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A multi-criteria evaluation and optimization of sustainable fiber-reinforced concrete developed with nylon waste fibers and micro-silica

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Abstract

Nylon waste fibers similar to new nylon fibers possess high tensile strength and toughness; hence, they can be used as an eco-friendly discrete reinforcement in high-strength concrete. This study aimed to analyze the mechanical and permeability characteristics and life cycle impact of high-strength concrete with varying amounts of nylon waste fiber and micro-silica. The results proved that nylon waste fiber was highly beneficial to the tensile and flexural strength of concrete. The incorporation of a 1% volume of nylon waste fiber caused net improvements of 50% in the flexural strength of concrete. At the combined addition of 0.5% volume fraction of nylon fiber and 7.5% micro-silica, splitting tensile and flexural strength of high-strength concrete experienced net improvements of 49% and 55%, respectively. Nylon fiber-reinforced concrete exhibited a ductile response and high flexural toughness and residual strength compared to plain concrete. A low volume fraction of waste fibers was beneficial to