RECO BLOCK: SIGNIFICANCE OF REPLACING RICE HUSK ASH AS NATURAL FILLER IN ECOFRIENDLY RETAINING WALL BLOCK

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ABSTRACT

Retaining wall blocks are dry-cast mixtures of cement and aggregates which can withstand external subverting strength attributable to retained soils merely through its self-weight without internal reinforcement. The hydration between cement and moisture substantially liberates heat in retaining wall units and lead to rupturing. Therefore, the present study aims to replace cement partially with rice husk ash (RHA) due to its pozzolanic and cementitious nature for durability enhancement and ease of environmental impact. RHA is processed through burning of raw rice husk (RRH) at controlled temperature of 600°C. Rice husk ash particulates replacement was set at 10%, 20%, 30%, 40% and up to 50% by weight. Compressive strength test was conducted to gauge the targeted strength performance of 30 ± 5N/mm^2. Additionally, water absorption and corrosion resistance test tested at 100 minutes time intervals and age of 1, 7, 14, 21 and 28 days of water curing respectively. The results reported that admixture of 30% rice husk ash particulates was indicated to be the optimum replacement level to achieve higher compressive strength, lower water absorption value and better resistance to deterioration by acid solution. The formation of calcium silicate hydrate (C-S-H) reinforced bonding has significantly contributed to these improved properties.

Key words: Rice husk ash, Pozzolanic, Compressive strength, Water absorption, Corrosion resistance

INTRODUCTION

The structural coherence of a dry-stacked compression of retaining wall blocks is reached by integrating shear attachment to increase the strength capacity of the interface which requires a constant bonding configuration. Requirement for compressive strength, water absorption and corrosion tolerance are governed by *NCMA TEK 2-4 Specification for Segmental Retaining Wall Units* [1]. Apparently, compressive strength and water absorption are the crucial properties used to determine the strength performance of a concrete that exposed to freeze-thaw resistance. The factors contributed to freeze-thaw deterioration are temperature cycles, exposure conditions and moisture content of the block

units [2]. Therefore, it is essential to investigate the significance of partially replacing cement with RHA particulates in the fabrication of retaining wall blocks.

MATERIAL AND METHOD

Cement utilized in this experimental works is Lafarge Ordinary Portland Cement (OPC) Type I classified for general purpose. It contains of relatively high tricalcium silicate (C_3S) for excellent early strength development. RRH used in the present study was obtained from Teluk Intan, Perak. The RHA was produced by burning the RRH at controlled temperature of 600°C and properly stored. Chemical composition of RHA was characterized by Energy-dispersive X-ray Spectroscopy (EDX). Particle size of fine and coarse aggregates at 500μm and 700μm was kept constant to the mix proportion of the samples whereby the cement by weight replaced by RHA varies in the range of 10%, 20%, 30%, 40% and 50% respectively. A set of RRH samples was prepared as reference. All samples were water cured at ambient temperature for up to 28 days. A series of testing was conducted to establish a relationship between connected strengths defined by compressive strength, water absorption value tested at 100 minutes time intervals and corrosion resistance at age of 1, 7, 14, 21 and 28 days, accordingly.

RESULTS AND DISCUSSION

Compressive Strength (BS EN 12390-3)

Comparative study on inclusion of RRH and RHA as partial replacement of cement indicated that RHA-concrete shows higher compressive strength than RRH-concrete for all tested samples. Utmost compressive strength of 31N/mm^2 was reported for 30% cement replacement by RHA. This is caused by the reduced calcium hydrate content during cement hydration where the calcium silicate is released within tricalcium silicate (C_3S) and dicalcium silicate (C_2S) [3]. However, the strengths show a decreasing trend for both RRH-concrete and RHA-concrete with increasing of rice husk weight after 40%. This might be due to the increase of replacement with rice husk affect the primary product of hydration formed between cement and water. Therefore, the reduction of strength was significant.

Water absorption in acid solution (BS 1881-122)

The results of water absorption test conducted for 100 minutes with an intervals of 10 minutes were tabulated for samples subjected to water curing after 28 days. The results reveal that as percentage of replacement of rice husk particulates increases, the water absorption values for RRH-concrete consequently increase. However, the water absorption values for RHA-concrete decrease from 10% to 30% replacement weight of rice husk particulates. Rice husk particulates replacement of 30% by weight gave the lowest water absorption value for the RHA-concrete. The pozzolanic reaction has significantly reduced the porosity of this concrete by producing more C-S-H gel to fill the voids created between cement particles with the presence of moisture and thus resist the capillary action [4]. Therefore, it can be concluded the replacement of cement with rice husk particulates contributes to improvement in rate of water absorption of the concrete. Figure 1 shows the bonding of C-S-H in Reco-block characterized by

Field Emission Scanning Electron Microscope (FESEM) in 5.00kX and 2.50kX magnification, respectively.

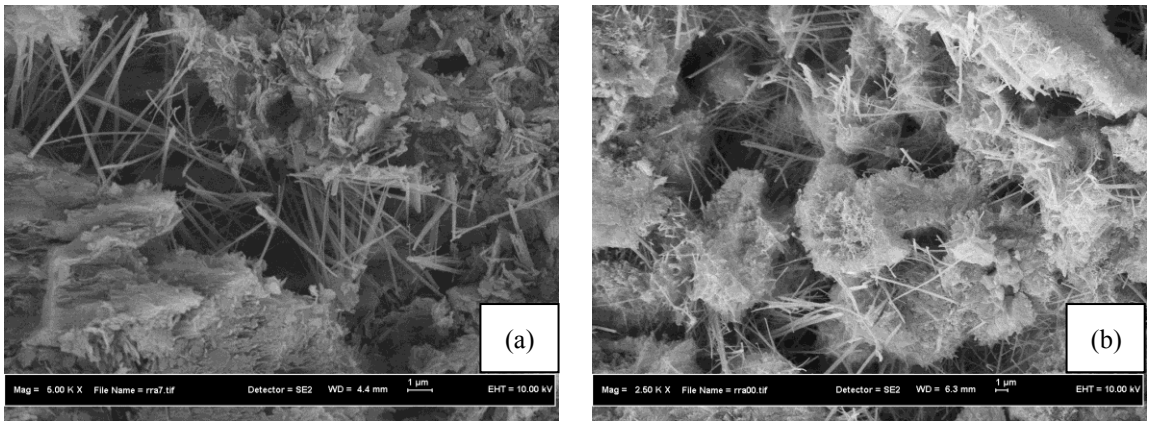

Figure 1. The bonding of C-S-H in Reco-block characterized by FESEM in (a) 5.00kX and (b) 2.50kX magnification

Effect of acids on RRH-RHA-concrete

Behaviour of ash proportion and period of exposure are the factors that indicated the effects of acids on RRH-RHA-concrete in this study. The average weight loss of RHA-concrete after 28 days of exposure in sulfuric and nitric acid were 6.9% and 11.7% respectively opposed to 18.8% and 23.4% for RRH-concrete. The improvement in invulnerable to sulfuric and nitric acid solution attack could be attributed to the cement replacement by RHA particulates which provides better pozzolanic reaction than RRH particulates [5].

CONCLUSION

Incorporating of 30% RHA particulates by weight to partially replace cement contributes to improved compressive strength at 31N/mm^2, lower rate of water absorption value and offers better resistance to deterioration by acid solution.

Acknowledgment: The authors wish to thank Universiti Teknologi Malaysia for funding the research project and UTM Research Management Centre (RMC) for managing the research activities under Vote QJ130000.2524.10H22

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