Formation of cementitious colloids in pore solution of cementitious materials

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In Japan, cementitious materials are used as engineered barriers at low-level radioactive waste disposal facilities with the expectation that they will restrict the migration of radionuclides over the long term. The two major functions that cementitious materials are expected to perform as engineered barriers are diffusion prevention and sorption of nuclides.

In recent years, it has been pointed out that cementitious colloids are present in pore solution in cementitious materials. The effect of the coexistence of these colloids on the solid-phase sorption of nuclides is unclear, so there is emerging consensus to consider these as new variables.

In this study, we first examined whether cementitious colloids are present in the liquid phase in equilibrium with several cementitious materials, with the aim of fully understanding the effects of different types of cementitious materials on the formation of cement colloids. Then, we evaluated the temporal stability of particle size, surface potential, and other physical properties of the cement colloids.

As a result, we confirmed the formation of cement colloids in samples of ordinary portland cement and several other cement by measured with DLS (Dynamic Light Scattering) method. We also demonstrated that mineral admixtures have a substantial effect on cement colloid formation, and that the dispersion stability of colloid particle size over time is different in materials containing fly ash. In contrast, in materials containing slag, cement colloid formation could not be detected in this study. We tried to quantify the concentration of cementitious colloid by DLS method. The concentration of cementitious colloid generated from low heat portland cement + Fly ash , which showed the most high concentration in this study, was 9.6×10^{11} particles/mL .

we obtained these results from fully sound cementitious materials. Therefore, it is important to evaluate the impact of long-term changes and other factors on cement colloid formation.