

Early stages of aluminosilicate glass dissolution

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Defining the activity of aluminosilicate glasses has, for a long time, challenged the cement research community. This has become an increasingly important property to assess as the cement industry seeks to reduce its CO₂ emissions by diluting the Portland cement fraction of concrete binders with Supplementary Cementitious Materials (SCMs), which are mostly aluminosilicate based. These substrates, such as fly ash, are activated by alkaline solutions and the rate of this activation is the basis for the rate of reaction product formation and binder strength development so understanding hydration rate offers an important materials selection tool.

To quantify the reactivity of SCMs during early hydration, the initial dissolution profiles in a range of activating solutions have been analysed. Using a closed system reactor, the sample was exposed to a continuously stirred activating solution, under nitrogen atmosphere, for a period up to 3 hours.

Solution analysis and apparent dissolution rate constant calculations appear to agree with previous works performed on similar materials [1-3]. In all dissolution profiles, however, Ca shows an initial maximum in the first 30 minutes of exposure to the activating solution, while Al and Si show a behavior that is characteristic of steady state dissolution. Enhanced early Ca release from glasses has been shown before in other systems. Surface compositional profiles measured on a soda-lime-silica glass [4] are consistent with the release and re-absorption profiles obtained from solution analyses.

The trends observed for the aluminosilicate glasses fall within a period that is too short to be compared with previous literature reports of aluminosilicate dissolution studies as the main interest has been the long term dissolution profiles. This fast initial Ca release and subsequent re-adsorption on the aluminosilicate surface may be significant in the early hydration reactions of a blended cement system. This presentation discusses its influence on the later and thus overall reaction kinetics of dissolution.

[1] Hamilton, J.P. *et al* (2001). *Geochimica et Cosmochimica Acta*, **65**, 3683-3702. [2] Hellmann, R. (1995). *Geochimica et Cosmochimica Acta*, **59**, 1669-1697. [3] Oelkers, E.H. *et al* (2009). *Reviews in Mineralogy & geochemistry*, **70**, 87-124. [4] Hench, L.L. *et al* (1978). *Journal of Non-Crystalline solids*, **28**, 83-105.