Experimental investigation on the Suitability of using Rice husk ash and Lime for Soil stabilization.

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Abstract—In the recent years, soil stabilization has become a major issue in construction engineering. For stabilizing soil, investigation on the effectiveness of using industrial wastes are rapidly increasing, as it also helps in utilizing hazardous by-products, which otherwise can be a threat to environment. Soil Stabilization is being successfully used for a variety of engineering works, the most common application being the construction of road and pavements, where the main objective is to increase the strength or stability of soil and to reduce the construction cost by making best the use of the locally available materials. Cement and lime are the two most commonly used materials for stabilizing soils. The cost of these materials have rapidly increased due to the sharp increase in the cost of energy, hence a substantial decrease in the cost of stabilization may be achieved by replacing a good proportion of stabilizing agent with material such as rice husk ash and lime. The main objective of this project is to check the feasibility of stabilizing the soil using rice husk ash and lime and to determine the improvement in shear strength parameters of the soil.

Keywords—soil stabilization, natural additives, rice husk ash, lime, Optimum moisture content, Unconfined compressive stress

1 INTRODUCTION

For any land based structure, the foundation is very important and has to be strong to support the entire structure. In order for the foundation to be strong, the soil around it plays a very critical role. So, to work with soils, we need to have proper knowledge about their properties and factors which affect their behavior. The process of soil stabilization helps to achieve the required properties in a soil needed for the construction work.

Soil stabilization is the treatment of soils to enable their strength and durability to be improved such that they become totally suitable for construction beyond their original classification.It has become major issue in construction engineering and the researches regarding the effectiveness of using industrial wastes are rapidly increasing. Soil Stabilization is being used for a variety of engineering works, the most common application being in the construction of road and pavements, where the main objective is to increase the strength or stability of soil and to reduce the construction cost by making best use of the locally available materials.Through this project, the use of natural additives such as rice husk ash and lime for stabilizing soil are emphasized.

2 LITERATURE REVIEW

Treatment with rice husk showed a general reduction in the maximum dry unit weight with increase in the rice husk content to minimum values at 9% rice husk content (Fattah et al. 2013). The optimum moisture content generally increased with increase in the RHA content. There is enormous increase in the unconfined compressive strength with increase in rice husk content for the soil to its maximum at RHA between (6–8)%. RHA and lime sludge addition increased the liquid limit and plastic limit of soil and decreased the dry density (Chandra et al. 2005). The unconfined compressive strength had a maximum value for a soil mix containing 10% RHA and 16% lime sludge. The results suggested that RHA and lime soil could be successfully used for the stabilization of a clay soil. The liquid limit of the expansive soil decreased by 22% with the addition of 10% RHA+5% Lime (Rao et al. 2012).

3 MATERIALS AND METHODOLOGY

3.1 SOILS:

The soil for the experiment is collected from the vicinity of Vadakara. The properties of soil used in the investigation are given in Table 1.

TABLE 1
Properties of the natural soil.

Property	*Value*
Specific gravity	2.53
UCC strength	27 KPa
Liquid limit	38.25%
Plastic limit	16.22%
OMC	19.5 %
MDD	1.7 g/cc
Plasticity index	22.03%

3.2 RICE HUSK ASH

RHA was collected from a rice mill at Vadakara. The RHA was ground and sieved through 0.075mm sieve before use. The properties of RHA are shown in Table 2.

TABLE 2

Properties	*Value*
Bulk density	96 – 160 (kg/m^3)
Hardness	5 - 6 (Mohr scale)
Ash	22-29%
Carbon	35%
Hydrogen	4-5%
Oxygen	31 - 37%
Nitrogen	0.23 - 0.32%
Sulphur	0.04 - 0.08%
Moisture	8 - 9%

3.3 LIME:

Lime required for the study has been collected locally.

3.4 METHODOLOGY:

The sample soil (ordinary soil) was collected and engineering and index properties of the soil was studied by conducting experiments including atterberg limits, compaction test and unconfined compression test. Specimens for unconfined compressive strength tests were prepared at optimum moisture content and maximum dry densities. After studying the geotechnical properties of soil, admixtures were collected and properties of admixtures were studied. An optimum lime content as obtained from previous studies on lime treated soil was added to the soil and engineering and index properties of lime treated soil was studied. Varying percentage of RHA was added to the lime treated soil and by conducting various laboratory tests optimum content of RHA was determined. After finding the strength parameters i.e. maximum dry density, optimum moisture content, unconfined compressive strengths of treated and untreated soil, results are compared.

4 RESULTS AND DISCUSSIONS:

4.1 LIME TREATED SOIL:

4.1.1 ATTERBERG LIMITS

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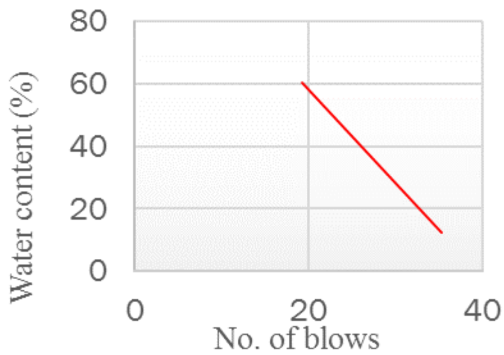

Fig. 1 Water content versus No. of blows

From previous studies on lime treated soils, an average of 5% lime addition has been found to give maximum improvements in shear strengths of soil. The liquid limit of soil mixed with 5% lime was obtained as 49.2% and plastic limit as 33.79%. The plasticity index has been obtained as 15.23.

4.1.2COMPACTION TEST:

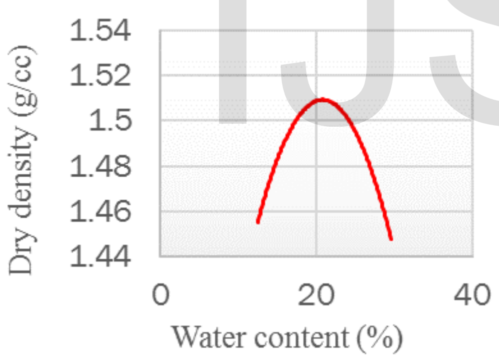

Fig.2 Dry density versus Water content

Standard Proctor compaction test was performed on lime treated soils. The obtained Optimum Moisture Content (OMC) is 21% and Maximum Dry Density (MDD) is 1.512 g/cc.

4.2SOIL TREATED WITH VARYING % OF RHA:

4.2.1ATTERBERG LIMITS:

At 4% RHA + lime+ soil, The obtained liquid limit is 56.12% and the plastic limit is 42.18. Hence the plasticity index is 13.94. At 8% RHA + lime + soil, The obtained liquid limit is 37.05% and the plastic limit is 24.62%. Hence the plasticity index is 12.43. At 12% RHA + lime + soil, The obtained liquid limit is 35.47% and the plastic limit is 24.62%. Hence the plasticity index is 10.85.

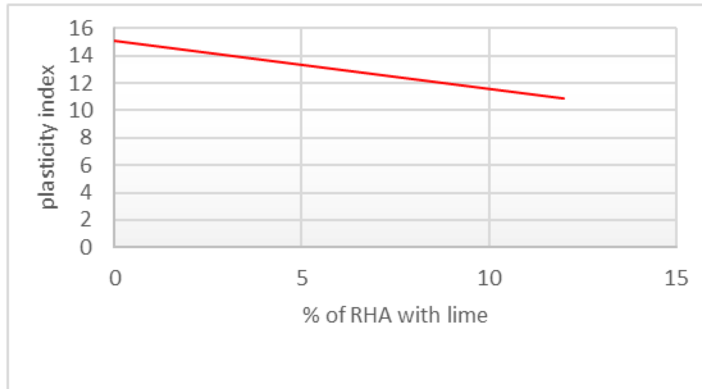

Fig. 3 Plasticity index versus % of RHA with lime

4.2.2 COMPACTION TEST

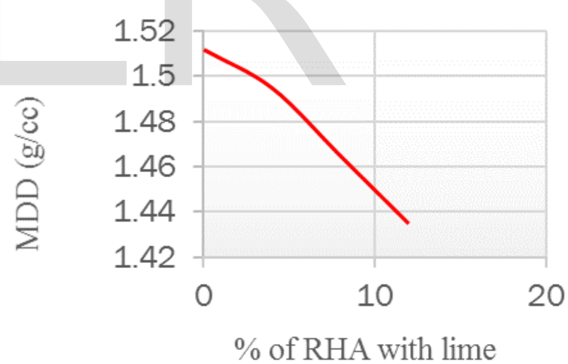

Fig. 4 Maximum Dry density (MDD) versus %of RHA with lime

The variation in maximum dry density and optimum moisture content with addition of varying percentages of RHA to lime-treated soil is shown in Fig. 5 and Fig. 6 respectively. It can be inferred that as the percentage RHA increases, the optimum moisture content also increases. This may be due to increased affinity of RHA towards water, thereby resulting in an increased water

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requirement for achieving the same degree of compaction. The decrease in maximum dry density can be attributed to the replacement of soil with a less denser RHA, resulting in an overall decrease in the sample density.

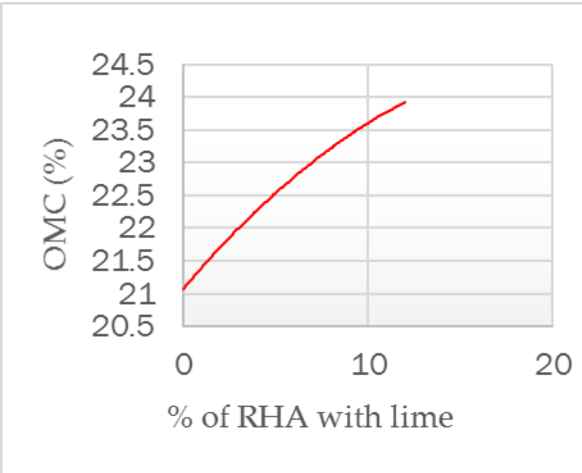

Fig. 5 Optimum moisture content versus % of RHA with lime

4.3UCC TEST:

Unconfined compression tests were conducted on lime-treated soils mixed with varying percentage of RHA. As seen in table 3, it was seen that lime-treated soil mixed with 8% RHA gave a maximum improvement in the UCS. At higher proportions of RHA, the shear strength decreased due to the overall decrease in the sample density.

TABLE 3
UCC Strength

SI.No	Sample	UCS (KPa)
1	Soil + 5 % lime	52.2
2	Soil + 4% RHA + lime	55.5
3	Soil + 8% RHA + lime	89.252
4	Soil + 12% RHA + lime	89.25

5 CONCLUSIONS

- Addition of RHA proves to be an effective method for improving the strength of lime treated soils.
- The OMC increased and the MDD decreased on adding both lime and RHA.
- For maximum improvement in strength, soil stabilization using 8% RHA content with 5% lime is recommended as optimum amount for practical purposes.

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