

An Experimental Study On Soil Stabilisation Using Composite Stabilizing Agents

Dr.J.Premalatha¹ M.Vignesh Kumar² T.Nithya³

¹Professor & Head of the Civil Engineering,

^{2,3}Final Year BE-Civil Engineering students, Kumaraguru College of Technology, Coimbatore.
Kumaraguru College of Technology,
Coimbatore-49.

ABSTRACT

Present study deals with the stabilization of black cotton soil which is highly prone to settlement. It involves the stabilization of soil with admixtures, lime, quarry dust and fly ash. The concentration of lime is kept constant as 6% but the quarry dust and fly ash quantities are varied by 5% in every test sample. The maximum concentration of quarry dust is 25% and for fly ash it is 20%. It involves the study of behavior of the sample under varying concentration of admixtures and the increase in the strength of the sample. The classification of soil and its testing are done in accordance with the Indian Standard code IS 2720 - 1985. The bearing capacity of the samples is determined by the California Bearing Ratio test. The sample showed the improved stability and bearing capacity with the addition of sustained amount of admixtures and the test results showed that lime, fly ash and quarry dust can be used together as an effective stabilizing agent to increase the load resisting capacity of the clay sample.

Keywords:

I. INTRODUCTION

Government of India is planning a new corridor electric trucks and proposals for new road projects connecting different parts of the country. The NHAI is bidding to develop two lane highways to multilane highways. So the future sees a vast investment in the road construction. These proposed roads lies in different soil conditions, some under severe clayey conditions such as those in the areas like Pattikad, Mannuthy where the development of NH47 is going on. So there is a necessary to stabilize these clayey conditions with very effective soil stabilization technique which is economical as well. Various methods can be employed to stabilize the soil like De-watering, Compaction, providing Reinforcements etc., but the most economical way is the usage stabilizing agents, especially in case of Roads. Clayey soil gets its expansive nature due to the presence of minerals like illite, montmorillonite, chlorite, hallosite, and smectite. The swelling and shrinkage nature of the Black Cotton Soil leads to various failures in pavements. And hence altering such properties would effectively yield a stratum which can be subjected to higher loads. Many attempts were made to stabilize the soil sample, lime being the most commonly used admixture. We have

conducted experiments to study the behavior of BC soil with the usage of a composite mixture of admixtures. The percentage of lime is fixed at 6% as per previous studies, and the behavior is studied with varied percentages fro quarry dust and fly ash.

& Normal)This document is a template. An electronic copy can be downloaded from the conference website. For questions on paper guidelines, please contact the conference publications committee as indicated on the conference website. Information about final paper submission is available from the conference website.

II. MATERIALS

A. SOIL SAMPLE

The soil sample is collected from Kumaraguru College of Technology, Coimbatore, TamilNadu. The top soil stratum is dug up to 1m depth and the samples are collected. In order to classify the soil sample the Indian Standard Code IS24720-1985 is referred.

B. LIME

Powdered Lime is collected directly from kilns near Kumaraguru College of Technology. The composition of powdered lime is listed below in Table 1.

C. FLYASH

Fly ash is a waste material obtained as a result of coal combustion. Fly ash is bought from the local market. The percentage variation of fly ash is 5%, 10%, 15 % and 20%. The composition of Fly ash is listed below in Table 2.

D. QUARRY DUST.

Quarry dust is waste material that is available in abundance. It is obtained from aggregate crusuing industries. The percentage variation for quarry dust is 5%, 15%, and 25%. The sample is collected from the local market. The composition of Quarry Dust is listed below in Table 3.

III. TABLE I
PROPERTIES OF LIME

Calcium Oxide, CaO (%)	73.22
Loss on Ignition, LOI (%)	24.35

Magnesium Oxide, MgO (%)	0.74
Ferric Oxide, Fe2O3 (%)	0.17
Aluminium Oxide, (%)	0.11
Calcium Sulphate, CaSO4 (%)	0.12
Phosphorus Oxide, P2O5 (%)	0.08

**IV. TABLE III
PROPERTIES OF FLY ASH**

Specific gravity, G	2.05
Bulk Density g/cm ³	1.51
4 OMC (%)	24.5
AASHTO Classification	A-4
Absorption (%)	1.9
Max Dry Density g/cm ³	12.4

**V. TABLE IIIII
PROPERTIES OF QUARRY DUST**

Specific gravity, G	2.75
Bulk Density g/cm ³	1.8
Max Dry Density g/cm ³	1.97
AASHTO Classification	A-4
Absorption (%)	1.5
Specific gravity, G	2.75

VI. EXPERIMENTS

The following experiments were conducted to study the behavior of sample.

Liquid Limit(LL)-IS2720 PART V-1985, Plastic

Limit(PL)-IS2720 PART VI-1985, Specific Gravity

test- IS 2720 PART III-1985, Shrinkage limit (SL)

Free Swell Index, Gradation (Sieve Analysis),

Hydrometer analysis, Modified Proctor Compaction

test- IS 2720 PART VIII-1985, Unconfined

Compaction Test and California Bearing Ratio

(CBR)test-IS 2720 part XVI-1987.

RESULTS AND DISCUSSIONS

Sieve analysis

TRIAL 1:

IS sieve size (mm)	Wt. Retained in each sieve (g)	% retained in each sieve	Cumulative % retained on each sieve	% finer
4.75	0.012	2.4	2.4	97.6
2.36	0.064	12.8	15.2	84.8
1.18	0.086	17.2	32.4	67.6
0.6	0.16	21.2	53.6	46.4
0.3	0.106	21.2	74.8	25.2
0.15	0.062	12.4	87.2	12.8
0.075	0.05	10	97.2	2.8
Pan	0.014	2.8	100	0

TRIAL 2:

IS sieve size (mm)	Wt. Retained in each sieve (g)	% retained in each sieve	Cumulative % retained on each sieve	% finer
4.75	0.01	2	2	98
2.36	0.082	16.4	18.4	81.6
1.18	0.102	20.4	38.8	61.2
0.6	0.114	22.8	61.6	38.4
0.3	0.096	19.2	80.8	19.2
0.15	0.058	11.6	92.4	7.6
0.075	0.028	5.6	98	2
Pan	0.01	2	100	0

$$C_u = D_{60}/D_{10} = 1.064/0.148 = 7.19$$

$$C_c = D_{30}^2/(D_{60} * D_{10}) = 0.416^2 / (1.064 * 0.148) = 1.098$$

SIEVE ANALYSIS FOR QUARRY DUST:

Weight of the sample taken = 1 Kg

Specific gravity

TRIAL	W ₁ (Kg)	W ₂ (Kg)	W ₃ (Kg)	W ₄ (Kg)	G _s
1	0.678	1.234	1.863	1.512	2.71
2	0.678	1.244	1.871	1.512	2.73

**VII. TABLE IVII
CBR TEST RESULTS**

CLAY SAMPLE	CBR=4.4 Liquid limit-26.85 OMC=23 Plastic limit-3.85					
	Lime	Fly ash	Quarry dust	OMC %	CBR %	Liquid limit
6	5	5	24	5.3	20.69	26.32
	5	15	21	6.7	15.45	14.63
	5	25	17	12.8	18.62	15.38
	10	5	22	6.0	21.66	19.47
	10	15	23	4.6	20.15	17.07
	15	5	21	9.1	8.834	14.66
	15	15	23	4.5	7.90	18.75
	20	5	24	4.6	22.76	18.28

CONCLUSION

The experimental study on behavior of black cotton soil is successfully completed and the following inferences were made:

- It is found that cohesive nature of BC soil decreases with increase in quantity of Quarry dust.
- The optimum moisture content for the sample mixture containing 6% lime, 5% fly ash and 25% quarry dust is found to be 17% which is comparatively lesser as when compared to normal sample being 23%.
- The CBR value for the same is found to be 3 times the sample obtained.
- This reaction is obtained as a result of pozzolanic interaction between lime, flyash and quarry dust with the clay minerals.
- As per IRC recommendations this sample mix can be employed for stabilizing rural roads, in subgrade.

In comparison IRC-37, the flexible pavement thickness can be reduced up to 45% of its original thickness. Thus the stabilization when adopted for flexible pavement would be cost efficient and effective.

ACKNOWLEDGMENT

The fulfillment of the project will not be attained unless we thank the people who contributed to it. We extend our sincere thanks to Prof.G.Manikandan, Assistant professor,R.Karthikeyan,supporting staff, Civil Engineering Department, Kumaraguru College of Technology for his continuous support and guidance.

We also would like to thank Mr.VinayalPrem and Mr.R.Sathish Kumar, Student, Kumaraguru College Of Technology, for their support and contribution.

References

1. Reference Journal:” Weak Soil Stabilization using Different Admixtures- A Comparative Study” International Journal of Engineering Research & Technology (IJERT),ISSN: 2278-0181, IJERTV3IS100068
2. IS.2720.4.1985 (Methods of test for soils)
3. Reference Journal: “ EFFECT OF LIME AND STONE DUST IN THE GEOTECHNICAL PROPERTIES OF BLACK COTTON SOIL “Int. J. of GEOMATE, Dec., 2014, Vol. 7, No. 2 (Sl. No. 14), pp. 1033-1039, Geotech., Const. Mat. and Env., ISSN:2186-2982(P), 2186-2990(O), Japan.
4. Reference Journal:”Effect of Stone Dust On Some Geotechnical properties Of Soil”IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 12, Issue 1 Ver. I (Jan- Feb. 2015), PP 61-64
5. Reference Journal: “Study on Behavior of Expansive Soil Treated With Quarry Dust”ISSN: 2277-3754 ISO 9001:2008 Certified International Journal of Engineering and Innovative Technology (IJEIT) Volume 4, Issue 10, April 2015