Variation in Strength Properties of Kaolinite by Addition of Jarofix

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***Abstract*— Increase in population has led to an increase in construction demands. This results in decreases in availability of useful land and paved the way to introduce new methods for soil modification. Nowadays different materials can be used for modifying the properties of existing soil. There is huge scarcity of construction materials and accumulation of industrial wastes all over the world. These waste materials face disposal problems and remain unutilized. Jarosite is a waste material produced from the zinc industry during extraction of zinc ore. It is converted to Jarofix, by the addition of two percentage lime and ten percentage cement to form a stabilized material. In this study jarofix is added in various percentages to improve the properties of kaolinite soil. Jarofix is added in various percentages in soil and their variations in strength characteristics are determined. With addition of jarofix in soil the optimum moisture content increases and dry density decreases. From conducting unconfined compressive strength test the optimum value of jarofix in soil is found. The percentage increase in strength determined.**

Keywords- Industrialwaste; zincindustry ;jarosite; jarofix; unconfined compressive strength

I. INTRODUCTION

Construction works on soft soil are often very challenging and very complex. In recent years due to rapid development of infrastructures along with scarcity of useful land and building materials, engineers are compelled to improve the properties of soil and to find alternate materials for construction all over the world. Soft soils mainly include clayey soils which have low shear strength properties. But due to economic reasons these soils are used for construction purposes. Stabilization is the process of blending and mixing materials with a soil to improve certain properties of the soil. Soil stabilization is an effective method in treating clayey soils for improving its strength properties. Soil Stabilization is the process by which the engineering properties of soil can be improved by adding other soil types, mineral materials or by mixing the appropriate chemical additive into the pulverized soil and then compacting them. Soil stabilization can be used to improve the strength properties of weak soil. For attaining strength of soft clays different types of additives can be used.

II. METHODOLOGY

A. Materials

The study is conducted on low plasticity (CL) soil collected from It is obtained from English East India Clay Limited Trivandrum. The properties of soil are given in Table 1.The industrial waste material obtained from zinc industry is used as an additive to improve the properties of soil. Jarofix sample is obtained from Binani Zinc Industry, Ernakulam. It is a waste material produced during extraction of zinc ore concentrate by hydrometallurgy operations which was collected from zinc industry. The properties of Jarofix are shown in Table 2. Chemical composition of jarofix is shown in Table 3.

Compaction characteristics of soils are very important from field application point of view. Determination of compaction characteristics of soil is an essential task for construction works. From conducting compaction test compaction characteristics such as maximum dry unit weight and optimum moisture content is obtained. In this study Standard Proctor compaction test is conducted to determine moisture content and dry density of soil. The Proctor compaction test is a laboratory method of experimentally determining the optimal moisture content at which a given soil type will become most dense and achieve its maximum dry density. The laboratory tests generally consist of compacting soil at known moisture content into a cylindrical mold of standard dimensions using a compactive effort of controlled magnitude. The soil is usually compacted into the mold in three layers, each layer receiving twenty five number of blows from a standard weighted hammer at a specified height. This process is then repeated for various moisture contents and the dry densities are determined. The graphical relationship of the dry density to moisture content is plotted to establish the compaction curve. The maximum dry density is obtained from the peak point of the compaction curve and its corresponding moisture content known as the optimal moisture content is obtained.

The unconfined compressive strength (UCS) is the maximum axial compressive stress that a cylindrical sample of material can withstand under unconfined conditions. The unconfined compression test is the most popular method for measuring shear strength of cohesive soil.

III. EXPERIMENTAL/ANALYTICAL STUDIES

A. Effect of Jarofix in soil

Standard proctor compaction test is conducted on CL soil by addition of jarofix by various percentages. Jarofix is added by 5%, 10%, 15%, 20% and 25% of kaolinite and its effect is analyzed. Jarofix is added to improve the properties of the

weak soil. The maximum dry density and optimum moisture content are determined.

The Unconfined compressive strength of all the above mix are also determined by means of unconfined compression testing machine. It was observed that the UCC value showed an increasing trend upto 15% jarofix content added to soil and then it decreased for further additions. Thus the optimum percentage of jarofix content was obtained at 15% jarofix content in kaolinite.

IV. RESULTS AND DISCUSSIONS

From the compaction test it is clear that when Jarofix is added to soil there is variation in properties of soil. The dry density decreases with increase in Jarofix content as shown in Fig.1. This is because of low specific gravity of the additive when compared to that of soil. The reduction in the dry density occurs because the agglomerated and flocculated particles of soil occupy larger spaces.

The optimum moisture content increases with increase in jarofix content. Addition of jarofix leads to formation of larger surface areas and require more water for the pozzolanic reactions to take place. The variations are shown in Fig.2.

From the UCC test it is evident that the strength of soil increases with addition of Jarofix upto 25% and then it decreases with increase in Jarofix. The maximum strength is obtained at 25% Jarofix added to soil. The strength is increased by 45%. The variation is shown in Fig.3.

V. CONCLUSIONS

Based on the above experimental investigations the following conclusions are drawn;

- The dry density decreases with increase in Jarofix content in soil.
- The optimum moisture content increases with increase in Jarofix content in soil.
- The unconfined compressive strength increases by 45% than the initial strength with addition of Jarofix in soil.

A. Figures and Tables

TABLE I. PROPERTIES OF KAOLINITE

SI No	Property	Values
1	Specific gravity	2.6
2	Optimum moisture content (%)	23
3	Maximum dry density(g/cc)	1.5
4	Unconfined compressive strength(KN/m^2)	63.2
5	Liquid limit (%)	33.5
6	Plastic limit (%)	21.8
7	Shrinkage limit (%)	14.1
8	Plasticity index (%)	11.7
9	Percentage sand (%)	11.7
10	Percentage silt (%)	29.1
11	Percentage clay (%)	59.2
12	IS Classification	CL

TABLE II. PROPERTIES OF JAROFIX

Sl No.	Property	Values
1	Specific gravity	2
2	Optimum moisture content (%)	47
3	Maximum dry density (g/cc)	13.8
4	Unconfined compressive strength (KN/m2)	236
5	Liquid limit (%)	64

TABLE III. COMPOSITION OF JAROSITE

Parameters	% Composition
Potassium	7.81
Iron	33.45
Hydrogen	1.21
Sulfur	12.81
Oxygen	44.73

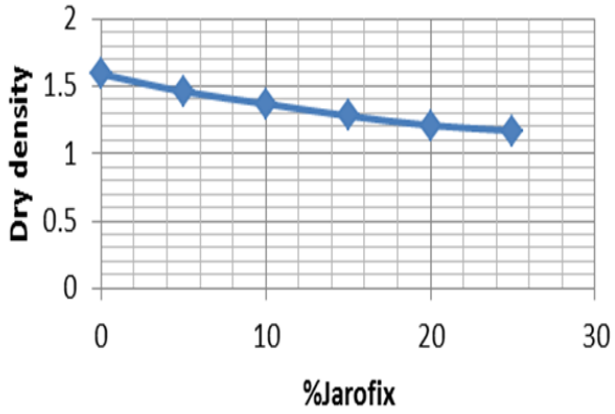

Fig.1 *Variation of Dry density*

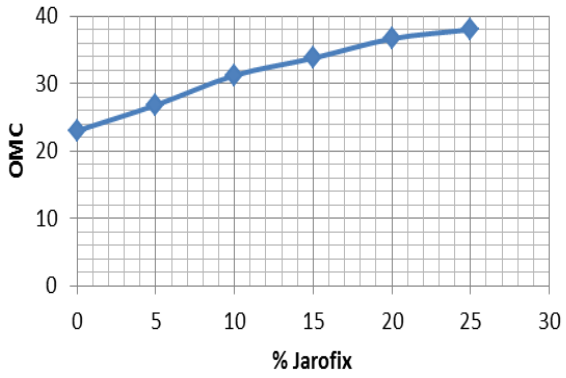

Fig.2 *Variation of Optimum moisture content*

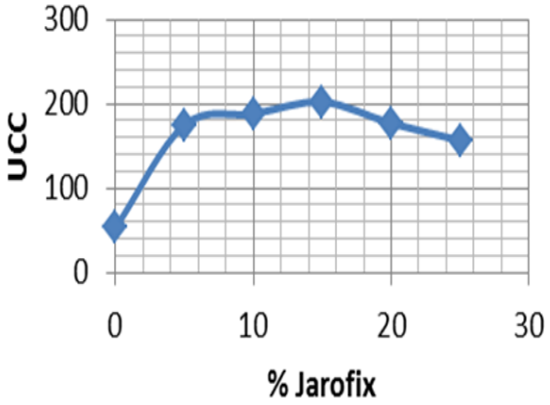

Fig.3 *Variation of Unconfined compressive strength*

REFERENCES

[1] Asokana, Saxenaa and Asolekarb (2010) "Recycling hazardous jarosite waste using coal combustion residues", Elsevier, pp 1342 – 1355.

[2] Baviskar, Bachhav and Kshirsagar (2016) "Stabilization of local expansive soil with fly ash and cement", International Journal of Engineering and Innovative Technology, Vol.5, Issue 11.

[3] Brooks (2009) "Soil stabilization with flyash and rice husk ash", International Journal of Research and Reviews in Applied Sciences, pp 2076-7366 Vol. 1, Issue 3.

[4] Dhakar and Jain (2016), "Stabilization of Soil Using Fly ash, Lime & Cement", Vol.5, issue 6.

[5] Izabel and Sangeetha (2014), "Stabilization of Marine Clay Using Jarofix",IJSER, pp 2347-3878.

[6] Ozdemir (2016), ―Improvement in Bearing Capacity of a Soft Soil by Addition of Fly Ash‖, Elsevier, Vol.143, pp 498–505.