

Evaluation of the compatibility of modified encapsulated sodium silicate for self-healing of cementitious composites

ABSTRACT

Healing agent carriers play a significant role in defining the performance of the autonomous self-healing system. Particularly, the ability to survive during the mixing process and the release of the healing agent when cracks occur without affecting the mechanical properties of the cementitious composite. Up to now, these issues are still a concern since glass capsules are unable to survive the mixing process, while some types of microcapsules were reported to cause a decrement in strength as well as limited strength recovery. Therefore, this study was twofold, addressing the surface treatment of polystyrene (PS) capsules and the evaluation of the compatibility of the modified capsules for cement-based applications. Secondly, assessing the healing performance of modified PS capsules in cementitious composites. Furthermore, the study also evaluates the potential healing performance due to the synergic effect between the encapsulation method and the autogenous self-healing mechanism. The investigation was carried out by measuring the changes in the pH of pore solution, FTIR analysis, survival ratio, and bonding strength. For self-healing assessment, the compression cracks on the cement paste were created at an early age and the strength recovery was measured at the age of 28 and 56 days. To identify the chemical compounds responsible for the healing process, SEM-EDX tests were conducted. Moreover, the effect of silica fume (SF) on bonding strength and self-healing was also evaluated. Based on the results, the modified PS capsules by roughing approach showed promising performance in terms of survivability, bonding, and recovery. The modified PS capsule increased the strength recovery by about 12.5–15% for 100%OPC and 95%OPC + 5%SF, respectively. The finding observed that the combining of modified PS capsules and the inclusion of SF gave high strength recovery of about 20% compared to 100%OPC without capsules. Thus, the modified PS capsule has a good potential for self-healing of cementitious-based applications.

Keyword: Self-healing; Modified polystyrene capsule; Sodium silicate; Silica fume; Autonomous; Autogenous; pH; FTIR; SEM; Strength recovery; Surface treatment