EXPERIMENTAL INVESTIGATION OF TEXTILE WASTE ON INDEX AND STRENGTH PROPERTIES OF EXPANSIVE SOIL FOR FLEXIBLE PAVEMENT

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Abstract— Textile waste released by various textile is a major problem today. These effluents are disposed either treated or untreated over land. Then it interacts with the soil and environment. This causes variation in geotechnical properties of soil. This variation can affect the construction and safety of building structures. So it is necessary to study the effect of various textile waste on soil properties. In this paper, an attempt is made to study the effect of textile waste on red soil. Textile waste is added in varying percentages from 10 to 50% with an increment of 10% to study the effect on index and strength properties of soil,

Keywords— **Textile waste, Expansive soil, California Bearing Ratio, Unconfined Compressive Strength, Plasticity index**

1. INTRODUCTION

Expansive soil possesses great threat for the construction of buildings due to its less characteristic shear strength and high swelling and shrinkage characteristics. Problematic soils, especially expansive soil deposits are considered to be a potential natural hazard, which can cause extensive damage to structures if not adequately treated. Soil improvement in its broadest sense is the alteration of any property of a soil to improve its engineering performance. The result of an application of a technique may be increased strength, reduced compressibility, reduced permeability or improved ground water condition.

The desirable properties of sub grade soil as highway material are stability, incompressibility, permanency of strength, minimum changes in volume under adverse conditions of weather and ground water, good drainage and ease of compaction. Red soil is a type of soil that develops in a warm temperate, moist climate under deciduous or mixed forest that have organic mineral layers which are found all around India. Industries are important role in the growth of the country on technology and economy part. At the same time, it disposal hazards waste effluents after industrial processing, this may lead to environmental pollution and it is very dangers to human health, hence an attempt is made to control the environmental pollution. Expansive soils are also referred to as "Red soil" in some parts of the world. Red soils have high shrinkage and swelling characteristics. In general, these soils are very much sensitive to changes in environment. The environment includes the stress system, the chemistry of pore water in the system, the seasonal variations in ground water table and temperature variations.

2. MATERIAL USED

2.1 RED SOIL

Red soils generally derived from a crystalline rock. They are usually poor growing soils, low in nutrients and humus and difficult to cultivate because of its low water holding capacity. Red soils denote the third largest group of India covering an area of about 3.5 lakhs sq.km over the Peninsular from Tamil Nadu in the south bundlekhand in the north and rajmahal hills in the east to kachchh in the west. They surround the black soil on their south, east and north.

FIG 1 – RED SOIL

2.2 TEXTILE WASTE

Textile waste is the waste produced by textile activity which includes any material that is rendered useless during a manufacturing process. It has existed since the start of the individual revolution.

FIG 2 – TEXTILE WASTE

Some examples of industrial wastes are chemical solvents, paints, sandpaper, paper products, industrial, by-products, metals and radioactive wastes. Toxic waste, chemical waste, industrial solid waste and municipal solid waste are designations of industrial wastes.

3. RESULTS AND DISCUSSIONS

The textile effluent was mixed with the soil sample in varying percentages from 0 to 50% with an increment of 10%. The resulting mixture was tested to determine the change in geotechnical properties such as liquid limit, compaction characteristics, UCC strength and curing strength.

3.1 LIQUID LIMIT

The liquid limit apparatus has a cup which is raised 1cm above a flat base and then dropped by rotating a handle. The grooving tool has a cutting edge of standard dimensions used to form a groove in the middle of the soil sample. A gauge block is used to check that the cup is adjusted to give a drop of exactly one cm. The observations are as follows.

Proportions	Moisture content(%)
Red soil alone	12.4
90%S-10%W	13.6
80%S-20%W	13.8
70%S-30%W	17.2
60%S-40%W	17.8
50%S-50%W	20.6

TABLE 1 – LIQUID LIMIT RESULTS

3.2 PLASTIC LIMIT

Plastic limit is the water content at which a soil will just begin to crumble when rolled into a thread approximately 3mm in dia. The Observations of plastic limit is given below.

Various proportion	Moisture content(%)
100% S	12.3
90%S + 10%W	13.08
80%S + 20%W	13.79
70%S + 30%W	17.52
60%S + 40%W	20.25
50%S + 50%W	22.5

TABLE 2 – PLASTIC LIMIT RESULTS

3.3 STANDARD PROCTOR COMPACTION

Standard Proctor's Compaction tests are conducted on soil samples under equal proportioning with 0%,10%,20%,30%,40%,50%. The maximum dry density and optimum moisture content with addition of textile waste combinations is shown below:

Soil proportion	Dry density (ϒ) (g/cc)	Optimum moisture content(%)
100%S	1.912	12.4
90%S + 10%W	1.758	12.2
80%S + 20%W	1.617	14.6
70%S + 30%W	1.66	14.3
60%S + 40%W	1.638	14.6
50%S + 50%W	1.74	15.2

TABLE 3 – STANDARD PROCTOR COMPACTION RESULTS

3.4 CALIFORNIA BEARING RATIO

The test is performed in CBR apparatus by measuring the pressure required to penetrate a soil sample at 2.5mm & 5mm with a plunger. The measured pressure in the dial gauge is then divided by the pressure required to achieve an equal penetration on a standard sample.

Description	soaked CBR Value	
Penetration value(mm)	2.5	5
90%S + 10%W	2.37	1.79

80%S + 20%W	2.06	1.63
70%S + 30%W	2.96	2.145
60%S + 40%W	1.93	2.58
50%S + 50%W	2.06	1.72

TABLE 4 – CBR RESULTS

4. DESIGN OF PAVEMENT

i. Two -lane single carriage way

ii. Initial traffic in the year of completion of construction = 400 CV/day

iii. Traffic growth rate per annum = 7.5%

iv. Design life = 15 years

v. Vehicle damage factor (based on axle load survey) = 2.5 (standard axles per commercial vehicle)

vi. Design CBR of sub grade soil = 2.96%

DESIGN CALCULATION

i. Distribution factor = 0.75

ii. Cumulative number of standard axles to be catered for the design

$$N = \frac{365 \times [(1+0.075)^{15} - 1]}{0.075} \times 400 \times 0.75 \times 2.5$$

= 7200000

= 7.2 msa

Total pavement thickness for CBR 2.96% & traffic 7.2 msa =725mm

Pavement composition interpolated for plate 1, CBR 2.96%

a) Bituminous surfacing = 33mm SDBC+ 78mm DBM

b) Road base = 250mm

c) Sub base = 360mm granular material of CBR not less than 30%

5. CONCLUSIONs

In this study, an attempt has been made to study the effect of textile effluent on the geotechnical properties soil. From the results the, following conclusions are drawn.

- Both the Liquid limit and Plastic limit values of the treated soil decrease with increase in percentage of Textile effluent.
- Unconfined compressive strength increases with increase in concentration of textile effluent. This is due to the strong bonding of the textile effluent with the soil.
- The utilization industrial wastes are economical and it is environmental friendly.
- The stability of soils mass is increased due to the addition of textile effluent.
- The OMC and MDD increases with increase in concentration of textile effluent.
- Pavement thickness for stabilized road is reduced and cost saving .

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