KAOLINITE STABILIZATION USING SODIUM HYDROXIDE

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Abstract: Soil stablilzation is required when the soil available for construction is not suitable for the intended purposes of all the soils, expansive soils are causing major problems to Civil Engineering structures. Such soils swell when given an access to water and shrink when they dry out. Soil stablilzation using chemical admixture is the most widespread method of ground improvement. In this study, NaOH as a chemical admixture and sand as filler are used for the Soil stabilization. The main aim of our project is to stabilize the Kaolinite soil using NaOH. We have added the filler (sand) to the soil as 50%, 100%, 150% and 200% keeping NaOH content as constant. Similarly we have added NaOH to the soil as 7%, 10%, 13% and 16% keeping the sand content as constant.We studied the unconfined compressive strength of the soil by adding NaOH and sand under wet, dry, soaked and cyclic condition.

Keywords : *Kaolinite, Sodium Hydroxide, Stabilization, Strength*

1. INTRODUCTION

Soil stabilization is the alteration of one or more soil properties, by mechanical or chemical means, tocreate an improved soil material possessing the desired engineering properties. There are three purposes for soilstabilization. These include increasing strength of an existing soil to enhance its load-bearing capacity,permeability improvement and enhancement of soil resistance to the process of weathering, and traffic usageamong others (ASTM, 1992).The mechanical and physical techniques of soil stabilization are based on decreasing the void rate bycompacting or physically altering the grain size factions involving the adjustment of the particle sizecomposition of soil. The chemical technique is also a common soil stabilization approach, since it produces a better quality soil with higher strength and durability than mechanical and physical techniques. The chemical techniques are dependent on reaction between chemical additives and soil particles which then produce a strong network that bind the soil grains. Sodium hydroxide in a solution is a white, odourless, non-volatile solution. It doesn't burn but highlyreactive. It reacts violently with water and numerous commonly encountered materials, generating enough heatto ignite nearby combustible materials. Its principal advantages are that it can easily react with water whichresults into a powerful compaction aid giving a higher density for the same compactive effort. Sodium hydroxide reacts very effectively with soil rich in aluminium (Alshaaer, 2000; Olaniyan, 2008).

2. AIM & OBJECTIVES

The aim of this thesis is to stabilize local Kaolinite soil material using Sodium Hydroxide. The objectives Includes the following:

To evaluate the property and suitability of kaolinitic soil before and after stabilization by chemical polymerization techniques.To Investigate the mechanical properties of the mineral polymer with respect to mix proportion, such as soil to sand ratio, percentage of stabilizing agent, water content and filler material granulometry.To evaluate the compressive strength, durability under wet condition and water absorption degree.

3. PROPORTIONS ADOPTED

Sand in varying proportions and NaOH proportion constant

Sand Content is added in varying Percentages to Soil as 50%, 100%, 150%, 200% & NaOH is added in 13%.

Clay : Sand : NaOH – 1:0.5:0.13, 1:1:0.13, 1:1.5:0.13, 1:2:0.13.

NaOH in varying proportions & Sand proportion constant.

NaOH is added in varying percentages as 7%, 10%, 13%, 16% & sand is added in 100%

Clay : Sand : NaOH – 1:1:0.07, 1:1:0.1, 1:1:0.13, 1:1:0.16

Figure 1: Kaolinite Soil

Figure 2: NaOH in pellet form

4. EXPERIMENTAL PROCEDURE

Atterberg Limit Test is first carried out on the soil sample**.** The Kaolinite soil passing through 425μ sieve was taken & required amount of water was added to it to carryout Standard Proctor Compaction Test. Immediately after the addition of water the compaction was carried out without any delay. The Compaction curve, maximum dry density & Optimum Moisture Content was Obtained. Then 11 Specimens were prepared for UCC Test, From which one specimen was tested at the initial stage i.e., after preparation of the specimen. The other specimens were kept for drying for one day. Then three of the specimens were kept for drying at 40^{o}C for one week. The other three specimens were kept inside the plastic recipients and soaked in water for one week. Another Three Specimens were kept for cycling process i.e., alternate drying & wetting for one week. Then one Specimen from each case were tested for compressive Strengths.

Then the proportions of filler material (sand) was varied keeping the sodium Hydroxide proportion constant and tested in order to find the best proportion. To the Soil first the filler (sand) was mixed properly then the Sodium hydroxide in pellet form is made into solution by adding water to it. This solution is then mixed with the soil-sand mixture, Then the mixture is compacted well and above procedure was followed. Another Batch was prepared by varying the proportion of sodium Hydroxide and keeping the Sand proportion constant.

By checking the compressive strength of each batch we can find the best one. The water absorption and density of each batch are then determined.

5. RESULTS AND DISCUSSION

The proctor compaction test was done for the Kaolinite soil. The following table shows the dry density for various water contents .

5.1Standard proctor compaction test values for Kaolinite soil

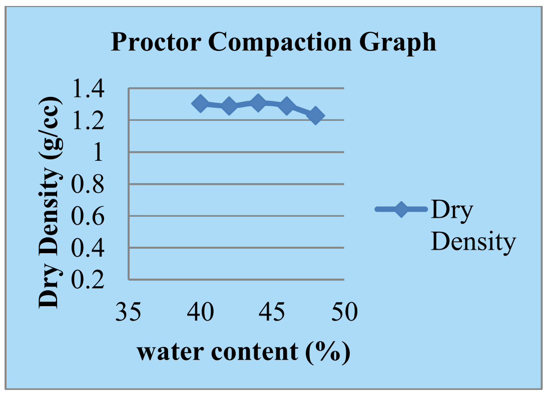

Figure 3: standard proctor compaction for kaolinite soil

5.2 Unconfined Compressive Strength Results

Table 1: UCC values of Kaolinite soil

Specimen Type	Compressive Strength (kg/cm^2)
After moulding	2.194
Dried specimen	4.19
Soaked Specimen	2.36
Cycling Specimen	5.23

From Table 1 it was observed that the dried and cycling specimens process higher compressive strength than others.

Table 2: UCC values of Kaolinite soil + NaOH + Sand in Varying Proportions

Proportion	After Moulding	After Drying the specimens for 1 week	After Soaking the specimens in water for 1 week	After Cycling the specimens for 1 week
Clay	2.194	4.19	2.36	5.23
1:0.5:0.13	3.2	7.43	2.44	6.03
1:1:0.13	4.94	9.77	2.85	6.45
1:1.5:0.13	4.6	9.2	2.609	6.11
1:2:0.13	3.86	7.6	2.35	5.61

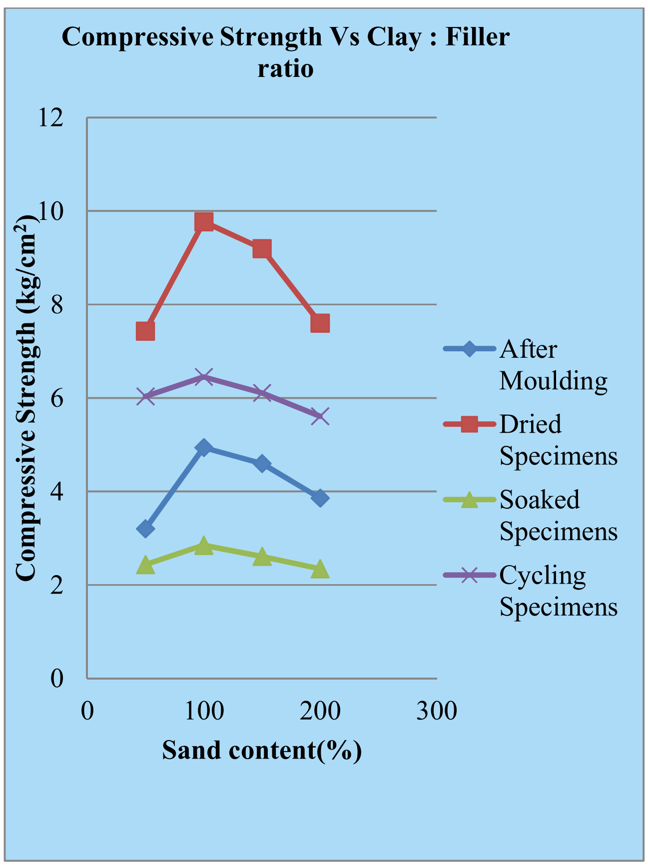

Figure 4: Variation of Compressive strength for Different Sand contents

Table 3: UCC values of Kaolinite soil + Sand + NaOH in Varying Proportions

Proportion	After Moulding	After Drying the specimens for 1 week	After Soaking the specimens in water for 1 week	After Cycling the specimens for 1 week
1:1:0.07	3.13	7.94	1.75	4.89
1:1:0.1	3.87	8.42	2.09	5.91
1:1:0.13	4.94	9.77	2.85	6.45
1:1:0.16	4.58	9.13	2.48	6.03

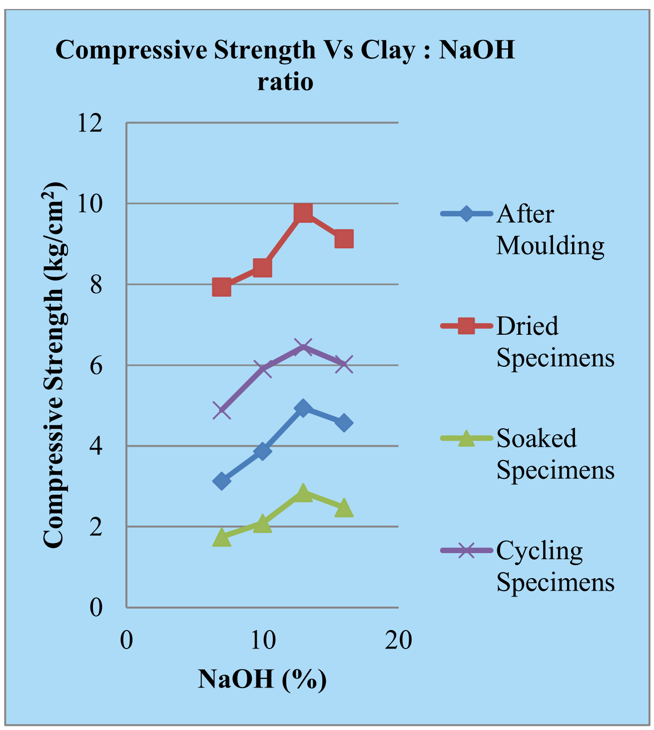

Figure 5: Variation of Compressive strength for Different NaOH contents

5.3 DENSITY

In order to evaluate the degree of packing of the soil grains, the densities of the specimens are determined by considering the weight & dimensions of the specimens after moulding & curing.

Table 4: Density of the specimens at various sand content

Sand Content(%)	After Moulding the specimens	After drying the specimens for 2 days	After Drying the specimens for 1 week	After Soaking the specimens in water for 1 week	After Cycling the specimens for 1 week
50	2.14	1.19	1.93	2.16	2.15
100	2.20	1.99	2.00	2.18	2.25
150	2.04	1.97	1.98	2.17	2.14
200	2.02	1.96	1.92	2.09	2.09

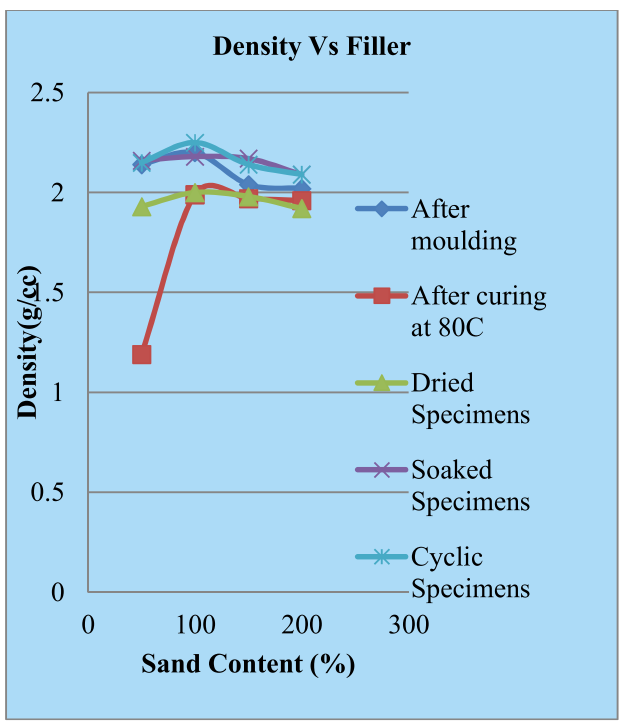

Figure 6: Variation of Density for different sand content

Table 5: Density of the specimens at various NaOH content

NaOH Content(%)	After Moulding the specimens	After drying the specimens for 2 days	After Drying the specimens for 1 week	After Soaking the specimens in water for 1 week	After Cycling the specimens for 1 week
7	2.18	2.03	2.15	2.36	2.29
10	2.18	2.01	2.13	2.32	2.36
13	2.19	1.99	2.03	2.26	2.27
16	2.19	1.99	2.05	2.19	2.15

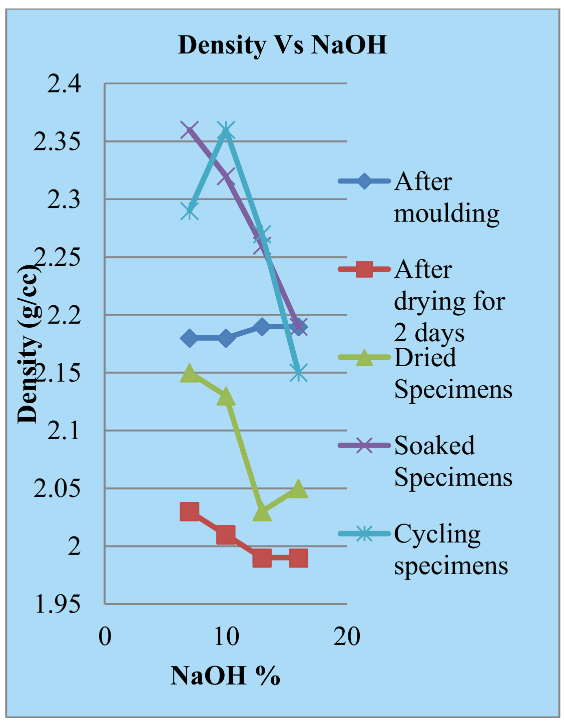

Figure 7: Variation of Density for different NaOH proportions

6. CONCLUSION

It was found from the above experiment that the sand content increases dry density and optimum moisture also increases. When Sodium hydroxide increases dry density and optimum moisture decrease.The Unconfined Compressive strength for 1:1:0.13 proportion is maximum (9.77 kg/m^2) under dry condition while varying sand & NaOH content.

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