Leaching Characteristics of Intermediate Level Liquid Radwastes

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1. Introduction

The intermediate level liquid radwastes (ILLW) will be generated during Mo-99 production at KIJANG research reactor [1]. The liquid radioactive waste over intermediate level will shift to final disposal site after solidification.

In this study, we performed leaching test for cementation of ILLW, and evaluated the results meet the acceptance criteria for disposal.

2. Experiments

2.1 Liquid Radwastes

The chemical composition and concentration of liquid radwastes in this study are NaCl 64.28 g/L and Na_2SO_4 106.53 g/L. The liquid waste stored for 4~5 years to reduce some nuclide which has short half-life [2].

2.2 Materials and Methods

Portland cement (type1) was used for solidification, and chemically simulated liquid wastes were used.

The cement and wastes were mixed following mechanical mixing method (KS-L-5109, KS). The concentration of Cs, Co and Sr are 3,000 ppm, 1,000 ppm, 1,000 ppm, respectively. We prepare 3 samples per each conditions and averaged the results.

The Leachability Index (LX) is defined as followings.

$$\mathrm{LX} = -\log D_e \qquad (1)$$

,where D_e = effective diffusion coefficient [cm^2/sec]

De can be obtained by eq. (2)

$$\mathrm{f(t)} = CFL = \frac{\sum \alpha_n}{A_0} = 2\frac{S}{V}\left[\frac{D_e}{\pi}\right]^{1/2} \cdot t^{1/2} \qquad (2)$$

CFL : Cumulative Fraction Leached

The slop can be calculated using $\frac{\sum \alpha_n}{A_0}$ term vs. $t^{1/2}$ term.

3. Results and Discussion

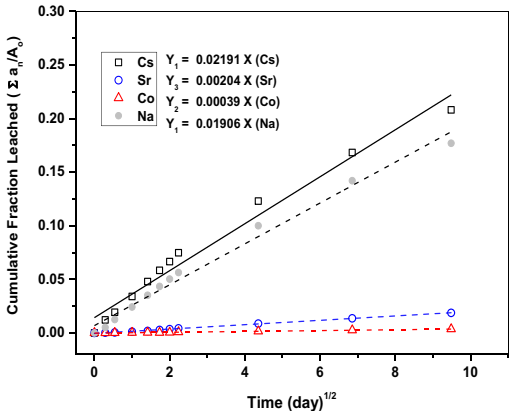

Fig. 1. Cumulative fraction leached and slope of each nuclide in cementation samples.

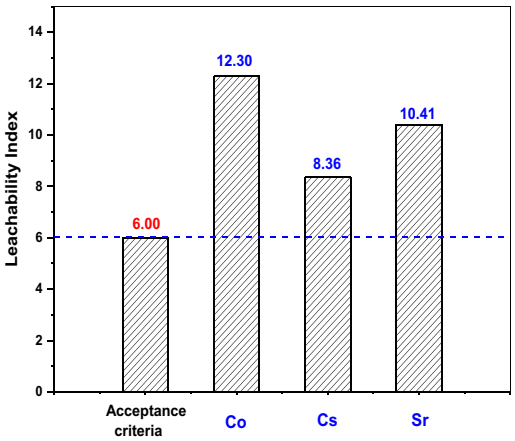

Fig. 2. Leachability index of each nuclide in cementation samples.

Fig. 1 shows cumulative fraction leached and slope for all nuclides in cementation. It clearly shows that they are following typical diffusion model.

Fig. 2 shows leachability index of each nuclide in cementation samples. All cases are meet the acceptance index of final disposal site.

4. Conclusion

4.1 De (effective diffusion coefficient) for each nuclide in cementation follow the typical diffusion model

4.2 The nuclides, high leaching rate to lowest leaching rate are Co, Sr, and Cs, the leachability indexes are 12.30, 10.41 and 8.36, respectively.

4.3 Leachability index for all nuclides in cementation meet acceptance criteria of final disposal site.

REFERENCES

[1] Martin W. A. Stewart, “Immobilisation of higher activity wastes from nuclear reactor production of 99Mo”, Australian Nuclear Science and Technology Organization (ANSTO), 2013.

[2] Korea Radioactive Wastes Agency.

[3] “Safety analysis report of Low-and intermediate-Level Radioactive Waste Disposal Facility”, 2008.