Investigation of Strength and Micro Structural Properties of Bricks And Paver Blocks Using RHA And WFS

Kartheeswaran.R[1] , Gowrishankar.R [2], Mohanaselvan.C [3], Raj Kumar.K[4]

[1]*Assistant Professor, Civil Engineering Department, V.S.B College of Engineering, Karur, Tamil Nadu, India.*

[2]*Assistant Professor, Civil Engineering Department, V.S.B College of Engineering, Karur, Tamil Nadu, India.*

[3]*Assistant Professor, Civil Engineering Department, V.S.B College of Engineering, Karur, Tamil Nadu, India.*

[4]*Assistant Professor, Civil Engineering Department, V.S.B College of Engineering, Karur, Tamil Nadu, India.*

kartheeswarankarthik@gmail.com**, **gowricivil@gmail.com**, **mohan.selvan79@gmail.com**, **k.rajkumaraccet@gmail.com

Abstract

Metal foundries use large amounts of the metal casting process. Foundries successful recycle and reuse the sand many times in a foundry and the remaining sand that is termed as foundry sand is removed from foundry. Waste Foundry sand (WFS) can be used in concrete to improve its strength and other durability factors. Blending of a large amount of waste material like Rice Husk Ash (RHA) is being done in large extents in the manufacture of cement and cementitious products. In this project Fine aggregate is replaced with 10, 12.5, 15, 17.5, 20, 22.5 and 25 % of foundry sand and cement is replaced with 10, 12.5, 15, 17.5 and 20% of RHA. Test results showed that there is 33% increase in compressive strength, 45% increase in split tensile strength and after replacing the cement and fine aggregates with 15% percentage of RHA and 20% of foundry sand. Hence RHA and Foundry sand can be safely used in concrete for durability and strength purposes.

Keywords: *Waste foundry sand, paver blocks, rice husk ash, micro structural properties, bricks*

1. Introduction

Molding sand is otherwise called as Foundry sand. Silica content in this sand is with very good quality and also having the uniform physical properties. The raw material for this foundry sand is ferrous and nonferrous metal [1]. Due to high thermal conductivity this sand is used in casting industries as a molding material. It can be generated by ferrous and non ferrous metal castings. The physical and chemical properties of foundry sand depend on the type of casting in an industry. Sand can be reused around 4 to 5 times and then sand should be recycled. Over 100 million tons of sand is used in metal casting industries [2]. Only 10 million tons of sand used by recycling process. The raw sand used for the casting industry should be high quality compared with construction sand. Clay bonded systems and chemically bonded systems are the two major types of binder systems used in alloy

industries [3]. Both the types of sands are suitable for use but both are having different physical and chemical characteristics.

Fig1. Foundry sand

Rice Husk Ash is a pozzolanic material since it have higher amount of silica content. RHA can be used as a partial replacement with cement in concrete [4]. Generally RHA can be used for High Performance Concrete.

Fig2. Rice Husk Ash

RHA can be replaced with cement upto 40% which will produce more or less equal to the compressive strength of the control mix.

2. Mix Design

Weight of water = 191.61 liters

Weight of cement = 383kg

Weight of fine aggregate = 594.59kg

Weight of coarse aggregate = 1242.58kg

Mix Ratio = 0.5:1:1.55:3.24

3. Compressive Strength

In this research the values of compressive strength for different replacement levels of foundry sand contents (10%,12.5%,15%,17.5%, 20%,22.5% and 25%) at the end of different curing periods (7,14,28 days) the variation of compressive strength with fine aggregate replacements at different curing ages respectively. compressive strength increases with the increase in foundry sand. compressive strength of concrete mixtures with 10%,12.5%,15%,17.5%, 20%,22.5% and 25% of foundry sand as sand replacement was higher than the control mixture at all ages and that the strength of all mixtures continued to increase with the age. The compressive strength increases by 33% when 20% of fine aggregate is replaced by foundry sand and 15% of cement is replaced by RHA at 28-days.

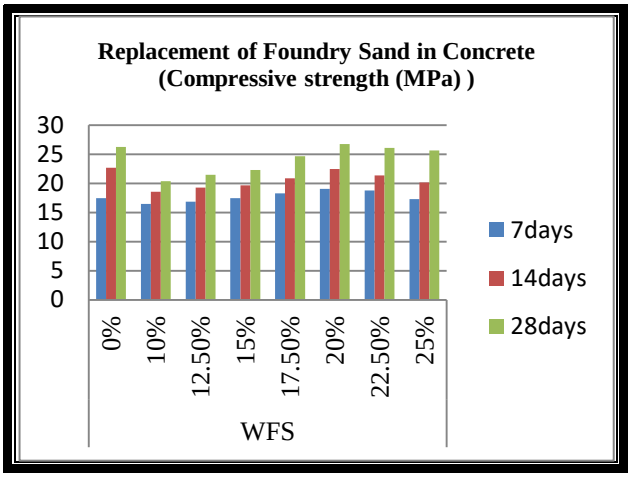

Figure: 3

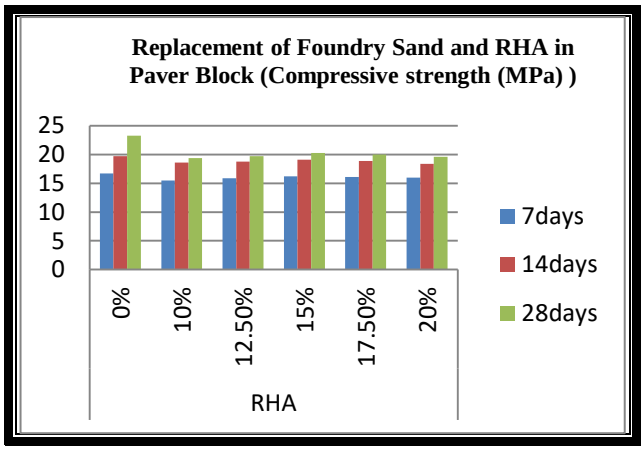

Figure: 4

4. Split Tensile Strength

The split tensile strength of the concrete including foundry sand depends on the percentage variation used. Various percentage replacements done with a constant w/c ratio 0.5. The replacement percentages are 10%, 12.5%, 15%, 17.5% and 20%. From these results it was observed that the split tensile strength of the concrete is increases with the increase in the percentage of foundry sand at 7, 14 and 28 days curing. The split tensile strength increases by 45% when 20% of fine aggregate is replaced by foundry sand and 15% of cement is replaced by RHA at 28-days.

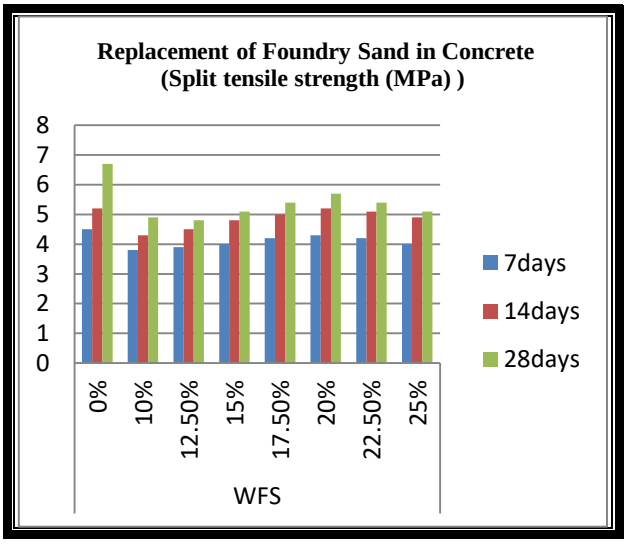

Figure: 5

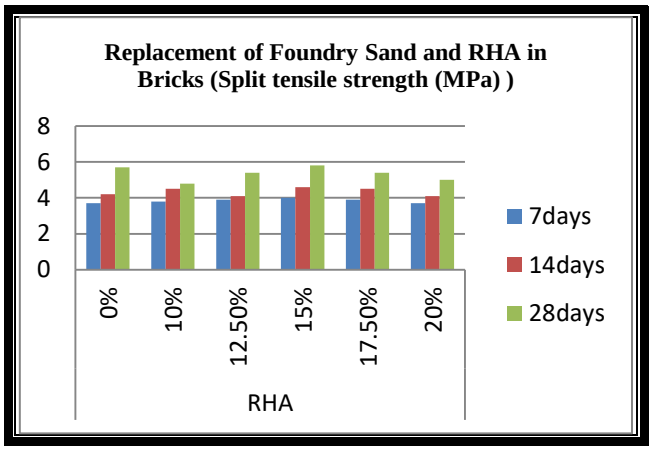

Figure: 6

5. Conclusion

From the work carried out in this project, it is observed that there is an increase in both compressive and split tensile strength when the replacement percentage for foundry sand is 20% in fine aggregate and 15% by RHA in cement. Hence it is planned to cast paver block and brick by replacing 20% of fine aggregate with foundry sand and 15% of cement with RHA. The compressive strength is increased by 33% when compared to ordinary mix without foundry sand at 28-days. Split Tensile Strength is increased by 45% with replacement levels of Foundry Sand with fine aggregate and cement with RHA. There was a drop in the compressive strength values beyond each 17.5% replacement of cement by RHA. It is also found that there was a drop in the compressive strength values beyond each 22.5% replacement of fine aggregate by foundry sand.

6.0 References

6.1 Journal Article

[1] Prasad M.L.V et al , "Eco-friendly fiber reinforced self compacting concrete for replacements of cement and natural sand with waste materials" , International Journal of Earth Sciences and Engineering 16(5), July 2016.
[2] Saveria monosi et al , "Used foundry sand in cement mortars and concrete production", The open waste Management Journal, 2010, 3, 18-25.
[3] Ankur C. Bhogayata et al , "Use of used foundry sand in concrete : A state of art review", International Journal of Research in Engineering and Technology Volume 03 Issue 02 Feb 2014 586-589.
[4] V.Saraswathy et al , " Corrosion performance of rice husk ash blended concrete", Elsevier Volume 21, Issue 8, August 2007.
[5] S.N. Raman et al ," High-strength rice husk ash concrete incorporating quarry dust as a partial substitute for sand", Construction and Building Materials 25 (2011) 3123–3130.
[6] Anita Rajor et al , "Influence of fungus on properties of concrete made with waste foundry sand ", Civ. Eng. April 2013.25:484-490.
[7] Rafat Siddique et al , "Micro-structural and metal leachate analysis of concrete made with fungal treated waste foundry sand", Construction and Building Materials 38 (2013) 94–100.
[8] Ana Paula da Silva Milani et al, "Physical, Mechanical, and thermal performance of cement-stabilized rammed earth–rice husk ash walls", J. Mater. Civ. Eng. 2012.24:775-782.
[9] Sivakumar Naganathan et al , "Properties of bricks made using fly ash, quarry dust and billet scale", construction and Building Materials 41 (2013) 131–138.
[10] R. Alonso-Santurde et al , "Recycling of foundry by-products in the ceramic industry: green and core sand in clay bricks", Construction and Building Materials 27 (2012) 97–106.
[11] Yogesh Aggarwal et al , "Strength, Durability, and Micro-structural Properties of Concrete made with Used-Foundry Sand (UFS)", Construction and Building Materials 25 (2011) 1916–1925.
[12] Godwin A. Akeke et al , "Structural properties of rice husk ash concrete", may 2013. vol. 3, no. 3 ISSN 2305-8269.
[13] M. Mahdi Khani et al , "The effect of rice husk ash on mechanical properties and durability of sustainable concretes ", International Journal of Civil Engineering. vol. 7, no. 2, June 2009.
[14] H. Merve Basar et al , "The effect of waste foundry sand (WFS) as partial replacement of sand on the mechanical, leaching and micro-structural characteristics of ready-mixed concrete" , construction and building materials 35 (2012) 508–515.
[15] Prof. Jayeshkumar Pitroda et al , "Used foundry sand: opportunities for development of eco-friendly low cost concrete", IJAET/Vol. IV/ Issue I/Jan.-March., 2013/63-66.
[16] Brijesh kumar et al , " Utilization of recycled wastes as ingredients in concrete mix" , ISSN: 2278-3075, Volume-2, Issue-2, January 2013 74.
[17] S.D.Nagrale et al , "Utilization of rice husk ash", (IJERA) ISSN: 2248-9622 vol. 2, July-August 2012.
[18] S.Dhanapandian et al , "An investigation on the effect of incorporation of granite and marble wastes in the production of bricks", Journal of Engineering and Applied Sciences, Vol. 4, no. 9, November 2009.