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RESEARCH ARTICLE

STABILIZATION OF CLAYEY SOIL USING CEMENT, GYPSUM AND WHEAT HUSK ASH

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ABSTRACT

This study describes the investigation that carried out to study the effects of Cement, gypsum and wheat husk ash on compaction properties of the clayey soil. Inorganic clay with low Plasticity was used in this study as a natural soil. For this purpose a series of laboratory experiments have been implemented and varieties of samples were made by mixing cement, gypsum and wheat husk ash with natural soil. Three different percentages of gypsum and wheat husk ash (3%, 6% and 9%) used as stabilization materials. The results demonstrated that adding cement has a significant effect on increasing the degree of compaction of the soil samples. In general, the results show that the performance of cement-stabilized soils was superior to gypsum in all the characterizations performed.

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INTRODUCTION

Soil stabilization is a collective term for any physical, chemical or biological methods, employed to improve certain properties of a natural soil to make it serve adequately for an intended engineering purpose. There is a rapid increase in waste quantity of plastic fibers, if this waste can be utilize for stabilization of soil than problem of solid waste can be resolve and also cost of soil stabilization can be reduced. This study presented a review of literature on soil stabilization using polypropylene and wheat husk fiber. Mr. Santosh and Prof. Vishwanath C.S. (2015), Reported that Addition of different % of Wheat Husk Ash (WHA) the water content decrease up to a limit afterwards again it increases. This is more effective for addition of 9% (optimum) WHA. Addition of different % of WHA the dry density increases up to a limit afterwards again it decreases. This is more effective for addition of 9% (optimum) WHA. The stress against different days for varying % WHA, for varying % of WHA, as number of day's increases stress also increases. This is more effective for 7days. This study describes the investigation that carried out to study the effects of Cement, gypsum, and wheat husk ash in compaction properties of the clayey soil. Inorganic clay with low Plasticity was used in this study as a natural soil.

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A series of laboratory experiments have been implemented and varieties of samples were made by mixing cement, gypsum, and wheat husk ash with natural soil. Three different percentages of cement (3%, 6% and9%), three different percentages of gypsum (3%, 6% and 9%), three different percentages of wheat husk ash (3%, 6% and 9%) were used as stabilization materials. For successfully transfer of load of structure on the soil it is necessary to prepare soil with desirable bearing capacity, also it is not possible every time to get soil having sufficient strength at every place. Process of increasing strength of soil by artificial process is known as stabilization of soil. The process of soil stabilization refers to changing the physical properties of soil in order to improve its strength, durability, or other qualities. Soil stabilization is important for road construction, and other concerns related to the building and maintenance of infrastructure. Jesna Varghese, Remya.U. R (2016), *et al* Indicated that reinforced soil with fiber has following properties- The relationship between optimum moisture content and maximum dry density of soil significantly affected by the addition of polypropylene fiber. During the study, MDD increases with decreasing OMC. From unconfined compressive test, it was observed that the unconfined compressive strength value of untreated soil was found to be 15.1 KN/m2 and the strength value increased with increase in addition of polypropylene fiber up to 0.05% and then decreases. S. Koliaset *al* in 2005, were discussed on cement. In their research the effectiveness of using high calcium fly ash and cement in stabilizing fine-grained clayey soils (CL,CH) was investigated in the laboratory. Strength tests in uni-axial compression, in indirect (splitting) tension and flexure were carried out on samples to which various percentages of fly ash and cement had been added. Modulus of elasticity was determined at 90 days with different types of load application and 90-day soaked CBR values are also reported. Vijaya Kumar *et al*., (2014), reported that Wear loss and coefficient of friction of slag composites decreases with the increase in normal loads. Wear loss and coefficient of friction increases with the increase in sliding velocities. The stick-on disc wear testing machine has been used to study the friction and wear behavior of the polymer composites. The wear loss and coefficient of friction are plotted against the normal loads and sliding speeds. It is noted from the graphical representation of the result that with the increase in load weight loss decreases and increase in sliding velocity weight loss also increases. A. S. Soganc (2015). The inclusion of fiber within unreinforced and reinforced soil caused an increase in the unconfined compressive strength of expansive soil. Increasing fiber content had increased the peak axial stress and decrease the loss of post-peak strength. For example, unconfined compression strength increased from 202 MPa to 285 MPa for samples reinforced with 1% fiber. The fiber reinforced soil exhibits more ductile behavior than unreinforced soil. Swell percent was reduced as the fiber increased. One dimensional swell decreased considerably with 1% fiber addition.

Mona Malekzadeh and Huriye Bilsel (2012), Reported that optimum water content is not influenced by polypropylene fiber inclusion, whereas maximum dry density has been reduced. This can be attributed to the reduction of average unit weight of solids in the soil-fiber mixture. Studying the influence of polypropylene fiber on swell characteristics, the overall conclusion is that one dimensional swell decreases considerably with 1% fiber addition. Unconfined compressive strength increases with polypropylene fiber inclusions. Maximum value of cohesion can be observed with 1% fiber content which is approximately 1.5 times of the unreinforced soil. From the analysis of split tensile strength test, it is observed that the maximum value of the tensile strength obtained for 1% fiber inclusion is 2.7 times of the unreinforced soil.

Objectives of the Study

The main objectives of this study described as follow:

- To understand the primary effects of cement, gypsum and wheat husk ash on the properties of a clayey soil.
- To determine the maximum dry density, optimum moisture content, for adding the percentages of 3%, 6% and 9% cement, 3%, 6% and 9%gypsum,, 3%, 6%, 9% wheat husk ash to the soil and determine the optimum percentage.

Research Approaches: Two tests conducted on the clayey soil (with no additives), which are, (plastic - liquid limits), and compaction characteristics tests. Firstly, A 5 kg of clayey soil collected, and then the two tests conducted to find out the (liquid-plastic limit) and (max dry density-optimum water content). Secondly, three sample of 5 kg of clayey soil mixed respectively, then the compaction characteristics tests performed on these samples. Third, three samples of 5 kg of clayey soil mixed up with different percentage of gypsum powder (3%, 6%, 9%) respectively, then the compaction characteristics tests performed on these samples. Finally, three samples of 5 kg of clayey soil mixed up with different percentage of wheat husk ash (3%, 6%, 9%) respectively, then the compaction characteristics tests performed on these samples.

RESULT AND DISCUSSION

The maximum dry density for clayey samples without additive materials is 1.57 whereas the corresponding optimum moisture content is range to 20.1, see figure 1.

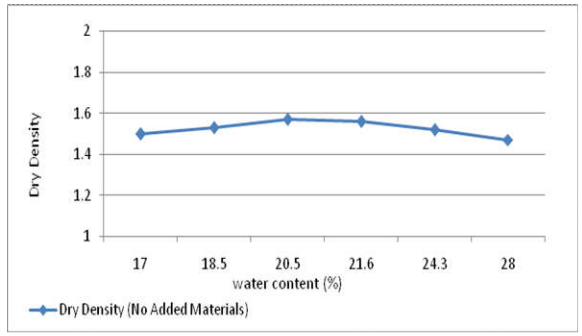

Figure1. Shows the relationship of water content /Dry density of sample without adding materials

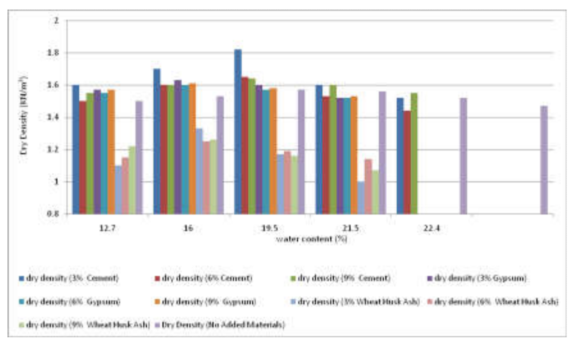

Figure 2. Shows the relationship of water content /Dry density of all samples

Table 1. Illustrates Test Results of All Samples

Type of Added Materials	Added Materials Ratio (%)	Average of Maximum Dry Density (KN/m^3)	Standard Erorr	Average of (OMC)
Cement	0	1.57	0.00166	20
	3	1.82	0.0115	19
	6	1.6	0.0088	20
	9	1.62	0.00577	17.8
Gypsum	0	1.57	0.00166	20
	3	1.63	0.00577	19
	6	1.6	0.00577	19
	9	1.61	0.0033	18.5
Wheat Husk Ash	0	1.57	0.00166	20
	3	1.33	0.01	34
	6	1.26	0.0088	36
	9	1.26	0.0033	39

In addition, the liquid limit measured to 33% and the plastic limit is 18.44%. On the other hand, by adding 3% of cement to sample the maximum dry density increased to 1.8 with corresponding moisture content to 19.5. The figure 2 also demonstrated that adding 6% and 9 % of cement increasing the dry density to 1.6 and 1.62 respectively. 3% of gypsum was added to soil samples results in increasing the dry density to 1.63 whereas the optimum moisture content is 18. When adding 6% and 9% of gypsum to the samples the maximum dry density recorded to 1.6 and 1.61 respectively. 3% of wheat husk ash added to the samples resulted in 1.33 of dry density, whereas the value of dry density is measured to 1.26 and 1.25 by adding 6% and 9% of wheat husk ash respectively. See figure-2- and Table 1. According the given results the maximum dry density without additive materials is 1.57 and this value increased to 16 % when adding 3% of cement. By adding 3% gypsum the dry density increased to 4 % and dry density of can be considered in dry density increased to 2% when adding 9% of gypsum in sample comparing to sample without additive materials. Wheat husk ash was added to the soil samples with the given ratio (3%, 6% and 9%) result in decreasing the dry density of samples to 20 %. To sum up, adding 3% of cement or gypsum results in high value of dry density. As shown in table (1), and figure (2).

Conclusion

This investigation performed to evaluate the performance of cement, gypsum, and wheat husk ash in stabilization and improving engineering properties of clay soil. The following conclusions drawn based on the laboratory test outcomes:

- Addition of cement, gypsum and wheat husk ash had varying effects on the clay soil under studied in terms of dry density and optimum water content.
- Adding of cement increases the maximum dry density and decreases the optimum moisture content of the soil. In addition, 3% of cement resulted in high dry density more than 6% and 9% of cement ratio.
- Adding of gypsum increases the maximum dry density and decreases the optimum moisture content of the soil. However adding of 3% gypsum increase the maximum dry density more than 6% and 9% of gypsum respectively.
- Adding of wheat husk ash decreases the maximum dry density and increases the optimum moisture content of the soil.
- Cement and gypsum stabilized soil-waste mixtures can be used in a variety of civil engineering applications.

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