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STABILIZATION OF EXPANSIVE SOIL WITH CORN COB ASH AND SUGARCANE STRAW ASH

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Abstract- **The physical, chemical, and mechanical properties of soil vary from location to location. The expansive soil is the most issue, causing damage to road and building foundations. On the other hand, solid agricultural waste is readily available and poses a significant threat to the environment and its ecology. Therefore, it is necessary to improve the property of problematic soil utilizing sustainable, locally available, and low-cost agricultural waste products. In the present study experimental investigation of sub grade soil determined soil characteristics by using Agro waste materials like Corn Cob Ash (CCA) and Sugarcane Straw Ash (SSA). The percentage of Corn Cob Ash and Sugarcane Straw Ash used is 5%CCA+1%SSA, 10% CCA+2% SSA, 15% CCA+3% SSA and 20% CCA +4% SSA. The comparison of soil characteristics like liquid limit, plastic limit, standard compaction, UN confined compressive strength and CBR test vales are determined for various percentages of Agro waste materials.**

Index Terms— **Lateritic soil, soil stabilization, Corn Cob Ash (CCA) and Sugarcane Straw Ash (SSA), Unconfined compressive strength, CBR.**

I. INTRODUCTION

The increasing demand for sustainable and cost-effective materials in civil engineering has driven attention toward the utilization of agricultural waste in construction practices. Expansive soils, with their undesirable engineering characteristics such as low strength, high compressibility, and poor water-retaining capacity, often require stabilization for safe infrastructure development. Among the innovative approaches, the incorporation of agricultural waste products has shown promising results in improving soil and construction material properties while addressing environmental concerns.

Agricultural by-products such as rice husk ash (RHA), sugarcane bagasse ash (SCBA), coconut shells, corn cob ash (CCA), and sugarcane straw ash (SCSA) possess pozzolanic and binding properties that enhance durability, strength, and resistance of construction materials. These materials serve as effective alternatives to conventional components like cement and aggregates, offering environmental, economic, and technical benefits. This paper explores the potential of these agricultural wastes in road construction and stabilization works, aiming to reduce material costs and carbon emissions while promoting resource conservation and waste management.

II. LITERATURE REVIEW

According to Ghosh et al. (2017), RHA, being rich in silica and exhibiting pozzolanic properties, enhances the compressive strength and durability of concrete when used as a partial replacement for cement. Their findings indicated a cost reduction of up to 20% in material expenses without compromising quality.

Patel and Shah (2019) explored the use of SCBA in concrete mixes and soil stabilization. The study confirmed that SCBA improves sulphate resistance and enhances the overall performance of concrete in aggressive environments. The use of SCBA also contributed to a reduction in carbon emissions, aligning with the goals of sustainable construction practices.

Kumar et al. (2020) focused on the Corn Cob Ash (CCA) and its role in soil stabilization. The study reported that when CCA is mixed with weak subgrade soils, it significantly improves load-bearing capacity and reduces plasticity. The pozzolanic reaction between silica/alumina and calcium hydroxide contributed to the formation of stable cementitious compounds, enhancing soil properties.

III. EXPERIMENTAL WORK

Tests were carried out to check the improvement in expansive soil by adding Corn Cob Ash (CCA) and Sugarcane Straw Ash (SCSA) in different percentages (5%, 10%, 15%, and 20%).

The soil samples were prepared by mixing the additives in dry condition, and the following tests were conducted as per Indian Standard (IS) codes:

1. Standard Proctor Test – IS 2720 (Part 7): To find Optimum Moisture Content (OMC) and Maximum Dry Density (MDD)
2. Liquid & Plastic Limit Test – IS 2720 (Part 5): To check the consistency limits
3. California Bearing Ratio (CBR) Test – IS 2720 (Part 16): To determine soil strength for road subgrades
4. Unconfined Compressive Strength (UCS) Test – IS 2720 (Part 10): To measure soil strength without confinement

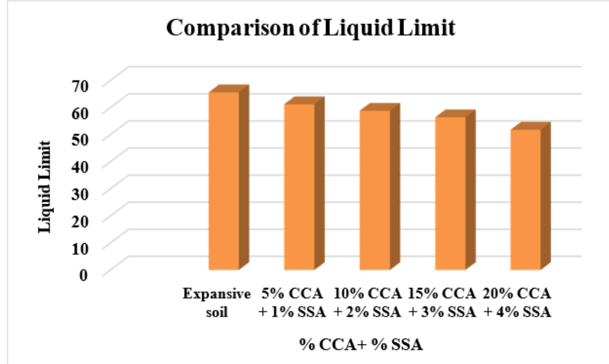
   The results were compared with untreated soil to understand the effect of CCA and SCSA in improving soil properties.

IV. RESULTS

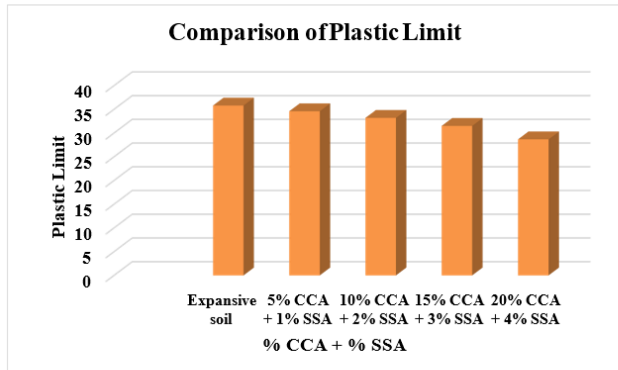
The results of the laboratory tests conducted on expansive soil with varying percentages of Corn Cob Ash (CCA) and Sugarcane Straw Ash (SCSA) are presented in this section.

Table 1: Geotechnical properties of expansive soil

S. No	Property	Value
1	Specific Gravity	2.44
2	Maximum Dry Density (MDD)	1.52 gm/cc
3	Optimum Moisture Content (OMC)	22.65%
4	Natural Moisture Content	7.28%
5	Free Swell Index	105%
6	Liquid Limit	65%
7	Plastic Limit	37.08%
8	Shrinkage Limit	17.37%



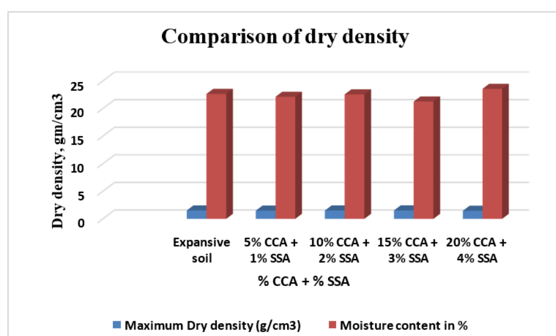
Graph 1. Comparison of Liquid Limit



Graph 2. Comparison of Plastic Limit

Table 2: Comparison of Standard proctor test results

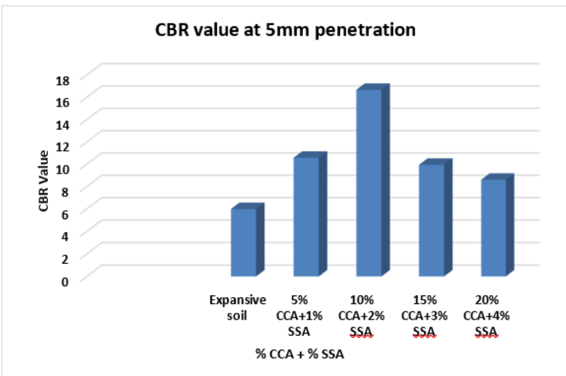
S. No	% Corn Cob Ash + % Sugar Crane Straw Ash	Maximum Dry density (g/cm3)	Moisture content in %
1	Expansive soil	1.52	22.65
2	5% CCA + 1% SSA	1.5	22.13
3	10% CCA + 2% SSA	1.52	22.56
4	15% CCA + 3% SSA	1.53	21.27
5	20% CCA + 4% SSA	1.47	23.57



Graph 2. Comparison of maximum dry density and moisture content

Table 3: Comparison of CBR Values

S. No	% Corn Cob Ash + % Sugar Crane Straw Ash	CBR value at 5mm penetration
1	Expansive soil	5.99
2	5% CCA+1% SSA	10.58
3	10% CCA+2% SSA	16.67
4	15% CCA+3% SSA	9.95
5	20% CCA+4% SSA	8.61



Graph 3. Comparison of CBR values

V. CONCLUSION

A major emphasis of this study is the evaluation of the performance of Corn Cob Ash and S sugar crane straw ash material in road construction. According to the findings of the research, if CCA and SSA are correctly combined and deposited, they may be employed as an excellent soil stabilizing strategy.

The following outcomes were achieved as a consequence of this project.

1. Corn cob ash is a good soil material for highly dynamic soils that expand and contract often.
2. The addition of CCA and SSA reduces swelling and enhances the strength of expansive soils.
3. The greatest dry density was obtained at 15% CCA and 3% SSA, whereas the maximum moisture content was seen at 20% CCA and 4% SSA.
4. The ideal value of unconfined compressive strength was determined to be 10% CCA and 2% SSA.
5. The best CBR value was determined to be 10% CCA and 2% SSA.
6. The liquid limit and plastic limit values fall when the proportion of CCA is increased from 0% to 20% with SSA.

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