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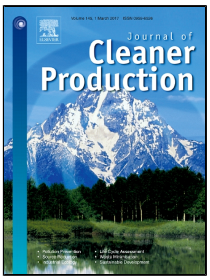

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Sustainable Use of Copper Slag in Self Compacting Concrete Containing Supplementary Cementitious Materials

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Abstract

Copper slag (CS) is an industrial by-product obtained in bulk quantity during matte smelting and refining process of copper metal. The current research is aimed to investigate the sustainable utilisation of CS as fine aggregates in Self Compacting Concrete (SCC) using fly ash (FA) and silica fume (SF) as Supplementary Cementitious Materials (SCMs). Total seven concrete mixes were cast in which one mix was binary blend containing 60 % ordinary portland cement (OPC), 40 % FA and 0 % SF with 100% sand and 0 % CS as control concrete. The other six mixes were ternary blends containing 60 % OPC, 30 % FA and 10 % SF with 0, 20, 40, 60, 80 and 100 % CS substitution. The fresh properties of SCC mixes were found to be escalating up to 100 % CS substitution. The maximum improvements in compressive and splitting tensile strength with respect to control were obtained as 20 % and 60 % CS substitution. Ultrasonic pulse velocity of all ternary SCC mixes was found to be increased, whereas initial surface absorption and sorptivity reduced in comparison to control concrete. The results of scanning electron microscopy and energy dispersive spectroscopy illustrate the formation of uniformly distributed and compact C-S-H gel in presence of CS after 120 d, with Ca/Si ratio ranging between 0.77 and 1.11. The SCC mix with 100 % CS substitution was found to be most economical with least consumption of embodied energy and emission of embodied carbon dioxide. This study