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Fiber-reinforced alkali-activated concrete: A review

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ABSTRACT

Alkali-activated materials (AAMs) received broad recognition from numerous researchers worldwide and may have potential applications in modern construction. The combined use of AAM and steel fibers are superior to typical binder systems because the matrix and fibers exhibit superior bond strength. The results obtained by various authors have shown that good dispersion of the fibers ensures good interaction between the fibers and the AAM matrix. The tensile strength of FR-AAC is superior to that of Ordinary Portland cement (OPC)-based materials, with the addition of silica fume (SF) being particularly remarkable. However, the tensile strength of fiber-reinforced alkali-activated concrete (FR-AAC) decreases with increasing fiber length. The bond strength increases with the increasing grade of concrete, the roughness of interface, and the solution's strength activated by alkalis. Regardless of fiber type, AAC's modulus of elasticity is linearly correlated with compressive strength. Fibers can affect the modulus of concrete due to the stiffness of the fiber and the porosity of the composite. Poisson's ratio for AAC corresponded to the ASTM C469-14 standard (about 0.22) and decreased to about 0.15–0.21 with silica fume addition. There are limited resources for the experimental Poisson's ratio and it is only estimated using the predictive equations available. Therefore, it is necessary to conduct additional experimental studies to estimate Poisson's ratios for FR-AAC composites. Retention of 59% and 44% in flexural strength during exposure at 800 °C and 1050 °C was observed in the FR-AAC stainless steel composite, and the chopped alumina fibers achieved higher yield strength at these temperatures. For FA-based AAC mortars with 1% SF with a hooked end, activated with a solution of NaOH and sodium silicate, an increase in the number of bends increased the bond strength, load pull-out and maximum pull-out strength. Autogenous shrinkage and drying shrinkage increase with higher silicate content, while shrinkage decreases with higher NaOH concentration. Relatively little research has been completed on FR-AAC in terms of durability or different environmental conditions. In addition, trends of development research toward the broad understanding regarding the application possibilities of FR-AAC as appropriate concrete materials for developing robust and green concrete composites for modern construction were extensively reviewed.

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