World Academy of Science, Engineering and Technology
International Journal of Structural and Construction Engineering
Vol:9, No:07, 2015

Fire Resistance of High Alumina Cement and Slag Based Ultra High Performance Fibre-Reinforced Cementitious Composites

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Abstract : Fibre-reinforced polymer (FRP) strengthened reinforced concrete (RC) structures are susceptible to intense deterioration when exposed to elevated temperatures, particularly in the incident of fire. FRP has the tendency to lose bond with the substrate due to the low glass transition temperature of epoxy; the key component of FRP matrix. In the past few decades, various types of high performance cementitious composites (HPCC) were explored for the protection of RC structural members against elevated temperature. However, there is an inadequate information on the influence of elevated temperature on the ultra high performance fibre-reinforced cementitious composites (UHPFRCC) containing ground granulated blast furnace slag (GGBS) as a replacement of high alumina cement (HAC) in conjunction with hybrid fibres (basalt and polypropylene fibres), which could be a prospective fire resisting material for the structural components. The influence of elevated temperatures on the compressive as well as flexural strength of UHPFRCC, made of HAC-GGBS and hybrid fibres, were examined in this study. Besides control sample (without fibres), three other samples, containing 0.5%, 1% and 1.5% of basalt fibres by total weight of mix and 1 kg/m³ of polypropylene fibres, were prepared and tested. Another mix was also prepared with only 1 kg/m³ of polypropylene fibres. Each of the samples were retained at ambient temperature as well as exposed to 400, 700 and 1000 °C followed by testing after 28 and 56 days of conventional curing. Investigation of results disclosed that the use of hybrid fibres significantly helped to improve the ambient temperature compressive and flexural strength of UHPFRCC, which was found to be 80 and 14.3 MPa respectively. However, the optimum residual compressive strength was marked by UHPFRCC-CP (with polypropylene fibres only), equally after both curing days (28 and 56 days), i.e. 41%. In addition, the utmost residual flexural strength, after 28 and 56 days of curing, was marked by UHPFRCC– CP and UHPFRCC– CB2 (1 kg/m³ of PP fibres + 1% of basalt fibres) i.e. 39% and 48.5% respectively.

Keywords : fibre reinforced polymer materials (FRP), ground granulated blast furnace slag (GGBS), high-alumina cement, hybrid, fibres
Conference Title : ICCSGE 2015 : International Conference on Concrete, Structural and Geotechnical Engineering
Conference Location : London, United Kingdom
Conference Dates : July 25-26, 2015