

Impact of physical adsorption on chloride binding capacity in alkali-activated materials

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Abstract

Alkali-activated materials (AAMs) are a group of binders that were discovered about 80 years ago and have recently attracted considerable interest due to their low carbon emissions compared to Portland cement (OPC). AAMs are based on an aluminosilicate powder activated by an alkali activator, generally based on Na^+ and/or K^+ . The binders have shown promising properties in terms of chloride diffusion prevention thanks to their low porosity, but the contribution of chloride binding capacity has not yet been determined.

In a classical OPC system, the precipitation of Friedel's salt (FS) and Kuzel's salt (KS) can reduce chloride diffusion by withdrawing Cl^- anions from the pore solution in stable chemical bonds. In addition, the C-S-H gel contributes to a small extent by physical adsorption of Cl^- anions on the gel surface. In the case of AAMs, specific phases are not present as a result of chloride interaction and the chemical binding capacity is mainly loaded by hydroxalite and minor AFm phases, which show better affinity to CO_3^{2-} and SO_4^{2-} , and thus are not stable enough to justify the detection of bound chloride. Therefore, for understanding reduced chloride diffusion in AAMs, the physical binding of chloride to the C-A-S-H and N-A-S-H gel surfaces seems to play a crucial role, as well as pore refinement.

The aim of the study was to investigate chloride binding capacity of alkali-activated binders based on fly ash and blast furnace slag after saturation in 0.5M NaCl solution. The total chloride content was estimated as free chloride content, chemical bound on AFm phases and physical bound on C-A-S-H/N-A-S-H gel surface through XRD and SEM/EDS.