International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 04 Issue: 10 | Oct -2017 www.irjet.net p-ISSN: 2395-0072

PARTIAL REPLACEMENT OF CEMENT BY RICE HUSK ASH

Er. RAVI BHUSHAN[1], SOPAN GOCHHE[2], ER. HARNEET SINGH[3], BIKRAM PRASAD BASTOLA[4]

Abstract: This paper summarizes the feasibility of using partial rice husk ash on the cement in order to mitigate the availability, affordability, quality and pollution issues. Solid masonry blocks size 150*150*15 of M20 grade were casted by replacement of cement to RHA by weight at 0%,5%,10%,15%,20%,25%. Cubes were made ready for testing after 7, and 28 days curing in water served as the control. Testing was included for the strength (compressive, flexure and split tensile), workability (water binding ratio and setting time), costing analysis. The test results revealed that the workability and strength are slightly better than the standard concrete by satisfying the limits initiated endorsed by standard. The reduction on cost by 3.08% relative to the initial values.

KEYWORD: RHA, CEMENT, Compression, Split tensile, Workability, Strength, Cost

1.0 INTRODUCTION

In current worldwide markets and increasing accentuation on quality, requirement for concrete having high strength with affordable cost has increased numerous fold. Over the past decades, research on concrete has entered broad-based areas of activities to enhance the concrete performance. The reason behind this is not only to the vast range of applications that concrete offers, but also due to its great affordability, strength, durability, and versatility. Numerous method has been applied and different kinds of concrete has been introduced like, Self -Compacting Concrete(SCC) was introduced that enhances the durability of the concrete, high strength concrete(HSS) was introduced that provide ultra-high strength. But such concrete is rarely available and high cost. The need to reduce the high cost of Ordinary Portland Cement with the desirable characteristics some materials has to be modified. From the intensified research into locally available products and reduction in cost partial replacement of the OPC with rice husk ash is proven to be effective fulfilling requirement.

Rice husk Ash is an agricultural product on which rice husk is burnt into ashes. RHA is found to be good material which fulfils the physical characteristics and chemical composition of mineral admixtures. A small amount addition of RHA (lesser than two to three by weight of the cement), to a given water cement ratio, is sufficient and helpful to improve the stability, durability as well as the workability tends to increase the compressive strength and durability of the concrete. Usage of the fine rice husk ask reduces the temperature as compared to the normal opc temperature. As per the researcher observation is was found that proper proportionate ration RHA can reduce the initial setting time and also it obtains its maximum strength with a few days. RHA depends mainly on silica content, silica crystallization phase, and size and surface area of ash particles. Rice husk usage benefits are briefed in many literatures, very few of them deals in their real life.

2.0 Research History On Partial Replacement of the OPC with Rice Husk

Research is always deliberated glancing concrete properties. It is envisioned that the minimum contain of the RHA as a partial replacement found to be not worthy enhancing the strength as well more amount of the RHA decreases its compressive strength value. P. Mehta (1992), studied that RHA contains silica in amorphous and highly cellular form that improves workability and stability, and it decreases the development and impermeability as well as durability in strengthening zone. Rukzon and Chidaprasirt (2000) studied that the strength of the Mortar with the partial replacement of RHA will gain 10 percent more after 7 days and 20 percent after 28 days comparing with regular concrete. Mehta and Pirth (2000) investigated that the use of the rice husk ash as a replacement material reduce the temperature in the high strength mass concrete. Ganesan et al (2007) studied that the concrete with partial replacement of cement with rice husk ash and he concluded in his study that concrete with replacement of 15% of rice husk ash showed an almost compressive strength and the compressive strength is loss at increasing content of rise husk ash more than 15%. Cordeiro et al (2009) carried out the studied of Brazilian rice husk ash and rice husk straw ash and explained that the grinding of these ashes increases the pozzolanicity of rice husk ash and the strength. Likewise, Ettu et al (2013, a) (2013, b) (2013, c) (2013, d), P.V. Rambabu et al (2015), Shivaji Barkale, UttayKalwane (2016) they has researched on it and many more are still researching so that is can be used globally.

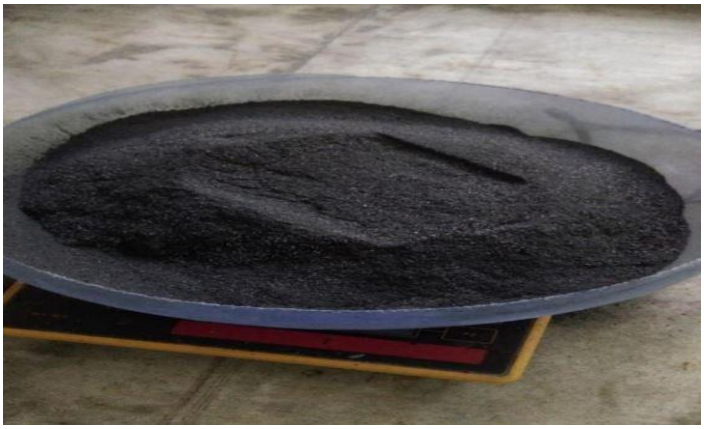
3.0 MATERIAL USED AND SPECIMEN PREPARATION

3.0.1. Cement

Cement is the fine grey powder that acts as a binding materials which is used for the construction. The cement that was used during experiment was Ordinary Portland Cement 43 grade confirming to IS 8112 impurities were removed before the process.

3.0.2. Rice Husk Ash (RHA)

Rice Husk Ash is the ash that is obtained by burning the rice husk until it gets reduced by 25%. The Rice Husk for the research was obtained locally. These Husk then were deliberated until fine ash is being produced. These ashes were sieved by the 600 micron where further impurities are being minimized.



3.0.2.1PROPERTIES OF RICE HUSK ASH

Physical Properties

S. No	Particular Properties	
1	Color	Gray
2	Shape Texture	Irregular
3	Mineralogy	Non Crystalline
4	Particle Size	< 45 microns
5	Specific Gravity	2.37
6	Odor	Odorless

3.0.3. Water

The water that is used for the research work was obtained locally that fulfill the requirement provided by Indian Standard. The water was clean and free from any visible impurities. Water is being supplied partially deliberating the proportionate ratio

3.0.4. Fine Aggregate

The sand that was used for the research work was obtained locally that fulfills the requirement provided by Indian Standard 383 1970.The purity of the sand was analyzed glancing the code provided by Indian Standard.

3.0.5. Coarse Aggregates

The aggregates that are used for this research work are taken from the locally available natural rocks that's get retained on 4.75micron sieve after being crushed. These granite passes the requirement provided by Indian Standard 383 1970.

4.0 Objective

1. Replacement of cement with the rice husk ash and comparison of strength of concrete thus obtained with conventional concrete.
2. Designing of concrete mixes using varying gradation of rice husk ash as replacement of cement.
3. Evaluation of strength characteristics such as compressive strength, flexure strength, split tensile strength of concrete and comparison of the same with conventional concrete.

5.0 Methodology

- Procurement of rice husk ash from the rice sellers.
- Lab testing of characteristics of rice husk ash specific gravity, physical state, particle size, odor, color, appearance etc.
- Preparation of design mix of M20 grade using relevant IS code.
- Preparation of different concrete mix using rice husk ash as partial replacement of cement by 0%,5%,10%,15%,20%,25%.
- Comparative study of compressive, flexural, split tensile strength of concrete mix thus prepared.

6.0 Proportioning

Grade: M20
Type of Cement: OPC 43 grade confirming to IS 8112
Maximum Nominal Size of Aggregates: 20 mm
Minimum cement content: 300 kg/ m3
Maximum w/c ratio: 0.50 ß

Workability: 0.90 C. F ß
Exposure condition: Moderate
Method of Concrete Placing: Hand
Degree of Supervision : Good
Maximum Cement Content: 540 kg/ m3

7.0 Test Data For Materials

7.1 Specific Gravity

Cement = 3.08
Coarse aggregate (below 20 mm) = 2.71
Fine Aggregate = 2.604

7.2 Sieve Analysis

Coarse aggregate = Graded
Fine Aggregate = Graded (ZONE II)

7.3 Water Absorption

Coarse aggregate = 0.51
Fine Aggregate = 1.48

7.4 Free (surface) Moisture

Coarse aggregate = NIL
Fine Aggregate = NIL

8.0 Result

8.1 Result of COMPACTION FACTOR FOR DIFFERENT RICE HUSK ASH CONCRETE MIX

COMPRESSIVE STRENGTH OF DIFFERENT MIXES			
Concrete mix	**Compression Factor**	**After 7 days**	**After 28 days**
RT-0 (0%RHA)	0.86	18.94	34.51
RT-1 (5%RHA)	0.77	17.55	36.24
RT-2 (10%RHA)	0.72	15.18	34.81
RT-3 (15%RHA)	0.66	9.91	27.23
RT-4 (20%RHA)	0.56	9.12	19.15
RT-5 (25%RHA)	0.49	8.24	14.49

The compaction factor value decreases as the percentage of the rice husk ash increases in the concrete mixes. The decrease in the value of compacting factor shows that the concrete is less workable. The increase in the percentage of the rice husk ash proves that the more water is requiring making the mix more workable. The increase the water demand for rice husk ash concrete is due to the amount of silica in the mixture. The compression strength of the concrete mix increases with replacement of rice husk ash up to 10% after that the gradually decrease in the compressive strength is noted. The maximum strength is shown by the RT-1 mix having 5% rice husk ash and gives the value of compressive strength 36.54 MPa. The value of compressive strength of mix RT-2 is less than the mix RT-1 but more than RT-0 (conventional mix) with value 34.81. The gradual decrease in compressive strength is noted and the value of RT-3 mix is 27.23 and RT-4 is 19.15 and RT-5 is 14.49. The RT-1 mix shows increment in strength with 5.04% and the mix RT-2 shows increment in strength with 3.94% after this mix all mixes shows a gradually percentage decrement 21.79,29.67, 24.33, for RT-3, RT-$, RT5 mix respectively

8.2 Result of FLEXURE STRENGTH OF DIFFERENT RICE HUSK ASH CONCRETE MIX

FLEXURE STRENGTH OF DIFFERENT RICE HUSK ASH CONCRETE MIX (N/mm2)				
MIX	**7 Days**		**28DAYS**	
	Flexure Strength	**Increase/Decrease in Strength**	**Flexure Strength**	**Increase/Decrease in Strength**
RT-0	2.38	0	4.45	
RT-1	2.95	23.94%	4.61	3.59%
RT-2	2.15	-27.11%	4.53	-1.73%
RT-3	1.65	-23.25%	3.48	-23.17%
RT-4	1.36	-21.24%	2.23	-35.91%
RT-5	1.2	-11.00%	1.8	-23.88%

The flexure strength of the rice husk ash concrete shows the increment in the strength of the RHA concrete the 7 days' flexure strength of RT-0 mix is 2.38 and the RT-1 gives the increment in the strength i.e.2.95 and after that all the mixes gives the decrease in the flexural strength and give the liner down of the curve. And the 28 days' flexural strength give good result and the strength of the RT-1 i.e. 5% replacement and RT-2 i.e. 10% replacement of rice husk ash gives the increment in the strength of the concrete mix as compare the strength of the mix RT-0 the value 4.45 and the both mixes increase values as 4.61 and 4.53 respectively for 5 and 10% replacement and the flexure strength of the other mixes gives the decrease in the value after the 10% replacement. Hence we can say that the rice husk ash can use as the replacement martial at the maximum replacement of 10% from the concrete mix. And the replacement of more rice husk ash than 10% tends to decrease in the flexural strength of the concrete mix.

8.3 Result of TENSILE STRENGTH OF DIFFERENT RICE HUSK ASH CONCRETE MIX

The split tensile strength of the concrete mix is find out by the check the sample in the compression testing machine and note down the maximum load carrying by the sample and from the maximum load. The result obtained are noted below:

TENSILE STRENGTH OF DIFFERENT RICE HUSK ASH CONCRETE MIX (N/mm2)				
MIX	**7 Days**		**28DAYS**	
	Tensile Strength	**Increase/Decrease in Strength**	**Tensile Strength**	**Increase/Decrease in Strength**
RT-0	2.23	0	2.85	0%
RT-1	2.97	33.0%	3.39	18.35%
RT-2	2.25	-4.22%	2.95	-12.3%
RT-3	2.07	-8.03%	2.44	-17.39%
RT-4	1.81	-12.45%	2.02	-17.24%
RT-5	1.11	-38.2%	1.85	-8.64%

The concrete with 5% rice husk ash shows the maximum tensile strength than other replacement value after the mix RT-1 the continuous decrease in tensile strength is noted the mix having 10% replacement i.e. RT-2 is gives the value less than the RT-1 but its gives the slightly more value than the conventional mix RT-0. From the curve we conclude that 10% RHA can replaced. After the RT2 mix the value goes on decreases as we increase the content of RHA. The mix RT-3, RT-4, RT-5 shows the %decrease in the tensile strength -8.03%, -12.45%, -38.2%respectively. Similarly, the 28 days' strength of the concrete mixes shows an increment up to RT-2 and the RT-1 shows the highest tensile strength value. The other mixes give a continuous decrease in the value of the tensile strength of the concrete mix. the % decrease value shows that the value of the tensile strength is decrease but less than the 7 days' strength. The % decrease in the mix RT-3, RT-4, RT-5, is -17.39%, -17.24%, and 8.64% respectively.

9.0 Cost Analysis

Analysis of rates for cement concrete (M-25) mix containing 100% cement and for mixes with 10 % partial replacement of cement with rice husk ash is to be done based on prevailing market rates. The cost of rice husk ash is negligible. The rice husk ash is found free from the industry where the rice husk is used as a fuel that's why we take only the transportation cost of the rice husk ash. On comparing it with conventional concrete it is found that concrete utilizing 10% rice husk ash as partial replacement of cement costing less than conventional concrete by 3.08%

10.0 CONCLUSIONS

- The workability of rice husk ash decreased with increase in percentage of rice husk ash. The compaction factor has been decreased with increase in percentage of rice husk ash.
- The compressive strength of the concrete with partial replacement of rice husk ash increases with increase the percentage of rice husk ash at some extent.
- The flexure strength of rice husk ash concrete has been increased for RT-1 with 3.59% and RT-2 with 1.79% with respect to conventional concrete. After that there is continuously decrease in strength of mixes RT-3, RT-4, RT-5 with 21.79%, 49.88%, 59.55% respectively with respect to conventional mix.
- Rice husk ash can be added to cement concrete as partial replacement of cement up to 10% without any significant reduction in any of the property of concrete. This will result in reduction in the cost of concrete to some extent.
- Rice husk ash is environment polluting material and is best supplementary material for cement replacement as it is easily available in rice producing areas.
- The rice husk concrete mix is economical than conventional concrete mix. It decreases the cost at a rate of 3.35% by replacement.

11.0 REFERENCES

1) Abdulfatai, Adinoyi Murana and Lawal sani(2014)"partial replacement of cement with rice husk ash as filler in asphalt concrete design." Journal of engineering and applied sciences.

2) Anjali V Nair and Mathews M Patel (2016)" effect of partial replacement of cement by rice husk ash in fibre reinforced concrete on mechanical and toughness properties." ISSN(P):2278-9987; ISSN(E):2278-9995

3) Aliu Adekunle, Daramola AS (2013)" optimization for the rice husk ash and saw dust ash as alternative binder for concrete's(E):2319-1813

4) Atul Dahiya, Himanshu, Naveen kumar, Durmesh yadav (2015)" effect of rice husk ash on properties of cement concrete's 2348-7550 5) Aliu Adekunle O,Daramola A.S.(2013). "Optimization for the use of rice husk ash and

saw dust as alternative binder for concrete". The international journal of engineering and sciences.

6) AL-Abdaly, N.M. (2007)" drying shrinkage cracking of high strength concrete. MSc. thesis university of babloyn.

7) Cordeiro, G.C Filho, Fairbairn (2009)" use of ultrafine rice husk ash with high carbon content as pozzolan in high performance concrete" material and structure:42-983992

8) C.Marthong(2012)"effect of rice husk ash as partial replacement of cement on concrete properties."ISSN:2278-0181

9) Chai Jaturapitakkul and Boonmark Roongreung," Cementing Material from Calcium Carbide Residue-Rice Husk Ash," Journal of materials in civil Engineering ASCE, September October 2003, pp. 470-475

10) Ettu l.o, Ajoku C.A, Nwachukwu K.c,Awodiji C.T.G, Eziefula U.G(2013)"strength variation of ordinary Portland cement –rice husk ash composites with varying percentage rice husk ash."ISSN:2277-9442

11) Gahassan Abood Habeeb, Hilmi bin Mahmud (2010)"study on properties of rice husk ash and its use as cement replacement materials. "Materials research 2010;13(2):185-190

12) Hanna, Maoatad, N.K(1984)" use of rice husk ash in concrete." The international journal of cement composities and light weight concrete. Vol no 6 Degussa construction chemicals.

13) I.B.Ologunagaba, A.S.Daramola,A.O.Aliu(2015)"feasibility of using rice husk ash as partial replacement for concrete. "International journal of engineering trends and technology vol 30 no 5

14) IS:650-1966; specification for standard sand for testing of cement

15) IS:4031(part1 and 2); methods of physical test for hydraulic cement (first edition)

16) IS:3535-1986; methods of sampling hydraulic cement (first edition)

17) IS:10262-1982; recommended guidelines for concrete mix design

18) IS: 456-2000; specification for plain and reinforced concrete

19) IS:2386 part3-1963; methods of test of aggregates, specific gravity, density, voids, absorption and bulking

20) Kartini(2011)"rice husk ash pozzolanic material for sustainability." international journal of applied sciences and technology vol 1 no 6

21)K.Ganesan, K.Rajagopal and K.Thangavelu," Effects of the Partial Replacement of Cement with Agro waste ashes (Rice husk ash and Bagasse Ash) on strength and Durability of Concrete," Proceedings of the International Conference on Recent Advances in Concrete and Construction Technology, December 7-9, 2005,SRMIST, Chennai, India pp.73-85.94 22) L.O.Eittu, J.C.Ezeh, U.C.Anya,K.C.N Wachukwu, and K.O.Njoku(2013)."strength of tevnary blended cement concrete containing afikpo rice husk ash and saw dust ash". International journal of engineering science invention

23)Mehta, P. K., & Monteiro, P. J. M. (2006). Concrete: Microstructure, Properties, and Materials, 3rded. New York: McGraw-Hill Companies.

24)Mehta, P. K. And Pirtz, D. (2000)." Use of rice husk ash to reduce temperature in high strength mass concrete". ACI journal

25)Malhotra V.M. and Mehta, P.K. (2004)"pozzolanic and cementitious material. "London Taylor and Francis

26)Mahmud, H.B. Koay, Y.C.N.hamid and Zain, M.F.M(2004)"use of rice husk ash to produce high strength high performance concrete. "National university of Malaysia

. 27)Ms.Nazia Pathan, "Use of Rice Husk Ash in making High Performance Concrete," National Seminar on Innovation Technologies in Construction of Concrete Structures 7 th & 8 th Feb.2003, Dept. of Civil Engineering, KITS, Ramtek,Maharashtra State

28)Naphol Yiibanpoot and Pitthaya Jamsawang(2014)"effect of cement replacemeant by rice husk ash on soft soil stabilization."kasetsart journal (nat sci)48:323-332

29)N.R.D.Murthy, P.Rathish Kumar, Seshu D.R and M.V. Seshagiri Rao," Effects of Rice Husk Ash on the Strength and Durability of Concrete ," ICI Journal July-September 2002, pp.3738.

30)OBILADE, I.O. (2014)." Use of rice husk ash as partial replacement for cement in concrete". International journal of engineering and applied sciences. EAAS & ARF.

31)O.A. Adenuga, A.A. Soyingbe and O.E. Ogunsanmi, (2010). "the use of rice husk ash as partial replacement of cement in concrete". The Lagos Journal of Environmental Studies

32)PV Rambabu, J Gopal verma, GV Ramarao(2015)" durability study on rice husk ash for optimum level of replacement of cement in concrete" international journal of engineering trends and technology.

33)P.Chandan kumar, P.Malleswara Rao(2010)"benifits of use of rice husk ash in concrete"journal of international pollution control.

34)P.Padma Rao, A.Pradhan Kumar,B.Bhaskar Singh,(2014)."a study on use of rice husk ash in concrete".IJEAR

35)Rohit siwach, S.S.Kajal, Nikita Rajpal (2015). "effect of fly ash and rice husk ash on strength characteristics of pavement quality concrete". International journal of science engineering & technology research.

36)S Sundaraman, S Azhagarsamy (2015)" a study on performance of concrete by patial replacement of cement with rice husk ash and silica fume" European journal of advance in engineering and technology.

37)Sakr, K. (2006). "Effects of Silica Fume and Rice Husk Ash on the Properties of Heavy Weight" Concrete. Journal of Materials in Civil Engineering properties." ISSN:2278-0181