Solidification of Spent Resin for Safe Storage

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1. Introduction

Spent ion-exchange resins from nuclear power plant are considered to be problematic waste so that, in many case, it requires special approaches and precautions during their solidification to meet the acceptance criteria for disposal. Because the radioactive materials can be released form spent ion-exchange resin during treatment, the selection of treatment options for spent ion-exchange resins must consider their physical, chemical, and radiological characteristics. Direct immobilization method, producing a stable end product by using cement, bitumen, polymer or high integrity containers, was proposed to be considered. In addition, in an environment without final disposal options and limited interim storage capacity, volume reduction is an essential criterion.

The overall objective of this study is an investigation of the solidification of spent ion-exchange resin waste. The specific objective of this research is looking for the optimal condition for solidification of spent ion-exchange resin waste in order to stable store to repository. The solidification ingredients for spent ion-exchange resin should be characterized advance and compare to make waste form with spent ion-exchange resin.

2. Materials and methods

The solidification ingredients, mortar and Epoxy (polyester) were investigated. The mortar was prepared with slag, fly ash, sand, and Portland (Type I) cement. The mortar sample was analyzed to investigate the characteristic by XRD (X-ray diffraction), FT-IR (Fourier Transform Infrared Spectroscopy), SEM-EDS (Scanning Electron Microscopy with Energy Dispersive Spectroscopy), and XRF (X-ray fluorescence). The polyester epoxy was prepared to compare with mortar for solidification of spent ion-exchange resin (Fig. 1).

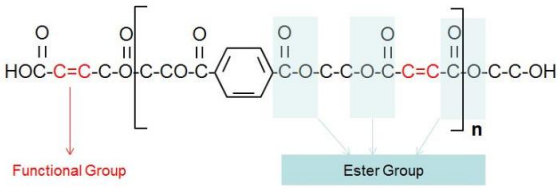


Fig. 1. Polyester Epoxy.

In this study, the GRAVEX GR 3-16 N (mixed bed) resin was used as spent ion-exchange resin. The characteristic of GRAVEX GR 3-16 N is shown in Table 1. Cation (GR 2-0 NG) and anion (GR 1-9 NG) exchange resin was mixed by 1 to 2 as volume ratio.

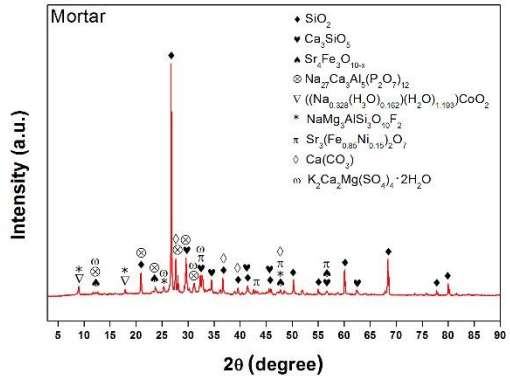
The solidifications of resin waste which formulated with (1) mortar, (2) mortar with epoxy, and (3) epoxy were formed and compared for compressive strength to meet the acceptance criteria for repository.

Table 1. The characteristics of GRAVEX GR 3-16 N

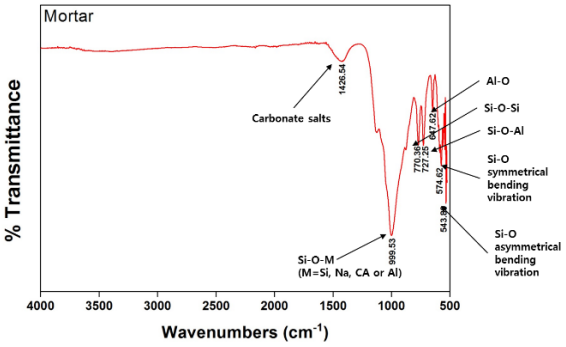
Resin	GR 2-0 NG Cation-exchange	GR 1-9 NG Anion-exchange
Interacting ion	H^+	OH^-
Functional group	$-SO_3H$	$-CH_2N(CH_3)_3OH$
Ion exchange capacity	>2.4eq/L (H^+)	>1.2eq/L (OH^-)
Average diameter	1.188mm (95%)	1.188mm (95%)
Water contents	36-42%	53-59%
Volume ratio	1	2

3. Results

The XRD patterns of mortar are shown in fig. 2 (a), and the FT-IR spectra of mortar are shown in fig. 2 (b). The XRD analysis shows SiO_2 as the most dominant phase in mortar, and the FT-IR peaks are consistent with the silicate and carbonate [1, 2]. In addition, the characteristics of polyester epoxy were investigated for solidification of resin waste. The resin waste was prepared by cobalt and cesium adsorption, and the compressive strength of solidifications of resin waste was tested, which meet the acceptance criteria.



(a) XRD



(b) FT-IR

Fig. 2. The (a)XRD and (b)FT-IR results of mortar.

4. Conclusion

The solidifications of mortar and polyester epoxy were tested for resin waste. In order to optimize the solidification of resin waste for acceptance to repository, the solidification ingredients should be characterized for the final formulation condition.

ACKNOWLEDGEMEMT

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