Study of rice husk ash on Concrete

[1]Vedprakash Prajapati, [2]Dr. Rajeev Chandak

[1]M.E. Scholar, [2]Professor
Department of Civil Engineering,
Jabalpur Engineering College, Jabalpur, India.

Abstract: **Concrete is a major civil engineering construction material, because the ingredients of concrete are locally available materials. Generally, the cement is used as major binding material. The usage of cement in concrete causes lot of environmental pollution due to emission of greenhouse gases so that, it is necessary to reduce usage of cement by introducing new supplementary cementitious materials which are the by-products of industries to reduce debris. Rice husk ash (RHA) is an agricultural based pozzolanic material, generated by rice mills in huge quantities. This paper summarizes the experimental work on concrete in which Plain Portland cement (PPC) cement were replaced by Rice husk ash (RHA). Concrete specimens were prepared with 5%, 10%, 15% and 20% RHA as a replacement of cement by weight, The most important mechanical property of concrete is compressive strength and it is evaluated on 150 mm sized cubes. The compressive strength is obtained for 7 and 28 days strength and results are analysed.**

Keywords: **Rice husk ash, Plain Portland cement (P.P.C.), Compressive strength, pozzolan.**

I INTRODUCTION

The optimized RHA, by controlled burn and grinding, has been used as a pozzolanic material in 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 a supplementary material in cement and concrete production. For example, a paper published in which they burnt 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. Due to this reason, this study investigates the compressive strength of concrete 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 of concrete is examined.

Concrete is a widely used construction material for various types of structures due to its structural stability and strength. All the materials required producing such huge quantities of concrete come from the earth's crust. Thus, it depletes its resources every year creating ecological strains. On other hand, human activities on the Earth produce solid waste in considerable quantities of over 2500MT per year, including industrial wastes, agricultural wastes and wastes from rural and urban societies. Recent technological advencements has shown that these materials are valuable as inorganic and organic resources and can produce various useful products. Amongst the solid wastes, the most prominent ones are fly ash, blast furnace slag, rice husk, silica fume and demolished construction materials. From the middle of 20th century, there had been an increase in the consumption of mineral admixtures by the cement and concrete industries. The increasing demand for cement and concrete is met by partial cement replacement. Substantial energy and cost savings can result when industrial by-products are used as a partial replacement for the energy of intense Portland cement. The use of by-product is an environmental friendly method of disposal of large quantities of materials that would otherwise, pollute land, water and air. Most of the increase in cement demand will be met by the use of supplementary cementing materials.

II LITRATURE REVIEW:

Some of the early researches have examined the use of rice husk ash (RHA) in concrete.

DaoVan & PhamDuy: Presented several key properties of high strength concrete using RHA. RHAs obtained from two sources: India and Vietnam. India's RHA are much better than that of the Vietnam RHA. The acceptable content is 10% to replace for cement with an acceptance of reduction in compressive strength. It is concluded that Rice husk is an abundant waste generated from agriculture product in Vietnam. Investigations in manufacturing high quality RHA in Vietnam is necessary.

Ramezanianpour & khani: Investigated the effects of rice husk ash on mechanical properties and durability of sustainable concretes. RHA replaced with cement by weight are 7%, 10% and 15%. Result shows that concrete incorporating with RHA had higher compressive strength, splitting tensile strength and modulus of elasticity at various ages compared with that of the control cement concrete. In addition, results show that RHA as an artificial pozzolanic material has enhanced the durability of RHA concretes and reduced the chloride diffusion.

Abhilash & Arbind: Evaluated one type of commercially available RHA as supplementary cementitious material for cement. There was a significant improvement in Compressive strength of the Concrete with RHA content of 10% for M30 and M60 at 7 days and 28 days i.e. 4.23% to 10.93%. It is concluded that we can replace 10% cement with the help of RHA without any ill effect.

Malleswara & Patnaikuni: Studied the performance of RHA concrete exposed to sea water. It can be concluded that for M20 grade, RHA concrete is subjected to seawater exposure for 28 days and 90 days. The 7.5% replacement showed better compressive strengths. Seawater exposure to 90 days is shown better compressive strength than normal concrete.

Maurice & Godwin: Investigated the effects of partially replacing OPC with RHA . It is concluded that Adding RHA to concrete resulted in increased water demand, increase in workability and enhanced strength compared to the control sample. This results show that an addition of RHA from 5-10% will increase the strength.

III EXPERIMENTAL PROGRAM:

Materials Used: The various material used in the preparation of concrete are cement, sand, cement coarse aggregates, rice husk ash (RHA) and water.

Rice husk ash:- Rice husk ash is a pozzalanic material which is obtained from paddy of local area in district- Jabalpur. It can be burnt into ash that fulfills 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. The physical and chemical properties are listed in table 1 and table 2 respectively.

Table 1 .Typical physical properties of RHA.

Property	Value
Appearance	Very fine powder
Colour	grey
Mineralogy	non-crystalline
Odour	odourless
Specific gravity	2.3

Table 2. Typical chemical composition of RHA

Compound	Percentage composition
Calcium oxide (CaO)	2.2
Silicon oxides (SiO_2)	86.94
Aluminum oxide (Al_2O_3)	0.2
Iron oxide (Fe_2O_3)	0.1
Magnesium oxide (MgO)	0.6
Sodium oxide (Na_2O)	0.8
Potassium oxide (K_2O)	2.3
Loss on ignition (LOI)	4.4

Cement: Plain Portland Cement (43 Grades) which is available in market is used.

Fine Aggregate: The natural river sand available in local market which passes through 4.75mm sieve with specific gravity of 2.62. Conforming to Zone II.

Coarse Aggregate: Crushed granite conforming to IS 383 - 1970 is used in this study. Coarse aggregate passing through 20mm and retained on 16 mm sieve and specific gravity 2.82 was used.

Water: Water is an important ingredient of concrete as it actively participated in chemical reaction with cement, clean portable water which is available in our college campus is used.

Mix Proportion: The mixture proportion for the controlled concrete of M25 grade was arrived from the trial mix as per IS 10262-2009.

Table 3. Mix proportions

S.no.	Mix	Cement (Kg/m^3)	Rice husk ash (Kg/m^3)	Fine aggregate (Kg/m^3)	Coarse aggregate (Kg/m^3)	Water (Kg/m^3)	w/c ratio
1.	M0	372	0	692	1216	186	0.5
2.	M5	353.4	18.6	692	1216	186	0.5
3.	M10	334.8	37.2	692	1216	186	0.5
4.	M15	316.2	55.8	692	1216	186	0.5
5.	M20	297.6	74.4	692	1216	186	0.5

IV METHODOLOGY:

Replacement levels of PPC by RHA of 0, 5%, 10%, 15% and 20 % were chosen for this research work. Batching was carried out by weighing as per calculated amount of each concrete constituent according to the mix ratio of 1:1.86:3.26 and M-25 grade of concrete was adopted. The constituents were then mixed thoroughly until a uniform mix was obtained. Water was then added and the mix was repeated. The fresh concrete mix was then placed in a mold of size 150 mm, compacted, and left for 24 hr. before testing Compressive specimens were tested at the ages of 7 and 28 days.

V RESULT AND DISCUSSION

Compressive Strength:-

The results of compressive strength presented in Table 4. The test was carried out obtain compressive strength of concrete at the age of 7 and 28 days. The cubes were tested using Compression Testing Machine (CTM) of capacity 2000KN available in structures lab. From Fig1 the compressive strength is up to 22.20 N/mm^2 and 31.12 N/mm^2 at 7 and 28 days. The maximum compressive strength is observed at 10% replacement of rice husk ash. If higher percentages of ash were used, then compressive strengths decreased. There is a significant impurities present in RHA like alumina , free lime and others.

Table 4. Compressive strength test result of RHA concrete at different ages.

S.NO.	Name of cube sample	Rice husk ash (%)	Average Ultimate Compressive strength(N/mm^2)	
			(7 days)	*(28 days)*
1.	M0	0	22.20	31.12
2.	M5	5	22.25	31.85
3.	M10	10	22.50	32.93
4.	M15	15	22.85	32.05
5.	M20	20	23.15	31.15

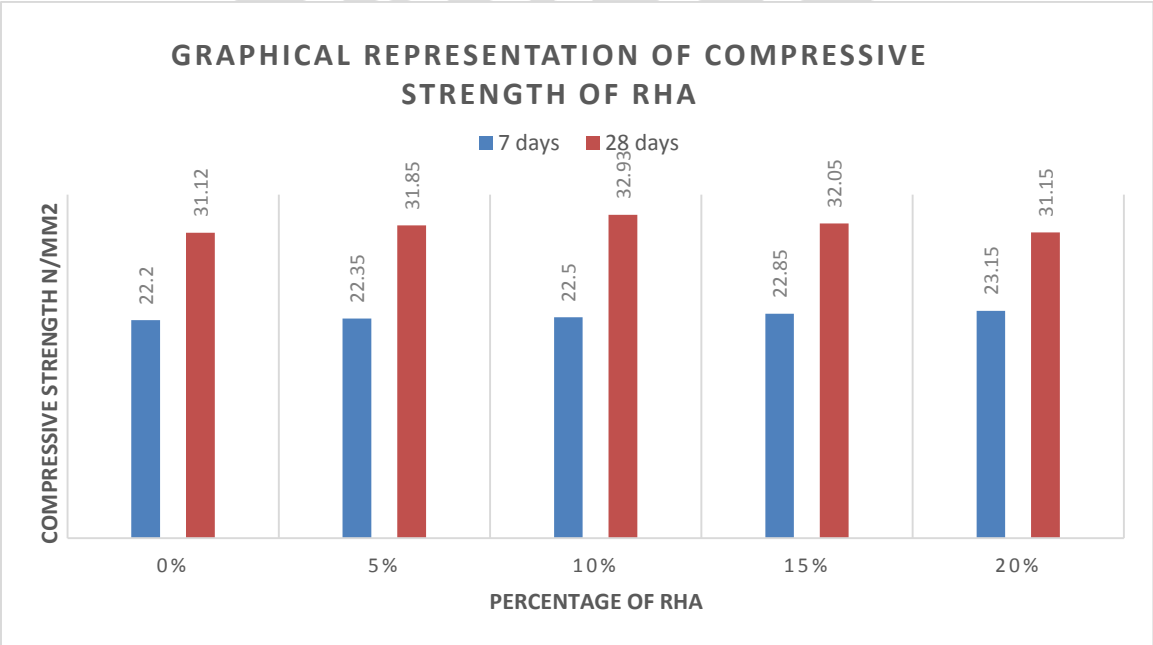

Figure 1. Relationship between compressive strength and different percentage of RHA. at a age of 7 and 28-days

VI CONCLUSION:

1. From test results, it is found that the higher compressive strength is attained compared to conventional concrete.
2. There is strength reduction with the addition of RHA due to the impurities present in RHA like free lime, alumina and other raw minerals.
3. However, strength achieved is highest when 15% RHA is replaced with cement at 7 days of age.
4. The strength is greater when 10% of RHA is replaced with cement at 28 days of age.
5. When the RHA addition is greater than 10% for 28 days old concrete cubes, the strength produced by the concrete gets reduced than the target strength.
6. If RHA replacement is more than 15% for 7 days old cubes, compressive strength gets reduced.

REFERENCES:

[1] IS 456-2000, Indian Standard, Plain And Reinforced Concrete - Code Of Practice
[2] Shazim Ali Memona, Muhammad Ali Shaikh and Hassan Akbar, "Utilization of Rice Husk Ash as viscosity modifying agent in Self Compacting Concrete", Construction and Building Materials, July 2010, pp.1044-1048
[3] P.K.Mehta, "Properties of Blended Cements Made from Rice Husk Ash", ACI Journal, September 1977 pp. 440-442
[4] R. Kishore, V. Bhishma Hikshma and P. Jeevana Prakash, "Study on Strength Characteristics of High Strength Rice Husk Ash Concrete", Procedia Engineering, 14 (2011), 2666–2672
[5] Shazim Ali Memona, Muhammad Ali Shaikh and Hassan Akbar, "Utilization of Rice Husk Ash as viscosity modifying agent in Self Compacting Concrete", Construction and Building Materials, July 2010, pp.1044-1048
[6] G.A Habeeb and M.M Fayyadh, "Rice Husk Ash Concrete: the Effect of RHA Average Particle Size on Mechanical Properties and Drying Shrinkage", Australian Journal of Basic and Applied Sciences, 2009, 3(3), 1616-1622
[7] Deepa G Nair , K. Sivaraman, and Job Thomas, "Mechanical Properties of Rice Husk Ash (RHA) High strength Concrete", American Journal of Engineering Research, Vol. 3, pp-14-19