ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 08, Issue, 08, pp. 22118-22121, August, 2018

ORIGINAL RESEARCH ARTICLE OPEN ACCESS

EXPERIMENTAL DETERMINATION OF THE BEHAVIOR OF BLACK COTTON SOIL USING DIFFERENT ADMIXTURES

***Uma G. Hullur**

Department of Civil Engineering, KLS GIT, Belagavi, Karnataka, India

ARTICLE INFO

Article History:
Received 28th May, 2018
Received in revised form
21st June, 2018
Accepted 09th July, 2018
Published online 30th August, 2018

Key Words:

Stabilization, Admixtures, Black cotton soil, FA, GGBFS, SF, Metakaolin, Cement, RHA, Proctor test.

ABSTRACT

Improving the engineering property of soils by the addition of admixtures is called the soil stabilization. Stabilization was carried by different methods. In the present study different admixtures were used with black cotton soil with varying percentages and carried out the proctor test. Here black cotton soil was mixed with 10%, 20% and 30% of admixtures such as cement, FA, GGBFS, SF Metakaolin and RHA. Proctor test was carried out to find the maximum dry density and optimum moisture content. The results showed, 10% FA gave maximum MDD ,10% SF gave maximum MDD,20% RHA gave maximum MDD,30% GGBFS gave maximum MDD,30%Metakolin gave maximum MDD and similarly 30% cement gave maximum MDD.Hence for stabilization the above percentages can be considered as the optimum values of admixtures with black cotton soil.

Citation: Uma G. Hullur, 2018. "Experimental determination of the behavior of Black cotton soil using different admixtures", *International Journal of Development Research*, 8, (08), 22118-22121.

INTRODUCTION

The design of foundation is very difficult in black cotton soil. Due to the non-availability of suitable land, the construction work is taking place in the land which has insufficient bearing capacity to support the weight of a structure. Hence to overcome this situation, the technique of stabilization of clayey soil proved to be successful. The important characteristic of clayey soils is their susceptibility to the volume change. Soil stabilization techniques are used to improve shear strength, CBR, reducing expansive characteristics, etc Expansive soils can be problematic in engineering applications, especially when they come in contact with water. Changes in soil volume can cause very major damage to the structures, as well as pavements. Hence the treatment of expansive soils can be done by adding some admixtures to improve the engineering properties. From many years ago the technique of soil stabilization is being in practice to improve the engineering properties of black cotton soils, but the results vary from soil to soil depending upon the mineralogy of the clay. The literature shows the use of admixtures to very small percentage which may be either industrial waste containing pozzolonic properties or lime or cement or combinations of any two. Hence in this study Cement, Fly ash (FA), silicafume (SF)[1], Metakaolin, Ground granulated blast furnace slag (GGBFS)[5] and rise husk ash (RHA) [2]are considered for stabilization process and the effort was made to identify the optimum level of admixtures at their optimum percentage considered so that the quantity of industries.

Corresponding author:* **Uma G. Hullur,
Department of Civil Engineering, KLS GIT, Belagavi, Karnataka, India.

LITERATURE REVIEW

Chhaya Negi *et al.* (2013) the main objective of this study was to evaluate the feasibility of using Silica fume as soil stabilization material. In this paper the effect of Silica fume on engineering characteristics of expansive clay like Black Cotton Soil has been presented. A series of laboratory experiment has been conducted on black cotton soil blended with Silica fume content from 5% to 20% by weight of dry soil. The experimental results showed a significant increase in California bearing ratio and unconfined compressive strength. The Differential free swell of the clay is reduced from 50% to 7% with increase in Silica fume content from 0% to 20% respectively. The Proctor compaction results showed a small decrease in Maximum dry density and increase in Optimum moisture content. From this investigation it was concluded that

the Silica fume has a potential to improve the characteristics of black cotton soil.

Hanifi Canakci, Aram Aziz and Fatih Celik (2014) conducted a study on expansive soil specimens treated with lignin from 0 to 20%, rice husk powder (RHP) 0 to 20% and rice husk ash (RHA) from 0 to 10% The test specimens were subjected to unconfined compressive strength (UCS), swelling test and Atterberg limit tests. The effects of additives on UCS and atterberg limit showed significant effect on strength values. A RHP content of 15% was found to be the optimum with regard to 3-day cure UCS.

Rathan Raj, Banupriya and Dharani: carried the investigation on treating the soil with the type of solid waste namely Rice Husk Ash for stabilization. Also they studied the effects of same on the index and engineering characteristics of problematic soil. The rice husk ash was mixed with soil in various proportions like 5%, 10%, 20%, 30%, 40%, 50% and 80%. The various tests were conducted on these proportions and optimized proportion was arrived.

Shivangi Bharadwaj and Dr. M. K. Trivedi (2016): The paper presented an experimental investigation, carried out to study the effects of Micro Silica Fume on index properties of black cotton soil. A series of laboratory experiments have been conducted on samples with 0%, 5%, 10% and 15% of Silica Fume by weight of dry soil. The test results showed a significant change in consistency limits of samples containing Silica fume. The Liquid limit would increase by 50% to 67% and Plasticity Index would increase from 24% to 31%. The shrinkage limit would increase from 10.44% to 13.01% and specific gravity would decreased by 2.69% to 2.59%. Also the Differential Free Swell decreased from 48.46% to 9% showing appreciable decrease in swelling behavior. The investigation showed that the Silica fume is a valuable material to modify the index properties of black cotton soil to make it suitable for different construction activities.

Manjunath S.Sharanappanavar *et al.* (2017): Considered the waste materials like Solid waste Incinerated Ash, Egg Shell Powder and Ground Granulated Blast Furnace Slag (GGBFS) for stabilizing the black cotton soil. The objective of this study was to evaluate the effect of Solid waste Incinerated Ash, Egg Shell Powder and GGBFS in stabilization of soft fine-grained black cotton soil, in turn to help in minimizing the disposal problems of solid waste. The different engineering properties of GGBFS, Egg Shells were studied and then the different proportions of GGBFS, Egg Shell Powder and Solid waste Incinerated Ash were proportioned with the Black Cotton Soil and the different properties such as densities, CBR and shear strength etc were analyzed. The results showed that there is an improvement in the in engineering properties of the Black cotton Soil for the proportion of 10:20:30.

MATERIALS AND METHODS

Materials: In the present study black cotton soil has been collected from Belagavi region. Different admixtures used for finding their optimum value for the purpose of stabilization are cement, Fly ash, Silica fume, Ground granulated blast furnace slag, Rice husk ash and Metakaolin.

Methodology: Initially the Index properties and soil classification tests were carried along with MDD, OMC, shear parameters and also the strength of the soil was determined.For the purpose of finding the optimum value among the admixtures used for stabilizing the black cotton soil, MDD and OMC were determined in the laboratory for addition of different percentages of admixtures to the soil. The following tabular column shows the details mixes of soil and admixture.

Soil type	Mixed proportions
Black cotton soil + cement	BCS90%+10%Cement
	BCS80%+20%Cement
	BCS70%+30%Cement
Black cotton soil + Fly ash	BCS90%+10%FA
	BCS80%+20%FA
	BCS70%+30%FA
Black cotton soil + GGBS	BCS90%+10%GGBS
	BCS80%+20%GGBS
	BCS70%+30%GGBS
Black cotton soil + silica fumes	BCS90%+10%SF
	BCS80%+20%SF
	BCS70%+30%SF
Black cotton soil + Metakaolin	BCS90%+10%META
	BCS80%+20%META
	BCS70%+30%META
Black cotton soil + RHA	BCS90%+10%RHA
	BCS80%+20%RHA
	BCS70%+30%RHA

RESULTS AND DISCUSSION

Tests conducted to find different properties of black cotton soil.

Table 1. The test results of properties of black cotton soil.

PROPERTIES OF SOIL			
Sl.No	Laboratory Tests	B.C Soil	
1	Specific gravity G	2.18	
2	Liquid Limit %	63.5	
3	Plastic Limit%	28.43	
4	Plasticity Index	35.07	
5	Max Dry Density	1.41gm/cc	
6	OMC	25%	
7	Free swell Index	47.37	
8	IS Soil Classification	CH	
9	Shrinkage limit	28.29%	
10	Direct Shear		
	C	0.3Kg/Cm²	
	ϕ	13	
11	CBR	UNSOAKED	SOAKED
	2.5mm	6.125	2.28
	5mm	5.23	2.10

After determining the properties of the black cotton soil, the test for determining the MDD and OMC were conducted by mixing the admixtures to the soil with varying percentages.

The above results showed that, for Cement, GGBFS, and Metakaolin the maximum value of MDD was achieved at 30%percentage. Fly ash and silica fume showed the maximum value of MDD at 10% whereas Rice husk ash showed the maximum MDD value at 20%.Hence the shear parameters and the CBR value for stabilized soil was found only for the optimum value of MDD achieved. The following are the test results for the stabilizers at their maximum MDD value. Test Results showing the shear parameters and CBR values at their corresponding percentages at which optimum value of MDD achieved.

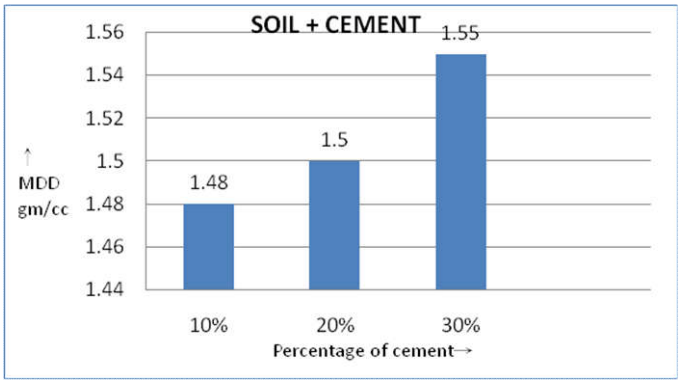

Figure 1. Shows MDD v/s varying percentage of cement. From the test results the maximum value of MDD was achieved at 30% of cement content. Here 30 % of cement is the maximum percentage of admixture considered

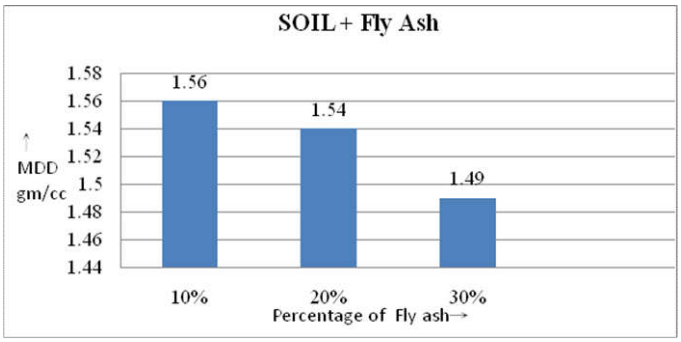

Figure 2. Shows MDD v/s varying percentage of fly ash. The graph shows the maximum MDD was achieved at initial percentage i.e. 10% of fly ash content. Further increase in the percentage of fly ash, there is decrease in MDD

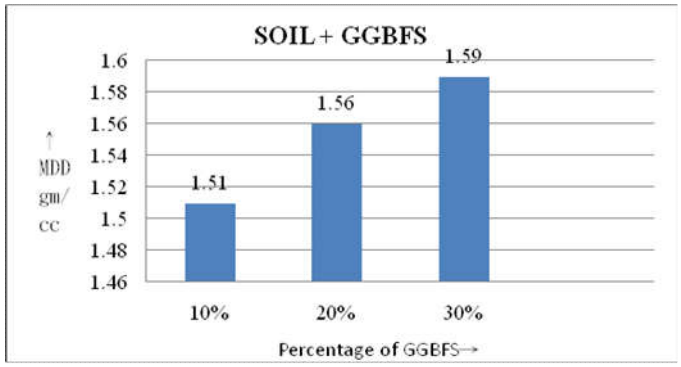

Figure 3. Shows MDD v/s varying percentage of GGBFS. From the test results it is observed that for 30% of GGBFS content, the MDD is maximum

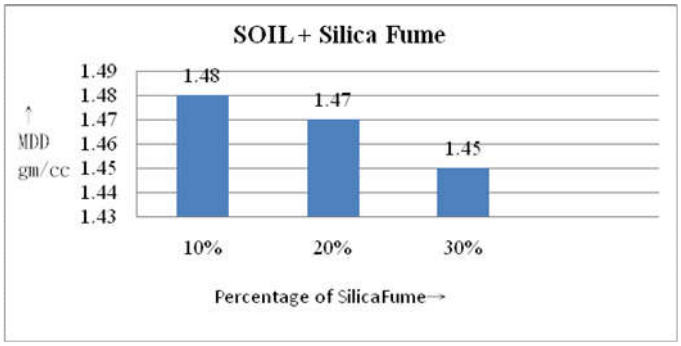

Figure 4. Shows MDD v/s varying percentage of Silica fume. Here the maximum MDD was achieved at 10%.Hence further increase in the percentage of admixture, the MDD decreased

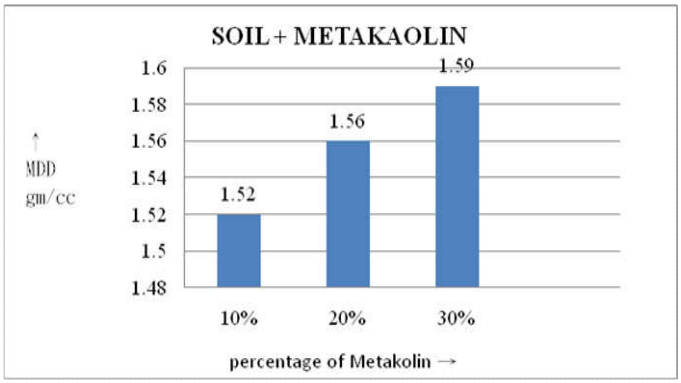

Figure 5. Shows MDD v/s varying percentage of Metakaolin .Here the results showed that at 30% of admixture, the MDD achieved was maximum, which is the maximum percentage under consideration

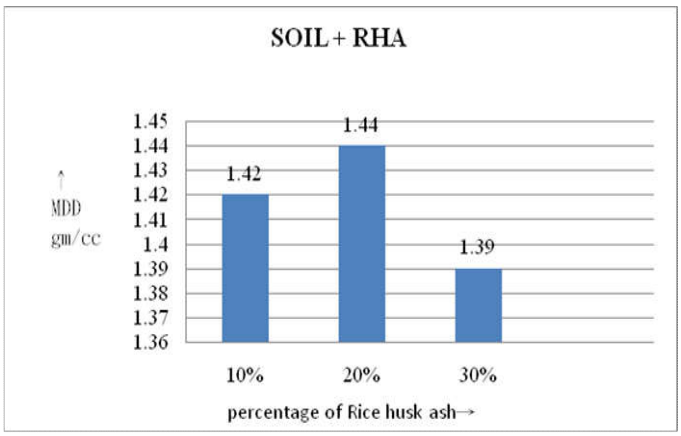

Figure 6. Shows MDD v/s varying percentage of rice husk ash. Among all the six admixtures considered, the rise husk ash showed the maximum MDD value at 20%, but if the percentage of RHA increased, there was decrease in the MDD

Table 2 to7. Shows the shear parameters and CBR values for un-soaked and soaked stabilized samples at their corresponding optimum values of MDD. The results showed the considerable increase in the CBR values of all the stabilized soil samples and also theC-Φ values which help in increasing the strength of the soil.

Table 2.

% of soil + admixtures	Direct shear test		CBR Test			
	C		Unsoaked		soaked	
	kg/Cm²	ϕ	2.5mm	5mm	2.5mm	5mm
70% soil+ 30% cement	0.25	22°	11.98	10.6	3.58	3.16

Table 3.

% of soil + admixtures	direct shear test		cbr test			
	C		Unsoaked		Soaked	
	kg/Cm²	ϕ	2.5mm	5mm	2.5mm	5mm
90% SOIL+10% FLY ASH	0.375	33	11.24	11.2	2.40	2.14

Table 4.

% Of soil + admixtures	Direct shear test		Cbr test			
	C		Unsoaked		Soaked	
	kg/Cm²	ϕ	2.5mm	5mm	2.5mm	5mm
70% SOIL+ 30% GGBFS	0.22	25°	4.30	3.94	4.30	3.69

Table 5.

% Of soil + admixtures	Direct shear test		Cbr test			
	C		Unsoaked		Soaked	
	kg/Cm²	ϕ	2.5mm	5mm	2.5mm	5mm
90% SOIL+ 10% Silica fume	0.2	13°	12.55	10.9	2.40	2.38

Table 6.

% Of soil + admixtures	Direct shear test		Cbr test			
	C		Unsoaked		Soaked	
	kg/Cm²	ϕ	2.5mm	5mm	2.5mm	5mm
70% soil+ 30%Metakoaline	0.3	31°	10.03	9.12	3.23	3.15

Table 7.

% Of soil + admixtures	Direct shear test		Cbr test			
	C		Unsoaked		Soaked	
	kg/Cm²	ϕ	2.5mm	5mm	2.5mm	5mm
80% SOIL+ 20% RHA	0.15	28°	10.94	9.5	2.56	2.19

Conclusion

- From the above results it can be concluded that the properties of the soil can be improved by stabilization process
- Among the six admixtures, cement, GGBFS and Metakaolin are the one which showed maximum dry density at their optimum level that is 30%.
- Fly ash and Silica fume also showed the improvement in their properties but at 10%
- RHA showed its maximum MDD at 20%
- Similarly the improvement in the shear parameters and CBR values were observed at their respective optimum values.
- Hence it can be concluded that the mixture of Cement,GGBFS,Metakaolin can be used in the stabilization process

REFERENCES

Chhaya Negi, R.K. Yadav, A.K. Singhai, 2013. "Effect of Silica Fume on Engineering Properties of Black Cotton Soil International *Journal of Computational Engineering Research,* Vol, 03, Issue, 7, Issn 2250-3005.

Hanifi Canakci a, Aram Aziz b and Fatih Celik, 2015. "Soil stabilization of clay with lignin, rice husk powder and ash" *Geomechanics and Engineering,* Vol. 8, No. 1, 67-79 September 17, 2014)

Manjunath S. Sharanappanavar, Shruti Byadgi, Priya Bhosale, Swati Nooli, Snehal Hindalkar, Savitri Khot, 2017. "A Study on Influence of GGBFS, Egg Shell Powder and Solid Waste Incinerated Ash to Improve the Index Properties of Black Cotton Soil" *International Journal of Engineering Technology Science and Research IJETSR,* ISSN 2394 – 3386 Volume 4, Issue 6.

Rathan Raj R, Banupriya S. and Dharani R. 2016. "Stabilization of soil using Rice Husk Ash"IJSTE - *International Journal of Science Technology and Engineering,* Volume 2, Issue 12, ISSN (online): 2349-784X.

Shivangi Bharadwaj, Dr. M. K. Trivedi, 2017. "Impact of Micro Silica Fume on Engineering Properties of Expansive Soil" *International Journal of Engineering Technology Science and Research,* IJETSR www.ijetsr.com ISSN 2394 – 3386 Volume 4, Issue 6.

****