Stabilization of Clay Soil using Polypropylene and Saw Dust Ash

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Abstract

This paper explains about a stabilization of clay soil using polypropylene and saw dust. To evaluate the effects of waste polypropylene and saw dust on shear strength of soil by carrying out an unconfined compression test and California bearing ratio test on different soil samples. To obtain index properties and engineering properties of those soil samples test like liquid limit, plastic limit, shrinkage limit, standard proctor test, unconfined compressive strength, California bearing ratio test were conducted. The ratio of the mix will be on adding polypropylene as (0%, 10%, 15%) and saw dust ash as (0%, 10%, 15%) and CBR is done with the un-soaked conditions.

Keywords – *Aggregate, California bearing ratio(CBR), compressive strength, unconfined compressive strength(UCC).*

I. INTRODUCTION

Soil stabilization is the process which is used to gain the engineering properties and strength of the soil.Soil stabilization is required when the soil having less strength. It includes compaction, reconsolidation, drainage and many other such processes. The prime objective of soil stabilization is to improve on-site materials to create a solid and strong sub-base and base courses. In certain regions of the world, typically developing countries, and in many countries soil stabilization is being used to construct the entire road. In the past, soil stabilization was done by utilizing the binding properties of clay soils, cement-based products such as soil cement, and/or utilizing the "rammed earth" technique (compaction) and lime. Some of the 'green technologies' are: enzymes, surfactants, biopolymers, synthetic polymers, co-polymer based products, cross-linking styrene acrylic polymers, tree resins, ionic stabilizers, fiber reinforcement, calcium chloride, calcite, sodium chloride, magnesium chloride and more. Some of these new stabilizing techniques create hydrophobic surfaces and mass that prevents road failure from water penetration or heavy frosts by inhibiting the ingress of water into the treated layer.However, recent technology has increased the number of traditional techniques which is used for soil stabilization purposes. Such non-traditional stabilizers include Polymer based products (e.g. cross-linking water-based styrene acrylic polymers that gives strength to the load-bearing capacity and tensile strength of soils), Copolymer Based Products, fiber reinforcement, calcium chloride, and Sodium Chloride.Traditionally and widely of soil stabilization. However, this can often be expensive and is not a very good "green" alternative.

II. MATERIAL USED

A. Soil used

Soil sample is collected from the proposed construction site in kariappati Madurai.
Standard test were conducted to determine the physical properties of the soil and the results are given in Table 1.

TABLE 1
Physical properties of soil

S.no	Test conducted	Result	
1	Sieve analysis	It is a mixed grained soil	
2	Liquid limit	52%	
3	Plastic limit	30.9	
4	Shrinkage limit	13.5	
5	Standard proctor	OMC 12%	MDD 1.992 kg/cm^3
6	CBR	1.64	
7	UCC	0.049	

B. Classification of soil sample

Based upon the test performed in laboratory for soil sample and according to the results, obtained, the soil sample is classified By using the sieve analysis our soil is conformed as the mixed grain soil.

C. polypropylene

Polypropylene is a industrial waste material and athermoplastic polymer used in a wide variety of applications. An addition of polymer done from the monomer propylene, it can be developed in a wide variety of structures giving rise to applications including packaging and labeling, textiles, plastic parts and reusable containers of various types, laboratory equipment, automotive components.. Polypropylene is the second widely used product plastic and it is mostly used in the manufacturing of packaging and labeling. Polypropylene will be much similar to polyethylene,

especially in solution behaviour and electrical properties. The methyl group will also improves the mechanical properties and the thermal resistance of the soil.This arrangementcreates a greater degree of crystallinity and results in a stiffer material that is more resistant to creep than both atactic polypropylene and polyethylene.

D. Saw dust ash

The Saw dust was collected from local Saw mill in Industrial area, the saw dust collected was obtained from sawing of teak and deodar wood. Saw dust is actually by-products of sawmills generated by sawing timber. It is the loose particles or wood chippings obtained by sawing wood into useable sizes. After collection, clean saw dust not having much bark and so not much organic content was air dried and burnt at the room temperature. The SDA was then sieved through 600 micron sieves to remove the lumps, gravels, un burnt particles and other materials which are deleterious to soil. The SDA passing through 600 microns sieve was used for the laboratory work. burning of saw dust and shows SDA used in the present study. Two waste products, dust and chips, form at the working surface during woodworking operations such as sawing, milling and sanding. These operations both shatter lignified wood cells and break out whole cells and groups of cells. Shattering of wood cells creates dust, while breaking out of whole groups of wood cells creates chips.

TABLE 2 Chemical properties of sawdust ash

Chemical	Percentage%
Sio_2	66.74
Al_2O_3	5.67
Fe_2O_3	3.39
CaO	1.85
MgO	3.72
K_2O	12.67

III. LABORATORY STUDIES

The Various tests conducted on the clayey soil samples included determination of the physical and chemical properties of soils at their natural state. On the other hand, the testing was conducted on the clayey soil samples mixed with different percentages of polypropylene and sawdust ash included the standard proctor unconfined compressive strength and California bearing ratio.

A. Standard proctor test

Standard proctor is the test used to determine the compaction of different types of soil and the properties of soil with a change in moisture content. And this is also used to determine the optimum moisture content(OMC) and maximum dry density(MDD).

B. California bearing ratio

The CBR is a penetration test for evaluation of the mechanical strength of natural ground, subgrades and base courses beneath new carriage construction. The CBR can also be used for measuring the load-bearing capacity of unimproved airstrips or of soils under paved airstrips. The harder the surface, the higher the CBR rating. 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 guage is then divided by the pressure required to achieve an equal penetration on a standard sample.

C. Unconfined compressive strength

The purpose of this laboratory test is to determine the unconfined compressive strength of a soil sample. We will measure this with the unconfined compression test, which is an unconsolidated undrained test where the lateral confining pressure is equal to zero.UCS test is performed in accordance with the IS Standards in (1973). The sample sizes will be of 38 mm diameter and 76 mm length. At the optimum moisture content (OMC) and maximum dry density(MDD) the tests were performed.

IV. RESULTS AND DISCUSSION

A. Standard proctor test (SPT)

The SPT test is conducted in the laboratory on soil sample with addition of polypropylene and sawdust ash in the different proportions. The table 3 which explains the optimum moisture content(OMC) and maximum dry density(MDD) of the different soil samples.

Table 3SPT test result on soil samples.

Additives	OMC	MDD
Clay soil	12%	1.992
Clay soil (90%) + Polypropylene(10%)	12%	1.518
Clay soil (90%)+ Sawdust ash(10%)	8%	1.636
Clay soil (70%)+ Polypropylene(15%)+ Sawdust ash(15%)	12%	1.086

B. Unconfined compressive strength

The purpose of this laboratory is to determine the unconfined compressive strength of a soil sample and the cohesion of the soil.By using the table 4, and the figure 1 shows the graph for UCC as given below.

TABLE 4
UCC test results on soil samples

Additives	Compressive strength	Cohesion
Clay soil (100%)	0.098	0.049

Clay soil(90%)+ polypropylene(10%)	0.114	0.057
Claysoil(90%)+sawdust ash(10%)	0.103	0.052
Claysoil(70%)+ polypropylene (15%)+sawdust ash(15%)	0.129	0.064

Figure 1 shows the graph for the UCC test which is conducted for the different proportions of the soil samples the value of 10% of polypropylene and 10% sawdust ash which is treated with the clay soil, and both treated with the mixer of 30% of soil samples.

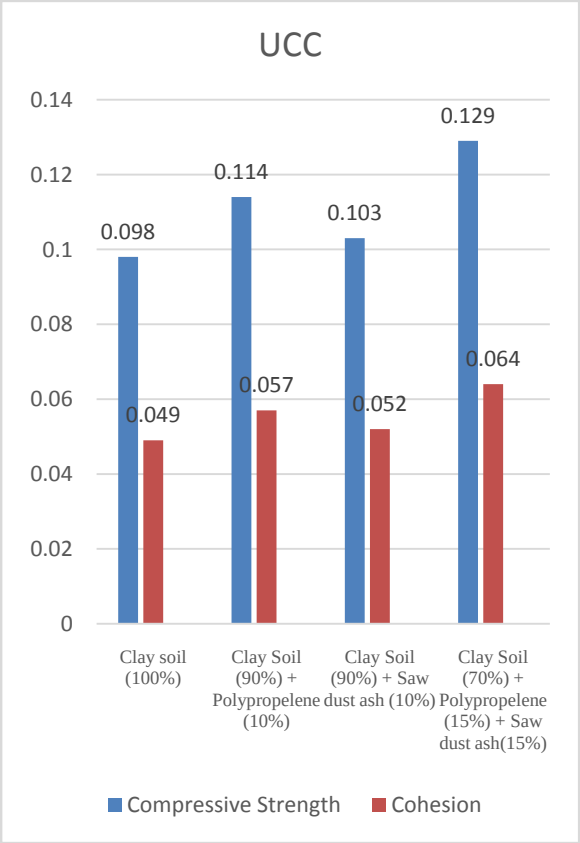

Figure 1 UCC test results for soil samples

C. California bearing ratio

CBR test was conducted in laboratory on soil sample with addition of different percentages of polypropylene and sawdust ash and the results are obtained in the table 5.

Table 5
CBR test results for soil samples

Additives	CBR ratio(%) for 2.5mm penetration
Clay soil (100%)	1.64
Clay soil(90%)+ Polypropylene(10%)	2.5
Clay soil(90%)+ Sawdust ash(10%)	2.26
Clay soil(70%)+ Polypropylene(15%)+ Sawdustash (15%)	2.78

Figure 2 shows the graph for the value of CBR ratio which is conducted for different proportions of different soil samples the value of 10% and 15% which is mixed and treated with the clay soil.

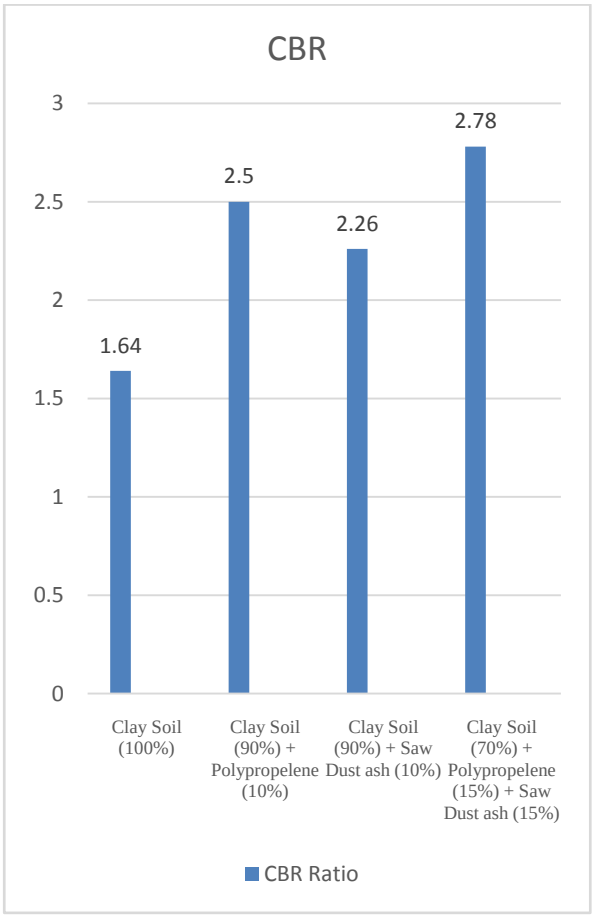

Figure 2 CBR test results for soil samples

V. CONCLUSION

- Based on the UCC comparison addition of 15% of polypropylene and 15% of sawdust ash which gives higher compression strength of 0.129 to the clay soil. And the cohesion property will be increased by 0.064.
- CBR test was performed based on the addition of (10% ,15%) of polypropylene and the sawdust ash also. Addition of industrial waste (PPP) alone gave an average improvement of 70% when compared with virgin sample. When the additive polypropylene is added to it the CBR value increased. So based on the respective results, quality of soil is increasing from bad condition to excellent condition based on CBR test values.

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