

EXPERIMENTAL STUDY ON PAVEMENT USING NON-WOVEN GEOTEXTILES

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Abstract

A Geotextile is a class of industrial grade textile that is composed of polypropylene and/or polyester resin that have yarns. Yarns have the property of chemical and thermal bonding to make a flat permeable sheet. Pavement typically consists of bituminous or concrete surface, aggregate base layer or support layer and then natural soil subgrade. Geotextile prevent the mixing of fine subgrade soils with aggregate support layer. This geotextile material is also used to extend the durability of flexible pavements. Here polypropylene was used as a geotextile material which has the properties similar to the plastics. Field evidences also indicate that geotextiles will improve the performance of the pavement. As in the developing countries like India using of polypropylene is economically beneficial. The tests were conducted in an in-situ manner. Finally the result was obtained by comparing pavement using geotextile and not using geotextile.

Introduction

- Geotextiles are polymer fabrics used in the construction of roads, drains, harbour works, break waters and for land reclamation and for many other civil engineering purposes.
- Geotextiles are defined as the permeable geo-synthetic material or we can say these are permeable fabric which has ability to separate, filter, reinforce and protect when used with soil.
- Geotextiles is one of the first textile product in human history and now it has become the need of every highway construction.

Literature Review

- Laboratory Evaluation of Flexible Pavement Structures Containing Geo-composite Drainage Layers.

Journal Name: Science Direct

Author: Jean Pascal Bilodeau, Catherine Saviou

The behaviour of flexible pavement structures in wet environments is significantly influenced by the infiltration of excess water. The use of geocomposite drainage layers is an alternative to promote rapid removal of any infiltration of excess water. Using four small-scale flexible pavement test sections, this laboratory study focused on measuring the effectiveness of the different

configurations of geo-composite drainage layers in terms of reduction in water content and improvement of mechanical properties during a drainage period.

Published on: April 2015, Pages : 162-170 . Volume 43 Issue 2

- **Laboratory Pull-out Equipment for Testing Soil Geosynthetic Interface for Flexible Pavement Design**

Journal Name: ASCE (American Society of Civil Engineers)

Author: Rajiv Gupta Ph.D., George D Zornberg Ph.D.

In this abstract the journal says that to reduce the testing times and to predict the soil-geo-synthetic interface characteristics at low displacements, new pullout test equipment was developed that allows testing geosynthetics for reinforced pavement application at low displacement magnitudes.

Published on: March 25 ,2014. Volume 21 Issue 4

- **Evaluation of anti-reflective cracking systems using geosynthetics in the interlayer zone**

Journal Name: Science Direct

Author: David Zamora –Barraza, Angel Vega Zamanilla

The purpose of this study is to evaluate the durability of anti-reflective cracking systems that have a geo-synthetic, geotextile in the interlayer zone. For this purpose, a dynamic test has been designed that simulates the passing of traffic loads on the road surface. Stresses are applied to a two-layer test piece, which represents the pavement structure, with an anti-crack reflection system between the lower part, which is to be reinforced, and the upper part, which is the new pavement. In the lower layer, a longitudinal groove has been made that simulates an initial crack.

Published on: April 2011 Pages 130-136 Volume 29 Issue 2

Properties of Materials

Aggregate

Aggregates are the important constituents of the concrete which give body to the concrete and also reduce shrinkage. Aggregates occupy 70 to 80 % of total volume of concrete. So, we can say that one should know definitely about the aggregates in depth to study more about concrete.



Figure 1: Aggregate

According to size In general, 40mm size aggregate used for normal strengths a and 20mm size is used for high strength concrete. The size range of various coarse aggregates given below

Table 1: Size of Coarse Aggregate

Coarse Aggregate	Size
Fine gravel	4mm – 8mm
Medium gravel	8mm – 16mm
Coarse gravel	16mm – 64mm
Cobbles	64mm – 256mm
Boulders	>256mm

Table 2: Property Tests on Aggregate

Designation	Test Result	Test Method
Impact value Test	24.06(%)	IS:2386 PART IV
Specific Gravity of Aggregate (20 mm)	2.62(mm)	IS 2386 PART III
Water Absorption	0.57(%)	IS:2386 PART III
Abrasion	1.06(kg)	IS:2386 PART V

**Figure 2: Weighing of Aggregate****Bitumen**

Bitumen is defined as “A viscous liquid, or a solid, consisting essentially of hydrocarbons and their derivatives, which is soluble in trichloro-ethylene and is substantially non-volatile and softens gradually when heated”. It is black or brown in colour & possesses waterproofing and adhesive properties



Figure 3: Bitumen

Table 3: Seive Analysis

Nominal size of Aggregate	Standard 19 mm	Used in the study 19 mm
Sieve size(mm)	Cumulative % by weight of total aggregate passing	
26.5	100	100
19	79-100	97
13.2	59-79	73
9.5	52-72	61
4.75	35-55	42
2.36	28-44	33
1.18	20-34	29
0.6	15-27	24
0.3	10-20	17
0.15	5-13	8
0.075	2-8	4

Table 4: Property Tests for Bitumen

Designation	Test Result	Permissible Limit	Test Method
Specific gravity of bitumen	1.025	0.99 min	IS: 1202 – 1978
Softening point of bitumen	54.35°C	47°C (min)	IS: 1205 – 1978
Bitumen	50 mm	45(min)	IS: 1203 – 1978
Penetration Test			
Ductility test	94 cm	100	IS: 1208 – 1978

Geo Textiles

- Geosynthetics wherein geotextile is a part are, used in a wide variety of applications for an infrastructure projects like roads , rivers and sea bank protection , canal lining, land fill, airport, taxiways, etc...
- Geotextile is an any permeable membrane used with foundation, soil, rock, earth, or any other geotechnical engineering related material as an integral part of a man-made product, structure or system.
- Geotextiles forms one of the largest group of Geosynthetic materials.
- The original term used for geotextiles and still sometime used is Filter fabrics.

Types of Geotextiles

Geotextiles are classified into three types. They are

- Woven
- Non-Woven
- Knitted

Functions and Applications of Geotextiles in Pavement

There are some main functions which was performed by geotextile in pavement. They are,

1. Separation
2. Filtration
3. Reinforcement
4. Drainage
5. Erosion control

Polypropylene

- Polypropylene is a type of thermo plastic resin. It is a part of both the average household and is in commercial and industrial applications. The chemical designation is C₃H₆. One of the benefits of using this type of plastic is that it can be useful in numerous applications including as a structural plastic or as a fiber-type plastic.
- The history of polypropylene began in 1954 when a German chemist named Karl Rehn and an Italian chemist named Giulio Natta first polymerized it.
- This led to a large commercial production of the product that began just three years later. Natta synthesized the first syndiotactic polypropylene.



Figure 4: Polypropylene

Uses of Polypropylene

- lastic parts - from toys to automobile products
- Carpeting - in all forms of carpeting, area rugs and in upholstery
- *Reusable* products - especially in containers and similar products
- Paper - used in various applications for stationery and other writing bindings
- Technology - commonly found in loudspeakers and similar types of equipment
- Laboratory equipment - in virtually every aspect where plastics are found
- Thermoplastic fibre reinforced composites.

Table 5: Properties of Polypropylene

S.NO	Property	Value
1	Type	Polypropylene
2	Shape	Straight Ends
3	Average Diameter	0.3 mm
4	Length	12 ± 2 mm
5	Specific Gravity	0.92 g/cc



Figure 5: Numbering the prepared Moulds



Figure 6: Performing Marshal Stability Test

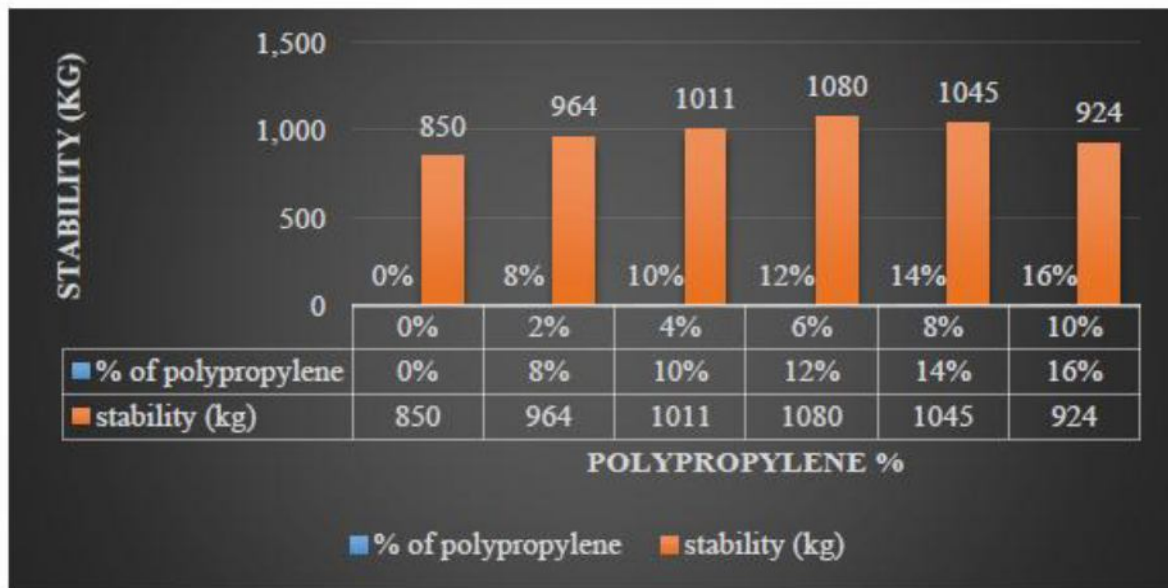
Table 6: Characteristics Values at Different Bitumen Content

Mould no	Bitumen Content (%)	Stability (kg)	Average Stability (kg)
1	4.25	780.2	
2		922	798.6
3		693.6	
4		780.1	
5	4.50	997.3	925.2
6		998.1	
7		630	
8	4.75	867.3	735.6
9		709.5	

Table 7: Characteristic Value of Specimen at 4.5% Bitumen Content

Mould No	Bitumen Content (%)	Polypropylene Content (%)	Stability (Kg)
1	4.50%	0	850
2		8	964
3		10	1011
4		12	1080
5		14	1045
6		16	924

Result



Conclusion

- Utilisation of geotextiles (polypropylene) improves the binding property of mix
- The optimum result of geotextile came out to be 8% from the experiments conducted.
- The properties of bitumen such as penetration, softening point improved with the addition of the polypropylene fibre.
- Roads using geotextiles can also be constructed in the areas having high temperatures (60°C).
- Geotextiles in roads increases the stability value and durability to a great extent.

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