Preliminary Development in the Synthesis of Alumina-acrylic Polymer Nanoparticles for Immobilizing Chloride Ion Tranport in Concrete

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Restricitng the diffusion of chloride ions from reaching the steel reinforcements in concrete structures is an effective method for preventing corroision Therefore, there is significant research put into ways to increase the chloride binding capacity of concrete. Nano-alumina additives are of increasing interest as they have previously shown to successfully chemically bind free chloride ions. Even so, optimal concentrations of nanoalumina are not well established. This is due to the propensity of nanoparticles to agglomerate into clusters at high concentrations which lowers the specific area for binding This research seeks to avoid this problem by encapsulating the particle within a semipermeable polymeric nanogel layer.

The encapsulation process involved radiolysis of polyacrylic acid (PAA) in an aluminum chloride aqueous solution by a high energy (11 MeV) electron beam. Dynamic Light Scattering (DLS) measurements established that the hydrodynamic radius of the Al-PAA nanoparticles is tunable by varying irradiation conditions (dose rate, dose, energy, solution chemistry and temperature). The nanogels also had a significantly smaller hydrodynamic radius (30-40 nm) than bare alumina nanoparticle clusters (200 nm) indicating improved dispersion. This is confirmed by Zeta potential measurements. The nanoparticles were characterized by Fourier Transform IR Spectroscopy (FTIR}, X-ray Diffraction (XRD) and Transmission Electron Microscopy (TEM)).