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Review on Effect of Replacement Lime and Sodium Silicate on The Stabilization OF Soil

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Abstract
Soil is the basic foundation for any civil engineering structures. It is required to bear the loads without failure. In some places, soil may be weak which cannot resist the oncoming loads. In such case, soil stabilization is needed. Soil stabilization can be explained as the alteration of the soil Properties by chemical or physical means in order to enhance the engineering quality of the soi. This paper deals with the complete analysis of the improvement of soil properties and its stabilization using lime and sodium silicate. The soil is treated with lime and sodium silicate with different percentages. For this, the percentage of lime was varied as 2.5%, 4.5% and 6.5% (by weight) and sodium silicate percentage was as 1.5%, 2.5%, and 3.5% (by weight). The maximum dry density decreased from 1.70 gm/cc to 1.63 gm/cc. 1.57 gm/cc and 3.5% (by weight). The maximum dry density decreased from 1.70gm/cc to 1.55gm/cc, 1.48gm/cc and 1.50gm/cc with addition of 1.5%, 2.5% and 3.5% sodium silicate to virgin soil. The OMC of soil increased from 16.50% to 18.88%,20.40% and 22.44% with addition of 2.5%, 4.5% and 6.5% lime (by weight). The OMC of soil and sodium silicate from 16.50% to 17.10%, 17.70% and 17.90% with addition 1.5%, 2.5% and 3.5%Sodium silicate (by weight). The unconfined compressive strength increases from 4.10 kg/cm2 to 5.20 kg/cm2 at 1.5% sodium silicate, the unconfined compressive strength increases from 4.10 kg/cm2 to 5.20kg/cm2 at 1.5% sodium silicate (by weight) and to 7.50kg/cm2 at 2.5% sodium silicate (by weight) addition. The value tends to all at 3.5% sodium silicate addition. For optimum mix i.e., soil + 2.5% sodium silicate, the unconfined compressive strength came out to be 9.73 kg/cm2 for uncured sample and 10.27kg/cm2 for cured samples. The C.B.R. Value for unsoaked and soaked virgin soil was found to be 6.2% and 3.2% respectively. When 4.5% lime was added to soil the C.B.R> Value for unsoaked and soaked condition increased to 15.6% and 5.4% respectively. When 2.5% sodium silicate was added to this soil + 4.5% mix, C.B.R. (unsoaked and soaked condition) was observed to be 18.7% and 8.6% respectively.
Key words: Soil -lime Stabilization, Soil Sodium Silicate Stabilization, compressive strength, C.B.R. (unsoaked and soaked condition).

Introduction

In this study of stabilization or stabilization of soil is one of the best or easily available method to improve the properties of soil. There are stabilizers like fly ash, rice-husk ash, lime, sodium silicate, jute, gypsum tyres etc. are used to strength the properties of soil. Mainly used stabilizers are cement and fly these two are costly ones that means by using these construction costs get high. So, in the present study, We add lime and sodium silicate as stabilizer to increase the engineering properties of clayey soil.The purpose of this study is to increase the strength of the of the clayey soil by making soil-lime sodium silicate mixture.

For this study we are going to performed test on the soil sample and determines its properties, and nature of soil.Also the properties and characteristic of stabilizing material is firstly determined. So that we can easily use the quantity and quality of stabilizer. After this test are to be performed to obtain the optimum moister content (OMC) and maximum dry density (MDD)of soil and the unconfined compressive strength of soi sample by adding constant content of lime as 2.5, 4.5, 6.5% and sodium silicate as 1.5, 2.5, 3.5%. The test is performed for obtaining optimum moisture content (OMC) and maximum dry density (MDD) of soil and the unconfined compressive strength of soil samples. On several number of samples, the tests are performed one by one by parent soil with lime and Sodium silicate to sample to provide the bearing capacity of soil little bit but as the percentage of lime and sodium silicate is increased 2.5 and1.5% the weight of soil. The mixture of clay soil and lime, sodium silicate as the dosage 2.5% and 1.5% and conduct the test standard proctor test and unconfined compression test. Due to this test, we get the new bearing capacity, strength, durability of soil. As similarly the percentage of lime and sodium silicate increase in 4.5%, 6.5 and 2.5%, 3.5%. so that we get the bearing capacity of soil to improve the shear strength and durability hardness and increase the life of structure. Because the lime and sodium silicate having good engineering properties to hold the soil particles and bonding the particle of soil together so that the permeability of soil is decreased that's why the bearing capacity and stability of soil is increased. On several number of samples, the tests are performed one by one by parent soil with lime and Sodium silicate to sample to provide the

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A) Soil -lime Stabilization

Lime stabilization improves the strength, stiffness and durability of fine-grained material. In addition, lime is sometimes used to improve the properties of the fine-grained fraction of granular, under concrete foundations, on embankment and canal linings. Adding lime to soil product of maximum density under higher optimum moisture content than in the untreated Soil, Moreover, Lime produces a decrease in plasticity index.

Which produce a cemented material that increase in strengths with lime. Lime -treated soils, in general, have greater strength and a higher module of elasticity than untreated soils.

Recommended percentages of lime for soil stabilization vary 2 to 10 percent. For coarse soils such as clay gravels, sandy soils with less than 50% silt- clay fraction, the percent of lime varies from 2 to 5, whereas for soils with more than 50 percent silt clay fraction, the percent of lime lies between 5 and 10.

- Lime is very cheap and easily available in India.
- Lime treatment is especially effective for heavy clays or for silt and clayey granular soils, which are likely to lose strength because of high water affinity in their silt clay fraction.
- Where the lime treatment is aimed at "modifying" the soil properties, (by reducing plasticity, improving workability, increasing grain size etc.) the criteria for mechanically stabilized mixture are applied.

B) Soil Sodium Silicate Stabilization

Sodium silicate is easily is easily available and cheap material. Soil stabilized with sodium silicate possess high strength than virgin soil. It is very effective in reducing the swelling potential and the swelling pressure of clayey soils. Sodium silicate reacts with soil particle to from colloid which polymerizes further to from a gel that binds soil or sediment particles together and fills voids.

Besides, sodium silicate is a white powder or colourless solution that is readily soluble in water, it has also been considered for use as a peptizing agent to improve the mix ability of the in situ and in this way increase the homogeneity and strength of stabilized soil.

- Sodium silicate is easily available and cheap material.
- It increases the bearing strength of the soil.
- It decreases the swelling potential and swelling pressure.

2. LITERATURE REVIEW

(Mitchell et al. (1961)) Researchers have illustrated the impact of lime addition on the strength of clay soils depends on several factors. These include, soil type, curing time and method, moisture, soil unit weight and time elapsed between mixing and compaction.

(Winterkorn 19705) Based on us experience lime requirements for stabilized base and sub base course of pavement are as follows:

1. Five to ten percent of lime by weight of oil, for heavy clay soils to serve as bases, or one to three percent in sub-bases.
2. Two to four percent of lime for clay-gravel materials to serve as bases in India, the amount of lime needed for stabilization is recommended to be decided by the criteria of ph. value, CBR and an unconfined compressive strength (IRC 1983).

Ai-Rawi et al. (1981) comparatively fewer studies have focused on the impact of lime stabilization on the compressibility as much as by the shear strength. In addition, sodium silicate as a glass material can be used efficiently in soil stabilization because it is cheap and available. This work show that the sodium silicate can improve the geotechnical properties by increasing strength of soil and reducing its volume change.

The aim of this work is to investigate the effect of lime and sodium silicate powder on different geotechnical engineering properties of soil. In order to achieve, an experimental program was designed into three steps.

Firstly, to estimate the optimum amount of lime and sodium silicate that required to improve the soil properties. This optimum value (fixation point) can be estimated by short term reaction using different indepen-

dent method like plasticity index.

Dal Hunter et al. (1988) for effective stabilization ,a soil must have not less than 15% fraction passing a 425-micron sieve and its plasticity index should be at 10. The organic content should not be more than 20% and the sulphate content should be more than 0.2% impurities such as sulphates of calcium and sodium induces considerable have in lime soil. Hence it is desirable that the hydrated lime should be free of such impurities. For proper mixing the soil should pulverized to about 25mm and smaller size, about 50 to 60% passing a 4.75. pulverization and mixing of soil and lime in the field can be done manually or mechanically. The mix is contacted at OMC making allowance for moister loses. It is recommended that all compaction should be completed within four after mixing of soil, lime, and water the based should be cured for 7 to 28 days under moist conditions.

Sivapullaiah et al. (1996) has reported the effect of fly ash, on the index properties namely liquid and plastic of Indian black cotton soil. The effect of lime when added have also and studied. They used black cotton soil collected from Davanagere, Karnataka state in India and two and two fly ashes, such as Nayeli fly ash (NFA) and Vijayawada fly ash '(VFA)' collected from Nayeli thermal power plant, Tamil Nadu and Vijayawada thermal power plant, Andhra Pradesh, respectively. From the experiment they concluded that the liquid limit, plastic limit a plasticity index properties of black cotton soil were significantly altered by the addition of fly ash. The plastic limit of black cotton soil increased with the increase of fly ash content. The addition of 50% VFA to the black cotton soil increased the plastic limit to 62% whereas the same percentage of NFA increased the plastic limit to 116%.

Cokca et al. (2001) studied the effect of fly ash on the swelling characteristics of expansive soil. In his study , high-calcium and low-calcium class C fly ashes from the soma and Tuncbilek thermal power plants, respectively, in Turkey< were used for stabilization of expansive soil. Lime and cement were mixed to the expansive soil at 0 – 8% to obtained optimum values. Soma fly ash and Tuncbilek fly ash were mixed to the expansive soil at 0-25%. The "free swell" testing method was used to determine the swelling potential of the specimens (ASTM D4546-90).

Goswami et al. (2007) in their study of the leaching characteristics of residual lateritic soil stabilized with fly ash and lime for geotechnical applications. With the help of singlebatch leaching test and column leaching test for different soil-fly ash-lime mixes found that the high PH induced by lime treatment of the mixes helps in keeping most of the metals within the stabilized soil matrix.

Sharma et al. (2008) studied the strength characteristics (UCS) of stabilizes expansive clay mixed with lime, calcium chloride, and rice-husk ash (RHA). The changes of unconfined compressive strength by the addition of addition of additives were reported. It was observed that the UCS of expansive clay improvement was observed by the addition of lime up to 5% or up to 1% calcium chloride. A maximum improvement was observed at 4% lime and 1% calcium chloride, respectively. An RHA content of 12% was found to be the optimum with regard to UCS in the presence of either lime (4%) or calcium chloride (1%).

Solanki et al. (2009) Observed the behaviour of UCS of silty clay stabilized with lime, class C fly ash, and cement kiln dust. They observed an increase in unconfined compressive strength with increase in the amount of the stabilizing agent. The increase in UCS value was found to vary with the type of stabilizing agents. The CKD-stabilized specimens exhibited a higher UCS value than the corresponding value of lime and CFA stabilized specimens.

Sahoo et al. (2010) Studied the compaction characteristics of soil mixed fly ash and lime using fly ash (class c category) from Penki thermal power station , Kanpur and soil from mesa road, Allahabad ,and observed that the optimum moisture content (OMC) and maximum dry unit weight (Yd) of the stabilized samples were increased and decreased gradually with the increase of fly ash and lime content respectively.

3) OBJECTIVE OF WORK

- The objective of this work is to study the suitability of sodium silicate for expansive soil stabilization, unsuitable for pavement sub grades, by increasing their bearing capacity and decreasing the swelling pressure and heave.
- In addition to this, it aims to investigate suitability of the chemical to decrease pavement thickness by increasing the bearing capacity of substandard sub base materials.
- Lime is well known sub base and sub grade stabilizers. This study aims to assess the potential improvement in strength and decrease in plasticity of soils though the application of the chemical additives at various curing durations.

4) CONCLUSIONS

- Lime acts immediately and improves various of soil such as resistance to shrinkage during moist conditions, reduction in plasticity, increase in CBR value and Subsequent increase in the compression resistance with the increase in time.
- Lime is used as an excellent soil stabilizing material for highly active soils which undergo through frequent expansion and shrinkage.
- The reaction is very quick and stabilization of soil starts within few hours.
- The maximum dry density decreased by the addition of lime and sodium silicate to the soil.
- The optimum moisture content increased by the addition of lime and sodium silicate to the soil.
- The unconfined compression strength increased by 137% for uncured sample of soil + 4.5% lime + 2.5% sodium silicate mix as compared to virgin soil. The increased in unconfined compression strength for cured sample of soil + 4.5% lime + 2.5% sodium silicate was 152% as compared to virgin soil.
- The California bearing ratio of soil + lime 4.5% + sodium silicate 2.5% increased by 211% (soaked) at 2.5 mm penetration, and 115.9% (unsoaked) and 66.9% (soaked) at 5.0 mm penetration.
- The California bearing ratio of soil + lime 4.5% + sodium silicate 2.5% increased by 211% (unsoaked) and 186% (soaked) at 2.5 mm penetration, and 172.4% (unsoaked) and 161.2% at 5.0 mm penetration.
- Hence, there is an overall gain strength parameter of clayey soil due to the addition of lime and sodium silicate.

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