Behaviour of the Fiber Reinforced Concrete with Partial Replacement of Cement by using Rice Husk ASH

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Abstract— This paper introduces an exploratory examination on the properties of Polypropylene fiber fortified cement with Rice Husk Ash (RHA) as Pozzolanic filler. Concrete made with Portland bond has certain attributes: it is generally solid in• pressure yet feeble in strain and has a tendency to be weak. These two shortcomings have restricted its utilization. Another central shortcoming of cement is that breaks begin to shape when cement is put and before it has legitimately solidified. These breaks are real reason for shortcoming in cement especially in extensive on location applications prompting resulting crack and disappointment and general absence of sturdiness. The shortcoming in strain can be overcome by the utilization of customary pole fortification and to some degree by the consideration of an adequate volume of specific filaments. In the present examination, a possibility study is made to utilize Rice Husk Ash as an admixture to as of now somewhat supplanted bond with Rice Husk Ash (Portland Pozzolana Cement) in Concrete, and an endeavor has been made to research the quality parameters of cement. For control cement, IS strategy for blend configuration is received and looking at this as a premise, blend outline for halfway substitution technique has been made. Three distinctive substitution levels specifically 10%, 20% and 30% are decided for the review worry to incomplete substitution technique. Substantial scope of curing periods beginning from 3days, 28days are considered in the present review. The RHA was obtained from a rice paddy processing industry in Nagapattinam. Compressive quality, flexural quality and split elasticity tests were Performed and the outcomes demonstrated that expansion of RHA and additionally fiber had incredible impact on solid properties.
Key words: Fiber Reinforced solid, Rice Husk Ash (RHA), Compressive quality, split elasticity, Flexural quality

I. Introduction

A. Enhanced Properties of RHA Cement

Portland concrete creates an abundance of lime. Including a pozzolan, for example, RHA this joins with lime within the sight of water, results in a steady and more undefined hydrate (calcium silicate). This is more grounded, not so much penetrable but rather more impervious to concoction assault. A wide assortment of natural conditions, for example, responsive total, high sulfate soils, solidify defrost conditions, and presentation to salt water, de-icing chemicals, and acids are injurious to concrete. Lab research and field encounter has demonstrated that watchful utilization of pozzolans is valuable in countering these issues. The pozzolan is not only a "filler", but rather a quality and execution upgrading added substance. Pounded fly fiery remains and ground granulated impact heater slag are the most widely recognized pozzolan materials for cement. Many reviews have been done to decide the adequacy of RHA as a pozzolan. They have focused on the amount of fiery remains in the blend and the enhanced qualities coming about because of its utilization.

B. Role of RHA in Reducing GHG Emissions

The bond business is lessening its CO_2 outflows by enhancing fabricating forms, packing more creation in the most effective plants and utilizing squanders gainfully as option powers in the concrete furnace. In spite of this, for each ton of bond delivered, around 0.75 tons of CO_2 (ozone depleting substance) is discharged by the copying fuel, and an extra 0.5 tons of CO_2 is discharged in the compound response that progressions crude material to clinker (calcinations). The possibility to win CERs comes basically from substituting Portland bond with RHA. There are other ecological advantages of substituting Portland concrete with RHA. The requirement for quarrying of essential crude materials is diminished, and general decreases in discharges of tidy, CO_2 and corrosive gasses are achieved.

C. Fiber Reinforced Concrete

Concrete is by nature a brittle material that performs well in compression, but is considerably less effective when in tension. Reinforcement is used to absorb these tensile forces so that the cracking which is inevitable in all high-strength concretes does not weaken the structure. For many years, steel in the form of bars or mesh (also known as "re-bar") has been used as reinforcement for concrete structures that are designed to experience some form of loading, whether that loading would be carrying traffic, spanning a void or bearing another structure such as a wall. In many structures, steel mesh has been used a crude (and often ineffective) method of crack control. Latest developments in concrete technology now include reinforcement in the form of fibers, notably polymeric fibers, as well as steel or glass fibers. Fiber-reinforcement is predominantly used for crack control and not structural strengthening. Although the concept of reinforcing brittle materials with fibers is quite old, the recent interest in reinforcing cement-based materials with randomly distributed fibers is quite old; the recent interest in reinforcing cement based materials with randomly distributed fibers is based on research starting in the 1960's.

Since then, there have been substantial research and development activities throughout the world. It has been established that the addition of randomly distributed polypropylene fibers to brittle cement based materials can increase their fracture toughness, ductility and impact resistance. Since fibers can be premixed in a conventional manner, the concept of polypropylene fiber concrete has added an extra dimension to concrete construction.

D. Scope of Study

The Experimental investigation is planned as under:

1) To obtain Mix proportions of Control concrete by IS method; and
2) To conduct compression test on FRC partially replaced by RHA and control concrete on standard IS specimen size of 150 mm x 150 mm x 150 mm.

E. Objectives of Study

The following are the objectives of the present study:

1) to study different strength properties of Rice Husk Ash concrete with age in comparison to control concrete; and
2) to study the relative strength development with age of Rice Hush Ash concrete with control concrete of same grade

II. MATERIAL

A. Rice Husk Ash

Rice husks are shells delivered amid the de husking of paddy rice. 1000 Kg of paddy rice can create around 200 Kg of husk, which on ignition creates around 40 Kg of ash7. Rice husk constitute around 1/fifth of the 300 million metric huge amounts of rice delivered every year on the planet. As per the report by Mehta8, the present yearly creation paddy rice is around 500 million tones that gives around 100 million tones of rice husk as a waste item from the processing. Rice husk is likewise not utilized for sustaining creatures since it is less nourishing properties and its unpredictable grating surface is not actually corrupted and can bring about genuine aggregation issues. Controlled consuming of rice husk in the vicinity of 500 and 600o C for brief span of around 2hrs yields cinder with low un-consumed carbon and anamorphous silica. At the point when rice husk is singed in an uncontrolled way, the fiery debris, which is basically silica, is changed over to crystalline structures and is less receptive Both the crystalline and nebulous rice husk cinder is utilized to fabricate a lime-rice husk powder blend or a Portland rice husk slag bond or the rice husk fiery debris can be utilized as a Portland concrete substitution in cement. Inquire about in India and the United States has found that if the frames or straw are singed at a controlled low temperature, the cinder gathered can be ground to deliver a pozzolan fundamentally the same as (and in some courses better than) silica smoke and warmth created amid consuming can advantageously utilized as a part of energy creation, by doing as such yield waste can successfully arranged, as well as can produce power for the region, and give astounding cement. The qualities of the run of the mill rice husk deliver in India has natural undefined silica (made of rice husk powder) with silica substance of over 85%, in little molecule size of under 25 microns, which is utilized for making green solid, elite solid, refectories, separators, fire retardants etc. The rice husk gathered from nearby plants in Nagapattinam, was scorched in a heater to deliver RHA. Subsequent to consuming it was cooled inside the heater for around 24 hours. The consumed fiery debris were taken out for crushing. At that point the fiery debris were granulated to a fine powder utilizing a pounding machine. Fig. 3.1 demonstrates the items acquired after the operations. The last result of RHA was reviewed as per BS-812 [1967].

Fig. 2.1: Paddy

Fig. 2.2: Rice Husk

Fig. 2.3: Grinding of RHA

Fig. 2.4: RHA after grinding

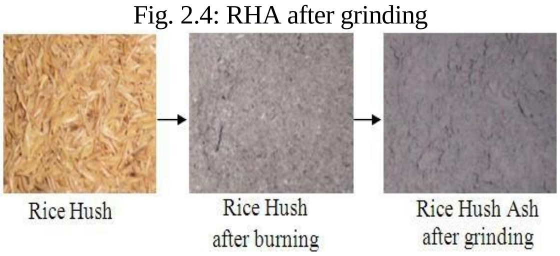

Fig. 2.5: RHA Process

B. Polypropylene Fiber

Polypropylene is a synthetic hydrocarbon polymer, the fiber of which is made using extrusion processes by hot drawing the material through a die. Its use enables reliable and effective utilization of intrinsic tensile and flexural strength of the material along with significant reduction of plastic shrinkage cracking and minimizing of thermal cracking.

The fibers we used is 100% virgin synthetic polypropylene fibers. Boasee Fibers is the name given by the manufacturer. It was bought from MJ SUPPLIERS in Madurai.

S. No.	Property	BOASEE FIBER™	Advantage of BOASEE FIBER™
1.	Material	100% virgin synthetic polypropylene fibers	Conforms to: 1. Type III fibers under ASTM C 1116 2. IS 456, 2000 - Amendment No. 3, August 2007 3. IRC 44, 2008 4. IRC SP 46, 2008
2.	Fiber lenth	3,12,15,18,20,24,26,40,110 mm	Multiple length provides choice of aspect ratio
3.	Dispersion	Excellent	Excellent dispersion in mixtures and superior dispersion in Manual mixing.
4.	SP. Gravity	0.91	Offers homogeneous concrete and mortar mix.
5.	Color	Brilliant White	It can't be distinguished
6.	Melt Point	160° C	Secures the structures
7.	Alkali Resistance	Very Good	Conforms to the test procedure laid by ICBO AC 32
8.	UV stability	Excellent	Higher UV Resistance ensures longevity.

Table 2.1: SPECIFICATIONS:

	Cut length	Pouch Size	Application	Recommended Dosage rate
Range of MICRO FIBERS	3mm	125 grams 500 grams	Plaster of paris / texture paints	10 grams per 20 kgs of pop 20 grams per litre of water Proofing emulsion
	6mm	125 grams	Internal & External Plastering / precast	125 grams / 50 kgs of Cement
	12mm, 15-18mm, 20mm, 24mm	125 grams 900 grams	Concrete, shotcrete, gunniting, precast, screed	125 grams / 50 kgs of Cement. 900 grams/Cubic Meter
Range of MICRO FIBER	24mm - 40mm	125 grams 900 grams	Concrete, shotcrete, gunniting, precast, screed	125 grams / 50 kgs of Cement. 900 grams/Cubic Meter
	40mm - 110mm	125 grams 900 grams	Concrete, shotcrete, gunniting, precast, screed	125 grams / 50 kgs of Cement. 900 grams/Cubic Meter
BLENDED FIBER	24mm - 40mm	125 grams 900 grams	Concrete, shotcrete, gunniting, precast, screed	125 grams / 50 kgs of Cement. 900 grams/Cubic Meter

Table 2.2: Range Of Products: I) Monofillament Ii) Multifillament (Fibrillated)

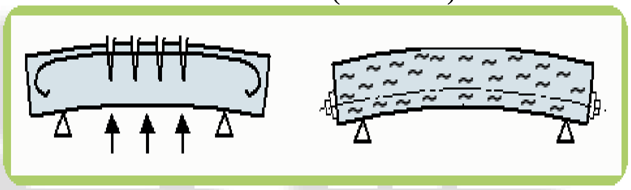

Fig. 2.6: Plain concrete Vs BOASEE FIBER reinforced concrete

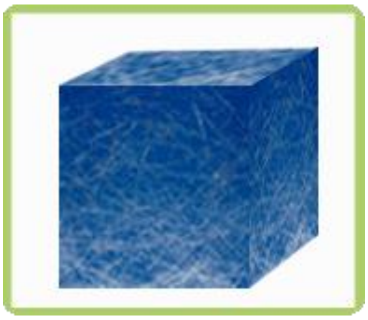

Fig. 2.7: FRC

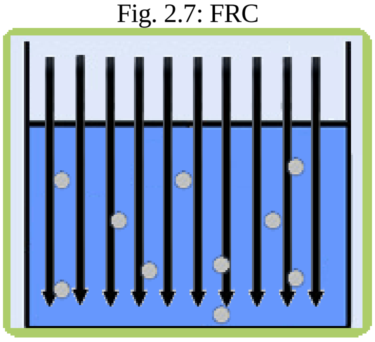

Fig. 2.8: Highly Permeable Concrete

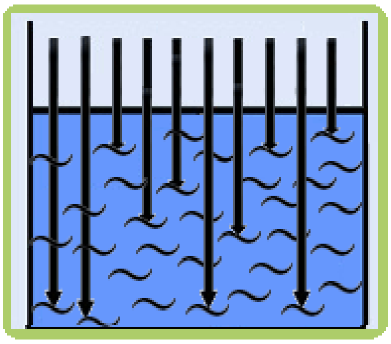

Fig. 2.9: Low Permeable concrete

Fig. 2.10: Boasee Fibers

C. Cement

The decision of the concrete substance relies on upon the quality prerequisites, introduction class for strength and the base measure of fines required in the blend. Bond utilized as a part of the exploratory work is Portland Pozzolona Cement Conforming to IS: 1489 (Part1)- 1991 and the quality focused on was more prominent than 30MPa.

D. Fine Aggregate

Fine total are material going through an IS strainer that is under 4.75mm Gage Usually normal sand is utilized as a fine total at spots where characteristic sand is not accessible pulverized stone is utilized as a fine total. The sand utilized for the trial works was privately obtained and adjusted to evaluating zone II. Sieve Analysis of the Fine Aggregate was completed in the research facility according to IS 383-1970. The fine total was initially sieved through 4.75mm sifter to evacuate any molecule more prominent than 4.75 mm strainer and afterward was washed to expel the clean.

As indicated by IS 383:1970 the fine total is being ordered into four diverse zone, that is Zone-I, Zone-II, Zone-III, Zone-IV

E. Coarse Aggregate

The materials which are held on 4.75mm strainer are called coarse total. The broken stone is for the most part utilized as a coarse total. The way of work chooses the most extreme size of the coarse total. Locally accessible coarse total having the most extreme size of 20 mm was utilized as a part of the present work. As indicated by IS 383:1970 coarse total most extreme 20mm coarse total is appropriate for solid work. Yet, where there is no limitation 40mm or substantial size might be allowed.

F. Water

Water is an essential element of concrete as it effectively takes an interest in the compound responses with bond. The quality of bond solid comes for the most part from the coupling activity of the hydration of concrete get the necessity of water ought to be lessened to the required compound response of un-hydrated concrete as the abundance water would wind up in just arrangement undesirable voids (or) capillaries in the solidified bond glue in the solidified bond glue in concrete.It is imperative to have the similarity between the given bond and the substance material admixtures alongside the water we utilized for mixing.It is by and large expressed in the solid codes and furthermore in the writing that the water fit for drinking is fit for making concrete. This may not be genuine always.The reasonable for drinking, but rather they are bad for bond concrete, as the sugar wood unfavorably influence the hydration process.The points of confinement of the substance of water must be resolved from the accompanying contemplations:

High substance of concrete is powerless to a quick loss of workability a record of higher measure of warmth hydration created. In this way, consideration is required to see that the underlying hydration rate of concrete ought not be fundamentally influenced; and the salt in water would not interface with the improvement of quality of later ages.

III. TEST ON MATERIALS

Testing Items	Test on values
Specific gravity	3.05
Standard consistency	28%
Initial setting time	31 minutes
Final setting time	8hr 30 minutes

Table 3.1: Cement

Testing Items	Test on values
Specific gravity	2.16

Table 3.2: Rice Husk Ash

Testing Items	Test on values
Specific gravity	2.2
Fineness modulus	3.43
Water absorption test	1%
Bulk Density test	1600 Kg/m^3

Table 3.3: Fine Aggregate

Testing Items	Test on values
Specific gravity	0.91
Melt Point	160° C
Fiber Aspect Ratio	<300

Table 3.4: Polypropylene Fiber

Testing Items	Test on values
Specific gravity	2.45
Bulk Density test	1510 Kg/m^3
Water absorption test	0.5 %

Table 3.5: Coarse Aggregate:

IV. EXPERIMENTAL PROGRAMME

This part manages the Mix outline technique received for Control concrete and the reviews did on properties of different materials utilized all through the Experimental work. Likewise the subtle elements of technique for Casting and Testing of Specimens are clarified.

Sl. No.	IS Sieve Designation	Grading limits Zone – II	Grading limit of fine
1	4.75 mm	90 – 100	99
2	2.36 mm	75 – 100	95.4
3	1.18 mm	60 – 90	78.4
4	0.600 μ	35 – 59	50.4
5	0.300 μ	8 – 30	17.4
6	0.150 μ	0 – 10	4.9

Table 4.1: Comparison of fine aggregate to standard values. Cumulative percentage of passing

A. *Mix Design*

Mix design can be characterized as the way toward choosing reasonable elements of cement and deciding with the protest of creating cement of certain quality and sturdiness as financially as could reasonably be expected.

Mix design forM25 grade concrete according to IS method.

Water	Cement	Fine aggregate	Coarse aggregate
186 kg/m3	432.56 kg/m^3	502.18 kg/m^3	1038.6 kg/m3
0.43	1	1.16	2.4

Table 4.2:

Cement = 432.56 kg/m^3
Fine aggregate = 502.18 kg/m^3
Coarse aggregate= 1038.6 kg/m^3
Water = 186 kg/m^3
Rice Husk Ash = 0%, 10%, 20%, 30% replacing of cement
Boasee fiber = 40% by cement content

V. TEST ON FRESH CONCRETE

A. *Properties of Concrete*

The properties of cement is two sorts, they are new and solidified solid properties. The execution of solid properties are for the most part relies on the blend configuration, shape and quality of totals. Water-bond proportion is fundamental variable of new solid properties. It might influence the strength of cement. The quality and life time of the structure is for the most part contingent upon properties of cement as it were.

B. *Fresh Concrete Properties*

The new solid property is depending up on properties like bond, evaluating of total and water. The droop test, compaction calculate test are utilized to discover the workability of the solid. The required amount of water is computed and added to the solid to discover the workability of cement. The test was completed by IS 6461 (Part 7)- 1973 - characterize the workability as that property of newly blended cement.

C. *Slump Cone Test*

The Slump cone test diminished upon the consideration of RHA as incomplete substitution of bond. In this way, it can be induced that to achieve the required workability, blends containing RHA will required higher water content than the relating traditional blends

Fig. 6.1: Slump Cone Test

Sl. No.	% of RHA	W/C ratio	Slump height (mm)
1	0	0.43	300
2	10%	0.43	295
3	20%	0.43	293
4	30%	0.43	287

Table 5.1: Slump values for various % of RHA

VI. TEST ON HARDENED CONCRETE

A. *Preparation of Test Specimen*

The elements for different blends were weighed and blends arranged by physically. Safeguards were taken to guarantee uniform blending of fixings. The example were thrown in steel form and compacted physically. The examples of 150x150x150 mm size of cube, 150mm width x300 mm high chamber examples, 150x150x1000 mm size of crystals were thrown for various tests. The examples are took into consideration curing after re-formed in 24 hours for 3, 7 and 28 days.

Fig. 6.1: Compression test

Replacement %	3 Days (N/mm^2)	7 Days (N/mm^2)	28 Days (N/mm^2)
Conventional	17.25	22.61	34.25
10%	17.10	22.20	34.20
20%	15.10	20.40	33.25
30%	11.15	14.70	22.30

Table 6.1: Compressive test result with various replacement (%)

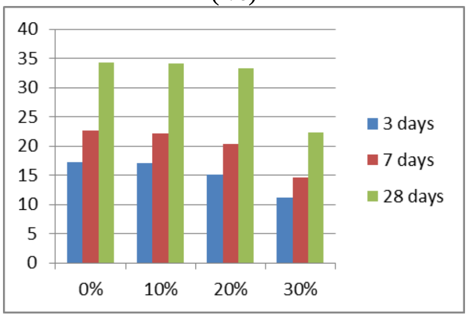

Fig. 6.2: Comparison of Compressive test result with various replacement (%)

Fig. 6.3: Split Tensile Test

Replacement %	3 Days (N/mm^2)	7 Days (N/mm^2)	28 Days (N/mm^2)
Conventional	1.41	2.12	3.2
10%	1.25	1.95	3.0
20%	1.13	1.79	2.6
30%	1.02	1.39	1.8

Table 6.2: split tensile strength test results with various replacements (%)

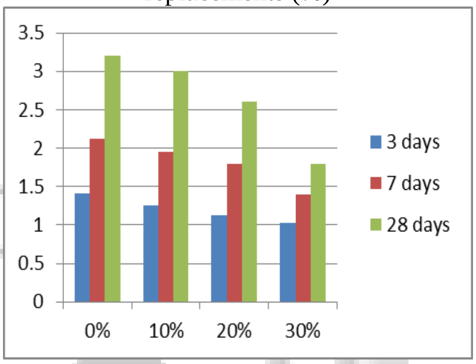

Fig. 6.4: Comparison of split tensile strength results

Fig. 6.5: Flexural Strength Test

Replacement %	3 Days (N/mm^2)	7 Days (N/mm^2)	28 Days (N/mm^2)
Conventional	0.180	0.365	0.491
10%	0.126	0.179	0.246
20%	0.032	0.095	0.147
30%	0.005	0.020	0.049

Table 6.3: Flexural strength test results with various replacement %

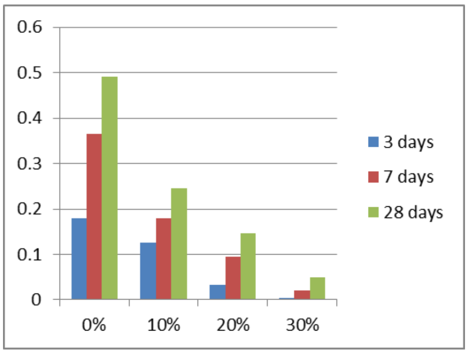

Fig. 12: Comparison of flexural strength test results on various replacement.

VII. Conclusion

In this present review with the stipulated time and research facility set up a bear the cost of has been taken to illuminate the utilization of supposed pozzolanic material like rice husk in fiber strengthened cement in agreement to their capability. It was inferred that, with supplanting of bond with RHA the consistency increments. Utilization of RHA which consumed appropriately in controlled temperature enhances the quality of mortar. However, utilization of RHA not giving attractive quality result. Using RHA over 20% in Portland concrete the quality decreasing gradually.

In instance of Portland concrete with the utilization of Boasee fiber, the 28 days compressive quality part malleable at 40% fiber content the outcome got is greatest. The 28 days flexural quality at 40% fiber does not give a decent outcomes. From the writing overviews, it is evaluated that the flexural quality will increment just when the fiber substance is under 30%.

Further if fiber rate builds then it was seen an incredible misfortune in the quality.

From the use of RHA as a pozzolanic material, the outflow of Green House Gases (GHG) can be diminished and can have a wonderful Environment

Hence we close as the usage of Rice Husk Ash-mixed with bond in Fiber Reinforced Concrete is the Eco-Friendly, and Economically great.

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