THE IMPACT OF WASTE MARBLE DUST ON SUBGRADE PROPERTIES OF EXPANSIVE SOIL

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ABSTRACT

In the civil engineering study well- know the durability of any type of structure is depending upon the foundation. The expansive soil stabilization is the biggest problem in civil engineering to improve the bearing capacity of subgrade soil. Most of the structure and pavements of roadways are deteriorated or failed due to improper stabilization of expansive soil. In this study use the waste marble dust to stabilize the expansive soil and record the effect of waste marble dust on the expansive soil subgrade properties CBR and unconfined compressive strength. In the experimental study found that the California bearing ratio and unconfined compressive strength results of the expansive soil were increased when mixed the waste marble dust with variable proportion's 5, 10, 15, 20, 25 and 30% into the total weight of soil.

Keywords: *Waste Marble Dust, Expensive soil, unconfined compressive strength, CBR.*

1. INTRODUCTION

Expensive soils stabilization is a difficult task for civil and geotechnical engineers all over the world. Costs associated with the sensations of swelling and shrinkage of expansive soils run into many lots of euros annually. [1]The Key aspects that want credentials once dealing with expansive soils include soil properties, suction/water conditions, water content variations temporal and special, (generated by trees and also the seasonal change), and also the geometry/stiffness of foundations and associated structures engineered on active shrink/swell soils. This paper reviews the phenomena of an expansive soil from a mineralogical, mechanical and particularly a geotechnical purpose of reading. Clay soils exhibit, sometimes, a major volume modification thanks to the variation of water content within the mass of the soil, in response to climate and also the action of vegetation.[2] These volume changes have an effect on the operate of the constructions and foundations in contact with the soil and they represent the causes of harm, particularly intense, during periods of drought.[3]

The second phase of this study focuses on the continuous increment of solid waste in the environment. The marble production rate in India is too high and a lot of waste marble solid waste are produced in manufacturing, quarrying and dressing process of marble production.[4] The use of a waste product or recycling is the need for the current time to reduce environmental pollution. The liquid waste is controlled by the number of techniques but the solid waste is difficult to disposal so the current era needs alternative techniques to utilize solid waste or how to control the solid waste.[5] The expansive soil stabilizes by the number of admixtures i.e. lime and cement[6], ceramic dust,[7] fly ash [8] but the waste marble dust is more suitable for improving the bearing capacity and easily available. Swelling of the earth strata due to change in moisture content of soil is the first indication of expansive soil. The Following are the some visual indication of Expansive Soil.

- Cracking in the foundation
- Rapture of pipelines
- Jamming of Door and Windows
- Heaving in Floor Slabs

2. EXPERIMENTAL MATERIALS

- **EXPANSIVE SOIL**

  The expansive soil collected for experimental study from Rania region which are located in district Sirsa, Haryana, India. The Rania region is famous for rice crop yielding and most the area is covered with expansive soil. Collected samples were examined in the laboratory to know the properties of soil with conducted number of tests on it. The properties of expansive soil showed in the table.

- **WASTE MARBLE DUST**

  The marble production rate is very high in the Rajasthan, India which is located nearest from Haryana. For this study marble were collected from Sangria, Rajasthan. The collected samples of marble firstly broken into the small pieces by the help of hammer and to make it in powdered form fed into the Los Angeles Abrasion machine and revolve 500 times after that it passes from 0.075 mm Is sieve. Some properties were examined in the geo-technology lab which showed in the below table.

Table 1: Engineering Properties of Waste Marble dust

Sr. No.	Properties	Values of Expansive soil	Values of Marble dust soil
1	Analysis of Grain Size	Clay size-59% Sand Size-17% silt size-27%	Clay size-21% Sand size-46%, Silt size-33%
2	Compaction Characteristics	OMC-24%	OMC-16.5%
3	Shearing parameters	-------	Cohesion-8.2KN/m^2 and Angle of internal friction-41˚
4	Specific Gravity	2.67	3.04
5	CBR	3.87%	------
6	UCS TEST	88 Kn/m^2	------
7	Free swell index	81%	28%
8	Liquid Limit	69%	21%
9	Plastic Limit	37%	11%
10	Shrinkage Limit	28%	4%

3. PREPARATION OF SAMPLES AND TEST PERFORMED

A. SAMPLE PREPARATION:

The waste marble dust were mixed in the expansive soil in 6 groups with varying proportion of 5 to 30% marble dust and three samples of every group have been occupied for experiment. The composition of every group of waste marble dust and expansive soil has been shown in table 2.

Table 2: The composition of waste marble dust and expansive soil

S.N	Group	Expansive soil weight (%)	Waste marble dust weight (%)
1	WMD 1	95	5
2	WMD 2	90	10
3	WMD 3	85	15
4	WMD 4	80	20
5	WMD 5	75	25
6	WMD 6	70	30

A. TEST PERFORMED:

- **CALIFORNIA BEARING RATIO TEST-** The Soaked CBR test is performed as per the Indian standard code (IS 2720-16).
- **UNCONFINED COMPRESSIVE STRENTH TEST-** The unconfined compressive strength test is performed as per the Indian standard code (IS 2720-10).

4. RESULTS AND DISCUSSION

A. CALIFORNIA BEARING RATIO TEST:-

Soaked CBR test is a penetration test which is observing the subgrade strength of the pavement [9]. In this experimental work found that the untreated value of CBR was 3.9% but after enhancement of waste marble dust (5% to 30%) the value was 4.3.The increased Soaked CBR results was also reported by of Madurwar, Shinde, and Thikare [10] when waste marble dust, stone dust and fly ash mixed in the expansive soil. CBR values of expansive soil increases due to change in optimum moisture content and Atterberg's limits value when adding the waste marble dust. [11]

S.NO.	SOIL SAMPLE NAME	WMD (%)	CBR (%)
1	WMD 1	5	4
2	WMD 2	10	4.2
3	WMD 3	15	4.5
4	WMD 4	20	4.9
5	WMD 5	25	5.2
6	WMD 6	30	5.5

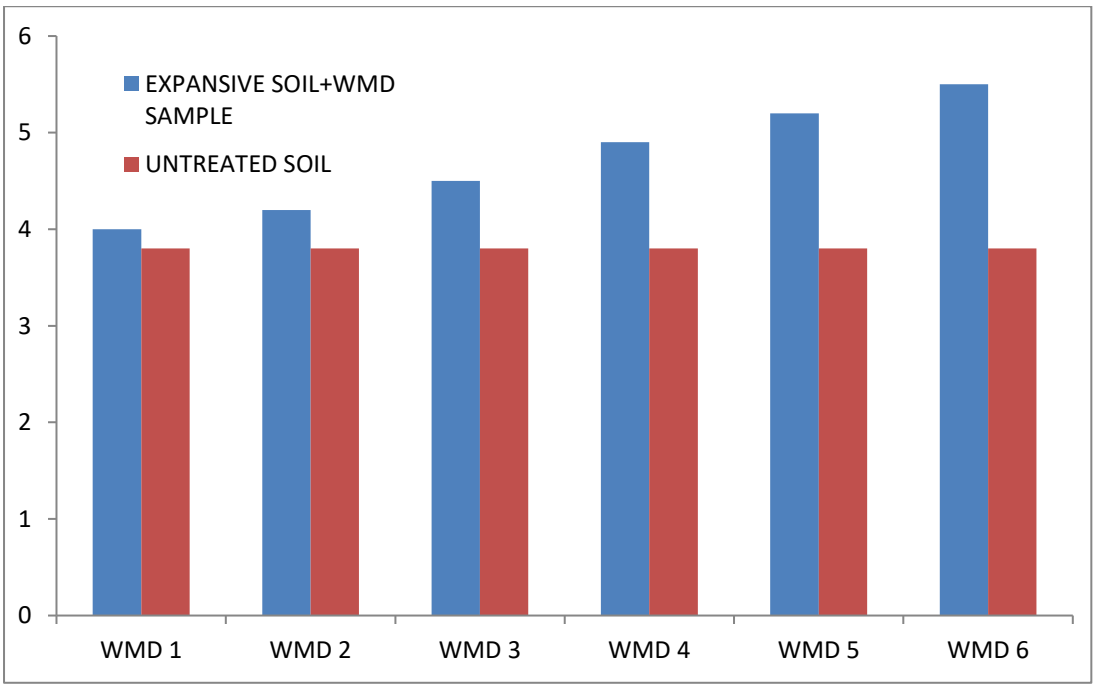


Fig. 2 Effects on Soaked CBR

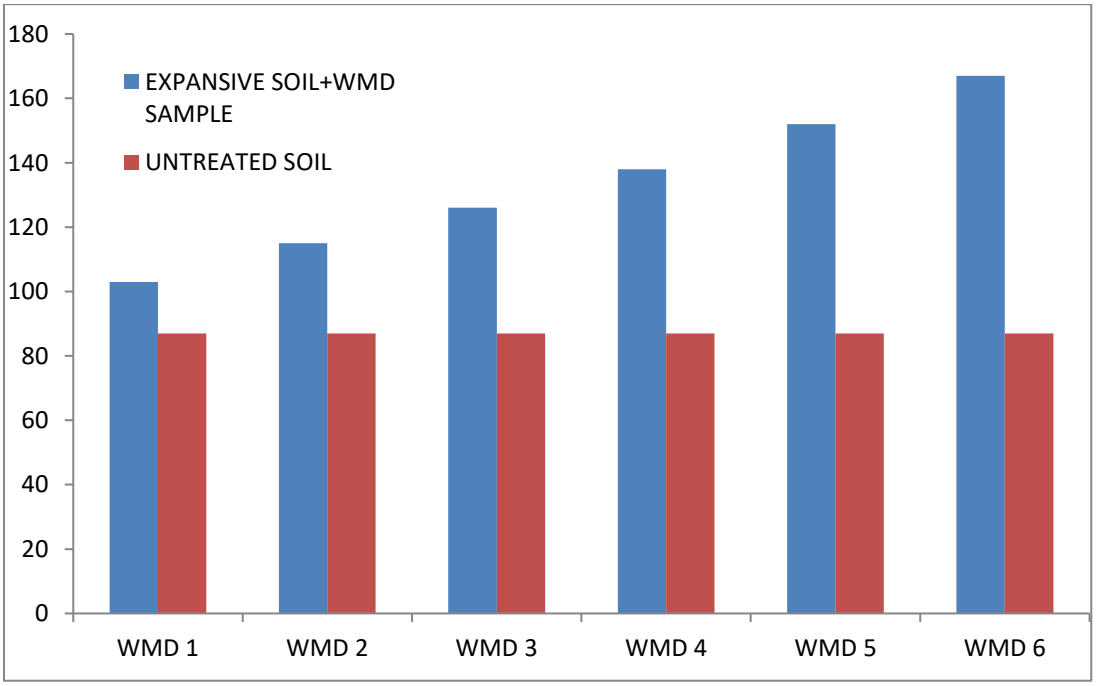
B. UNCONFINED COMPRESSION STRENGTH TEST

The Unconfined compression test was conducted on the soil sample with marble dust powder. Marble dust was added to soil in varying percentages (10, 15, 20, 25 and 30%) respectively. The test results were represented in the table. The enhancement in the UCS value was attributed to the continuing

formation of cementations compounds (calcium silicate hydrate) due to the reaction between the calcium carbonate present in the marble powder, soil and water. [12]

S.NO.	SOIL SAMPLE NAME	WMD (%)	UCS (KN/m^2)
1	WMD 1	5	103
2	WMD 2	10	115
3	WMD 3	15	126
4	WMD 4	20	138
5	WMD 5	25	152
6	WMD 6	30	167

Table Results of UCS Test



5. CONCULUSIONS

It has been concluded the waste marble dust material is effective for stabilization of expansive soil. The following conclusions have been observed:

1. The soaked CBR was increased with use of waste marble dust and showed better performance with use of 30% waste marble dust to the total weight of soil.
2. The Unconfined Compressive Strength of expansive soil were enhanced with use of waste marble dust in stabilization and 30% use was effective and economy in stabilization.
3. The Atterberg's Limit were decreased by the use of waste marble dust
4. The expansive soil group changed from CH to CL when mixed waste marble dust in the soil.

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