Effect on Engineering properties of Black Cotton Soil by Alkali Content "Sodium Hydroxide" (NaOH)

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Abstract

The aim's of this study stabilizing and mixing black cotton soil, with different concentration of NaOH does not Environment effective and time consuming. And determine its effect it's on Engineering properties of soil, like OMC, MDD, Cohesion, shear strength, angle of internal friction and compressive strength of soil. For this study soil has been collected from Archa village Jabalpur (M.P.) at 0.5m depth NaOH is mixed with soil at different concentration varying from 0 to 16%. On the other hand, increasing the concentration of NaOH mix with soil yielded increases the shear strength, Angle of internal friction meanwhile compressive strength of soil and cohesion shows decreases in its value with the increasing concentration of NaOH. So in those way ions [Na^+] [OH^-] react with soil minerals and reach at yielded value of soil at 16% concentration of NaOH.

Keywords: Stabilization, NaOH concentration, Engineering properties

I. INTRODUCTION

Black cotton soil also known as expensive soil due to shrinkage and swelling with change its moisture content. That properties of swelling and shrinkage is due to the presence of minerals Montominrollite and Kaolinite and illite. These soil tend to swell when moisture content is high and shrinks upon reduction or absence of moisture content. As a result of which distress in the soil and due to imbibe water Occurs and causing severe damage to the overlaying structure.

Stabilization means to improve the properties of sol so as to obtain the desired effect on soil as to make it fit according to use. In other words stabilization improves the physiochemical properties of soil, these properties are dependent on the mineral present in the soil. Stablization of soils done to overcome problems of settlement and shrinkage and stability also, increase the mechanical Physical properties in these properties are dependent to clay minerals like Kaolinite and Montominerille minerals. These minerals (AlO4) and (SiO4) react with ions or burst the bond between particles and water due to separate the particles, particles get change the soil behavior clay to sand, these particles increase the density and enhance the strength. Stabilization of soil to be done to overcome the problem Settlement and stability.

Chemical Stabilize the soft sol with various additives. (NaOH, KOH, NaCl)

II. LITERATURE REVIEW

R. shivhanker (2011) have studied as the percentage of NaOH is increased the OMC content increases and MDD decreased. Sivapullaiah (2011) has evaluated if further increased in the amount of NaOH, the peak stress continuously decreases. It has been shown the plasticity and compressibility of soil decreases. As well as the stiffness of soil reduced with increases in moisture content and percent NaOH concentration.

Sarat kumar das and Parthi kumar parthi (2013) Evaluate that if the alkali activation of waste materials has become an important area of research in many laboratory because it possible to use these materials to synthesize inexpensive and ecology like fly ash cement NaCl.

R. Dayaker Babu and K. Ramu (2013) Evaluated that the waste and week soft soil can be improved effectively by replacing locally available granular material and further stabilizing it with optimum content of geopolymer.

III. MATERIAL USED

A. NaOH

NaOH is a white, odorless, nonvolatile material. It reacts with water and generates high heat, but not combustible due to these heat broken bound between particles and change the property of clayey soil. Its advantage are that it can easily react with water which a results into a powerful compaction aid and giving a higher density for same comp active effort, soil is react with NaOH highly due to rich in aluminum.

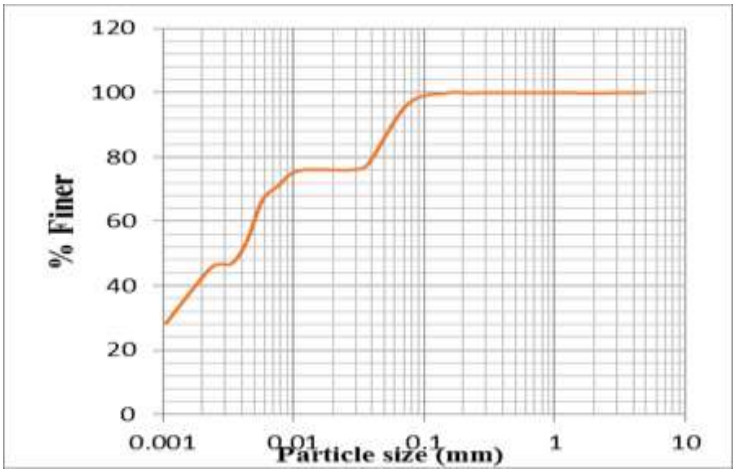

Fig. 1:

The particle size distribution of collected soil sample and number of tests was performed on oven dried soil sample and the observed geotechnical properties are Listed below the tab

Table - 1
Geotechnical properties of black cotton soil

Sr. No.	*Characteristics of Soil*	*Value*
1	*Specific gravity*	*1.99*
2	*Sand Content*	*2%*
3	*Silt Content*	*66.18%*
4	*Clay Content*	*31.82%*
5	*Liquid Limit*	*64.48%*
6	*Plastic Limit*	*26.25%*
7	*Shrinkage Limit*	*38.23%*
8	*Free swell Index*	*28.83*
9	*OMC*	*22.61%*
10	*MDD*	*1.96g/cm^3*
11	*UCS*	*170.75KN/m^2*
12	*COHESION*	*0.90KN/m^2*
13	*Angle of internal friction*	*14.5*

IV. METHODOLOGY

Black cotton soil has to be collect from Archa village at 0.5m depth free from organic matter. The sample of oven dried and mixed with NaOH at different concentration varying from 0-16%. Following test are performing in the mix of soil and NaOH at each concentration. (Like 2, 4, 6, 8, 10, 12, 14, 16%).

V. TEST PERFORMED

Modified proctor compaction test; IS: 2720 (part 8) – 1983.
Unconfined compressive strength test; IS: 2720 (part 10) – 1991.
Unconsolidated undrained triaxial compression; IS: 2720 (part 11) –1993.

Table - 2
Sample Nomenclatures

Sample	*Concentration*
Sample 1:	*Soil + 0% NaOH concentration*
Sample 2:	*Soil + 2% NaOH concentration*
Sample 3:	*Soil + 4% NaOH concentrations*
Sample 4:	*Soil + 6% NaOH concentrations*
Sample 5:	*Soil + 8% NaOH concentration*
Sample 6:	*Soil + 12% NaOH concentration*
Sample 7:	*Soil + 14% NaOH concentration*
Sample 8:	*Soil + 16% NaOH concentration*

Table 1 shows the particle size distribution curve of black cotton soil. And according to IS classification, this soil is classified as "Clay high plasticity (CH)".

VI. RESULT AND DISCUSSION

A. Compaction Characteristics:

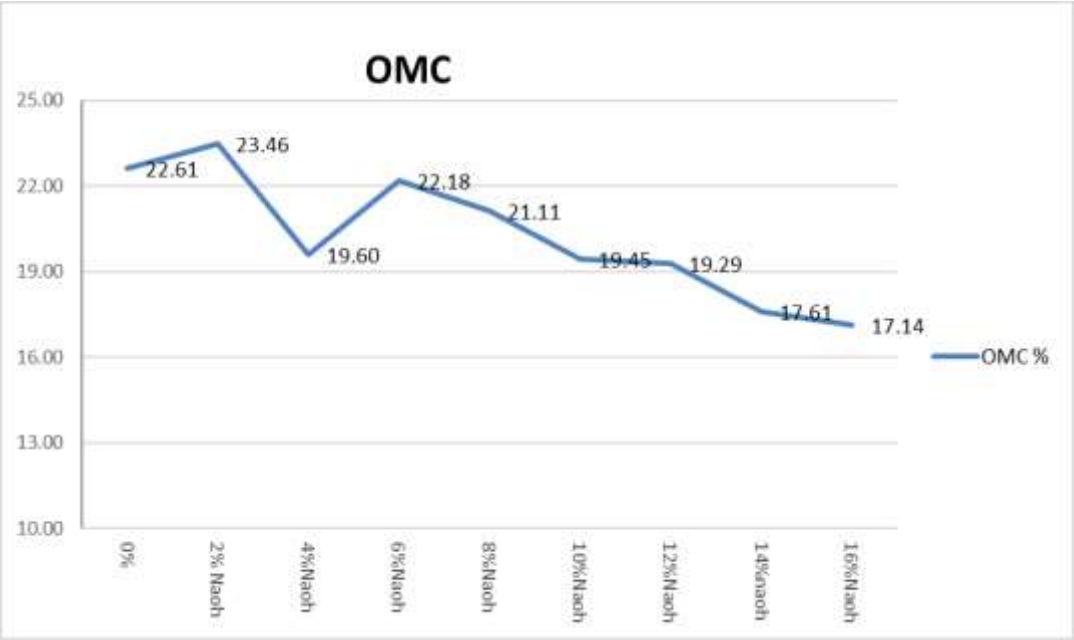

Fig. 2: Optimum moisture Content variation graph

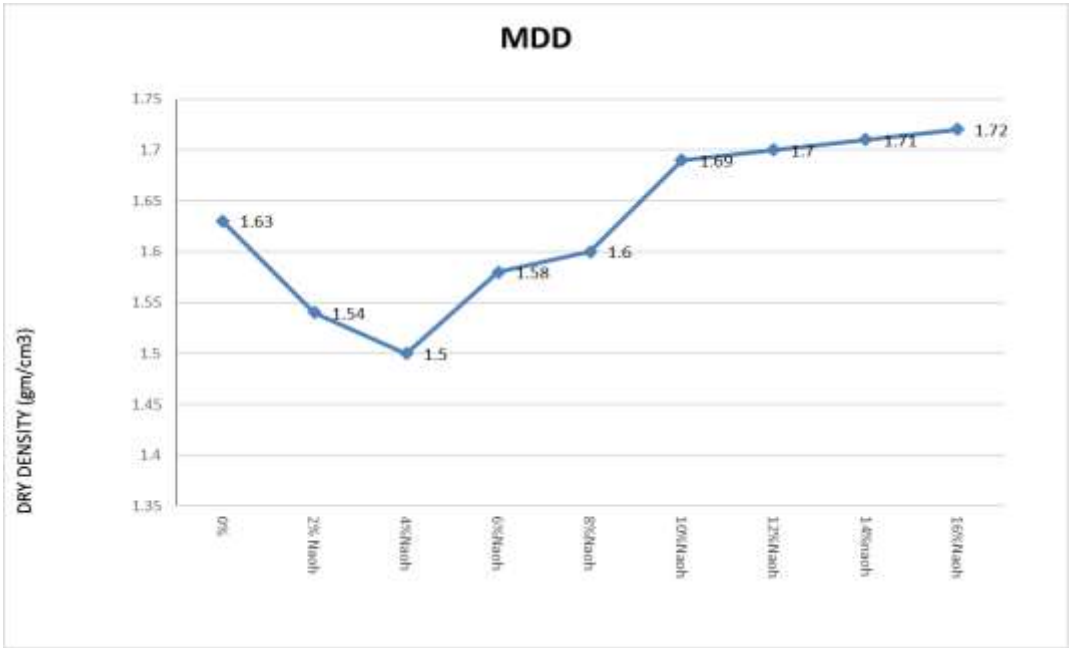

Fig. 3: Maximum dry density variation graph

Current study shows that different concentration of NaOH in exhibits different results. With NaOH concentration varying from 2 to 16%. OMC starts decreasing gradually from 27.40-17.10%. OMC is 22.6% for 0% NaOH, and also MDD gradually increases from 1.47 to 1.94 g/cm3at 2 to 16% NaOH concentration.

B. Unconfined Compressive Test:

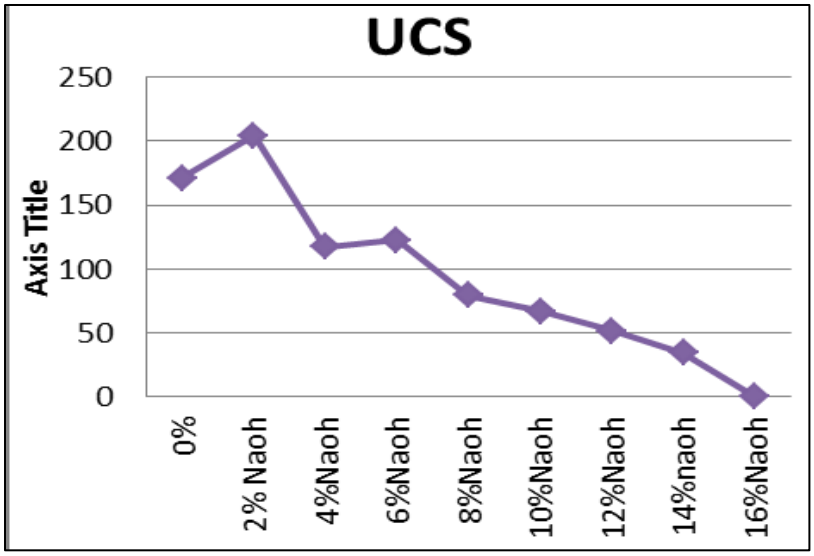

Fig. 4: Effect of NaOH concentration on unconfined compression test

Unconfined compressive strength decreases from 204 KN/m^2 to 35.35 KN/m^2 with the - increases NaOH concentration from 0-14%. It's impossible to find out unconfined compressive strength above 16%. The behavior of soil changes from cohesive to non-cohesive gradually with increases of NaOH concentration from 0 to 16%.

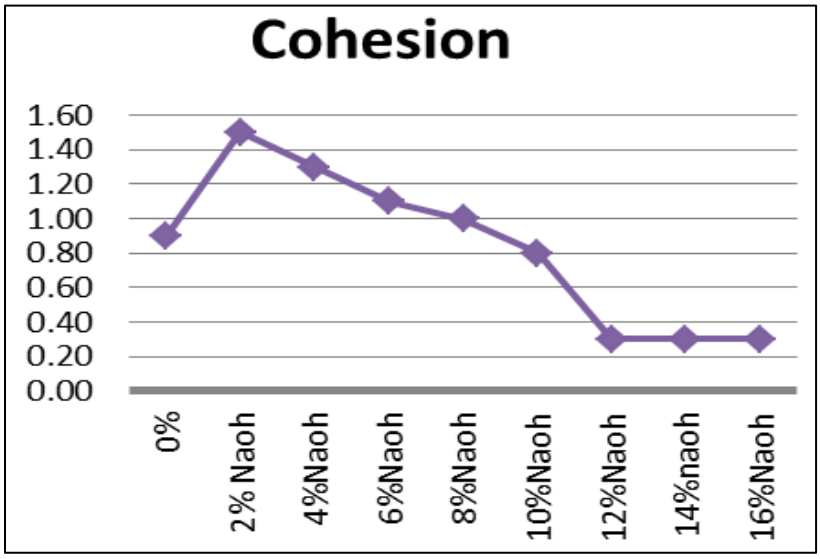

Fig. 5: Effect of NaOH concentration on Maximum dry density

VII. SHEAR PARAMETERS

R Sivapullaiah have to studied that to consider the effect of varying percentage of sodium hydroxide on the shear strength of NaOH on the shear strength so shedi soil consolidated undrained strength of soil mixed with varying amount of NaOH has been consolidated in terms of stress strain behavior and variations in the shear strength parameters it's can be seen cohesion soil decreases and angle of internal friction increases contentiously.

In my study Shows that the variation in cohesion by mixing different percentage of alkali content (NaOH) with black cotton it is observed that increase NaOH concentration with decreased cohesion simultaneously 0 to 16% and also decreased cohesion 0.9 to 0.3 KN/m2. But if firstly increase NaOH concentration from 0 to 2% so shown the graph as continues increased with NaOH and within simultaneously decreased cohesion.

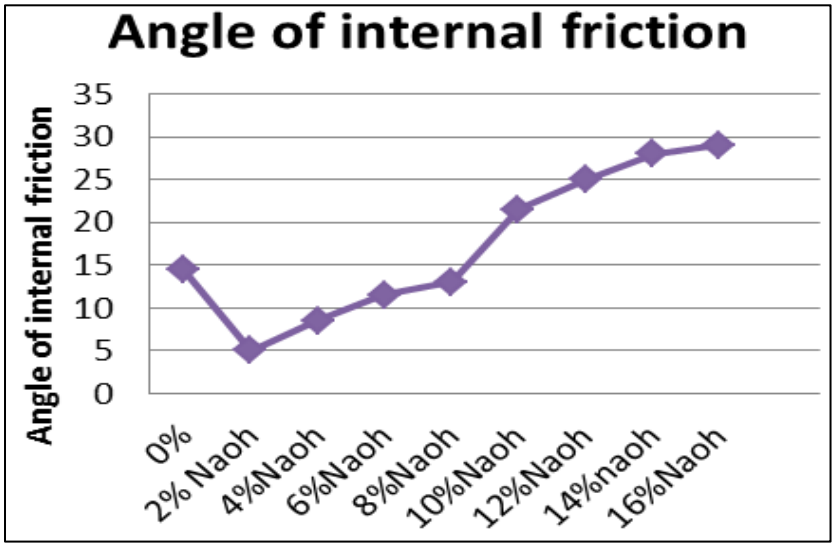

Fig. 5: Effect of NaOH concentration on Maximum dry density

The variation in angle of internal friction with different percent of NaOH concentration increased with soil due to simultaneously in- creased angle of internal friction (ϕ) 14.5 to 29.

In my studies and also Dayaker Babu and K. Ramustudied studies correlate that increase NaOH concentration with black cotton soil as shown the result of cohesion increases and angle of internal decreasing simultaneously with different NaOH percentage. So in my study and others researchers are shown the same results with NaOH concentration, it is a best option for enhance the engineering properties of black cotton soil like cohesion and angle of internal friction.

VIII. Conclusion

In this study within some experimental work it has observed results:

When black cotton soil concentrated with different NaOH percentage by weight of water is reacts with present minerals (Kaolinite and montominerllite) with in ions (Na+ & OH-) react with different concentration for changes in engineering properties are

1) The Optimum moisture content 17.10% are decrease and maximum dry density 1.94 g/cm3 increase, as well as at 16% NaOH concentration shown 17.10% OMC given stable condition for OMC and MDD both properties of soil.
2) At 0 to 16% NaOH concentration with the unconfined compressive strength of soil is decrease and at reaches at zero, it's say that strength does not exist in black cotton soil and change in sand properties.
3) NaOH concentration at 2% given the better result of unconfined compressive strength of soil comparison to normal soil and also 16% concentration of NaOH concentration, it has to be concluded that when we increased more NaOH concentration soil change in sand properties because sandy soil does not exist axially compressive strength.

So it will be concluded that in these studies at 8% NaOH concentration make a best packing material in soil and increases the density and their sandy soil factors.

References

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