

Effect of Marble Dust Powder & Wood Sawdust Ash on UCS and CBR Values of Soil

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ABSTRACT: This paper aims at studying the effects of wood sawdust ash and marble dust powder as admixtures in soil to improve the engineering properties of soil. Wood sawdust ash and marble dust powder form a major percentage of waste materials originated by wood and marble industry respectively. To improve the geotechnical properties of soil, CBR and UCS tests were performed on the soil sample mixed with 2%+2%, 4%+4%, 6%+6%, and 8%+8% of wood sawdust ash and marble dust powder. Based on Indian Standard guidelines Standard Proctor Test was also conducted to determine the maximum dry density and optimum moisture content at varied percentages of waste admixtures in the soil. It was observed that the UCS values increased by a maximum of 7.59% at 6%+6% wood sawdust ash and marble dust powder mix. Similarly, CBR value was increased by a maximum percentage of 17.18% at 4%+4% wood sawdust ash and marble dust powder mix. Collectively, the admixtures had an overall positive effect on the geotechnical properties of soil and they can be used as a measure to improve soil strength and contribute towards decreasing the environmental impact of waste materials on our surroundings. This will not only solve the waste disposal problem but also improve the strength characteristics of soil. The findings of this study can be implemented in rural regions where traffic load is considerably low.

KEYWORDS: Soil Stabilization, **Unconfined** Compressive Strength, CBR, Waste Materials

I. INTRODUCTION

Clayey and silty soils are an engineer's nightmare. With changes in water content, these soils exhibit major changes in their physical properties and at the same time soil strength also reduces considerably making the structure to be founded above it vulnerable to damage. Such soils exhibit property changes when they are brought from natural state to a disturbed state. Therefore strengthening or stabilization of such soils is important to impart strength to them so that they can sustain the loading of structures to be built above them. Stabilization can be done by using chemical admixtures or by mixing the soil with waste materials which serve the dual purpose of not only strengthening the soil but also reduce the environmental hazards. The objective primarily remains to be able to make soil sustain the heavy loads it is subjected to throughout the life cycle of the structure.

In the era of high rise buildings, where cost of land is sky rocketing, it is important to stabilize soil to not only make a safer structure but to also keep a check on the cost of overall construction. Also, for a particular chosen site, the soil type may not be suitable for the type of construction required and that surely calls for stabilizing the soil. Waste materials having cementitious properties or ability to bind soil particles together to impart strength can be used to bring soil properties at an acceptable level for a given construction project. In this study, sawdust ash and marble dust powder have been used to improve the strength properties of soil.

The primary objective of this study was:

- i. Comparison of UCS of plain soil with stabilized soil mixed with varying percentage of sawdust ash and marble dust powder.
- ii. Comparison of CBR of plain soil with stabilized soil mixed with varying percentage of sawdust ash and marble dust powder.

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II. MATERIALS USED

Soil

In the present study soil was brought from Nada Sahib near Panchkula Haryana (India). Soil Classification was done in accordance to IS: 1498. The soil type was found to be CI i.e. clay soil with intermediate compressibility. In accordance to IS: 2720, various tests were performed on the soil sample to determine Atterberg Limits details of which are given below in Table 1.

Table 1: Soil Properties.

Sr. No.	Properties	values
1.	Liquid limit (W_L)	38.28
2.	Plastic Limit (W_P)	23.41
3.	Plasticity Index (I_P)	14.87
4.	Soil Type As Per IS:1498	CI
5.	Optimum Moisture Content (%)	11.6
6.	Max. Dry Density (g/cc)	1.85
7.	Soaked CBR Value (%)	1.63
8.	Unconfined Comp. Strength (kg/cm ²)	4.308

Stabilizing Materials

In this study, waste materials were used as primary stabilizing materials. Two ingredients used as stabilizing admixtures were wood sawdust ash and marble dust powder. Marble dust powder & wood sawdust ash which are generally found local in Chandigarh i.e. Marble dust powder found from marble cutting industry & wood sawdust are obtain from the timber milling factory in Chandigarh. Wood sawdust was burnt in controlled condition with a burning rate of 3 hours per kilogram. The sample was burnt overnight and the resultant wood sawdust ash was collected. The collected ash was then sieved through IS: 90 Micron Sieve before mixing it with the soil sample. Marble Dust Powder was collected was collected from Industrial Area, Chandigarh. Properties of the stabilizing admixtures are given below in Table 2 and Table 3.

Table 2: Properties of Wood Sawdust Ash

1.	Colour	Greyish Black
2.	Specific Gravity	2.03
3.	Water Absorption (%)	64
4.	Fineness	600 μ m
5.	Fineness Modulus	1.81
6.	Rate of Burning	3 Hours per kg

Table 3: Physical Properties of Marble Dust Powder

Sr. No.	Properties	Values
1.	Specific Gravity	2.63
2.	Particle Size	<90 μ
3.	Colour	White
4.	Odour	Odourless
5.	Moisture Content (%)	0.60
6.	Bulk Density (gm/cm ³)	1.370

III. METHODOLOGY

- i. **Optimum Moisture Content and Maximum Dry Density:** OMC and MDD was determined for plain soil and subsequently for soil mixed with 2+2%, 4+4%, 6+6%, and 8+8% of wood saw dust ash and marble dust powder. The percentage chosen for mixing was with respect to dry weight of the plain soil sample taken for experimental work. The tests were done in accordance to IS: 2720-Part-8.
- ii. **Unconfined Compressive Strength and California Bearing Ratio:** Same percentage of stabilizing waste materials was taken to determine the UCS value. The UCS test was done in accordance to IS: 2720-Part-10. The CBR test was done in accordance to IS: 2720-Part-16.

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IV. EXPERIMENTAL RESULTS

Unconfined Compressive Strength: The UCS values were found at OMC and MDD conditions for every percentage of the soil mix. The plain soil UCS was 4.308kg/cm². The UCS value increased upto 6%+6% and then reduced for the 8%+8% wood sawdust ash and marble powder mix by weight of the dry soil. The maximum UCS value recorded was 4.635 kg/cm², which was a 7.59% increase (at 6%+6% mix) from the UCS value for plain soil. The results obtained at varying percentages are tabulated below.

Table 4: UCS Values of Stabilized Soil.

Waste Materials (%)	UCS values (kg/ cm ²)
Plain Soil	4.308
2%+2%	4.407
4%+4%	4.468
6%+6%	4.635
8%+8%	4.056

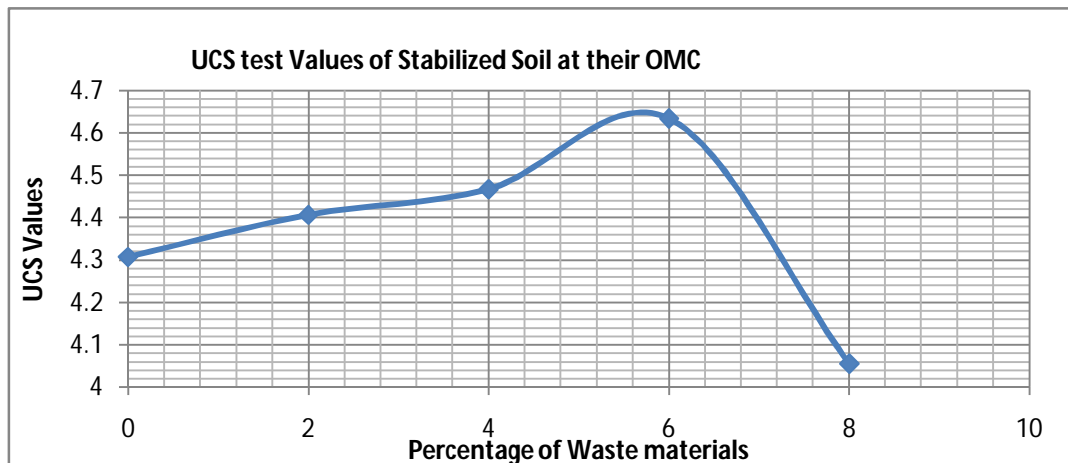


Figure 1: UCS values of Stabilized Soil.

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Table 5: Comparison of the Unconfined Compressive Strength of the plain soil with the stabilized soil.

Waste Materials (%)	UCS values (%)
Plain Soil	4.308
2%+2%	(+) 2.29 %
4%+4%	(+) 3.70 %
6%+6%	(+) 7.59 %
8%+8%	(-) 5.86 %

Soaked California Bearing Ratio: The maximum CBR value was obtained at 4%+4% mixes. The maximum CBR value obtained was 1.91 which was a 17.18% more than that obtained for plain soil. The values obtained at varying percentages of wood sawdust ash and marble dust powder are tabulated below.

Table 6: Soaked CBR values of Stabilized Soil.

Waste Materials (%)	Soaked CBR Values (%)
Plain Soil	1.63
2%+2%	1.75
4%+4%	1.91
6%+6%	1.82
8%+8%	1.81

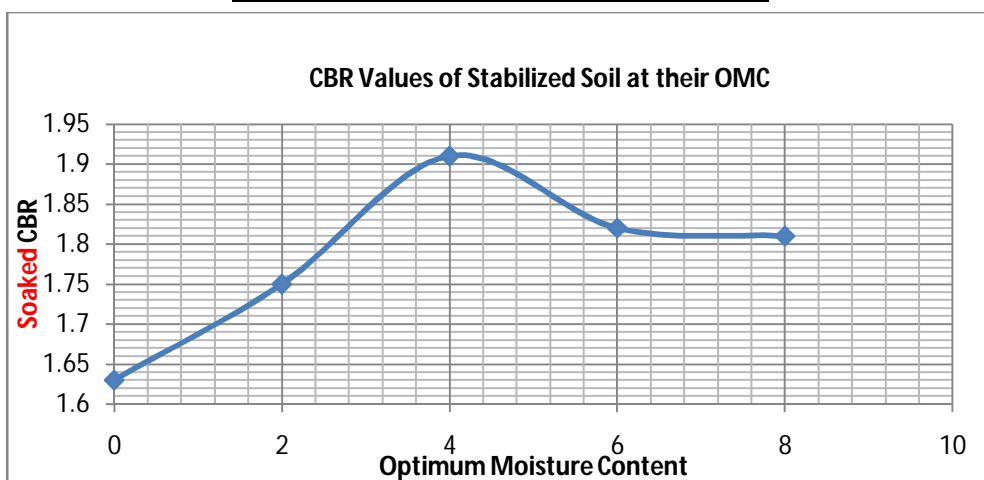


Figure 2: Soaked CBR values of Stabilized Soil.

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Table 7: Comparison of the **Soaked** California Bearing Ratio of the plain soil with the stabilized soil.

Waste Materials (%)	Soaked CBR values (%)
Plain Soil	1.63
2%+2%	(+) 7.36%
4%+4%	(+) 17.18%
6%+6%	(+) 11.66%
8%+8%	(+) 11.04%

V. CONCLUSION

This study concludes that addition of waste material can prove out to be a good stabilizing agent for weaker soils. Wood sawdust ash and marble powder increase UCS and CBR value by as much as 7.59% and 17.18% respectively. An addition of 4%+4% waste material by weight of dry soil is recommended to be used to increase the UCS value. To increase the CBR value, a 6%+6% waste material mix is recommended for use.

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