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STABILIZATION OF EXPANSIVE SOIL WITH MARBLE DUST AND ALCCOFINE

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ABSTRACT

Expansive or reactive soil is a soil composed predominantly of clay. Clay undergoes significant volume change in response to changes in the soil moisture content. This volume change is realized by swelling upon wetting, and shrinkage upon drying. Being constructed on expansive soils, buildings are frequently prone to severe movement caused by non-uniform soil moisture changes with consequent cracking and damage related to the distortion. Rainfall and evaporation, garden watering, leaking water pipes, or tree root activity may trigger these moisture changes. In this Study, an attempt has been made to improve the bearing capacity of soil using admixtures/Alternate materials.

I.INTRODUCTION

Having a very small particle, a large specific surface area and a high Cation Exchange Capacity (CEC) are properties of expansive soils. The expansion of specified type of clay depends on: the engineering factors of the soil, and local environmental conditions, and geology. Geology is the main factor of the presence in the soil of these types of expansive clay minerals. Plasticity, dry density, and soil moisture content are included in the engineering factors. Furthermore, the most important local environmental conditions to take into account are the amount of the clay fraction in the soil, its initial moisture conditions, and confining.

If expansive soils have been prevented from reacting to changes in their moisture condition by mitigating measures, for example drain systems, which are provided to come forward, the results are still low shear strength and large secondary compression should be imposed upon soils. However, many engineering structures especially geotechnical and geo-environmental ones are designed by positioning them on point of bearing although these problems are obviously known. The ignorance of these problems probably originates from the indispensability of that usage thanks to their prevalence. Geotechnical engineers opt either to excavate or replace the entire soil or to improve the geotechnical properties of the soil to attuned to the potential problem rather than trying to change the whole system. Using soil additives including lime, cement, rice husk ash, asphalt, and limestone ash has widely become one of the most popular methods to improve the geotechnical

properties of poor construction materials like expansive soils. In addition to that, marble stone dust can be used as an additive in order to improve the expansive soils.

II.PROBLEM FORMULATION

In the field of geotechnical engineering in general and soil stabilization in particular, the parent soils are practically categorized under either cohesion less soils (i.e., sandy and larger particle-sized soils) or cohesive soils (i.e., primarily clay and silt). Since the soil stabilization mechanism of fine-grained soils requires calcium (in the form of lime) as the major stabilizing agent, it is possible that some MARBLE DUST, especially those high in free lime, would similarly be useful in stabilizing clay soils. In the case of sandy soils, which are commonly selected in the pavement layers, the usage of MARBLR DUST may provide cementitious materials when it is mixed with water in a way similar to the mechanism by which Portland cements provide their binding characteristics. Any potential application of MARBLE DUST, in clay stabilization, is governed by the physical and chemical composition of the dust. In practical terms, the dusts vary from plant to plant in chemical, mineralogical, and physical composition, depending upon the feed raw materials, type of kiln operation, dust collection facility, and the fuel used.

III.OBJECTIVE

This research is an attempt to investigate the effect of marble dust and Alccofine on the stabilization of expansive soils. This main objective of this study will be to stabilize the expansive soil by adding marble dust at varying %ages and adding Alccofine as an additive to attain the following objectives:

1) To utilize the waste material of marble dust in stabilizing the expensive soil, which otherwise will be very uncomical.

2) To optimize the properties of expensive soil using marble dust and to get the optimize dose of Alccofine to get the maximum strength.

3) To add the marble powder with the Alccofine 4-12% and an Alccofine 1101 at an interval of 5%.

IV.SCOPE OF THE STUDY

Construction materials are more judged by their ecological characteristics because of the continual depletion of quarry aggregates. In India, huge amount of marble waste is being generated because of lack of technology and also unscientific methods of quarrying marble. Due to generation of marble waste there is a direct exposure of this material with the environment because of which serious environmental problems occur. Also, the marble cutting industry generates a high volume of wastes. Not much of the work has been done on the use of Alccofine as a soil stabilizer. Except few studies where Alccofine solely has been used to increase the workability or performance of soil.

The National and International Scenario of the past studies can be concluded in a statement that so far, no evidence has been found where marble dust and Alccofine are used collectively for soil stabilization. In the

present study, the attempt has been made to do the same. Thus, soil stabilization with use of marble dust in presence of Alccofine would be quite beneficial.

V.EXPERIMENTAL PROGRAM

Table 5.1. composition of the sample prepared to attain the desired results

Details of samples Sample No.	S0	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Varying percentage of Alccofine	0	0	0	0	0	5	5	5	5	10	10	10	10
%age of Marble dust	0	4	8	12	16	4	8	12	16	4	8	12	16

The sample S1 will be prepared by using 4% marble dust only and no alccofine. In sample S2 the percentage of marble dust will be increased to 8% and in sample S3 the percentage of marble dust will be increased to 12% and S4 with 16% marble dust with no alccofine. These results will give the idea of only marble dust as stabilizer and will also be helpful in estimating the optimize dose of alccofine. In sample S5, S6 and S7 and S8, the ration of marble dust will be kept as 4%, 8% , 12% and 16% respectively and at a constant %age of 5% alccofine. The samples S9, S10 and S11 & S12 will be comprising of 4%, 8%, 12% and 16% marble dust respectively and at a constant dosage of 10% Alccofine. All the results will be compared with the results of soil without any admixture for liquid limit test, plastic limit test, standard proctor test, unconfined compression test and CBR test.

VI.EXPERIMENTAL RESULTS

6.1. Grain Size Distribution

Table 6.1Grain Size Distribution of Soil

S. No.	Sieve (mm)	Wt. of retain Soil (gm)	% Retain	Cumulative %	% Finer
1	4.75	2.9	0.58	0.58	99.42
2	2.36	0.4	0.08	0.66	99.34
3	1.18	2.9	0.58	1.24	98.76
4	0.6	4.8	0.96	2.2	97.8
5	0.425	12.2	2.44	4.64	95.36
6	0.3	26.9	5.38	10.02	89.98
7	0.18	68.7	13.74	23.76	76.24
8	0.075	186.2	37.24	61	39
9	0	0	0	0	0

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

Table 6.2 Compaction Test for Different Marble Dust Mixes

S.NO.	Designation	MDD ((gm/cc))	OMC (%)
1	S0	1.89	9.17
2	S1	1.65	11.04
3	S2	1.57	12.50
4	S3	1.50	16.30
5	S4	1.42	17.56

6.3. Unconfined compression Test

Table 6.3 Unconfined Compression Test for Different Marble Dust Mixes

S.No.	Designation	Unconfined Compressive Strength (kg/cm^2)	Unconfined Compressive Strength (kPa)
1	S0	1.73	170
2	S1	1.81	178
3	S2	1.42	139
4	S3	1.31	128
5	S4	1.23	121

The range of unconfined compressive strength of soil varies from 1.73 kg/cm^2 to 1.81 kg/cm^2. This shows that mixture of soils and available alumina and silica, and free lime from marble dust reacts slowly and with increases of time the mixture gets more of strength.

Table 6.4 Unconfined Compression Test for Different marble dust & 5% Alccofine Mixes

S.No.	Designation	Unconfined Compressive Strength (kg/cm^2)	Unconfined Compressive Strength (kPa)
1	S0	1.73	170
2	S5	4.64	455
3	S6	5.94	583
4	S7	7.54	739
5	S8	8.01	786

The range of unconfined compressive strength of soil varies from 1.73 kg/cm^2 to 8.01 kg/cm^2 . It is noted that the compressive strength of soil increases when treated with Alccofine by 5% and marble dust by 16%.

Table 6.5 Unconfined Compression Test for Marble dust &10% Alccofine Mixes

S.No.	Designation	Unconfined Compressive Strength (kg/cm^2)	Unconfined Compressive Strength (kPa)
1	S0	1.73	170
2	S9	1.81	178
3	S10	5.0	490
4	S11	5.31	521
5	S12	5.73	562

6.4. CBR Test

Table 6.6 C.B.R. Test for Different Marble Dust Mixes both Unsoaked and Soaked Condition

S.No.	Designation	Unsoaked C.B.R. Values (%)	Soaked C.B.R. Values (%)
1	S0	10.56	5.59
2	S1	27.74	14.60
3	S2	32.60	15.56
4	S3	33.09	16.54
5	S4	35.04	17.46

Table 6.7 C.B.R. Test for Different Alccofine Mixes both Unsoaked and Soaked Condition

S.No.	Designation	Unsoaked C.B.R. Values (%)	Soaked C.B.R. Values (%)
1	S0	10.56	5.59
2	S5	13.47	7.06
3	S6	15.08	8.90
4	S7	19.46	10.70
5	S8	22.70	12.42

Table 6.8 C.B.R. Test for Marble dust and 10% Alccofine Mixes both Unsoaked and Soaked Condition

S.No.	Designation	Unsoaked C.B.R. Values (%)	Soaked C.B.R. Values (%)
1	S0	10.56	5.59
2	S9	27.74	14.60
3	S10	26.27	19.46
4	S11	24.61	12.0
5	S12	23.34	11.43

The soaked CBR value of soil (5.59%) and soil-marble dust mix increases from 14.6% to 19.46%. Based upon the study it is concluded that proportion of 10% Alccofine and 8% marble dust together in a soil is the best combination of materials having maximum soaked CBR value. Hence this proportion may be used in road pavement and embankments.

VII. CONCLUSIONS AND RECOMMENDATIONS

The present study has shown quite encouraging results and following important conclusions and recommendations can be drawn from the study:

- The OMC of soil-marble dust mix increases with increasing the percentage of marble dust. The maximum dry density (MDD) is observed to decrease with increase in the percentage of marble dust. The dry density is decrease when the soil mixed with different percentage of marble dust. The decrease in dry density of soil by addition of marble dust may be due to in part low specific gravity (Density low) of marble dust, mechanical action.
- The values of unconfined compressive strength increase as more percentage of soil is replaced with marble dust. The reason being that marble dust is fine dust made up of tiny spheres of silicon and alumina glass and also consists of small percentage of Cao. The free lime in the dust reacts with water and form $Ca(OH)_2$ which is cementatious material and hence it gives more strength to the soil. Also, due to mechanical

stabilization that is the fine dust particle combination with the coarse particles of the soils, there is increase in strength.

- Mixture of soils and available alumina and silica, and free lime from marble dust reacts slowly and with increases of time the mixture gets more of strength.
- When the percentage of marble dust is increased beyond 4% the strength starts decreasing. The marble dust in itself is a very course material when added to the soils in high percentage (more than 4%) it starts exerting its own properties to the soil marble dust mix samples.
- As per results reveals that there is a considerable improvement in compressive strength in case of all the soils on account of treatment with marble dust and 5% Alccofine.
- Both unsoaked and soaked CBR value of soil increases as the marble dust content increases with 5% Alccofine.
- It is clear that the unsoaked CBR values of soil-marble dust mix is not increases as the marble dust content increases at fixed %age of Alccofine.
- Based upon the study it is concluded that proportion of 10% Alccofine and 8% marble dust together in a soil is the best combination of materials having maximum soaked CBR value.

VIII. SCOPE FOR FUTURE WORK

- In the present study only up to 16 percent replacement of marble dust by soil has been considered. The other percentages percent need to be investigated.
- Other types of waste material like stone quarry, plastics, recycled aggregates, polythene bags etc. also need be tried to know the effect of various type of reinforcement.
- Durability of Alccofine needs to be checked, by conducting the tests for different curing period.

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