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Chemical Stabilization of Clayey Soil Using Blend of Calcium Carbide Residue and Ground Granulated Blast Furnace Slag

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Abstract:- This study investigated the use of two kinds of industrial wastes Ground Granulated Blast Furnace Slag (GGBS) and Calcium Carbide Residue (CCR) in the stability of soil. These industrial wastes are generally dumped or thrown, which produce detrimental effect on the environment. The use of these wastes as soil stabilization improves the properties of soil which helps in various purposes such as designing of pavements, embankments, etc. and save the environment from the ill impact. The soil can be treated and stabilized well at a relatively low cost by using these additives.
From the experimental results, it has been observed that various properties of soil added with these stabilizers at certain percentage show remarkable positive changes as compared to the natural soil obtained. The permeability of the soil has reduced, which states that it can be used for the impervious core in Embankments.
In this research, GGBS and CCR were employed in stabilizing soils, GGBS was fixed at 20% respectively using index properties tests and then CCR was varied (i.e. 0.5%, 1.0% and 1.5%). Standard proctor test results showed general decrease in MDD values and increase in OMC values which may be obvious as the specific gravity of the additives is less than that of the soil.
The value of Unconfined Compressive Strength has increased enabling increase in the bearing capacity of soil. The increased value of California Bearing Ratio in both soaked and unsoaked conditions indicates that the designing of flexible pavements becomes economical by reducing the thickness of base and sub-base courses.

Keywords**:** *Clayey Soil, Cement , Lime, Sieve Rice Husk, Pycnometer Test, Casagrande Test, Liquid Limit Device, CBR Test, UCS Test.*

I. INTRODUCTION

Soil stabilization is the process adopted for improvement of the engineering properties of the soil and then making it in more stable. It is required when the soil available at site location during the site location during the construction is not suitable for the intended purpose.

For growth of the country along with the technological advancements, development in infrastructure field is also required and with the rapid rate of urban growth in our country it is becoming difficult to find the proper quality of soil for engineering applications. Hence, it has become a challenge for a geotechnical engineer to come up with some new ideas which would allow us to work on the even poor quality of soil without any risk of Failure of the structure. With a diversification of many types of soil in our country a major category of soil which is of many problems to engineers is expansive soil which creates a lot of problems to structure formed on them. This study focuses on the expansive soils and how various geotechnical parameters can be enhanced by the use of coir fiber and Bagasse Ash. The major goal of soil stabilization is to enhance the strength properties and reduce the settlement. Soil stabilization is an efficient and unfailing technique for enhancing soil strength and firmness. The material which is use to mix with soil for the soil stabilization is known as the soil stabilizer. It is illustrious that the mechanism of soil stabilization by coir fiber and Bagasse Ash is a worthy method of ground improvement, which leads to increase in UCS, CBR value of clay soil, hence it increases the stability of structures, i.e. sub grade and foundation.

II. MATERIALS

A. Soil

Soil is taken from for this exploration work. The measure of soil is taken around 150 kg of locally accessible clayey soil (CI) was gathered and air dried in open ranges. The superfluous materials like rocks and vegetative matter were expel physically from soil. The irregularities are available in soil are additionally broken with the assistance of wooden sledge and after that sieved through 4.75 mm strainer to concentrate rock part. By then the earth illustration was oven dried for 24 hours at 100 °C before it was mixed with Calcium Carbide Residue and Ground Granulated Blast Furnace Slag using it for trials. The properties of soil used are given below in table.1

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Table 1 Properties of Soil

S.NO.	PROPERTIES	RESULTS
1.	Liquid Limit	36 %
2.	Plastic Limit	21.5 %
3.	Plasticity Index	14.5 %
4.	Optimum Moisture Content	14.06 %
5.	Maximum Dry Density	19.3 kN/m³
6.	Specific Gravity	2.56
7.	Indian Soil Classification	CI

B. Calcium Carbide Residue

The Calcium Carbide Residue Residue is used in this research was taken from Locally market table 2.

Table 2 Chemical Composition of Calcium Carbide Residue Residue

S. No	Name of constituent	Percentage
1	SiO_2	6.49
2	$Al_2O_3 + Fe_2O_3$	5.80
3	Calcium Oxide (CaO)	70.78
4	Magnesium oxide (MgO)	0.69
5	SO_3	0.66

C. Water

Consumable water was utilized as a part of this research is taken from college. Consumable water is carefully measured to be free from undesirable chemicals materials and furthermore malicious material

III. SOIL PREPARE & EXPERIMENT

It also provide the de details that how the various resources are utilize and processed in the present study. It also gives the details of mix proportions ratios. The most profitable perspective in this part is aftereffects of different tests are additionally included this section. The results included modified proctor test (OMC and MDD) UCS and CBR test results.

The soil take up in the proposed study was gathered from local area. Right off the bat the soil knots were broken with the assistance of a wooden hammer and after that air dried. At that point soil was gone through from sifter 4.75 mm and after that gathered in packs. The amount of soil required is then oven dried at 105˚C for 1 day.

- *Pycnometer Test*
- *Casagrande Test*
- *Thread Test*
- *Modified Proctor Test*
- *CBR Test*
- *UCS*

IV. RESULT AND DISCUSSION

A. Standard Ptoctor Test

Soil Granulated blast furnace slag mixture.

Table 3 MDD and OMC for soil– GGBS– Calcium Carbide Residue mix

S. No.	Proportion Soil : GGBS: Calcium Carbide Residue	MDD (kN/m³)	OMC (%)
1	100:0:0	18.7	14.1
2	79.5:20:0.5	18.6	15.80
3	79:20:1.0	18.1	16.30
4	78.5:20:1.5	18.3	16.10

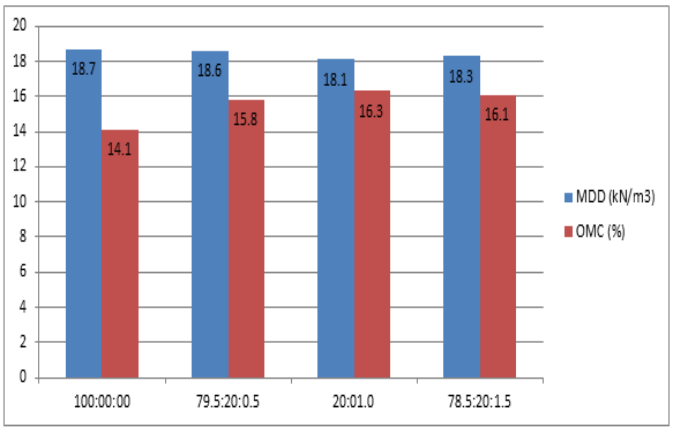

Fig 1 Varation Between MDD and OMC of GGBS, Calcium Carbide Residue and Soil with Different Prportions

B. Uconfined Comptession Strength Test

Table 4 UCS for Soil Gfound Granulated Blast Furnance Slag and Calcium Carbide Residue Mixture.

Clayey Soil:GGBS:CC	Curing Period (Days)	UCS (kN/m²)
100 : 00	7	260.12
79.5:20:0.5	7	357.27
79:20:1.0	7	371.87
78.5:20:1.5	7	405.15

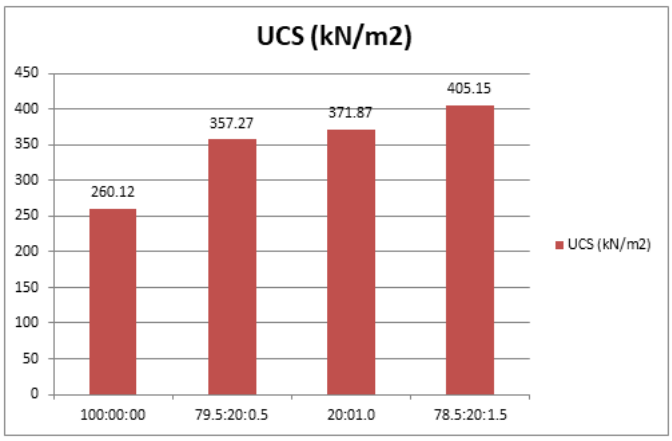

Fig 2 Variation Between Compression Value of Ground Granulated Blast Furnace Slag Calcium Carbide.

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C. California Bearing Ratio Test

SOIL: Calcium carbide Residue Mixture

Table 5 CBR of SOIL Ground Granulated Blast Furnace Slag and Calcium Carbide Residue Mixture.

CS:GGBS:CC	CBR (%)
100:00:00	3.4
79.5:20:0.5	4.2
79:20:1.0	4.5
78.5:20:1.5	4.8

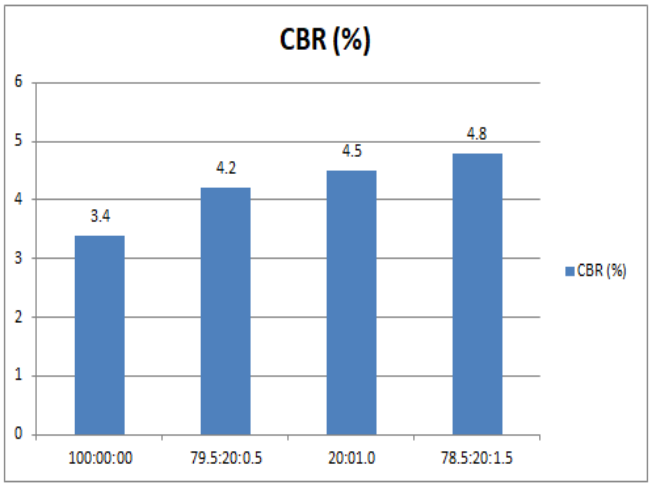

Fig 3 Varation B/W California Bearing Ration Values Of GGBS , Calcium Carbide Residue and Soil with Different Proportions.

V. DISCUSSIONS

A. Modified Protector Test

- *There is an also increase of OMC from 15.80 to 16.10% and decrease of MDD from 18.6 to 18.3% when the percentages of Calcium Carbide Residue vary from 1.0%, 1.5% and 2.0 and Ground Granulated blast furnace slag is fixed at 20%.*
- *Specific gravity of Ground Granulated blast furnace slag is lower than as compared to soil. So MDD is decreased and OMC is increased*
- *There is an expansion in OMC when the amount of Ground Granulated blast furnace slag is expanded. The purpose for of this pozzolanic response of Ground Granulated blast furnace slag with soil that needs more water for completion of cation trade response.*

B. CBR Test

- *Presence of pozzolanic compounds in Ground Granulated blast furnace slag and CaOH available in soil might be increase the CBR value due to formation of cementitious compounds in soil. Due to excess of Ground Granulated blast furnace slag in soil ultimately occupies spaces within sample because of this Ground Granulated blast furnace slag could not be mobilized for the reaction at 20% of Ground Granulated blast furnace slag in soil.*
- *The CBR value of virgin soil is 3.4 and it increase to 1.41 times when Ground Granulated blast furnace slag 20% and Calcium Carbide Residue 1.5% is added to virgin soil. This enhancement in CBR may be because of the gradual formation of hydration compounds in the soil due to the reaction between the stabilizers and the essentials particle present in the soil.*

C. UCS Test

- *UCS value of virgin soil enhances fundamentally with expansion of Ground Granulated blast furnace slag contents. The UCS value increment from 260.12 kN/m² to 362.73 kN/m² with expansion of Ground Granulated blast furnace slag upto 20 % in the wake of curing time of 7 days. U.C.S. value decreases with more expansion of Ground Granulated blast furnace slag. The expansion in U.C.S. value might be a direct result of the slow advancement of the cementitious mixes in the soil by the response between pozzolanic mixes in Ground Granulated blast furnace slag and CaOH accessible in soil.*
- *The reason behind of this when Ground Granulated blast furnace slag and Calcium Carbide Residue comes in contact with water, pozzolanic reactions takes place during the curing period.*

VI. CONCLUSION

- From this study it is concluded that Ground Granulated blast furnace slag is waste product that can be used as stabilizers to clay soil and this would help to solve the conventional problem of disposal of them.
- The optimum value of Ground Granulated blast furnace slag is used for this work was 20 % because of the optimum value of C.B.R. is found at 20% of Ground Granulated blast furnace slag when added to soil.
- The C.B.R value increases with increase of Calcium Carbide Residue along with fixed quantity of Ground Granulated blast furnace slag. It increased 1.41 times from the untreated soil.
- The optimum value of Ground Granulated blast furnace slag and Calcium Carbide Residue required for soil stabilization is 20% and 1.5% by weight of soil respectively
- Unconfined compressive strength increases with increase of quantity of Calcium Carbide Residue and with fixed quantity of Ground Granulated blast furnace slag. The value of Unconfined compressive strength is increased 1.55 times from the untreated soil.

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