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Durability and strength assessment of copper slag concrete

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DECLARATION

I declare that this research report is my own work. It is being submitted for the degree of Masters of Science in Engineering to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other University.

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ABSTRACT

The results of laboratory studies conducted to evaluate the characteristics, strength and durability properties of concrete made with pulverized copper slag as partial replacement for Portland cement (PC) is presented. Concrete cube specimens were made with basic material proportions ranging from 0, 2.5, 5, 10 and 15% by weight of PC. For cement paste, test conducted were the initial and final setting times and the total heat of dissipation up to 60 hours of hydration. Fresh concrete mix was assessed for workability while, the compressive strength development of the pulverised copper slag admixed concrete was determined using three curing methods namely, ambient air, solar chamber and water curing. Moreover, for durability properties, oxygen permeability, water sorptivity, chloride conductivity and sulphate attack were performed to assess the long term performances of the concrete in harsh environmental conditions.

The experimental results indicate a significant drop in the compressive strength as the copper slag content increases for all curing methods. Moreover, for the control samples, the percentage decrease in the compressive strength for the 3 day curing for water cured sample, compared to the solar chamber and ambient air were respectively 31% and 28%. However, beyond 28 up to 90 days of curing, the water cured samples yielded a higher compressive strength, followed by the solar chamber and ambient air. This trend was similar for all percentage replacement of cement with the pulverized copper slag. For all percentage replacement of Portland cement with copper slag, the concrete disc samples generally performed better in all the three durability tests. The resistance of copper slag concrete to sulphate attack was better compared to the control.

DEDICATION

This work is dedicated to my friend Richmond Adu-Gyamfi, my family both nuclear and extended for their enormous support.

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STATEMENT OF ACHIEVEMENTS

Listed below are successful Journal and Conference papers submitted based on this research report

1. Boakye, D. M. & Uzoegbo, H. C. (2014). Durability and Strength Assessment of Copper Slag Concrete. Rilem International Workshop on Performance Based Specification and Control of Concrete Durability, Zagreb Croatia, 2014 (Accepted for publication in June, 2014)
2. Boakye, D.M, Uzoegbo, H.C., Mojagotlhe, N. & Malemona, M. (2014). Effect of Different Curing Methods on the Comprehensive Strength of Pulverized Copper Slag Concrete. Journal of Materials and Engineering Structures. pp. 11-21 (Accepted for publication on 21st April, 2014)
3. Boakye, D M. & Uzoegbo, H. C. (2013). Performances of Copper Slag as Partial Replacement of Sand and Cement in Concrete Technology. Conference on Advances in Cement and Concrete Technology in Africa, ACCTA South Africa, January 28-30, 2013.

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