EFFECT OF RICE HUSK ASH ON ENGINEERING PROPERTIES OF EXPANSIVE SOIL

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ABSTRACT: In the present scenario, rice growing countries like India produce 12 million tons of Rice Husk which is 20-25% of the rice produced annually. Rice Husk is an agricultural residue that is used in industries as fuel in boilers and power generation. Rice Husk has a high ash content varying from 18-22%. This Rice Husk Ash contributes to pollution and efforts were being made to overcome this environmental issue by utilizing this material as stabilizing material. To reduce the problems posed by expansive soil, admixtures can be used to stabilize the soil. In the present study, Rice Husk Ash (RHA) is used as an admixture to expansive soil which resulted in considerable improvement in the properties of the soil. The present study includes properties such as consistency limits and strength of the soil with RHA content of 2.5%, 5%, 7.5%,10%.

1. INTRODUCTION

The problem with expansive soils has been recorded all over the world. Because of alternative swelling and shrinkage, lightly loaded civil engineering structures like residential buildings, pavements and canal lining are severely damaged. It is therefore necessary to mitigate the problems posed by expansive soils and prevent the cracking of structures. The over dependent on the utilization of industrially manufactured soil improving additives (cement, lime etc), have kept the cost of construction financially high. Thus the use of agricultural waste will considerably reduce the cost of construction and as well as reducing the environmental hazards they cause. In the present study, we have used rice husk ash as an additive to improve properties of the expansive soils. Rice husk ash is added in different percentages (2.5%, 5%, 7.5%, and 10%) by weight of thesoil.

Rice husks are the shells produced during dehusking operation of paddy, which varies from 20% (Mehta, 1986) to 23% (Della et al., 2002) by weight of the paddy. The rice husk is considered as a waste material and is being generally disposed of by dumping or burning in the boiler for processing paddy. The burning of rice husk generates about 20% of its weight as ash (Mehta, 1986). Silica is the main constituent of rice husk ash (RHA) and the quality (% of amorphous and unburnt carbon) depends upon the burning process (Nair et al., 2006). The RHA is defined as a pozzolanic material (ASTM C 168, ASTM 1997) due to its high amorphous silica content (Mehta, 1986). In India, the annual production of paddy is about 100 million tones, thereby generating more than 4 million tons of RHA (Ramakrishna and Kumar,2008).

The objective of this paper is to study the effect of RHA and to improve the engineering properties of the expansive soils and thus making it morestable.

2. MATERIALS

The materials used in the experiments are expansive soil, Rice Husk Ash

2.1 ExpansiveSoil

Expansive soil collected from Bhorampetcheruvu located at Bachupally. The properties of the expansive clay used in this investigation are given in Table 1.

2.2 Rice HuskAsh

Rice Husk Ash collected from brick manufacturing unit situated in Nandigam near Vijayawada. The chemical composition of RHA is listed in Table 2. The RHA had 90.2% silica content. This high amount provides good pozzolanic action.

Fig.1ExpansiveSoil

Fig.2. Rice HuskAsh

Table 1. Index andCompactionProperties

Soil Properties	Test Results
Specific Gravity(G)	2.625
Liquid Limit (w_L) (%)	64
Plastic Limit (w_P) (%)	35
Plasticity Index (PI)	29
Free Swell Index (%)	51
Optimum Moisture content OMC (%)	20.98
Maximum dry density MDD(kN/m^3)	16.1
Unconfined Compressive Strength (kPa)	60
C.B.R. (Unsoaked) (%)	4.82
C.B.R (soaked) (%)	1.98

Table 2. Chemical Composition of Rice HuskAsh

Element	Mass Fraction
Silica	80-90%
Alumina	1-2.5%
Ferric Oxide	0.5%
Titanium dioxide	Nil
Calcium oxide	1-2%
Magnesium dioxide	0.5-2%
Sodium oxide	0.2-0.5%
Potash	0.2%
Loss on ignition	10-20%

3. LABORATORYTESTS

The laboratory studies were carried out on the samples of expansive soil and expansive soil + RHA for varying percentages.

Liquid limit: The liquid limit test was conducted on expansive soil, expansive soil+ rice husk ash, using Casagrande's liquid limit apparatus as per the procedures laid down in IS: 2720 part 4 (1970).

Plastic limit: The plastic limit test was conducted on expansive soil, expansive soil+ rice husk ash as per the specifications laid down in IS: 2720 part 4(1970).

Free swell index: This test is performed by pouring slowly 10 grams of dry soil, 10 grams of (soil+ rice husk ash) passing through 425 micron sieve, in two different 100 cc glass jars filled with distilled water. The swollen volume of expansive soil, expansive soil- rice husk ash are recorded as per IS 2720 part 40 (1985).

$$\text{Free swell(\%)} = \frac{\text{Final volume} - \text{Initial volume}}{\text{Initial volume}} * 100$$

Proctor's standard compaction Test: Preparation of soil sample for proctor's compaction test was done as per IS: 2720 part-6 (1974).

Unconfined compressive strength: The unconfined compressive strength tests are conducted on expansive soil, expansive soil+ rice husk ash+ lime mixes, expansive soil+ rice husk ash mixture as per IS 2720 part 10 (1973). All the samples are prepared by static compaction using split mould at optimum moisture content and maximum dry density to maintain same initial dry density and water content. The test was conducted under a constant strain rate of 1.5mm/min. The proving ring reading is noted for 50 divisions, and loading was continued until 3 (or) more readings are decreasing (or) constant (or) strain 20% has been reached.

California bearing ratio Test: The California Bearing Ratio tests are conducted on expansive soil, expansive soil+ rice husk ash mixtures as per IS 2720 part 16 (1979).

4. TEST RESULTS ANDANALYSIS

The index properties of expansive soil with varying percentages of Rice Husk Ash (RHA) are shown in following Table.3.

Table.3.Index properties of expansive soil with RHA

RHA% / Experiments	0%	2.5 %	5%	7.5%	10%
Liquid Limit	64	47	50.2	48.8	47.6
Plastic Limit	35	16.6 7	50	37.5	47.6
Plasticity Index	29	30.3 4	20.2	11.3	0
Free swell Index	51	44	40	36	30
Specific Gravity	2.625	2.58	2.54	2.5	2.46

The OMC goes on increasing irrespective of percentage addition of RHA shown in fig.3. The OMC increases to a value of 33% from 20.98% when 10% RHA was added to expansive soil. The increase in the optimum moisture content may be caused by the absorption of water by the RHA (Haji Ali et al., 1992).

Figure 3**:** Variation of OMC with %ofRHA

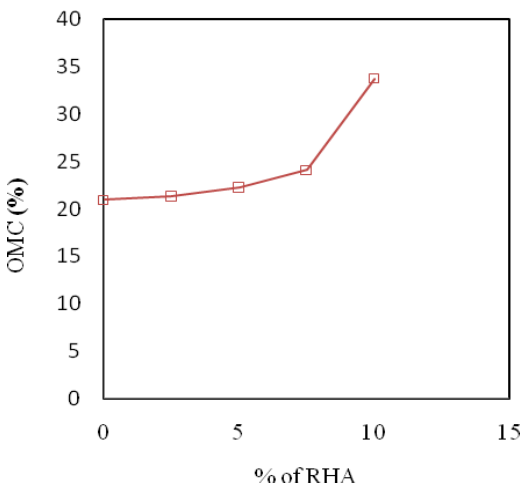
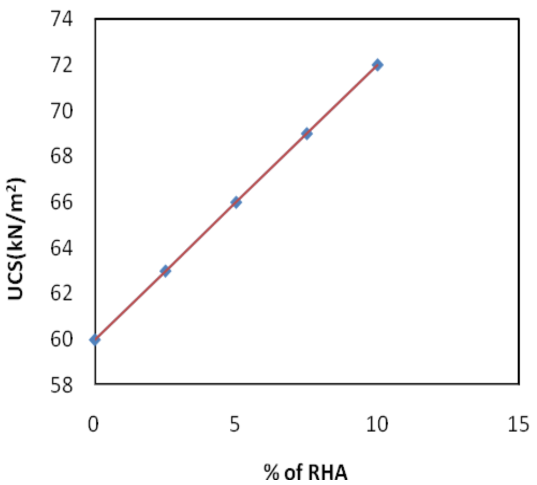


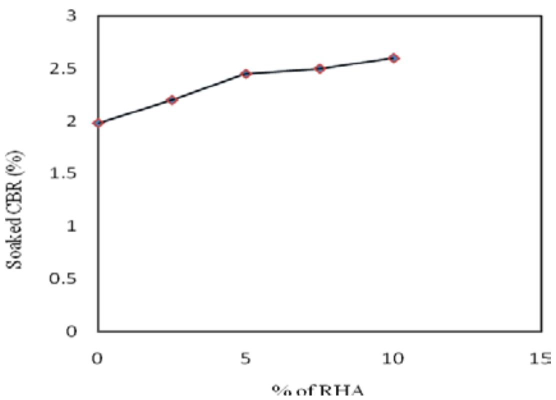
Figure 4**:** Variation of UCS with % ofRHA



The results of UCS tests on expansive soil treated with different percentage of RHA have been shown in Fig. 4. By increasing the percentage of addition of RHA the UCS of soil goes on increasing up to 10% addition of RHA. The UCS of soil increases to 72kN/m² from 60 kN/m² of neat soil, when 10 % RHA was added, this is because of the frictional resistance from RHA in addition to the cohesion from expansive soil. Reduction in UCS occurs due toreduction in cohesion because of the reduction in soilcontent.

The results of soaked CBR tests on expansive soil treated with different percentage of RHA has been shown in Fig.5 .It is observed that by addition of 10% RHA the soaked CBR of soil increases to 2.6% from 1.98%.

Figure 5: Variation of CBR with % of RHA



5. CONCLUSIONS

The following conclusions were drawn from the present study.

- Specific gravity decreases by increasing RHA from 0% to10%
- Optimum moisture content increases by increasing RHA from 0% to10%.
- Maximum dry density decreases by increasing RHA from 0% to10%.
- With the increase of RHA content upto10%, UCS increased by83%.
- CBR improved by 47% with addition of 10%RHA.

From the present study it is evident that the RHA 10% is adequate for stabilizing the expansive soil and the scope for present study can be done with RHA percentage more than 10% for best effective results.

6. REFERENCES

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