A LABORATORY STUDY ON THE STABILIZATION OF SOIL USING STONE DUST, BLACK SOIL, AND RICE HUSK ASH

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ABSTRACT:

The use of industrial wastes to stabilise soil is being studied extensively since it is a growing problem in construction engineering. This experimental work briefly outlines the availability of Stone Dust (SD) in the area and how it could be used in the building sector to reduce the quantity of waste that would otherwise be dumped in the environment, hence reducing pollution. The rising price of stabilising materials like cement, lime, etc., is making traditional soil stabilisation methods increasingly expensive. Replacement of some stabilising drugs with SD and RHA could reduce stabilisation costs. It will reduce pollution and other environmental problems. The soil sample used in the research is medium-plasticity black soil, which needs to be fortified. Rice husk ash and stone dust are used in varying proportions to stabilise the soil. Maximum dry density (MDD), optimal moisture content (OMC), and unconfined compressive stress (UCS) are only a few of the soil parameters monitored for variations (UCS). With increased Stone Dust and RHA, soil UCS is significantly enhanced.

Keywords: *Soil Stabilization, Black soil, Rice Husk Ash (RHA), Stone Dust, Optimum Moisture Content (OMC), Unconfined Compressive Stress (UCS).*

INTRODUCTION

Every part of the country must be linked with all-weather roads so people can move around easily and freely. The pavement should be carefully planned and built so that it can withstand both static and moving loads. The quality of the materials used in road building directly affects the performance of the pavement. The foundation of a paved area is the subgrade, the existing ground below [1-8]. It's common to think of pavement performance in terms of pavement structures and mix design, but the subgrade soils play a far more significant role than many people realise.

Using locally sourced, low-priced materials to build the subgrade, subbase, etc., will drastically reduce the overall cost of paving a road. If local soils are not stable enough to bear the loads, appropriate procedures to improve soil qualities must be used. Some of these techniques include stabilising the soil. By increasing subgrade stiffness and decreasing expansion tendencies, chemical stabilisation of the subgrade (with materials like Quicklime, Portland cement, Fly Ash, or Composites) serves as a foundation (able to support and distribute loads under saturated conditions).

NEED OF PRESENT STUDY:

Sub-grade CBR needs to be raised in salty black soil. When wet, expansive soil has incredible strength but becomes incredibly soft; when dry, it expands/swells due to its mineralogical makeup, which causes it to either break open or get consolidated. Various novel foundation approaches are available to deal with the issue of expanding soils [9]. When deciding on a method, it's important to carefully compare each option to find the one that works best with the system at hand. Lime, calcium chloride, Rice Husk Ash, fly ash, gypsum, and other chemicals stabilise expansive soils.

SOIL STABILIZATION:

"Soil stabilisation" refers to increasing the soil's stability by enhancing its engineering features. Metcalf (1972) and KEZDI (2001) discuss the mixing process as the fundamental principle of soil stability (1979). When the available building dirt is unsuitable, this method must be used. Stabilisation encompasses various techniques, including draining, compaction, and pre-consolidation. When materials are blended and mixed with soil, it improves the soil's qualities. Mixing commercially available additives that can change the gradation, texture, or flexibility of the soil or function as a binder for the cementation of the oil may also be a part of the process. When employed in earthen constructions, soil stabilisation lessens the soil's permeability and compressibility, reduces the soil's swelling in the case of expansive soils, and raises the soil's shear strength. Boosting the carrying capacity of foundation soils calls for stabilisation. However, the primary application of stabilisation is to enhance natural grounds for constructing roads and airport runways.

MATERIALS

Among the many sorts of materials employed in this project's laboratory tests are the following:

1. Black soil
2. Stone dust
3. Rice husk

BLACK SOIL:

Swelling (during the wet period) and shrinking (during the dry period) are typical of this dark soil (dry period). When it dries, it causes fissures that are 30–45 centimetres. This soil is ideal for rice, Ravi, sugarcane, cashews, and other crops. This type of soil developed in locations with much rain due to leaching.

STONE DUST:

Minor minerals in soils can be found in abundance in the igneous and metamorphic rocks from which these materials are generated. When used on soil, this has tremendous positive effects. It's up to the producer or their community to decide whether or not to use the dust themselves or offer it for sale. Since charcoal promotes the growth of soil microorganisms, adding a few pieces to the drum will maximise the advantages of the treated soil.

RICE HUSK:

The husk is a byproduct of the rice milling process. Paddy grain has this enclosing it. About 78% of the paddy's weight is converted into rice, broken grains, and bran during milling. The husk makes up 22 per cent of the paddy's weight. This husk is burned in the rice mills to create steam for the parboiling process. Contains pozzolanic and coarser soil particles, unlike products like fly ash, which solely include pozzolanic properties. Researchers have shown that adding a small amount of stone dust to soil can dramatically alter its qualities. Based on the soil's dry weight, the percentages of stone dust added to the soil in this investigation were 10%, 20%, 30%, 40%, and 50%.

EXPERIMENTAL PROGRAMME

LAB TESTING:

The various tests conducted on the sample are the following:

1. ATTERBERG'S limits
2. Specific gravity
3. Proctor compaction test
4. CBR test

RESULT AND DISCUSSIONS

PROPERTIES OF THE SOIL:

Sl. No.	Particulars	Test values
1	Specific gravity	2.65
2	Liquid limit %	31
3	Plastic limit %	16
4	Plasticity index %	10-11
5	Shrinkage limit %	24

Table: 1. Properties of soil

STANDARD PROCTOR TEST RESULTS:

Using a conventional proctor compaction machine, we determined the OMC and MDD of soil, stone dust, Rice Husk, and various combinations of soil with lime and rice husk ash.

Mix proportions	Water content (%)	Dry density (g/cc)
Soil	14	1.65
Soil + 3% SD	19	1.58
Soil + 6% SD	17	1.58
Soil + 9% SD	19	1.60
Stone Dust	10	1.68

Table 2 SPT RESULTS

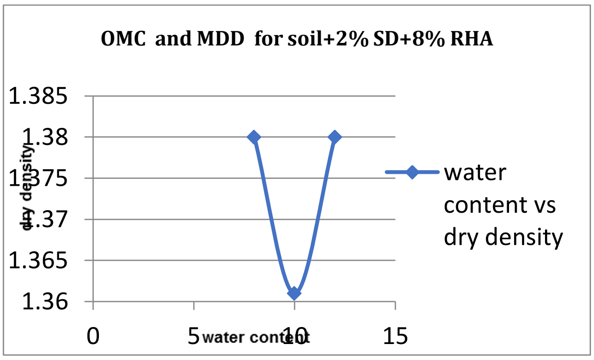

Fig:1. OMC and MDD for soil+2% SD+8% RHA

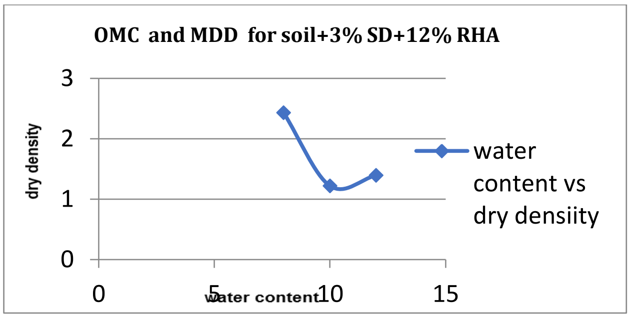

Fig:2. OMC and MDD for soil+3% SD+12% RHA

CONCLUSION

- Adding 5%, 10%, or 15% by weight of rice husk ash to black soil, as well as 3%, 6%, or 9% by weight of stone dust, enhanced the O.M.C of the soil.
- Adding stone dust to the soil, as opposed to rice husk ash, increases the MDD of the soil.
- As opposed to rice husk ash, adding stone dust to the black soil has boosted the soil's C.B.R. value.
- Soil CBR values are being measured with various additives for this study. The CBR values of the soil can be improved using this additional mixture. This allows us to spend less on expensive additives.
- There are less expensive and more accessible options, such as rice husk and stone dust.
- The following table displays the changes in CBR values brought about by incorporating various soil amendments.

s.no	Mix proportions	CBR at 2.5mm	CBR at 5mm
1	Black soil	1.08	1.01
2	Soil + 3% SD	0.174	0.31
3	Soil + 6% SD	3.915	3.91
4	Soil + 9% SD	4.35	4.205
5	SD	16.96	8.55
6	Soil + 5% RHA	0.14	0.17
7	Soil + 10% RHA	0.32	0.30
8	Soil + 15% RHA	0.21	0.72
9	Rice husk ash	0.95	1.17

Table: 2. Comparison of CBR values

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