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Design, Development and Analysis of Latex based Geomembrane for Pavement Stabilization

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***Abstract*—In some locations, the soil is naturally weak and unsuited to make a stable base for road construction. Traditionally, higher quality aggregates are brought in to upgrade the road base. However, as this can be expensive, additives are also mixed in to improve the soil properties. As a solution, geomembranes can be introduced between the soil layers. The geomembranes used in this study are made from natural rubber latex and is laid between the layers to improve the load bearing capacity of the soil. This geomembrane can prove to be a better alternative than other natural geotextiles available today. With pavement stabilisation, the properties of the base layer of the road are improved. The objective is to increase strength, improve the pavements life span, reduce the quantity of base course material and to reduce the rut depth. With an improved pavement-base and enhanced loadbearing capacity and stability, the degradation of any overlying surface will be greatly reduced. Proper pavement stabilisation will decrease maintenance needs and road wear, which in turn leads to requiring less labour and a better economic solution**.

Keywords—pavement stabilisation; geomembrane; geotextiles;

I. INTRODUCTION

Good quality aggregates may not always be available near the road construction site. Hauling supplementary aggregates from a long distance may not be economically feasible, and is a non-sustainable solution considering the fuel consumption and greenhouse gasses emitted from moving the materials. Using existing aggregates from the site also means you avoid the issue of landfilling of old materials. Road base stabilization using geomembrane is an effective and environmentally friendly method. By applying proper road stabilization when constructing the road, the maintenance need is greatly reduced. This saves transport of materials and equipment, reduces cost and is less labour intensive. The total emissions from road construction with a stabilized road base are greatly reduced.

II. PAVEMENT STABILIZATION

A. scope

Pavement stabilization aims at improving the strength and performance of the pavement by adding the geomembranes along with cost reduction. The rubber plantation industry which is currently in down trend will be uplifted if the geomembrane is found to be suitable for pavement. For the manufacturing of geomembrane, a suitable machinery also needs to be developed and to study the function of geomembranes.

B. objective

The objective of study is to design and develop a geomembrane using the natural rubber latex. This study also involves the determination of tensile properties of geomembrane and the improvement in the pavement life span can be also evaluated by the addition of geomembrane. It also helps to reduce the quantity of base course material without sacrificing the performance of pavement.

C. Development

Natural rubber latex is collected, processed and the resultant rubber sheet is obtained, which is then differentiated as three different grades. The holes are introduced in to the resultant rubber sheets for filtration purpose and then the resultant geomembranes are dried. Rubber sheets of three different

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thickness are obtained and are categorised as three different grades A, B and C.

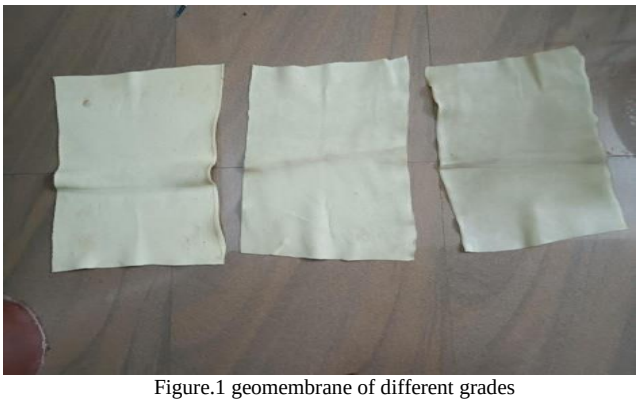

Figure.1 geomembrane of different grades

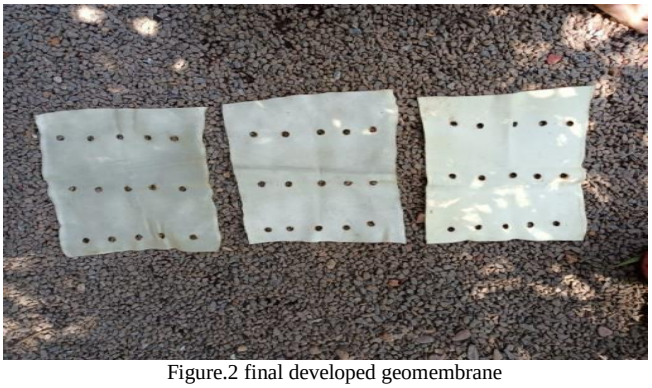

Figure.2 final developed geomembrane

The grades along with their weight per unit area showed in the table given below.

Table.1Grades of geomembrane

GRADES	gm/m²
Grade A	3000
Grade B	2500
Grade C	2000

III. METHODOLOGY

A suitable material for soil stabilization is selected which is then designed and developed as the required geomembrane for soil stabilization. Various test for soil and geomembrane was done which includes tensile tests, sieve analysis, specific gravity, moisture content and CBR.

IV. TEST ON SOIL

A soil sample is collected and taken to the lab for various test. The data obtained from the test are shown in table 2.

Table.2

SI NO	Engineering properties	values
1	Sieve	Cc=0.964, cu=4.59
2	Water content%	11.11
3	Specific gravity	2.8

A. Universal testing machine

It is used to determine the tear strength and tensile strength of various grades of geomembrane and find out which grade shows better result.

Table.3 Consolidated result

Grade	Tensile strength (MPa)		Tear strength(N/mm)	
	Longitudinal	Transverse	Longitudinal	Transverse
A	0.96	0.83	6.70	6.74
B	0.85	0.71	5.56	5.36
C	0.70	0.60	4.74	5.66

B. CBR

CBR test is done to evaluate the strength of soil as well as with the geomembrane. The latter was done by placing a 150mm diameter geomembrane between the layers of soil. A graph is plotted between load and penetration according to the obtained data from the graph. The graph is shown below.The CBR values obtained are shown in Table 4

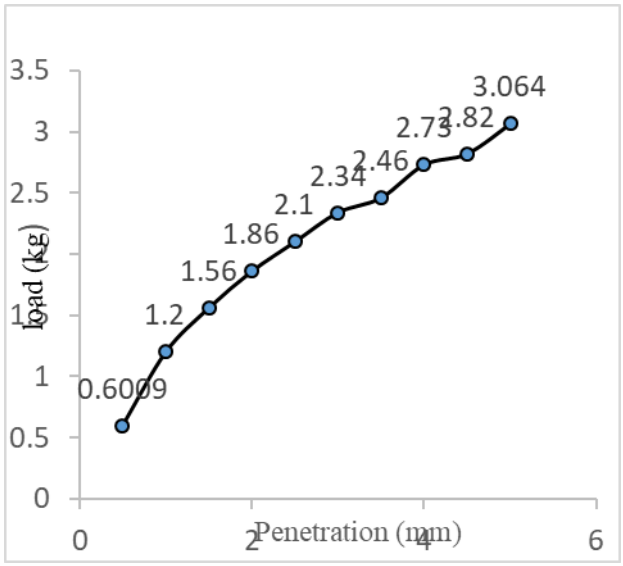

Figure 3. Plot of load versus penetration(Soil)

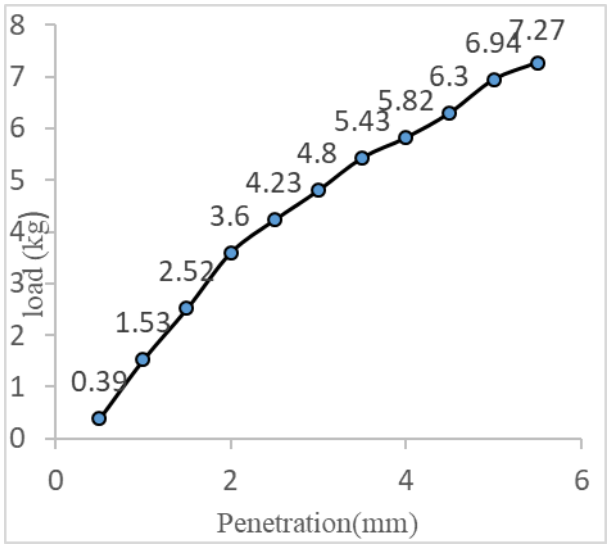

Figure 4. Plot of load versus penetration(Grade A)

Table.4 CBR test result

GRADE	CBR (%)
Soil	12.20
Grade A	34.4
Grade B	19.25
Grade C	14.55

CONCLUSION

- Out of the three grades designed and developed, Grade A having highest per unit area showed better results

Tensile strength of A> tensile strength of B> strength of C
Tear strength of A >Tear strength of B > tear strength of C

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- Introduction of geomembrane into the soil enhanced the CBR of the soil
- Grade with higher mass per unit area showed better results

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