well the fabric design regarding the openness of the structure would affect the soil erosion. These openings would allow the clay to pass through from the banks to the water and thus causing the erosion.

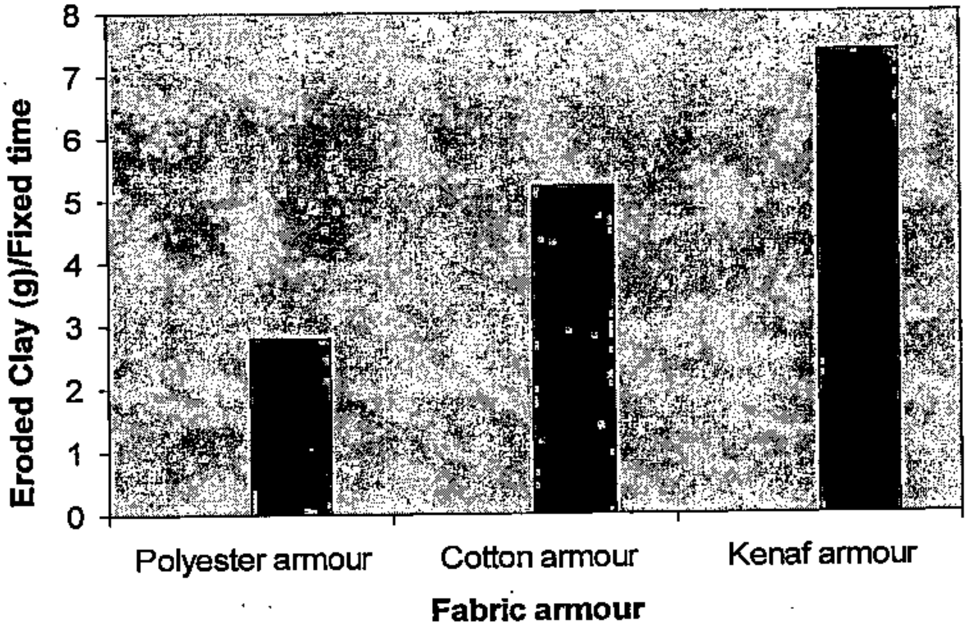

Figure (8)

Fig (9) showed the relationship between the eroded clay and the type of armour used. The natural situation i.e, without protection is considered as 100% erosion.

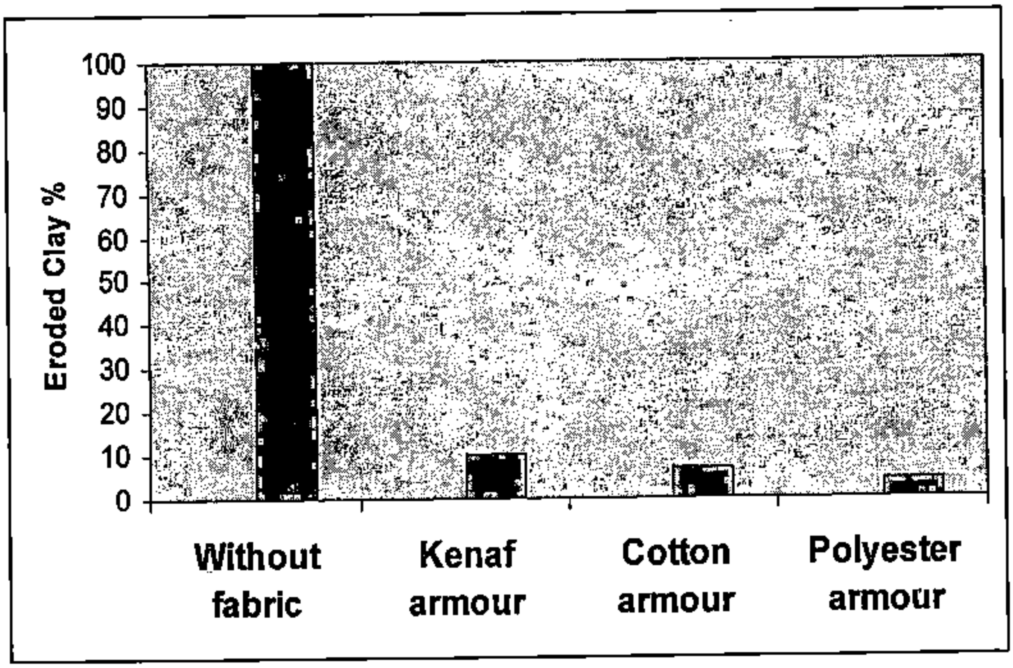

Figure (9)
Showing the % of the eroded clay when using Kenaf, Cotton and Polyester geotextiles as armours

When the kenaf armour was used, the percentage of the eroded clay was found to be10%.

When cotton and polyester armours were used, the percentages of the eroded clay were 7 % and 4% respectively as shown in Figure (9).

6.0 CONCLUSION:

- A successful solution for the soil erosion of the River Nile banks has been achieved by this work. The solution to this problem is achieved by using geotextile to protect the banks of rivers from being eroded. Polyester armour was found to be the best when used as an erosion protector.
- The application of geotextile armours is recommended at locations along river banks where maximum soil erosion is observed.
- This cheap method of protection will minimize the soil erosion as well as the soil loss.

This simple technique should encourage this application to all banks of all rivers.

7.0 REFERENCES:

[1] Technology of Textile Properties / Marjorie A-Taylor, A.T.J/ January 1978.

[2] http://web.utk.edu/~mse/pages/textiles/ Geotextiles.htm.

[3]File://G:\erosion control.htm