ASSESSMENT OF BC SOIL PERFORMANCE USING WOLLASTONITE & PLASTIC SHEDDED AS A SUPPLEMENT

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***Abstract*— Soil stabilisation is an ongoing process, that improves physical soil character such as increased shear capacity etc can be done by compacting or adding appropriate additives such as wollastonite powder and shredded plastic waste.**

In this study, different tests like the standard proctor compaction test, the California bearing ratio test, the unconfined compression strength test, etc. have been carried out to Identify the qualities of black cotton soil and how it reacts with an additional substance. The additive materials for enhancing features of soil being decided as wollastonite powder and shredded plastic waste. Wollastonite powder and shredded plastic waste have been chosen as the addition materials to improve the characteristics of soil. Wollastonite is a calcium silicate mineral (CaSiO3) that is found in numerous locations below the surface of the earth and finds use in a variety of engineering sectors, among other things. It may also include trace amounts of iron, magnesium, and manganese.

Keywords—Wollastonite , shredded plastic trash(Waste), Standard proctor compaction , California bearing Ratio , Unconfined Compression Strengtth.

1. INTRODUCTION

Along with air and water, soil is one of the most significant natural resources in the world since it is essential to life on earth. The soil in civil engineering causes all naturally occurring, largely unconsolidated organic or inorganic earth materials to float above the surface of the planet. In engineering, loose rock components known as regolith are referred to as soil. Generally speaking, soil is the depth of regolith that has been impacted and/or modified by plant roots. Its depth can range from a few centimeters to several meters. A good quality soil has a volume composition of 45% minerals (sand, silt, and clay), 25% water, 25% air, and 5% both live and dead organic stuff. A technique for enhancing the engineering qualities of soil is soil stabilization.

Black cotton soil is an expansive soil and inorganic clay of high to medium compressibility. Black cotton soil is clay-rich soil that is, it contains calcium, carbonate, potash and holds moisture and is mainly found in the tropics and sub tropics region. It is dark in colour and is known as native dirt. These are made from lava eruptions. This soil is made of a very fine clayey substance and is renowned for its ability to hold moisture. A cohesive soil is black cotton soil. For civil engineers, it's a challenging or problematic type of soil. It has the capacity for both expanding during rainy weather and decreasing throughout the summer. When Black Cotton Soil increases throughout the rainy season, the structure experiences uplift pressure, which causes heave in the foundations, plinth beams, ground floors of buildings, canals, roads, etc. When Black Cotton Soil shrinks during the summer, walls, slabs, plinth protection, floors, etc. develop cracks.

A calcium silicate mineral called wollastonite ($CaSiO_3$) may also contain trace levels of iron, magnesium, and manganese, which act as calcium's substitutes. Usually, it's white. It develops when impure limestone or dolomite is heated to a high pressure, which occasionally happens in the presence of fluids that include silica, such as in skarns, or when it comes into contact with metamorphic rocks. Garnets, vesuvianite, diopside, tremolite, epidote, plagioclase feldspar, pyroxene, and calcite are among the minerals that are associated. It has the name of William Hyde Wollastonite (1766–1828), an English chemist and mineralogist.

Plastic waste that has been cut into two or more pieces is put into a shredder for additional cutting. The plastic is cleaned before shredding and occasionally after shredding as required by the manufacturer. When shredding stiff plastic, a different machine is used than when shredding thin film plastic. When working with plastic products, vinyl materials, and PVC pipes, shredders are incredibly helpful. Any undesired type of plastic can be converted into a workable, practical material that can be utilised to create a variety of goods. It is significantly simpler to reuse or handle waste that has been shred. Shredding is a productive way to get rid of garbage, which significantly lowers the price of recycling in many businesses.

2. OBJECTIVES

The following are the objectives for our project work

- To investigate the effects of adding shredded plastic waste and wollastonite powder on the MDD of black cotton soil.
- Adding shredded plastic waste and wollastonite powder to soil to boost dry density and California bearing ratio (CBR).
- Utilising shredded plastic waste and wollastonite powder as an additive to help stabilise soil.

3. MATERIALS

2.1 SOIL

The wide black cotton soil was taken from the SP office opposite Wisdom School on the back side of Davanagere District, Karnataka. All organic wastes and other waste products were removed from the soil's surface. The topsoil was excavated to a depth of 1.5 feet before being collected. Fig 1 depicts the image of Collected B C soil from site and Table 1 lists the qualities that of B C soil.

Fig 1. Collected B C Soil

Table 1: The features of black cotton soil

SL.NO	CHARACTERISTICS	RESULT
1	Specific Gravity Test Pycnometer method Density Bottle method	 2.43% 2.32%
2	Water Content	21.14%
3	Liquid Limit Test Plastic Limit Test	40.41% 21.0%
4	Standard Proctor Test	20.08%
5	CBR Test for Soil Sample	2.33%
6	Unconfined Compression Test	28.16 kg/cm^2

2.2 WOLLASTONITE

The study's source of wollastonite is Wolkam Chemicals, which is situated in Rajasthan. We procured material from Indian Mart website. Fig 2 shows the image of Wollastonite powder and Table 2 lists the chemical and physical characteristics of wollastonite.

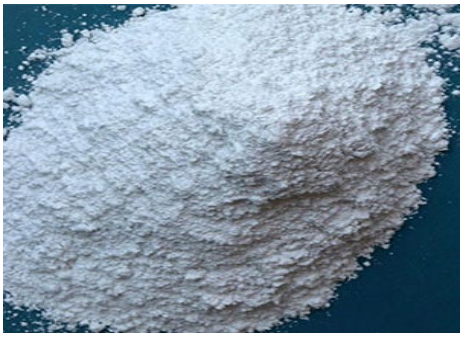

Fig 2. Wollastonite powder

Table 2: Characteristics of Wollastonite

SL.NO	CHARACTERISTICS	WOLLASTONITE
1	Appearance	White
2	Form	Powder
3	Hardness(Moths)	4.5-5.5
4	pH	8.9–9.7
5	MeltingPoint(°c)	1540
6	CaO	43–47%
7	SiO_2	48–53%
8	Sedimentation	45–75
9	Whiteness	87–92

2.3 SHREDDED WASTE PLASTIC

Shredded plastic garbage can be purchased at a local market or through waste plastic recyclers. As waste plastic is cut or shredded by shredder machine, the size of shredded plastic waste varies in shape and has no fixed aspect ratio. Fig 3 shows the image of Shredded Plastic before crush.

Fig 3. Shredded Plastic before crush

- ***SAMPLE PREPARATION***

According to the below table's percentage by weight of the soil, laboratory tests were conducted on samples of soil, soil plus wollastonite, and soil plus shredder waste plastic.

Table 3: Sample Preparation

Sl.no	Soil particulars	% wollastonite + shredded plastic
1	Natural Soil	Natural Expansive soil
2	sample of soil 1	Natural BC soil + 5% of wollastonite + 0.5% of the shredded plastic trash
3	sample of soil 2	Natural BC soil + 10% of wollastonite + 0.5% of the shredded plastic trash
4	sample of soil 3	Natural BC soil + 15% of wollastonite + 00.5% of the shredded plastic trash
5	sample of soil 4	Natural BC soil + 20% of wollastonite + 0.5% of the shredded plastic trash

Fig 4. Light compaction test in lab

4. TEST RESULTS

3.1.1. OVERALL MAXIMUM DRY DENSITY TEST RESULTS

Table 4. Tabulation of Overall MDD Result

Soil sample with percentage of wollastonite powder and shredded plastic waste added	MDD(gm/cc)
Natural BC soil	1.56
Natural BC soil + 5% of wollastonite + 0.5% of the shredded plastic trash	1.60
Natural BC soil + 10% of wollastonite + 0.5% of the shredded plastic trash	1.68
Natural BC soil + 15% of wollastonite + 0.5% of the shredded plastic trash	1.71
Natural BC soil + 20% of wollastonite + 0.5% of the shredded plastic trash	**1.96**

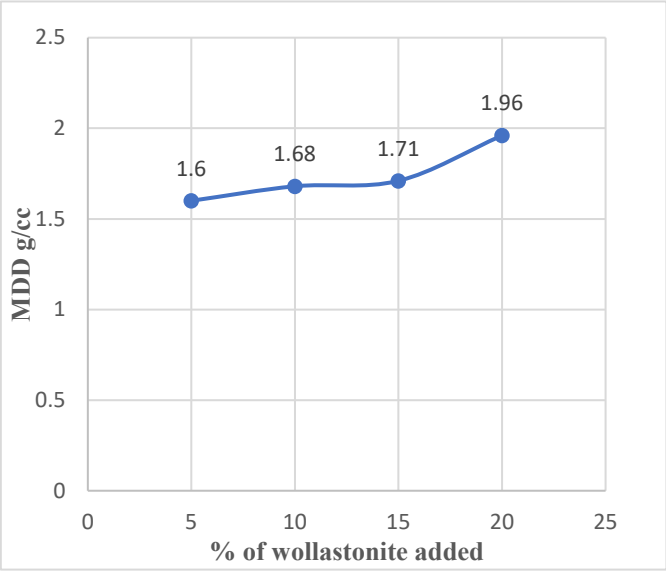

Fig 5. Overall MDD Graph

3.1.2. OVERALL OPTIMUM MOISTURE CONTENT RESULT

Table 5.Tabulation of Overall OMC Result

Soil sample with percentage of wollastonite powder and shredded plastic waste	OMC(%)
Natural BC soil	20.08
Natural BC soil + 5% of wollastonite + 0.5% of the shredded plastic trash	22.61
Natural BC soil + 10% of wollastonite + 0.5% of the shredded plastic trash	19.07
Natural BC soil + 15% of wollastonite + 0.5% of the shredded plastic trash	19.06
Natural BC soil + 20% of wollastonite + 0.5% of the shredded plastic trash	**15.75**

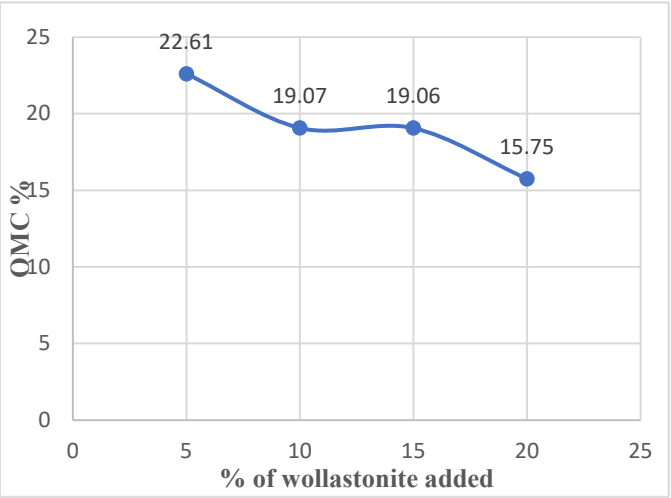

Fig 6. Overall OMC Graph

3.1.3. OVERALL CALIFORNIA BEARING RATIO VALUE RESULTS

Table. 6.Tabulation of Overall CBR Result

Soil sample with percentage of wollastonite powder and shredded plastic waste	CBR (%)
Natural BC soil	2.33
Natural BC soil + 5% of wollastonite + 0.5% of the shredded plastic trash	4.14
Natural BC soil + 10% of wollastonite + 0.5% of the shredded plastic trash	4.72
Natural BC soil +15% of wollastonite 0.5% of the shredded plastic trash	6.51
Natural BC soil + 20% of wollastonite + 0.5% of the shredded plastic trash	**10.06**

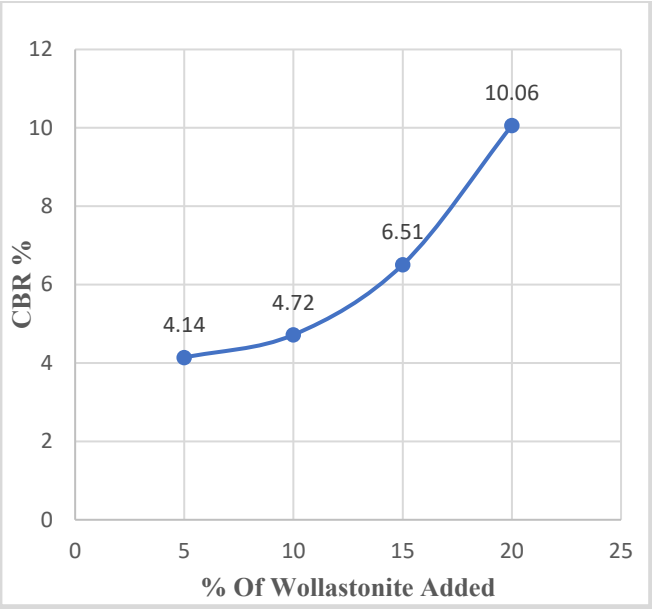

Fig 7. Overall CBR Graph

3.1.4. OVERALL UNCONFINED COMPRESSION STRENGTH TEST RESULT

Table 7.Tabulation of Overall UCS Test Result

Soil sample with percentage of wollastonite powder and shredded plastic waste	UCS(kg/cm^2)
Natural BC soil	28.16
Natural BC soil + 5% of wollastonite + 0.5% of the shredded plastic trash	36.67
Natural BC soil + 10% of wollastonite + 0.5% of the shredded plastic trash	37.46
Natural BC soil + 15% of wollastonite + 0.5% of the shredded plastic trash	38.25
Natural BC soil + 20% of wollastonite + 0.5% of the shredded plastic trash	**39.04**

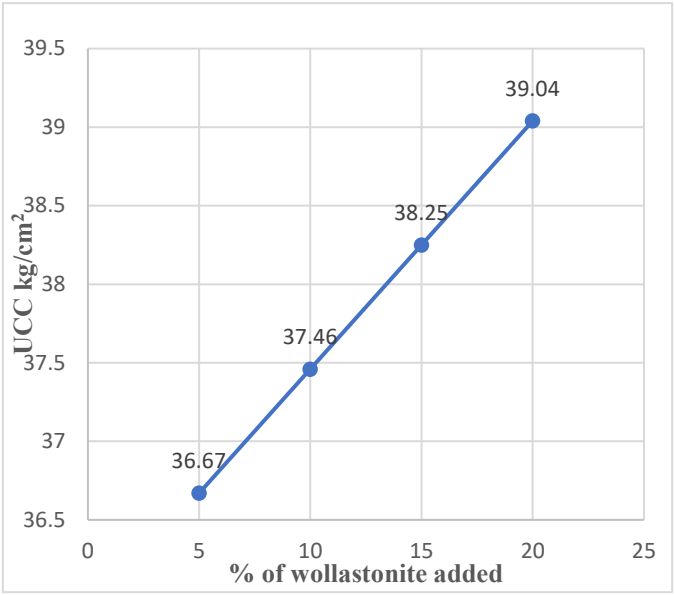

Fig 8. Overall UCC Graph

Fig 9. CBR test in lab

Fig 10. UCS test in lab

5. CONCLUSIONS

- It is evident that increasing the value of BC soil by combining wollastonite powder with continuous amounts of 5%, 10%, 15%, 20%, and 0.5% shredded plastic waste.
- The CBR value is increased by 10.06 percent with a mixture of 20% wollastonite powder and shredded plastic trash added to black cotton soil.
- The maximum dry density of the Black Cotton soil increases with the addition of wollastonite powder and shredded plastic waste, going from 1.56 to 1.96 gm/cc at the 20% concentration and 0.5% addition, respectively.
- The unconfined compression strength of soil is increased by the addition of wollastonite powder and shredded plastic waste, going from 28.16 kg/cm^2 to 39.04 kg/cm^2 with a 20% addition of wollastonite powder and 0.5% addition of shredded plastic waste.
- Building and road construction in areas with black cotton soil is extremely problematic from a geotechnical standpoint since the soil is highly compressible, has weak shear strength, and is prone to volumetric instability.
- Finally, it can be inferred from our experimental work that the wollastonite powder and shredded plastic waste increased the strength parameters of BC soil.

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