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Interpretation of Rice Husk Ash on Geotechnical Properties of Cohesive Soil

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Abstract - *Due to higher compressibility and poor bearing capacity the available soil at various locations may not be suitable as construction material and supporting material to huge multistoried buildings or as a filler material. This soil can be improved by using the industrial waste such as rice husk ash and fly ash. The industrial wastes have big problem of storage/space/land so their disposal is very expensive. Therefore the industrial waste like rice husk ash, fly ash and used tyres are to be used as a substitute material by mixing them in definite proportion with sand, cement and lime.*

Key Words: Soil stabilization, bearing capacity, Compressibility, swelling, permeability, shrinkage, compaction..

1. INTRODUCTION

Soil is the natural construction material. It transmits the load of building or structures to the sub soil. Sometimes the existing soil has the poor bearing capacity, high compressibility and excessive swelling. Such like soil needs to be improved to prevent the failure of multistoried buildings. The properties of soil have to be improved with fly ash or rice husk ash both having the cementing properties. Clays does not have engineering properties. They have generally low shear strength and on getting water they have loosen shear strength. Clays expand on wetting and shrink on drying which is undesirable for pavements and buildings and are one of the failures of the structures. Clays develop huge lateral pressure and have low resilient modulus values. Thus clay is treated as poor material for supporting the pavements or buildings. Different stabilization techniques are used to improve the engineering properties of clayey soil. Presently stabilization of soil is done by adding lime, cement, fly ash and desirable results have been obtained. The probability of adding pozzolana cement to the clayey soil in isolation or mixed with Portland cement is required to be investigated. The engineering properties of natural clayey soil are necessitated to be improved for supporting the super structures and hence soft soil is made usable by using the ground improvement techniques.

1.2 SOIL STABILIZATION

The ground improvement techniques or the stabilization of soil is very old practice in use. The modification is done with the following additives:

1. Cement
2. Sand
3. Lime
4. Silica fume

In our country the by-products like rice husk ash and fly ash are available in plenty and are generally of very low value rather sometimes they are waste in rice mills specially in rice producing belts like Haryana, Punjab, UP, MP etc. The developing countries are adopting the principles of zero waste and these by-products are termed as new resource for ground improvement technique.

2. INTRODUCTION TO RICE HUSK AND RICE HUSK ASH

At the time of milling of rice in the rice mills, the rice husk is obtained as a by-product. This is the cover or the outer portion of the paddy grain which protects the rice. One done of paddy generates 7 tonnes of rice and .25 tonnes of rice husk and 0.05 tonnes of rice brain (polish). The production of all kinds in the world is approximately 7 to 8 million tonnes every year. India and china are two major countries which produce approximately half of the total production of paddy. In the past husk was used as a fuel for producing the steam from water in rice mills itself. In the process of use of rice husk for generating the steam, the burning of rice husk becomes rice husk ash and this process cause a lot of air pollution but at the same time the rice husk ash is a residual product which goes waste. This residual waste can be utilized in Eco products of high value. As per available data India is the biggest rice producing country and having this rice husk ash in plenty.

Table-1: Availability Of Rice Paddy And Rice Husk

(Million metric production), (Hwang & Chandra, 2009)

COUNTRY	RICE PADDY (Million metric tonnes)	RICE HUSK (Million metric tonnes)
Bangladesh	27	5.46
Brazil	9	1.8
Burma	13	2.6
China	180	36
India	110	22

Indonesia	45	9
Japan	13	2.6
Korea	9	1.8
Philippines	9	1.8
Taiwan	14	1.8
Thailand	20	4
US	7	1.4
Vietnam	18	3.6
Others	26	5.2
Total	500	100

2.1 SPECIFICATIONS OF RICE HUSK

The rice husk is obtained in Sheller in its full size but in huller the same is obtained in broken form. The rice husk is 20-25% of rice grain or paddy. Rice husk is available after milling of paddy and the same is waste product. Rice husk is composed of two parts:

1. Organic matter
2. Inorganic matter

There is 75% organic matter by weight and balance is inorganic 25% approximately depending upon the following factors.

1. Geology of area where paddy is produced.
2. Temperature prevalent in that area.
3. Practices adopted by farmers.

2.2 ENGINEERING PROPERTIES OF RICE HUSK ASH

The use of this by-product depends upon its engineering properties, chemical composition and its structure. Though the structure and Engineering properties are same of the paddy produced under same condition and in the same type of soil where as the chemical composition may vary from sample to sample. This difference is due to climatic conditions and type of paddy like Basmati, 1121, Dhan etc. As per Koteswara Rao D. et al, 2012 rice husk ash in turn contains around 85-90% Amorphous silica. The chemical composition is shown in the table given below:

Table -2: Chemical Composition Of Rice Husk Ash

(Koteswara Rao D et al, 2012)

Constituents	Percentage
SiO_2	86%
Al_2O_3	2.6%
Fe_2O_3	1.8%
CaO	3.6%
MgO	0.27%
Loss in ignition	4.2%

2.3 STRUCTURE & COMPONENTS OF RICE HUSK

It is reported that in rice husk, Silica is in inorganic linkage and a few Molecules of Silica are bonded covalently with the compounds of organic nature. This portion is undissolved in Alkali & can be withstand at very high temperature once the organic part of rice husk is separated, the rest of residue is inorganic which may be relatively pure a good source of silica. Silica is present all over in the hydrated Amorphous form, can be either Opal or Silica gel.

2.4 RICE HUSK ASH & ITS REACTION

Imperfection in the crystal lattice and its surface defines the reactivity of a Solid Material. Amorphous silica is highly Reactive. The Reactivity of Ash is mainly controlled by:

1. Thermal Treatment
2. Oxidation Conditions
3. Morphology of Hull

2.5 CHARACTERISTICS OF RICE ASH IN THE MATTER OF POZZOLANICITY

Cementation calcium silicate hydrates is produced by the combination of silica with calcium hydroxide which is the pozzolanic activity. Pozzolanicity is determined by comparing the amount of calcium hydroxide in liquid phase in the material that is to be tested having the sufficient calcium hydroxide to saturate solution having similar alkalinity.The graph is plotted to depict the pozzolanizity between m- moles/liter of CAO and moles/liter of OH which is compared with solubility curve at 40^{o} C of calcium hydroxide. The mixture is considered to be pozzolanic if the values fall under the solubility curve.

2.6 DISPOSAL OF RICE HUSK ASH

In the Indian context being the largest paddy Producing country. Consequently producing huge quantity of rice husk and the rice husk ash, its disposal a highly expensive and problematic.

They are having very low nutritional value and its decomposition is a long process. If the rice husk ash in not disposed of appropriately which is the tune of about 500 million tonnes in the world, it pollutes the atmosphere . The present day one of the adopted is the practice of disposal of rice husk is the brick kilns. These kiln procedure bricks and other clay procedure. The other useful goods are also produced by efficiently disposing off the rice husk .the rice husk on its burning yields approximately 20% of rice husk ash and its disposal is highly problematic.

The present investigation Envisages utilization of Rice Husk Ash for improving the Geotechniques by the mixing of ash with soil and ash.

2.7 USES OF RICE HUSK

A lot of researches are going on all round the world for efficiently and effectively utilization of rice husk. A few of its uses in various applications are listed as under:

Its Applications as Non -Energy Material

1. Animal husbandry feed.
2. In the soil it is incorporated for Compositing.
3. Bio-fertilizer.
4. Manufacturing of board.
5. Sorbent of material in Environment.
6. Pest Control.
7. Building Material.
8. In Manure.
9. As a Filling Agent.

In the generation of Energy

1. Combustion: brick kilns, rice dryers, stoves etc.
2. Gasification: electricity generation, cook stoves.
3. Pyrolysis: in research, commercial applications.

2.8 USES OF RICE HUSK ASH

Absorbent: oils and chemicals.

Insulator: insulation in rolling mills, refrigerants and refractory bricks.

Release agent: ceramics and concrete industry.

Repellants: in the form of "vinegartar".

Pozzolana: cement and concrete industry.

It can be used as a substitute for micro silica.

It can be used as a water purifier.

It can be used as a vulcanizing agent.

As a stabilizer: In rice husk ash as an inert material with silica in crystalline form as far as structure of particles as concerned. It is quite probable that it will not form calcium silicate on Reacting with lime. It is also quiet probable that ;it will not react like fly ash. Therefore it is safely inform Rice Husk Ash gives good result when used as Stabilization agent Material.

In light weight filling material: When the moisture content of rice husk ash is kept as in its Reasonable limit it can be easily compacted as the same is very light in weight. The angle of internal friction for the same is very high and it provides more stability. Anyhow under heavy rolling it provides Erosion and shearing due to lack of cohesion. So to prevent this problem it is desirable to provide after every 2 to 3 ft. layer of rice husk ash, a layer of 3 to 6 inch thick cohesive Material.

Other uses: When the rice husk ash is used as filter material over a wide range of moisture with small pore size and high Permeability makes the same more useful as a final filter for water supply. Un-burnt Rice Husk may be used as first stage water filter since the rice husk is very cheap so it can be frequently changed or Replaced. The Rice Husk Ash is suggested to be used in light weight concrete and also as a filler material.

2.9 EFFECT OF TEMPERATURE

Crystalline silica and Amorphous

When the Rice husk is burned at very high percentage of crystalline is formed but when the rice husk is burned under controlled conditions, highly reactive Amorphous is produced. As formed at a temperature about (800-850 k) consist of Amorphous silica which is white mineral with talc, clay and CaCO3, these are used as filler in Paper, Paint and Rubber etc. The amorphous silica has larger surface area, small particle size and high purity can be used as absorbent or catalyst in fine chemical Synthesis. The Production of Amorphous silica from the husk some treatments like thermal and ether chemicals was attempted before and after combustion at temperature ranging from about (800-850k)for different intervals of time. The crystalline form Cristobalite and Trydimite were detected at temperature>1073k and >1423k respectively. For producing maximum Amorphous silica the controlled temperature is maintained. According to Patel. et al.(2001) report that the temperature of Carbonization is preferably held below 973k to avoid any transformation of the amorphous phase to a crystalline form. The Reheating of ash to remove carbon residue take long time and higher temperature and result conversion of amorphous silica into crystalline form.

If rice husk ash should be used by mixing with some admixture and after value addition the same can be in the best interest of national economy the chemical composition is the property of any material and its end used. The same is also important for pretreatment of rice husk. The rice husk ash is produced about 20 years in weight from the rice husk. The characteristics of rice husk is very light in weight facilitates its transportation in water and wind and also other road/ railway transport. Coagulation of rice husk ash is not practically possible due to water and air pollution. Cumulative of generation of ash requires a lot of space for disposal. The exploitation of the inherent properties of the rice husk ash is the only solution of its disposal. The chemical and physical properties of rice husk ash have been experimented / studied by number of scholars.

The cement, sand, lime, clay are the main material available for soil stabilization with rice husk ash. The cost of construction goes very high due to availability of material in limited quantity and increased of prices of these materials.

The waste industrial material is the only alternatives to reduce the cost of construction which also prevents industrial hazards. A large quantity of CO2 is produced by each tones of production of Portland cement.

Therefore the substitutions a part of Portland cement with rice husk ash will affect the stabilization process. Therefore the utilization of rice husk ash in the present scenario suggested several ways of utilization of rice husk ash for soil stabilization. The use of rice husk ash has brought good results about early strength and durability as well as economy.

Geo-technical engineering deals with the soil behavior as construction material also material for supporting the structure. The logical conclusion is required to be arrived at about the behavior of rice husk ash in the process of soil stabilization to support the heavy structure and also as a construction material mixed with other construction materials and also as a filling material. The industrial waste as rice husk ash for soil improvement is sustainable, techno-economical and viable.

The property of soil have to be determine fast to a certain if the soil is used as a construction material, filling material or supporting medium to the heavy structure. In the country like USA, UK a lot of effort have been made to study about behavior but in our country there is a wide range of scope for carrying out the study about rice husk ash for using in the civil engineering construction but very limited research made by various researchers is available in the field of rice husk ash and its use with respect to durability and construction. Industry as a construction material mixed with other materials like sand, cement and earth with respect to its durability needed during melting and drying process ash.

3.CONCLUSIONS

We have studied the properties of rice husk ash when used with cohesive soil. Use of rice husk ash with cohesive soil improves its quality and properties used in construction like stability, durability, strength, etc. The increase in rice husk ash contents will decrease the dry density and optimum moisture content increases. The addition of rice husk ash in soil samples decreases the dry density and ultimately the strength is decreased and also same due to increase in OMC and property of rice husk ash. The problems of disposal of rice husk ash are solved by utilizing the rice husk ash mixed with cement in the fixed proportion and substituted in the clayey soil. The cost of construction and supporting material is also reduced.

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