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Solidification of Radioactive Resins with Geopolymer Package: A Circular Economy Concept of Handling Nuclear Waste with Mine Tailings

Notwithstanding the advantages of environmentally-friendly nuclear power plants in the new energy industry, efficient disposal of radioactive nuclear wastes is still lacking. Up-to-date, encapsulation of radioactive ion-exchange resins with green and cost-effectiveness packages such as geopolymer has recently emerged. In this contribution, geopolymer packages were elaborated up to 42 wt.% of un-calcined-phosphate tailings to encapsulate radioactive ion-exchange resins under different alkali-mixed content and environments during the long term leaching tests. The alkali mixed content-dependent and environmental-dependent chemical stability and leaching kinetics, as well as their leaching mechanisms, have been revealed. The addition of sodium citrate (Na-citrate; 1.5 wt. %) was also assessed. The results showed that non-activated phosphate tailings-based geopolymer packages exhibited better stability and encapsulation performance than that of individual metakaolin-based geopolymer matrix and Portland cement binder, recording compressive strength values greater than the waste acceptance criteria. For the encapsulation of ^{134}Cs , the Na-citrate addition positively affected its retention and leaching rates under the same leaching conditions. Both higher alkali-mixed content and acid solution destroyed the chemical stability and accelerated the leaching behaviors of ^{134}Cs from the encapsulation packages. XRD, FTIR-ATR and SEM/EDS examinations of geopolymer packages reflected their multilayered structures and semicrystalline natures and to what extent these packages and the encapsulated resins had good/ poor stabilities. This research enables NPS, which is traditionally considered as a by-product from the Moroccan phosphate industry, to be used as a replacement and partially reactive material in MK-based geopolymer packages for encapsulation/immobilization of radioactive wastes.

Do you wish to participate as a Young Professional?

Yes

Speaker's title

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Do you wish to be considered for a Young Professional grant?

Yes

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