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Cement-Based with Partial Replacement of Nano-Silica for Improvement in Compressive Strength

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Abstract
This study aims to utilize nano-silica in cement paste to improve the strength of hardened cement-based materials, and to determine the most significant percentage of addition based on improvement in compressive strength as well as to relate it with formation of hydration products. Nano-silica used had been synthesized from rice husk ash (RHA) by precipitation method. The synthesized powder consists of ~ 99% amorphous silica particles in the size range of 74 nm to 93 nm. Nano-silica had partially replaced some amount of cement in percentage of 0%, 1%, 3% and 5%. At each curing duration of 7 and 28 days, the hardened cement-based samples were collected and characterized through compression test and XRD analysis. Significant increments were observed in compressive strength of cement-based materials upon the addition of nano-silica. This study found that addition of 3% nano-silica resulted in the highest improvement in compressive strength compared to the other samples with and without addition of nano-silica throughout the curing duration. Addition beyond this value resulted in the significant decrement in compressive strength at all curing duration. Meanwhile, XRD analysis indicates the presence of hydration products such as Ca(OH)2 and C-S–H at different intensities. Upon addition of nano-silica, the decrement in peak intensity of Ca(OH)2 and increment in peak intensity of C-S–H were obvious which maximised at 28 days of curing. This indicates the presence of nano-silica promotes hydration reaction and produce more hydration products which responsible to a significant improvement in compressive strength of cement-based samples at all curing duration.

Author Keywords
Cement-based sample; Compressive strength; Nano-silica

Index Keywords
Cements, Compression testing, Curing, Hardening, Hydrated lime, Hydration, Particle size analysis, Precipitation (chemical), Silica, X ray diffraction; Cement based material, Cement paste, Cement-based, Cement-based sample, Hydration products, Nano Silica, Partial replacement, Peak intensity, Synthesised, XRD analysis; Compressive strength

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