Using Brick Dust Manufacturing Waste and Cement Dust Manufacturing Waste as Stabilizing Material for Expansive Soil

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Abstract: Improvement of properties of expansive soil in terms of cost, durability and strength 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) & cement dust manufacturing waste (CDMW) as stabilizer brick dust manufacturing waste (BDMW) and Cement dust manufacturing waste (CDMW) are industrial by-product. Day by day increasing the cement bending material for infrastructure. The disposal of this fine dust like CDMW and brick dust manufacturing waste (BDMW) becomes a more difficult as environmental aspect and also it's affect human nature as get suspended on air. In this paper we study about soil engineering properties with addition of cement dust manufacturing waste (CDMW) 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. Assosiate professor

Index Terms **: Expansive soil, Cement dust manufacturing waste (CDMW) stabilizer1, Brick dust manufacturing waste (BDMW) stabilizer2, soil stabilization, shear strength, OMC& MDD, CBR value.**

I. INTRODUCTION

Expansive soils problem increase day by day in worldwide for civil engineering. It is extended nearly one-fifth of our country, chiefly in the states of, Gujarat Maharashtra, Madhya Pradesh, Uttar Pradesh, Rajasthan, Karnataka, Andhra Pradesh and Tamil Naidu. Black cotton soil is type of expansive. 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. Swelling pressure development due to moisture content of clay increases large magnitude of pressure act on structure built on expansive soil. When moisture content of clay decrease 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 (CDMW) and conclude the more effective stabilizer from both of them.

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 are collect from Amreli (Gujarat) which are used in this study. 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	58
2	Plastic limit (%), PL	22
3	Plasticity index , PI	36
4	Shrinkage limits SL	100
5	% Free swell index	2.61
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 %	20.70
13	MDD gm/cm^3	1.58
14	Activity %	1.07
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 smaller amount of aluminum oxide, iron oxide and Silicon oxide.

2.2.2 CEMENT DUST MANUFACTURING WASTE.

CDMW consists primarily of silicon dioxide and calcium carbonate which is similar to the cement kiln raw feed, but the amount of alkalis, sulphate and chloride is usually considerably higher in the dust. Many factors affect the chemical and physical properties of CDMW. With respect to raw material cement manufacturing plant operations differ considerably, type of process, dust collection facility, and type of fuel used the use of the terms typical or average CDMW when comparing different plants can be misleading. The dust from each plant can vary markedly in chemical, mineralogical and physical composition.

TABLE 4 OXIDE CONCENTRATION OF CDMW

SR NO.	COMPOUND	CONTENT %WT
1	SiO_2	0
2	CaO	51.30
3	Al_2O_3	4.85
4	Fe_2O_3	1.55
5	PH	11

CDMW was collected from Abuja cement factory at Kodinar, industry of cement production manly focus on ordinary Portland cement. Factory located at Ambujanagar, Ta Kodinar, dist Gir Somnath, Gujarat.

3.0 TEST CONDUCTED.

Test conducted to conclude the difference in soil property after stabilizing both stabilizer either in improved or need improvement. Test conducted are mostly to found those soil parameter which needed to improve in expansive soil, and also it gives results about improvement occurred or not by utilizing the stabilizers.

3.1 SAMPLE PREPARATION.

Soil sample collected near Amreli city, per standard IS 2720 (part 1)-1983 and store it. The soil sample before testing, 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 (CDMW)

The sample 2 prepared as direct mixed with CDMW by % weight of soil. The mixture proportion is also based on old research work carried out on it.

1 Sample: 10% CDMW mixed with soil

2 Sample: 15% CDMW mixed with soil
3 Sample: 20% CDMW mixed with 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

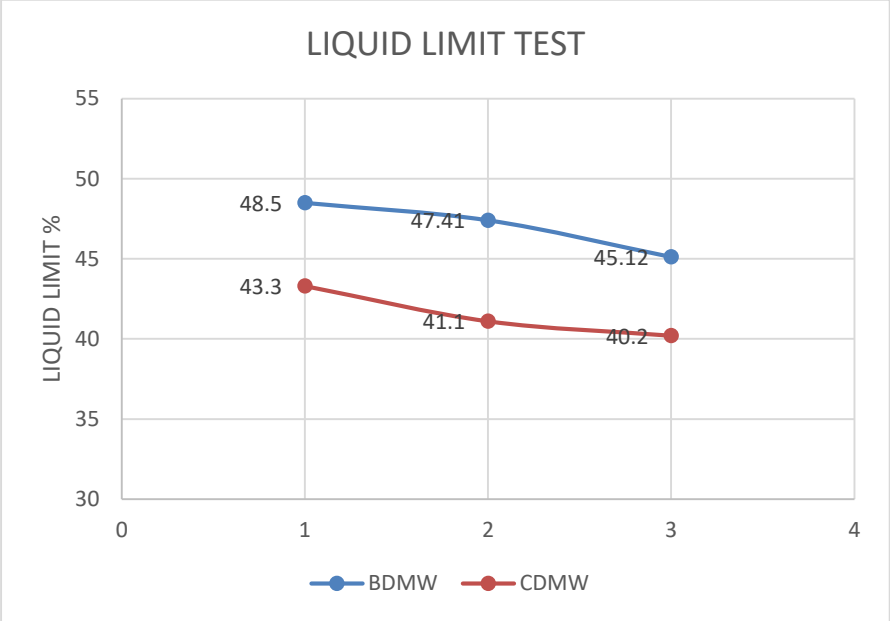
SR NO	TEST PERFORMED	TEST RESULTS					
		10% BDMW SAMPLE 1	15% BDMW SAMPLE 2	20% BDMW SAMPLE 3	10% CDMW SAMPLE 1	15% CDMW SAMPLE 2	20% CDMW SAMPLE 3
1	LIQUID LIMIT TEST RESULST	48.50	47.41	45.12	43.3	41.1	40.2
2	PLASTIC LIMIT TEST RESULTS	27.10	25.23	23.12	21.75	18.78	17.27
3	OPTIMUM MOISTURE CONTENT (%)	23.50	22.23	21.78	21.62	20.96	21.22
	MAXIMUM DRY DENSITY (GM/CM^3)	1.60	1.62	1.72	1.62	1.89	1.92
4	UNCONFINED COMPRESIVE STRENGTH TEST (kN/m^2)	137.50	138	142.2	138.47	157.42	162.33
5	SHEAR STERNGTH OF SOIL (kN/m^2)	65.238	66.23	67.15	69.235	78.71	81.165
6	CBR VALUE	2.71	2.8	2.86	2.9	3.74	3.89
7	SWELLING PRESSURE (kg/cm^2)	1.1	1	0.83	0.79	0.84	0.98

5 RESULTS COMPARISON

Soil property investigate above is now compared 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.

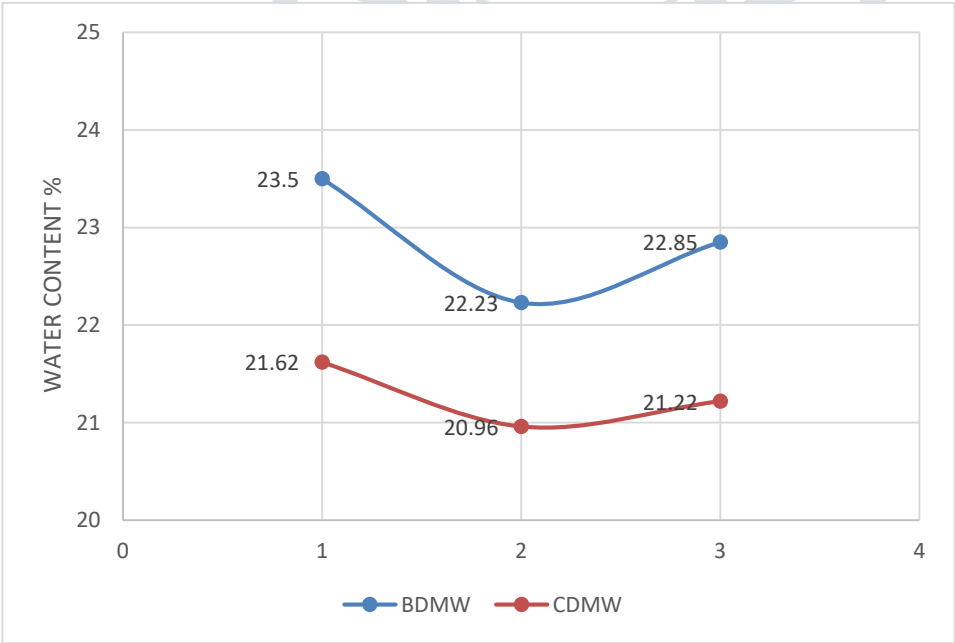
CHART 1 LIQUID LIMIT TEST



Clear image of liquid limit of soil is obtained from this graph. The cement dust stabilizer more helpful to reduce liquid limit as compared to BDMW. Reduce in liquid limit change the state of compressibility of soil.

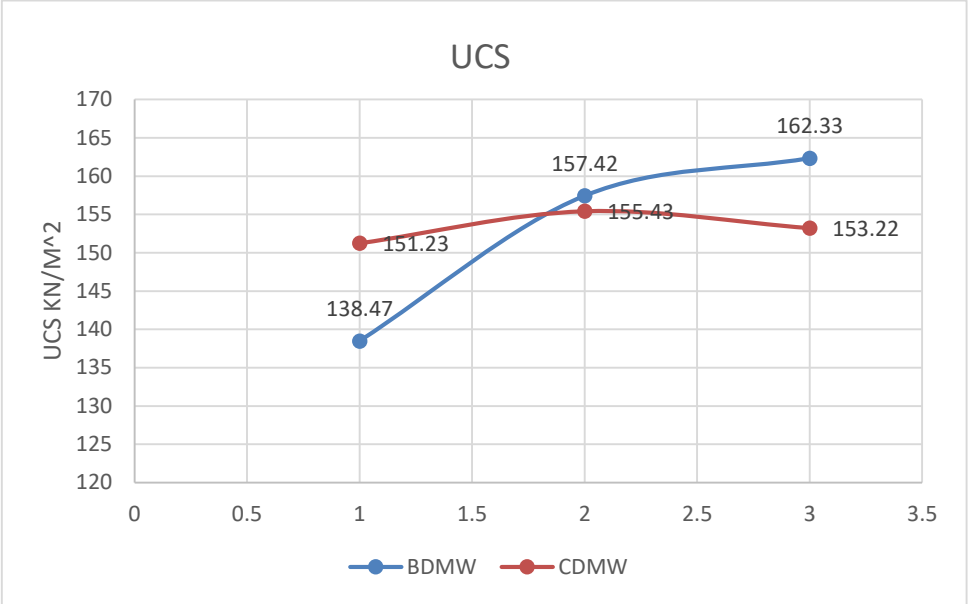
5.2 STANDARD PROCTOR TEST RESULTS COMPARISON.

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 CDMW also gives lower water content as compare to BDMW. Lower water content can also help in reducing swelling potential of expansive soil.

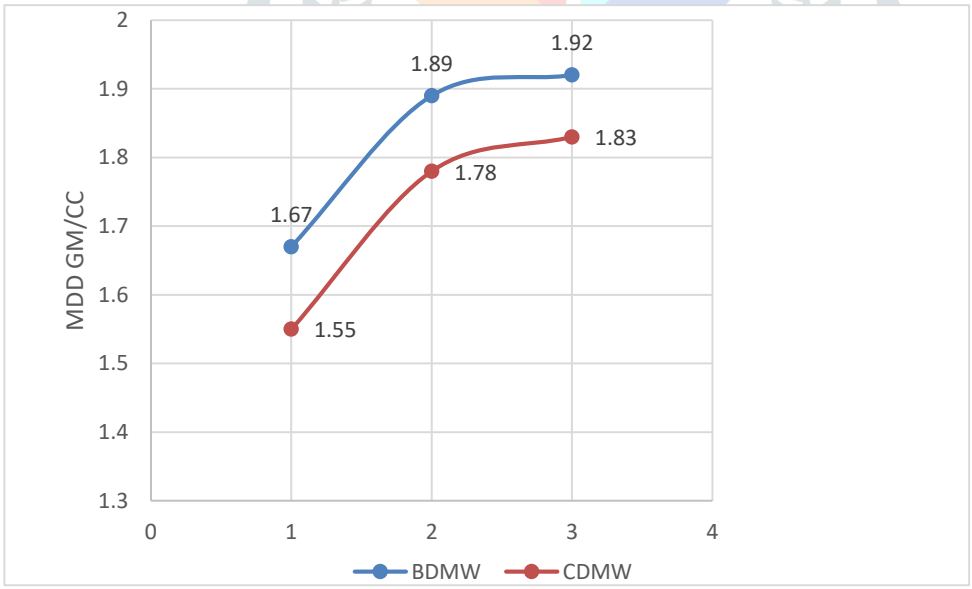
CHART 3 MAXIMIUM DRY DENSITY



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 stabilizer give more MDD. Also cement dust give little more dense results as compare to BDMW.

5.3 UNCONFINED COMPRESIVE STRENGTH TEST

CHART 4 UNCONFINED COMPRESIVE STRENGTH



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

6. CONCLUSION.

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

1. Both stabilizer help to improve engineering properties of soil, CDMW gives better improvement compared to BDMW.
2. In result of liquid limit test the soil may have liquidity at fixed water content in BDMW stabilizer as compare to CDMW stabilizer. The liquidity nature of soil responsible for it compressibility and loss in shear strength.
3. As per compaction test the soil is stabilized with CDMW little more densified as compare to BDMW stabilized soil. While also CDMW helps 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 BDMW content as stabilizer while other hand the quick response will be seen in CDMW mixture increment as shown in graph.
5. From above results and literature review we can sharply conclude that the CDMW as little more favorable as compare to BDMW in soil stabilization process.

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