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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 ≥ 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 μm and $SP_2$ < 600 μm) 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 (50–75 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



## Notes

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## References

1. ACI THPC/TAC: ACI defines high performance concrete, (the Technical Activities Committee Report (Chairman - H.G. Russell)). American Concrete Institute, USA (1999)Google Scholar
2. Aïtcin, P.C.: High Performance Concrete. Taylor & Francis e-Library, New York (2004)Google Scholar
3. British Standard Institution – BSI: Cement – composition, specifications and conformity criteria for common cements, BS EN 197: Part 1, London, BSI (2000)Google Scholar
4. BSI: Testing of fresh concrete, BS EN 12350: Part 1, Sampling, London (2000)Google Scholar
5. BSI: Testing of fresh concrete, BS EN 12350: Part 5, Flow Table Test, London(2000)Google Scholar
6. BSI: Testing of hardened concrete, BS EN 12390: Part 1, shape, dimension and other requirement for specimens and mould, London (2000)Google Scholar

7. BSI: Testing of hardened concrete, BS EN 12390: Part 2, making and curing specimen for strength tests, London (2000)Google Scholar

8. BSI: Testing of hardened concrete, BS EN 12390: Part 3, compressive strength test specimens, London (2002)Google Scholar

9. Busari, A.A., Akinmusuru, J., Dahunsi, B.: Response surface analysis of the compressive strength of metakaolin self-compacting concrete. Adv. Sci. Technol. Res. J. **13**(2), 7–13 (2019)CrossRefGoogle Scholar

10. Han, C., Shen, W., Ji, X., Wang, Z., Ding, Q., Xu, G., Tang, X.: Behavior of high-performance concrete pastes with different mineral admixtures in simulated seawater environment. Constr. Build. Mater. **187**, 426–438 (2018)CrossRefGoogle Scholar

11. Nduka, D., Ameh, J., Joshua, O., Ojelabi, R.: Awareness and benefits of self-curing concrete in construction projects: builders and civil engineers perceptions. Buildings **8**(8), 109 (2018)CrossRefGoogle Scholar

12. Neville, A.M.: Properties of Concrete, 5th edn. Pearson Educational Limited, Harlow (2012)Google Scholar

13. Olawuyi, B.J., Boshoff, W.P.: Compressive strength of high-performance concrete with absorption capacity of Super-Absorbing-Polymers (SAP). In: Proceedings of the Research and Application in Structural Engineering, Mechanics and Computation, Cape Town, South Africa, pp. 2–4 (2013)Google Scholar

14. Olawuyi, B.J., Boshoff, W.P.: Influence of SAP content and curing age on air void distribution of high-performance concrete using 3D volume analysis. Constr. Build. Mater. **135**, 580–589 (2017)CrossRefGoogle Scholar

15. Olawuyi, B.J., Boshoff, W.P.: Influence of superabsorbent polymer on the splitting tensile strength and fracture energy of high-performance concrete. In: MATEC Web of Conferences, vol. 199, p. 11004. EDP Sciences (2018)Google Scholar

16. Shetty, M.S.: Concrete Technology - Theory and Practice. S. Chand and Company Limited, New Delhi (2004)Google Scholar

17. Yang, J., Liu, L., Liao, Q., Wu, J., Li, J., Zhang, L.: Effect of superabsorbent polymers on the drying and autogenous shrinkage properties of self-levelling mortar. Constr. Build. Mater. **201**, 401–407 (2019)CrossRefGoogle Scholar

18. Zhou, D., Wang, R., Tyrer, M., Wong, H., Cheeseman, C.: Sustainable infrastructure development through use of calcined excavated waste clay as a supplementary cementitious material. J. Clean. Prod. **168**, 1180–1192 (2017)CrossRefGoogle Scholar

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