International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622
National Conference on Advances in Engineering and Technology
(AET- 29th March 2014)

RESEARCH ARTICLE OPEN ACCESS

Effect on Strength of Concrete after Adding Rice Husk Ash

Parvinder Singh[*], Balwinder Lallotra[**] and Vandana Patyal[***]
[*] Civil Engineering Department, Maharishi Markandeshwar University, Ambala.
(Email: singhparvinder270@gmail.com)
[**] Civil Engineering Department, Maharishi Markandeshwar University, Ambala.
(Email: balwinder.com@gmail.com)
[***] Civil Engineering Department, Maharishi Markandeshwar University, Ambala.
(Email: vandanapatyal2009@gmail.com)

ABSTRACT
The rice husk is one of the agriculture waste products which are creating health hazard and other environmental problems in our society. In India, there are large numbers of food plant which produces about the million tonnes of Rice Husk Ash (RHA) annually. As India is a fast growing country and need huge infrastructure, so there is an urgent need to utilize this waste to produce an economical and eco friendly concrete for infrastructural development. IS 456:2000 (Indian Standard: Plain and Reinforced Concrete – Code of practice) marked M15 and M20 grade of concrete as Ordinary concrete and the concrete grade above M15 are suitable for making RCC. This paper is based on the possibilities of using Rice Husk Ash (RHA) to replace cement partially. A comprehensive study on the properties of concrete (include workability of fresh concrete, compressive strength, modulus of elasticity for hardened concrete) containing rice husk ash is carried out. The results show that the strength of concrete grade M15 and M20 is maximum when 12.5% of cement content is replaced with Rice husk ash.

Key Words: Cement, Compressive strength, Pozzolanic reaction, Rice husk ash.

I. INTRODUCTION

Rice is one of the major food crops in the world. Its production generates an equally great amount of waste in the world, namely rice husk (RH), a by-product of the multistage processing of rice. The chemical composition of RH has been found to vary from sample to sample. Any of the differences in type of paddy, crop year, climatic and geographical conditions, soil chemistry, sample preparation, or method of analysis could be a reason for this variation. In many smaller towns and villages in southern parts of India, materials result in the form of fibers and granular materials as waste [1]. RH is an excellent source of high-grade silica. Rice husk has recently been recognized as pozzolona. A pozzolona is a siliceous/ aluminous material which in itself has little or no cementitious value. Addition of rice husk ash to Portland cement does not only improve the early strength of concrete, but also forms a calcium silicate hydrate (CSH) gel around the cement particles which is highly dense and less porous, and increase the strength of concrete against cracking. It was revealed that the structural nature of the silica produced from rice husk is independent of the purification methods but largely dependent on the incineration temperature used in the production process. Recycling of waste components contribute to energy savings in cement production, to conservation of natural resources, and to protection of the environment. Furthermore, the use of certain components with potentially pozzolanic reactivity can significantly improve the properties of concrete. One of the most suitable sources of pozzolanic material among agricultural waste components is rice husk, as it is available in large quantities and contains a relatively large amount of silica. Unlike natural pozzolana, the ash is an annually renewable source of silica. It is worth to mention that the use of RHA in concrete may lead to the improved workability, the reduced heat evolution, the reduced permeability, and the increased strength at longer ages.

II. OBJECTIVE

The objective of this study is to find out the various properties of concrete after adding various percentage of rise husk ash by weight of cement content in M15 and M20 concrete. In this study, rice husk ash in varying percentages (15%, 20%, 25%, 30% etc) by weight of cement is added and compressive strength of different concrete samples is determined.

III. MATERIALS

3.1 Rice Husk Ash

Rice Husk Ash is a major agricultural product obtained from paddy. The high percentage of

siliceous material present in rice husk ash indicated that it has pozzolanic properties.

3.2 Cement

Ordinary Portland cement (43 grades) available in local market is used in the investigation.

3.3 Fine Aggregate

River sand is used as fine aggregates and its specific gravity is 3.22. Table 1 shows the grading of fine aggregate.

Table 1: Grading of fine aggregate

IS sieve (mm)	% Retained	% Cumulative Retained	Cumulative % passing	Requirement of cum. % passing for Zone-II sand As per IS 383
10	0	0	100	100
4.75	2	2	98	90-100
2.36	13	15	85	75-100
1.18	20	35	65	55-90
600 micron	20	55	45	35-59
300 micron	24	79	21	8-30
150 micron	18	97	3	0-10
Residual	13	100	0	-

Fineness modulus: E_F= Cumulative % passing/100
=417/100
= 4.17

3.4 Coarse Aggregates

Crushed angular 20 mm size stones are used as coarse aggregates and its specific gravity is 4.17. Table 2 shows the grading of coarse aggregate.

Table 2: Grading of coarse aggregate

IS sieve (mm)	% Retained	% Cumulative Retained	Cumulative % passing	Requirement of cum. % passing for 20mm graded coarse agg. As per IS 383
40	0	0	100	100
20	4	4	96	95-100
16	36	40	60	-
12.5	24	64	36	-
10	10	74	26	25-55
4.75	22	96	4	0-10

Fineness modulus: E_C= Cumulative % passing/100
=322/100
= 3.22

IV. RESULTS

4.1 Cube Compressive Strength

Compressive strength tests are carried out on cube specimens of the age of 7 and 28 days curing. The test set up for compression strength on cube is shown in Fig 1 and Fig 2.

Fig 1: Compression Testing Machine

Fig 2: Cube Compressive Strength

4.2 Compressive Strength Results

Compressive strength tests are carried out on specimen size 150mm*150mm*150mm on 2000 KN capacity compression testing machine. Compressive strength results for M15 grade concrete is shown in the Table 4 and Fig 3. Table 3 shows the nomenclature of material used.

Table 3: Nomenclature

Symbol	M15 grade of concrete with	Symbol	M20 grade of concrete with
M15	No replacement	M20	No replacement
M15-R5	5% replacement	M20-R5	5% replacement
M15-R10	10% replacement	M20-R10	10% replacement
M15-R15	15% replacement	M20-R15	15% replacement
M15-R20	20% replacement	M20-R20	20% replacement

Table 4: Compressive Strength Result for M15 Concrete

SAMPLE	7DAYS STRENGTH N/mm^2	28 DAYS STRENGTH N/mm^2
M15	12.63	18.65
M15-R5	12.94	19.87
M15-R10	13.76	22.75
M15-R12.5	14.43	24.09
M15-R15	13.44	22.01
M15-R20	12.35	20.73
M15-R21	11.75	18.97
M15-R22	10.23	17.13

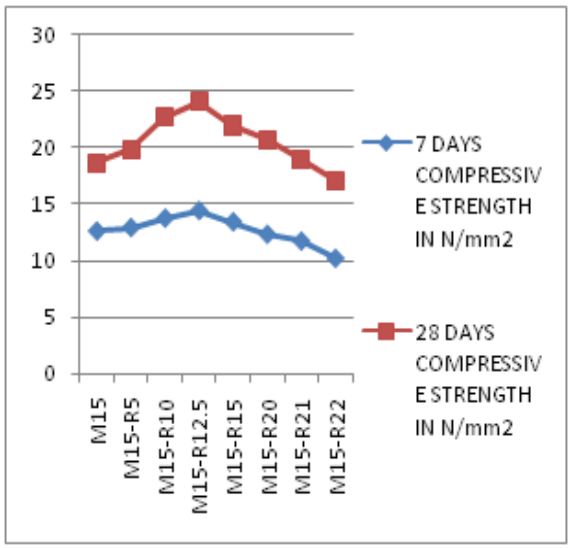

Fig 3: Graph for M15 Grade Concrete for 7 and 28 Days

Compressive strength results for M20 grade concrete is shown in the table 4 and the same is illustrated with the help of Fig 5.

Table 5: Compressive Strength Results for M20 Concrete

SAMPLE	7DAYS STRENGTH N/mm^2	28 DAYS STRENGTH N/mm^2
M20	16.70	23.72
M20-R5	17.94	25.20
M20-R10	18.87	27.89
M20-R12.5	19.04	28.13
M20-R15	17.02	27.02
M20-R20	16.54	23.79

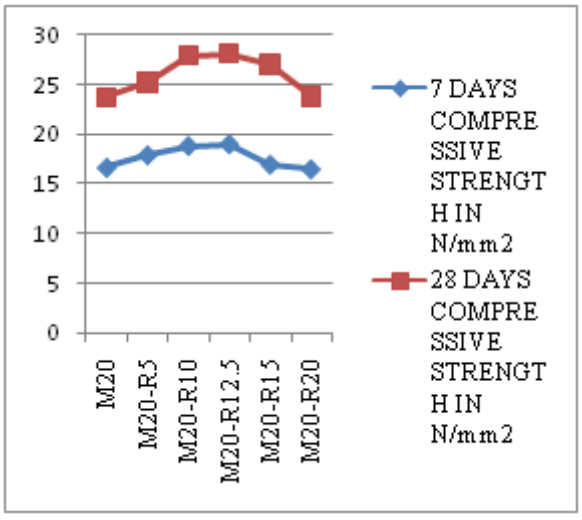

Figure 4: Graph Showing Results for M20 Grade Concrete for 7 and 28 Days

V. COST ANALYSIS AND COMPARISION

The cost comparisons for M15 Concrete and M20 Concrete are shown in Table 5 and Table 6.

Table 5: Cost Comparison for M15 Concrete

GRADE OF CONCRETE	CEMENT REPLACEMENT %AGE	CEMENT IN KG	PRICE PER KG	RHA IN KG	PRICE PER KG	COARSE AGGREGATE IN KG	PRICE PER KG	FINE AGGREGATE IN KG	PRICE PER KG	MIXING AND PLACING COST PER CUM (RS)	TOTAL COST PER CUMEC OF CONCRETE (Rs)
M15	NIL	300	6	-	1	1502.58	2	1118.36	2	600	7641
	5%	285	6	15	1	1502.58	2	1118.36	2	600	7567
	10%	270	6	30	1	1502.58	2	1118.36	2	600	7492
	12.5	262.5	6	37.5	1	1502.58	2	1118.36	2	600	7455
	15%	255	6	45	1	1502.58	2	1118.36	2	600	7417
	20%	240	6	60	1	1502.58	2	1118.36	2	600	7342
	21%	237	6	63	1	1502.58	2	1118.36	2	600	7327
	22%	234	6	66	1	1502.58	2	1118.36	2	600	7312

Table 6: Cost Comparison for M20 Concrete

GRADE OF CONCRETE	CEMENT REPLACEMENT %AGE	CEMENT IN KG	PRICE PER KG	RHA IN KG	PRICE PER KG	COARSE AGGREGATE IN KG	PRICE PER KG	FINE AGGREGATE IN KG	PRICE PER KG	MIXING AND PLACING COST PER CUM (RS)	TOTAL COST PER CUMEC OF CONCRETE (Rs)
M20	NIL	380	6	-	1	1407.699	2	1017.47	2	600	7730
	5%	361	6	19	1	1407.699	2	1017.47	2	600	7635
	10%	342	6	38	1	1407.699	2	1017.47	2	600	7540
	12.5%	332.5	6	47.5	1	1407.699	2	1017.47	2	600	7493
	15%	323	6	57	1	1407.699	2	1017.47	2	600	7445
	20%	304	6	76	1	1407.699	2	1017.47	2	600	7350

VI. CONCLUSION

Based on the experimental work, it can be concluded that RHA mixed cubes has equal or somewhere gives more strength with that of conventional concrete cubes. For M15 grade concrete, load carrying capacity is increased by 15 to 30 percent for certain percentages of Rice Husk and for M20 concrete, load carrying capacity is increased by 15 to 20 percent for certain percentages of Rice Husk.

Rice husk ash concrete proves to be eco friendly as it protects environment by utilization of waste products. By referring the cost comparison table, it can easily estimated that for the same strength, as in case of no replacement, we can save up to 22 percent of cement by replacing it by rice husk ash, hence it proves economical too.

REFERENCES

[1] M. Sivaraja and S. Kandasamy "Potential reuse of waste rice husk as fibre composites in concrete", *Asian journal of Civil Engineering (Building and housing),* 12(2), 2011, 205-217.

[2] Iyenagbe B. Ugheoke and Othman Mamat "A critical assessment and new research directions of rice husk silica processing methods and properties", *Maejo Int. J. Sci. Technol*., 6(3), 2012, 430-448.

[3] Ezzat Rafiee, Shabnam Shahebrahimi, Mostafa Feyzi1 and Mahdi Shaterzadeh, "Optimization of synthesis and characterization of nanosilica produced from rice husk (a common waste material)" , *International Nano Letters*, 29(2), 2012.

[4] M.U Dabai, C. Muhammad,B.U. Bagudo and A. Musa "Studies on the Effect of Rice Husk Ash as Cement Admixture", *Nigerian Journal of Basic and Applied Science*, 17(2), 2009, 252-256.

[5] Fernanda Giannotti da Silva, Jefferson B. L. Liborio, Paulo Helene ,"Improvement of physical and chemical properties of concrete with brazilian silica rice husk (SRH)", *Fecha de recepción*, 23(1), 2008,18 – 25.

[6] A. A. Ramezanianpour, M. Mahdi khani, Gh. Ahmadibeni "The Effect of Rice Husk Ash on Mechanical Properties and Durability of Sustainable Concretes", 7(2), 2009, 83-91.

[7] C.Marthong, "Effect of Rice Husk Ash (RHA) as Partial Replacement of Cement on Concrete Properties" *International Journal of Engineering Research & Technology (IJERT),* 1(6), 2012, 1-7.

[8] V. Ramasamy, "Compressive Strength and Durability Properties of Rice Husk Ash Concrete", 16(1), 2012, 93-102.

[9] IS:456-2000 *code of practice of design of concrete structures*.

[10] M.L. Gambhir, " Concrete Technology*", TMH Pub.*,2004.

[11] A.K. Goyal & I.C. Syal, "Design of concrete structures*", S.Chand Pub*., 2008.

[12] A.K. Jain, "Design of concrete structures", *Nem Chand & Bros*., 2002.