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Structural analysis and mechanical behavior of cement mortars with valorisation by drinking water treatment sludge as partial replacement

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ABSTRACT

The generation of sludge is a by-product of drinking water production. This study explores using alum sludge (AS) in construction materials as a substitute for cement in proportions of 5%, 10%, 15%, 20%, and 25%. Although alum sludge is not a natural pozzolan based on its chemical composition, it can be classified as a Class N pozzolanic material, making it suitable for replacing cement in concrete. Experimental results show that a 5% substitution is the optimal rate for replacing cement with sludge. XRD and Scanning electron microscopy–energy dispersive spectroscopy (SEM–EDS) analyses of the alum sludge–cement mortars identified the formation of hydrated compounds like portlandite ($Ca(OH)_2$) and calcium silicate hydrate (C–S–H). After 28 d of curing, all sludge mortars achieved compressive strengths that meet the standards for building materials.

Keywords: Reuse; Alum sludge; Mortars; Construction materials; Compressive strength

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