

The Effects of Nanosized-Palm Oil Fuel Ash on Early Age Hydration of Hardened Cement Paste: The Microstructure Studies

ABSTRACT

Integration of cement-based products with nanosized-palm oil fuel ash as supplementary cementing material (SCM) amend its hydration's degree at early age phase and the microstructural groundworks are relevant to explain the findings. Hence, the present work investigates the microstructure properties of the hardened cement paste (HCP) incorporating nPOFA to study on the effect of nPOFA in cement hydration at an early age phase. An Ordinary Portland Cement (OPC) paste as a set of HCP blended with micro sized-palm oil fuel ash (mPOFA) (10-30%) and nPOFA (10-60%) were prepared and cured for 28 days. The microstructural examination of OPC, mPOFA and nPOFA cement pastes at 28 days curing age via Thermogravimetric (TG) analysis, X-Ray diffraction (XRD) analysis, morphology study and Fourier transform infrared (FTIR) spectroscopy analysis. In TG analysis, the relative weight loss of calcium hydroxide (CH) of nPOFA pastes is lower than OPC and mPOFA. Based on the CH peaks at $2\theta = 18.1^\circ$ and 34.0° in the diffractogram, it shows that nPOFA pastes give the low CH peaks compare to OPC and mPOFA pastes. In addition, the nPOFA pastes form the dense and compact microstructure of HCP compare to other pastes. Observations from FTIR analysis, nPOFA pastes display a high frequency of Si-O band due to the high rate of pozzolanic reaction. Overall, the findings confirmed the contribution of nPOFA in accelerating the rate of cement hydration and pozzolanic reaction as it reduced the amount of CH in the cementitious matrix.