THE USE OF COPPER SLAG AND POLYPROPYLENE FIBER TO STRENGTHEN THE ENGINEERING PROPERTIES OF BLACK COTTON SOIL

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ABSTRACT - *The objective of study is intended to decide the strengthening impact of haphazardly disseminated short polypropylene filaments on the California bearing ratio test and unconfined compressive strength of black cotton soil. The expansion of polypropylene stands brought about increment in ideal dampness substance and decline in most extreme dry thickness. Copper slag is one of the waste materials that are being used broadly in the structure outline improvement. In this paper the stabilization is done to determine the effect of both polypropylene fiber and copper slag on engineering properties of black cotton soil. Here the dry density, CBR value and unified compression test were carried out. The proportion of copper slag used are (6%, 12%.18% and 24 %,) with respect to dry weight of the soil and also the proportion of polypropylene fiber used are (0.5%.1%, 1.5% and 2 %.) With the dry weight of the dirt. Then by mixing both polypropylene fiber and copper slag with proportion 0.5%, 1%, 1.5%, 2%, And 3%.6%, 9%, 12%, respectively with the dry weight of the soil.*

Key Words**: soil stabilization, copper slag, polypropylene fiber, compaction, CBR, UCS.**

1. INTRODUCTION

In India, extensive soils are dark cotton soil. The name, dark Cotton" as on horticulture stand point. The dark cotton soil is a kind of broad soil with high versality and hold dampness all through the dry season which is the reason they are significant for developing yields. .It display low bearing limit, low permeability and high volume changes because of essence of montmorilonite minerals in its metrological substance. Along these lines before development of a street and other building structure on such sub grade. It is imperative either supplant it with no extensive soil or make it reasonable for development. Supplanting the current soil won't not be a plausible alternative, along these lines the most ideal choice is to balance out the current soil with appropriate stabilizers. The procedure of soil adjustment accomplishes the required quality in as soil required for the development work. There are numerous dirt change strategies either chemical or mechanical. They may delegate a ground support, ground change and ground treatment. Soil dependability is standout amongst the most vital thickness in geotechnical designing practices. With visit disappointment of soil mass, whether it is on slant or level ground have ended up being expansive regarding both life and property, strengthening soil utilizing pressure opposing components is an appealing methods for enhancing execution of the dirt in savvy way. Soil is a great degree complex; heterogeneous

substance has been subjected to verities of nature, with no control the properties of soil change from one to different as well as at the place with profundity and with an adjustment in the ecological stocking's and sort. Expansion of strands can be utilized as a support for development and alteration in building properties of soil. Soil support has been presented in the field of geotechnical building so as to enhance the properties of ground soil. Soil fortification has been presented in the field of geotechnical designing with a specific end goal to enhance the properties of ground soil. Expansion of strands, for example coir fiber, tire chips, glass fiber, polyester fiber and alteration in designing properties of dark cotton soil. Sweeping soils are an overall issue that creates challenges for structural architects. They are considered as potential regular risk which can make broad harm structure if not satisfactorily treated. A portion of the current endeavors made by couple of specialist has investigated the reasonableness of granulated copper slag, delivered as waste from broiling of copper slag being effectively utilized as thruway development materials. It has discovered its pertinence in different layout of the pavements both adaptable and inflexible in mix with the nearby soils or some other waste materials

1.1 LITERATURE REVIEW

A Mohan Chand (2017) [1]:

In this paper aimed to determine the behavior of black cotton soil reinforced with copper slag in random manner. In this project the unified compression test and CBR test were carried out. Here the maximum dry density got is 15.16 KN/m3 and optimum moisture content is 21.96%. In this paper we can observe that with increase in percentage of copper slag dry density of soil also increases (1.69 max values) and also for steel slag dry density of soil attains maximum value of 1.62 g/cc. The shear strength of soil attains maximum at 20% of copper slag with respectively 0,7,14 days of curing period of increased percentage value are 122.3%, 81.3%, 86.4%and also for steel slag 91.4%, 64.7%,72.5%, when both used of 20% of curing period 0,7,14 days the increased percentage value are 164.7%, 110.8%, 113.7%. The CBR value of soil attains maximum value of 20% of steel slag and 20% of copper slag is 4.82 for unsoaked and 3.62 for soaked.

Dr M S Dixit (2016) [2]:

In this work the expansion of polypropylene stands brought about increment in ideal dampness substances and diminishing in most extreme dry thickness. Coordinate shear test directed on soil indicates increment in estimation of attachments and decline in estimation of edge of inner grating. CBR and UCS values are also observed. Expansion of polypropylene filaments to the direct brought about most extreme dry thickness in the scope of 3% to 14%.likewise the expansion of stands brought about increment in ideal dampness content in the scope of 1 to 9%. With increase in addition of polypropylene fiber in soil increases in value of cohesion was observed in the range of 2% to 21%. The CBR esteem increments in the scope of 11% to 47% for expansion up 2.25% of polypropylene filaments and abatements subsequently. The connection between ideal dampness substance and most extreme dry thickness of soil essentially influenced by the expansion of polypropylene fiber.

1.2. MATERIALS AND METHODOLOGY

1.2.1 Materials:

Black cotton soil:

The black cotton soil was gathered from karanja jalashaya near humanabad, bidar district from an open excavation at a depth more than 2M from the ground level surface.

Table 1.2.1 Basic Properties of Black Cotton Soil

Properties	Black cotton soil
Specific gravity	2.42
Liquid limit	90.27%
Plastic limit	47.7%
Plasticity index	42.5%
Shrinkage limit	18.12%
Optimum moisture content %	23.52%
Maximum dry density KN/m^3	1.60 KN/M3
CBR %	
Soaked	2.58
Unsoaked	3.22
Unified compressive strength KN/m^2	0.775 kg/cm2

Copper slag

Copper slag was collected from the Air blast equipment India pvt.Ltd .Hyderabad. The shade of the copper slag is dark, smooth, utilized as a part of the examination.

Polypropylene fiber

For the investigation fiber used in the experimental work was collected from Vansant enterprises, Dwarakapuri colony Hyderabad. This material is chosen because of its low cost and hydrophobic and chemically inert nature which does not absorb or react with soil moisture or leach ate

METHODOLOGY:

The unified compressive strength test and California bearing ratio test were carried out at different varying percentage, i.e. copper slag at 6%, 12%, 18%, 24%, and 30%. And polypropylene fiber at 0.5%, 1%, 1.5%, 2%, 2.5%.of dry weight of the soil. And then by mixing both the materials the effect on strength properties of black cotton soil can be evaluated. . Polypropylene fiber has kept constant as taken in previous trials and the percentage of copper slag has changed i.e. 3%, 6%, 9%, 12%, and 15%.

1.3 RESULTS AND DISCUSSION

1.3.1 Compaction Test

Table 1.3.1 MDD and OMC of BCS and BCS treated with various percentage of copper slag

Particulars	Compaction test	
	MDD (gm/cc)	OMC (%)
BCS alone	1.60	23.5
BCS + 6% CS	1.50	12.5
BCS + 12% CS	1.56	24
BCS + 18% CS	1.75	16.5
BCS + 24% CS	2	30

Chart: 1.3.1 MDD and OMC of BCS and BCS treated with various percentage of copper slag

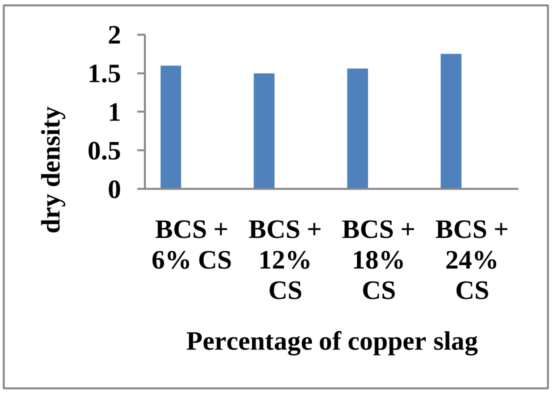

Table 1.3.2 MDD and OMC of BCS for various percentage of polypropylene fiber

Particulars	Compaction test	
	MDD gm/cc	OMC %
BCS+0.5% PPF	1.60	30
BCS + 1% PPF	1.36	23
BCS + 1.5% PPF	1.35	29
BCS + 2% PPF	1.43	31

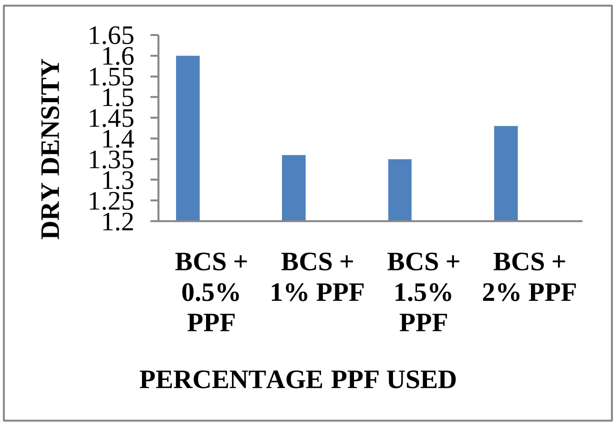

Chart: 1.3.2 MDD and OMC of BCS for various percentage of polypropylene fiber

Table 1.3.3 MDD and OMC of BCS for both mixing copper slag and polypropylene fiber

Particulars	Compaction test	
	MDD gm/cc	OMC %
BCS+ 3% CS + 0.5% PPF	1.65	30
BCS + 6% CS + 1% PPF	1.49	31
BCS + 9% CS + 1.5% PPF	1.51	29
BCS + 12% CS + 2% PPF	1.5	27

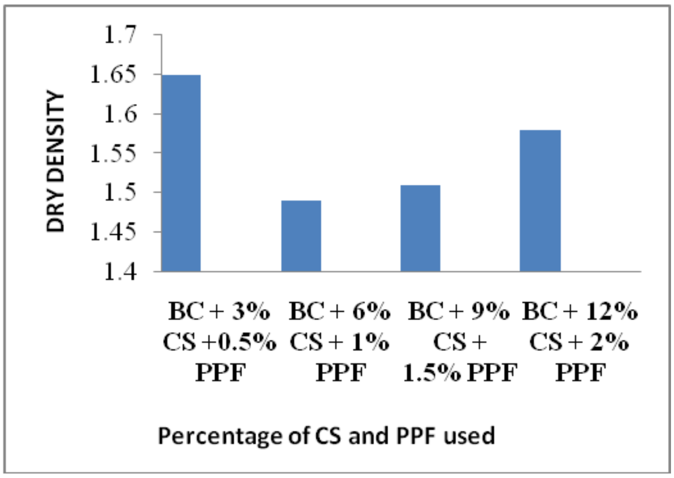

Chart: 1.3.3 MDD and OMC of BCS for both mixing copper slag and polypropylene fiber

1.4 UNIFIED COMPRESSION TEST

Table: 1.4.1 unified compressive strength of BCS treated with various percentage of copper slag at 0 days curing.

Particulars	UCS (kg/cm^2)
BCS + 6% CS	1.722
BCS + 12% CS	0.685
BCS + 18% CS	0.712
BCS + 24% CS	0.50

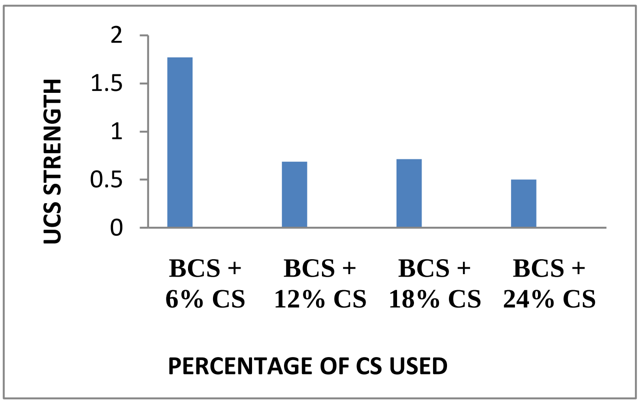

Chart: 1.4.1 unified compressive strength of BCS treated with various percentage of copper slag at 0 days curing.

Table: 1.4.2 unified compressive strength of BCS treated with various percentage of PPF.

Particulars	UCS (kg/cm^2)
BCS + 0.5% PPF	0.944
BCS + 1% PPF	0.782
BCS + 1.5% PPF	0.665
BCS + 2% PPF	0.538

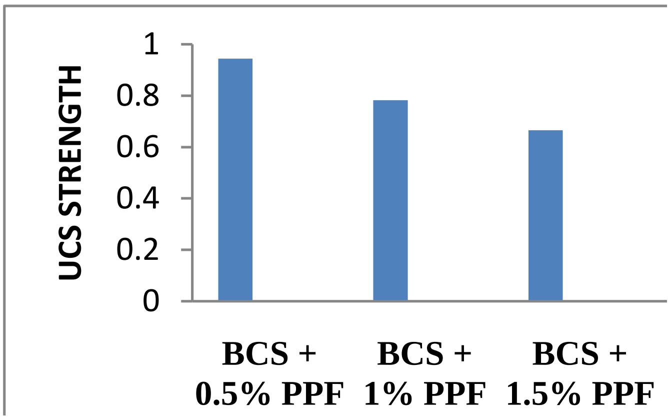

Chart: 1.4.2 unified compressive strength of BCS treated with various percentage of PPF.

Table: 1.4.3 unified compression strength of BCS treated with both copper slag and PPF.

Particulars	UCS (kg/cm^2)
BCS + 3% CS + 0.5% PPF	0.626
BCS + 6% CS +1% PPF	0.602
BCS + 9% + 1.5% PPF	0.550
BCS + 12% CS + 2% PPF	0.235

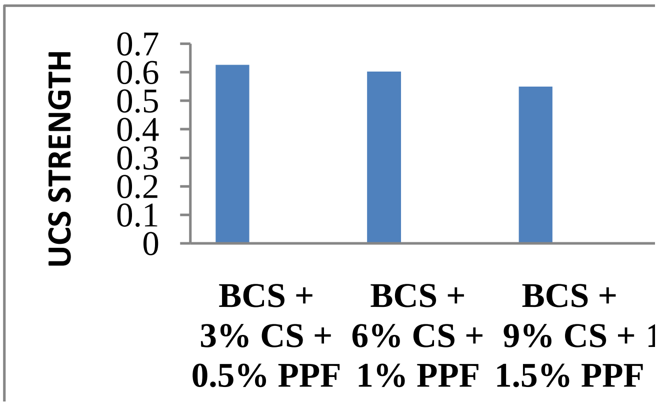

Chart: 1.4.3 unified compression strength of BCS treated with both copper slag and PPF.

1.5 CALIFORNIA BEARING RATIO TEST

Table: 1.5.1 Unsoaked California bearing ratio value for various percentage of copper slag

Particulars	CBR VALUE %
BCS + 6% CS	4.89
BCS + 12% CS	3.87
BCS + 18% CS	4.50
BCS + 24% CS	3.22

Chart: 1.5.1 Unsoaked California bearing ratio value for various percentage of copper slag

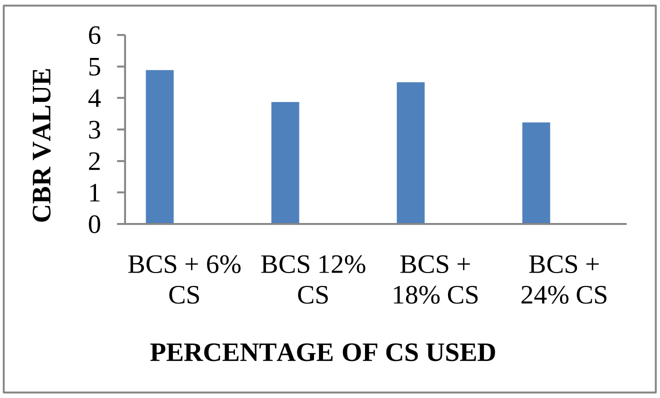

Table 1.5.2 Unsoaked California bearing ratio value for BCS treated with PPF

Particulars	CBR VALUE %
BCS + 0.5% PPF	5.80
BCS + 1% PPF	3.87
BCS + 1.5% PPF	3.22
BCS + 2% PPF	3.20

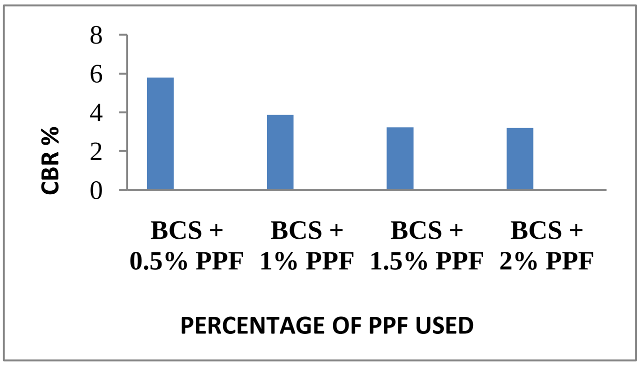

Chart: 1.5.2 Unsoaked California bearing ratio value for BCS treated with PPF

Table: 1.5.3 unsoaked and soaked California bearing ratio value for both copper slag and PPF

Particulars	Unsoaked	Soaked
BCS + 3% CS + 0.5% PPF	5.16	2.58
BCS + 6% + 1% PPF	5.81	1.93
BCS + 9% CS + 1.5% PPF	4.51	2.15
BCS + 12% CS + 2% PPF	3.87	1.93

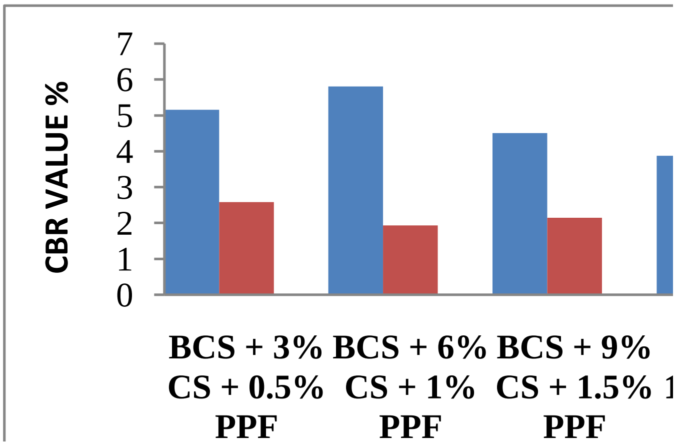

Chart: 1.5.3 unsoaked and soaked California bearing ratio value for both copper slag and PPF

CONCLUSIONS

- Compressive strength for copper slag (6% to 24%), the strength ranges from 1.722 kg/cm2 to 0.50 kg/cm2.
- The bound together compressive quality for polypropylene fiber (0.5% to 2%) , the quality reaches from 0.944 kg/cm2 to 0.538 kg/cm2. The greatest dry thickness and ideal dampness content when copper slag (6% to 24%) blended with the dark cotton soil . the MDD and OMC of BC soil ranges from 1.55 g/cc to 1.80g/cc and OMC 24% in mix of 24% copper slag.
- The combination of BC soil with polypropylene fiber (0.5% to 2%), the maximum dry density and optimum moisture content ranges from 1.55 g/cc to 1.42 g/cc and OMC 25% in combination with 2% polypropylene fiber.
- In case of polypropylene fiber as the quantity of material increases, the maximum dry density also decreases. So the 1 to 2% of polypropylene fiber can be used for better stabilization.
- When by mixing both copper slag (3 to 12%) and polypropylene fiber (0.5 to 2%), the greatest dry thickness and ideal dampness ranges from 1.68 g/cc to 1.52 g/cc, here we can observe that as we increase the material the MDD decreases.
- The unified compressive strength when both copper slag and polypropylene fiber mixed, unified strength ranges from 0.626 kg/cm2 to 0.235 kg/cm2
- The unsoaked California bearing ratio value of copper slag (6% to 24%) when treated with BC soil, CBR values ranges from 4.89% to 3.22%.
- The unsoaked California bearing ratio value when polypropylene fiber (0.5% to 2%) mixed with BC soil, CBR value ranges from 5.80% to 3.22%.
- The soaked and unsoaked California bearing ratio value when both copper slag and polypropylene fiber mixed with the BC soil, soaked CBR value are 2.58% to 1.93%. And unsoaked CBR value is 5.16% to 3.87%.
- From observing above result we can conclude that, the as the percentage of material increased, the unified strength and CBR value are decreasing. For the better stabilization the lesser percentage of materials should be used.

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