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Investigating the effects of using different types of SiO2 nanoparticles on the mechanical properties of binary blended concrete.

ABSTRACT

The aim of this study was to assess the effects of two different types of SiO2 nanoparticles (N and M series) with different ratios on the workability and compressive strength of developed binary blended concretes cured in water and lime solution as two different curing media. N and M series SiO2 nanoparticles with an average size of 15 nm were used as obtained from the suppliers. Fresh and hardened concretes incorporating 0.5%, 1.0%, 1.5% and 2.0% of N and 2% of M series nanoparticles with constant water to binder ratio and aggregate content were made and tested. Fresh mixtures were tested for workability and hardened concretes were tested for compressive strength at 7, 28 and 90 days of curing. Fresh concrete test results showed that the workability of binary blends was reduced in the presence of both types of SiO2 nanoparticles. Hardened concrete test results revealed that the optimal replacement level of cement by N series of SiO2 nanoparticles for producing concrete with considerably improved strength was set at 1.0 wt.% after curing in water. However, the ultimate strengths of binary blended concretes were gained at 2.0 wt.% replacement of cement by both series after curing in lime solution. It is concluded that SiO2 nanoparticles play significant roles in mechanical properties of concrete by formation of additional calcium silicate hydrate gel during treatment, which played an important role in raising highly the compressive strength of binary blends. The current study sheds light on the implications of nanotechnology in nano-engineering of concrete.

Keyword: Nano-structures; Mechanical properties; Microstructures; Strength