Leaching Test of 200L Cemented Waste Drum Incorporated Spent Resins

Young-Gerl Ryue, Young-Yong Ji, Kyung-Kil Kwak and Ki-Hong Kim
Korea Atomic Energy Research Institute, 150 Duckjin-dong, Yuseong-gu, Daejeon
He-on Kim, Duck-Sin Kim
KHNP Co., Ltd., Radwaste Project Site Office, 139-9 Gajeong-dong, Yuseong-gu, Daejeon
Whan-Gyeong ,Je
Hanil Nuclear Co., Ltd., 3F, Dongyoung Venturestel, 202-4, Anyang7-dong, Manan-gu, Anyang

Spent resins were produced in the water treatment process in Kori NPP(#2), and then were solidified with cement in DOT-17H metal drum (210L). It was expected that the ratio of solidification was 0.33 < water/cement (wt.%) < 0.40, 0.134 < incorporation ratio of spent resins(wt.%) < 0.179. The contact surface dose rate which was measured in October, 2003 was 1.5 mSv/hr.

The static leach test was conducted in a hot cell at the Radioactive Waste Form Characterization Facility (RWFCF) in KAERI. A lid-opened waste drum after decontamination of the drum's outer surface was immersed into a leach vessel, which contained 264L of deionized water, equivalent to 10 times the surface area exposed in leachant. Deionized water with an electrical conductivity of less than 3.41 mho/cm was used as a leachant. The test temperature was constantly kept at 20°C in the hot cell. A leachate of 500 ml was periodically sampled a through timer-attached solenoid valve during the circulation of the leachate by a low flow rate pump. After an analysis of the radioactivity, an analyzed leachate was refilled into the leaching vessel. The amount of Cs-137 and Co-60 in the leachate was analyzed by γ-ray spectroscopy using a HPGe 25190-P detector. The effective diffusion coefficient of radionuclide of waste form(diameter/height ≠ 1) was determined by semi-infinite diffusion model.

The pH and conductivity obtained during 247 days of the leaching test were shown in Figure 1. The range of pH and conductivity were 7.17 ~ 11.95 and 3.41 ~ 1,657 μScm, respectively.

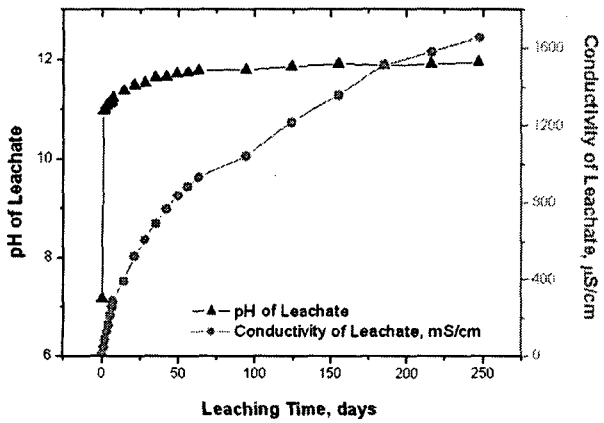

Figure 1. pH and Conductivity of Leachate

The conductivity rose sharply in the first leaching day and then rose gently according to the increase of leaching time, but the pH continuously rose with increasing of leaching time. These indicated that the release of radioactive nuclides and salts from the inside of drum continued. The relationship between the activity of Cs-137 in leaching vessel and the square root of leaching time is shown in Figure 2. The black points represent the activity of Cs-137 in leaching vessel and the red points represent the change of the activity before and after the sampling of leachate. The activity curve (or cumulative fraction leached curve) showed that the leaching mechanism of Cs-137 was controlled by the diffusion, typically, except some periods(before and after the 49 days' leaching time.).

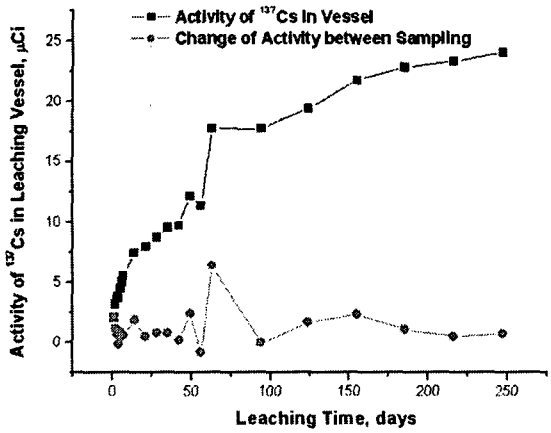

Figure. 2. Activities of Cs-137 in Leaching Vessel

The activity of Co-60 in leaching vessel showed in Figure 3 according to the function of the square root of leaching time. The black points represent the activity of Co-60 in leaching vessel and the red points represent the change of the activity before and after the sampling of leachate. The leaching behavior of Co-60 from a cemented waste form did not show the diffusion mechanism such as Cs-137, but we could interpret that his behavior meets the diffusion mechanism by fitting the points. However the leaching rate of Co-60 was very smaller than that of Cs-137.

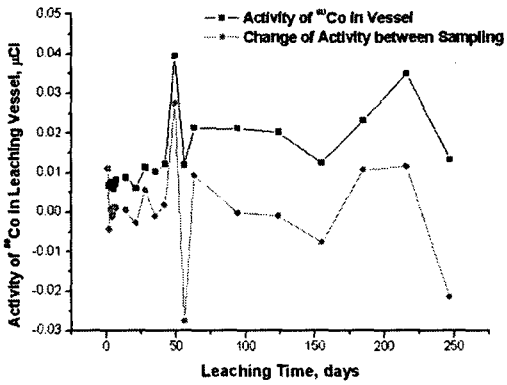

Figure. 3. Activities of Co-60 in Leaching Vessel