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Evaluation of Properties of Concrete using Basalt Fibre and Rice husk Ash - An Experimental Study

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ABSTRACT:*The objective of this paper is to investigate and compare various properties of basalt fiber reinforced concrete with partial replacement of cement with Rice husk ash in M20 grade concrete. Fibre reinforced concrete is most widely used in quest of improving tensile and flexural strength of concrete. Various types of fibers such as steel, polypropylene, glass and polyester are generally used in concrete. Rice husk is generated by rice milling industry during milling of paddy and it is a waste material. Rice husk ash (RHA) is about 25% by weight of rice husk when burnt in boilers. Rice husk ash is a good super-pozzolana. This super-pozzolana can be used in a big way to make special concrete mixes which will also help to reduce weight of concrete, increase strength of concrete and also increases workability of concrete. An attempt is made by using waste material like Rice husk ash by partially replacing it with cement and adding Basalt fibre in different proportion in concrete to study its effect on various properties of Concrete. The experimental test results demonstrated considerable changes in compressive strength, flexural strength and split tensile strength of specimen at 7 and 28 days with addition of basalt fibers and partially replacing cement with Rice husk ash.*

Keywords: Basalt fiber, Ricehusk Ash, Split Tensile strength, Compressive strength, Flexural Strength

1.INTRODUCTION

Industry is always in hunt to find new, superior and inexpensive material to manufacture new product, which is very beneficial to the industry and society. The manufacture of composite material has taken amomentous growth and is observed in recent time. With this in mind energy conservation property, anticorrosive(or corrosion resistant) property, the sustainability and environment are important when a product is altered or new product is manufactured.

Basalt fibre is a relatively new product in field of fibre reinforced polymers (FRPs) and structural composites. Chemical composition of basalt fiber is to glass fibre but basalt fiber has better characteristics such as higher strength and highly resistant to alkaline, acidic and salt attack making it a good candidate for concrete, bridge and shoreline structures or any other structures subjected to acid attack or salt attack.

Basalt fibre has the features of broad application like it has higher oxidation resistance, higher compressive strength and higher tensile strength.The manufacturing process of basalt and glass fibres is similar. Basalt rock is the only raw material needed for making ofbasalt fibre. It is a continuous fibre and produced through melting of igneous basalt rock and drawing from steel mesh at about 2,700° F (1,500° C). Chopped strands of fibres can be made available as per requirement.Though the temperature required to produce fibres from basalt is higher than glass, it is reported by some researchers that production of fibres from basalt requires less energy by due to the uniformity of its heating. [5]

Tones of Rice husk is generated by Rice mill industry during milling process of paddy which comes from the fields. This produced husk is used as fuel in the boilers for the processing of the paddy and also use as fuel for the electricity production.When the rice husk gets burnt in boilers, Rice husk Ash of about 25% weight of Rice husk is produced. According to an estimate, that 70 million ton RHA is produced annually in the world

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and it becomesgreat environment threat which causes damage to the land and the surrounding area where it got dumped.

In the milling process, about 78% of weight contains rice, broken rice and bran. Rest of 22% of the weight remains as husk. It is used as a fuel in the rice mill for steam generation. Husk ash contains about 75% organic matter which got burned and rest of 25 % we get as Rice husk Ash. So we can say that for every 100 kg of paddy milled, about 22 kg(22%) of husk is produced, and when this husk got burnt in boiler, about 5.5 kg (25%) of RHA is generated. [2]

Figure 1 Basalt Fibres

Figure 2 Rice husk Ash

2.PROPERTIES

a) Properties of Basalt Fibre

Colour: Golden Brown

Length: Chopped strands are available in length of 6mm, 8mm, 12mm etc as per requirement

Density: 2.7 gm/cc

Tensile Strength: 3000-3500 MPa

Modulus of Elasticity: 79.3-93 GPa

Elongation – 3.1

Specific gravity - 1.15

Resistance to alkali - Excellent

Water absorption - 4 %

UV resistance – High[1]

b) Properties of Rice husk Ash

Component	Percentage
SiO_2	88.32
Al_2O_3	0.46
Fe_2O_3	0.67
CaO	0.67
MgO	0.44
K_2O	2.91
Na_2O	0.12

Color: Grey

Specific Gravity: 2.11

Fineness (passing through 45 µm sieve) : 98%

Density: 2.06 gm/cc[3]

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3.OBJECTIVES OF STUDY

i. To study design aspects of Concrete with varying content of Basalt fibre and partially replacing cement with Rice husk ash
ii. Perform laboratory test that are related to compressive, tensile and flexure by use of basalt fiber in the concrete and partially replacing cement with Rice husk ash.
iii. Understand the various applications involving BF and RHA in concrete.

4. TEST RESULTS AND OBSERVATIONS

This paper presents an experimental investigation that was carried out to evaluate the performance characteristics of Concrete cubes, cylinders and beams with Basalt fiber with varying content and replacing cement with Rice husk ash by 10%. The chopped strands basalt fibers of 6mm length were supplied by NickunjEximp enterprises Pvt. Ltd Mumbai, Maharashtra and Rice husk ash was supplied by Dhanalaxmi Enterprise, Navsari, Gujarat. The primary objective of this investigation was to determine the strength of concrete with Basalt fibres in varying content and by partially replacing ordinary portland cement with RHA, according to IS 516:1959 methods of tests for strength of concrete.[4]

Table 1 Compositions of Concrete used in Experimental work

Sr No.	Description	Proportion for M20 Concrete	RHA (by % of weight of cement)	BF (by % of volume)	w/c Ratio
1	Sample 1	1:1.5:3	0	0	0.5
2	Sample 2	1:1.5:3	10	0	0.5
3	Sample 3	1:1.5:3	10	0.5	0.5
4	Sample 4	1:1.5:3	10	1	0.5
5	Sample 5	1:1.5:3	10	1.5	0.5
6	Sample 6	1:1.5:3	10	2	0.5

4.1 Test Results

Table 2 Average Compressive Strength after 7 and 28 days

Sr No.	Description	Average Compressive Strength (N/mm^2)	
		7 Days	28 days
1	Sample 1	20.66	24.98
2	Sample 2	22.42	28.68
3	Sample 3	22.73	30.82
4	Sample 4	23.22	32.42
5	Sample 5	23.68	33.08
6	Sample 6	23.41	32.92

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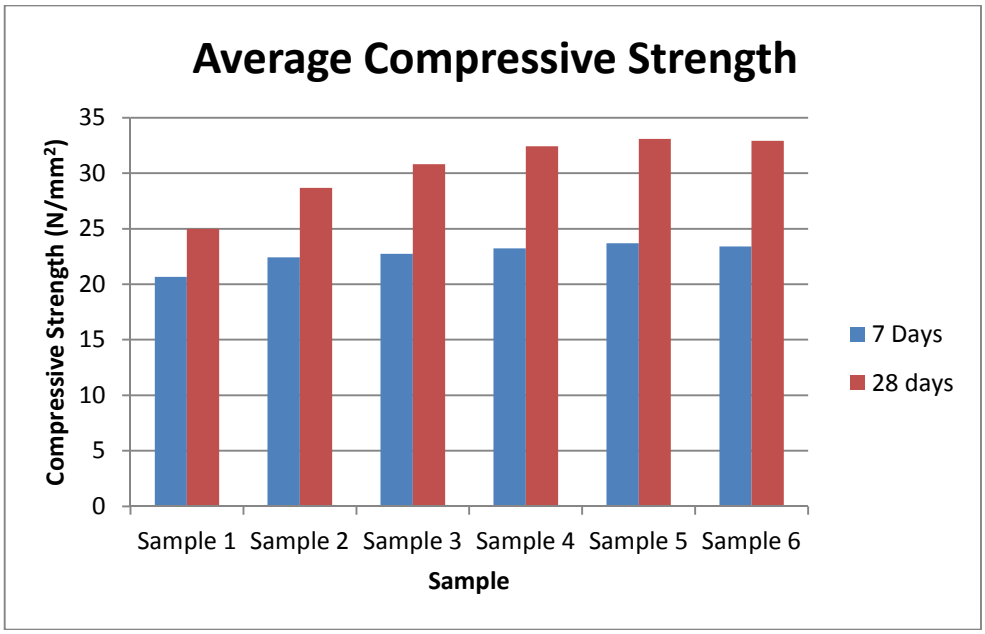

Figure 3 Average Compressive Strength

Table 3 Average Split Tensile Strength after 7 and 28 days

Sr No.	Description	Average Split Tensile Strength (N/mm^2)	
		7 Days	28 days
1	Sample 1	3.20	3.84
2	Sample 2	3.18	3.87
3	Sample 3	3.35	4.04
4	Sample 4	3.51	4.32
5	Sample 5	3.85	4.60
6	Sample 6	3.67	4.38

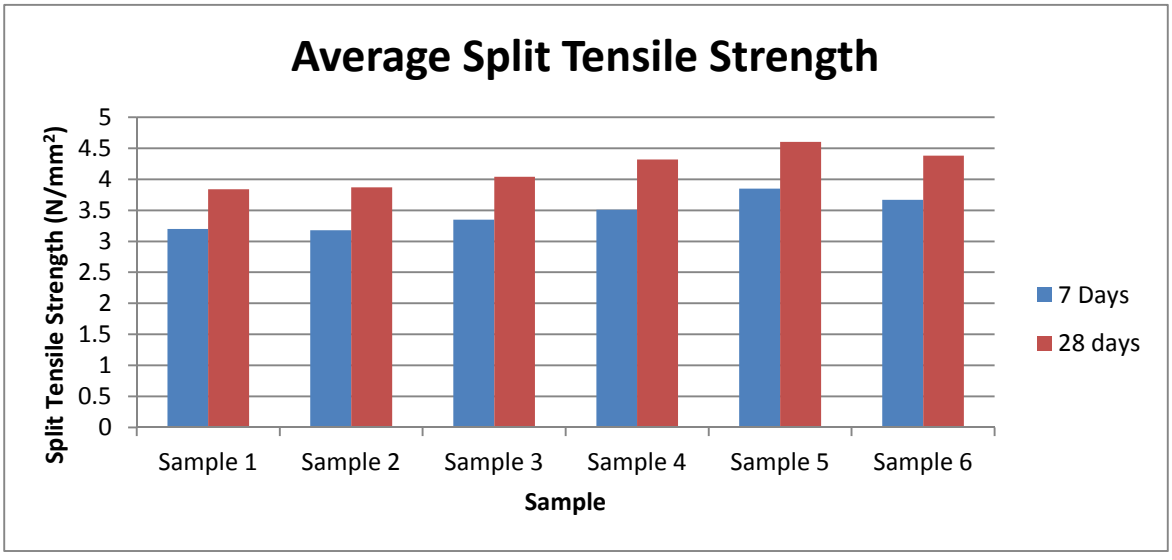

Figure 4 Average Split Tensile Strength

Table 4 Average Flexural Strength after 7 and 28 days

Sr No.	Description	Average Flexural Strength (N/mm^2)	
		7 Days	28 days
1	Sample 1	5.81	6.16
2	Sample 2	5.88	6.26
3	Sample 3	6.02	6.39
4	Sample 4	6.06	6.52
5	Sample 5	6.19	6.73
6	Sample 6	6.15	6.61

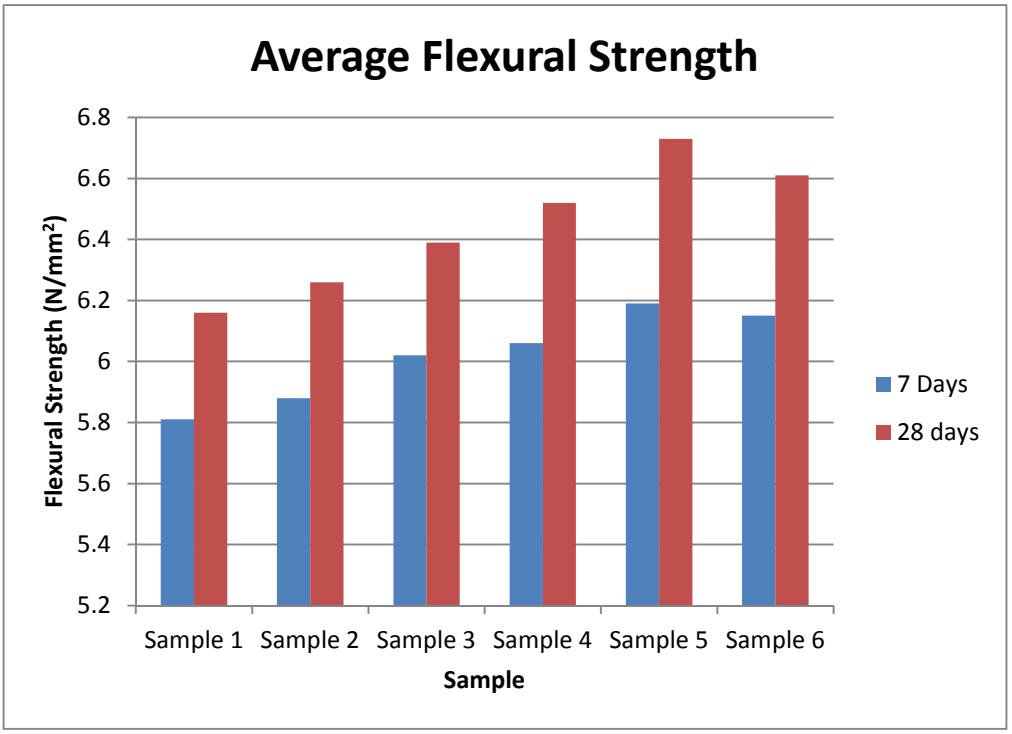

Figure 5 Average Flexural Strength

5.RESULTS AND DISCUSSION

i. As seen from Table 2, average 7 days and 28 days compressive strength have increased about 14.62% and 32.43% respectively after adding 1.5% BF and replacing 10% cement with RHA, which is highest among all proportions.
ii. As seen from Table 3, average 7 days and 28 days split tensile strength have increased about 20% after adding 1.5% BF and replacing 10% cement with RHA, which is highest among all proportions.
iii. As seen from Table 4, average 7 days and 28 days flexural strength have increased about 6.55% and 9.70% respectively after adding 1.5% BF and replacing 10% cement with RHA, which is highest among all proportions.
iv. One should take care while adding basalt fibre in concrete. It should be not allowed to mix for more than 1.5 minute, otherwise it will segregate.
v. The basalt fibres should be added in the concrete before adding water, otherwise it will stick at surface which will cause wastage of material.

6.CONCLUSION

i. It has been observed that the workability of concrete decreases with the addition of Basalt Fibres. But this difficulty can be overcome by using plasticizers or super-plasticizers.

ii. It was observed in concrete with basalt fibre and rice husk ash that after occurring failure of specimen the concrete particles were not separated easily hence there is increase of cohesion in concrete and also there were very few cracks visible on face of cylinder after completion of Split tensile strength and Beams were also not easily broken into two halves after its failure as compared to normal concrete

iii. The ductility characteristic of concrete has improved with the addition of basalt fibres. The failure of fibre concrete is gradual as compared to that of brittle failure of plain concrete.

iv. It was observed that weight of concrete specimen decreased after adding basalt fibre and rice husk ash in normal concrete.

v. Based on results of tests it can be concluded that among proportions used for experiment, Concrete with 1.5% Basalt fibre with replacing cement with rice husk ash by 10% increased compressive, split tensile and flexural strength by 32%.20% and 10% respectively after 28 days.

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