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AN EXPERIMENTAL STUDY ON RICE HUSK ASH AND GLASS FIBER REINFORCED CONCRETE

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Abstract— *The infrastructure needs of our country is increasing day by day and with concrete is a main constituent of construction material in a significant portion of this infra-structural system. It is necessary to enhance its characteristics by means of strength and durability. It is also reasonable to compensate concrete in the form of using waste materials and saves in cost by the use of admixtures such as Rice Husk ash, fly ash, silica fume, etc. as partial replacement of cement. The composite matrix that is obtained by combining cement, Rice Husk ash, aggregates and fibers is known as "Rice Husk ash Fiber reinforced concrete". The fiber in the cement Rice Husk ash based matrix acts as crack- arresters, which restrict the growth of micro cracks and prevent these from enlarging under load. The experimental work has carried out to study the effects of replacement of cement (by weight) with (5%, 10%, 15%) Rice Husk ash and the effects of addition of (0.5%, 1%, 1.5%) Glass Fiber composite. A M30 Grade of concrete control mixture of proportions 1:1.91:3 with w/c of 0.50 was designed. This study reports the feasibility of use of Glass fibers and Rice Husk ash content on structural properties such as compressive strength, split tensile strength, and flexural strength test.*

Keywords*- Concrete, Glass Fiber, Rice Husk Ash.*

I. INTRODUCTION

Concrete is a man-made material which is used for various construction works such as house construction, bridge construction, roads and pavements. Simply, concrete is a mixture of cement paste and aggregates. Concrete is an important part of society's infrastructure. Concrete is a composite material containing hydraulic cement, water, coarse aggregate and fine aggregate. The resulting material is a stone like structure which is formed by the chemical reaction of the cement and water. Concrete has unlimited opportunities for advanced applications, design and construction techniques. It is the material of choice where strength, impermeability, durability, performance, fire resistance and abrasion resistance are needed. Its high compressive strength and mould ability has made its wide spread use. It has major disadvantages that it is brittle and weak in tension.

Still concrete is better option than any other available materials for construction works. Concrete with advanced technologies such as reinforced cement concrete (R.C.C.) and fiber reinforced concrete (F.R.C.) provides extra strength and durability against sliding, cracking, buckling and overturning. These cracks are basically micro Cracks. These cracks increase in size and magnitude as the time elapses and the finally makes the concrete to fail. The formation of cracks is the main reason for the failure of the concrete. To increase the tensile strength of concrete many attempts have been made.

Concrete properties can be improved by the use of industrial and domestic wastes such as fly ash, rice husk ash, blast furnace slag, timber ash, steel fiber, glass fiber and plastic wastes. These wastes can be found as natural materials, by-products or industrial wastes. Dumping of these wastes on earth surface is causing the environment pollution. Rice husk ash (RHA) is a waste material, is a by-product obtained from the burning of rice husk. It has high reactivity and pozzolonic property. To conserve resources, utilization of industrial and biogenic wastes as supplementary cementing Materials has become an important part of concrete construction. Industrialization has resulted in large deposition of plastic waste. It is non-biodegradable material which is harmful to the environment. Plastic waste can be used as fibers in concrete to improve the properties of concrete. Many researches were conducted to use industrial by-products and wastes such as rice husk ash and plastic waste.[1]

Glass fibres are made of silicon oxide with addition of small amounts of other oxides. Glass fibres are characteristic for their high strength, good temperature and corrosion resistance, and low price. Alkali resistant E-glass fibres of 12mm length, 0.014mm nominal diameter, specific gravity of 1.9 and density of 2650 kg/m3 were used fig.1.

In the form first used, glass fiber were found to be alkali reactive and products in which they were used deteriorated rapidly. Alkali-resistant glass containing 16% zirconia was successfully formulated in the 1960's and by 1971 was in commercial production in the UK. Other sources of alkali-resistant glass were developed during the 1970's and 1980's in other parts of the world, with higher zirconia contents. Alkali-resistant glass fiber is used in the manufacture of

glass-reinforced cement (GRC) products, which have a wide range of applications.
Glass fiber is available in continuous or chopped lengths. Fiber lengths of up to 35-mm are used in spray applications and 25-mm lengths are used in premix applications.
Glass fiber has high tensile strength (2 – 4 GPa) and elastic modulus (70 – 80 GPa) but has brittle stress-strain characteristics (2.5 – 4.8% elongation at break) and low creep at room temperature. Claims have been made that up to 5% glass fiber by volume has been used successfully in sand-cement mortar without balling. Glass-fiber products exposed to outdoor environment have shown a loss of strength and ductility. The reasons for this are not clear and it is speculated that alkali attack or fiber embrittlement are possible causes. Because of the lack of data on long-term durability, GRC has been confined to non-structural uses where it has wide applications. It is suitable for use in direct spray techniques and premix processes and has been used as a replacement for asbestos fiber in flat sheet, pipes and a variety of precast products. GRC products are used extensively in agriculture; for architectural cladding and components; and for small containers.

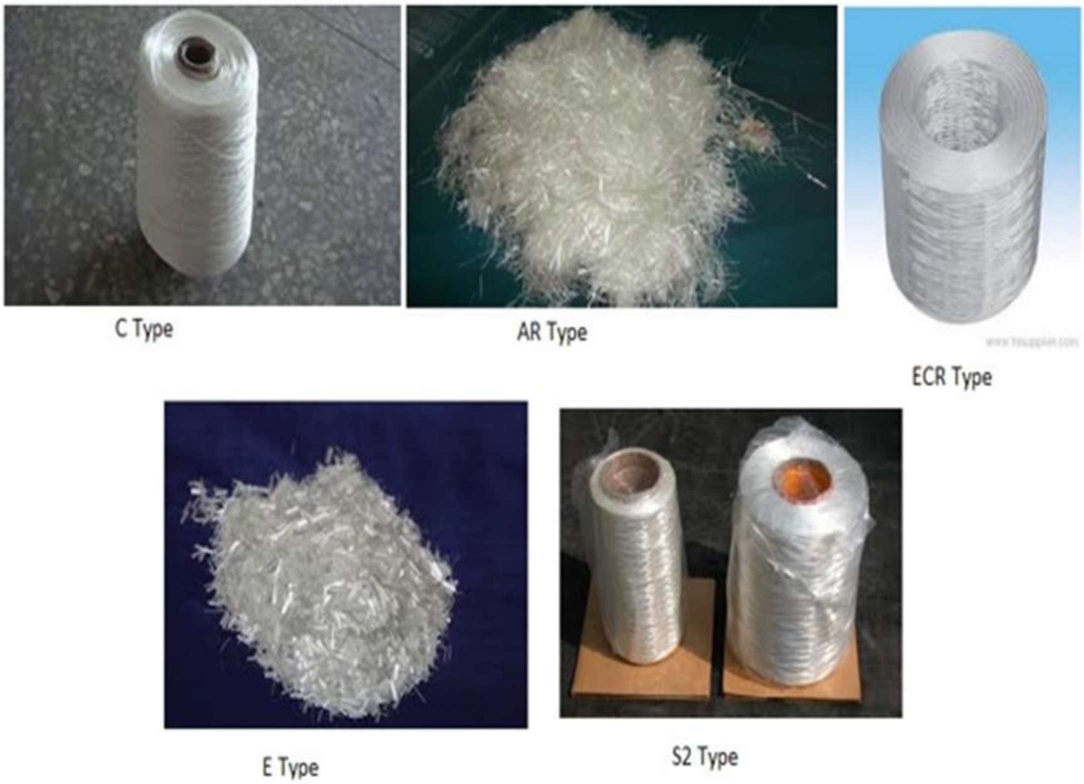

Fig. 1 Types of Fibers

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. [12]

II. LITERATURE REVIEW

1. **ANKUR, VARINDER SINGH, RAVI KANT PAREEK "EFFECT OF RICE HUSK ASH AND PLASTIC FIBERS ON CONCRETE STRENGTH"** International Journal of Civil And Structural Engineering Volume 6, No 1, 2015.

Ankur, Varinder Singh, Ravi Kant Pareek, "Effect Of Rice Husk Ash And Plastic Fibers On Concrete Strength" This paper reports the study of compressive strength and split tensile strength of concrete involving rice husk ash (RHA) and plastic fiber in different proportions. M-20 grade of concrete was taken for
Experimental study.
RHA content was used from 5% to 15% at the interval of 5% by replacing Ordinary Portland Cement (O.P.C.) and plastic fibers were used from 1% to 3% at the interval of 1% by replacing the coarse aggregate. Plastic fibers were obtained by cutting the polythene bags into small pieces. The compressive strength and split tensile strength of concrete was checked at 7 days and 28 days of curing period. The results show that concrete

samples having RHA and plastic fibers showed better strength as compared to controlled concrete samples.
In the experimental investigation, Cement concrete cubes of size 150mm x 150mm x 150mm and concrete cylinders of size 150mm x 300mm with different proportions to find out the compressive strength and split tensile strength were casted. Specimens were tested after a curing period of 7 days and 28 days. Table-1 shows the details of specimens casted for experimental investigation.

Table 1: Details of Specimens

Sr.	**TEST**	**Specimen**	**RHA Added (%)**	**Plastic Fiber Added (%)**	**No. of Specimens**	
					For 7 days	**For 28 days**
1	Compressive Strength Test	Cube	0	0	2	2
			5	1	2	2
			10	2	2	2
			15	3	2	2
2	Split Tensile Strength Test	Cylinder	0	0	2	2
			5	1	2	2
			10	2	2	2
			15	3	2	2

Compressive strength of concrete was measured at the ages of 7 and 28 days and shown in Table-2 and Table-3. It was observed that the average compressive strength of concrete was 15.23 MPa and 22.67 MPa with the replacement of 5% RHA and 1% plastic fibers which shows that 1.11% and 1.08% increase in the compressive strength at 7 and 28 days respectively. Average compressive strength of concrete was 16.56 MPa and 25.67 MPa with the replacement of 10% RHA and 2% plastic fibers which show that 1.20% and 1.22% increase in the compressive strength at 7 and 28 days respectively. It was observed that the average compressive strength of concrete was 13.67 MPa and 20.78 MPa with the replacement of 15% RHA and 3% plastic fibers which shows that 0.99% and 0.98 % decrease in the compressive strength at 7 and 28 days respectively. Split tensile strength test results of fiber reinforced concrete with and without RHA and plastic fibers are presented in Table-4 and Table-5. It was observed that the average spilt tensile strength of concrete was 2.09 MPa and 4.42 MPa with the replacement of 5% RHA and 1% plastic fibers which shows that 1.09% and 1.07% increase in the spilt tensile strength at 7 and 28 days respectively. Average spilt tensile strength of concrete was 2.4 MPa and 4.99 MPa with the replacement of 10% RHA and 2% plastic fibers which shows that 1.26% and 1.21% increase in the spilt tensile strength at 7 and 28 days respectively. It was observed that the average spilt tensile strength of concrete was 1.88 MPa and 4.06 MPa with the replacement of 15% RHA and 3% plastic fibers which shows that 0.98% and 0.98 % decrease in the spilt tensile strength at 7 and 28 days respectively.

Table 2: Compressive strength data at the age of 7 days for M20 concrete

Sr. No	Sample	RHA Used (%)	Plastic Fibers Used (%)	Compressive Strength (MPa)	Average Compressive Strength (MPa)
1	1	0	0	13.55	13.78
	2			14.00	
	1			15.56	

2	2	5	1	14.89	15.23
3	1	10	2	16.00	16.56
	2			17.11	
4	1	15	3	13.78	13.67
	2			13.55	

Table 3: Compressive Strength Data at the Age of 28 Days for M20 Concrete

Sr. No.	Sample No.	RHA Used (%)	Plastic Fibers Used (%)	Compressive Strength (MPa)	Average Compressive Strength (MPa)
1	1	0	0	22.22	21
	2			19.78	
2	1	5	1	21.78	22.67
	2			23.56	
3	1	10	2	25.78	25.67
	2			25.56	
4	1	15	3	21.11	20.78
	2			20.44	

Table 4: Split Tensile Strength Data at the Age of 7 Days for M20 Concrete

Sr.	Sample	RHA Used (%)	Plastic Fibers Used	Split Tensile Strength (MPa)	Split Tensile Strength (MPa)
1	1	0	0	1.70	1.91
	2			2.12	
2	1	5	1	1.98	2.09
	2			2.19	
3	1	10	2	2.47	2.4
	2			2.33	
4	1	15	3	1.77	1.88
	2			1.98	

Table 5: Split Tensile Strength Data at the Age of 28 Days for M20 Concrete

Sr. No.	Sample	RHA Used (%)	Plastic Fibers Used (%)	Split Tensile Strength (MPa)	Average Split Tensile Strength (MPa)
1	1	0	0	4.24	4.14
	2			4.03	
2	1	5	1	4.24	4.42
	2			4.60	
3	1	10	2	4.88	4.99
	2			5.09	

4	1	15	3	4.31	4.06
	2			3.81	

Based on the experimental study with different samples of concrete and different proportions of rice husk ash (RHA) and plastic fiber, following conclusions were drawn-:
1. The replacement of 5 % and 10% RHA and 1% and 2% plastic fibers shows increase in the compressive strength of concrete cubes at 7 days as well as at 28 days.
2. The replacement of 5 % and 10% RHA and 1% and 2% plastic fibers shows increase in the split tensile strength of concrete cylinders at 7 days as well as at 28 days.
3. The replacement of 15 % RHA and 3% plastic fibers shows decrease in the compressive strength of concrete cubes at 7 days as well as at 28 days.
4. The replacement of 15 % RHA and 3% plastic fibers shows decrease in the split tensile strength of concrete cubes at 7 days as well as at 28 days.
5. It was observed that concrete involving RHA and plastic fiber does not show sudden failure.

2. P.PADMA RAO, A.PRADHAN KUMAR, 3B.BHASKAR SINGH, "A STUDY ON USE OF RICE HUSK ASH IN CONCRETE", IJEAR Vol. 4, Issue Spl-2, Jan - June 2014

P.Padma Rao, A.Pradhan Kumar, 3b.Bhaskar Singh, "A Study On Use Of Rice Husk Ash In Concrete**"** In the present investigation, a feasibility study is made to use Rice Husk Ash as an admixture to an already replaced Cement with fly ash (Portland Pozzolana Cement) in Concrete, and an attempt has been made to investigate the strength parameters of concrete (Compressive and Flexural). For control concrete, IS method of mix design is adopted and considering this a basis, mix design for replacement method has been made. Five different replacement levels namely 5%, 7.5%, 10%, 12.5% and 15% are chosen for the study concern to replacement method. Large range of curing periods starting from 3days, 7days, 28days and 56days are considered in the present study.

3. OBILADE, I.O, "USE OF RICE HUSK ASH AS PARTIAL REPLACEMENT FOR CEMENT IN CONCRETE", International Journal of Engineering and Applied Sciences Sept. 2014. Vol.5. No. 04

Obilade, I.O,"Use Of Rice Husk Ash As Partial Replacement For Cement In Concrete" This paper summarizes the research work on the properties of Rice Husk Ash (RHA) when used as partial replacement for Ordinary Portland Cement (OPC) in concrete. OPC was replaced with RHA by weight at 0%, 5%, 10%, 15%, 20% and 25%. 0% replacement served as the control. Compacting factor test was carried out on fresh concrete while Compressive Strength test was carried out on hardened 150mm concrete cubes after 7, 14 and 28 days curing in water. The results revealed that the Compacting factor decreased as the percentage replacement of OPC with RHA increased. The compressive strength of the hardened concrete also decreased with increasing OPC replacement with RHA. It is recommended that further studies be carried out to gather more facts about the suitability of partial replacement of OPC with RHA in concrete.

4. VAISHALI G GHORPADE ,"AN EXPERIMENTAL INVESTIGATION ON GLASS FIBER REINFORCED HIGH PERFORMANCE CONCRETE WITH SILICA FUME AS ADMIXTURE", 35th Conference On Our World In Concrete & Structures.Vaishali G Ghorpade,

Vaishali G Ghorpade, "An Experimental Investigation On Glass Fiber Reinforced High Performance Concrete With Silica Fume As Admixture" In the present investigation to study the behaviour of Glass fiber in High Performance Concrete. To attain the set out objectives of the present investigation, an aggregate binder ratio of 2.0 has been chosen and cement has been replaced Performance Concrete. Hardened Glass fiber Reinforced High Performance Concrete (GFRHPC) is tested for Compression, split tension and flexural strengths. The results are quite encouraging for use of Glass fiber in producing High Performance Concrete.

5. RAMA MOHAN RAO.P, SUDARSANA RAO.H, SEKAR.S.K, "EFFECT OF GLASS FIBER ON FLY ASH BASE CONCRETE", International Journal Of Civil And Structural Engineering Volume 1, No 3, 2010.Rama Mohan Rao.P, Sudarsana Rao.H, Sekar.S.K,

Rama Mohan Rao.P, Sudarsana Rao.H, Sekar.S.K, "Effect Of Glass Fiber On Fly Ash Base Concrete", In the present experimental investigation glass fiber in different volume fractions with 25% and 40% replacement of cement by fly ash has been used to study the effect on compressive strength, split tensile strength, flexural strength of concrete. For each mix standard sizes of cubes, cylinders and prisms as per Indian Standards were cast and tested for compressive strength , split tensile strength and flexural strength at age of 7days, 28 days and 56 days as per Indian Standards.

III. CONCLUSION

From the above literature we conclude that:

1. Use of fibre increase tensile and flexural strength of the concrete.
2. Addition of 0.5%, 12 mm length, AR-type (G1) glass fibre. It gives 2.19% lesser strength compare to control mix and 9.60% higher strength compared to other fibers.
3. The compacting factor values of the concrete reduced as the percentage of RHA increased.
4. The replacement of 5 % and 10% RHA and 1% and 2% plastic fibers shows increase in the compressive strength of concrete cubes at 7 days as well as at 28 days.
5. The replacement of 5 % and 10% RHA and 1% and 2% plastic fibers shows increasein the split tensile strength of concrete cylinders at 7 days as well as at 28 days.
6. The replacement of 15 % RHA and 3% plastic fibers shows decrease in the compressive strength of concrete cubes at 7 days as well as at 28 days.
7. The replacement of 15 % RHA and 3% plastic fibers shows decrease in the splittensile strength of concrete cubes at 7 days as well as at 28 days.
8. It was observed that concrete involving RHA and plastic fiber does not show sudden failure.

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