

Effects of Potential Chloride-Free Admixtures on Selected Mechanical Properties of Kenya Clay-Based Cement Mortars

Authors : Joseph Mwiti Marangu, Joseph Karanja Thiong'o, Jackson Muthengia Wachira

Abstract : The mechanical performance of hydrated cements mortars mainly depends on its compressive strength and setting time. These properties are crucial in the construction industry. Pozzolana based cements are mostly characterized by low 28 day compressive strength and long setting times. These are some of the major impediments to their production and diverse uses despite numerous technological and environmental benefits associated with them. The study investigated the effects of potential chemical activators on calcined clay- Portland cement blends with an aim to achieve high early compressive strength and shorter setting times in cement mortar. In addition, standard consistency, soundness and insoluble residue of all cement categories was determined. The test cement was made by blending calcined clays with Ordinary Portland Cement (OPC) at replacement levels from 35 to 50 percent by mass of the OPC to make test cement labeled PCC for the purposes of this study. Mortar prisms measuring 40mmx40mmx160mm were prepared and cured in accordance with KS EAS 148-3:2000 standard. Solutions of Na₂SO₄, NaOH, Na₂SiO₃ and Na₂CO₃ containing 0.5- 2.5M were separately added during casting. Compressive strength was determined at 2rd, 7th, 28th and 90th day of curing. For comparison purposes, commercial Portland Pozzolana cement (PPC) and Ordinary Portland Cement (OPC) were also investigated without activators under similar conditions. X-Ray Florescence (XRF) was used for chemical analysis while X-Ray Diffraction (XRD) and Fourier Transform Infrared Spectroscopy (FTIR) were used for mineralogical analysis of the test samples. The results indicated that addition of activators significantly increased the 2nd and 7th day compressive strength but minimal increase on the 28th and 90th day compressive strength. A relatively linear relationship was observed between compressive strength and concentration of activator solutions up to 28th of curing. Addition of the said activators significantly reduced both initial and final setting time. Standard consistency and soundness varied with increased amount of clay in the test cement and concentration of activators. Amount of insoluble residues increased with increased replacement of OPC with calcined clays. Mineralogical studies showed that N-A-S-H is formed in addition to C-S-H. In conclusion, the concentration of 2 molar for all activator solutions produced the optimum compressive strength and greatly reduced the setting times for all cement mortars.

Keywords : activators, admixture, cement, clay, pozzolana

Conference Title : ICCCC 2017 : International Conference on Cement and Concrete Chemistry

Conference Location : Istanbul, Türkiye

Conference Dates : October 26-27, 2017