INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume3, Issue1)
Available online at: www.ijariit.com

An Experimental study on Strength Behavior of Steel Fiber, Glass Fiber with Fly Ash and Rice Husk Ash

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Abstract: ***Hybrid Fiber-reinforced concrete is a composite material consisting of mixtures of cement, fine aggregate, coarse aggregate, steel fiber and glass fiber. The hybrid fiber reinforced concrete exhibits better fatigue strength and increased static and dynamic tensile strength. In this project, the strength of fiber reinforced concrete was investigated with partial replacement of cement with rice husk ash and fly ash. Steel fiber and glass fiber was added in the order of 0.25%, 0.5% and 0.75% by volume of concrete and 0.25%, 0.5% and 0.75% by weight of cement. Rice Husk Ash was used to replace ordinary Portland cement by 20% and fly ash 20% by weight of cement proportion.***

Keywords: Compressive Strength, Split tensile strength, rice husk ash, Quarry dust and Polypropylene fiber.

I. INTRODUCTION

Concrete is the most widely used construction material in Civil Engineering industry because of its high structural strength and stability. The secret of its popularity lies in the simple fact that except cement, all other ingredients of concrete are commonly available local materials like aggregate and water. Earlier we knew only about the conventional ingredients of concrete like cement, aggregate and water, but today we are well conversant of the importance of admixtures too. The concrete industry is constantly looking for supplementary material with the objective of reducing the solid waste disposal problem. Leaving the waste materials to the environment directly can cause environmental problem. Hence the reuse of waste materials has been emphasized. The potential application of industry by-products in concrete are as partial aggregate replacement or as partial cement replacement, depending on their chemical composition and grain size.

II. OBJECTIVES

- To investigate the effects of using rice husk ash as partial replacement of cement and fine aggregate in concrete.
- To study the physical and chemical properties of rice husk ash and quarry dust.
- To investigate and compare the strength of hardened concrete for various fiber mixture with optimum percentages of rice husk ash and fly ash obtained

III. LITERATURE REVIEW

Anitha Selva Sofia S D et al., (2013), describe the Experimental investigation on quarry dust concrete with chemical admixture. The main objective of investigation is to evaluate the possibilities of using quarry dust as a replacement of fine aggregate along with super plasticizers. The chemical admixture used for the investigation is super plasticizers conplast sp 430. 0%, 10%, 20%, 30%, 40%, 50% and 100% of traditional fine aggregate was replacement with quarry dust. They concluded that the conventional fine aggregate is completely replaced with quarry dust along with 1% dosage of super plasticizers increase in the compressive strength is around 85%.

Ahsana Fathima K M, et al (2014), describes the Behavioral study of steel fiber and polypropylene fiber. The main aim of this experiment is to study the strength properties of steel fiber and polypropylene fiber reinforced concrete of M30 grade with 0%, 0.25%, 0.5% and 0.75% by volume of concrete. They showed the results that the polypropylene fiber reinforced concrete yield higher flexural strength with addition of 0.5% polypropylene fiber by volume of concrete.

SaeidHesami , Saeed Ahmadi , Mahdi Nematzadeh et al, Construction *and Building Materials* 53 (2014): 680-691. The use of pervious concrete pavement is significantly increasing due to reduction of road runoff and absorption of noise. However, this type of pavement cannot be used for heavy traffic due to a high amount of voids and consequently low strength of pervious concrete. Rice husk ash (RHA) was used in order to strengthen pozzolanic cement paste and the effect of 0%, 2%, 4%, 6%, 8 %, 10% and 12% weight percentages as a cement replacement in concrete mixtures on the mechanical properties was studied. Moreover, 0.2% Vf of glass (where Vf is the proportion of fiber volume to total volume of concrete), 0.5% Vf of steel and 0.3% Vf of polyphenylenesulfide (PPS) fibers were used to improve the mechanical properties of the pervious concrete.

IV. MATERIALS USED

A. CEMENT

The cement used for this study is 53-grade Ordinary Portland cement. It is usually originates from limestone.

TABLE 1 PROPERTIES OF CEMENT

S. No	Physical Properties	Value
1	Specific gravity	3.14
2	standard consistency	30%
3	Initial setting time	53 min
4	final setting time	570 min

B.AGGREGATES

Aggregates are those chemically inert materials which when bonded by cement paste from concrete. Aggregate constitute the bulk of total volume of concrete and hence they influence the strength of concrete to great extent.

1) Fine Aggregate: The material which passed through I.S sieve No. 480 (4.75mm) is termed as fine aggregates. The source of fine aggregate used from natural river bed.
The fine aggregate used which have fineness modulus of 3.1, specific gravity of 2.6

2) *Coarse Aggregate:* the material whose particles are of such size as are retained on I.S. sieve No. 480 (4.75mm) is used as coarse aggregates. The aggregate used which have specific gravity of 2.73 and fineness modulus of 7.5.

C. RICE HUSK ASH

Rice milling generates a byproduct know as husk. This surrounds the paddy grain. During milling of paddy about 78 % of weight is received as rice, broken rice and bran .Rest 22 % of the weight of paddy is received as husk. This husk is used as fuel in the rice mills to generate steam for the parboiling process. This husk contains about 75 % organic volatile matter and the balance 25 % of the weight of this husk is converted into ash during the firing process, is known as rice husk ash (RHA). This RHA in turn contains around 85 % - 90 % amorphous silica. So for every 1000 kg of paddy milled , about 220 kg (22 %) of husk is produced , and when this husk is burnt in the boilers , about 55 kg (25 %) of RHA is generated.

TABLE 2 PHYSICAL PROPERTIES OF RICE HUSK ASH

S. No.	Physical property	value
1	Type	Alkali resistant glass fiber
2	Length	12mm
3	Color	Brilliant White

D. GLASS FIBER

Glass fibers, the most popular of the synthetics, are chemically inert, hydrophobic and lightweight. They are produced as continuous cylindrical monofilaments that can be chopped to specific lengths or cut as films and tapes and formed into fine fibrils of rectangular cross section used at a rate of at least 0.1% by volume of concrete, glass fibers reduced plastic shrinkage cracking and subsidence cracking over steel reinforcement.

TABLE 3 PHYSICAL PROPERTIES OF GLASS FIBER

S. No.	Physical property	value
1	Type	Alkali resistant glass fiber
2	Length	12mm
3	Color	Brilliant White

E. STEEL FIBER

Steel fibers are short, discrete length of steel with an aspect ratio (ratio of length to diameter) from about 20 to 100, and with any of several cross sections. Some steel fibers have hooked ends to improve resistance to pullout from a cement based matrix. Steel fiber reinforced concrete is a composite material.

TABLE 4 PHYSICAL PROPERTIES OF STEEL FIBER

S. No.	Physical property	value
1	Diameter	0.3mm
2	Length	12mm
3	Aspect ratio	100

V. EXPERIMENTAL INVESTIGATION

The experimental investigation consisted of making M30 concrete with various proportion of rice husk ash as replacement to cement. With optimum results quarry dust is added to mix as partial replacement for fine aggregate and polypropylene fiber is added as 0.5%, 1% and 1.5% and determining the compressive strength of concrete. M40 mix was designed as per IS 10262: 2009 and its mix ratio was found to be 1:2.02:3.6:0.40. The required materials were weighted and mixing of concrete is carried out. Cube specimen of size 150mm X 150mm is casted. The specimens are de-moulded after 24 hours of casting and the specimens are cured in tank for 7 days. Cylinder specimens of size 150mm X 300mm are also casted and cured in tank for 7 days. Prism specimen size 100 X 100X 500mm is also casted and cured in tank for 7 days.

TABLE 5 SPECIMEN DETAILS

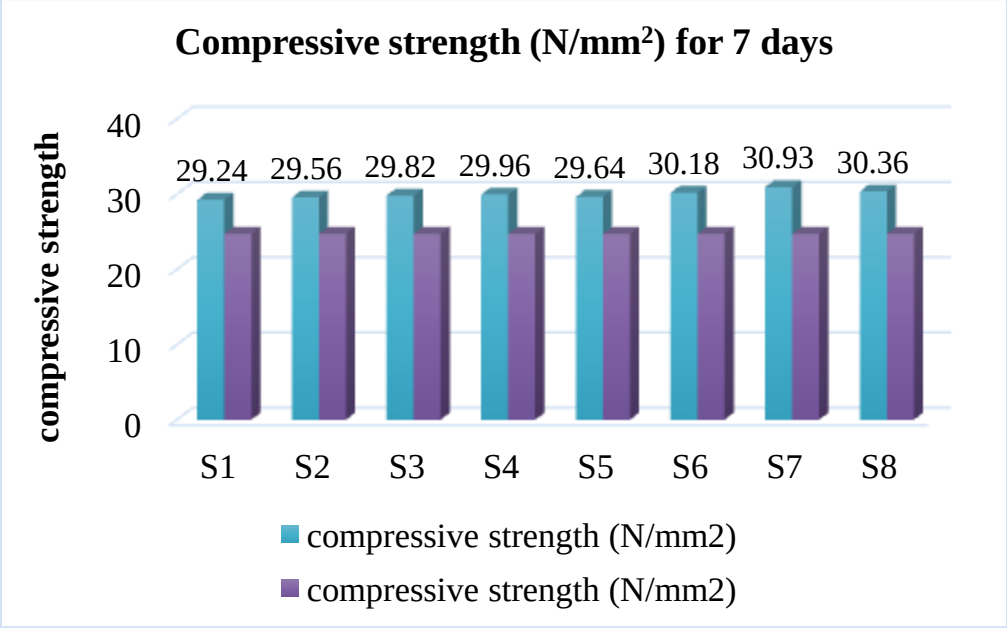
Specimen	Rice Husk Ash (%by weight of cement)	Fly ash (% by weight of cement	Steel fiber (% by volume of concrete)	Glass fiber (% by volume of cement)
S1	20	20	0	0
S2	20	20	0.25	0
S3	20	20	0.5	0
S4	20	20	0.75	0
S5	20	20	0	0.25
S6	20	20	0.25	0.25
S7	20	20	0.5	0.25
S8	20	20	0.75	0.25

VI. RESULTS AND DISCUSSION

Tests for Compressive Strength: The compressive strength of concrete for cubes, all mixes at 7 and 28 days of curing. Three cubes were casted for various percentage replacements of cement by MP

TABLE 6 COMPRESSIVE STRENGTH TEST DETAILS

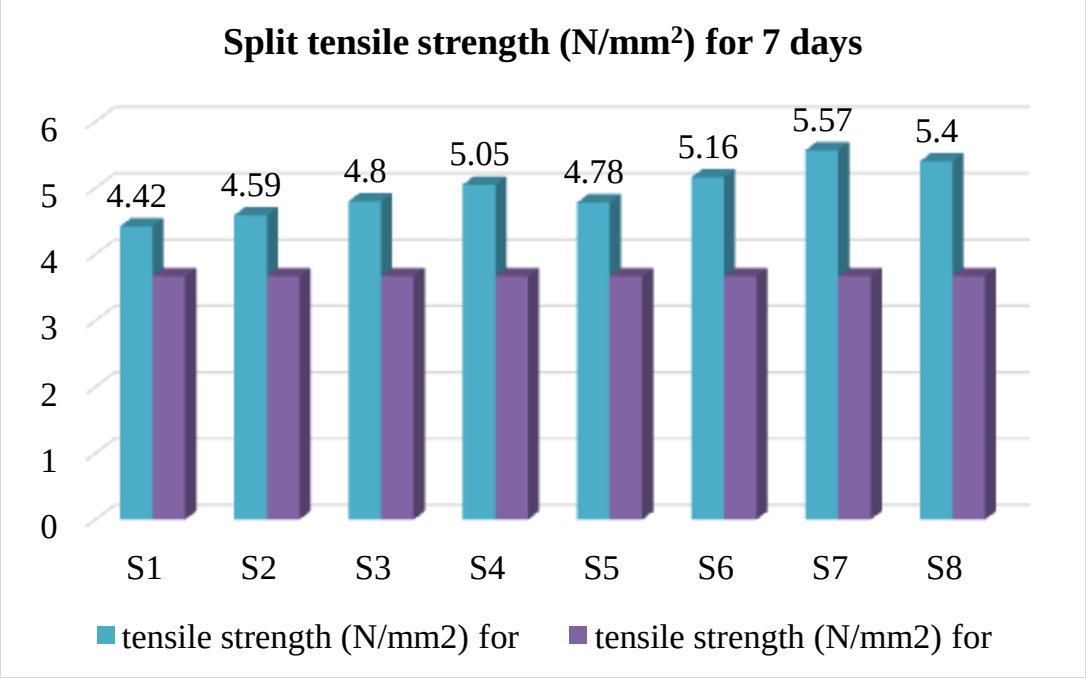
Specimen	compressive strength (N/mm^2)	
	Mean load kN	**7 days**
S1	657	29.24
S2	665	29.56
S3	670	29.82
S4	674	29.96
S5	666	29.64
S6	679	30.18
S7	**695**	**30.93**
S8	683	30.36



Tests for Tensile Strength: The compressive strength of concrete for cylinder, all mixes at 7 and 28 days of curing. Three cylinders were casted for various percentage replacements of cement by MP

TABLE 7 TENSILE STRENGTH TEST DETAILS

Specimen	Tensile strength (N/mm^2)	
	Mean load kN	**7 days**
S1	312	4.42
S2	324	4.59
S3	339	4.8
S4	356	5.05
S5	337	4.78
S6	364	5.16
S7	**393**	**5.57**
S8	381	5.4



CONCLUSION

- The hybrid fiber reinforced concrete exhibits better fatigue strength and increased static and dynamic tensile strength.
- Totally 48 cube specimens were casted to conducted compression strength and totally 32 cylindrical specimens were casted to test split tensile strength. Totally 8 mixer were prepare to test the behavior of fiber. The specimens were casted and cured at 7 days to obtained better results.
- The results were compared with M40 grade of concrete without fiber. It is obtained the minimum value of specimen S1 and the maximum specimen value S7
- The S7 specimen mixture of 20% replacement of Rice Husk Ash and 20% of fly ash with cement, 0.25% of Glass Fiber and 0.5% of steel fiber showed higher compressive strength of 30.93 N/mm^2 at 7 days, and spilt tensile strength of 5.57 N/mm^2 at 7 days,

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