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A REVIEW STUDY ON THE EFFECT ON PROPERTIES OF CONCRETE BY USING RICE HUSK ASH (RHA) AS PARTIAL REPLACEMENT FOR CEMENT IN CONCRETE

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Abstract - *The main objective of using Rice Husk Ash is to use it with cement in concrete as an admixture. It has high pozzolanic characteristics and contributes to high strength impermeability of concrete. It is a material of future as concrete admixture. Use of RHA will contribute not only to the production of concrete of higher quality and lower cost but also the reduction of CO2 emission from the production of cement. High and rising cost of building material can be reduced by use of alternative additive that is cheap, effective, environmentally friendly, locally available and reduce the overall dead wt. of building. RHA concrete can be effectively used as light wt concrete for the construction of structure. Concrete which is made from waste material that are eco-friendly are called as green concrete. Using RHA in concrete will help to reduce the amount of cement due to partial replacement of cement by RHA and using the waste material. There are three test to be conducted with various percentage of RHA in the mix design and check the compressive strength after 7 and 28 days. In this paper the brief of studies is made on researches by various authors.*

***Key Words*: RHA, Compressive Strength, Slump test, Eco-friendly and Water cement ratio**

1. INTRODUCTION

In developing country like India due to the remarkable development in infrastructure, the cement is being used in large quantity. For the production of large amount of cement, large amount of CO2 is being emitted depending on the production process and the fuel used. Because of CO2 our environment is being directly affected.

Rice husk ash is obtained by burning the rice husk in controlled manner without causing environmental pollution. RHA exhibits high pozzolanic characteristics and contributes to high strength and impermeability of concrete. Rice husk consists of 90%emorphous silica. India produces about 122 million tons of paddy every year. Each ton of paddy produces about 40 kg of RHA. There is a good potential of RHA as pozzolanic material. In U.S.A. highly pozzolanic RHA is patented and marketed under the name Agrosilica. It exhibit super pozzolanic property when used in small quantity. If 10% by wt of cement it greatly enhances the workability and impermeability of concrete. The partial replacement of cement by RHA results in lower energy consumption associated the production of cement. The reference also addresses economic development, tight environmental regulations and consolidation in the rice mill industry. Rice husk is an agricultural by product. Other agricultural by products the burned rice husk presents a high yield of ash composed of silica. Extensive research in the past three decades introduced RHA as a supplementary raw material in cement based products, whereby significant improvement in strength and durability can be achieved.

Some industrial and agricultural products that would otherwise litter the environment as waste or at best be put into only limited use could gainfully be employed as building material. During milling of paddy about 22% of the wt of paddy is received as husk. This husk contains 75% of organic volatile matter and the balance 25% of this husk is converted into ash which is known as RHA.

1.1 Solid waste material

There has been a great deal of concern about land pollution since the onset of industrialization. Till recently land disposal has been the only option available for solid residue. Use of waste material is big option in finding solution to this problem. On the other hand these solid waste may have potential for reuse one such potential application is for infrastructure development work in civil engg. Among all the solid waste which are produced in large amount in India are fly ash, ground granulated blast furnace slag (GGBS) and rice husk.

1.2 Components of rice husk ash

The main constituents of rice husk ash are cellulose, pentosan, lignin and silica. Pentosan is considered a good source of furfural production. Amorphous silica is good source for preparation of pure silicon and a number of silicon compounds such as silicon carbide, silicon nitrite, ceramic and cement etc.

1.2 Properties of RHA

Rice hull has thermal conductivity of about 0.0359 w/(m.^{o}C) which is comparable with insulating materials energy content of rice hull is 11.5-13 MJ/kg at 14% moisture content. It has less than 10% total digestible nutrients and a bulk density of 100-160 kg/m^3. It is used

as building material, cattle feed, fuel, ash and pure silica and furfural.

2. LITERATURE REVIEW ON RHA

Talsania et al. (2013) examined that the compressive strength test and flexural strength test was carried out for 7, 14 and 28 days to measure the compressive strength and flexural strength of concrete. So the aim of the investigation is to study the behaviour of pervious concrete while replacing the RHA with different proportions in concrete. Test results have reflected, the compressive strength achieved up to 10% replacement of cement with RHA will be optimum without effecting properties of fresh and hardened.

Hamid, Rahizuwan et al. (2013) study showed that the use of rice husk ash with different grinding decrease the workability of concrete but increase the compressive strength of concrete. The compressive strength of concrete at 7, 14, 28 and 60 has been found to be increase with increase of RHA. It is found that increasing grinding time has better compressive strength.

Gupta, Sunil et al. (2014) the study showed that the use of RHA in the production of porcelain has proved to be durable and strong. In making good porcelain 20% silica is required and the cost of RHA porcelain work out to be less than that of ordinary porcelain so the addition of RHA in porcelain help in making an economical concrete the compressive strength is increase with addition of RHA as well as the increase strength workability & pozzolanic properties of porcelain.

Kulkarni, Suresh, Markarand et al. (2014) in this paper, five different replacement levels namely 5%, 7.5%, 10%, 12.5% and 15% has to be done. The strength achieved at different age namely 3, 7, 28 and 56 days and it is observed that the maximum strength is achieved with 7.5% (7days) 7.5% (28days) and7.5% (56 days) and the maximum flexural strength is higher at 7 days and 28 days.

Sampaio, Joaquim (2014) in this research paper Portuguese rice husk ash has been used to find out the high durability of concrete. The replacement of cement by Portuguese rice husk ash is 5%, 10% and 15% and the result shows high performance of concrete than normal concrete and also give better durability.

Singh, Smita and Singh Dilip (2014) examined that the replacement of cement by rice husk ash in the levels 5%, 10%, 15% by weight of cement and the compressive strength of concrete cube at 7 days for 5%, 10%, and 15% was 20.81, 19.33, and 17.77. At 14 days are 22.22, 19.77, and 17.77. It observed that there is a gradual increase in compressive strength from 0 to 14 days.

I.O. Obilade (2014) examined that for 0%, 5%, 10%, 15%, 20% and 25% replacement of OPC with RHA, compacting factor test and compressive strength test were carried out. The result revealed that the compacting factor decreased as %age replacement of OPC with RHA increased. The compressive strength of the hardened concrete also decreased with increasing OPC replacement with RHA.

Khassaf, S.I. et al. (2014) found that the replacement of 10% ,20% and30% in cement increase the compressive strength, tensile strength by increased of RHA% until 20% and decrease with increase of RHA to 30% . There is a significant reduction of workability with increase amount of RHA content in concrete. The partial replacement of cement by RHA indicates that at long term age, the RHA concrete showed higher compressive strength in comparison with that of concrete without RHA, there is substantial increase in tensile strength due to addition of RHA. Decrease the drying shrinkage with increase the RHA.

Mahure, H, Shriram H. Mahure and Mokitkar, V.M. (2014) in this paper an attempt had been made to study fresh and hardened properties of self compacting concrete using Rice Husk Ash as partial replacement of cement in different percentages in addition to filler. The compressive strength, flexural strength and split tensile strength, flow ability and adequate self compatibility were obtained. And shown the test result was much better performance after 90 days curing as compared with the same at 28 days.

Chukwudebelu et al. (2015) examined that the compressive strength of dense and hollow brick made rice husk ash had been determined at 7, 14 and 21 days. In this study rice husk ash was wetted for 3, 6, 9, 12 and 15 hour. The composites materials were filled in cylinder and rectangular mould at ratio 1:1, 3:1, 2:3 and 3:2 for 7, 14 and 21 days and result showed higher compressive strength in ratio 1:1 when the age of wetting is increased. Rice husk ash can be excellent material for brick production.

Syed Ali Reza Zareei, Mujtaba Ahmadi (2017) this paper presents benefits resulted from various ratios of RHA on concrete with properties of 5, 10, 15, 20 and 25% by weight of cement in addition to 10% micro silica to be compared with a reference mixture with 100% Portland cement. Test results indicated the positive relationship between 15% replacement of RHA with increase in compressive strength by about 20%. The optimum level of strength and durability properties gain with addition upto 20%, beyond that is associated the slight decrease in strength parameters by about 45%.

Ankit Goutam, R. Batra, N. Singh (2019) RHA consists of amorphous silica which can be used as pozzolona in making concrete and cement instead of disposing it without compromising on the properties of cement or concrete if replaced in specific proportion with other

constituents of cement or concrete. In this study the OPC is replaced in different proportion with RHA to obtain concrete with comparable and satisfactory strength and properties to that of normal concrete. The proportion of replacement chosen are at 2.5% internal starting from 5% to 15% and the casted concrete were tested under compression at different ages and results obtained are compared with normal concrete with same grade and it is concluded that the results are comparable.

Joel Sam (2020) This paper reviewed the work that has been done on the use of fly ash and RHA as partial replacement for concrete, its chemical composition and effect on the compressive strength of concrete. Charts, tables and figures were employed to study the various chemical compounds of fly ash and RHA. The data on the compressive strength of concrete after fly ash and RHA has been added in percentage increments of 0, 10, 20, 30, 40, 50 and 0, 5, 7.5, 10, 12.5, 15, respectively and analysed over a minimum period of 7 days and a maximum period of 28 days and find out that the optimal percentage of partial replacement of fly ash and RHA for strong compressive concrete strength is 30% for fly ash and 7.5% for RHA.

3. CONCLUSIONS

After reviewing the various researches the following conclusion were drawn:

1. Cement can be replaced with RHA by wt at 0%, 5%, 10%, 15% and 20% and 0% replacement served as the control.
2. Compressive strength of concrete made up to 15% RHA has observed more than normal concrete. But at 20% RHA compressive strength of concrete decreases.
3. Workability of concrete with 5% RHA increase with increase in the water cement ratio.
4. Compacting factor of concrete with 5% RHA decrease with increase in the water cement ratio.
5. Increase in RHA percentage decreases the drying shrinkage in concrete.
6. The use of RHA in concrete leads to around 8 to 12% saving in material cost.

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