Experimental Study of Soil Subgrade When Stabilized with Rice Husk Ash and Polypropylene

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Abstract— Pavement quality depends upon on the potency of the land. Intensity level of sub grade is the big parameter for estimating the thickness of pavement. In case of pavement the sub-form should be uniform in terms of Geotechnical properties like shear strength, compressibility etc. Construction of pavement could be natural soil which can likewise be expanded, clayey or organic. Natural soils, suffer volume amendment due to wet content that causes heaving, cracking and the break-up of the road paving. As a result of this reason, stabilization of those sorts of soil is significant, to suppress swelling and increase the effectiveness of the land. The rising price of traditional stabilizing agents and the indigence for the economical utilization of industrial and agricultural wastes for beneficial engineering purposes has prompted an investigation into the stabilizing potential of Rice Husk Ash (RHA) and Polypropylene (PP) in subgrade soil. The aim of this study is to utilize the effectiveness of Rice Husk Ash and Polypropylene material to enhance the attributes of natural soil used for subgrade material in pavement. The soil was stabilized different percentages (5, 10, 15, 20, 25 & 30) of RHA and after obtaining an optimum part of RHA, PP with percentage of 0.25%, 0.50%, 0.75%, 1.00%, is appended along with RHA individually, for the structure of sub grade soil and test like Liquid Limit, Plastic Limit, Plasticity Index, Specific Gravity, Optimum Moisture Content, Maximum Dry Density, Swelling Pressure and CBR are performed.

Keywords: Rice Husk Ash (RHA), Polypropylene (PP), Swelling, OMC, MDD, CBR

I. INTRODUCTION

A sound knowledge of performance of the subgrade soil under prevailing in-situ condition is necessary prior to the construction of the pavement. The better the strength/stiffness quality of the materials the better would be the long-term performance of the pavement. Hence, the design of pavement should be focused on the efficient and effective use of existing subgrade materials by stabilizing it with some stabilizing agents to optimize their performance. In this study Geotechnical properties of Natural Soil, PP, RHA individually, for the construction of sub grade soil is determined, suitability of stabilized soil for sub grade soil is determined. Geotechnical properties of Natural soil (Black Cotton Soil), Stabilized with different percentages of (5, 10, 15, 20, 25 & 30) of RHA and after getting optimum percentage of RHA, PP with percentage of 0.25%, 0.50%, 0.75%, 1.00%, is added along with RHA individually, for the construction of sub grade soil.

II. METHODOLOGY

The successful construction of highways requires the construction of a structure that is capable of carrying the imposed traffic loads. One of the most important layers of the road is the actual foundation, or subgrade. Subgrade soil form the integral part of the road pavement structure as it provides the support to the pavement from beneath. The main function of the subgrade is to give adequate support to the pavement and for this; the subgrade should possess sufficient stability under adverse climate and loading condition. If these structures are founded on soil with low bearing capacity, they are likely to fail either during or after construction, with or without application of wheel load on them. Where the pavement is founded in an inherently weak soil, this material will be typically then removed and replaced with a stronger granular material or improving the soil towards the desired property by addition of chemical (Christopher, H, 2010). This removal and replacement technique can be both costly and time consuming. Where aggregates are scarce, the use of these non-renewable resources is viewed as non-sustainable, particularly if haulage distances are significant.

The subgrade soil property can be improved by mainly its CBR value as strength to mix Rice Husk Ash, if easily available near the construction site and reduce pavement thickness. In this project, we stabilized the Natural soil by adding Rice husk ash and Polypropylene fibers in the different ratio with natural soil. Soil stabilization is the process of improving the engineering properties of the soil and thus making it more stable. It is required when available soil for construction is not suitable for the intended purpose. However, the main use of stabilization is improving the natural soils for the construction of highway and airfields. There are various methodology and experiments enumerated in this chapter. In this chapter the materials used in the investigation are illustrated with respect to their Sources and their physical and chemical properties. All laboratory investigations on soil and materials are carried out in Geotechnical laboratory. Rice husk ash is procured from Vardhman yarns. Rice husk ash was mixed in varying percentage of 5%,10%,15%,20%,25%, and 30% of natural soil on dry weight basis in the suitable required proportions. After deducing the optimum value out of the proportions stated above, Polypropylene was mixed in the deduced mixture above in different batches with increasing weight of 0.25%, 0.50, 0.75% and 1% with respect to the weight of mixture.

Soil investigation is done for various purpose. Current study describes the soil investigation for Stabilization of soil for subgrade. It has been observed that, it is essential to investigate the type of soil from selected area and based on soil investigation research work can be concluded. There are various test performed in laboratory as per IS code standards like test Grain size distribution, liquid limit, plastic limit, plasticity index, specific gravity, compaction, optimum moisture content (OMC), maximum

dry density (MDD), swelling and California bearing ratio (CBR) test were.

III. Result & discussion

Tests Results of Natural &Rice Husk Ash Samples (NR), Liquid Limit tests Clay with Low Compressibility (CL) treated with different percentage of Rice Husk Ash (RHA)can be seen that with increase in percentage of ash the Liquid Limit of CL soil goes on decreasing from 26 to 16%, when RHA waste is increased from 0 to 20% is effective beyond also there is an increase in liquid limit from 16% to 22% when RHA waste is increased from 20 to 30% and further the value for 100% RHA, the sample shows non plastic behavior.

The results of Plastic Limit tests CL soil treated with different percentage of RHA can be seen that with increase in percentage of ash the Plastic Limit of CL soil goes on decreasing from 17.40% to 10.70%, when RHA waste is increased from 0 to 20% is effective beyond also there is an increase in Plastic Limit from 10.70 to 14.30% when RHA waste is increased from 20% to 30%.

The results of Plasticity Index tests CL soil treated with different percentage of RHA can be seen that with increase in percentage of ash the Plasticity Index of CL soil goes on decreasing from 8.60% to 5.30%, when RHA waste is increased from 0 to 20 % is effective beyond also there is an increase in Plasticity Index from 5.30 to 7.70% when RHA waste is increased from 20% to 30%.

The results of Specific Gravity tests on CL soil treated with different percentage of RHA i.e. NR Sample shows that there is a decrease in specific gravity from 2.63 to 2.39 with increase in percentage of ash from 0 to 30% and 1.87 for 100% RHA.

Natural Soil is mixed with varying percentages of Rice Husk Ash (RHA) waste material by weight. From the test results Moisture Content continuously increases 12.18 to 23.80% and for 100% RHA value of water content is 47.22%.However The Maximum Dry Density decreases from 1.88 g/cc to 1.44 g/cc from 0 to 30% of RHA and the value are 0.98 g/cc for 100% RHA.

The results of Unsoaked CBR tests on CL Soil treated with different percentage of RHA and from the results it can be seen that with increase in percentage of ash waste, the Unsoaked CBR of soil goes on increasing from 7.04 to 17.33% when RHA is increased from 0 to 20% is effective beyond also there is a decrease in CBR of soil from 17.33 to 11.91% when RHA waste is increased from 20% to 30% and further the value for 100% RHA is 7.95%.

The results of Soaked CBR tests on CL Soil treated with different percentage of RHA and from the results it can be seen that with increase in percentage of ash waste, the soaked CBR of soil goes on increasing from 4.21 to 9.21% when RHA is increased from 0 to 20% is effective beyond also there is a decrease in CBR of soil from 9.21 to 5.78% when RHA waste is increased from 20% to 30% and further the value for 100% RHA is 5.41%.

The results of Swelling Pressure tests on CL Soil treated with different percentage of RHA and from the results it can be seen that with increase in percentage of ash waste, the Swelling Pressure of soil goes on decreasing from 2.15 to 0.67 when RHA is increased from 0 to 20% is effective beyond also there is an increase in Swelling Pressure of soil from 0.67 to 1.42 when RHA waste is increased from 20% to 30% and further the value for 100% RHA is 1.95.

Natural soil with 20% of Rice Husk Ash i.e. NR20 mix give optimum value of CBR in both soaked and unsoaked condition, now polypropylene is added upto 1% with an interval of 0.25%. 0.75% of polypropylene fiber with 20% Rice Husk Ash gives maximum value of CBR in both soaked and unsoaked condition, when natural soil of low compressibility is stabilized by Rice Husk Ash after obtaining the optimum percentage of Rice Husk Ash i.e. 20% then polypropylene fiber is added in the in the mix and it has been found that 0.75% of polypropylene gives best result with 20% Rice Husk Ash, by the help of CBR test result.

IV. Conclusion

The investigation of stabilizing potential of Rice Husk Ash (RHA) and Polypropylene (PP) in subgrade soil is raised due to the need for economical utilization of industrial and agricultural wastes and the rising monetary value of traditional stabilizing agents. When Rice Husk Ash and Polypropylene material is applied to enhance the attributes of natural land. The soil was stabilized different percentages of (5, 10, 15, 20, 25 & 30) of RHA and after obtaining an optimum part of RHA, PP with percentage of 0.25%, 0.50%, 0.75%, 1.00%, is appended along with WH individually, for the structure of sub grade soil and test like Liquid Limit, Plastic Limit, Plasticity Index, Specific Gravity, Optimum Moisture Content, Maximum Dry Density, Swelling Pressure and CBR are performed. Soil stabilized with Rice Husk Ash and with polypropylene for soil subgrade conclusion drawn is:

- Unsoaked California Bearing Ratio tests result on natural soil treated with different percentage of Rice Husk Ash and from the results it can be seen that with increase in percentage of ash waste, the unsoaked California Bearing Ratio of soil goes on increasing from 7.04 to 17.33% when Rice Husk Ash is increased from 0 to 20% is effective beyond also there is a decrease in California
- Bearing Ratio of soil from 17.33 to 11.91% when Rice Husk Ash waste is increased from 20% to 30% and further the value for 100% Rice Husk Ash is 7.95%.The results of soaked California Bearing Ratio tests on cl soil treated with different percentage of Rice Husk Ash and from the results it can be seen that with increase in percentage of ash waste, the soaked California Bearing Ratio of soil goes on increasing from 4.21 to 9.21%.
- When Rice Husk Ash is increased from 0 to 20% is effective beyond also there is a decrease in California Bearing Ratio of soil from 9.21 to 5.78% when Rice Husk Ash waste is increased from 20% to 30% and further the value for 100% Rice Husk Ash is 5.41%.0.75% of polypropylene fiber with 20% Rice Husk Ash gives maximum value of California Bearing ratio in both soaked and unsoaked condition, when natural soil of low compressibility is stabilized by Rice

Husk Ash after obtaining the optimum percentage of Rice Husk Ash i.e. 20% then polypropylene fiber is added in the mix and it has been found that 0.75% of polypropylene gives best result with 20% Rice Husk Ash, by the help of California Bearing ratio test result.

– With Rice Husk Ash soil attain strength, based on California bearing ratio test which is extremally good and give optimum percentage of Rice Husk Ash i.e. 20% and when polypropylene is mixed in soil, with 20% Rice Husk Ash on basis of California bearing ratio, soil which contains polypropylene 0.75% with 20% Rice Husk Ash attain maximum strength.

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