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Stabilization of Black Cotton Soil Using Lime and Coconut Shell Ash

Sharanakumar[1], Supritha G[2], Tannu Rajput[3], Lalith srinivas[4]

[1]*Assistant Professor, Department of Civil Engineering, GCEM,Bangalore*
[2,3,4.] *UG Students Department of Civil Engineering, GCEM,Bangalore*

Abstract - *Expansive soil denote clayey soil has the tendency to swell or shrink depending on its moisture content, due to its expansive characteristics of soil. The structures constructed on this may develop cracks in due course of time. It is essential to stabilize such soils, prior to any construction work to improve its engineering properties. At present waste materials like stone dust from crushers, coconut shell ash and Lime from industry are in abundance at various parts of our society. This paper deals with feasibility study carried out to find the suitability of using materials like coconut shell ash and Lime. Tests like CBR is performed on the soil samples by using coconut shell ash and Lime mixed with black cotton soil at different percentages. Coconut shell ash and lime are used to improve the strength of black cotton soil. In addition, as a further step, the innovative material is used for stabilization, this study endeavor is industrial waste material like electric arc furnace and lime fine for the soil improvement.*

Key Words: **Expansive soil, CBR, coconut shell ash, lime, Stabilization.**

1. INTRODUCTION

The rising populace of the world, particularly agricultural countries has prompted expanding interest for streets, rail lines, lodging offices and different foundations. Soil with higher steadiness is expected to bear the heaviness of these designs; by and large, security of any development related structure in a roundabout way or straightforwardly relies upon the dirt soundness. Sweeping soils swell or expansion in volume in rainstorm seasons on imbibition of water, and psychologist or lessen in volume due to dissipation of water in dry seasons. Because of the substitute expanding and shrinkage of sweeping soils, designs, for example, establishments, asphalts and private structures and so on developed on it encountered extreme harm. The target of far reaching soil adjustment might be to settle volume change qualities, alter pliancy and further develop usefulness, or adjust versatility and volume change attributes while significantly further developing strength. For the most part, engineers expect to accomplish the last one on the grounds that the sub grade layer should not exclusively be volumetric stable, yet should likewise uphold traffic or building loads. The issue then becomes what convention to involve to accomplish adjustment and how to approve adjustment in dirt soils Compacting in-situ soil blended in with concrete slurry is a broadly involved soil improvement strategy for far reaching soil that is in generally a dry state. The upside of this strategy is that satisfactory strength is accomplished in a brief timeframe.

2. LITERATURE REVIEW

Balarabe Wada Isah and S. Mary Rebekah Sharmila (2012) [1] Soil Stabilization Using Calcium Carbide Residue and Coconut Shell Ash

Calcium rich and silica rich waste materials are bounteously accessible in numerous nations. These squanders finished in a waste dump there by contaminating climate and jeopardizing the existences of individuals living inside the area. Calcium carbide buildup CCR and coconut shell debris CSA are such squanders produce as aftereffect of modern and agrarian exercises. Using these losses for adjustment purposes might bring about furnishing an item with satisfactory strength for development purposes. In this exploration, CCR and CSA were utilized in balancing out CI and CH soils, CCR was fixed at 4% and 6% in CI and CH separately utilizing file properties tests and afterward CSA was shifted (i.e., 4, 9, 14, and 19%). Standard delegate test results showed general diminishing in MDD values and expansion in OMC values which might be clear as the particular gravity of the added substances is not exactly that of the dirt. Likewise, UCC test results showed a colossal improvement in the strength of both the dirts with the improvement of up to 11.38 and 6.03 times the strength of the virgin soils at 7 days restoring period with mix of S1+4%CCR+4%CSA and S2+6%CCR+4%CSA separately. Consequently CCR and CSA can be utilized for extensive soil adjustment subject to additionally explores.

Athira T, Ashish Johnson, Sowmya V Krishnankutty (2012) [2] Expansive Soil Stabilization using Coconut Shell Powder and Lime

Far reaching soils signify clayey soil that have the inclination to enlarge as well as to recoil while the predominant dampness condition is permitted to change. There are different strategies for working on the properties of extensive soil. The principal objective of this paper is to research the viability of coconut shell powder and lime in balancing out the extensive soil gathered from Chittoor of Palakkad area, Kerala. Coconut shell powder (CSP) and lime are normally accessible materials and are additionally

efficient. This paper presents the improvement of compressive strength of far reaching soil when settled with various doses of coconut shell powder (0%, 3%, 6%, 9% and

12%) and lime (3%, 6% and 9%). The tests were led for different measurements of coconut shell powder and lime subsequent to relieving times of 0, 7 and 28 days to concentrate on the drying and wetting properties. From the outcomes we surmised that coconut shell powder and lime are compelling in working on the properties of extensive soil.

3. MATERIALS AND METHODOLOGY

3.1 BLACK COTTON SOIL

Dark cotton soil can be named as sweeping soil. The exploration on dark cotton soil is need on account of the expanding and shrinkage capacity. As of late considerate specialists are dealing with additional on location issues with dark cotton soil. The dark cotton soil is by and large generally tracked down in bone-dry and semi-parched locales on the planet. It is tracked down in each state in India particularly in focal and Deccan level. Dark cotton soil has high compressibility, low bearing limit and low shearing strength. It is completed for adjustment of dark cotton soil like lime powder, iron powder and coconut shell debris. Broad soil is probably going to be unsaturated and has montmorillonite earth minerals. The majority of the dirt is available in and around Mumbai, Madras, Nagpur and, surprisingly, on the stream banks as dark cotton.

Figure-1 BLACK COTTON SOIL

Experiments	S1	S2	Unit
Liquid Limit	46	69	%
Plastic Limit	20.11	23	%
Plasticity Index	25.89	46	%
Shrinkage Limit	10.85	9.77	%
Specific Gravity	2.55	2.6	
Differential Free Swell	65	90	%
MDD	1.67	1.47	g/cc
OMC	18	24	%
UCC	0.8	1.4	g/cm^2
CBR	2.7	3.2	%
Gravel	0	0	%
Sand	25.75	17.7	%
Silt and Clay	74.29	82.2	%
IS Classification	CI	CH	

Table-1 : Index properties of BCS

The manufacture of Phenolic moulding powder, filler for synthetic resin glues etc.

3.2 COCONUT SHELL ASH

Kerala is the land of coconut trees. Coconut trees provide various advantages in which the influenceof Coconut shell ash is noticeable. Coconut shell ash is applied as a raw material for activated carbon industries, compound filter in

Figure-2 COCONUT SHELL ASH

3.3LIME

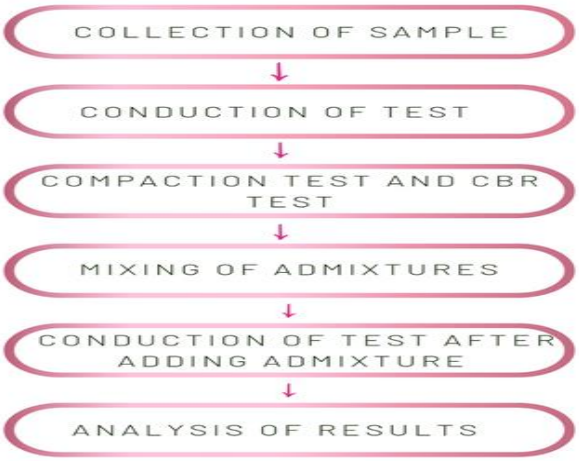
Lime is normally involved stabilizer for the adjustment of broad soil to control the enlarging and shrinkage properties because of climatic changes. Lime responds with extensive soil within the sight of water and changes the physio-compound properties of the dirt

Figure-3 LIME

Properties of Lime

Chemical Composition	Values
Silica	4.02%
Insoluble matter	5.64%
Ferric oxide	1.92%
Alumina	1.36%
Calcium	59.42%
Magnesia	0.92%
Loss on ignition	26.72%

4 METHODOLOGY



5. Test and Result

5.1 CBR test (CALIFORNIA BEARING RATIO)

Test sifters of gap sizes 20 mm and 5 mm.

A round and hollow, consumption safe, metal form, for example the CBR shape, having an ostensible inside measurement of 152±0.5 mm. The shape will be fitted with a separable base-plate and a removable expansion. The shape is displayed in Figure 4.3.3. The inside faces will be smooth, spotless and dry before each utilization.

A pressure gadget (load press) for static compaction, (for2.5 kg hammer). Even platens will be largeenough to cover a 150mm breadth circle and capableof an upward partition of at the very least 300 mm. The gadget will be fit for applying a power of something like 300 kN.

Metal fittings, 152±0.5 mm in breadth and 50±1.0 mm thick, for static compaction of a dirt example (for 2.5 kg hammer). A handle which might be in a bad way into the fittings makes evacuation more straightforward after compaction. The fundamental aspects are displayed in Figure 5.1.3. Three attachments are expected for 2.5 kg hammer

A metal rammer, (for 4.5 kg hammer). This shall be either the 2.5 kg rammer or the 4.5 kg rammer, both as specified, depending on the degree of compaction required. A mechanical compacting apparatus may be used provided that it also complies with the requirements of that document.

Figure-4 CBR TEST

- Strainer the example through 20mm IS sieve.Take 5 kg of the example of soil specimenAdd water to the dirt in the amount to such an extent that ideal dampness content or field dampness content is reached.
- Then soil and water are blended completely. Spacer circle is set over the base plate at the lower part of form and a coarse channel paper is set over the spacer disc.The arranged soil water blend is separated into five. The form is cleaned and oil is applied.
- Then fill one fifth of the form with the pre-arranged soil. That layer is compacted by giving 56 equitably circulated blows utilizing a mallet of weight 4.89kg.The top layer of the compacted soil is damaged.Again second layer is filled and process is rehashed. After third layer, collar is additionally appended to the form and interaction is continued.After fifth layer collar is taken

out and overabundance soil is struck off. Eliminate base plate and reverse the form. Then it is cinched to baseplate.

- Overcharge loads of 2.5kg is put on top surface of soil.Mold containing example is put ready on the testing machine. The entrance unclogger is gotten contactwith the dirt and a heap of 4kg(seating burden) is applied so that contact among soil and unclogger is laid out.
- Then dial readings are acclimated to nothing. Load is applied with the end goal that entrance rate is 1.25mm each moment. Load at entrance of 0.5, 1, 1.5, 2, 2.5, 3, 4, 5, 7.5, 10 and 12.5mm are notedsoil with 6% of coconut shell debris and 10% of lime, the CBR esteem we got 3.2 %.

5.3 CBR TEST VALUES:

CBR test was conducted on soil sample with various % of admixtures namely Lime and coconut shell ash, we have got following results

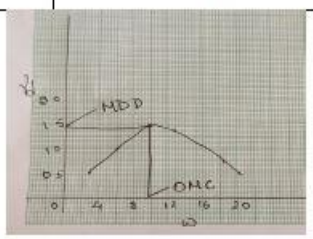
SL NO	% of Admixtures added	CBR in %
1	3 % OF CSA & 5% LIME	2.5
2	6 % OF CSA & 10% LIME	3.2
3	9 % OF CSA & 15% LIME	2.7

By seeing above table, we can conclude that, soil with 6% of coconut shell ash and 10% of lime, the CBR value we got 3.2 %

5.2 STANDARD PROCTOR TEST

5.2.1 3% OF CSA AND 5%OF LIME

SL.NO	DETERMINATION	1	2	3	4
1	WATER CONTENT %	10%	14%	18%	20%
2	MASS OF MOLD + COMPACTED SOIL=M_1	6664	6725	6795	6837
3	MASS OF MOLD (gms)=M_2	4944	4944	4944	4944
4	MASS OF COMPACTED SOIL=M_1-M_2	1720	1179	1851	1893
5	BULK UNIT WEIGHT OF COMPACTED SOIL γ_b=M/V in kN/m3	1.82	1.88	1.96	2.00
6	WATER CONTENT	16.3	18.8	19.4	22.8
7	DRY UNIT WEIGHT, $\gamma_d = \gamma b/(1+w)$ in kN/m^3	1.57	1.58	1.64	1.62

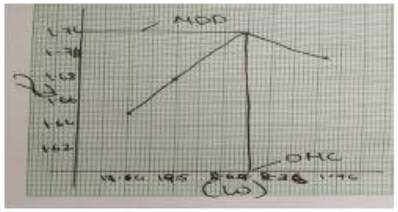


MDD=1.77
OMC= 1.22

Graph 01: 3% OF CSA AND 5% OF LIME

5.2.2 6% OF CSA AND 10% OF LIME

SL.NO	DETERMINATION	1	2	3	4
1	WATER CONTENT %	10%	14%	18%	20%
2	MASS OF MOLD + COMPACTED SOIL=M_1	6763	6828	6998	7634
3	MASS OF MOLD (gms)=M_2	4944	4944	4944	4944
4	MASS OF COMPACTED SOIL=M_1-M_2	1825	1280	1949	1997
5	BULK UNIT WEIGHT OF COMPACTED SOIL=M/V	1.92	1.98	2.06	2.16
6	WATER CONTENT	17.4	19.4	20.7	23.6
7	DRY UNIT , $\gamma_d = \gamma t/(1+w)$	1.65	1.68	1.76	1.72

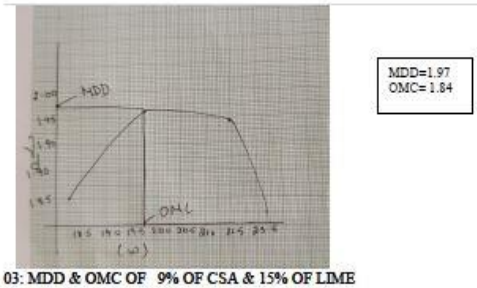


MDD=2.92
OMC= 1.25

Graph 02: MDD & OMC OF 6% OF CSA & 10% OF LIME

5.2.3 9% OF CSA AND 15% OF LIME

SL.NO	DETERMINATION	1	2	3	4
1	WATER CONTENT %	10%	14%	18%	20%
2	MASS OF MOLD + COMPACTED SOIL=M_1	6873	6848	7002	7730
3	MASS OF MOLD (gms)=M_2	4944	4944	4944	4944
4	MASS OF COMPACTED SOIL=M_1-M_2	1929	1904	2058	2786
5	BULK UNIT WEIGHT OF COMPACTED SOIL=M/V	2.04	2.01	2.41	2.78
6	WATER CONTENT	18.2	20.2	21.7	23.48
7	DRY UNIT , $\gamma d = \gamma t/(1+w)$ Kn/m^3	1.85	1.86	1.96	1.48



Graph 03: MDD & OMC OF 9% OF CSA & 15% OF LIME

3. CONCLUSIONS

- Since we know about the low dependability of dark cotton soil, we added promptly accessible and squander inferred admixtures such lime and coconut shell debris.
- Test were led on soil to track down it's record properties and CBR and compaction at different convergence of admixtures were led to track down ideal dry thickness and most extreme dry thickness.
- As we add 5% lime and 3% CSA we found the OMC is 17.7% and MDD is 12.2 kN/m3.
- As we add 15% lime and 9% CSA we found the OMC is 12.5% and MDD=29.2 kN/m3.

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BIOGRAPHIES :

Sharanakumar,
Assistant professor, Dept. of Civil Engineering GCEM,Bengaluru, Karnataka, India. 2023

"Ms.Supritha G, under Graduate Student of Civil Engineering, GCEM,Bengaluru,Karnataka, India-2023 "

"Mr.Lalith srinivas, under Graduate Student of Civil Engineering, GCEM,Bengaluru,Karnataka, India-2023 "

"Ms.Tannu Rajput, under Graduate Student of Civil Engineering, GCEM,Bengaluru,Karnataka, India-2023 "