STRENGTH VARIATIONS OF RICE HUSK ASH CONCRETE EXPOSED TO ACID MEDIA

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ABSTRACT

India is a major rice producing country, and the husk generated during milling is mostly used as a fuel in the boilers for processing paddy, producing energy through direct combustion and / or by gasification. About 20 million tonnes of Rice Husk Ash (RHA) is produced annually. This RHA is a great environment threat causing damage to the land and the surrounding area in which it is dumped. Rice Husk Ash Concrete has evolved as an innovative technology, capable of achieving the status of being an outstanding advancement in the sphere of concrete technology. The utilization of RHA will reduce the dumping of RHA as well as decrease the construction cost also. In reality many of concrete structures exposed to severe environmental condition exposed to mineral acids present in soil and severe aggressive condition in case of industrial area where there the durability of concrete structure is important. In this aspect our project is aimed to test the RHA concrete exposed to mineral acid media. . In the present Study HCL Solution has been Considered for various ages showed that an RHA replacement of 5% to 7.5% showed better compressive strengths than other replacements at all ages and for M25 and M35 grades of concrete .This is due to the presence of the calcium silicates formed from the Rice Husk Ash. Where Calcium Silicates are highly acid resistant.

Keywords: Compressive Strength, Calcium Silicate, Durability, Hydrochloric Acid (HCl), Rice Husk Ash (RHA).

I INTRODUCTION

Rice covers 1% of the earth's surface and is a primary source of food for billions of people. Globally, approximately 600 million tonnes of rice paddy is produced each year. On average 20% of the rice paddy is husk, giving an annual total production of 120 million tonnes. In the majority of rice producing countries much of the husk produced from the processing of rice is either burnt or dumped as waste. Rice husks are one of the largest readily available but most under-utilized biomass resources, being an ideal fuel for electricity generation. The calorific value varies with rice variety, moisture and bran content but a typical value for husks with 8-10% moisture content and essentially zero bran is 15 MJ/kg. The treatment of rice husk as a 'resource' for energy production is a departure from the perception that husks present disposal problems.. Rice husk is unusually high in ash compared to other biomass fuels – close to 20%. The ash is 92 to 95% silica (SiO_2), highly porous and lightweight, with a very high external surface area. Its absorbent and insulating properties are useful to many industrial applications, and the ash has been the subject of many research studies. . It is also highly absorbent, and is used to absorb oil on hard surfaces and potentially to filter arsenic from water. More recently, studies have been carried out to purify it and use it in place of silica in a range of industrial uses; including silicon chip manufacture.RHA is a general term describing all types of ash produced from burning rice husks. In practice, the type of ash varies considerably according to the burning technique. Two forms predominate in combustion and gasification. The silica in the ash undergoes structural transformations depending on the temperature regime it undergoes during combustion. At 550°C – 800°C amorphous silica is formed and at greater Temperatures, crystalline Silica is formed. These types of silica have different properties and it is important to produce ash of the correct specifications for the particular end use.

1.1 Acid Attack

Concrete is susceptible to acid attack because of its alkaline nature. The components of the cement paste break down during contact with acids. Most pronounced is the dissolution of calcium hydroxide Concrete can be attacked by liquids with pH value less than 6.5. But the attack is severe only at a Ph value below 5.5. At a Ph value below 4.5 the attack is very severe.

II MATERIALS AND METHODS

In the present investigation Rice husk ash has been used as partial replacement of cement in concrete mixes. On replacing cement with different weight percentage of RHA, the compressive strength properties are studied at 5% of HCL solution (7, 28 and 56 days). Total five series of specimen of size 100 × 100 × 100mm designed in this investigation consist of one series of specimens of normal strength concrete 0% and four series of specimens of RHA concrete with percentage replacements of cement with RHA by 5%,7.5%,10%, and 15% for M25 and M35 grade concrete. A total of 90 cubes have been casted, are cured with Normal water for 28 days and after 28 days they were exposed to 5% HCL solution. 3 cubes from each series are taken and exposed to 5% HCL solution for 7days, 28 days and 56 days.

2.1 Cement

Cement used in the experimental work is ORDINARY PORTLAND CEMENT (OPC 53 GRADE) conforming to IS: 1489 (Part1)-1991. from a single batch was used for the entire work and care has been taken to store it in airtight containers to prevent it from being affected by the atmospheric and monsoon moisture and humidity.

2.2 Rice Husk Ash (RHA)

Rice Husk Ash used in the present experimental study was obtained from ***N.K Enterprises Jharsuguda, Orissa.*** Specifications, Physical Properties and Chemical Composition of this RHA as given by the Supplier are given in the following Tables:

Table1. Specifications Of Rice Husk Ash (RHA)

Sl. No	Property	Value
1.	Silica	90% minimum
2.	Humidity	2% maximum
3.	Mean Particle Size	25 microns
4.	Colour	Grey
5.	Loss of Ignition at 800^0C	4% maximum

Table2. Physical Properties OF Rice Husk Ash (RHA)

Sl. No	Property	Value
1.	Physical State	Solid-Non Hazardous
2.	Appearance	Very Fine Powder
3.	Partical Size	25 microns-mean
4.	Colour	Grey
5.	Odour	Odourless
6.	Specific Gravity	2.3

Table3. Chemical Properties OF Rice Husk Ash (RHA)

Sl. No	Component	Symbol	%
1.	Silica	SiO_2	93.80%
2.	Alumina	Al_2O_3	0.74%
3.	Ferric oxide	Fe_2O_3	0.30%
4.	Titanium dioxide	TiO_2	0.10%
5.	Calcium oxide	CaO	0.89%

6.	Magnesium oxide	MgO	0.32%
7.	Loss of ignition	LOI	3.37%
8.	Sodium oxide	Na_2O	0.28%
9.	Potassium oxide	K_2O	0.12%

Table 1 , 2&3 represents the Specifications, physical and chemical properties of Rice husk ash and their corresponding values obtained from laboratory testing's..

2.3 Fine Aggregate

Fine aggregate was purchased which satisfied the required properties of fine aggregate required for experimental work and the sand conforms to zone III as per the specifications of IS 383: 1970.

a) Specific gravity = 2.7

b) Fineness modulus = 2.71

2.4 Coarse Aggregate

Crushed granite of 20 mm maximum size has been used as coarse aggregate. The sieve analysis of combined aggregates confirms to the specifications of IS 383: 1970 for graded aggregates.

a) Specific gravity =2.64

b) Fineness Modulus = 6.816

2.5 Water

Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. Since it helps to form the strength giving cement gel, the quantity and quality of water is required to be looked in to very carefully. Mixing water should not contain undesirable organic substances or inorganic constituents in excessive proportions. In this study clean potable water conforming to IS: 3025-1986 was obtained for mixing and curing of concrete.

2.6 HCL

Hydrochloric Acid is clear, colourless ,highly pungent solution of Hydrogen chloride in water.It is highly corrosive , strong mineral acid with many industial uses. In aqueous hydrochloric acid, the H^+ joins a water molecule to form a hydronium ion, H_3O^+

$$HCl + H_2O \rightarrow H_3O^+ + Cl^-$$

The other ion formed is Cl^-, the chloride ion. Hydrochloric acid can therefore be used to prepare salts called chlorides, such as sodium chloride. Hydrochloric acid is a strong acid, since it is essentially completely dissociated in water.

Table4. Properties OF Hydrochloric acid (HCL)

1.	Molecular formula	Hcl in water (H_2O)
2.	Molar mass	36.46 g/mol(HCl)
3.	Appearance	Clear colorless to light –yellow liquid
4.	Density	1.18g/cm^3
5.	Melting point	27.32^{0}C
6.	Boiling point	110^{0}C
7.	Solubility in water	Miscible
8.	Acidity	(pKa)-8.0
9.	Viscosity	1.9 mPas at 25^{O}C

III RESULTS AND DISCUSSIONS

In order to study the durability of RHA Concrete exposed to Hcl solution the cubes of RHA Concrete with various replacements, were cast and tested. A replacement of 0%, 5%, 7.5%, 10% and 15% of RHA in cement was chosen to study the variation in compressive strength due to acid water curing and find out the rate of water absorption. From the results of the present study and information from the literature, the above mentioned replacement range of 5% to 15% was selected for this study of durability aspects. The p^H has been maintained constantly and uniform throughout the study.M25, M35 grade RHA Concrete cubes of size 100x100x100mm

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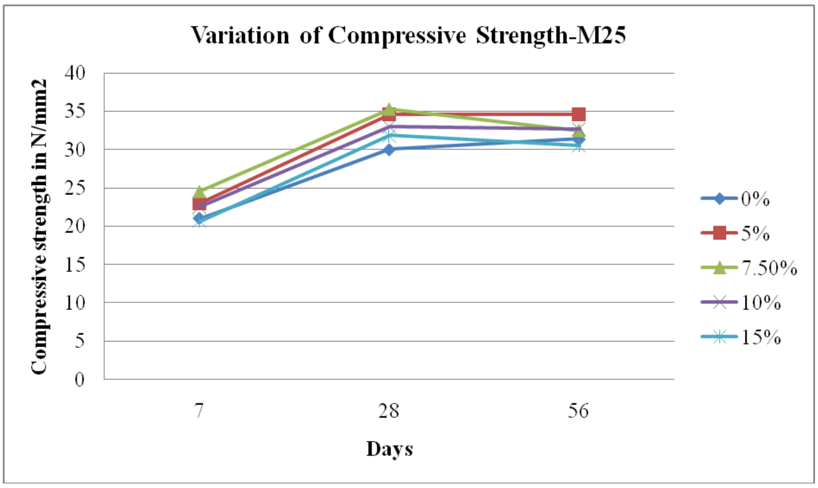
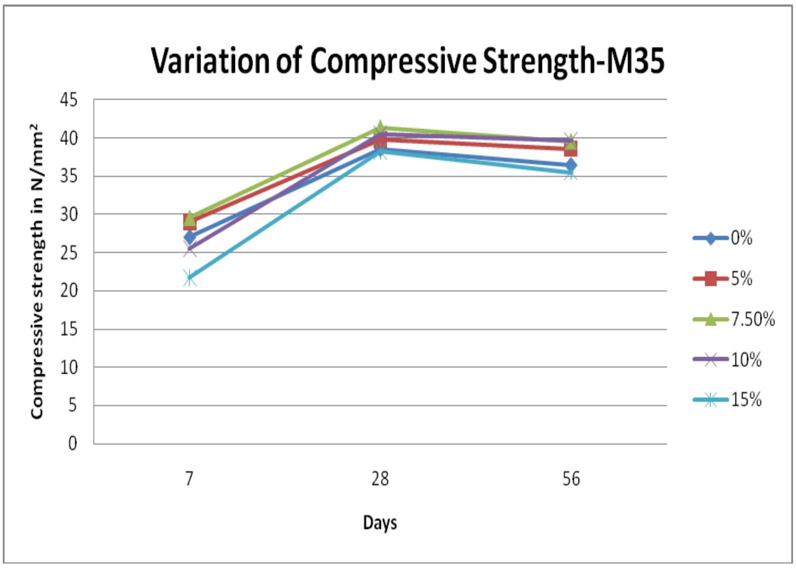
were cast and cured and compressive strength is tested for 7days, 28days and 56days of Hcl solution. The results and discussions of the above tests were presented below.



Compressive strengths of M25 grade



Compressive strengths of M35 grade

IV CONCLUSION

After exhaustive discussions of the results, the following conclusions have been derive

1. Comparative study on Rice Husk Ash concrete with various replacement percentages of RHA showed that, a replacement level of 7.5% RHA in concrete performs and shows better strength than other replacements. For M25 and M35 grades of concretes 7.5% replacement showed better compressive strength than normal

concrete and showed almost similar strength of normal concrete in tension. Hence, 7.5 % RHA replacement may be recommended as the optimum replacement level.

2. The studies on Rice Husk Ash concretes exposed to HCL Solution for various ages showed that an RHA replacement range of 5% to 7.5 % showed better compressive strengths than other replacements at all ages and for M25 and M35grades of concretes.
3. It is concluded that M25 grade RHA concrete for HCL solution exposure in 28 days and 56 days the 7.5% replacement showed better compressive strengths.
4. It is concluded that M35 grade RHA concrete for HCL solution exposure in 28 days 5% replacement showed better compressive strength. After 56 days RHA concrete exposure to HCL solution 7.5% replacement showed better compressive strength due to presence of Calcium Silicate in RHA Concrete.
5. It is concluded that RHA concrete shows better compressive strengths than the normal concrete in HCL solution exposure.

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