INNOVATIVE MATRIX FOR RADIACTIVE WASTE CONDITIONING; GEOPOLYMERS AND DIATOMACEOUS EARTH

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Developments in technology nowadays aim to produce more efficient, low-cost, and more environmentally friendly materials. In the radioactive waste management field, cement is one of the most interesting materials thanks to the considerable extent of knowledge about it, its precursor availability, and its low cost. Thus, extensive research is focused on improving its properties for radioactive waste conditioning capabilities. Alternative conditioning matrices such as geopolymers with excellent mechanical properties enabled it to become a high-performance substitute of Portland cement for specific wastes (e.g., organic oily wastes, decommissioning wastes). Geopolymers are synthesised from alumino-silicate sources and high alkaline solutions in three steps: dissolution, polycondensation, and stabilization. Clay is a potential source of aluminosilicate since it is composed of high amounts of alumina and silica. In this study, we are using synthetic metakaolin clay as the backbone of the geopolymer system with aim to encapsulate and incorporate nuclear waste without further treatment processes. In addition to the clay, we propose using diatomaceous earth, fossilised remains of diatoms, which are a type of hard-shelled microalgae containing high amounts of silica, to improve both the geopolymer matrix and its retention capabilities for waste material. Different amounts of clay and diatomaceous earth with varied solution concentrations have been tested to determine the optimum geopolymer formulations and to reduce the environmental impact along with the cost. The produced geopolymers have been studied with X-ray and infrared spectroscopy to enlighten their structure. Precursors for geopolymers have been studied with X-ray fluorescence spectroscopy to characterise their chemical compositions. Diatomaceous earth impact on the geopolymer mechanical properties and its waste retention capabilities are still under investigation. The geopolymer matrix conditioning properties will be tested for sludges arising from radioactive waste effluents. Chemical durability will be tested through leaching experiments and post mortem solid phase analysis.

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