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Effect of Rice Husk Ash on Properties of Concrete

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Abstract: **The optimized RHA, by controlled burn and/or grinding, has been used as a pozzolanic material in cement and concrete. Using it provides several advantages, such as improved strength and durability properties, and environmental benefits related to the disposal of waste materials and to reduced carbon dioxide emissions. Up to now, little research has been done to investigate the use of RHA as supplementary material in cement and concrete production in Vietnam.The main objective of this work is to study the suitability of the rice husk ash as a pozzolanic material for cement replacement in concrete. However it is expected that the use of rice husk ash in concrete improve the strength properties of concrete. Also it is an attempt made to develop the concrete using rice husk ash as a source material for partial replacement of cement, which satisfies the various structural properties of concrete like compressive strength.From the entire experimental work & studies it is concluded that mix M2 (M0+20%RHA) is the best combination among all mixes, which gives max, tensile, flexure & compression strength over normal concrete.**

1. INTRODUCTION

Rice husk can be burnt into ash that fulfils the physical characteristics and chemical composition of mineral admixtures. Pozzolanic activity of rice husk ash (RHA) depends on (i) silica content, (ii) silica crystallization phase, and (iii) size and surface area of ash particles. In addition, ash must contain only a small amount of carbon.RHA that has amorphous silica content and large surface area can be produced by combustion of rice husk at controlled temperature. Suitable incinerator/furnace as well as grinding method is required for burning and grinding rice husk in order to obtain good quality ash. Although the studies on pozzolanic activity of RHA, its use as a supplementary cementitious material, and its environmental and economical benefits are available in many literatures, very few of them deal with rice husk combustion and grinding methods.

The optimized RHA, by controlled burn and/or grinding, has been used as a pozzolanic material in cement and concrete. Using it provides several advantages, such as improved strength and durability properties, and environmental benefits related to the disposal of waste materials and to reduced carbon dioxide emissions. Up to now, little research has been done to investigate the use of RHA as supplementary material in cement and concrete production in Vietnam. For example, in 2005 Bui et al.published a paper in which they burnt Vietnam rice husk in a drum incinerator for RHA production and researched the particle-size effect on the strength of RHA blended gap-graded Portland cement concrete. For this reason, this study investigates the strength activity index of mortars containing residual RHA that is generated when burning rice husk pellets and RHA as received after grinding residual RHA. The effect of partial replacement of cement with different percentages of ground RHA on the compressive strength and durability of concrete is examined.

1.1 Performance of rice husk concrete expose to industrial environment

A comprehensive programme to investigate the performance of plane concrete and rice husk ash concrete expose to industrial environment was chalked out in this short duration study. The programme is composed of compressive strength study, weight loss study, effect of carbonation, P^H test study and ultrasonic pulse velocity test study. investigation to study the behavior of plain concrete having mix proportion 1:1.35:3 and rice husk ash concrete having a specified weight of rice husk ash exposed to industrial environment (5%H2SO4, 55HIL, 10%(NH4)2SO4 and 10%NaOH solution) for 28 days revealed that plain concrete cube deteriorated more than rice husk concrete . The strength of PCC expose to aggressive medium reduced significantly .ten percent replacement of cement by rice husk ash makes the concrete impervious and enhances the resistance of concrete to different environment. The compressive strength and durability of concrete increased significantly when 10%RHA (by weight) in place of cement was added. The reduction in strength was mainly due to expansive salt formation and weakening of bonds. The formation of expansive salt also reduced in loss of cementations properties and loss of weight. The plain concrete exposed to H2SO4 solution was found to be least durable. This study also shows that higher the ultrasonic pulse velocity, lower is the deterioration. This paper presents the result of an experimental investigation of comparative performance of plain concrete and rice husk concrete expose to different industrial environment.

1.2 Properties of RHA

Rice Husk Ash is a Pozzolanic material. It is having different physical & chemical properties. The product obtained from R.H.A. is identified by trade name Silpoz which is much finer than cement.

RHA characteristics

A residual RHA obtained from open filed burning. The material was carefully homogenized and prepared in two conditions:

Natural RHA (NRHA): the ash was only dried, homogenized, and packed to enhance the transport to the laboratory. Grinded RHA (GRHA): after drying and homogenization process the RHA was ground in a laboratory ball mill by one hour for optimization.

Physical Properties of R.H.A.

Table 1: Physical Properties of R.H.A

Sr. No.	Particulars	Properties
1	Colour	Gray
2	Shape Texture	Irregular
3	Mineralogy	Non Crystalline
4	Particle Size	< 45 micron
5	Odour	Odourless
6	Specific gravity	2.3
7	Appearance	Very fine

Chemical Properties of R.H.A.

Table 2: Chemical Properties of R.H.A

Sr. No.	Particulars	Proportion
1	Silicon dioxide	86.94%
2	Aluminum oxide	0.2%
3	Iron oxide	0.1%
4	Calcium Oxide	03.-2.2%
5	Magnesium Oxide	0.2- 0.6%
6	Sodium Oxide	0.1- 0.8%
7	Potassium Oxide	2.15-2.30%
8	Ignition Loss	3.15-4.4%

2. EXPERIMENTAL WORK

The primary aim of experimental work is to study the properties of Rice Husk Ash. Preparation of mix design .Replacement of cement with RHA as different proportions with cement.

2.1 Objective

1 Effect of Rice Husk Ash on workability.

2 Effect on Compressive strength of concrete

3 Effect on flexural strength of concrete

4 Effect on split tensile strength of concrete

5. Comparison of result of different tests with varying proportion of RHA.

2.2 Methodology

The main objective of this work is to study the suitability of the rice husk ash as a pozzolanic material for cement replacement in concrete. However it is expected that the use of rice husk ash in concrete improve the strength properties of concrete. Also it is an attempt made to develop the concrete using rice husk ash as a source material for partial replacement of cement, which satisfies the various structural properties of concrete like compressive strength and Flexural strength.

It is also expected that the final outcome of the project will have an overall beneficial effect on the utility of rice husk ash concrete in the field of civil engineering construction work.

Literature review presented in chapter 2 has given good insight for the concrete with rice husk ash. Following parameters influences behavior of the rice husk ash concrete, so these parameters are kept constant for the experimental work.

- Percentage replacement of cement by rice husk ash
- Fineness of rice husk ash
- Chemical composition of rice husk ash
- Water to cementitious material ratio (w/b ratio)
- Type of Curing

Also from the literature survey, it is observed that the parameters suggested by different researchers and their results are not matching with each other. It was due to variation in properties of different materials considered in the work.Therefore the percentage replacement of cement by rice husk ash and method of mix design is fixed after preliminary investigation.

3. MIX DESIGN OF CONCRETE

IS-Code method of mix design was used for mix design of M-30 grade of concrete. The quantities of ingredient materials & mix proportions as per design are as under.

Table 3: Quantities of Materials per Cubic meter of Concrete

Material	Proportion by weight	Weight in kg
Cement	1	476.00
F.A.	1.25	595.00
C.A.(20mm)	2.73	1299.48
W/C ratio	0.45	186.00

4. TEST RESULTS AND DISCUSSION

4.1 Tests on Hardened Concrete- Compressive strength

Table 4: Test results of compressive strength on concrete cubes for different mixes ($M_0 – M_3$) at 7&28 days.

Sr.no.	Mix design	%RHA	Compressive strength(N/mm^2)		% increase or decrease in strength over control mix	
			7 days	28 days	7 days	28 days
1	M_0	0	27.2	37	0	0
2	M_1	10	27.8	42.8	2	15.67
3	M_2	20	28.3	39.8	4	7.56
4	M_3	30	27.4	37	0.73	0

a) Effect of RICE HUSK ASH on 7 days Compressive Strength of Normal Concrete:

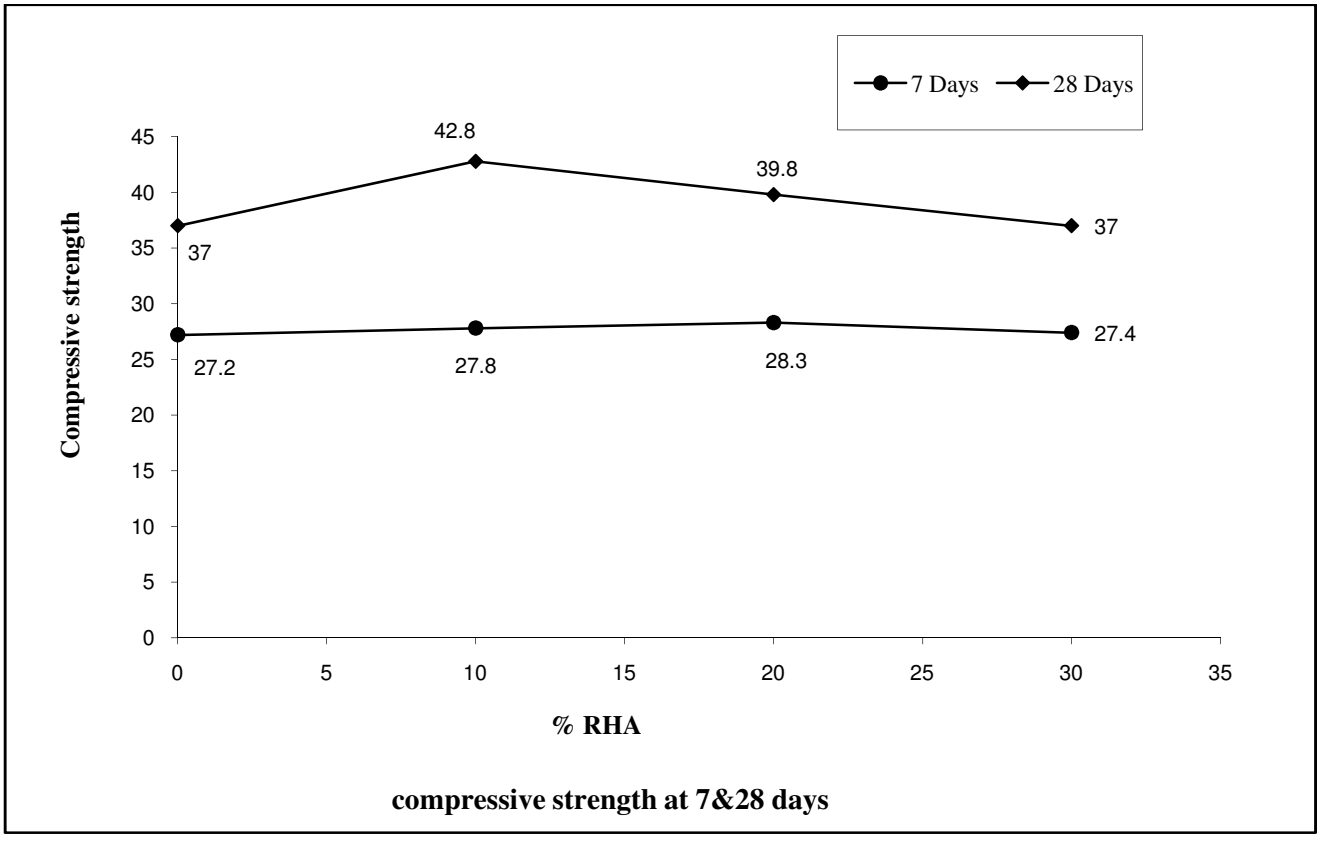
7 days compressive strength test results show that due to addition of RICE HUSK ASH in Normal concrete the early strength gain is slight.

In comparison of normal concrete compressive strength is increased by about 2% after addition of 10% RICE HUSK ASH; similarly the strength is increased about 4% after addition of 20% RICE HUSK ASH, and it is about 1% gain of strength after addition of 30% RICE HUSK ASH to normal concrete. Thus it can be observed that after addition of RICE HUSK ASH to normal concrete the early strength takes place slightly.

b) Effect of RICE HUSK ASH on 28 days Compressive Strength:

It is observed from table 13 that after addition of 10% RICE HUSK ASH to normal concrete there is about 16% increase in strength as compared to normal concrete, it is again increased about 8% when 20% RICE HUSK ASH is added to normal concrete. Itis decrease to of the original value of strength of normal concrete when 30% RICE HUSK ASH is added. Therefore the 30% RICE HUSK ASH is the optimum content at which it is showing parallel result as compared to normal concrete.

Graph 2: Effect of RHA on 7 & 28 days compressive strength



compressive strength at 7&28 days

5. CONCLUSION

Based on experiments and test results on fresh & hardened concrete the following conclusions are drawn:

1. Improvement in Fresh Concrete Properties:

a. Due to addition of rice Husk ash, concrete becomes cohesive and more plastic and thus permits easier placing and finishing of concrete. It also increases workability of concrete.

b. The bulk density of RHA concrete is reducing with increase in RHA content.

2. Compressive Strength:

1. Due to addition of RHA it is observed that early strength gain is slightly increasing with addition of 10%, 20% & 30% RHA in normal concrete at 7 days.
2. But in 28 days tests results it is found that with addition of 20% RHA in normal concrete strength is running parallel or more than of normal concrete. Thus 20% RHA is the optimum content for getting nearly equal strength at 28 days.
3. As the replacement of cement by RHA in concrete increases, the workability of concrete decreases.
4. Replacement of cement with Rice Husk Ash leads to increase in the compressive strength improved the workability and achieved the target strength at 20% replacement for the grade of concrete.
5. The pozzolonic activity of rice husk ash is not only effective in enhance the concrete strength, but also in improving the impermeability characteristics of concrete.
6. The optimum replacement level of Rice Husk Ash is found to be to20% for M30 grade of concrete.
7. The use of rice husk ash as an alternative for cement & as additive to reduce corrosion and increase durability of concrete strength.
8. The utilization of RHA holds promising prospects in the country because it softens the impact on the environment & capital cost of the structure.
9. RHA is also use for manufacturing load bearing blocks bricks tiles in low cost.
10. As the Rice Husk Ash is waste material, it reduces the cost of construction.
11. It helps in reducing the pollution in environment.

3. Ideal Combination

From the entire experimental work & studies it is concluded that mix M2 (M0+20% RHA) is the best combination among all mixes, which gives max, tensile, flexure & compression strength over normal concrete.

Rice Husk Ash is one of the most active research areas that encompass a number of disciplines including civil engineering and. construction materials. Rice Husk Ash (RHA) is an agricultural waste product which is produced in large quantities globally every. year and due to the difficulty involved in its disposal, can RHA becoming an environmental hazard in rice producing countries.Â strength achieved up to 10% replacement of cement with RHA will be optimum without effecting properties of fresh and hardened. concrete. KEYWORDS: Rice Husk Ash (RHA), Compressive Strength, Flexural Strength, Eco-Friendly, Pervious Concrete, Industrial. Waste, Low Cost, OPC Cement. I. INTRODUCTION. Rice husk ash is used in concrete construction as an alternative of cement. The types, properties, advantages and uses of rice husk in construction is discussed. The rice paddy milling industries give the by-product rice husk. Due to the increasing rate of environmental pollution and the consideration of sustainability factor have made the idea of utilizing rice husk.Â The rice husk ash has good reactivity when used as a partial substitute for cement. These are prominent in countries where the rice production is abundant. The properly rice husk ashes are found to be active within the cement paste. So, the use and practical application of rice husk ash for concrete manufacturing are important. Rice Husk Ash Classification and Chemical Composition. Rice husk ash has also been reported to improve the properties of concrete or cement paste due to the pozzolanic reaction and its role as a micro-filler. It is often thought that the first function (pozzolanic reaction) is most important. The partial replacement of cement by rice husk ash in cement paste and mortar would provide micro-structure improvement, pore filling effect and better packing characteristics of the mixer (Kondraivendhan, 2012).Â [3]Dahiya A., Himanshu, Kumar N., Yadav D. (2015): Effects of Rice Husk Ash on Properties of Cement Concrete. International Journal of Advanced Technology in Engineering and Science Vol. No. 3, Issue No 12 ISSN 2348-7550 pp 59 â€“ 63.