Engineering Properties of Ternary Cementless Blended Materials

Wei-Ting Lin[1,*], Kinga Korniejenko[2], Marek Hebda[2], Michał Łach[2], Janusz Mikuła[2]

[1]Department of Civil Engineering, National Ilan University, Yilan, Taiwan

[2]Institute of Materials Engineering, Faculty of Materials Engineering and Physics, Cracow University of Technology, Kraków, Poland

Received 23 January 2020; received in revised form 15 April 2020; accepted 08 June 2020

DOI: https://doi.org/10.46604/ijeti.2020.5201

Abstract

This study combined three by-products to fully replace cement as cementless blended materials without the need for an alkali activator. The feasibility of the cementless materials was assessed in terms of workability, mechanical properties, permeability, and microscopic properties. An innovation cementless blended material is consisted of desulfurized gypsum, water-quenched blast-furnace slag, and co-fired fly ash, resulting in a ternary mixture. The results were shown to perform well in terms of compressive strength, absorption, and chloride ion penetration. Scanning electron microscopic micrographs revealed that desulfurized gypsum accelerated hardening and improved the compressive strength through the formation of C-S-H and C-A-S-H gels produced by $Ca(OH)_2$, SiO_2, and Al_2O_3. The improvements in permeability can be attributed to the coating of gypsum particles by hydration products. Overall, our results confirm the efficacy of combining 3% gypsum, 60% slag, and 37% fly ash as the cementless composites with excellent strength and permeability.

Keywords: non-cement binder, co-fired fly ash, GGBS, chloride migration, green materials

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* Corresponding author. E-mail address: wtlin@niu.edu.tw

Tel.: +886-3-9137567; Fax: +886-3-9360125

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