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STABILIZATION OF BLACK COTTON SOIL BY USING COPPER SLAG AND FLY ASH

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Abstract: Stabilization of Black Cotton (BC) soils have been in recently attracted many researchers. Soil stabilisation is necessary when the available soil for construction projects, such as black cotton soil, is not adequate for the intended application. In order to improve the strength and stability of a certain soil mass as well as other engineering and physical features, a process known as soil stabilisation is performed. For the purpose of a foundation, the soil must be solid and sturdy. However, the expansive nature of some soils, particularly black cotton soil, causes issues. cotton in black Montmorillonite is present in large concentrations in black cotton soil. Which is the cause of the expansiveness. These properties result in sudden soil cracks. When atmospheric conditions change, using this kind of land could seriously injure the building. Expansive soil is one of the major soil deposits in India they exhibit high swelling and shrinkage when exposed to changes in moisture content and hence have been found to be most troublesome from engineering considerations. So there is a need to stabilizethese soils when they are used for construction. In this regard, the expansive soil properties are found out. To this soil, as a first consideration, stabilized with copper slag adding at an interval of 5% reaching up to 30%. In second consideration, fly-ash is selected as a stabilizing agent to stabilize the expansive soil at an interval of 2%, 4% reaching up to 6%. In the last consideration, sample of expansive soil with 30% copper slag is taken to be stabilized with fly-ash at an interval of 5%, 10% and 15%. finally regression analysis for these test results is carried out.

Key Words- *Black Cotton Soil, Copper Slag, Fly Ash…*

1. INTRODUCTION

Soil stabilization is the process in improving the engineering properties of soils and thus making it more stable. It is essential when the soil accessible for construction is not suitable for the anticipated purpose. In its broadest sense, stabilization included compaction, reconsolidation, drainage and many other such process. However, the term stabilization is generally restricted to the processes which alter the soil material itself for improvement of its properties a cementing material or a chemical is added to a natural soil for the purpose of stabilization. Is to improve the natural soils for the construction of foundations, highways and airfields. Soil stabilization is used to reduce the permeability and compressibility of the soil mass n earth structures and to increase its shear strength. Soil stabilization is of stab required to increase the bearing capacity of foundation soils. However, the main use of the principles of soils stabilization are used for controlling the grading of soils and aggregates in the construction of bases and sub-bases of the foundations, highways and airfields. Soils stabilization is also used to make an area trafficable within a short period of time for military and other emergency purpose. Sometimes, soil stabilization is used for city and suburban streets to make them more noise-absorbing. The expansive soil is a very problematic soil these soils occur in up to 3.7m depth on average in India. The black soil is occupying nearly 30% of area. The black soils contain various sever our problem just like more shrinkage more swelling less strength and stability and having volumetric change. Based upon the seasonal change to avoid these problem used.Admixtures like poly propylene, polyethylene etc, the waste material occur from manufacture process these material are create not only environment problem but also create the hazardous and disposal problem that why to avoid this problem these waste material are used in the strengthens soils Soil stabilisation is necessary when the available soil for construction projects, such as black cotton soil, is not adequate for the intended application. In order to improve the strength and stability of a certain soil mass as well as other engineering and physical features, a process known as soil stabilisation is performed. For the purpose of a foundation, the soil must be solid and sturdy. However, the expansive nature of some soils, particularly black cotton soil, causes issues. cotton in black Montmorillonite is present in large concentrations in black cotton soil. Which is the cause of the expansiveness. These properties result in sudden soil cracks. When atmospheric conditions change, using this kind of land could seriously injure the building. The soil can be stabilized by applying an admixture that lowers its swelling potential in order to get rid of it. This article discusses a variety of soil stabilizing techniques. (CBR) of Copper Slag with fly Ash Stabilized sub-Grade Soil. To identify factors affecting Compressive Strength (CBR) of Stabilized Sub-Grade Soil containing Copper slag and fly ash and Sensitivity Analysis of Sub-Grade Soil CBR. Sub-grade soil stabilization is one of the primary and major processes in the construction of any highway. Instead of borrowing a suitable soil from long distance it is economical to use locally available plastic soil after stabilization with cost effective and easily available industrial wastes. In this present study, components used are marble dust which is an industrial waste product, fly ash.

For this study secondary data has been collected. From the website of KSE the monthly stock prices for the sample firms are obtained from Jan 2010 to Dec 2014. And from the website of SBP the data for the macroeconomic variables are collected for the period of five years. The time series monthly data is collected on stock prices for sample firmsand relative macroeconomic variables for the period of 5 years. The data collection period is ranging from January 2010 to Dec 2014. Monthly prices of KSE - 100 Index is taken from yahoo finance.

2. LITERATURE REVIEW

Prof. Jinka Chandrasekhar and Timir A Chokshi (2015) discussed that Copper slag is one of the waste materials that are being used extensively in the civil engineering construction industry. Copper producing units in India leave thousands of tonnes of copper slag as waste every day. Large quantities of the accumulated slag is dumped and left on costly land, causing wastage of good cultivable land. Based on U.S. environmental protection agency regulations, governing solid waste characteristics, copper slag can be classified as a non-hazardous material. Granulated copper slag is more porous and, therefore, has particle size equal to that of coarse sand. In this paper, a review of the previous research studies carried out by various researchers on utilization of copper slag in geotechnical applications is discussed and presented. 2. Nalbantoglu et al. (2001) found that addition of fly ash decreases swelling potential in expansive soils. The hydraulic conductivity of treated soils was also found to increase with increasing lime or fly ash and with increasing curing time.

S.A Kanalli, Sureka nagesh, Ganesh K (2015) Utilization of Mine waste as construction material and stabilizer with Black Cotton Soil. The CBR test here was conducted according to IRC, The Soaked CBR value increased for the combination of Black cotton soil and copper slag. By utilizing this mix, we can avoid the problems of swelling and shrinkage of expansive soil The coefficient of permeability of copper slag was found to be 2.8×10 -6 m/ that indicates its potentiality for its use as a drainage layer in road base. The coefficient of permeability of copper slag local soil mix was found to be 5.7 ×10 -9 m/s, thus proving its impervious nature and thus it's suitability as a subgrade in road pavement.

Bambhaniya Mehul Ashokbhai, Joshi Kisan Rajubhai, Solanki Prashanth Amarabhai, Mehul M. Chavda (2018) Utilization of copper slag to improve geotechnical properties of soil. Copper slag is blackish granular material similar to coarse sand which is having a moisture density curve as flat which is similar to the sandy soil and by mixing of copper slag the California bearing ratio value is increases and by this, we can avoid the problem of swelling and shrinkage of expansive soil. The proper utilization can solve the disposal of copper slag in nature.

C. Prof. Mohammed A. Qureshi (2015) Improvement in Soil properties of Expansive Soil by using Copper Slag. The study of copper slag can be recommended as effective stabilizing agents for improvement of soils for highway embankments, subgrade, and sub-base. It reduces the construction cost of land reclamation due to saving in material cost. It reduces the environmental impact due to quarrying and aggregate mining.

Shubham more, Apeksha lokhande, Shaikh sabir, pooja Aade, Nilambarika Bansode, Omkar joshi (2018) Stabilization of black cotton soil by using steel slag, By adding the steel slag waste in the poorly graded black cotton soil may improves the California bearing ratio and the liquid limit is about slightly increases, With the proper utilization of steel slag Maximum dry density increasing in order the Optimum moisture content starts decreasing and it reduces the cost of stabilization, Use of copper slag in the black cotton soil reduces the hazardous effect on environment by the disposal. maximum dry density is increasing by neutralizing and orderly rearranging the clay partials and increases the compressive strength of the soils by increasing the inter particles bonding between them.

P. Bharath Goud, D. Sruthi Laya (2018) stabilization of black cotton soil with copper slag and rice husk ash – An environmental approach,The black cotton soil collected from the local villages has been stabilized with copper slag and rice husk ash and the plasticity will increases and California bearing ratio is also increases Maximum dry density is increasing accordingly but the free swell index reduced by the addition of RHA and CS. of waste materials as stabilizers gives economic and ecological solution for stabilization of sub grade of road embankment.

Shilpa Devi Gadde, Mohammed Ibrahim (2019) an experimental analysis on the influence of copper slag as stabiliser on black cotton soil. Based on experimental study they found that the soil stabilization using copper slag is a very effective process for the strengthening of soil. Since copper slag is a low-cost material, it obtains high strength and makes the structure strong and durable. Due to stabilization the soil the bearing capacity of the soil gets increasing and any foundation can be construction in the soil. By the proper mixing the plasticity Maximum dry density, California bearing ratio, liquid limit will increase.

S.A Kanalli, Sureka nagesh, Ganesh K (2015) Utilization of Mine waste as construction material and stabilizer with Black Cotton Soil. The CBR test here was conducted according to IRC, The Soaked CBR value increased for the combination of Black cotton soil and copper slag. By utilizing this mix, we can avoid the problems of swelling and shrinkage of expansive soil The coefficient of permeability of copper slag was found to be 2.8×10 -6 m/ that indicates its potentiality for its use as a drainage layer in road base. The coefficient of permeability of copper slag local soil mix was found to be 5.7 ×10 -9 m/s, thus proving its impervious nature and thus it's suitability as a subgrade in road pavement.

3. MATERIALS & METHODS.

3.1 Black Cotton Soil.

Black cotton soil is very favourable for the cultivation of cotton. It is called black cotton soil because it is black in colour formed by the presence of titaniferous magnetite. Black cotton soil is clay-rich soil. it contains calcium, carbonate, potash, and holds moisture and is mainly formed in the tropics and subtropics region. Black cotton soil is also rich in lime, iron, and magnesium but contains a low amount of phosphorous, nitrogen, and organic matter. So, it is more fertile in low lands than on the uplands. we can see the cracks in many lands having black soil, this is because during the dry season they form the crack for the circulation of the air. Though it is very good soil for cultivation but is problematic soil for civil engineering work due to its swelling and shrinkage property. Black cotton soil is heavy clay soil, varying from clay to loam; it is generally light to dark grey in colour. Cotton grows in this kind of soil. The soil prevails generally in central and southern parts of India. The most important characteristic of the soil is, when dry, it shrinks and is hard like stone and has very high bearing capacity. Large cracks are formed in the bulk of the soil. The whole area splits up and cracks up to 150 mm wide are formed up to a depth of 3.0 to 3.5 metre.

Black Cotton Soil.

3.2 Copper Slag.

Copper slag is an industrial waste by product obtained by the manufacture process it is mettle smelting and reefing of copper. We taken copper slag 2%, 4%, 6% while performining. the copper slay is used for replacement of fine aggregated in concrete as in up to 15% by weight of copper slay is used as fly ash replacement together with up to 1.5%. The multiple extraction leading tests indicate that the elements present in the slag are stable and are not leachable even through repetitive leaching under acid rain in a natural environment the highest concentration of all the elements is for below the prescribed limits. it has been estimated that approximately 24.6million tons of slay are generated from the world of copper industry. Although copper slag is widely used in the sand blasting in and in the manufacturing of abrasive tools, the reminder is disposed of without any further reuse or reclamation. Copper slag possesses mechanical and chemical character to the copper slays Copper slag.

Copper Slag.

3.3 Fly Ash.

Large quantities of coal are being burnt in thermal power stations to meet the ever increasing demand for thermal power. Combustion of coal results in a residue consisting of inorganic mineral constituents and organic matter which is not fully burned. we take 5%, 10%, 15%. The inorganic mineral constituents from ash: about 80% of the ash is fly ash. Environmentally safe disposal of large quantities of ash is not only tedious but also expensive. To reduce the problems of disposal, great efforts are being made to utilize fly ash. Fly ash is a by-product of thermal power plants which use coal as fuel. A waste material extracted from the gases emanating from coal fired furnaces, generally of a thermal power plant, is called fly ash. One of the chief usages of volcanic ashes in the ancient ages were the use of it as hydraulic cements, and fly ash bears close resemblance to these 5 volcanic ashes. These ashes were believed to be one of the best pozzolans (binding agent) used in and around the globe. The demand of power supply has exponentially heightened these days due to increasing urbanization and industrialization phenomena.

3.4 METHODS

3.4.1 Atterberg's limit test

Liquid limit test

From liquid limit test, the compression index may be estimated, which is used in settlement analysis. If the natural moisture content of soil is higher than liquid limit, the soil can be considered as soft and if the moisture content is lesser than liquid limit, the soil is brittle and stiffer. The value of liquid limit is used in classification of the soil and it gives an idea about plasticity of the soil.

Plastic limit test

Plastic Limit is determined by repeatedly remolding a small ball of moist plastic soil and manually rolling it out into a 1/8in thread. A plastic limit roller device can also be used to perform this test. The Plastic Limit is the moisture content at which the thread 0crumbles before being completely rolled out.

Plasticity index

The plasticity index of a soil is the numerical difference between its liquid limit and its plastic limit, and is a dimensionless number. Both the liquid and plastic limits are moisture contents.
Plasticity Index = Liquid Limit - Plastic Limit

3.4.2 California Bearing Ratio Test:-

The California bearing ratio test is penetration test meant for the evaluation of subgrade strength of roads and pavements. The results obtained by these tests are used with the empirical curves to determine the thickness of pavement and its component layers.

This test is performed to measure the strength of the soil. The specimens are prepared by mixing different percentage of copper slag (2% 4% & 6%) and Fly Ash (5% 10% & 15%)one with only BC soil without adding copper slag & Fly Ash then they are kept under CBR testing machine to determine CBR values. The CBR test denotes a measure of resistance to penetration of a soil or flexible pavement material, of standard plunger under controlled test conditions.

Apparatus:- CBR test equipment consists of a machine fitted with the plunger which penetrates at the specified rate into the test specimen placed in the CBR Mould. Hollow cylindrical mould of inner diameter 150 mm and height 175 mm, spacer disc, compaction rammer of 4.5 kg with a drop of 450 mm, metal weights i.e., two discs weighing 2.5 kg each. Other accessories like IS sieve 19 mm, tray, mixing bowl, straight edge, filter paper, weight balance, measuring jar.

California Bearing Ratio Test

3.4.3 Standard Proctor Compaction Test

The Proctor Test is conducted to study the density of soil and its corresponding optimum moisture content. Compaction of soil is a mechanical process by which the soil particles are constrained to be packed more closely together by reducing the air voids. Soil compaction causes decrease in air voids and consequently an increase in dry density. This may result in increase in shearing strength.

3.4.4 Unconfined compression test.

The Unconfined Compression Test is a laboratory test used to derive the Unconfirmed Compressive Strength (UCS) of a rock specimen. Unconfirmed Compressive Strength (UCS) stands for the maximum axial compressive stress that a specimen can bear under zero confining stress. The unconfined compression test is the most popular method of soil shear testing because it is one of the fastest and least expensive methods of measuring shear strength. It is used primarily for saturated, cohesive soils recovered from thin-walled sampling tubes. The test is not applicable to cohesionless or coarse-grained soils.

4. RESULT AND DISCUSSION

Atterbergs Limit

Parameters	BC soil	BC soil 2% Cs + 5% fly ash	BC soil + 4% CS + 10% fly ash	BC soil + 6% CS + 15% fly ash
Liquid Limit	69.9%	48.7%	46.44%	42.33%
Plastic Limit	28.36%	23.10%	22.09%	21.46%
Plasticity Index , Ip	41.54%	25.6%	24.35%	20.87%

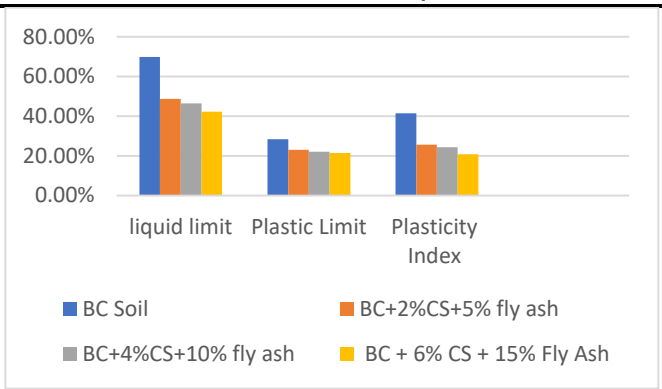

Chart -1: Atterbergs Limit.

California Bearing Ratio

	BC soil	BC soil 2% Cs + 5% fly ash	BC soil + 4% CS + 10% fly ash	BC soil + 6% CS + 15% fly ash
At 2.5 mm penetration	1.75%	1.83%	1.87%	1.75%
At 5mm penetration	1.81%	1.88%	2.01%	2.09%
At 7.5mm Penetration	1.77%	1.91%	2.07%	2.13%
CBR VALUE	1.81%	1.91%	2.07%	2.13%

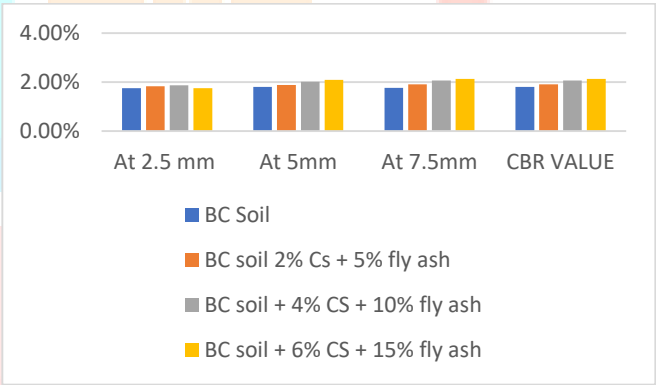

Chart - California Bearing Ratio

Standard Proctor Compaction Test

	Max Dry Density,g/cm^3	Optimum Moisture Content%
BC Soil	1.90	13.91
BC soil 2% Cs + 5% fly ash	2.20	14.71
BC soil + 4% CS + 10% fly ash	1.99	12.05
BC soil + 6% CS + 15% fly ash	2.07	14.54

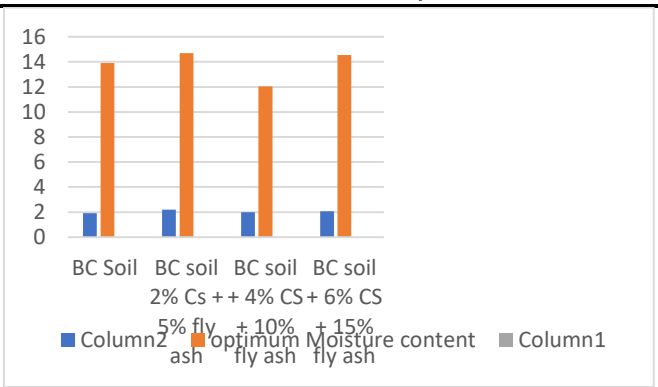

Chart – 3 Standard Proctor Compaction Test

5. RESULT & DISCUSSION

To study the effect after adding Copper Slag and Fly Ash in the Black Cotton soil, all the test were conducted.

- Atterberg's Limit.
  In Liquid Limit test, as result shown in the above table of Atterberg;s Limit there is a no such huge variation in the result
  In plastic Limit test, there is a little Variation
  There were changes in liquid limit and plastic limit after adding Copper Slag & Fly ash
- California Bearing Ratio.
  In CBR Test, as shown in result there is Increase in CBR Value with Increase in copper slag and fly Ash percentage Thus the strength of soil can be improve by using Copper slag and fly Ash as soil stabilizer.
- Standard Proctor test.
  Maximum dry density reduced slightly with an increase in content of copper slag & Fly ash Optimum moisture content value had great improvement with increase in Black Cotton soil

6. CONCLUSIONS

On the basis of the result of Experimental test performed:-

- In Atterberg's Limit, as we went on adding the percentage of admixture, the liquid Limit decreased
- In plastic Limit, with Increase in addition of copper & Fly ash there was decrease in plastic limit.
- In CBR, there was an Increase in CBR value with Increase in Percentage of copper Slag & fly Ash.

REFERENCES

[1]. Prof. Jinka Chandrasekhar and Timir A Chokshi (2015)
[2]. S.A Kanalli, Sureka nagesh, Ganesh K (2015)
[3]. Bambhaniya Mehul Ashokbhai, Joshi Kisan Rajubhai, Solanki Prashanth Amarabhai, Mehul M. Chavda (2018) [4]. P. Bharath Goud, D. Sruthi Laya (2018)
[4]. C. Prof. Mohammed A. Qureshi (2015)
[5]. Shubham more, Apeksha lokhande, Shaikh sabir, pooja Aade, Nilambarika Bansode, Omkar joshi (2018)
[6]. P. Bharath Goud, D. Sruthi Laya (2018)
[7]. Shilpa Devi Gadde, Mohammed Ibrahim (2019)
[7]. S.A Kanalli, Sureka nagesh, Ganesh K (2015)
[7]. Tushal Baraskar (2014)