IJCRT.ORG ISSN : 2320-2882
INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)
An International Open Access, Peer-reviewed, Refereed Journal

EXPERIMENTAL INVESTIGATION ON STRENGTHENING OF COHESIVE SOIL USING RISK HUSK ASH & METAKAOLIN

Mr. Puneeth K
Assistant Professor
Department of Civil Engineering
ATME COLLEGE OF ENGINEERING, Mysore, India

Abstract- Soil stabilization is a method of improving soil properties by combining with other materials. It is the process of enhancing the shear strength parameters of soil and thereby increasing the bearing capacity of soil. Soil stabilization is used to lessen permeability and compressibility of the soil mass in earth structures. In common soil stabilization changes physical, chemical and mechanical properties to meet the engineering principle. Soil stabilization can be achieved by in-situ stabilization or ex - situ stabilization methodology. In the present case, an investigation is done to increase the strength properties of cohesive soil using a rice husk ash which is a solid waste and the mixture is treated with metakaolin as an additive and is tested for various strength parameters.

Index Terms - Cohesive soil, Rice husk ash, Metakaolin

I. Introduction

Soil stabilization is a technique of improving soil properties by blending and mixing with other materials. It is the process of improving the shear strength properties of soil and accordingly increasing its bearing capacity. Increment in the bearing capacity is required when the soil available for construction is not suitable to carry structural load. Stabilization reduces the permeability and compressibility of the soil mass in earth structures which increases its shear strength and decrease the settlement of structures. Soil stabilization includes the use of stabilizing agents (binder materials) in weak soils to improve its geotechnical properties such as compressibility, strength, permeability and durability.

Soil stabilization is a general term for any physical, chemical, mechanical, biological, or combined method of changing natural soil to meet an engineering purpose. Improvements comprises of increasing the weight bearing capabilities, tensile strength, and overall performance of in-situ sub soils, sands, and waste materials in order to strengthen road pavements. Some of the renewable technologies used for stabilization are: enzymes, surfactants, biopolymers, and synthetic polymers, co-polymer-based products, cross-linking styrene acrylic polymers, tree resins, ionic stabilizers, fiber reinforcement, calcium chloride, calcite, sodium chloride, magnesium chloride and more. Some of these new stabilizing techniques create hydrophobic surfaces and prevent road failure from water penetration or heavy frosts by inhibiting the ingress of water into the treated layer. Other stabilization techniques include using on-site materials including sub-soils, sands, mining waste, natural stone industry waste and crushed construction waste to provide stable, dust free local roads for complete dust control and soil stabilization.

In present investigation a solid waste namely Rice husk ash with Metakaolin is selected to study the effects of the index and engineering characteristics of cohesive soil. In order to utilize the rice husk ash for the improvement of cohesive soil a detailed program has been formulated and index, compaction, shear strength and CBR tests have been conducted with increasing % of solid waste and a constant percentage of metakaolin.

[1] Aamir Farooq etal conducted experiments on "Stabilization of soil by use of geo-jute as soil stabilizer" and he found that with increasing fiber content the dry density of soil decreases where as the shear strength of soil increases with increase in Jute fiber content and also by increasing the jute fiber content percentage maximum dry density decreased and Optimum moisture content increased.

[3] Muthupriya etal Conducted experiment on "Soil Stabilization by using Industrial Waste Material as a Stabilizer" like clay, lime, industrial waste sand and found that there is an appreciable improvement in the optimum moisture content and maximum dry density for the soil treated with industrial wastes. In terms of material cost, the use of less costly Admixtures can reduce the required amount of industrial waste. Soils had the greatest improvement with all soils becoming non plastic with the addition of sufficient amounts of industrial waste.

The objective of the present work is to explore the possibility of using Rice husk ash with metakoalin in construction programme. To study the effect of Rice husk ash with metakoalin on the density and OMC of cohesive soil. To study the effect of Rice husk ashes with metakoalin on consistency limits and shear strength parameters of cohesive soil. To study the changes in CBR of cohesive soil by addition of Rice husk ash with metakoalin.

II. Materials

A. Soil

Soil is a mixture of organic matter, minerals, gases, liquids, and organisms that together support life. Soil samples are collected from Bannur (Mysore district) and are tested for their geotechnical properties and strength.

B. Rice husk ash

Rice husk ash (RHA) is a by-product from the burning of rice husk. Rice husk is extremely prevalent in East and South-East Asia because of the rice production in this area. The rich land and tropical climate make for perfect conditions to cultivate rice and is taken advantage by these Asian countries. The husk of the rice is removed in the farming process before it is sold and consumed. It has been found beneficial to burn this rice husk in kilns to make various things. The rice husk ash is then used as a substitute or admixture in cement. Therefore, the entire rice product is used in an efficient and environmentally friendly approach. Rice husk ash is collected from Mysuru and is tested for their geotechnical properties and strength.

C. Metakaolin

Metakaolin is the anhydrous claimed form of the clay mineral kaolinite. Minerals that are rich in kaolinite are known as china clay or kaolin, traditionally used in the manufacture of porcelain. The particle size of metakaolin is smaller than cement particles, but not as fine as silica fume. Metakaolin is collected from Bangalore and is tested for their geotechnical properties and strength.

III. Methodology

A suitable cohesive soil is replaced with 10%, 20% & 30% of Rice husk ash as a replacement for soil and mixed with 20% metakoalin separately as additives & tested for its basic properties & strength properties.

Table 3.1: Tests conducted on materials

Soil	Rice husk ash	Metakaolin
➢ Specific gravity ➢ Consistency Limits ➢ Dry density & OMC ➢ Tri Axial Test ➢ CBR	➢ Specific gravity	➢ Specific gravity

Table 3.2: Tests conducted on materials

Index Properties	Engineering properties
➢ Consistency Limits	➢ Dry density & OMC ➢ Tri Axial Test ➢ CBR

Table 3.3: Specific gravity of materials

Material	Specific gravity
Soil	2.55
Rice husk ash	3.0
Metakaolin	2.25

Table 3.4: Index & engineering properties of soil

Tests conducted	Results
Specific gravity	2.55
Liquid limit	60%
Plastic limit	11.5%
Shrinkage limit	8.85%
Proctor test (OMC)	14.2%
Proctor test (Max dry density)	1900 g/cc
Shear strength (c)	5.09 kg/ cm^2
Angle of friction (ϕ)	20%
CBR for 2.5	5.23 mm
CBR for 5.0	4.9 mm

IV. Results & Discussion

Cohesive soil was replaced with varying percentage of rice husk ash i.e. 10%, 20% and 30%. The replaced soil sample was treated with constant percentage of metakoalin i.e. 20% as an additive in all the three cases and was tested for index and engineering properties.

Table 4.1: Soil replaced with 10% rice husk ash and 20% metakaolin

Test conducted	Results
Liquid limit	32%
Plastic limit	14.13%
Shrinkage limit	27.32%
Proctor test (OMC)	13%
Proctor test (Max dry density)	1920 g/cc
Shear strength (c)	9.17 kg/cm^2
Angle of friction (ϕ)	12°
CBR for 2.5	11.48mm
CBR for 5.0	11.42mm

Table 4.2: Soil replaced with 20% rice husk ash and 20% metakaolin

Test conducted	Results
Liquid limit	35%
Plastic limit	17.67%
Shrinkage limit	27.73%
Proctor test (OMC)	15.2%
Proctor test (Max dry density)	1690 g/cc
Shear strength (c)	8.15 kg/cm^2
Angle of friction (ϕ)	15°
CBR for 2.5	10.99 mm
CBR for 5.0	10.94 mm

Table 4.3: Soil replaced with 30% rice husk ash and 20% metakaolin

Test conducted	Results
Liquid limit	39%
Plastic limit	20.17%
Shrinkage limit	29.10%
Proctor test (OMC)	17.8%
Proctor test (Max dry density)	1380g/cc
Shear strength (c)	7.02 kg/cm^2
Angle of friction (ϕ)	17°
CBR for 2.5	9.87mm
CBR for 5.0	9.45mm

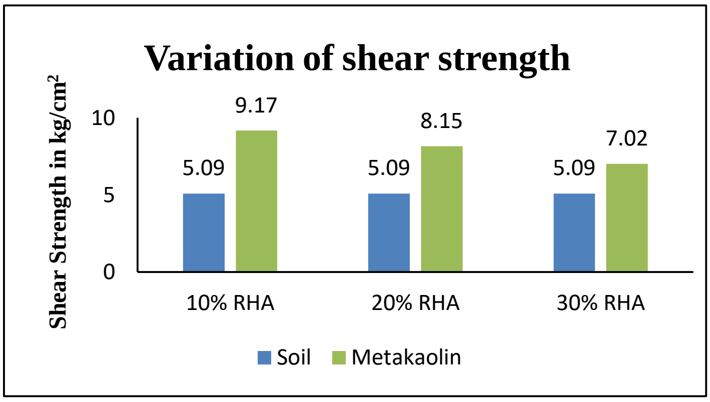

Fig 4.1: The above graph indicates the variation of shear strength of cohesive soil and soil replaced by 10%, 20% and 30% of rice husk ash with addition of 20% metakaolin

V. Conclusion

- Rice husk ash can be used as a replacement for soil upto a limit of 10%.
- Usage of Metakaolin as additive improves the engineering properties of the cohesive soil.
- Soil replaced with 10% Rice husk ash and treated with 20% metakaolin increases the shear strength by 80% and reduces the internal frictional angle by 40% when compared with soil alone.
- Soil replaced with 10% Rice husk ash and treated with 20% metakaolin decreases the optimum moisture content by 8.5%.
- Soil replaced with 10% Rice husk ash and treated with 20% Metakaolin increases the Dry density by 1%.
- California bearing ratio of the soil replaced with 10% rice husk ash and mixed with 20% metakaolin increases by 120% when compared with soil alone.

References

1. Aamir Farooq, Prof. (Dr.) Rajesh Goyal, "Stabilization of soil by use of geo-jute as soil stabilizer, IRJET, e- ISSN: 2395 – 0056, Volume 04 Issue: 08, Aug 2017.
2. M Adams Joe, A Maria Rajesh, "Soil stabilization using industrial waste and lime", IJSRET, ISSN 2278 – 0882 volume 4, Issue 7, July 2015.
3. Muthupriya P et. al. "Soil Stabilization by using Industrial Waste Material as a Stabilizer", IJCRGG, ISSN 0974 – 4290, Vol 10 No. 8, 2017
4. Karthik S et. al., "Soil Stabilization by Using Fly Ash, IOSR – JMCE, e – ISSN: 2278 - 1684, Volume 10, Issue 6, 2014.
5. Charan H.D. (1995). "Probabilistic analysis of randomly distributed fibre soil." Ph.D. Thesis, Dept. of Civil Engg. I.I.T Roorkee, Roorkee, India.
6. IS: 2720, Part XVI, 1965. Laboratory determination of CBR, Bureau of Indian Standards; New Delhi.
7. IS: 2720, Part VII, 1965. "Determination of Moisture content – Dry density Relation using Light Compaction", Bureau of Indian Standards; New Delhi.
8. IS 2720 (Part 5) – 1985, IS 2720 (part 5) – 1985], IS 2720 (part 20): 1992, IS 2720 (part VII) – 1980.
9. Achmad Fauzi, Zuraidah Djauhari and Usama Juniansyah Fauzi "Soil Engineering Properties Improvement by Utilization of Cut Waste Plastic and Crushed Waste Glass as Additive" Iacsit International Journal of Engineering and Technology, Vol. 8, No. 1, January 2016.