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Stabilization of Black Cotton Soil Using Industrial Waste Material for Pavement Construction

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ABSTRACT

One of the ongoing waste challenges is mine waste. One of the primary pollution concerns is the amount of solid waste produced throughout the mining operation. Mine waste includes acid and highly concentrated heavy metals, however, proper waste management practices are not followed. Finding a place to deposit this mine waste is challenging because of the limited real estate market and the rising land costs, which also have negative environmental consequences on the surrounding ecosystems. As per a study of earlier studies, 12–15% of the volume of mine waste is used as fine aggregate, and 55–60% of it is used as coarse aggregate. On the other hand, the Black Cotton soil is problematic because of the high swell-inducing montmorillonite potential for swelling and shrinking. The strength of the soil increases with lower water content and vice versa. Pavement failure is caused by early distress on surfaces with poor soil subgrade.

Keywords: Black Cotton Soil, Industrial Waste

1. INTRODUCTION

Mine waste consists of heavy metals that also cause erosion and dust. The impacts can have a long-lasting socioeconomic and environmental effects. It may lead to tremendously difficult consequences and may prove expensive to handle through remedial measures. Management of Wastes from the extractive industries plays a vital role in ensuring the long-term stability of the disposal unit and preventing water and soil pollution that is rising from acid or alkaline drainage and heavy metal leaching. 16 to 20 million tons ofore produce 40 to 50 million tons of waste per year with a waste ratio of 3:1 for the present condition. Iron ore tailing is such a kind of industrial waste generated during the production process of iron ore. The total recoverable reserves of iron ore in India are about 9,602 million tonnes of hematite and 3,408 million tonnes of magnetite. Chhattisgarh,Madhya Pradesh, Karnataka, Jharkhand, Odisha, Goa, Maharashtra, Andhra Pradesh, Kerala, Rajasthan, andTamilNaduare the principal Indian producers of iron ore.

2.OBJECTIVES

- To study the petrographic characterization of iron ore tailings for utilizing soil stabilization.
- To study the effect of iron ore tailings on index properties and consistency limits.
- To study the effect of iron ore tailings on shear strength properties.
- To study the effect of iron ore tailings on compaction properties.

3.SCOPE

This study was conducted to know the appropriateness of iron ore tailing (IOT) as a soil stabilizeradditive for black cotton soil. The qualities of black cotton soil were tested to ascertain the impact of IOTat different compactive efforts according to Indian standards(IS code). According to the protocols defined in IS 2720, all tests were conducted.

4.MATERIALS

Black cotton soil is collected which is having low value of CBR.**Iron ore tailings** are collected which is in the form of fine aggregates.
The soil sample used in this research work was obtained from Bidar district, Karnataka state, India. It was collected in disturbed sample to avoid any organic material. The material sample were packed in plastic bag and sealed for laboratory test.
Iron ore littering (mineral waste) will be thrown into the Kudremuk reservoir by KIOCL Limited, a public miner and exporter of iron ore pellets. We have requested authorization from the Ministry of Steel to remove sludgefromtheLakyadam. The iron ore tailings sieved through 0.075micron and kept in packaged plastic bag and sealed. Iron ore tailings is kept in air tight to avoid pre-hydration.

5.METHODOLOGY

These are the experiments conducted on black cotton soil with or without Red Mud.

1. Specific Gravity
2. Atterberg's Limits i)Liquid limit ii)Plastic limit iii)Plasticity Index
3. Standard Proctor Compaction Test
4. Unconfined Compressive Test
5. California Bearing Ratio

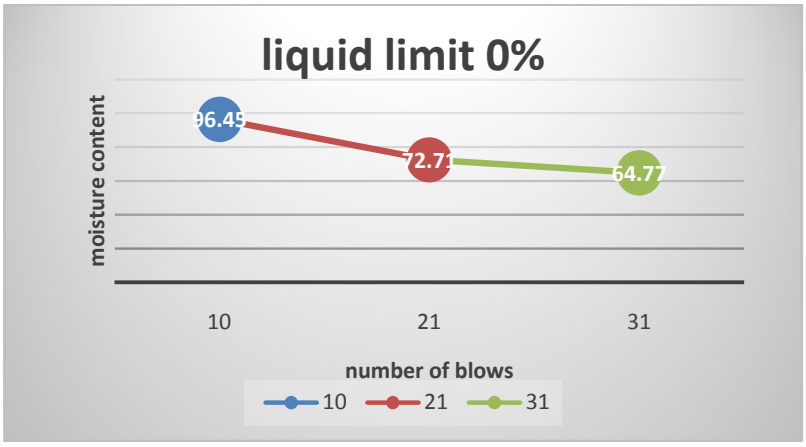
6. RESULTS

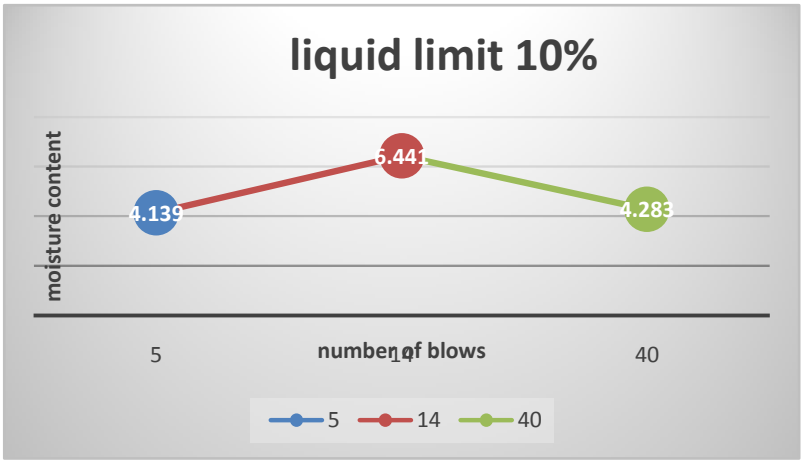
The tests were conducted on Black cotton soil as per left-justified code for each test.

Table 4.1 Basic Test Results on Black Cotton Soil

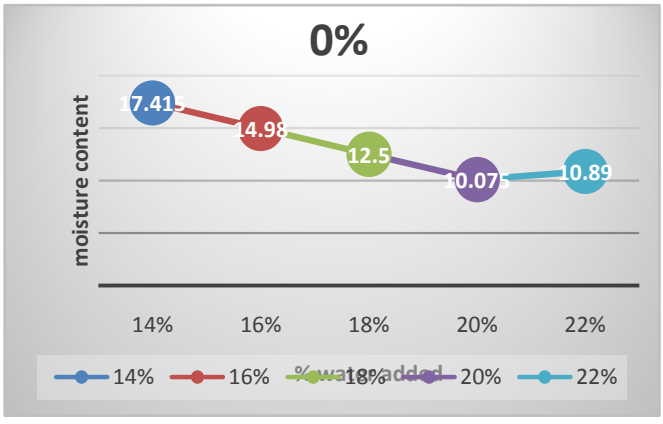
SI No	TESTS	RESULTS
1	SPECIFIC GRAVITY	2.321
2	LIQUID LIMIT %	77.97
3	PLASTIC LIMIT %	42.17
4	PLASTICITY %	35.8
5	COMPACTION FACTOR MDD % OMC %	1.65 24
6	UNCONFINED COMPRESSIVE STRENGTH kn/m^2	0.814

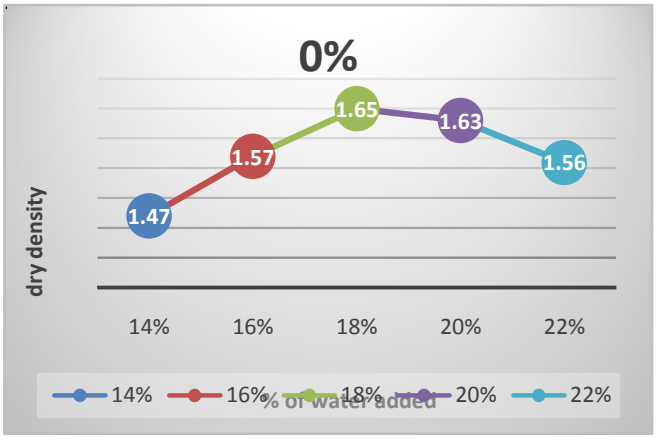
LIQUID LIMIT

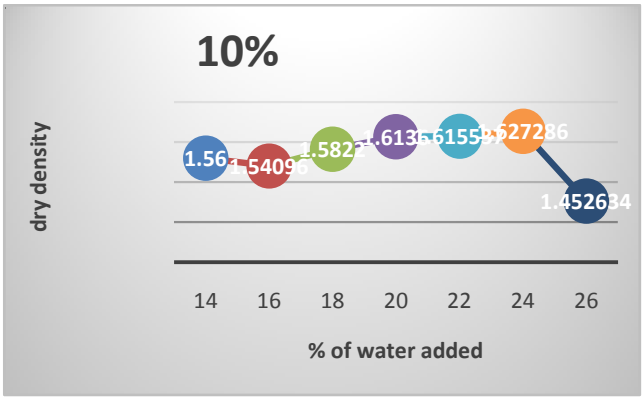


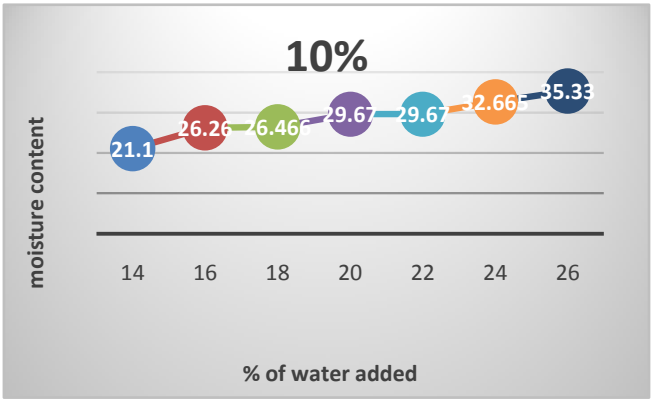


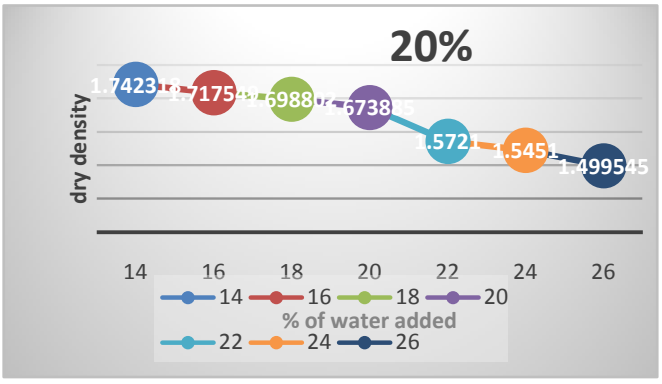
COMPACTION TEST

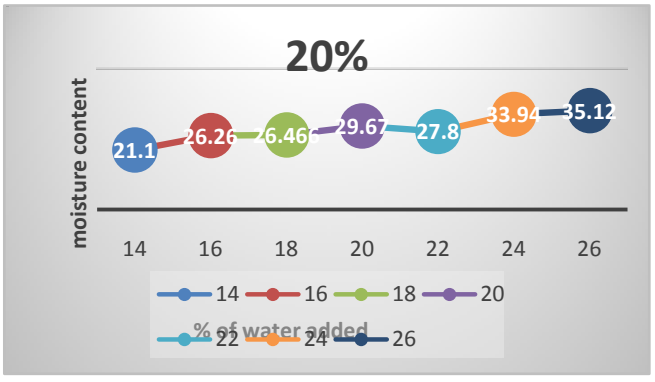


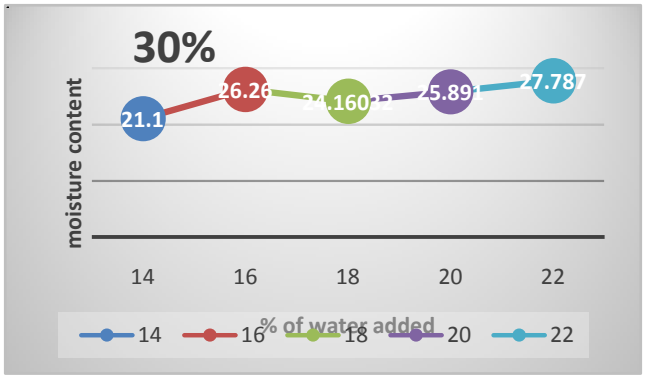


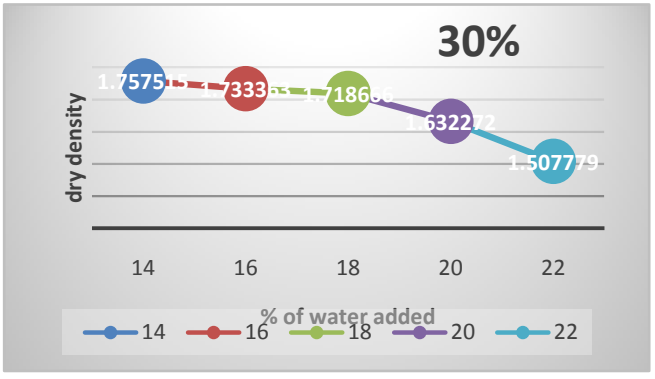

10%
dry density
1.56
1.452634
14 16 18 20 22 24 26
% of water added


10%
moisture content
21.1
26.26
29.67
29.67
35.33
14 16 18 20 22 24 26
% of water added

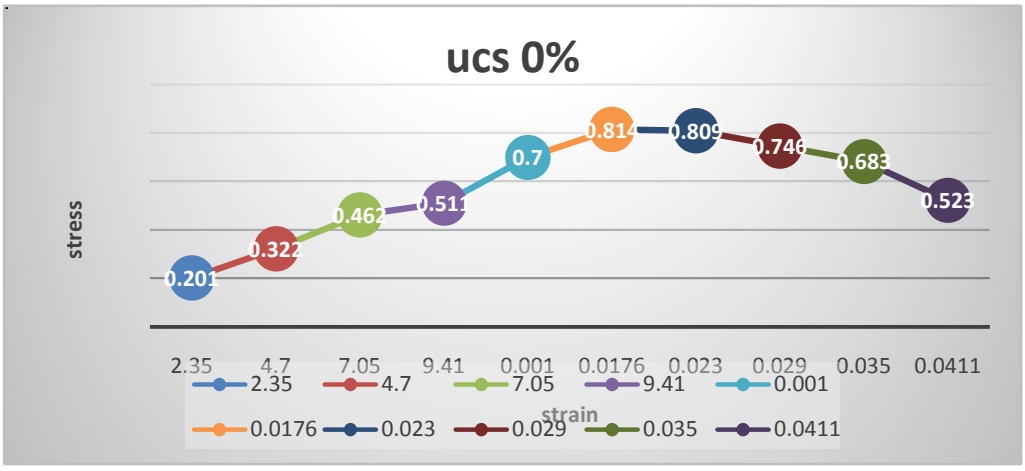

20%
dry density
1.499545
14 16 18 20 22 24 26
14 16 18 20
% of water added
22 24 26


20%
moisture content
21.1
26.26
29.67
27.8
35.12
14 16 18 20 22 24 26
14 16 18 20
22 24 26

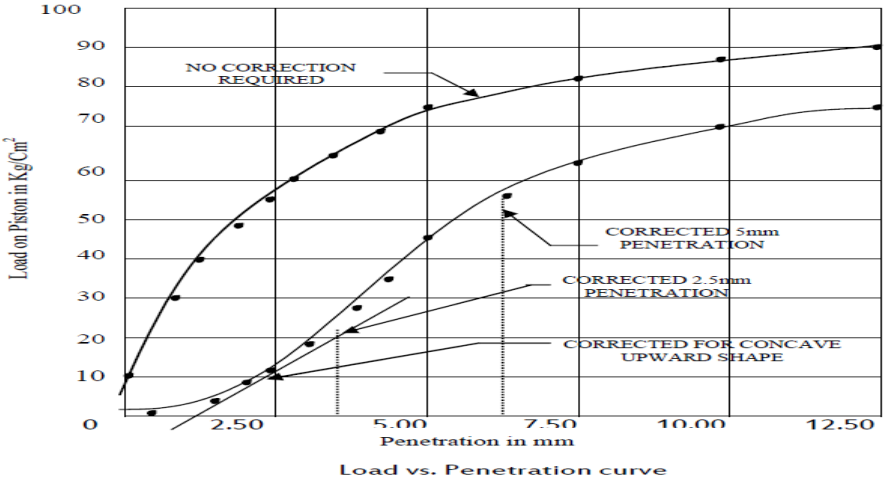

30%
moisture content
21.1
26.26
27.787
14 16 18 20 22
14 16 18 20 22
% of water added


30%
dry density
1.507779
14 16 18 20 22
14 16 18 20 22
% of water added

UNCONFINED COMPRESSION STRENGTH



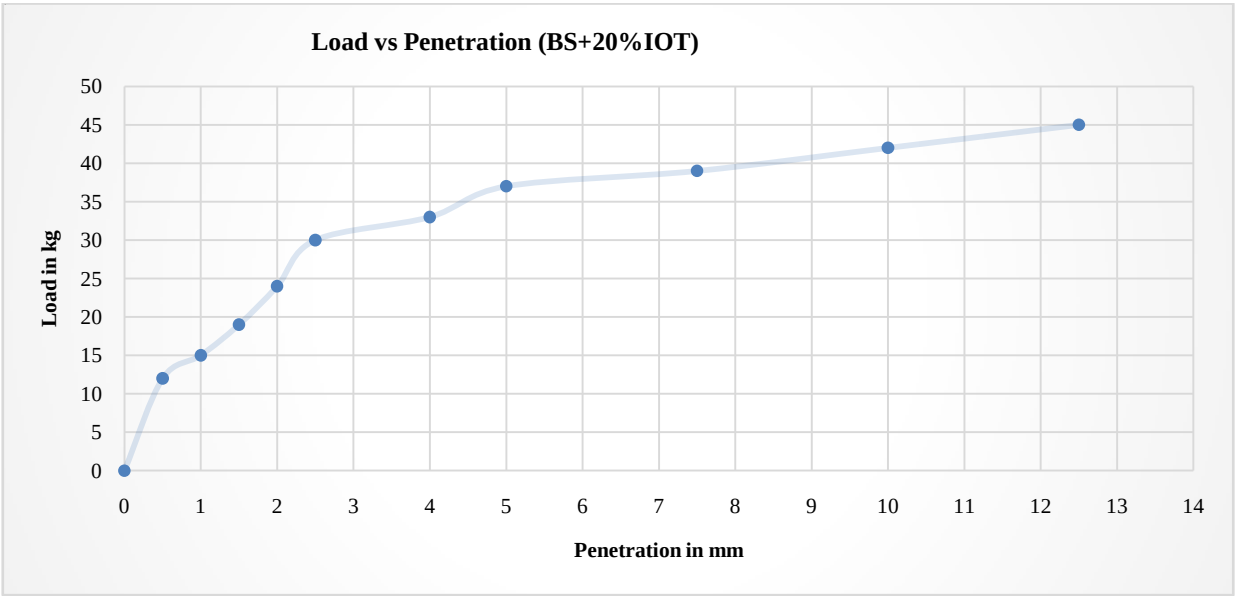
CALIFORNIA BEARING RATIO



CONCLUSIONS

- Based on the investigation distributed during this study, the following conclusions are drawn:
- From the results of the current study, it's complete that, the soil stabilization victimization of iron ore tailings could be an effective method for the strengthening of soil. Since iron ore tailings could be a low-value material obtain high strength and makes the structure strong and sturdy. The check has been conducted on black cotton soils. because of the stabilization of the soil, the bearing capability of the soil gets increasing and any foundation is constructed within the soil.
- To minimise industrial waste (Iron ore tailings) releasing directly to the environment which can harm atmosphere through this work I recommend Iron ore tailings can be used as stabiliser in pavement construction .
- The results shows after adding 10%,20% and 30% of Iron ore tailings to weight of black cotton soil.
- The liquid limit and plastic limit increased with the addition of IOT whereas the shrinkage limit decreased with addition of IOT.
- Also the water decreases as the amount of IOT addition which are shown in the compaction test results.
- CBR values of soaked CBR and unsoaked CBR was increased with addition of IOT and were peaked at 30% of IOT.
- Through all the above test results 30% addition of IOT reached the values typical pavement construction soil standards.

RECOMMENDATION

Through the results obtained in this study

- An optimal of 30% addition of Iron ore tailings to the weight of black cotton soil can increase the properties of black cotton soil and also helps in the sstabilizationof pavement construction.
- Iron ore tailings alone cannot be used as a stabilizer in black cotton soil, addition of lime and cement also to be used with the addition of Iron ore tailings as stabilizer of black cotton soil in the pavement construction.