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Mineralogical Properties of Kaolin and Metakaolin from Selected Areas in Nigeria and Its Application to Concrete Production

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Abstract: *Thermal treatment was applied on same mass of kaolin samples selected from Edo, Ogun, Ekiti and Ondo states of Nigeria at varying temperature of 500, 600, 700, 800, 900 and 1000°C for 30, 60, 120 and 180 minutes to obtain metakaolin, which is a complementary cementitious material in concrete production or as a geopolymer in Metakaolin based concrete. However, not all kaolin deposits can offer these characteristics. Virtual comprehensive dehydroxylation of the material was achieved at optimal calcination parameters of 800°C/60 min. The thermal, chemical, differential thermal (DTA), X-ray Diffraction Spectroscopy (XRD) and Fourier Transform Infrared Spectroscopy (FTIR) characterisations of raw kaolin samples were carried out. FTIR and XRD investigations revealed the presence of kaolinite in the raw samples. Metakaolin powder was used to substitute cement portion in the designed mix of 1:1.1:2.6 and prescribed mixes of 1:1.5:3 and 1:2:4 at 0, 5, 10, 15, 20 and 25% using varying water-cement ratios ranging from 0.4 to 0.6. Compressive strength of the cubes was determined at the curing days of 7, 28 and 90. Flexural strength of beams was also determined at curing days of 28, 90 and 180. Results from the DTA showed that kaolin can be calcined to get metakaolin at temperature ranging from 700°C - 850°C. The transition of the kaolinite to metakaolinite was established in all the samples after thermal treatment (calcination) by the FTIR. Results showed that the yield increased as the calcination temperature increased. For compressive strength, results showed that the highest strength was obtained at 15% Metakaolin replacement and 0.4 water-cement ratio. At this, Metakaolin concrete (Mk-C) gained strength rapidly, exhibiting approximately 43.6%, 41.8% and 41.9% increase over 7-day Mk-C strength by 28-days for 1:1.5:3, 1:2:4 and 1:1.1:2.6 mix ratios.*

Keywords: *Calcination, Compressive strength, Fourier Transform Infra-red Spectroscopy, Flexural strength, Scanning Electron microscopy, X-ray diffraction spectroscopy*