JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

STUDY OF COMPARATIVE EXPERIMENT ON EXPANSIVE SOIL BY STABILIZING MATERIAL GEOPOLYMER AND CEMENT MANUFACTURING DUST

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Abstract: Improvement of properties of expansive soil in terms of strength, durability and cost is the key from engineering point of view. The expansive soils could be stabilized using industrial waste. In paper present about study and comparison of properties of black cotton soil stabilized with the help of brick dust manufacturing waste (BDMW) & geopolymer as stabilizer. Brick dust manufacturing waste (BDMW) is industrial by-product. The disposal of this fine dust like brick dust manufacturing waste (BDMW) becomes a more difficult as environmental aspect and also, it's affected human nature as get suspended on air. In this paper we study about soil engineering properties with addition of geopolymer as stabilizer and brick dust manufacturing waste (BDMW) as stabilizer and compare in terms of soil properties like shear strength, swelling pressure and various engineering parameters like OMC& MDD, CBR value by conducting appropriate tests. With the help of above properties results we can Keeping in mind that the needs for bulk mass of solid waste can be utilized effectively, and also help to keeping good environment by using stabilizer as waste material.

***Index Terms*: Expansive soil, geopolymer stabilizer, Brick dust manufacturing waste (BDMW) stabilizer, soil stabilization, shear strength, OMC& MDD, CBR value, Black cotton soil**.

I. INTRODUCTION

Expansive soils are worldwide problem faced by civil engineer. It is extended nearly one-fifth of our country, chiefly in the states of Maharashtra, Gujarat, Madhya Pradesh, Uttar Pradesh, Rajasthan, Karnataka, Andhra Pradesh and Tamil Naidu. Expansive soils also call black cotton soil. The swelling pressure is considered as the most problematic challenge, because of the potential of swelling pressure is more danger of unpredictable upward movements of structures built at expansive soils. Any structure built on expansive soil may be subjected to large magnitudes of pressures due to development of swelling pressure when moisture content of clay increases. When moisture content of clay decreases settlement, problem creates in structure due to differential settlement structure became damage.

Now a days used for mineral stabilization of soils uses the stabilizer like lime and class-F fly ash, Portland cement, or other industrial by-products such as cement kiln dust. Physical stabilization techniques aim at reducing the potential of swell pressure and improve engineering properties like bearing capacity or others. In paper we focus on the comparative study of stabilizer 1 brick dust manufacturing waste (BDMW) and stabilizer 2 geopolymer and conclude the more effective stabilizer from both.

2. METHODOLOGY

2.1. INTRODUCTION

The purpose of this experimental study is to evaluate engineering properties of expansive soil without treated by stabilizer and with treated by stabilizer and conclude the results and comprised stabilizer.

2.2. MATERIAL USED

The clayey soil samples used in these studies are collect from Amreli (Gujarat). The soil is classified as CH soil according to Unified Soil Classification System. Index properties is shown in Table 1 and Chemical properties is shown in Table 2

Table 1 index properties of clayey soil

SR NO.	PROPERTIES OF SOILS	RESULTS
1	Liquid limit (%), LL	55
2	Plastic limit (%), PL	23
3	Plasticity index, PI	32
4	Shrinkage limits SL	100
5	% Free swell index	2.69
6	Specific gravity, G_S	01
7	% of Gravels	14
8	% of Sand	85
9	% of silt and clay	34
10	% of clay	51
11	% silt	16.50
12	OMC %	20.50
13	MDD gm/cm^3	1.56
14	Activity %	1.09
15	Type of soil	CH

Table 2 chemical properties of clayey soil

SR NO.	CHEMICAL PROPERTIES	RESULT
1	**P^H**	7.76
2	**EC**	274
3	**TDS**	212
4	**TSS**	20
5	**N**	0.64
6	**P**	0.44
7	**COD**	9
8	**$caco_3$**	109
9	**ca**	97
10	**mg**	5.7
11	**Na**	139
12	**K**	1.1
13	**cl**	172
14	**Co_3**	36
15	**So_4**	0.9
16	**Hco_3**	48
17	**F**	0.1

2.2.1 BRICK DUST MANUFACTURING WASTE.

Table 3 oxide concentration of brick

SR NO.	COMPOUND	CONTENT %WT
1	C_aO	62
2	SiO_2	22
3	Al_2O_3	05
4	Fe_2O_3	03

BDMW was collected from brick manufacturers. Which contain mainly helpful cementing component called calcium oxide (cao) commonly known as quicklime. Brick often also contains silicon oxide and smaller amounts of aluminum oxide, iron oxide.

2.2.2 GEOPOLYMER

The geopolymers are inorganic typical ceramic material, which have long range covalent bond non crystalline network. Generally volcanic glass is main component of geopolymer blends. Commercially geopolymer is used as fire and heat resistant coating and adhesive material. Here in this experiment the metakaolin based geopolymer is used. The chemical formula of this polymer is (Na-K)-(Si-O-Al-O-Si-O-), ratio Si: Al=2

3.0 TEST CONDUCTED.

Test conducted for the purpose to conclude the difference in soil property after stabilized by both stabilizer either in improved or need improvement. Test conducted are mostly major that the found those soil parameters which needed to improve in expansive soil, and also it gives results about improvement happen or not by utilizing the stabilizers.

3.1 SAMPLE PREPARATION.

Soil sample collected near Amreli city, soil sample collection is as per standard IS 2720 (part 1)-1983 and store it. The soil sample before testing, soil of sample mixed with stabilizer in different proportion as mention bellow.

3.1.1 SAMPLE 1 (BDMW)

The sample 1 prepared as direct mixed with BDMW by % weight of soil. The mixture proportion is also based on old research work carried out on it.

1 Sample: 10% BDMW mixed with soil
2 Sample: 15% BDMW mixed with soil
3 Sample: 20% BDMW mixed with soil

3.1.2 SAMPLE 2 LIME FLY ASH

The sample1 prepared as combination of Geopolymer. There are combination prepared based on literature and old research work carried out on the stabilization work.

1 sample: 10% Geopolymer by weight of soil.
2 sample: 15% Geopolymer by weight of soil.
3 sample: 20% Geopolymer by weight of soil.

3.2 TEST PERFORMEND.

1. Liquid Limit Test.
2. Plastic Limit Test.
3. Unconfined Compressive Strength Test.
4. CBR Test.
5. Standard Proctor Test.
6. Swelling Pressure Test.

4 TEST RESULTS.

Table 4 Test Results

SR NO	TEST PERFORMED	TEST RESULTS					
		10% Geopolymer SAMPLE 1	15% Geopolymer SAMPLE 2	20% Geopolymer SAMPLE 3	10% BDMW SAMPLE 1	15% BDMW SAMPLE 2	20% BDMW SAMPLE 3
1	LIQUID LIMIT TEST RESULST	42.3	40.1	40.2	47.50	46.41	44.12
2	PLASTIC LIMIT TEST RESULTS	20.75	18.78	16.27	26.10	25.00	22.21
3	OPTIMUM MOISTURE CONTENT (%)	20.62	20.00	21.12	24.50	23.23	22.78
	MAXIMUM DRY DENSITY (gm/cm^3)	1.62	1.89	1.92	1.55	1.78	1.83
4	UNCONFINED COMPRESIVE STRENGTH TEST (kN/m^2)	138.47	157.42	162.33	151.23	155.43	153.22
5	SHEAR STERNGTH OF SOIL (kN/m^2)	69.235	78.71	81.165	65.238	66.23	67.15
	CBR VALUE	2.91	3.74	3.89	2.71	2.82	2.86
7	SWELLING PRESSURE (kg/cm^2)	0.79	0.84	0.98	1.1	1	0.83

5 RESULTS COMPARISON

Soil property investigate above is now compare with both stabilizer effective proportion. For comparison of the test results the graph is plotted bellow is in form of **property investigated** Vs **sample series** (soil stabilizer mixed proportion mention above).

5.1 LIQUID LIMIT TEST RESULTS COMPARISON.

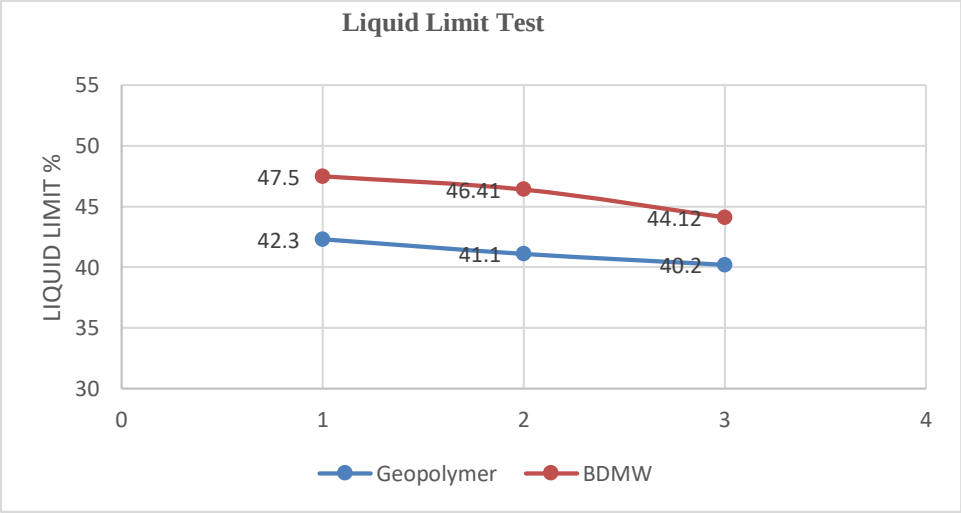

Chart 1 Liquid Limit Test

From the graph the clear image of effect on liquid limit of soil can carried out. The geopolymer more helpful to reduce liquid limit as compared to BDMW. Reduce in liquid limit change the state of compressibility of soil.

5.2 STANDARD PROCTOR TEST RESULTS COMPARISON.

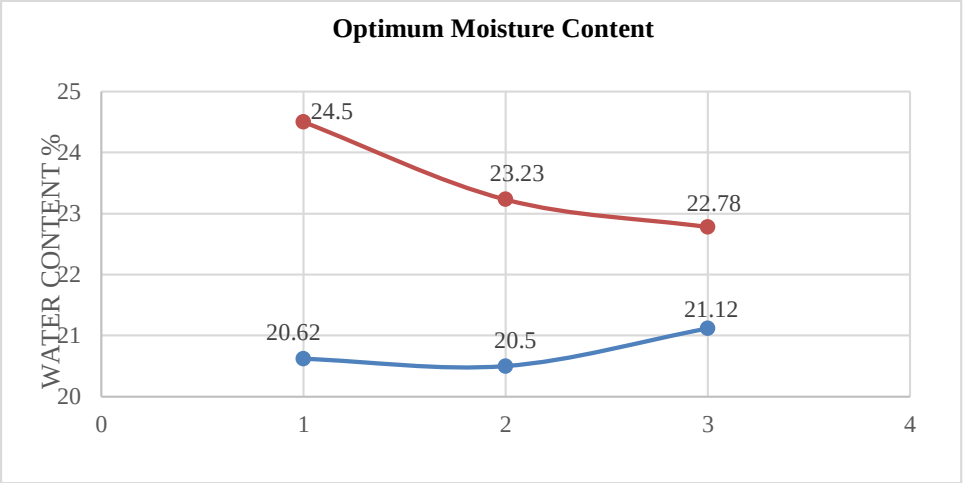

Chart 2 Optimum Moisture Content

Optimum moisture content has profile to tends to low some amount and after rise on increase of content of stabilizer. In the results the geopolymer also gives lower water content as compare to BDMW. Lower water content can also help in reducing swelling potential of expansive soil.

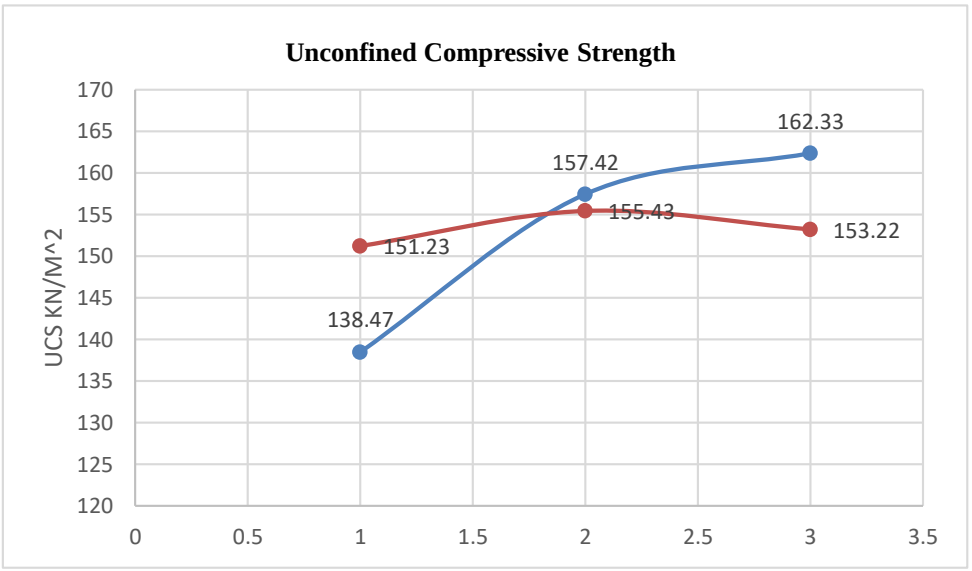

Chart 3 Maximum Dry Density

In compaction test the rise in maximum dry density shows while increase stabilizer content and constant after optimum dosage, in this experiment the results about sample 2 of both stabilizers give more MDD. Also geopolymer give little more dense results as compare to BDMW.

5.3 UNCONFINED COMPRESIVE STRENGTH TEST

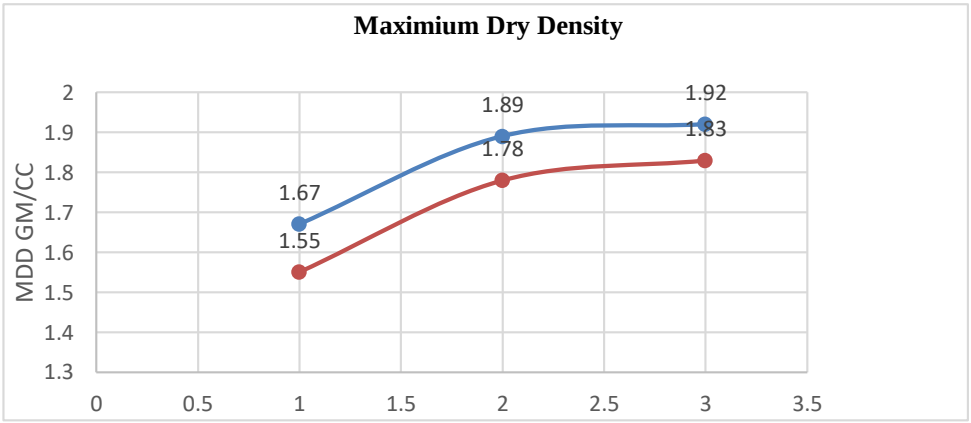

Chart 4 Unconfined Compressive Strength

Both stabilizers are similar in the results of UCS test. For cohesive soil shear strength is majorly depends on cohesion present between soil particles. So, the both stabilizers help to improve shear strength of soil as increase in UCS value.

6. CONCLUSION.

Basing on the above paper by usage of both stabilizers the soil will get stabilized. The main thing we have to observe is at what mixture proportion for which soil gives higher stabilization values. Above experimental work helps to conclude some important point as below.

1. Both stabilizers help to improve engineering properties of soil but some where the BDMW fails to give improvement as compare to Geopolymer
2. In result of liquid limit test the soil may have liquidity at fixed water content in geopolymer stabilizer as compare to BDMW stabilizer. The liquidity nature of soil responsible for its compressibility and loss in shear strength.
3. As per compaction test the soil is with stabilized with geopolymer little more dandified as compare to BDMW stabilized soil. While also geopolymer help to achieve MDD at little less water content as compare to BDMW stabilized soil.
4. In unconfined compression test there is no major response in increase in UCS value in increment of geopolymer content as stabilizer while other hand the quick response will be seen in BDMW mixture increment as shown in graph.
5. From above results and literature review we can sharply conclude that the geopolymer as little more favorable as compare to BDMW in soil stabilization process.

REFFERENCE

[1] Al-Mhaidib, Abdullah I. "Swelling Behaviour of Expansive Shales from the Middle Region of Saudi Arabia", Geotechnical and Geological Engineering Vol.16, pp. 291-307, 1999.
[2] Basma, Adnan A."Prediction of Expansion Degree for Natural Compacted Clays", Geotechnical Testing Journal, Vol.16, No.4, pp. 542-549, December 1993.
[3] Bishop, A.W. and Wesley, L.D. "A Hydraulic Trixie Apparatus for Controlled Stress Path Testing" Geotechnique Vol.25, No.4, pp. 657-670, 1975.
[4] Skempton, A.W., "The colloidal activityof clays", Proc. 3rd Int. Conf. on S.M. & F.E.,Zurich, Vol.1, pp 57-61, 1953.
[5] Rees, S.W. And Thomas, H.R.,“Simulating seasonal ground movement in unsaturated clay”, Jrl. of Geotech. Engg., ASCE Vol.119, pp 1127-1143,1993.
[6] Jennings, Snethen, D.R., "Characterization of expansive soil using soil suction data", Proc. 4th Int. Conf. on Expansive Soils, Vol.1, pp 54-75,1980
[7] Dr. Damyanti G Badagha.;” Utilization of Waste Materials to Produce Economical Concrete: Achived Goal for Environment Prevention & Sustainable Development”, journal of management research and analysis ISSN:2394-2770, volume 05 Issue 04, February 2019
[8] Dr. Robert M. Brooks.; “Soil Stabilization with Fly ash and Rice Husk Ash", International Journal of Research and Reviews in Applied Sciences ISSN: 2076-734X, EISSN: 2076-7366 Volume 1, Issue 3, December 2009
[9] Tara Sen and Umesh Mishra.;” Usage of Industrial Waste Products in Village Road Construction” International Journal of Environmental Science and Development, Vol. 1, No. 2, June 2010 ISSN: 2010-0264
Karthik.S, Ashok kumar.E, Gowtham.P, Elango.G, Gokul.D, Thangaraj.S ‘Soil Stabilization by Using Fly Ash
[10] Brackley, I.J.A., "A Model of Unsaturated Clay Structure and its Application to Swell Behaviour", Proc. of 6th Regional Conf. For Africa on Soil Mech. And Found. Engrg. Durban, South Africa, pp.71-79. 1975
[11] Brackley, I.J.A., "Swell Under Load",Pros. of 6th Regional Conf. For Africa on Soil Mech. And Found. Engrg. Durban, SouthAfrica, pp. 65-70, 1975.
[12] Katti, R.K. "Search for Solutions to Problems in Black Cotton Soils". Indian Geotechnical Journal, LG.S. Vol. 9, No.1, 1979