Contrastive Analysis on Mechanical Properties of M Sand and River Sand Cement Mortar Bricks With Partial Restoration of Rice Husk Ash

R. Sivasankar, R. Sutharsan, G. Gobinath, T. Thiruvarulselvan.

Abstract*— Normally Rice Husk Ash (RHA) is treated as agricultural waste that do not afford any human feed products across the globe, these kind of agricultural waste can be converted into a convenient product and also M sand is used as a substitute for the river sand, the proportions of river sand from 100%, 75%, 50%, 25%, 0% were restored by M sand, along with that rice husk ash in various proportions from 0%, 5%, 10%, 15%, 20%, 25%, 30% to determine the optimum percentage of rice husk ash without affecting strength properties of bricks. The optimum restoration of 35% of RHA delivered the average compressive strength of 5.34 MPa which is higher than that of common buildingbricks.

Keywords*—RHA- Rice Husk Ash, M Sand – Manufacturing sand

I. INTRODUCTION

1.1. General

Bricks have been extensively used from the ancient times in all over the world as building blocks in both load bearing structure and non-load bearing structure. J. Sutas et al (2011) has made a comparative study on the rice husk (RH) and Rice husk ash (RHA) when added to the brick. The addition of rice husk in the brickmaterial shows the lesser compressive strength. Whereas while adding the rice husk ash (RHA), the compressive strength of the ordinary brick was increased. M. Jamilet al (2016) concluded that the Rice Husk Ash (RHA) plays a major role by its physical as well as chemical activities and made its contribution in the properties of concrete. Most of the researchers have demonstrated the total effect of RHA in concrete andmortar. A.C. Abdullah et al (2016), has reported a study on the compressive strength of the Rice husk (RH) brick.

The test for the RHA was based on the Malaysian standards and requirements. The experiment also carried out to know the mechanical and the chemical properties of the Rice husk (RH). The treated or processed RH has a good result on the compressive strength when compared to the untreated RH.

Revised Manuscript Received on December 15, 2019.

R.Sivasankar, Assistant Professor, Department of Civil Engineering, National Engineering College, K.R.Nagar,kovilpatti.

R.Sutharsan, Assistant Professor, Department of Civil Engineering,Kalasalingam Academy of Research and Education,India.

G.Gobinath, Student, Department of Civil Engineering, National Engineering College, K.R.Nagar, kovilpatti.

T.Thiruvarulselvan. Student, Department of Civil Engineering, National Engineering College, K.R.Nagar, kovilpatti.

To reduce the effect of global warming by the reductionemission ofCO_2,severalmaterials hasbeen used asa substitute for the already existing materials. One such material is rice husk ash (RHA) which has been partially replaced in the Portland cement. In this study the utilization of rice husk ash(RHA) and its significance has been clearly identified.

1.2 SAND

1.2.1 Properties of RiverSand

The size of the river sand is 4.75mm. Al_2O_3 and Fe_2O_3 are normally added as impurities in the river sand. River sand is usually available in different particles size which exhibit uniform behavior. K.Katano, et al (1999) investigated that the behavior of concrete made with bothsea water and unwashed sea sand. It helps them to develop to high densifiedconcrete.

1.2.2 Properties of M-Sand

B. V. Venkataramareddy et al (2012) presented a study on the properties of M-Sand and their behaviors when used as construction materials. As the demand for the Conventional sand is getting increased day by day the need for the alternate source of the fine aggregate is essential. According to IS 456 a minimum slump of 50mm should be achieved for the medium workability which is also achieved by this M-Sand. As a test result on the grain size distribution it results a similar curve to the normal conventional river sand.ThespecificgravityfortheM-Sandwasarrivedas 2.63 whichnearly equal to the Conventional River sand. More than 10 laboratory experiments were carried out for the testing of the characteristic of the M-Sand both for themortar and the concrete. The test results of the M-sand were compared with the normal conventional sand and the value obtained was even greater than the river sand. The M-Sand fineness was also studied in this journal and it satisfies theIS 383 code. Thus the testing results shows and it suggest the M-Sand material can be used as an optional material in replacement for fine aggregates that normallyused.

II. OBJECTIVES

- To determine the optimum percentage of rice husk ash for partial replacement ofcementto manufacture cement mortarbrick.
- To determine the mechanical properties of cement mortar brick casted with rice huskash

III. METHODOLOGY

III.1 General

This chapter consists of the experimental work done to study about the properties of river sand and m-sand mortarbricks. Thus this chapter also explains about the step by step working process of manufacturing ofbricks.

IV. MATERIALCOLLECTIONANDTESTING

IV.1 General

Cement, river sand, water, m-sand, rice husk ash were procured and tested in the laboratory, physical and chemical properties of the materials were found. The details of the materials are explained in this chapter.

IV.2 Cement

Ordinary Portland cement of 53 grade confirming IS 12269 was used in the experimental work. Table 4.1 shows the physical properties of cement.

Table 4.1 Physical Properties of Cement

S.NO	PROPERTY	CEMENT
1	Specific gravity	3.134
2	Bulk unit weight	1450 kg/m^3
3	Consistency	36%
4	Initial setting time	33 mins
5	Final setting time	10 hours

IV.3 comparison of physical properties of river sand and M- Sand

Table 4.2 Comparison of physical properties of river sand and M-Sand

S.NO	PROPERTIES	RIVER SAND	M-SAND
1	Specific gravity	2.67	2.63
2	Bulk unit weight	1692kg/m^3	1685kg/m^3
3	Fineness modulus	3.674	4
4	Uniformity coefficient (Cu)	4.05	4
5	Coefficient of Curvature (Cc)	1.77	1.77

IV.4 Rice husk ash(RHA)

An agro-waste is commonly generated in our locality. By giving an eco-friendly constructional product rice husk ash is more effective. It never plays an important role as a raw material for food production. It's a pozzolanic material having silicates as a major chemical contribution imparts strength to the brick. It can be used as a replacement material for the cement.

Fig 4.1 Rice Husk Ash (RHA)

V. MOULD PREPARATION

The mould which was used for the casting of bricks was made up of plywood and the size of the chamber brickmould is 230mmx100mmx75mm.

Fig.5.1 sample mould preparation

VI. ARRIVAL OF MIXPROPORTION

VI.1 Trial MixProportion

Initially by conducting consistency test for cement consistency value of 36% was obtained. By using this value initial water content as 10% was fixed.The mortar cubeswith 70.6 mm size werecasted with 1:3 and 1:2 ratioandtested in compressive testing machine by varying the water content of 10% and 12% to determine the Mix ratio for further study. 28 days compressive strength test results of 70.6 mm Cubes were tabulatedbelow.

Table 6.1 28 days compressive strength test results for river sand mortar cubes with 1:3 and 1:2ratio.

Sample	Mix ratio	water content (%)	compressive strength (N/mm^2)	Avg. compressive strength
1	1:3	10	48.95	46.41
2	1:3	10	43.73	
3	1:3	10	46.55	
4	1:3	12	38.52	37.05
5	1:3	12	35.71	
6	1:3	12	36.92	
7	1:2	10	31.70	32.37
8	1:2	10	33.70	
9	1:2	10	31.72	
10	1:2	12	29.30	30.3
11	1:2	12	31.70	
12	1:2	12	29.90	

From the above results the maximum compressive strength of 46.41 N/mm^2 for 1:3 ratios with 10% of water content was obtained. So Mix ratio 1:3 (1 proportion cement and 3 proportions sand) with 10% water content was used for further study.

VI.2 Mixproportion

To quantify the effects of M-sand by replacing fine aggregate, cement-mortar bricks were casted by varying the content of river sand from 0 to 100%. Bricks casted with M- sand show better results than River sand bricks. Hence M-sand is usedfor furtherstudy.

Table 6.2 Mix proportions of cement with varying percentage of Rice huskash

Mix name	Mix ratio	M-sand(%)	Cement (%)	Rice huskash (%)
MIX A	1:03	100	95	5
MIX B	1:03	100	90	10
MIX C	1:03	100	85	15
MIX D	1:03	100	80	20
MIX E	1:03	100	75	25
MIX F	1:03	100	70	30
MIX G	1:03	100	65	35
MIX H	1:03	100	60	40

VII. SAMPLETESTING

VII.1 General

The test specimens were casted in wooden mouldsof size (230mmx100mmx75mm)for various mix proportions for both types of sands (River sand and M-sand). The results obtained are tabulated in the following chapter.

VII.2 Compressive strength test

The test specimens were casted in brickmoulds of size (230mmx100mmx75mm) and tested in compression testing machine. The results obtained are tabulated below.

Table 7.1 Avg.28 day's compressive strength of Mortar bricks

Mix name	Mix ratio	M-Sand (%)	Cement (%)	Rice husk ash (%)	Avg. 28 days compressive strength (N/mm^2)
MIX A	1:3	100	95	5	13.97
MIX B	1:3	100	90	10	14.86
MIX C	1:3	100	85	15	12.46
MIX D	1:3	100	80	20	10.21
MIX E	1:3	100	75	25	7.7
MIX F	1:3	100	70	30	6.32
MIX G	1:3	100	65	35	5.34
MIX H	1:3	100	60	40	1.20

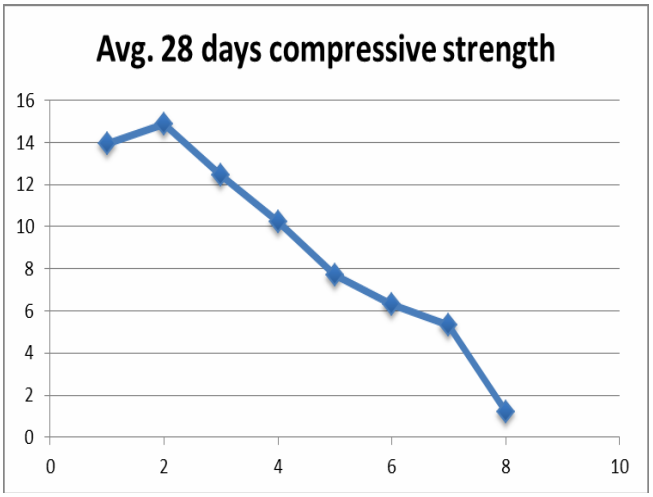

Fig7.2 Compressive strength of cement mortar bricks

From the above graph compressive strength of mortar bricks made with 100% replacement of M-sand and 10% replacement of rice husk ash (MIX-B)gives higher compressive strength compared to other mixes. But MIX-G(100% M-sand and 35% rice husk ash) gives compressive strength of 5.34 Mpa which is more than common building bricks.

VII.3 Water absorptiontest

For this test, the bricks were taken and it is immersed in water for a period of 24 hours. On completion of the duration, the bricks were subjected to weighing. The water absorption should not exceed 20% of the average weight of dry bricks.

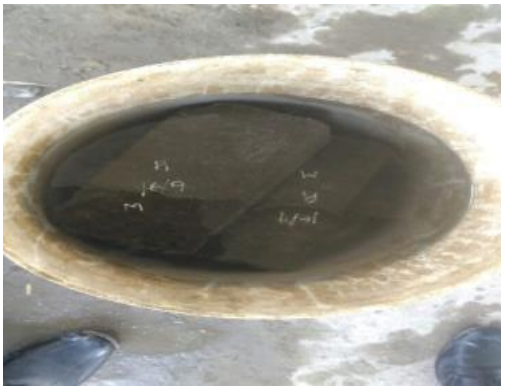

Fig 7.2 water absorption test on cement mortar bricks

Average water absorption value for 35% replacement of RHA is 10.34% which is less than the second class brick and satisfies the condition .For all sample the water absorption value is less than 20%.so it will not affect the strength and durability of the bricks.

VII.4 Soundness

In this test a clear ringing sound is produced when the bricks where strikes each other by hand. Total of 5 trials were carried out to test the soundnessofbricks. Out of five all the bricks show good soundness property.

Fig7.3Soundness test for cement mortar brick

VII.5 Impact test

In this test the bricks are allowed to fall from a height of 1 meter on ground (not hard surface). Good quality brick shouldn't break. In case, it breaks, it's better not to use for construction. All the samples were passed in this test.

VII.6 Hardness test

Hardness test is done to check hardness of brick.This is an indirect test to know its compressive strength and to know how well the brick is kilned. This is tested by using a sharp tools or finger nail and scratching against the brick surface. If there is no impression of the scratch on the brick surface, the brick is sufficiently hard and fit for use. All these bricks show good hardness property.

VII.7 Presence of SolubleSalts

Efflorescence is a fine, white, powdery deposit of water-soluble salts left on the surface of masonry as the water evaporates. A good brick shouldn't contain solublesalts in it. In this test bricks are immersed in water for 24 hrs and then allowed to dry completely. If any white or grey patches appear on the brick surface, then the brick contains soluble salts. All the sample bricks do not contain any presence of white or grey powdery on bricks.

VIII. RESULTS AND DISCUSSIONS

- The river sand and M-sand cement mortar cubes were made with 1:3 mix ratioof10% and 12% water content on combined weight of cement and sand. The optimum water content giving maximum compressive strength was finalized for manufacturing bricks. The water content fixed from the result was10%.
- By fixing the water content the cement mortars cubes were casted with 1:3 and 1:2 mixratios.
- By comparing the compressive strengths of 1:3 and 1:2 ratio mortars, compressive strength of 1:3 ratio cement mortar cube strength was higher than the compressive strength of 1:2 ratio cement mortar cube. Therefore 1:3 ratio was chosen for furtherwork.
- By replacing the cement with 35 percentage of rice husk ash, the average compressive strength achieved was 5.34 N/mm^2 which is more than common building bricks.
- The water absorption of MIX G was found to be 10.34% which satisfies the requirement of second
- Allthesampleshavepassedinthehardness test.
- All samples have passed the impact test.
- Five samples which have been immersed water showed no greypatches.

IX. CONCLUSION

The conclusion accomplished from theoretical and experimental study is given below. With the 35% replacement of RHA in cement content brick gives the compressive strength greater than the common building bricks.Up to 35 % of Rick husk ash in place of cement can be used. As the agro waste can be used as the replacement of cement so the brick is cost effective. These bricks can be used in construction as it passes all the tests related to bricks.

REFERENCES

1. Jamil.M et al (2016)," Physical and chemical contributions of Rice Husk Ash on the properties of mortar" Construction and Building Materials 128 (2016) 185–198.
2. Jamil M, Kaish A.B.M.A, Raman S.N, Zain M.F.M (2013), Pozzolaniccontributionof rice husk ash in cementitious system, Constr. Build. Mater. 47 (2013) 588–593.
3. Sutas .J, Mana.A(2012) " Effect of Rice husk ash to properties of Bricks" I-SEEC 2011, Proceedia Engineering vol 32(2012) pp.1061-1067.
4. IS: 2116 – 1980 (1998), "Specification for sand for masonry mortars",Bureau of Indian Standards, New Delhi, India.
5. IS 2386-1963 (part-III)"Determination of specific gravity, voids, absorption" Bureau of Indian standards,New Delhi,India.
6. PL. Meyyappan, K.Kumaran, M.Gopalakrishnan and E. Harikrishnan (2018), "Effect of glass fibers, flyash and quarry ash on Strength and Durability Aspects of Concrete – An Experimental Study", IOP Conference Series: Material Science and Engineering, doi:10.1088/1757-899X/396/1/012001.
7. PL. Meyyappan, K.Kumaran, M.Gopalakrishnan and E. Harikrishnan (2018), "Experimental Investigation on the Effect of Silica fume and Pumice stone in Developing Light Weight Concrete", IOP Conference Series: Material Science and Engineering, doi:10.1088/1757-899X/561/1/012064.
8. PL. Meyyappan, P. Amuthakannan, R. Sutharsan and M. Ahamed Azik Ali (2019), "Utilization of M-Sand & Basalt Fiber in Concrete: An Experimental Study on Strength and Durability Properties", IOP Conference Series: Material Science and Engineering, doi:10.1088/1757-899X/561/1/012035.

AUTHORS PROFILE

Mr. R. Sivasankar completed his M.E in Structural Engineering in College of EngineeringGuindy, Chennai in the year 2016. He completed his Bachelor of Engineering in Government college of Engineering, Tirunelveli under Anna University in the year 2013. He is working as Assistant Professor in Department of Civil Engineering at National Engineering college, Kovilpatti, Tamilnadu, India. He has published various quality papers in the reputed journals. His main thrust research area is concrete Technology.

Mr. R.. Sutharsan completed his M.E in Structural Engineering in Thiagarajar College of Engineering, Madurai in the year 2016. He completed his Bachelor of Engineering under Anna University in the year 2013. He is working as Assistant Professor in Department of Civil Engineering at Kalasalingam University, Tamilnadu, India. His main thrust research areas is Fiber reinforced concrete.