Statistical Interpretation of Marble Dust and Alccofine for Soil Stabilization

Manish Kumar Soni, Sandeep Singh

Abstract*: This research paper pacts about the investigational study on the stabilization of soil with marble dust and Alccofine. Soil stabilization is a procedure to serve a soil to sustain, modify or expand the execution of soil. Marble dust is made from trimming and smoothening of marble stone and is one of the industry produced waste material. Alccofine is new initiation, micro fine material of particle size much finer than other hydraulic materials like cement, flyash, silica etc. being manufactured in India. Marble dust and Alccofine is added in varying percentages to the soil sample. Basic properties of soil like Atterberg limit, Specific gravity, Gradation analysis, CBR, UCS and compaction were performed on the samples.

***Index Terms*: Bearing capacity, UCS, CBR, Stabilization**

I. INTRODUCTION

The engineering properties of soil rest on the several things like minerals, water table, soil water behaviour etc. which differ from area to area and place to place due to which we can't get desire properties suitable to our needs of construction. Several civil engineering workings such as the construction of highway, building structure, dam and other structure have a strong relationship with soil. All these structures need a strong layer of soil to make sure the structure are strong and stable. To resolve this problem we have technique called stabilization which means to stable or to change or to enhance the soil properties in positive manner. Soil stabilization is to be explained as the increasing or maintaining the soil properties by physical and chemical modification of soil to improve their engineering properties. The main objective of this study was to investigate the effect of Marble dust and Alccofine 1108 on strength behaviour of clay soil.

II. MATERIALS AND METHODS

The materials which are to be used in this study as follows:

A. Soil: The soil sample for carrying out the experimental investigation was collected from Sector 125, Sunny Enclave, Mohali. Test according to Indian Standards are performed on the soil to examine the properties of unmodified and modified the soil with stabilizer. Properties of clay soil are shown in table 2.1.

Table 2.1 Property of Parent Soil

S No.	Value	Property
1.	Specific Gravity	2.7
2.	Liquid Limit	26.84
3.	Plastic Limit	10.38
4.	Plasticity Index	16.46
5.	Optimum Moisture Content (OMC)	14%
6.	Maximum Dry Density (MDD)	1.82 gm/cc
7.	CBR value	2.36%

B. Marble dust: The marble dust is made during trimming, smoothening and grinding of marble stones. The waste is produced from the industries in the form of both solid and slurry (Fig 1.). Marble dust for the present study were collected from one of the marble stone shop, Jai Mata Marbles on the Kharar- Landran road, Mohali. Table 2.2 shows the properties of marble dust.

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Table 2.2 Properties of Marble Dust

Component	Wt%
Lime (CaO)	38-42%
Silica (SiO2)	20-25%
Alumina (Al2O3)	2-4%
Other Oxides like Na, Mg	1.5 to 2.5%
Loss on Ignition (LOI)	30-32%

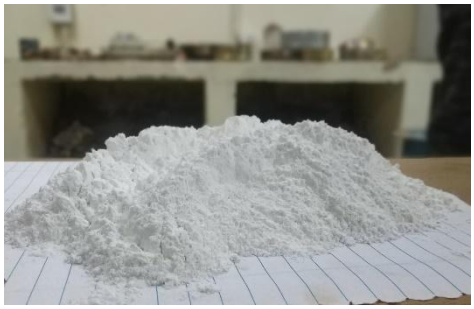

Fig 1. Marble Dust

C. Alccofine**:** Alccofine 1108 is cement based micro fine booster fasten powder. It is based on individual particle size distribution (PSD) technology to advance constructive filler of fine gap, opening and vacuum. As measured to further hydraulically setting materials like OPC it has more micro fine particle size. It has slightness by blaine of more than 8000 cm^2/gm. It is manufactured in state of the art manufacturing plant in a well-ordered environment issueing in compatible quality. The Alccofine material is collected from JV Ambuja Cements Ltd & Alcon, Goa.

Fig 2. Alccofine 1108

III. EXPERIMENTAL PROGRAM:

Table 3.1. Arrangement of samples equipped to conquer the desired results

Sample No.	0	1	2	3	4	5	6	7
Percentages of Marble Dust	0	2.85	5.70	8.55	11.40	14.25	17.10	20
Percentage of Alccofine	0	2.14	4.28	6.42	8.56	10.70	1284	15

The soil sample is firstly added with marble dust as a stabilizing agent with different percentages i,e 2.85, 5.70, 8.55, 11.40, 14.25, 17.10 & 20 to get optimum moisture content. These outcomes will give the idea of only marble dust as stabilizer. Secondly, soil is mixed with Alccofine at different percentages like 2.14, 4.28, 6.42, 8.56, 10.70, 12.84 & 15 which will be compared with the parent soil and will be helpful in estimating the optimize dose of Alccofine.

IV. EXPERIMENTAL RESULTS:

4.1. Grain Size Distribution

Table 4.1 Grain Size Distribution of soil

S No.	Sieve (mm)	Wt. of retain soil (gm)	% retain	Cumulative %	% Finer
1.	4.75	8	0.8	0.8	99.2
2.	2.36	16	1.6	2.4	97.6
3.	1.18	72	7.2	9.6	90.4
4.	0.425	136	13.6	23.2	76.8
5.	0.300	128	12.8	36	64
6.	0.150	244	24.4	60.4	39.6
7.	0.075	380	38.0	98.4	1.6
8.	PAN	16	1.6	100	0

4.2. Standard Proctor Test- Compaction Test of Soil with Different %age of Marble Dust

Table 4.2 Compaction Test for different Marble Dust Mixes

S No.	%age of Marble Dust	MDD (gm/cc)	OMC (%)
1.	2.85	1.78	14
2.	5.70	1.82	14
3.	8.55	1.85	14
4.	11.40	1.87	14
5.	14.25	1.88	14
6.	17.10	1.90	14
7.	20	1.89	14

4.3 Standard Proctor Test- Compaction Test of Soil with Different %age of Alccofine 1108

Table 4.3. Compaction Test for different Alccofine Mixes

S No.	%age of Alccofine	MDD (gm/cc)	OMC (%)
1.	2.14	1.74	18
2.	4.28	1.76	18
3.	6.42	1.78	16
4.	8.56	1.80	16
5.	10.70	1.83	14
6.	12.84	1.81	16
7.	15	1.79	18

Table 4.4. Composition of samples

S No.	MD	Alccofine	LL	PL	PI	MDD	OMC	CBR	UCS (KN/m^2)
1.	2.85	2.14	46.85	19.85	27	1.87	12	15.7	117.70
2.	2.85	4.28	49.05	20.52	28.53	1.85	12	15.82	144.18
3.	2.85	6.42	51.65	21.82	29.83	1.85	12	16.1	227.56
4	2.85	8.56	53	27.5	25.5	1.83	12	17.44	311.93
5	2.85	10.7	55.25	24.62	30.63	1.84	14	16.72	337.42
6	2.85	12.84	57.39	26.6	30.79	1.84	14	17.16	357.04
7	2.85	15	58.2	30.2	28	1.83	14	18.02	386.46

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8	5.70	2.14	49.7	20.85	28.85	1.85	12	15.9	170.26
9	5.70	4.28	51.84	21.92	29.92	1.82	14	16.12	275.13
10	5.70	6.42	53	22.5	30.5	1.81	14	16.24	348.26
11	5.70	8.56	55.1	26.56	28.54	1.80	14	17.18	355.95
12	5.70	10.7	57.2	25.6	31.6	1.79	14	16.92	423.29
13	5.70	12.84	59.5	28.75	30.75	1.78	14	17.66	445.43
14	5.70	15	60.23	25.9	34.33	1.77	14	16.94	476.22
15	8.55	2.14	41.55	17.78	23.77	1.87	14	15.28	212.60
16	8.55	4.28	43	18.5	24.5	1.89	14	15.42	318.42
17	8.55	6.42	45.35	20.67	24.68	1.90	14	15.92	405.98
18	8.55	8.56	46.2	22.1	24.1	1.90	14	16.24	429.05
19	8.55	10.7	48.2	23.0	25.2	1.93	14	16.44	480.04
20	8.55	12.84	50	27.0	23	1.94	14	17.38	523.34
21	8.55	15	51.75	26.87	24.88	1.95	14	17.32	533.93
22	11.40	2.14	44.37	21.51	22.86	1.86	14	16.14	284.78
23	11.40	4.28	46.5	17.25	29.25	1.87	14	15.08	355.97
24	11.40	6.42	51.0	19.5	31.5	1.89	14	15.54	465.62
25	11.40	8.56	52.65	21.32	31.33	1.90	14	15.96	521.44
26	11.40	10.7	55.82	23.92	31.9	1.92	14	16.54	563.75
27	11.40	12.84	57.96	25.0	32.96	2.10	14	16.76	690.71
28	11.40	15	59.0	25.75	33.25	1.95	14	16.94	798.40
29	14.25	2.14	40.28	19.39	20.89	1.90	12	15.68	156.81
30	14.25	4.28	42.68	20.34	22.34	1.88	14	15.88	268.40
31	14.25	6.42	44.82	23.41	21.41	1.87	14	16.58	348.26
32	14.25	8.56	47.22	21.61	25.61	1.85	14	16.12	352.11
33	14.25	10.7	49.36	26.68	22.68	1.83	14	17.3	399.25
34	14.25	12.84	51.7	30.85	20.85	1.82	14	18.28	442.55
35	14.25	15	53.94	28.97	24.97	1.80	14	17.8	514.69
36	17.10	2.14	43.23	22.24	20.99	1.92	14	16.34	107.74
37	17.10	4.28	45.47	20.73	24.74	1.90	14	15.92	208.76
38	17.10	6.42	47.61	20.8	26.81	1.85	14	15.98	299.20

39	17.10	8.56	50.01	26.05	23.96	1.83	14	17.14	265.51
40	17.10	10.7	52.15	25.01	27.14	1.79	14	16.86	357.88
41	17.10	12.84	55	23.5	31.5	1.77	14	16.46	393.48
42	17.10	15	57.64	26.82	30.82	1.76	14	17.22	441.59
43	20	2.14	42.12	19.69	22.43	1.88	12	15.74	152.59
44	20	4.28	44.25	20.12	24.13	1.87	14	15.8	177.5
45	20	6.42	46.39	21.19	25.2	1.84	14	16.02	207.81
46	20	8.56	48.72	20.36	28.36	1.82	14	15.78	197.22
47	20	10.7	51.0	27	24	1.81	14	17.36	328.04
48	20	12.84	53.36	28.68	24.68	1.8	14	17.72	365.57
49	20	15	56.61	26.3	30.31	1.79	14	17.1	414.63

Table 4.4 gives the countless soil properties after the experimental directed in the laboratory for fourty nine samples taken for present investigation. The properties comprise index properties of soils such as liquid limit, plastic limit and plasticity index, compaction characteristics such as maximum dry density and optimum moisture content. California Bearing Ratio test is conducted at optimum moisture content. Among all the values of CBR and UCS the highest value is taken as optimum which is 17.8% and 798 kN/m².

V. CONCLUSIONS

Based on the tests and investigation conducted on soil sample the following conclusions were given,

1. The maximum dry density of parent soil is 1.82 gm/cc as it increases with the adding of marble dust and OMC of the soil-marble dust remains same.
2. In Alccofine maximum dry density increases with the rise in the Alccofine percentages. The maximum dry density of soil using Alccofine is 1.83gm/cc and then it decreases.
3. The plasticity index of soil sample is 16.86%. Soil sample is classified as Medium clay soil.
4. The unconfined compressive strength (UCS) of unprocessed soil sample is 98.5 kN/m² . On adding the mixture of marble dust and Alccofine, unconfined compressive strength increases to 798 kN/m² for 28 days curing.
5. The California bearing ratio (CBR) of soil increased from 2.36% for the parent soil sample to 3.75% in case of marble dust and 3.15% in case of Alccofine. While in combination with marble dust and Alccofine it is increased to 17.8%.

REFERENCES

1. Parte Shyam Singh and Yadav R.K, "Effect of Marble Dust on Engineering Characteristics of Black Cotton Soil", International Journal of Emerging Trends in Engineering and Development Issue 4, Vol.5 (Aug.-Sep. 2014), 104-111.
2. Sachin N. Bhavsar and Ankit J. Patel "Analysis of Clayey Soil Using Waste Material". International Journal for Innovative Research in Science & Technology (IJIRST). ISSN: 2349 – 6010, Volume 01, Issue 06, November 2014.
3. Muthu Kumar and Tamilarasan V S, "Experimental Study on Expansive Soil with Marble Powder", International Journal of Engineering Trends and Technology, Volume 22 Number 11 (April 2015) 504- 507.
4. Ravi Shankar Mishra and Brajesh Mishra, "Improvement in Characteristics of Expansive Soil by Using Quarry Waste and Its Comparison with Other Materials like Cement and Lime Being Used for Soil Improvement - A Comparative Study", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 4, Issue 8, August 2015, 7416- 7431.
5. Chayan Gupta and Dr. Ravi Kumar Sharma, "Influence of Marble Dust, Fly Ash and Beas Sand on Sub Grade Characteristics of Expansive Soil", IOSR Journal of Mechanical and Civil Engineering, International Conference on Advances in Engineering & Technology – 2014, pp 13-18.
6. Vinay Agrawal and Mohit Gupta "Expansive soil stabilization using marble dust". International journal of earth sciences and engineering (IJESE). ISSN 0974- 5904, Volume 04, No 06 SPL, October 2011, pp 59-62.
7. Akshaya Kumar Sabat and Radhikesh P. Nanda, "Effect of marble dust on strength and durability of Rice husk ash stabilised expansive soil", International Journal Of Civil And Structural Engineering, Volume 1, No 4, 2011, 939-948.