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Studies on Concrete Characteristic Strength Using Fly Ash And Rice Husk Ash

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ABSTRACT
Through out the world, the most widely used construction material is concrete, commonly made by mixing Portland cement with sand, crushed rock, and water. As concrete is being widely used for the construction of most of the buildings, bridges etc, it has been labelled as the backbone to the infrastructure development of a nation. Currently our country is doing major work to improve and develop its infrastructure by constructing industrial and commercial projects and National Highways which creats major economic problem. At present about 120 million ton of cement is being produced in India every year. That much amount of cement is expected to reach close to 470 million ton by 2017[3].Though the production of cement is at comfortable level to meet, the rapidly increasing cost of production of cement is a matter of concern. Hence, currently the entire construction industry is in search of suitable and effective the waste product that would considerably minimize the use of cement and ultimately reduce the construction cost. Few of such products have already been identified like Rice Husk Ash (RHA), Fly Ash(FA), Silica Fume etc. Amongst them RHA is known to have good prospects in minimizing the usage of cement.

Keywords: Concrete, Characterization, Fly Ash(FA), Rice Husk Ash(RHA)

I. INTRODUCTION

In an ancient period, construction work was mostly carried out with help of mudstone from industry. Fly Ash is a by-product of burned coal from power station and Rice Husk Ash is the by-product of burned Rice Husk at higher temperature. Considerable efforts are being taken worldwide to utilise natural waste and by-product as supplementary cementing materials to improve the properties of cement concrete. RHA is by-product of paddy industry. Rice Husk Ash(RHA) is a highly reactive pozzolanic material produced by controlled burning or Rice Husk. Fly Ash(FA) is finely divided produced by coal fired power station. Fly Ash (FA) possesses pozzolanic properties similar to naturally occurring pozzolanic material [1]. Different materials with pozzolanic properties such as fly ash , condened silica fume, blast-furnance slag and Rice Husk Ash(RHA) have played an important part in the production of high performance existing residues and by-products, the possibility of using Rice Husk Ash (RHA) in the production of structural concrete is very important for India. India is the second largest rice paddy cultivating country in the world. Both the technical advantages offered by structural concrete containing Rice Husk and the social benefits related to the decrease in the number of problems of ash disposal in the environment have simulated the development of research into the potentialities of this material[2]. If the waste cannot be disposed properly it will lead to social and environmental problem.

This research paper deals with the study of effects on the behaviour of concrete produced from partial replacement of cement with combination of FA and RHA at equal proportion. The objectives and scope of present study are

1. To study the relative strength development of [RHA, FA, (RHA+FA)] concrete.
2. Use of industrial waste in a useful manner.
3. To conduct Compression Test on [RHA, FA, (RHA+FA)] concrete on standard IS specimen size (150X150X150) mm.
4. To conduct Flexural Test on [RHA, FA,(RHA+FA)] and concrete on standard IS specimen size (100X100X500)mm.
5. To conduct Split Tensile Test on [RHA, FA, (RHA+FA)] concrete on standard IS specimen size (150diaX300)mm.
6. To provide economical construction material.
7. Provide safeguard to the environment by utilizing waste properly.

II. EXPERIMENTAL PROGRAM

2.1Materials

2.1.1 Cement

The cement used was Portland Slag Cement(33grade) with Brand Name "ULTRA TECH". Specific Gravity of the cement was 3.15. Consistency of cement was 31%. Initial and Final Setting Time of the cement was 95 min and 285 min, respectively, conforming to IS - 455:1989[5].The cement for the whole work was procured in a single consignment and properly stored.

Table1. Chemical properties of cement:

Material	Cement
SiO_2	19.71
AL_2O_3	5.20
Fe_2O_3	3.73
CaO	62.91
MgO	2.54
LOI	0.96
SO_3	2.72
K_2O	0.90
Na_2O_3	0.25

2.1.2 Rice Husk Ash (RHA)

The RHA for the whole work was produced in a single consignment and properly stored. RHA was fined by Los Angeles Abrasion Testing Machine. And is sieved from IS 150 micron sieve.

Specific Gravity of RHA was 2.25 and Bulk Density of RHA was 0.855g/cc.

Table 2: Chemical Composition of RHA

Material	RHA
SiO_2	92.99
Fe_2O_3	0.43
AL_2O_3	0.18
CaO	1.03
MgO	0.35
SO_3	0.10
AL_2O_3+Fe_2O_3	0.61
Na_2O_3	3.56
K_2O	0.72

2.1.3 Fly Ash (FA)

The FA used in the experiments has been obtained from CFIR Thermal Power Plant, Digwadih, Distric – Dhanbad,Jharkhand. Specific Gravity of FA was 2.10. Bulk Density of FA was 0.749gm/cm^3 conforming to IS:3812-1981[14]

Table 3. Chemical composition of FA

Material	FA
LOI	4.5
SiO_2	56.65
AL_2O_3	27.35
Fe_2O_3	4.79
CaO	2.19
MgO	0.57
Soluble SiO_2	3.95

2.1.4 Fine Aggregate

Sand: Ordinary Sand from Sindri (dist. Dhanbad) has been used. The properties are determined as per specification laid down in IS 2386-1963[6]. According to the IS Code:383-1970 this sand falls in zone ii[7].

Table 4: Properties Of Fine Aggregate

Property	Fine Aggregate
Specific gravity	2.626
Unit weight	1.624gm/cc
Fineness Modulus	2.32
Water Absorption	0.5%
Bulking	26%

2.1.5 Coarse Aggregate

Crushed Stone from "Dala" with maximum size of 20 mm and down gauge has been used as coarse aggregate. The properties as per specification laid down in IS:383-1970.

Table 5. Properties Of Coarse Aggregate

Property	Coarse Aggregate
Specific Gravity	2.75
Unit Weight	1.60gm/cc
Fineness Modulus	6.13
Water Absorption	1%

2.1.6 Water

Water used for making concrete is conformed to the following requirements as shown in table 6.

Solids	Max. Permissible limit
Organic	200mg/l
Inorganic	3000mg/l
Sulphates(So_4)	500mg/l
Chlorides(as cl)	2000mg/l

2.2 Preparation Of Specimens

The mix design is produced for maximum size of aggregate is 20mm conventional aggregate RHA and FA with replacement of cement. The replacement of RHA and FA respectively and combindly with cement by 6%, 12%, 18% and 24% is studied by casting cubes, cylinders and prisms. The concrete is prepared in

laboratory. The concrete is poured into the mould in 3 layers by poking with tamping rod. The cast specimens are removed after 24 hours and these are immersed in a water tank . After curing 28 days the specimens are removed and these are tested for Compression, Split and Flexural strength as shown in fig.1, fig.2 and fig. 3 respectively, and the results compared with conventional concrete.

Fig. 1 Compression Test

Fig. 2 Split Tension Test

Fig.3 Flexural test

III. Tests

The cubes of 150X150X150 mm size and cylinders of 150mm diaX300mm and prisms of 100X100X500mm, were tested for Compression, Split Tensile and Flexural Strength. Tests were done as per following codes of Bureau Of Indian Standards. The test for Compressive Strength on cubes were measured at 28 days of curing as per IS:516-1959[8], test for Flexural Strength on beam was measured at 28 days of curing as per IS:516-1959[8] and test for Split Tensile Strength on cylinder was measured at 28 days of curing as per IS:5816-1999[9].

IV. Mix Design

The mix proportion was done as per the IS:10262-1982[10]. The target mean strength was 31.6N/mm^2 for Portland Slag Cement.

The final mix that is used 1:1.28:2.78 is obtained for water cement ratio is 0.45.

Table 7: Mix Proportions Per Cubic Meter

Sl. No.	Mix id	RHA%	*FA%*	Cement(Kg)	Water(Kg)	F.A(Kg)	C.A(Kg)	RHA (Kg)	FA (Kg)
1	NC	0	0	428	204	540.64	1209.75	-	-
2	FA1	0	6	402.32	204	540.64	1209.75	-	25.68
3	FA2	0	12	376.64	204	540.64	1209.75	-	51.36
4	FA3	0	18	350.96	204	540.64	1209.75	-	77.04
5	FA4	0	24	325.28	204	540.64	1209.75	-	102.72
6	RHA1	6	0	402.32	204	540.64	1209.75	25.68	-
7	RHA2	12	0	376.64	204	540.64	1209.75	51.36	-
8	RHA3	18	0	350.96	204	540.64	1209.75	77.04	-
9	RHA4	24	0	325.28	204	540.64	1209.75	102.72	-
10	(R+F)1	3	3	402.32	204	540.64	1209.75	12.840	12.840
11	(R+F)2	6	6	376.64	204	540.64	1209.75	25.68	25.68
12	(R+F)3	9	9	350.96	204	540.64	1209.75	38.520	38.520
13	(R+F)4	12	12	325.28	204	540.64	1209.75	51.36	51.36

Table 8: Test Results in N/mm^2

Mix	Compressive Strength at 28 days	Split Tensile Strength at 28 days	Flexural Strength at 28 days
NC	34.62	3.53	7.30
FA1	35.05	3.61	7.30
FA2	34.95	3.60	6.70
FA3	32.81	3.51	6.20
FA4	31.50	3.36	6.0
RHA1	33.56	3.20	7.00
RHA2	35.00	3.50	7.50
RHA3	33.75	3.10	7.15
RHA4	32.56	2.80	6.75
(R+F)1	29.50	3.00	6.90
(R+F)2	28.00	2.90	6.35
(R+F)3	27.65	2.65	6.00
(R+F)4	26.00	2.00	5.70

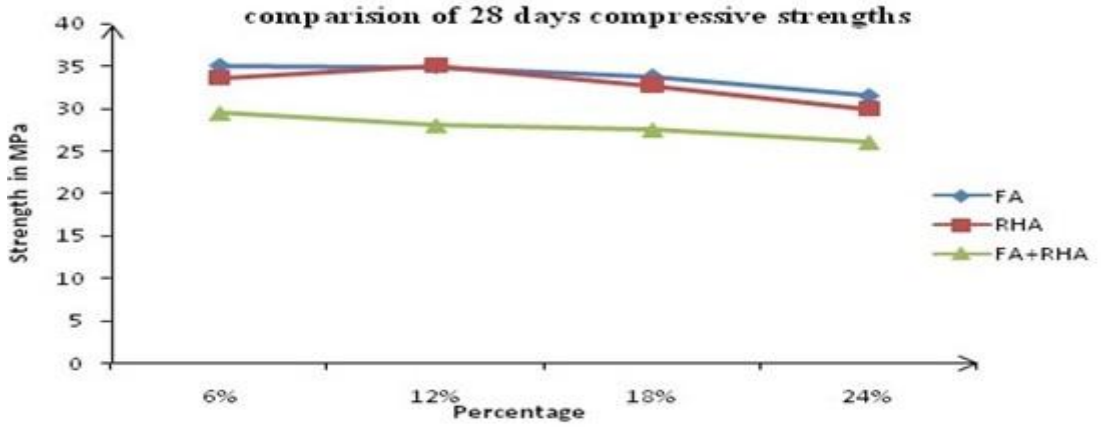

Fig.4 comparision of compressive test

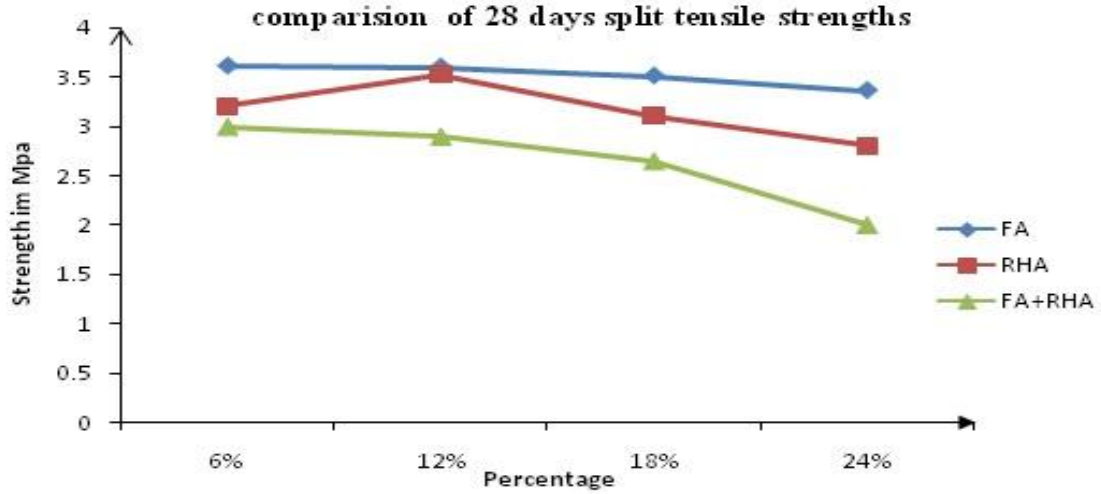

Fig.5 comparision of split tensile strengts

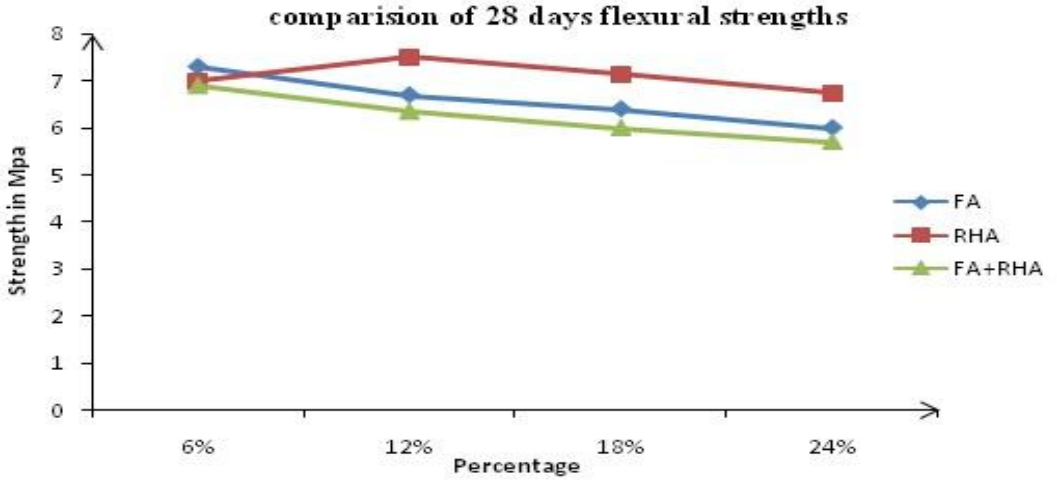

Fig.6 comparision of flexural test

V. CONCLUSIONS

Based on the Results presented above, the following conclusions can be drawn:

1. Compressive Strength increases with the increase in the percentage of F A and RHA up to replacement (12% FA and 12% RHA) of cement in concrete for M25.
2. It was found that rice husk when burned produced amount of silica (more than 80%). For this reason it provides excellent thermal insulation.
3. RHA contains more silica, and hence we prefer RHA use in concrete than silica fume to increase the strength.
4. Through RHA is harmful for human being but the cost RHA is very low, we prefer RHA use in concrete as compare to silica fumes.

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