Comparative Study on Effect of Expansive Soil Properties While Using Stabilizer as Lime Fly ash And Cement Dust Manufacturing Waste

Kinjal Rank[1] Jaydeep Bhanderi[2] Dr. J. V. Mehta[3] Shyamkumar Marsonia[4] Trivedi Harshraj[5]
[1]Assistant Professor, [2]Assistant Professor, [3]Assoaciate Professor, [4]Reserch Scholar [5]Reserch Scholar
[1]Civil Engineering Department,
[1]VVP Engineering College, Rajkot, India

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 lime fly ash as stabilizer & cement dust manufacturing waste (CDMW) as stabilizer Fly ash and Cement dust manufacturing waste (CDMW) are industrial by-product, Day by day increasing the rate of various infrastructure demand of cement binding mineral may increase rapidly. The disposal of this fine dust like CDMW and fly ash 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 lime fly ash 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, Cement dust manufacturing waste (CDMW) stabilizer1, lime fly ash stabilizer2, soil stabilization, shear strength, OMC& MDD, CBR value.**

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 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 (lime fly ash) 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

2.2.1. SOIL.

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.

TABLE 1 SOIL PROPERTIES

SR NO.	PROPERTIES OF SOILS	RESULTS
1	Liquid limit (%), LL	53
2	Plastic limit (%), PL	25
3	Plasticity index , PI	28
4	Shrinkage limits SL	18.5
5	% Free swell index	75
6	Specific gravity, G_S	2.63
7	% of Gravels	0
8	% of Sand	36
9	% of silt and clay	64
10	% of clay	28
11	% silt	36
12	OMC %	17.17
13	MDD gm/cm^3	1.7
14	Activity %	1
15	Type of soil	CH

2.2.2 LIME-FLY ASH.

TABLE 2 OXIDE CONCENTRATION OF FLY ASH

Lime:

SR NO.	COMPOUND	CONTENT %WT
1	SiO_2	61
2	CaO	7.20
3	Al_2O_3	19
4	Fe_2O_3	3.50

Industrial grade lime was purchased. Lime which contain mainly helpful cementing component called calcium oxide (cao) commonly known as quicklime, caustic and alkaline crystalline solid at room temperature. As a commercial product, lime often also contains magnesium oxide, silicon oxide and smaller amounts of aluminum oxide and iron oxide.

Fly ash (class F): Fly ash (waste material) was collected from Ambuja cement at Ambujanagar, ta Kodiar, dist Gir Somnath, Gujarat.

2.2.3 CEMENT DUST MANUFACTURING WASTE.

CDMW consists primarily of calcium carbonate and silicon dioxide which is similar to the cement kiln raw feed, but the amount of alkalis, chloride and sulphate is usually considerably higher in the dust. Many factors affect the chemical and physical properties of CDMW. Because cement manufacturing plant operations differ considerably with respect to raw material, 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 3 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 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 parameter 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 Rajkot 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 (LIME FLY ASH)

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

1 sample: 3% lime and 15% fly ash by weight of soil.
2 sample: 5% lime and 20% fly ash by weight of soil.
3 sample: 7% lime and 25% fly ash by weight of 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					
		3%LIME 15% FLYASH SAMPLE 1	5%LIME 20% FLYASH SAMPLE 2	7%LIME 25% FLYASH SAMPLE 3	10% CDMW SAMPLE 1	15% CDMW SAMPLE 2	20% CDMW SAMPLE 3

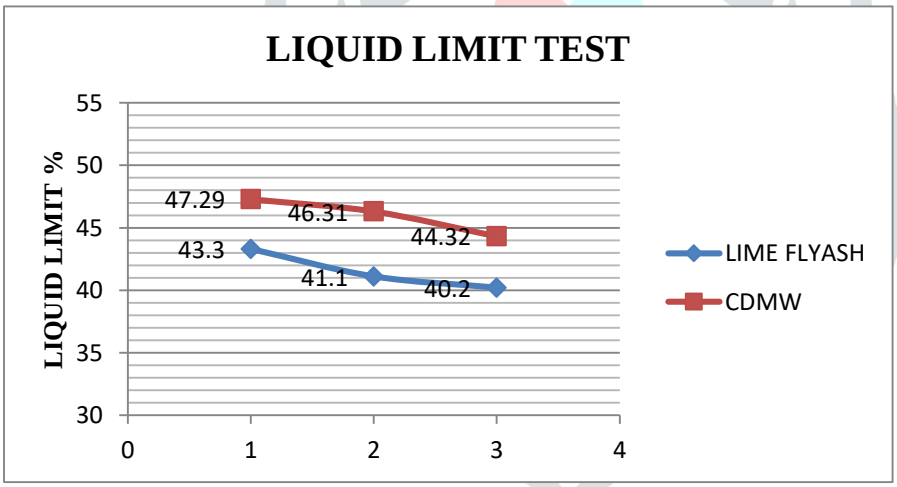
1	LIQUID LIMIT TEST RESULST	43.3	41.1	40.2	47.29	46.31	44.32
2	PLASTIC LIMIT TEST RESULTS	21.75	18.78	17.27	26	23	21
3	OPTIMUM MOISTURE CONTENT (%)	21.62	20.96	21.22	23.72	22.92	23.71
	MAXIMUM DRY DENSITY (GM/CM^3)	1.62	1.89	1.92	1.55	1.78	1.83
4	UNCONFINED COMPRESIVE STRENGTH TEST (kN/m^2)	138.47	157.42	162.33	151.23	155.43	153.22
5	SHEAR STERNGTH OF SOIL (kN/m^2)	69.235	78.71	81.165	75.615	77.715	76.61
6	CBR VALUE	2.9	3.74	3.89	2.76	3.67	3.78
7	SWELLING PRESSURE (kg/cm^2)	0.79	0.84	0.98	1.2	0.95	0.88

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.

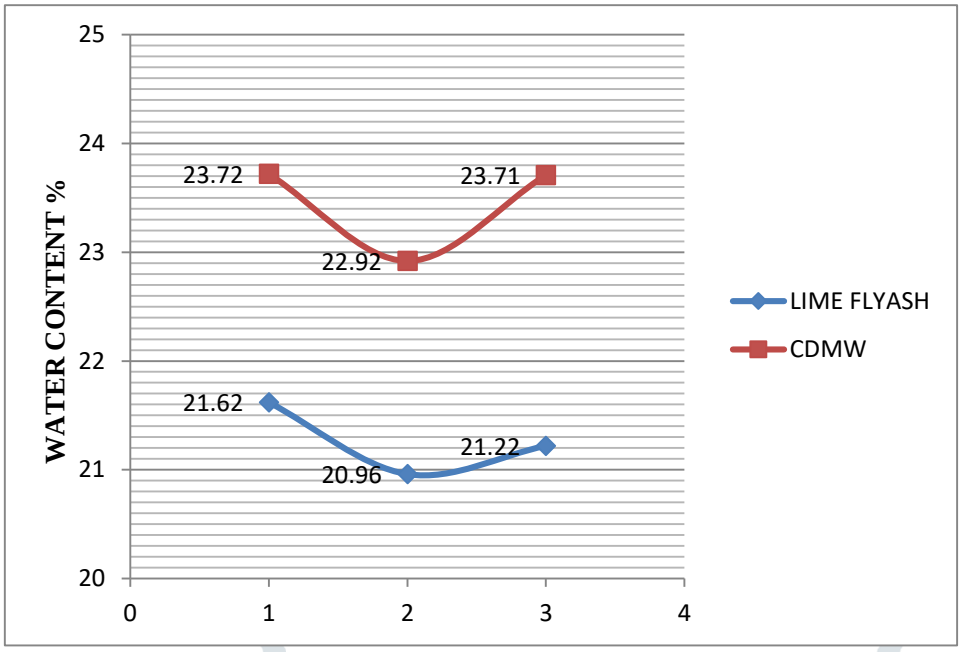
CHART 1 LIQUID LIMIT TEST



From the graph the clear image of effect on liquid limit of soil can carried out. The lime fly ash stabilizer more helpful to reduce liquid limit as compared to CDMW. Reduce in liquid limit change the state of compressibility of soil.

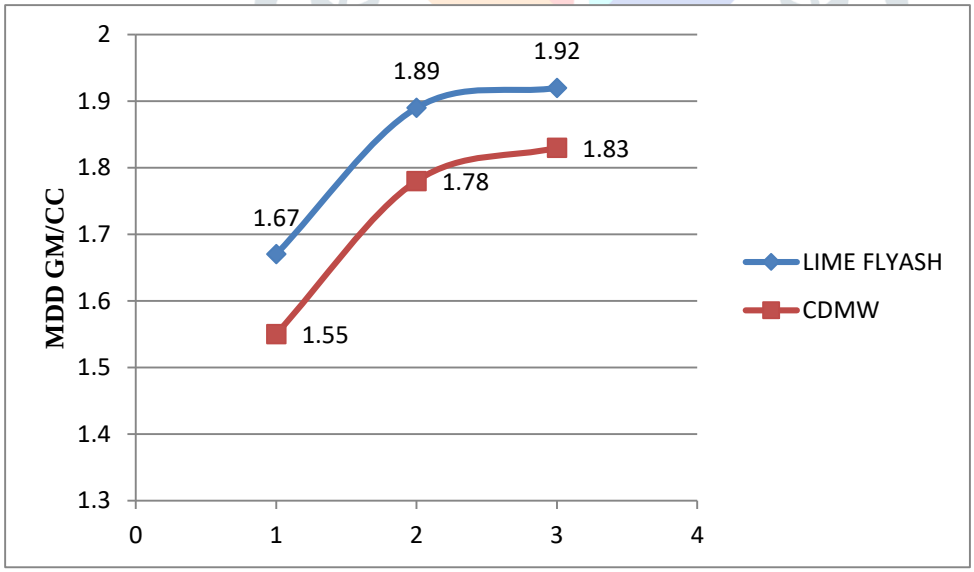
5.2 STANDARD PROCTOR TEST RESULTS COMPARISON.

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

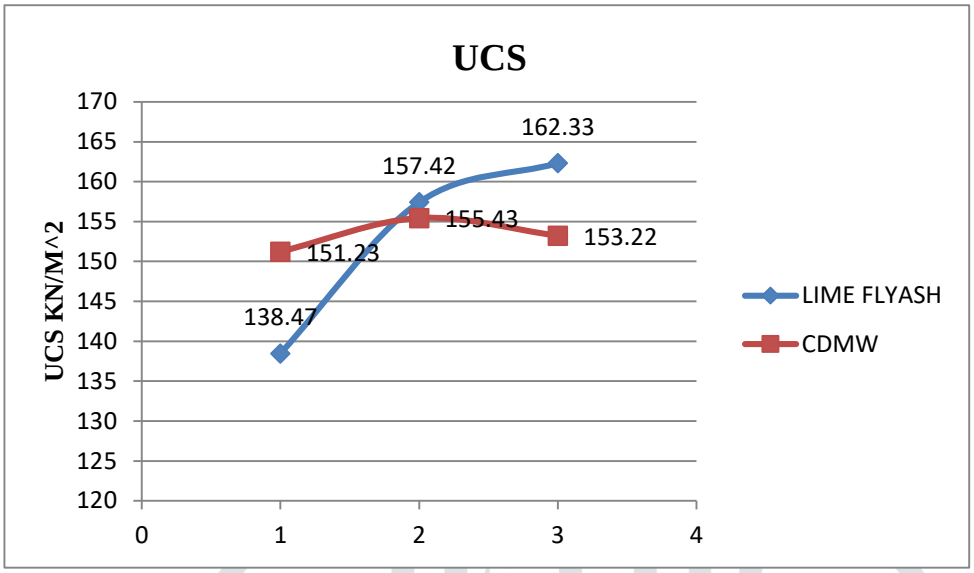
CHART 3 MAXIMIUM DRY DENSITY



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 lime fly ash give little more dense results as compare to CDMW.

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 is majorly depends on cohesion present between soil particles. So the both stabilizer 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 definitely get stabilized. The main thing we have to observe is at what 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 but some where the CDMW fails to give improvement as compare to lime fly ash.
2. In result of liquid limit test the soil may have liquidity at fixed water content in CDMW stabilizer as compare to lime fly ash stabilizer. The liquidity nature of soil responsible for it compressibility and loss in shear strength.
3. As per compaction test the soil is with stabilized with lime fly ash little more dandified as compare to CDMW stabilized soil. While also lime fly ash help to achieve MDD at little less water content as compare to CDMW stabilized soil.
4. In unconfined compression test there is no major response in increase in UCS value in increment of CDMW content as stabilizer while other hand the quick response will be seen in lime fly ash mixture increment as shown in graph.
5. From above results and literature review we can sharply conclude that the lime fly ash as little more favorable as compare to CDMW in soil stabilization process.

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