DEVELOPMENT AND PERFORMANCE OF SELF-HEALING BLENDED CEMENT GROUTS WITH MICROENCAPSULATED MINERAL AGENTS

ABSTRACT

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Suspension grouts can find use in a plethora of infrastructure applications where the grading of concrete prohibits its use. Primarily grouting has been performed with aqueous cement suspensions. Nevertheless the well-established use of cement faces sustainability and durability challenges. The latter is further exacerbated by the remote positioning of these installations prohibiting *in situ* access and repair. Therefore the development of effective materials which are sustainable and persistent over the lifetime of the installation becomes essential. To a certain degree compositional enhancement of cementitious binders can alleviate these caveats by postponing the effects of damage. Nonetheless it is not a panacea. An alternative conception recently emerged to extend material viability, is intrinsic or engineered crack-and damage-healing. In fact cementitious materials have been known to exhibit self-healing behaviour under certain conditions and thus different strategies have been proposed to enhance and consolidate that effect. The objective of this research was to induce and enhance that intrinsic physical response to deterioration in grouting materials through compositional enhancement and incorporation of mineral agents enclosed in microcapsules. Initially the autogenous healing capacity of cementitious blends was assessed and the contribution of compositional variation through direct mineral addition was scrutinized. Age at the time of cracking was considered in particular. Results indicated that the adoption of supplementary cementitious materials and mineral additives enhanced crack recovery. The potential of these systems to recover mechanical performance as well as transport properties was demonstrated. Subsequently, three different shell materials were investigated and assessed as potential microencapsulation systems for the delivery of healing agents; polyurethane, urea-formaldehyde and silica; focus was put on mineral based healing agents. Smooth spherical microcapsules of 20-100μm in diameter were produced with different shell materials; however only polyurethane could be regarded suitable for the delivery of a mineral agent. Thus, polyurethane microcapsules were prepared as carriers of a silica compound and embedded in the cement matrix. These ruptured upon stress build-up and released the enclosed silica compound which reacted with the calcium hydroxide in cement producing a C-S-H gel that healed the cracks. The results demonstrated the significant potential of mineral precursors as healing materials delivered as part of a microcapsule system.