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Utilization Of Water Treatment Sludge to Develop Self-Healing Concrete

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Extended Abstract

Prof. Zhuge will introduce some recent research progress on utilisation of drinking water treatment sludge (DWTS) into green concrete products, especially making new self-healing concrete sewage pipes, which offers an economical and environmentally friendly way to manage stockpiled sludge. The traditional DWTS management method, disposing of sludge in landfill sites, poses a critical environmental and economic concern due to a significant increase in sludge amount and disposal cost. In this presentation, the feasibility of reusing DWTS as sand, cement replacement is investigated as well as precursor for alkaline-activated material. Based on the microstructural analysis and advanced nanoindentation method, it was found that the high aluminium content in DWTS was incorporated into C-(A)-S-H gel; the original 'Al-minor' C-(A)-S-H gel in pure cement paste was converted to 'Al-rich' C-(A)-S-H gel. Also, DWTS promoted the formation of aluminium-bearing hydrates, such as ettringite and calcium aluminate hydrates (C-A-H).

An innovative capsule containing a blend of DWTS and calcium hydroxide ($Ca(OH)_2$) is introduced as a sustainable healing agent for sealing concrete cracks. Experimental results show that cracks with an initial width of 400 μm were fully healed after 7 days of water curing, over 90% recovery in watertightness, and a 73% increase in compressive strength after 28 days. Subsequent incorporation of SAPs extended the healing limit to 800 μm, with rapid early-stage closure. The results show significant improvements in compressive strength and recovery of water permeability in the healed specimens.