DIRECT IMMOBILISATION OF LIQUID ORGANIC RADIOACTIVE WASTE IN A GEOPOLYMER MATRIX

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Managing and disposing of radioactive liquid organic waste (RLOW) is a complex task due to its hazardous nature and long-term environmental impact. Geopolymer materials, produced through the alkali activation of aluminosilicate precursors, have emerged as promising candidates for immobilising various types of waste, including radioactive waste, due to their chemical stability, mechanical strength, and resistance to degradation. This study investigates the feasibility and effectiveness of the direct conditioning of RLOW surrogate into a blast furnace slag (BFS) matrix, focusing on key properties such as mechanical strength, porosity, and durability under various curing conditions. Two experimental series were conducted, using different waste oils as surrogates for RLOW and a variety of surfactants to evaluate their impact on the geopolymers. Samples were cured under sealed and aerated conditions to assess how these variables influence the resulting material. Several methods, such as UV/Vis spectroscopy, microscopy, porosimetry and compressive strength testing, were utilised to analyse the physical, chemical, and mechanical characteristics of the produced geopolymer waste forms. Compressive strength test results indicate potential suitability for long-term storage and disposal RLOW. However, increasing waste oil and surfactant concentrations generally reduced compressive strength and was associated with increased porosity. Additionally, leaching tests were performed to evaluate the potential release of oil and selected elements from the stabilised waste form. The findings demonstrated minimal oil leaching, suggesting a high level of immobilisation efficiency. These findings suggest the potential of geopolymer matrices for encapsulating RLOW. However, they also highlight the need for careful optimisation of surfactant and waste concentrations to ensure a balance between the volume of incorporated waste oil and mechanical performance. Further research and optimisation are required to refine these formulations and expand the application to other liquid organic waste types, aiming to develop practical and scalable solutions for radioactive waste management.

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