

Comparison on leaching mechanism of ^{137}Cs and ^{60}Co from the Paraffin Waste Form

Kyoung-Kil Kwak, Young-Yong Ji, Young-Gerl Ryu, Chang-Man Kim,
Korea Atomic Energy Research Institute, 150 Deokjin-dong, Yuseong-Gu, Daejeon, Korea,
305-353nkkkwak@kaeri.re.kr

1. Introduction

The incorporation ratio wt% of paraffin waste form was boron waste/paraffin=3.3:1, such as to domestic NPP. Using several specimens with different diameters and heights, 50/50mm, 80/80mm specimens. The leachant shall be demineralized water and sea-water, Leaching rates of cesium and cobalt were measured. in accordance with IAEA standard leach test procedure for 246 days. Using the tracers are ^{60}Co and ^{137}Cs . The radioactivity initially present in specimens are ^{60}Co : 38.47, 37.37 μCi and ^{137}Cs :13.56, 14.75 μCi . The experiment result showed that the paraffin waste form of leaching rates are large more than the cement waste form. The cumulative fraction leached of seawater were cobalt is 0.067 and cesium 0.1062. The cumulative fraction leached of demi-water were cobalt is 0.1171 and cesium 0.1739. As test result, The cumulative fraction leached of demi-water are increased more than seawater. increase of diameter, The showed that the CFLs were decreased.

2. Methods and Results

2.1 Manufactured of specimen

The mixing weight ratio of waste form between boric acid and paraffin was 3.3/1. Using several specimens with different diameters and heights(50/50,80/80mm). The mixing temperatures was given that the range from 70 $^{\circ}\text{C}$ to 100 $^{\circ}\text{C}$. Paraffin / boric acid / nuclide of ^{60}Co and ^{137}Cs . mixtures. The mixture shall be placed in the PVC mold so that it is properly filled. The gap shall be filled with rubber bond which is waterproof. The curing period given a week at air.

2.2 Leaching test

The leaching test shall be performed at a temperature of 25 $^{\circ}\text{C} \pm 5^{\circ}\text{C}$. Using four specimens with different diameter and two leachant, Leaching rates of ^{60}Co and ^{137}Cs were measured in accordance with IAEA standard leach test procedure for 246days. The leachant shall be demineralized water and sea-water. The amount of leachant added shall be accurately measured and shall be such that value of the ratio volume of leaching solution/exposed area of sample does not exceed 10 cm. Sampling frequency was daily during the first week, once per week for the following eight weeks, once per month during the following six months and then.

2.3 Equation

- The results shall be expressed by a plot of the cumulative fraction of radioactivity leached from the specimen as a function of the total time of leaching thus $\Sigma a_n/A_0 / (F/V)$ versus Σt_n

$\Sigma a_n/A_0$ versus Σt_n

where a_n = radioactivity leached during the leachant renewal period, n

A_0 = radioactivity initially present in specimen

F = exposed surface area of specimen (cm^2)

V = volume of specimen (cm^3)

t_n = duration (days) of leachant renewal period

- The results may also be expressed by a plot of the incremental leaching rate, R_n ,

as a function of the time, t(days) of leaching, where

$R_n = \Sigma a_n/A_0 / (F/V)t_n$

and the other terms are as defined above.

Values for R_n , calculated as above, shall be plotted against $t_n - (t_n - t_{n-1})/2$

2.4 leaching behavior of ^{60}Co and ^{137}Cs from the Paraffin Waste Form

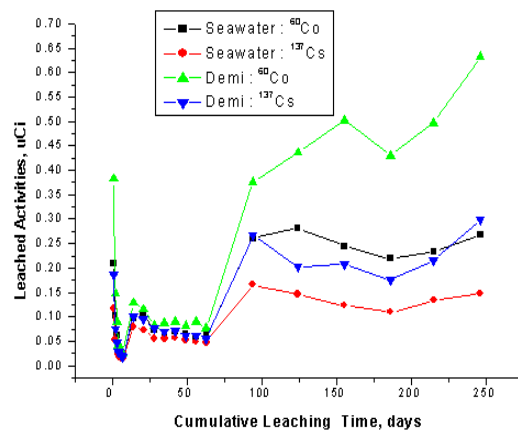


Fig. 1. Leached Activities with Cumulative Leaching Time

Fig 1. shows that the leached activities in demiwater are increased more than the artificial seawater. initially, leached small activities during the 63 days. leached activities were increased since 94days. It is seems that the boric acid was dissolution. and that, the boric acid is attached ^{60}Co and ^{137}Cs .

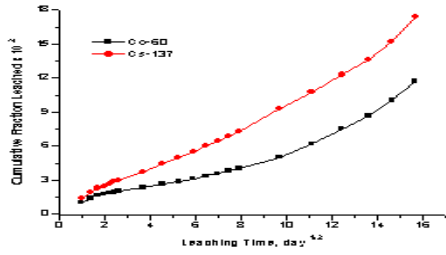


Fig. 2. CFLs of ^{137}Cs and ^{60}Co in paraffin waste form

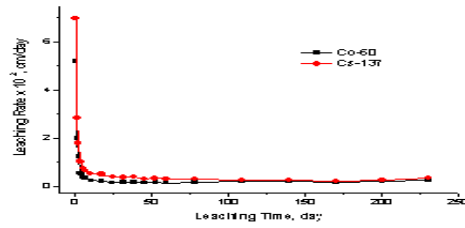


Fig. 3. Leaching rates of ^{137}Cs and ^{60}Co in paraffin waste form

The experiment result showed that the CFLs of ^{137}Cs are increased more than the CFLs of ^{60}Co . The cumulative fraction leached of ^{60}Co is 0.1171 and ^{137}Cs is 0.1739. Fig. 3 shows that the leaching rate of ^{137}Cs are increased more than ^{60}Co .

2.5 Comparison on leaching behavior of ^{137}Cs and ^{60}Co with various leachant and exposed surface area

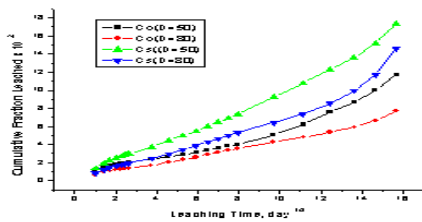


Fig. 4. CFLs of ^{137}Cs and ^{60}Co in paraffin waste form various diameter

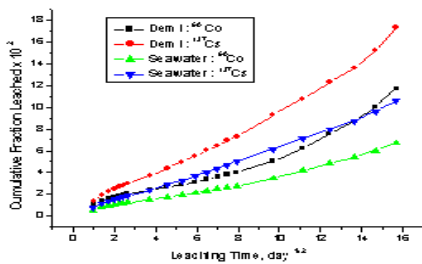


Fig. 5. CFLs of ^{137}Cs and ^{60}Co in paraffin waste form various leachant

The cumulative fraction leached of small (D=50) specimens were ^{60}Co is 0.1171 and ^{137}Cs is 0.1739. The cumulative fraction leached of large (D=80) specimens were ^{60}Co is 0.0773 and ^{137}Cs is 0.1462. As test result, The cumulative fraction leached of demi-water are increase

d more than seawater. increase of diameter, The showed that the CFLs were decreased.

2.6 Weight change with increase of leaching rate

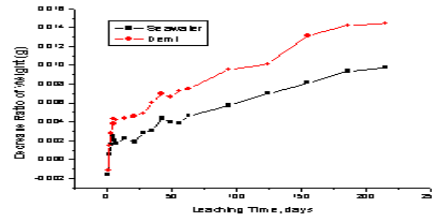


Fig. 6. Decrease ratio of weight in paraffin waste form

The relation between decrease ratio of weight and cumulated fraction leached is compared with the Fig.4, Fig.6. The rate of change is resemble between weight and increase CFLs. It is seems that the boric acid was dissolution. and that, the boric acid is attached ^{60}Co and ^{137}Cs . the paraffine wasteform is consist of boric acid. The weight loss is most of dissolution and diffusion.

3. Conclusion

1. The cumulative fraction leached of ^{137}Cs are large more than ^{60}Co .
2. The cumulative fraction leached of demiwater were ^{60}Co is 0.1171 and ^{137}Cs is 0.1739. The cumulative fraction leached of seawater were ^{60}Co is 0.0670 and ^{137}Cs is 0.1062. As test result, The cumulative fraction leached of demi-water are increased more than seawater.
3. The cumulative fraction leached of small (D=50) specimens were ^{60}Co is 0.1171 and ^{137}Cs is 0.1739. The cumulative fraction leached of big (D=80) specimens were ^{60}Co is 0.0773 and ^{137}Cs is 0.1462. As test result, increase of diameter, The showed that the CFLs were decreased.

Reference

1. Parkhunhee etc. "A Study on the Characterization of Radioactive Waste Form" KAERI-NEMMAC/RR65/92.
2. Kim kihong etc. "A Study on the Characterization of Radioactive Waste Form" KAERI-NEMMAC/RR-139/94.
3. U.S. Nuclear Regulatory Commission, "Low-Level Waste Licensing Branch Technical Position on Waste Form" Rev. 0. May 1983.