Making a Pellet-type LiCl-KCl-UCl3 salt for Electrorefining

M.S.WOO*, H.J.JIN, I.T.KIM, J.G.KIM.
Korea Atomic Energy Research Institute
1045 Daedeok-daero, Yusong-gu, Daejon 305-353, Korea

* *mswoo@kaeri.re.kr.*

1. Introduction

In this work, uranium electrorefining is to recover from LiCl-KCl eutectic salt include crude uranium by electrochemical method. In the process, the reactor of an electrorefiner consists of the electrodes and the molten chloride salt which is LiCl-KCl-UCl3. The role of uranium chloride salt (UCl3) is to stabilize the initial cell voltage between electrodes in the electrorefining reactor. The process to produce a uranium chloride salt includes two steps: a reaction process of gaseous chlorine with liquid cadmium to form the CdCl2 occurring in a Cd layer, followed by a process to produce UCl3 by the reaction of U in the LiCl-KCl eutectic salt and CdCl2 [1] The apparatus for producing UCl3 consists of a chlorine gas generator, a uranium chlorinator, a Cd distiller, the pelletizer, and a off-gas and a dry scrubber. The temperature of the reactants is maintained at about 600 ℃. After the reaction is completed in the uranium chlorinator, The salt products is transferred to the Cd distiller to decrease residual Cd concentration in the salts, and then salt is transferred to the mould of pelletizer by a transfer system to make pellet type salt.

2. Methods and Results

2.1 Experimental

The Equipment for making UCl3 salt in this work consists of a chlorine gas supplier, a uranium chlorinator, a Cd distiller, a pelletizer, and an off-gas scrubber and a dry scrubber, a personal computer and recorder system. Salt transfer used by salt transfer equipment 500 ℃ heated. Molten salt in the stainless steel (SUS) reactor vessel was mixed by SUS blades attached to the uranium basket. Argon gas was supplied into the reactor in order to control argon atmosphere in the reactor as well as some time, to control the flow velocity of chlorine gas. A eutectic salt, LiCl-KCl(59-41 mol%), of 716 g per batch was prepared at 600 ℃. At the same time, an uranium metal of 1,013 g and a Cd metal of 789 g per batch were prepared in order to making UCl3. The Uranium chlorination was carried out for 72 hrs at 600 ℃. Cd distillation was carried out by vacuum distillation for 2 hrs at 60torr, 600 ℃. And then pellet type salt made by mould of the pelletizer in the argon atmosphere at 90~130 ℃. Sampling time interval from the reactor was 2 hrs. The chemical analyses of the samples were done by using an XRD and an ICP.

2.2 Results and discussion

The salt products, eutectic LiCl-KCl-UCl3, after the uranium chlorination reaction for 72 hrs at 600℃ include residual cadmium metal. To remove residual cadmium, the salt products were transferred to Cd distiller and distilled for 2 hour at 60 torr. 600℃. After Cd distillation, Cd concentration in the eutectic LiCl-KCl-UCl3 salt was decreased up to 200ppm. Result of XRD analysis of the distilled UCl3 salt product was good products compared with before Cd distillation products, as shown in Fig.1. The distilled eutectic salt was transferred to a pelletizer through a pressurized transfer system in order to make the pellet type salt. Heating temperature of transfer system was maintained at about 500 ℃. The pellet type salt was fabricated in mould of pelletizer at 90~130℃, as shown in Fig. 2. Fabricated pellet was easily separated from mould in the room temperature.

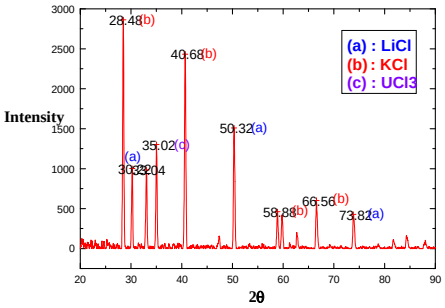

Fig. 1 Pellet-type LiCl-KCl-UCl3 salt

Fig. 2 XRD analysis of LiCl-KCl-UCl3 salt product

3. Conclusions

Making pellet type LiCl-KCl-UCl3 salt for electrorefining was carried out using the chlorinator, Cd distiller, and pelletizer. Salt transfer carried out by salt transfer equipment heated 500℃. The Cd concentration of final salt products distillated at 60torr, 2 hrs, 600℃ was 200ppm from the ICP, XRD analysis. And pellet type salt products were fabricated by using the mould of pelletizer at 90~130℃.

REFERENCES

[1] Miller et al, "Method for Making a Uranium Chloride Salt Product", Patent No.: US 6,800,262B1, Date of Patent: Oct.5, 2004.