

The Development of a Low Carbon Cementitious Material Produced from Cement, Ground Granulated Blast Furnace Slag and High Calcium Fly Ash

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Abstract : This research represents experimental work for investigation of the influence of utilising Ground Granulated Blast Furnace Slag (GGBS) and High Calcium Fly Ash (HCFA) as a partial replacement for Ordinary Portland Cement (OPC) and produce a low carbon cementitious material with comparable compressive strength to OPC. Firstly, GGBS was used as a partial replacement to OPC to produce a binary blended cementitious material (BBCM); the replacements were 0, 10, 15, 20, 25, 30, 35, 40, 45 and 50% by the dry mass of OPC. The optimum BBCM was mixed with HCFA to produce a ternary blended cementitious material (TBCM). The replacements were 0, 10, 15, 20, 25, 30, 35, 40, 45 and 50% by the dry mass of BBCM. The compressive strength at ages of 7 and 28 days was utilised for assessing the performance of the test specimens in comparison to the reference mixture using 100% OPC as a binder. The results showed that the optimum BBCM was the mix produced from 25% GGBS and 75% OPC with compressive strength of 32.2 MPa at the age of 28 days. In addition, the results of the TBCM have shown that the addition of 10, 15, 20 and 25% of HCFA to the optimum BBCM improved the compressive strength by 22.7, 11.3, 5.2 and 2.1% respectively at 28 days. However, the replacement of optimum BBCM with more than 25% HCFA have showed a gradual drop in the compressive strength in comparison to the control mix. TBCM with 25% HCFA was considered to be the optimum as it showed better compressive strength than the control mix and at the same time reduced the amount of cement to 56%. Reducing the cement content to 56% will contribute to decrease the cost of construction materials, provide better compressive strength and also reduce the CO₂ emissions into the atmosphere.

Keywords : cementitious material, compressive strength, GGBS, HCFA, OPC

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