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Leaching behavior of cementitious material immobilizing C_s-containing B-10 enriched boric acid waste

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Recently, boric acid enriched in B-10 has received attention over natural boric acid in nuclear industry, because the elevated content of B-10 is a prospective neutron absorber. Advantages connected to the use of B-10 enriched boric acid are the increased controllability of reactor core which results in use of reduced amount of boric acid and, subsequently, the reduction in the amount of the radioactive boric acid waste produced during reactor operation. In the other hand, consequent radioactive boric acid waste requires an adequate stabilization technology as it contains fission products of health concerns, importantly C_s-137. Cementation is one of the proven, commercially viable, durable, widely used, simple and flexible technology for immobilization of low-level radioactive wastes (Hyatt and Ojovan, 2019). General integrity and durability of the cementitious waste form containing boric acid is B-leachability dependent (Rostamiparsa et al, 2020). The B-10 enriched boric acid leaching is expected to control also the C_s-leaching. However, no study is found in which this is proven and the different geochemical behavior and phase distribution of the B and C_s might cause deviations. This calls for the investigation of the connection between B- and C_s-leaching behaviors in cementitious materials, in this case, especially focusing on B-10 enriched boric acid waste form. In this ongoing experimental work the B- and C_s-leaching behavior of cementitious materials are studied, which are made of Portland cement, boric acid enriched in B-10 isotope and C_sCl. Boron- and Cs-leachability from the cementitious matrix are investigated in parallel by a standardized reference leaching test (ASTM, 2017). The tests are carried out by immersing the 28 days cured cement paste samples in deionized water in a glass bottle. Leachant renewal and solution sampling are done on a daily basis for the whole leaching test period of 11 days. Analysis of leached fractions are quantitatively measured by ICP-OES. Characterization of solid samples are conducted by XRD, SEM-EDX and Raman micro-spectroscopy methods. This is the first study to shed light on the connection between B-leaching and C_s-leaching in cementitious materials containing B-10 enriched boric acid.

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