Environmental assessment for applying cement mixtures containing high content of coal fly ash

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Coal fly ash can be utilized as a substitute material in cement mixtures, such as controlled low strength material (CLSM) and grout, which in infrastructure applications may come into contact with runoff, infiltration or groundwater. Evaluating the potential for leaching of constituents of potential concern (COPCs) from formulations containing high content of fly ash enables definition of criteria for usage in infrastructure applications that ensures environmental protection.

Cement mixtures with and without fly ash were cured for different time periods and tested according to a monolith leaching procedure designed for determination of the inorganic constituent leaching rates from construction materials and wastes. A Colombian fly ash was chosen because of its high concentration of COPCs and its low pozzolanic activity as a bounding case for fly ash types produced in Israel. Concentrations of COPCs in the materials and eluates from pH dependence and monolithic tests were clearly enriched in the fly ash blends compared with the corresponding reference materials. However, although the grout with fly ash contains higher concentrations of COPCs due to its greater fly ash content, COPCs were leached in lower concentrations due to the high content of cement which plays a strong role in stabilizing COPCs.

Surface carbonation from atmospheric carbon dioxide impacts release of COPCs with pH dependent aqueous-solid partitioning because it decreases solution pH. Release of oxyanions (B, Cr, Mo, Sb, Se, V, mostly originating from fly ash) also is greater with increasing carbonation due loss of ettringite in the cement, where ettringite sequesters oxyanions through anion substitution for sulphate in the mineral.

Environmental safety assessment of the cementitious mixtures with fly ash in three Israeli climate regions is based on COPCs release rates from CLSM & grout to calculate average annual concentration in runoff and inflitration water and compared to regulatory criteria. In the Israeli environment, cementitious mixtures containing even a high fly ash content will not adversely impact water resources via runoff and infiltration.