

## Uptake of ions by C-S-H

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Calcium silicate hydrates (C-S-H) are the main solid phase present in hydrated cements, its composition changes depending on the solution composition. The silica chain length in C-S-H increases with the silicon concentration and the calcium content in the interlayer space with the calcium concentrations. Other earth alkaline and alkaline cations as well as aluminium and iron can be present in different sites in C-S-H depending on the Ca/Si ratio.

At low Ca/Si ratios, silicon in the bridging position can be replaced by four-fold coordinated aluminium. At all Ca/Si ratios approximately 10% of the aluminium is present as penta-coordinated,  $Al_V$ , while at Ca/Si >1 hexa-coordinated aluminium,  $Al_{VI}$ , becomes important. Aluminium uptake in C-S-H increases strongly at higher aluminium concentrations in the solution, while higher pH values decrease aluminium uptake. Similarly, also iron(III) and iron(II) uptake depend strongly on the dissolved iron concentrations.

Sodium and potassium are taken up preferentially at low calcium concentrations to compensate the negative surface charge of C-S-H and thus by low Ca/Si C-S-H as present in e.g. in Portland cements blended with fly ash or silica fume. The presence of sodium and potassium does not significantly change the structure of C-S-H but at high concentrations a shortening of the silica chain length has been observed. At constant Ca/Si ratio, more alkalis are bound at higher pH than at lower pH values, as high pH values lower the calcium concentrations and thus the competition with  $Ca^{2+}$ .