

Abstract

The flowability of a cement paste can be increased significantly by addition of superplasticizers SP's. The mechanism of cement particle dispersion depends on the type of SP used. Sulfonated superplasticizers induce negative zeta potentials on cement particles, allowing dispersion by electrostatic forces. A polycarboxylate based polymer was determined as the most effective SP. Here, the dispersing capabilities were not attributed to electrostatic forces but rather the coating of cement particles, making them slightly hydrophobic, and thus to a degree water expelling. This mechanism of action was observed to retard the hydration rate of the cements and the achieved flowability could be maintained for longer times i.e. reduced slump loss.

The Cement/Colloidal Nano-Silica (CNS) system was investigated. The CNS particles were shown to preserve their integrity during the hydration process, in spite of the high alkalinity. The high monomeric silica activity resulting from the very clinker dissolution responsible for the alkalinity, suppresses CNS dissolution. The significant acceleration of the initial hydration rate of Alite and Belite pastes observed upon CNS addition, suggests a rapid Calcium-Silicate-Hydrate C-S-H formation on active CNS surfaces to cause the effect.

The products formed during Alite and Belite hydrations are not identical. The differences observed in the spectral signatures for C-S-H spectra is attributed to that shorter Si-O-Si oligomers dominate in the former whereas longer chains produce the latter.

The presence of a polycarboxylate SP retards the evolution of spectral signatures related to C-S-H gel formation in both Alite and Belite pastes. This effect can to some extent be overcome by the addition of CNS to the clinker/SP mix. The effects upon SP and CNS additions observed using vibrational spectroscopy and quantum chemistry is consistent with the understanding based on rheology measurements on fresh cement pastes.