Anions uptake by calcium silicate hydrates: influence of type of counter-ions and temperature

G. Plusquellec, I. Pochard, A. Nonat
ICB, UMR 6303 CNRS - Université de Bourgogne, 9 avenue Alain Savary, 21078 Dijon Cedex

gilles.plusquellec@u-bourgogne.fr

Abstract

The main phase of hydrated Portland cement is calcium silicate hydrate (C-S-H), which confers to the material its mechanical properties. The interactions between C-S-H and anions are an important issue mainly from the point of view of durability of cementitious materials. For example, chlorides intervene in the corrosion of the armatures of reinforced concrete, and the uptake/release of sulfate by C-S-H may cause expansion or cracking of the material (by the formation of delayed ettringite).

The aim of this study is to investigate quantitatively the adsorption of anions by C-S-H and the involved mechanisms. Adsorption isotherms and electrical properties at the surface/solution interface have been measured after adding different salt in C-S-H suspensions of different Ca/Si ratios. Different anions (chloride, nitrate and bromide) and counter-ions (calcium, potassium and sodium) have been used.

It was found that uptake of anions by C-S-H is made through the surface adsorption of Calcium. Indeed, the negative surface charge of C-S-H (induced by the ionization of the silanol sites) can be overcompensated by Ca^{2+} cations. Thus, anion uptake only occurs if Ca^{2+} is present in a sufficient concentration in the equilibrium solution. It has also been found that two chloride ions are adsorbed per calcium. However, the type of anion could also have an influence on the adsorption of calcium at the surface of the C-S-H, then affecting the anion adsorption. A temperature study (5, 23, and 40°C) has also been done to probe the influence temperature on the anion uptake.