Characterization of Libyan Metakaolin and its effects on the Mechanical Properties of Mortar

Ruben Paul Borg
Faculty for the Built Environment, University of Malta, Malta

Ahmed M. M. Hamed
Faculty for the Built Environment, University of Malta, Malta

Ramadan Edreis
Industrial Research Center, Tripoli, Libya

Ali M Mansor
Faculty of Engineering, University of Tripoli, Libya

Environmental concerns, stemming from high energy demands and CO_2 emission associated with cement manufacture, have brought about pressures to reduce cement consumption through the use of supplementary cementitious materials (SCMs). Besides addressing environmental concerns, the incorporation of SCMs in cement bound materials and concrete can modify and improve specific concrete properties. Metakaolin (MK) in an important SCM which can enhance the performance of cementitious composites through its high pozzolanic reactivity. This study was carried out to characterise the materials and to assess the effect of Libyan metakaolin (LMK) on the mechanical properties including the compressive strength of cement mortar. LMK was produced by calcining kaolinite clay at 700°C for 2 h. X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Differential Thermal Analysis / Thermo-Gravimetric analysis (DTA/TG) and Fourier Transform Infrared Spectroscopy (FTIR) were performed on the raw and calcined kaolinite powders. Seven mixes were prepared with different LMK replacement percentages (0 to 30%), by weight of cement, and a constant water binder ratio (w/b) of 0.5. The specimens were cured for 3, 7, 28, 56 and 90 days. At the end of each curing period, the specimens were tested for compressive strength. The results confirm the transformation of kaolinite clay into metakaolin and the pozzolanic reactivity of the produced LMK and conform to ASTM requirements in this respect. The study confirms that LMK could be effectively used in reducing cement content by up to 30% by weight without compromising compressive strength of the cement mortar.