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Influence of Superabsorbent Polymers on Properties of High-Performance Concrete with Active Supplementary Cementitious Materials of Nigeria

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Abstract

Concrete of strengths classes $\geq C55/67$ referred to as high strength or high-performance concrete (HSC/HPC) are noted to be generally of low water/binder (W/B), made from binary or ternary cements with silica fume (SF) being a necessary constituent, and often requiring internal curing. Non-availability and high cost of SF in most sub-Saharan Africa like Nigeria however makes HSC/HPC production in this region very difficult and hence the continued search for alternative supplementary cementitious materials (SCM) with good performance properties as constituents of ternary/binary cements in HPC. This study thereby examines the strength properties of metastable calcined clay (MCC) based HPC cured internally with superabsorbent polymer (SAP) 0.2–0.3% (by weight of binder (b_{wob})). HPC mixtures of varied MCC and Rice husk ash (RHA) contents containing two SAP grain sizes labelled ($SP_1 < 300 \mu m$ and $SP_2 < 600 \mu m$) were cast in 100 mm cubes and cured for varying ages (7, 14, 28 and 56 days) before testing. The hardened specimens were subjected to compressive strength and water absorption tests at the varied curing ages for the performance assessment of the binder types and SAP grain sizes in HPC with age. This study revealed the possibility of achieving Class 1 HPC ($50\text{--}75 \text{ N/mm}^2$) utilizing industry manufactured calcined clay and locally produced RHA in Nigeria. The compressive strength of HPCs increased as the curing age increases for both SCM type, SAP contents and grain sizes. RHA based HPCs however showed better strength performance at the

early ages than the MCC based. SAP addition in MCC based HPCs led to slight decrease in compressive strength as the SAP contents increased while the RHA based HPCs on the other hand, revealed slight increase in compressive strength with increase in SAP contents.

Keywords

Superabsorbent polymers Metastable calcined clay Rice husk ash High-performance concrete Strength properties

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Notes

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