Melt Decontamination of Aluminum Waste by Electric Arc Melting

Wang-Kyu Choi, Pyung-Seob Song, Byung-Youn Min*, Chong-Hun Jung, Won-Zin Oh

Korea Atomic Energy Research Institute, 150 Duckjin-dong, Yuseong-gu, Daejeon

*Chungnam National University, 220 Gung-dong, Yuseong-gu, Daejeon

nwkchoi@kaeri.re.kr

In Korea, the decontamination and decommissioning of the retired TRIGA MARK II and III research reactors and a uranium conversion plant at the Korea Atomic Energy Research Institute (KAERI) has been under way. Hundreds of tons of metallic wastes are expected from the D&D of these facilities [1]. Therefore, prompt countermeasures should be taken to deal with the amount of wastes generated by dismantling the retired nuclear facilities. Most of the dismantled material is slightly contaminated. A recycle or volume reduction of the metallic wastes can be considered as one of the waste management options under the circumstances of the absence of a waste disposal site in Korea and the capacity limitation of the temporary waste storage facility at KAERI. A recycle or volume reduction of the metallic wastes through the application of appropriate treatment technologies has merits from the view point of the increase in resource recycling as well as a decrease in the amount of wastes to be disposed resulting in a reduction of the disposal cost and an enhancement of the disposal safety.

In this study, the characteristics of the aluminum waste melting and the distribution of the radioactive nuclides were investigated in the view point of the decontamination of the aluminum wastes generated from the decommissioning of the TRIGA MARK Ⅱ and Ⅲ research reactors at the Korea Atomic Energy Research Institute(KAERI). The melting of aluminum was carried out with the use of surrogate nuclides such as cobalt, cesium, and strontium and fluxes such as $NaCl\text{-}KCl\text{-}Na_3AlF_6$ (type A), NaCl-NaF-KF (type B), CaF_2(type C), and $LiF\text{-}KCl\text{-}BaCl_2$ (type D) in the d. c. graphite arc melting system. The fluidity of aluminum melt was increased with the addition of the fluxes, which has slight difference according to the type of fluxes. The formation of the slag during the aluminum melting added the flux type B and C was larger than that with the flux A and D. The rate of the slag formation linearly increased with increasing the flux concentration. The results of the XRD analysis showed that the surrogate nuclides move into the slag, which can be easily separated from the melt. and then they combine with the aluminum oxide to form a more stable compound. The distribution ratio of cobalt in the ingot was more than 40% according to the types of fluxes. A removal efficiency of more than 98% for the cesium and strontium from the ingot could be achieved due to their transportation from the ingot to the slag and the dust phase. Therefore, it can be expected that a greater part of the aluminum wastes generated from the retired research reactors can be recycled or their volumes reduced for a disposal by a melting.