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EFFECT OF FINE PARTICLES ON BLACK COTTON SOIL

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ABSTRACT

The black cotton soil is a major problem in geotechnical engineering. The black cotton soil is expansive soil which expand it self when it comes in the contact in water. When the ground water table is low the condition is good for black cotton soil but with increasing the time, if water table increases, this is varying harmful for the black cotton soil because the particle rearranges due to water and volume increases. When this water table decreases the particles also rearranges and the shrinkage increases.

This paper is dealing with the effect of fine particles in black cotton soil. The raw material Kota stone slurry is used as fine particles at dry state. The Kota stone slurry is waste product which is developed or produced of stone industry. The different percentage of Kota stone slurry is mixed with black cotton soil to study the effect of fine particle in black cotton soil. The percentage of Kota stone slurry is varied from 5% to 30%.

Keywords :Shrinkage Limit, Volumetric Shrinkage, Kota stone slurry, Liquid Limit, Plastic Limit and Plasticity Index.

I.INTRODUCTION

Black cotton soil is highly expansive soil and cohesive soil. The black cotton soil is known as highly swell soil. The black cotton soil is mostly found in the central and western parts which covers approximately 20% of total area of India. Due to expansive and highly swelling characteristics of black cotton soil, this is big issue for the highway and other civil engineering specializations. In dry state, black cotton soil is very strong but in lose state the strength parameters decrease. Black cotton soils are highly expansive clay with high potential for shrinkage results of changing moisture content. From the old ages, the stone is used as construction material. From previous years, the amount of stone slurry waste has been generated in stone production plants with significant environmental impacts. This waste causes serious environmental problems. The main objective of this work is to investigate the shrinkage parameters of black cotton soil by using Kota stone slurry.

II.LITERATURE REVIEW

Chayan Gupta et. al. (2016)[1] – They studied the black cotton soil modification by the application of waste materials. They considered 3 waste materials which is used for improving the engineering properties of black cotton soil. These waste materials are river sand, fly ash and marble dust. From the test results, they obtained

that black cotton soil, black cotton soil with river sand, black cotton soil with fly ash and black cotton soil with marble dust are having 13%, 16.13%, 17.79% and 16.68% shrinkage limit. The test results show that when the fine particles are added with black cotton soil, the shrinkage limit increases

Parte Shyam Singh et. al. (2014)[2] – They studied the effect of marble dust on index properties of black cotton soil. They mixed marble dust with varying 10% to 40% percent. They obtained shrinkage limit for black cotton soil is 8.06%. Same as for mix of marble dust (at different percentage 10% to 40%) with black cotton soil, the shrinkage limit is increased from black cotton soil shrinkage limit and it vary from 10.33% to 18.39%. The test results show, when the amount of marble dust increases, the shrinkage limit also increases

Verma S. K. et. al. (2013)[3] – A review paper is presented on behavioural study of expansive soils and its effect on structure. In this paper they studied the effect of various materials on black cotton soil. They descried many engineering properties of black cotton soil which is affected by many materials. They studied that, the addition of fly ash lime reduces the plasticity characteristics of expansive soil and liquid limit and plastic limit, plasticity index, linear shrinkage decreased drastically and shrinkage limit increased with the addition of fly ash lime. The liquid limit, plasticity index and linear shrinkage were found to be lower for samples cured compared to fresh mixes of clay fly ash lime. The many researcher had reported the occurrence of substantial irreversible components of either wetting induced swelling drying induced shrinkage during cycles of wetting and drying performed on unsaturated highly expansive clays containing active clay minerals such a montmorillonite. This form of irreversible behaviour cannot be represented by existing elasto – plastic clay and that the constitutive models developed for unsaturated non – expansive clays were inappropriate.

The potential use and the effectiveness of expansive soils stabilization using fly ash and fly ash lime as admixture are evaluated. The test results show that the plasticity index, activity, free swell, swell potential, swelling pressure and axial shrinkage percentage decreased with an increase in fly ash or fly ash lime content and the axial shrinkage percentage decreased with increase in fly ash or fly ash lime content.

It also studied that, the increase in the dry density subsequently leads to decrease the soil shrinkage and expansive strains. The increase in the content of agglomerated particles leads to decrease in the dry density and increase in voids which increase the water content.

Udayashankar D. Hakari et. al. (2012)[4] – They studied the stabilization of black cotton soil using fly ash at Hubballi Dharwad Municipal Corporation Area, Karnataka, India. For the stabilization of black cotton soil, they used fly ash as stabilization materials. From the laboratory test study, they concluded that when the percentage of fly ash increases, the shrinkage limit also increases. The graphical presentation is shown in fig. 1

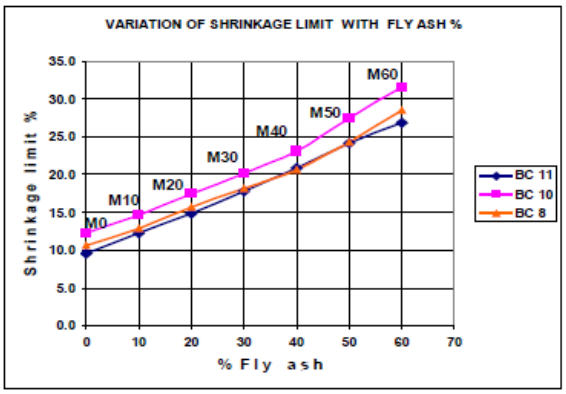

Fig. 1. Variation of Shrinkage Limit with Fly Ash

The addition of fly ash in increasing percentage, it is seen that the shrinkage limits of samples follow a steady increase with the addition of fly ash in increasing percentage. The increase in shrinkage limit with fly ash is mainly due to the flocculation of clay particles caused by the free lime present in fly ash resulting in the reduction of friction between the particles and also due to the substitution of finer particles of black cotton soil by relatively coarser fly ash particles.

RAW MATERIAL

Black cotton soil – Sample is taken from Borkheda, Kota, Rajasthan (India).

Kota stone slurry – Sample is taken from stone industry which is situated at Anantpura Industrial Area, Kota, Rajasthan (India).

III.TEST RESULTS

In laboratory the following test were conducted and the following test results are obtained.

1. Liquid Limit

From the laboratory test results, it is obtained that the black cotton soil and Kota stone slurry having liquid limit 41.41% and 34.28% respectively. It is also observed that when the amount of Kota stone slurry increases the liquid limit of mix specimen decreases. The test results are shown in Table 1 and the graphical presentation is shown in fig. 2

TABLE 1 – LIQUID LIMIT OF SPECIMENS

Test Specimen	Liquid Limit (%)
Black Cotton Soil (BCS)	41.41
Kota Stone Slurry (KSS)	34.28

BCS + 5.0% KSS	40.38
BCS + 10.0% KSS	37.42
BCS + 15.0% KSS	34.56
BCS + 20.0% KSS	28.09
BCS + 25.0% KSS	19.57
BCS + 30.0% KSS	13.01

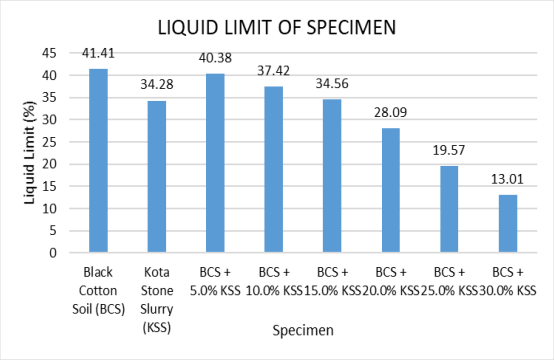

Fig. 2 – Liquid limit of Specimen

2. Plastic Limit

From the laboratory test results, it is obtained that the black cotton soil and Kota stone slurry having plastic limit 18.46% and 21.77% respectively. It is also observed that when the amount of Kota stone slurry increases the plastic limit of mix specimen decreases. The test results are shown in Table 2

TABLE 2 – PLASTIC LIMIT OF SPECIMENS

Test Specimen	Plastic Limit (%)
Black Cotton Soil (BCS)	18.46
Kota Stone Slurry (KSS)	21.77
BCS + 5.0% KSS	18.01
BCS + 10.0% KSS	17.14
BCS + 15.0% KSS	14.09

BCS + 20.0% KSS	10.65
BCS + 25.0% KSS	09.29
BCS + 30.0% KSS	09.16

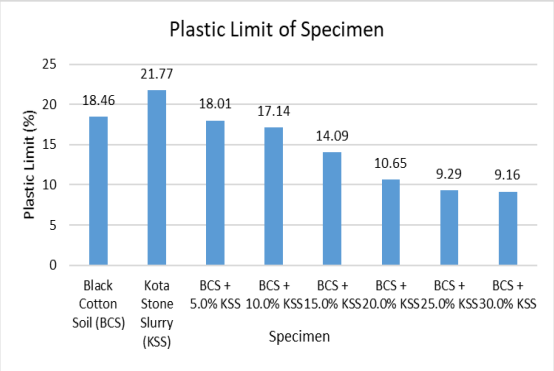

Fig. 3. – Plastic limit of Specimen

3. Plasticity Index

TABLE 3 – PLASTICITY INDEX OF SPECIMENS

Test Specimen	Plasticity Index (%)
Black Cotton Soil (BCS)	22.95
Kota Stone Slurry (KSS)	12.51
BCS + 5.0% KSS	22.37
BCS + 10.0% KSS	20.28
BCS + 15.0% KSS	20.47
BCS + 20.0% KSS	17.44
BCS + 25.0% KSS	10.28

BCS + 30.0% KSS	03.85

Similarly, from the laboratory test results, it is obtained that the black cotton soil and Kota stone slurry having plasticity index 22.95% and 12.51% respectively. It is also observed that when the amount of Kota stone slurry increases the plasticity index of mix specimen decreases but on 15% Kota stone slurry mix specimen the plasticity index increases from the 10% mix specimen. The test results are shown in Table 3 and the graphical presentation is shown in fig. 4

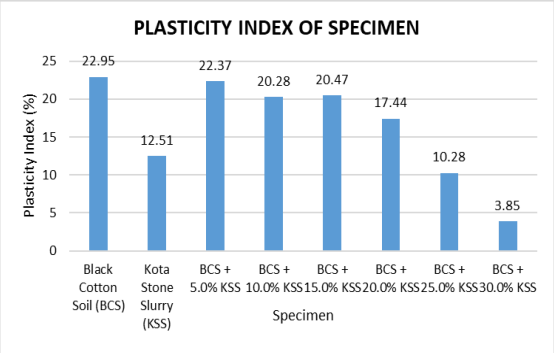

Fig. 4 – Plasticity Index of Specimen

4. Shrinkage Limit

From test results it is obtained that the black cotton soil having 13.82% shrinkage limit but when the 5% Kota stone slurry is added in black cotton soil the shrinkage limit decreases 12.47%.

TABLE 4 – SHRINKAGE LIMIT OF SPECIMENS

Test Specimen	Shrinkage Limit (%)
Black Cotton Soil (BCS)	13.82
BCS + 5.0% KSS	12.47
BCS + 10.0% KSS	14.14
BCS + 15.0% KSS	15.51

BCS + 20.0% KSS	17.23
BCS + 25.0% KSS	19.17
BCS + 30.0% KSS	20.44

When the percentage of Kota stone slurry increase from 5% to 30%, the shrinkage limit increases from 14.14% to 20.44%. The test results are shown in Table 4 and graphical presentation is shown in fig. 5

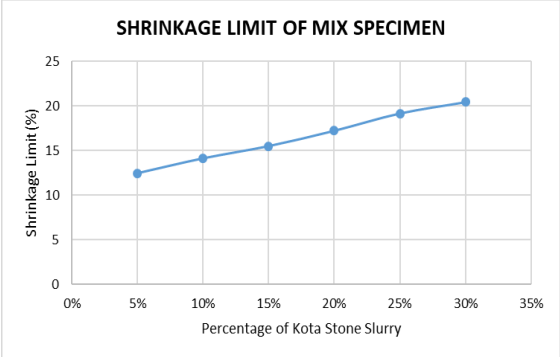

Fig. 5 – Shrinkage Limit of Specimen

5. Volumetric Shrinkage

TABLE 5 – VOL. SHRINKAGE OF SPECIMENS

Test Specimen	Vol. Shrinkage (%)
Black Cotton Soil (BCS)	72.71
BCS + 5.0% KSS	43.96
BCS + 10.0% KSS	39.85
BCS + 15.0% KSS	48.83

BCS + 20.0% KSS	44.77
BCS + 25.0% KSS	37.68
BCS + 30.0% KSS	35.08

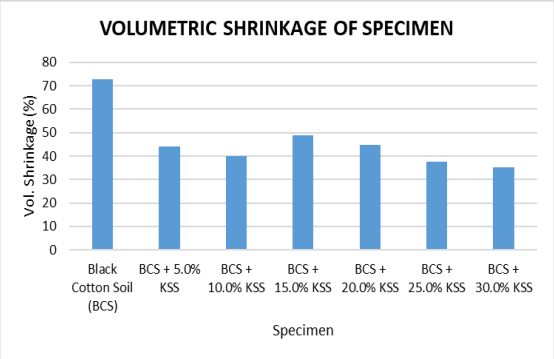

Fig. 6 – Volumetric Shrinkage of Specimen

From Table 5, it is observed that the black cotton soil having 72.71% volumetric shrinkage but when 5% Kota stone slurry is added in black cotton soil, the volumetric shrinkage decreases about 43.96% and it continuously decreases till 10% Kota stone slurry mix specimen but when 15% Kota stone slurry is mixed, the volumetric shrinkage increases 48.83% and after this it decreases

IV.DISCUSSION ON TEST RESULTS

The black cotton soil changes the behaviour due to Kota stone slurry. The Kota stone slurry is low plasticity material and black cotton soil is inorganic clay of medium plasticity but when amount of Kota stone slurry increases, the black cotton soil changes behaviour from CI to CL. It is also seen that when the amount of Kota stone slurry increases, the shrinkage limit increases with increasing KSS. The reason of increasing shrinkage limit is rearrangement of particles and friction between the soil and Kota stone slurry particles.

V.CONCLUSIONS

With increasing the amount of KSS in black cotton soil, the specimen turned gradually medium plasticity clay (CI) to low plasticity clay (CL). The availability of moisture content also effects the shrinkage limit of black cotton soil and mix specimen. If quantity of fine particles increases, the shrinkage limit increases. The reason of increasing shrinkage limit is friction between particles and rearrangement of particles due to dry state.

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REFERENCES

[1] Chayan Gupta, Ravi Kumar Sharma, "Black Cotton Soil Modification by the Application of Waste Materials", Periodic Polytechnica Civil Engineering, PP 479 – 490, DOI 10.3311/PPci 8010.

[2] Parte Shyam Singh, Yadav R. K., "Effect of Marble Dust on Index Properties of Black Cotton Soil", IJERST, ISSN – 2319 – 5991, Vol. 3, No. 3, ISSUE 2014.

[3] Verma S. K., Maru S., "Behavioural Study of Expansive Soils and Its Effect on Structures – A Review", IJIET, Vol. 2, ISSN – 2319 – 1058, ISSUE – 1 April 2013.

[4] Udayashankar D. Hakari, S. C. Puranik, "Stabilization of Black Cotton Soils Using Fly Ash, Hubballi – Dharwad Municipal Corporation Area, Karnataka, India, GJRECSE, Vol 12, ISSN (O) – 2249 – 4596, ISSN (P) – 0975 – 5861, ISSUE – February 2012.

[5] Dr. B. C. Punamia, Ashok Jain, Arun Jain, Soil Mechanics and Foundations, Laxmi Publications, New Delhi.

[6] Dr. K. R. Arora, Soil Mechanics and Foundation Engineering, Standard Publications, New Delhi.

[7] Indian Standard Code : IS 1498 – 1970, Classification and identification of soils for general engineering purposes (first revision).

[8] Indian Standard Code : IS 2720 (Part 5) – 1985, Determination of liquid limit and plastic limit (second revision).

[9] Indian Standard Code : IS 2720 (Part 6) – 1972, Determination of Shrinkage Factor (first revision)