Influence of Spent Bleaching Earth and Misspend Cement on Shear Strength Behaviour of Unsaturated Clays

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ABSTRACT

Expansive clay is a major source of undulations induced in any type of structures. Swelling of expansive soils causes serious problems and produces harm to many structures. Many research organizations are doing extensive work on waste materials concerning the viability and environmental suitability. Spent bleaching earth and misspend cement are waste derivatives from oil industry and cement warehouse. To avoid dumping problem and storage problems, it is the best method technique applied in expansive soils. Attempts are made to investigate the stabilization process identified in unconfined compressive strength and tri-axial compressive strength. Stability of any structure depends on strength properties of underground soil on which it is constructed. Structures basically transfer all the loads come on itself directly to the ground. If the underlying soil is not stable enough to support transferred loads then various types of failure occur such as settlement of the structure, cracks and so on. To solve this issue, soil improvement is necessary because it not only lowers the construction cost but also cuts the risk of any damage of structure later on. Numerous improvement methods can be adopted to make ordinary soil stable enough to support the structural loads. In this research work a number of tests may conduct using both ordinary soil and stabilised soil. This thesis explains the strength behavior of SBE treated black cotton soil reinforced with MC. The various percentage of SBE as 5%, 10%, 15%, 20% and 25% was used to find out the optimum value of RBI Grade. MC has been randomly included into the SBE treated soil at four different percentages of MC content, i.e. 2%, 4%, 6%, 8% and 10%.

KEYWORDS: Expansive soil, UCS, Tri-Axial, SBE and MC

I. INTRODUCTION

1.Expansive soils: Expansive soil is one among the problematic soils that has a high potential for shrinking or swelling due to change of moisture content. Expansive soils can be found on almost all the continents on the Earth. Destructive results caused by this type of soils have been reported in

many countries. In India, large tracts are covered by expansive soils known as black cotton soils. The major area of their occurrence is the south Vindhya range covering almost the entire Deccan Plateau. These soils cover an area of about 200,000 square miles and thus form about 20% of the total area of India. The primary problem that

arises with regard to expansive soils is that deformations are significantly greater than the elastic deformations and they cannot be predicted by the classical elastic or plastic theory. Movement is usually in an uneven pattern and of such a magnitude to cause extensive damage to the structures resting on them.

II. MATERIALS USED AND THEIR PROPERTIES

The details of the various materials used in the laboratory experimentation are reported in the following sections.

2.1. Expansive Soil: The soil used was a typical black cotton soil collected from muramalla East Godavari District, Andhra Pradesh State, India. The properties of soil are presented in the Table 3.1. All the tests carried on the soil are as per IS specifications. Table 3.1 shows the Properties of Expansive Soil.

Table 1: Properties of Expansive Soil

S no	Properties	Value		
1	Grain Size Distribution	Sand Size Particles 9%	Silt Particles 13%	Clay particles 78%
2	Specific gravity	2.68		
3	Differential free swell	148		
4	Atterberg's Limits	Liquid Limit 81.35%	Plastic Limit 31.35%	Plasticity Index 50.00%
5	IS soil classification	CH		
6	Compaction Properties	Optimum Moisture Content 20.55%		Max. Dry Density 15.22/m ³
7	California Bearing Ratio(CBR)	Un soaked C.B.R 2.58%		Soaked C.B.R 1.88%
8	Shear Strength Parameters	Cohesion 0.50kPa		Angle of Internal Friction 0.2Deg

2.2 Spent bleaching earth (SBE) is a solid waste generated from the bleaching process in palm oil

industry. This solid waste is currently disposed directly in landfills without treatment, causing severe water and air pollution. Which is collected from the oil industry near samalkota.

2.3 Waste cement: There are two kinds of waste: industrial waste and domestic waste. We focus on processing industrial waste at cement plants. We process domestic waste as well at some plants. ... After analysing the components of waste, waste can be effectively used as a substitute for cement feedstock or a substitute for thermal energy. Waste collected at jangareddygudem.

Fig: waste cement

2.4 Soil SBE Mixture with MC: The SBE treated Expansive soil is mixed with various percentage of MC as 2% to 10% with an increment of 2% to perform modified compaction test.

Table: 2 Expansive soil treated with SBE and MC and Obtained OMC & MDD Values

S.No.	Sample	OMC (%)	MDD (KN/m ³)
1	100% ES	20.55	15.22
2	100% ES + 20% SBE+2%MC	31	14.01
3	100% ES + 20% SBE+4%MC	33	13.68
4	100% ES + 20% SBE+6%MC	35.12	13.21
5	100% ES + 20% SBE+8%MC	36.23	13.01
6	100% ES + 20% SBE+10%MC	37.3	12.89

Fig: 1 Shows the OMC for treated with 20% SBE and different percentages of MC to the Expansive soil.

Fig:2 Shows the MDD for treated with 20% SBE and different percentages of MC to the Expansive soil.

Table 3 Expansive soil treated with SBE and MC and Obtained DFS Values

S.No.	Particulars	DFS %
1	100% ES	148
2	100% ES + 20% SBE	89
3	100% ES + 20% SBE+5%MC	82
4	100% ES + 20% SBE+10%MC	76
5	100% ES + 20% SBE+15%MC	71
6	100% ES + 20% SBE+20%MC	65
7	100% ES + 20% SBE+25%MC	61

Fig: 3 Shows the DFS for treated with 20% SBE and different percentages of MC to the Expansive soil

Table 4 Expansive soil treated with SBE and MC and Obtained Soaked & Un-soaked CBR values

S.No.	Particulars	CBR % (Un-Soaked)	CBR % (Soaked)
1	100% ES	2.58	1.88
2	100% ES + 25% SBE	5	4
3	100% ES + 20% SBE+2%MC	5.5	4.38
4	100% ES + 20% SBE+4%MC	6.2	4.98
5	100% ES + 20% SBE+6%MC	7	5.8
6	100% ES + 20% SBE+8%MC	8.5	6.6
7	100% ES + 20% SBE+10%MC	8.4	6.4

Fig: 4 Shows the Variation of Un-soaked CBR values with 20% of SBE and different percentages of MC

Fig: 5 Shows the Variation of Soaked CBR values with 20% of SBE and different percentages of MC

Table 5 Expansive soil treated with SBE and MC and Obtained UCS Values

S No	Particulars	Days UCS(kN/ m2)			
		0	7	14	28
1	100% ES	350	350	350	350
2	100% ES + 20% SBE	571	680	1001	1050
3	100% ES + 20% SBE+2%MC	740	880	970	1100
4	100% ES + 20% SBE+4%MC	950	1025	1200	1340
5	100% ES + 20% SBE+6%MC	1229	1350	1430	1570

6	100% ES + 20% SBE+8%MC	1340	1510	1740	1740
7	100% ES + 20% SBE+10%MC	1295	1440	1700	1720

Fig: 6 Shows the UCS for treated with 20% SBE and different percentages of MC to the Expansive soil

Table 6: Table showing shear strength parameters:

Materials added to the soil	Percentage of materials added to the soil	Shear strength properties (KPa)					
		1 day		7 days		14days	
		Cohesion, C_u (kg/cm ²)	Angle of internal friction, ϕ , (Deg.)	Cohesion, C_u (kg/cm ²)	Angle of internal friction, ϕ , (Deg.)	Cohesion, C_u (kg/cm ²)	Angle of internal friction, ϕ , (Deg.)
Without material	0	0.56	2°	0.56	--	0.56	--
SBE	2	0.61	3°	1.11	5°	1.28	6°
	4	0.72	5°	1.23	6°	1.32	7°
	6	0.65	6°	1.15	8°	1.26	7°
	8	0.63	7°	1.10	8°	1.24	8°
100%ES + 20% SBE + % MS	5	0.79	2°	1.25	4°	1.36	6°
	10	0.89	3°	1.28	5°	1.39	7°
	15	0.86	4°	1.25	5°	1.33	6°
	20	0.83	4°	1.34	6°	1.32	6°

III. CONCLUSIONS

- The results of Liquid Limit tests on expansive soil treated with different percentages of SBE can be seen that with increase in percentage of SBE the liquid limit of soil goes on decreasing from 81.35% to 60.21% when SBE is increased from 0 to 25%. The results of plastic Limit tests on expansive soil treated with different percentages of SBE can be seen that with increase in percentage of SBE the plastic limit of soil goes on decreasing from 31.55% to 50.85% when SBE is increased from 0 to 25%. The results of Plasticity Index of expansive soil treated with different percentages of SBE, it can be seen that with increase in percentage of SBE the plasticity Index of soil goes on decreasing from 50% to 9.36% when SBE is increased from 0 to 25%.
- The results of Compaction tests on expansive soil treated with different percentages of SBE

can be seen that with Decrease of MDD with the increasing addition of SBE, while the other side of OMC increasing. The MDD of soil goes on decreasing from 0% to 8% when SBE added at 20%. The results of Compaction tests on expansive soil treated with different percentages of SBE can be seen that with Decrease of MDD with the increasing addition of SBE, while the other side of OMC increasing. The OMC of soil goes on increasing from 0% to 42% when SBE added at 20%. The results of Compaction tests on expansive soil treated with 20% SBE and different percentages of MC can be seen that with Decrease of MDD with the increasing addition of MC and 20% SBE, while the other side of OMC increasing. The MDD of soil goes on decreasing from 0% to 14.58% when SBE added at 20% as shown in fig. 5.6. The results of Compaction tests on expansive soil treated with 20% SBE and different percentages of MC can be seen that with Decrease of MDD with the increasing addition of SBE, while the other side of OMC increasing. The OMC of soil goes on increasing from 0% to 76.30% when SBE added at 20% and 8% MC.

- The results of DFS tests on expansive soil treated with different percentages of SBE can be observed that the Decrease of DFS with the increasing addition of SBE. The DFS of soil goes on decreasing from 0% to 76.10% at added 20% SBE. The results of DFS tests on expansive soil treated with 20% SBE and different percentages of MC can be seen that the Decrease of DFS with the increasing addition of MC and 20% SBE. The DFS of soil goes on decreasing from 0% to 142% when SBE added at 10%.
- The results of CBR tests on expansive soil treated with different percentages of SBE can be seen that with increase of un-Soaked CBR with the increasing addition of SBE. The Un-Soaked CBR of soil goes on increasing from 0% to 93.70% by adding 20% SBE. The results of CBR tests on expansive soil treated with different percentages of SBE can be seen that with increase of Soaked CBR with the increasing addition of SBE. The Soaked CBR of soil goes on increasing from 0% to 91% when SBE. The results of CBR tests on expansive soil treated with 20% SBE and different percentages of MC can be seen that the increase of Un-Soaked CBR with the increasing addition of MC and 20% SBE. The Un-Soaked

CBR of soil goes on increasing from 0% to 229% when SBE added at 20% and different percentages of MC. The results of CBR tests on expansive soil treated with 20% SBE and different percentages of MC can be seen that the increase of Soaked CBR with the increasing addition of MC and 8% SBE. The Soaked CBR of soil goes on increasing from 0% to 251% when SBE added at 20% and different percentages of MC.

- The results of UCS tests on expansive soil treated with different percentages of SBE can be seen that the increase of UCS with the increasing addition of SBE. The UCS of soil goes on increasing from 0% to 200 for 28 days by adding 20% SBE. The results of UCS tests on expansive soil treated with 20% SBE and different percentages of MC can be seen that the increase of UCS with the increasing addition of MC and 20% SBE. The UCS of soil goes on increasing from 0% to 397% for 28 days when SBE added at 8% and different percentages of MC.

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