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Microstructure related mechanical behaviors of short-cut super-fine stainless wire reinforced reactive powder concrete

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Abstract:

Short-cut super-fine stainless wire (SSSW) with super-fine diameter and high aspect ratio is used to reinforce reactive powder concrete (RPC). The mechanical behaviors of SSSW reinforced RPC (SSSWRRPC) cured at different regimes are investigated under different loading conditions. The calculation models of flexural strength and toughness of SSSWRRPC are established based on the microstructure analysis, the composite theory, the expression of bond strength between SSSWs and RPC matrix, and the effective coefficient of SSSWs numbers. The results demonstrate that, by incorporating only 0.5 vol. % of SSSW, the mechanical strength and toughness of RPC has been significantly increased. The 1.5 vol. % of SSSW can increase the flexural strength and fracture energy 103.2% and 442.2% respectively. The reinforcing effect of SSSWs in aspect ratio of 500 and diameter of 20 μm is superior to that of SSSWs in aspect ratio of 1250 and diameter of 8 μm. The improvement of mechanical behavior is closely related to curing condition. The microstructure analysis indicates that the strengthen effect of SSSW on RPC results from the extensive reinforcing network, the inhibition on micro-cracks development and the pull-out, contortion and stripping of SSSWs under loading.

Key words: Reactive power concrete; Short-cut super-fine stainless wire; Fiber reinforcement; Mechanical properties; Flexural toughness; Microstructure.