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STABILIZATION OF BLACK COTTON SOIL BY 15% KOTA STONE SLURRY WITH WOODEN SAW DUST

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ABSTRACT

Black Cotton soil is expansive soil which expand when it contacts with water. This is the major reason of failure of black cotton soil strata and soil strata may be improved by different types of admixtures. The different areas having different types of black cotton soil and it is engineering properties. In this research paper, the engineering properties of black cotton soil is tried to improve by using wooden saw dust with 15% Kota stone slurry. Most of the times, the black cotton soil is stabilized by polypropylene fibre and lime etc. Sometimes soil is stabilized by using Kota stone slurry but this research paper is based on stabilization of black cotton soil by 15% Kota stone slurry with different percentage of wooden saw dust. In this research, the 15% Kota stone slurry is mixed with different percentage of wooden saw dust in black cotton soil. The engineering parameters are also determined by conducting tests for 15% Kota stone slurry with black cotton soil mix specimen. For stabilization of black cotton soil with 15% of Kota stone slurry, the Atterberg's limits (Liquid Limit, Plastic Limit, Plasticity Index), standard proctor test and unconfined compressive strength test are conducted but with different percentage of wooden saw dust.

Keywords : Wooden Saw Dust, Maximum Dry Density, Optimum Moisture Content, UCS of Wooden Saw Dust, 15% Kota stone slurry with Wooden Saw Dust.

I. INTRODUCTION

Expansive soil is one of the tropical and major soil deposits in India, which is highly problematic in nature. When exposed to moisture regime, t shows either an enormous increase or decrease in volume, attributing to severe damages on structures built on such soils. The concept of reinforcing soil masses by including some kind of fibre was practiced by early civilizations which used soil mixed with straw or other available fibre to improve durability and strength of the dried brick used as building materials. From previous years, the amount of stone slurry waste has been generated in stone production plants with significant environmental impacts. This waste is used with different percentage of wooden saw dust. The percentage of saw dust may vary from 2.5% to 12.5%. The laboratory tests are conducted for determining the engineering properties of black cotton soil with fibre and

Kota stone slurry. The main objective of this work is to investigate the possibility of improving engineering properties of black cotton soil by using Kota stone slurry.

II. LITERATURE REVIEW

For the stabilization of black cotton soil, many researchers did work on the black cotton soil with different materials. In the past many researchers have carried out their research work for stabilizing of black cotton soil using different types of admixture, stone dust and wooden saw dust. Some detailed literatures have been reviewed on this topic i.e. related to stabilization of black cotton soil and some of the reviewed of the reviewed literatures are presented in proceeding paragraphs.

Gyaneshwar Singh Uchariya et. al. (2016) studied the stabilization of clay by using wood ash and fly ash. They stated that ash from biomass fuel contains a significant amount of CaO and addition of such material will increase the physical as well as chemical properties of soil. properties to be increased are CBR value, shear strength, liquid limit. The plasticity was reduced 32% and CBR and strength increased 25% to 50% and 45% to 65%. After the performing the experiments, it is obtained that highest strength increases are developed after 7 to 14 days of curing at 20 to 30% of wood ash ad fly ash clay mixture. They also observed that wood ash produced by the optimal (12%) ashes contents is quickly used up with in first 2 weeks of curing the imply of these results. At last they concluded that wood ash material can stabilize the clay soil.

Roshni R. et. al. (2014) performed experimental study on strength behaviour of expansive soil treated with phosphogypsum and wood ash. They took two materials – wood ash (WA) and phosphogypsum (PG) to stabilize problematic clay soil sample. The effect of varying percentage of wood ash on the strength properties of two expansive soil samples stabilized with 4% phosphogypsum. Strength characteristics of soil sample as well as soil mixed with 4% phosphogypsum and 88%, 10%, 12% and 14% of wood ash respectively were found by UCC ash. After performing experiments, the concluded the UCS value and CBR value increase after 14-day curing. The CBR value increases from 3.14% and 2.11% to 34.31% and 56.82% for both samples (WA and PG). From UCS and CBR data, the defined that as the time allowed for curing increases the rate of strength gained also increased.

Thompson Henry Tolulope Ogunribido (2012) studied geotechnical properties of saw dust ash stabilized southwestern Nigeria lateritic soils. He prepared 3 specimens for each 2%, 4%, 6%, 8% and 10% of saw dust ash with soil. He observed that by using wooden saw ash the geotechnical properties are improving. From the results he concluded that all the geotechnical properties of soil are improved after adding saw dust ash and the optimum results can be achieved by adding 6% of saw dust ash as to the lateritic soil weight.

III. EXPERIMENTAL INVESTIGATIONS

Various such as Atterberg's limit (liquid limit and plastic limit), OMC and MDD, UCS, etc tests have been performed to find out the engineering properties of black cotton soil as well as soil with 15% Kota stone slurry and varied percentage of Recron 3s fibre. The percentage of Kota stone slurry is 15% and fibre may have varied from 0.5% to 2.5% at 0.5% interval.

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3.1 Material Used

- **Black Cotton Soil –** About 100 kg of soil sample for the present work was collected from the Borkheda, Kota.
- **Kota Stone Slurry –** Kota stone slurry for the present work was obtained from Kota stone slurry industry, Anantpura, Kota.
- **Wooden Saw Dust –** Wooden industry, Nainawa, Kota

3.2 Engineering Properties of Soil, Kota Stone Slurry and Mix Specimen

The following engineering properties are determined for black cotton soil and Kota stone slurry by the laboratory experiments as shown in Table 3.1.

Table 3.1 Engineering Properties of Black Cotton Soil and Kota Stone Slurry

Parameters	Black Cotton Soil	Kota Stone Slurry
Specific Gravity	2.44	2.35
Liquid Limit (%)	41.41	34.28
Plastic Limit (%)	18.46	21.77
MDD (kg/cm^3)	1.755	1.635
OMC (%)	17.4	17.1
Colour	Red – Brown	Grey Dirty White
IS Classification	CI	CL

The Kota stone slurry is mixed at 15% by weight of black cotton soil. The liquid limit and plastic limit for this mix specimen is 34.56% and 14.09% respectively determined, which is less than to black cotton soil values.

3.3 Standard Proctor Test

The object of testing is to find out the maximum dry density and optimum moisture content of mix specimen. The mix specimen is prepared by different percentage of wooden saw dust with 15% Kota stone slurry in black cotton soil. The test results of mix specimen are showing in Table 3.2.

Table 3.2 MDD and OMC for wooden saw dust Mix Specimen

Test Specimen	MDD (kg/cm^3)	OMC (%)
Black Cotton Soil (BCS)	1.725	17.4
BCS + 15% KSS	1.755	15.2
BCS + 15% KSS + 2.5% Dust	1.830	14.0
BCS + 15% KSS + 5.0% Dust	1.835	10.0

BCS + 15% KSS + 7.5% Dust	1.760	12.6
BCS + 15% KSS + 10.0% Dust	1.760	16.0
BCS + 15% KSS + 12.5% Dust	1.695	18.2

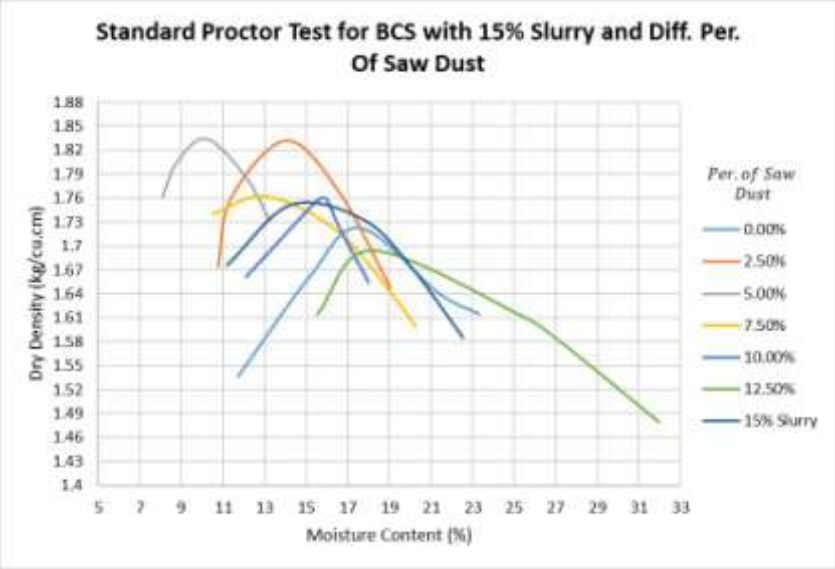

Fig. 3.1 Standard proctor test results of black cotton soil with 15% KSS and varied percentage of dust

From fig. 3.1, it shows that the grey curve is having MDD and OMC, 1.835 kg/cm^3 and 10.0% respectively for 15% Kota stone slurry with black cotton soil mix specimen. When 2.5% to 5.0% dust is added in black cotton soil and 15% Kota stone slurry mix specimen, the maximum dry density increases from 1.830 kg/cm^3 to 1.835 kg/cm^3 but when the percentage of dust increases from 5.0% to till 12.5%, the MDD decreases 1.695 kg/cm^3 for 12.5% dust mix specimen. Same as in case of OMC, the OMC decreases with increasing the percentage of dust in mix specimen from 14.0% to 10.0% but after 5.0% dust mix, the value of OMC continuously increases with increasing the percentage of fibre in mix specimen.

3.4 Unconfined Compressive Strength

The object of testing is to determine the shear strength parameter of clay and 15% Kota stone slurry with varied percentage of wooden saw dust by loading axially cylindrical specimen. the observation and calculation of UCS test is shown in Table 3.3.

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Table 3.3 – UCS Test for Wooden Saw Dust Mix Specimen

Test Specimen	UCS, q_u (N/cm^2)	Shear Strength C_u (N/cm^2)	Percentage Variation in C_u
Black Cotton Soil (BCS)	15.967	07.983	-
BCS + 15% KSS	21.465	10.732	34.43
BCS + 15% KSS + 2.5% Dust	18.953	09.476	- 11.704
BCS + 15% KSS + 5.0% Dust	28.505	14.252	32.797
BCS + 15% KSS + 7.5% Dust	35.871	17.936	67.115
BCS + 15% KSS + 10.0% Dust	39.636	19.818	84.653
BCS + 15% KSS + 12.5% Dust	42.001	21.100	95.670

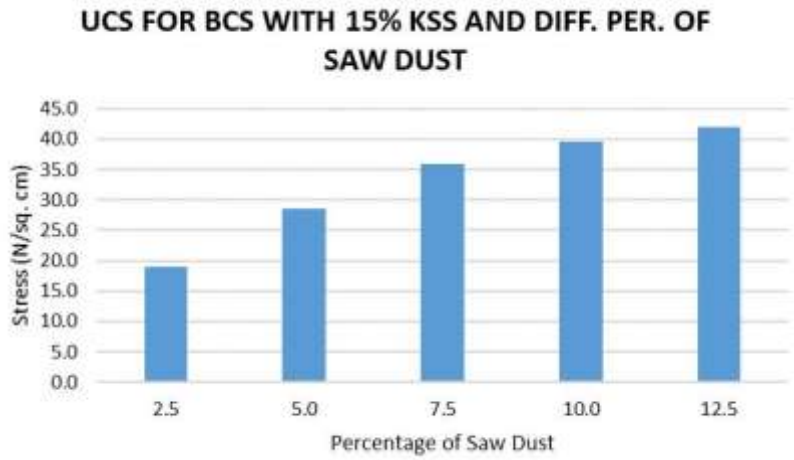

Fig. 3.5 – UCS for black cotton soil with 15% KSS and diff. per. of saw dust

From Table 3.3, it is shown that when 15% Kota stone slurry is added in black cotton soil, the shear strength is increased 34.43% to shear strength of the black cotton soil but when 2.5% saw dust is added in black cotton soil with 15% Kota stone slurry mix specimen, the shear strength 11.70% decreases from 15% Kota stone slurry mix specimen. When 5.0% dust is added in 15% Kota stone slurry mix specimen, the shear strength 32.79% increases. After 5.0% saw dust mix specimen, the value of shear strength continuously increases with increasing the percentage of wooden saw dust.

IV. DISCUSSIONS ON TEST RESULTS

The black cotton soil changes it is behaviour due to Kota stone slurry and wooden saw dust. The Kota stone slurry is low plasticity material and black cotton soil is inorganic clay of medium plasticity. The plasticity of black cotton soil decreases with increasing the amount of Kota stone slurry. The maximum dry density and optimum moisture content is 1.755 kg/cm3 and 15.2% determined for 15% Kota stone slurry mix specimen but when Recron 3s fibre is added in mix specimen of 15% KSS and BCS, the maximum dry density and optimum moisture content is varied with increasing the percentage of fibre. The maximum dry density is increases about 1.835 kg/cm^3. The shear strength is

also increased with increasing the percentage of wooden saw dust in 15% KSS and black cotton soil mix specimen. The maximum shear strength is observed for black cotton soil with 15% Kota stone slurry and 12.5% dust mix specimen, which is 21.00 N/cm^2. When 2.5% dust is added in 15% KSS with black cotton soil mix specimen, the value is 11.70% decreased form 15% Kota stone slurry mix specimen.

V. CONCLUSIONS

- Black cotton soil changes behaviour CI to CL due to low plasticity material Kota stone slurry.
- The maximum dry density is 1.835 kg/cm^3 obtained for 5.0% dust mix specimen at 10% optimum moisture content.
- The maximum dry density is 4.56% increased from the 15% Kota stone slurry mix specimen.
- The maximum shear strength is 21.00 N/cm^2 obtained for 12.5% dust mix specimen. When 2.5% dust is mixed with 15% Kota stone slurry and black cotton soil mix, the shear strength decreases to 11.70%
- From the 5.0% saw dust mix specimen, if percentage of saw dust increases the value of shear strength also increases about 95.67% from the 15% Kota stone slurry mix specimen.

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