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Soil Stabilization using Tannery Waste

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Abstract - *Soil is the basic foundation for any civil engineering structures. It should has property to bear the loads without failure. In some places, soil may be weak which cannot resist the oncoming loads. In such cases, soil stabilization is needed. Soil stabilization is the process of changing soil properties by different methods where the main objective is to increase the strength or stability of soil and to reduce he construction cost by making best use of locally available materials. Stabilization is being used for a variety of engineering works, the most common application being in the construction of road and airfield pavements. The following are the stabilizers that are used so far are cement, lime, bitumen, fly ash, raw plastic bottles, and plastic sludge. In this research, tannery waste is used as stabilizer. The laboratory test was conducted with and without adding stabilizer with soil sample. Test results are compared.*

Key Words: stabilization; soil; tannery; waste

1. INTRODUCTION

Stabilization is the technique of blending and mixing materials with a soil to improve the soil's strength and durability. The process may include blending soils to achieve a desired gradation or mixing commercially available additives that may alter the gradation, change the strength and durability, or act as a binder to cement the soil.

Tanning is the process of treating skins and hides of animals to produce leather, which is more durable and less susceptible to decomposition. Wastes generated by the leather processing industries pose a major challenge to the environment. According to conservative estimates, more than 600,000 tons per year of solid waste are generated worldwide by leather industry and approximately 40-50% of the hides are lost to shavings and trimmings. In this project waste from production unit is taken as stabilizer. This waste is mixed with black cotton soil in the proportion of 2:3 and experimental studies (specific gravity, liquid limit, plastic limit, standard proctor test, California bearing ratio and consolidation test) are carried out and results are compared with black cotton soil sample.

2. OBJECTIVES AND METHODOLOGIES

The main objective of this research is to stabilize the soil using tannery waste and achieve desired strength. The methodology for this research shown in Fig. 1.,

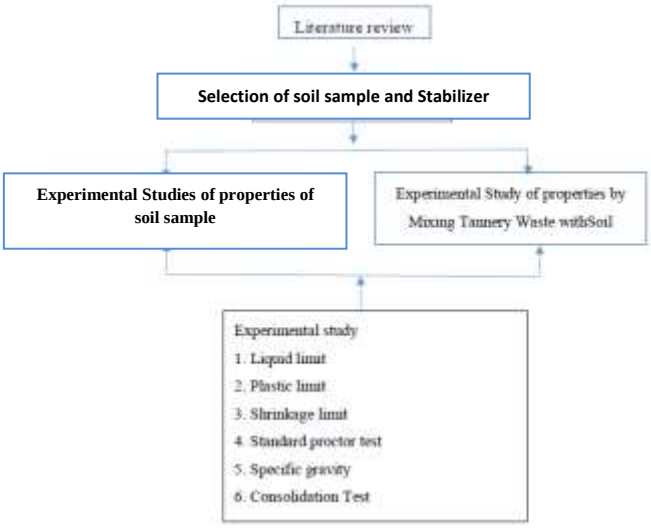

Fig 1.Methodology

In this research, the soil sample is selected based on the comparison of properties of various types of soil sample. Stabilizer is selected based on the generation of industrial waste materials from various categories. The properties of soil sample analyzed and compared with and without adding stabilizer.

3. SELECTION OF SOIL SAMPLE AND STABILIZER

The soil sample is selected based on the comparison of properties of various types of soil which is listed in Table I. From the comparison of soil, the black cotton soil has high plasticity, high liquid limit and it is highly expansive soil. Due to this property, black cotton soil has low bearing capacity and low strength. Hence this research aims to improve the strength of black cotton soil. The soil sample is collected from the location New Balaji nagar, Thudiyalur, Coimbatore.

Table -1: Comparison of properties of various types of soil

S.No	Soil Type	Liquid Limit	Plastic Limit	Plasticity Index	Max dry density
1	Alluvial Soil	40-43.82%,	20-23%	20-24	1.632-1.732g/cc
2	Red Soil	62-65%	28-32%	30-35	2.6-2.7 g/cc
3	Black cotton soil	49-52%	29-32%	20-22	1.632-1.732g/cc
4	Laterite soil	80-89%	50-60%	30-35	-
5	Silt	60-100%	30-50%	30-40	-

Wastes generated by the leather processing industries pose a major challenge to the environment. According to conservative estimates, more than 600,000 tons per year of solid waste are generated worldwide by leather industry and approximately 40–50% of the hides are lost to shavings and trimmings. The generation of Tannery waste in different countries shown in chart 1. From Figure China produces the maximum amount of tannery waste (2500 millions square feet). In India more than 500 millions square feet tannery wastes are produced every year. It is equal to 1/4th of tannery waste produced by China. In this research the waste generated from production unit has taken as stabilizer which contains 75% of lime 20% of sodium sulphate and remaining 5% of other contents. Lime is blending material which has property to reduce the expansive character, plasticity and swelling potential of black cotton soil when mixed.

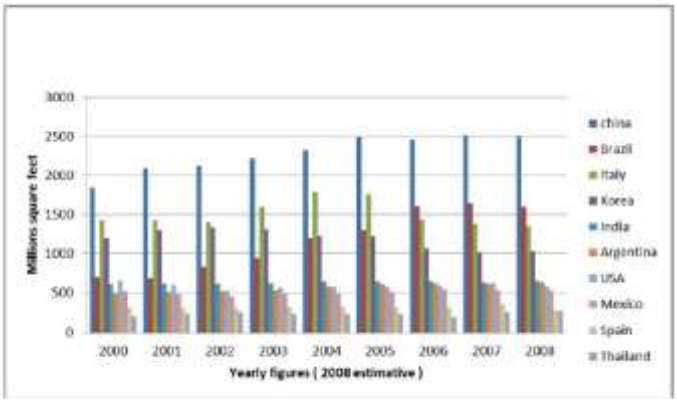

Chart -1: Tannery Waste Generation in Different Country

4. EXPERIMENTAL STUDY ON BLACK COTTON SOIL & STABILIZED BLACK COTTON SOIL

The collected soil sample is tested in laboratory for the properties of Specific Gravity, Liquid Limit, Plastic Limit, Standard Proctor Test, California Bearing Ratio Test, Consolidation Test in both the condition with and without stabilization and the test results are compared which is shown in Table 2.

5. RESULTS AND DISCUSSIONS

From Table 2., The Liquid limit and Plasticity index value are reduced which denotes the swelling potential of soil get reduced. The increase in California Bearing Ratio value of treated black cotton soil indicates the increase in bearing strength of that soil. The coefficient of consolidation for treated soil is lower than coefficient of consolidation of untreated soil. The CBR value of treated black cotton soil is 4.2% and 4.8% respectively which is between 3% and 5%. Thus it has normal subgrade strength. Optimum moisture reduced from 33.34% to 28.34% which denotes a decrease in swelling character of treated Black cotton soil.

Table -2: Comparison of Soil Properties without and with adding stabilizer

S.No	Soil Properties	Results	
		Untreated Soil	Treated Soil
1	Specific Gravity	2.87	1.88
2	Liquid Limit	52.66%	45.75%
3	Plastic Limit	19.60%	30.21%
4	Plasticity Index	33.06	15.54%
5	Maximum Dry Density in g/cc	1.45	1.6
6	Optimum Moisture content	33.34%	28.34%
6	California bearing ratio (5mm penetration)	3.8%	4.2%
7	California bearing ratio (2.5mm penetration)	2.7%	4.8%
7	Coefficient of Consolidation in mm^2/sec	$1.5x10^{-4}$	$0.9x10^{-4}$

6. CONCLUSION

Black cotton soil, Owing to its undesirable engineering properties such as high swelling and shrinkage, the soil is not good either as foundation or embankment material. To make the best use of black cotton soil, its properties are to be modified to suit the requirements in any specific case by means of stabilization. Therefore, it is necessary to properly choose the stabilizer through careful investigation to improve the strength, compressibility and permeability characteristics. At the same time, the economics of the process of the stabilization should also be considered. Here the Tannery waste is used as stabilizer and mixed with black cotton soil in the proportion of 2:3. Based on the results and analysis the strength of black cotton soil is increased when treated with tannery waste.

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