Comparison of Strength between Control Concrete & Rice Husk Ash Cement Concrete on Addition of Polypropylene Fiber

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Abstract— The present day world is witnessing construction in very challenging and difficult circumstances, where a great emphasis is on sustainability. Rice husk ash and polypropylene fiber, by-products of rice mill and textile industry simultaneously, can enhance behavior of concrete significantly .In this experimental work the objective was to study the effect of rice husk and polypropylene on compressive and split tensile strength of M20 concrete. Rice husk ash and polypropylene have been mixed with concrete in combination in different proportions. Rice husk has been used in 2.5%, 5% &10% by weight of cement. Polypropylene fiber content varies from 0%, 0.25%, 0.5% &0.75% by weight of concrete. We can see the maximum strength value by plotting the test result of cube for compressive strength test and cylinder for split tensile strength test for 7days and 28 days. At 10% rice husk and 0.5% polypropylene 7 days peak compressive strength has been achieved which is 22.6% higher than controlled concrete. At 5% rice husk and 0.5% polypropylene fiber 7 days peak split tensile strength has been achieved which is 53.57% higher than controlled concrete. At 10% rice husk ash and 0.5% polypropylene fiber 28 days peak compressive strength has been achieved which is 54.61% higher than controlled concrete. At 5% rice husk and 0.5% polypropylene fiber 28 days peak split tensile strength has been achieved which is 31.34% higher than controlled concrete.

Keywords: Rice Husk Ash, Polypropylene Fiber, Compressive Strength, Split Tensile Strength, Ordinary Portland Cement (OPC)

I. INTRODUCTION

In India, rice milling produces a byproduct which is also known as husk. Rice husk is a waste material, and has been disposed of by dumping or burning. By using rice husk ash in concrete, we can improve the properties of concrete up to some extent. RHA is found to be good material which fulfils the physical characteristics and chemical composition of mineral admixtures. A small amount of addition of RHA (less than 10 % by weight of cement), is sufficient to improve the durability as well as the strength of concrete. RHA contain high silica content that reduces shrinkage and leads to increases in the strength of concrete Polypropylene fiber are synthetic fiber obtain as a byproduct from textile industry. Polypropylene fiber is characterized by low specific gravity and low cost. The use of polypropylene fiber has increased tremendously in construction because it behaves like reinforcement. Addition of polypropylene fiber in concrete improves the compressive and tensile strength of concrete. The addition of polypropylene fibers in the concrete significantly affects the compressive strength and split tensile strength of concrete. Addition of polypropylene fiber in concrete increases the compressive strength by 20% to 55% and splitting tensile strength by 30% to 50% respectively. In this study the influence of different amount of rice husk ash and polypropylene fibers content on concrete properties were investigated by measuring compressive strength and splitting tensile strength.

A. Objectives

The main purpose of this project is to investigate mechanical properties of rice husk ash cement concrete with the addition of polypropylene fiber. Mainly following objectives are considered

1) To study the properties of fresh and hardened concrete.
2) To study the physical and chemical properties of raw material.
3) To investigate how much percentage of rice husk ash and polypropylene fiber improve mechanical properties of concrete.
4) To study the improvement of split tensile strength of concrete by using rice husk ash and polypropylene fiber.
5) To study the improvement of compressive strength of concrete by using rice husk ash and polypropylene fiber.
6) To study the cost analysis by using RHA and polypropylene fiber.

B. Planning For Experiment

For this project three types of materials are taken. Mixes are divided into ten batches i.e. (M-1, M-2, M-3, M-4, M-5, M-6, M-7, M-8, M-9 and M-10). Composition of patterns and batches will be same for all work in this project work.

S.N.	BATCHES	DISCRIPTION (CEMENT+RICE RICE HUSK ASH + POLYPROPYLENE FIBER)
01.	M-1	100+0+0
02.	M-2	97.5+2.5+0.25
03.	M-3	97.5+2.5+0.50
04.	M-4	97.5+2.5+0.75
05.	M-5	95+5+0.25
06.	M-6	95+5+0.50
07.	M-7	95+5+0.75
08.	M-8	90+10+0.25
09.	M-9	90+10+0.50
10.	M-10	90+10+0.75

Table 1:

II. MIX DESIGN

The M20 grade concrete generally used for general purpose, For concrete mix design raw material are collected from resources with specified specifications and quality. All the materials are tested as per IS code. In previous time concrete

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mixed design conforms to IS 456-2000 but in present time with latest provisions concrete mix design calculation has been done as per as per IS 10262-2009.

1) Step 1: Data required for mix proportioning
2) Step 2: Calculation of target mean strength = 26.6 N/mm²
3) Step 3: Calculation or selection of water cement ratio = 0.48
4) Step 4: Calculation of water content = 197.16 litre/m^3
5) Step 5: Calculation of cement content = 411kg/m^3
6) Step 6: Calculation of mix proportion Mass of coarse aggregate = 1134 kg/m³ Mass of fine aggregate = 670 kg/m³
7) Step 7: Final Mix proportion by weight for trial mix:

S. No.	Characteristic properties	Values
1	Grade of concrete	M -20
2	Maximum nominal size of aggregates	20mm
3	Grade of cement	OPC 53 grade
4	Specific gravity of fine aggregate	2.65
5	Maximum water-cement ratio	0.5
6	Workability (for slump test)	100 mm
7	Grading Zone of fine aggregate	Zone-II
8	Specific gravity of cement	3.15
9	Specific gravity of coarse aggregate	2.68
10	Aggregate shape	Angular
11	Entrapped air	2.00%
12	Admixture used	Nil
13	Maximum temperature of concrete at the time of pouring	27 ± 2°C
14	Minimum cement content	450 kg/m³
15	Minimum cement content	300 kg/m³
16	Surface moisture – fine aggregates & coarse aggregates	Nil
17	Method of transporting & placing	Manual
18	Exposure conditions IS-456:2009 Table no 4	Mild

Table 2:

Water	Cement	Fine aggregate	Coarse aggregate
197	411 kg	670 kg	1134 kg
0.48	1	1.63	2.75

Table 3:

III. TEST ON CONCRETE

A. Compressive Strength Test

The compressive strength test for concrete specimens has been performed in Compression Testing Machine (CTM) having maximum loading capacity of 2000KN. 30 concrete specimens were tested for 7 days compressive strength and 30 concrete specimens were tested for 28 days compressive strength.

Fig. 3.1: Compression Testing Machine

B. Split Tensile Strength Test

The split tensile strength test for concrete specimens has been performed in Split Tensile Testing Machine. 30 concrete specimens were tested for 7 days split tensile strength and 30 concrete specimens were tested for 28 days split tensile strength.

Fig. 3.2: Universal testing Machine

IV. CALCULATION OF NUMBER OF CUBE AND CYLINDER SPECIMEN REQUIRED

Sample No	% of rice husk ash	% of polypropylene	No of cube		No of cylinder	
			7 days test	28 days test	7 days test	28 days test
1.	0	0	3	3	3	3
2.	2.5	0.25	3	3	3	3
3.	2.5	0.5	3	3	3	3
4.	2.5	0.75	3	3	3	3
5.	5	0.25	3	3	3	3
6.	5	0.5	3	3	3	3
7.	5	0.75	3	3	3	3
8.	10	0.25	3	3	3	3
9.	10	0.5	3	3	3	3
10.	10	0.75	3	3	3	3
Sub Total			30	30	30	30
Total no of specimen required						120

Table 4:

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V. RESULT & DISCUSSION

A. Compressive Strength

1) 7 Days Compressive Strength

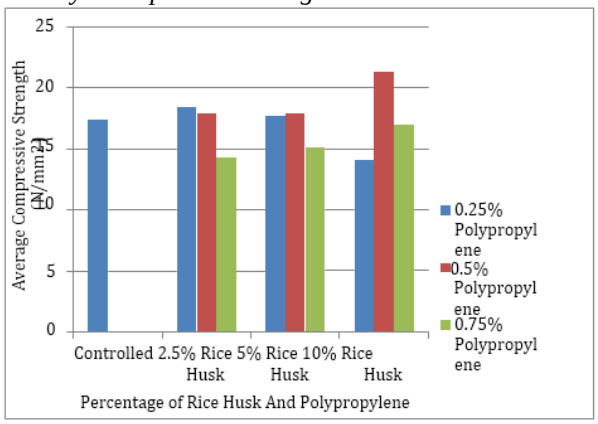

Fig. 5.1.1: 7 Days Compressive Strength

For 7 days compressive strength, the peak strength was obtained as 21.37N/mm2 from concrete containing 10% rice husk ash + 0.5% Polypropylene fiber which was 22.6% higher than compressive strength of controlled concrete (17.43N/mm2). It is also observed that for concrete containing 0.25% Propylene fiber + 2.5% rice husk ash, compressive strength was little higher than controlled concrete. But further increase in rice husk ash percentage compressive strength decreased. For 0.5% Polypropylene fiber + 2.5% rice husk ash compressive strength was little higher than controlled concrete. But with increase in rice husk ash, compressive strength also increased. For 0.75% polypropylene fiber + 2.5% rice husk ash compressive strength was lesser than controlled concrete. But with increase in rice husk ash compressive strength also increased but could reach equal to compressive strength of controlled concrete.

2) 28 Days Compressive Strength

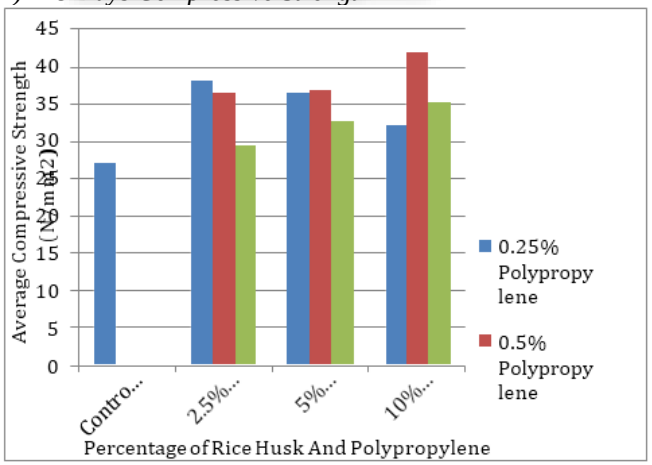

Fig. 5.1.2: 28 Days Compressive Strength

For 28 days compressive strength the peak strength was obtained as 42.055N/mm2 from concrete containing 10% rice husk ash + 0.5% Polypropylene fiber which was 54.6% higher than compressive strength of controlled concrete (27.2N/mm^2). It is also observed that for 0.25% polypropylene fiber + 2.5% rice husk ash compressive strength was significantly higher than controlled concrete. But further increase in rice husk ash percentage compressive strength decreased, but always higher than compressive strength of controlled concrete. For 0.5% polypropylene fiber + 2.5% rice husk ash compressive strength was significantly higher than controlled concrete. But with increase in rice husk ash compressive strength also increased. For 0.75% polypropylene fiber + 2.5% rice husk ash compressive strength was little higher than controlled concrete. But with increase in rice husk ash compressive strength also increased.

B. Split tensile strength

1) 7 Days Split Tensile Strength

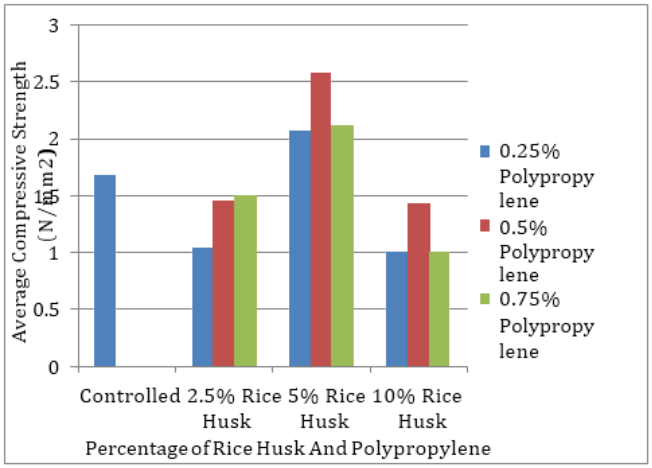

Fig. 5.2.1: 7 Days Split Tensile Strength

For 7 days split tensile strength the peak strength was obtained as 2.58N/mm^2 from concrete containing 5% rice husk ash + 0.5% Polypropylene fiber which was 53.57% higher than compressive strength of controlled concrete (1.68N/mm^2). It is also observed that for 2.5% rice husk ash split tensile strength was lesser than split tensile strength of controlled concrete for every percentage of Polypropylene fiber. For 5% rice husk ash split tensile strength was significantly higher than split tensile strength of controlled concrete for every percentage of Polypropylene fiber. For 10% rice husk ash split tensile strength was lesser than split tensile strength of controlled concrete for all proportions of Polypropylene fiber

2) 28 Days Split Tensile Strength

For 28 days split tensile strength the peak strength was obtained as 3.31N/mm^2 from concrete contained 5% rice husk ash + 0.5% Polypropylene fiber which was 31.3% higher than compressive strength of controlled concrete (2.52N/mm^2). It is also observed that for 2.5% rice husk ash split tensile strength was lesser than split tensile strength of controlled concrete for every percentage of Polypropylene fiber. For 5% rice husk ash split tensile strength was higher than split tensile strength of controlled concrete for every percentage of Polypropylene fiber. For 10% rice husk ash split tensile strength was significantly lesser than split tensile strength of controlled concrete for every percentage of Polypropylene fiber.

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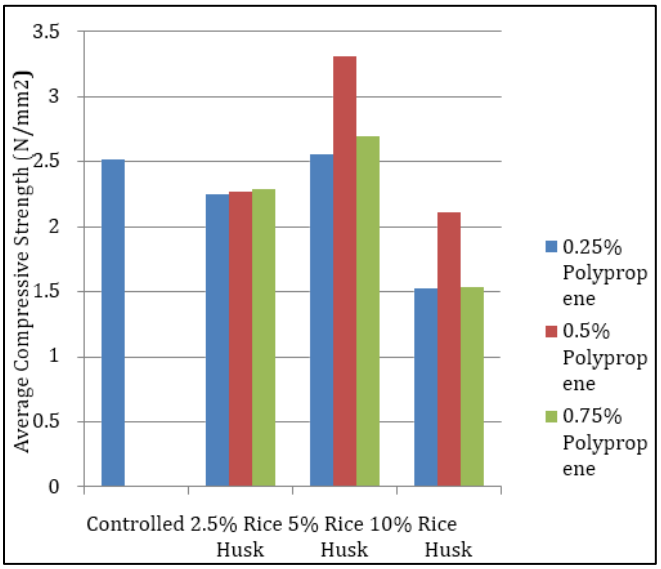

Fig. 5.2.2: 28 Days Split Tensile Strength

VI. CONCLUSIONS

From all the result and discussions following conclusions can be made:

1) Addition of rice husk and Polypropylene in concrete improves characteristic compressive and split tensile strength.
2) Optimum dosage of rice husk can be taken from 5% by weight of cement.
3) Optimum dosage of Polypropylene fiber can be taken from 0.5% by weight of concrete.
4) Maximum increase in compressive strength for 7 and 28 days is 22.6% and 54.61% respectively as compare to control concrete.
5) Maximum increase in split tensile strength for 7 and 28 days is 53.57% and 31.34% respectively as compare to control concrete.
6) For 7 days compressive strength test the concrete containing 0.5% PPF gives greater strength as compare to control concrete for every percentage of RHA.
7) For 28 days compressive strength test the concrete containing 0.25%, 0.5% and 0.75% PPF gives greater strength as compare to control concrete for every percentage of RHA.
8) Cost of per cubic meter concrete containing 5% rice husk + 0.5% polypropylene is Rs2778.44 which is Rs19.1 lesser than cost of per cubic meter controlled concrete.

From above points it is clear that concrete containing 5% rice husk and 0.5% Polypropylene achieves significantly higher characteristic compressive and split tensile strength as compare to controlled concrete with economy. So according to this experimental study the recommended dosage of rice husk and Polypropylene fiber is 5% and 0.5% respectively.

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