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The Study of Alternative Encapsulants for the Treatment of Intermediate Level Radioactive Waste

In the UK, currently the preferred method of immobilising intermediate level waste (ILW) is through the use of Portland cement (PC) based grouts, to produce a passively safe waste package. However, certain types of ILW present a challenge to this method, with the result that this immobilisation matrix may not represent the optimum mechanism available. Such challenges are related to either chemical compatibility issues between the waste and encapsulant which may limit waste loadings, or those related to rheology such as the infilling of wastes with tortuous pathways.

To address these issues and identify potential enhanced encapsulation options for the treatment of 'problematic'ILW in the UK, the Encapsulants Integrated Research Team (EIRT) has been established as a collaboration between Sellafield Ltd (SL) and the National Nuclear Laboratory (NNL) to identify and provide data on alternative immobilisation matrices such that they may provide product, cost and process resilience improvements over conventional PC based matrices for the treatment of problematic ILW.

Following an extensive literature review, a structured research programme has been undertaken on the following four cement systems: geopolymers, calcium sulfoaluminate (CSA) cements, high alumina cements and magnesium phosphate cements. The aim of this programme has been to initially identify at nominally 160 mL scale, a range of potential formulations with adequate setting characteristics for each encapsulant using statistical experimental design and analysis, in order to assess the effects of varying mix parameters for each encapsulant on typical processing properties required for the treatment of ILW; bleed, viscosity, pH and setting time.

Following this, a further 44 3 L scale geopolymer mixes and 84 3 L scale CSA mixes have been undertaken investigating the performance of these systems based on the learning from the 160 mL scale trials, in which grout performance with varying mix parameters was assessed by fluidity, viscosity, bleed, setting time and heat of hydration. Product quality was assessed to 90 d using compressive strength and dimensional stability analyses, whilst microstructural analysis has also been conducted up to 90 d curing. Optimum formulations from the geopolymer study are currently being investigated for the immobilization of surrogate organic liquids and an inorganic ion exchange resin, both of which present waste loading challenges in PC based grouts. This paper therefore presents the results of these preliminary studies and outlines the intended future work programme.

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Do you wish to participate as a Young Professional?

No

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

No

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