UNIVERSITI TEKNOLOGI MARA

THE COMPATIBILITY OF RICE HUSK ASH (RHA) AND SEWAGE SLUDGE ASH (SSA) AS SOURCE MATERIALS IN PRODUCING GEOPOLYMER MORTAR

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ABSTRACT

The aluminosilicate rich source materials are abundance and major component as binder materials in geopolymer. Higher silica and alumina content toward geopolymerisation refining is difficult to be done by single source materials that contain less aluminosilicate species. Typically, rice husk ash (RHA) was silica richness whereas sewage sludge ash (SSA) was alumina and silica richness. For this research, the combination of those richness alumina and silica materials was expected to overcome the problem by providing ultra-binding effect. In this study, the utilisation of RHA and SSA was done using replacement of RHA with SSA and the mix generated based on modified trial originally formulated by previous researcher. For this research the rice husk and sewage sludge were the main aluminosilicate materials whereas sand as a filler. Firstly, river sand was obtained from Concrete Laboratory, UiTM Shah Alam was prepared. The sieving analysis was performed to ensure the quality and uniformity. Meanwhile, the rice husk and sewage sludge waste were procured from rice milling and wastewater treatment plant by sunlight drying followed by underwent calcination and grinding process to produce rice husk ash and sewage sludge ash. Characterisation of the aluminosilicate materials was confirmed by particle size, chemical composition and microstructural properties wherein evaluated using laser particle analyser, X-Ray Fluorescence (XRF), X-Ray Diffraction (XRD), Fourier Transform Infrared (FTIR) and Scanning Electron Microscopy (SEM). Geopolymer mixes were developed by replacement of RHA with SSA so called binder based on percentage increment of 5%, 10%, 15% and 20% in six (6) different NaOH molarity 4, 6, 8, 10, 12 and 14 and sodium silicate. For this, the RHA to sand and binder to solution ratio were maintained at 1:2 and 1:1, respectively. Similarly, the sodium hydroxide to sodium silicate ratio also constant at the similar ratio of 1:1. The geopolymerisation in mortar was assessed in terms of density and compressive strength regards oven and air cured. Better strength was yielded at 15% SSA replacement and 10M of NaOH was marked 18.0 MPa and 16.0 MPa when the specimen was cured in oven and air, respectively. For the purpose of comparison, another two (2) molarities of 8M and 12M was proceeds with 10M which the one that gave the highest strength to compete and was proceeds another three (3) characterisation test namely flowability, flexural strength and water absorption test. In this vine, the 15% SSA replacement prepared with 10M NaOH was wined. Data from X-ray Diffraction (XRD) and Fourier Transform Infrared Spectroscopy (FTIR) was confirmed that the geopolymerisation reaction happened between RHA, SSA and alkaline solutions. The denser and homogenous matrix also visualised when the specimens subjected to SEM. Finally, RSM was used to obtain the relationship between factors (SSA replacement level and NaOH molarity) and responses (density, compressive strength, and flexural strength). The strong relationship was detected when the increment in SSA replacement level and NaOH molarity to RHA based geopolymer mortar. Compared to NaOH molarity the responses were much sensitive to that of SSA replacement level. Therefore, it can be concluded that the blended of RHA and SSA geopolymer mortar were much better than the mortar made with RHA only.

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