

## Method for making a Pellet-type LiCl-KCl-UCl<sub>3</sub> SALT

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### 1. Introduction

A pyrometallurgical partitioning technology to recover uranium from a uranium-TRU mixture which is the product material of electroreduction system is being developed at KAERI since 1997. In the process, the reactor of an electrorefiner consists of the electrodes and the molten chloride salt which is LiCl-KCl-UCl<sub>3</sub>. The role of uranium chloride salt (UCl<sub>3</sub>) 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 CdCl<sub>2</sub> occurring in a Cd layer, followed by a process to produce UCl<sub>3</sub> by the reaction of U in the LiCl-KCl eutectic salt and CdCl<sub>2</sub> [1]. The apparatus for producing UCl<sub>3</sub> consists of a chlorine gas generator, a uranium chlorinator, a Cd distiller, the pelletizer, and an off-gas and a dry scrubber. The temperature of the reactants is maintained at about 600 °C. After the reaction is completed in the uranium chlorinator, the salt products are transferred to the Cd distiller to decrease residual Cd concentration in the salts, and then salt is transferred to the mould of a pelletizer by a transfer system to make a pellet type salt.

### 2. Experimental

The uranium chlorinator equipment used for making the uranium chloride salt in this work consists of a chlorine gas generator, a uranium chlorinator, a Cd distiller, a pelletizer, an off-gas scrubber, a dry scrubber, and a personal computer and recorder system. 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 °C. At the same time, uranium metal of 1,013 g and Cd metal of 789 g per batch were prepared in order to making UCl<sub>3</sub>. The Uranium chlorination was carried out for 72 hrs at 600 °C. Cd distillation was carried out using a vacuum distillation for 2 hrs at 60 torr, 600 °C. Then pellet type salt was made by mould of the pelletizer in an argon atmosphere at 90~130 °C. Sampling time interval from the reactor was 2 hrs. The chemical analyses of the samples were done using an XRD and an ICP.

### 3. Results and discussion

The salt products, eutectic LiCl-KCl-UCl<sub>3</sub>, after a uranium chlorination reaction for 72 hrs at 600 °C include residual cadmium metal. To remove residual cadmium, the salt products were transferred to a Cd distiller. The Cd concentration in the eutectic LiCl-KCl-UCl<sub>3</sub> salt was then decreased up to 200 ppm by the Cd distillation for 2 hrs at 60 torr, 600 °C. The XRD analysis results of the salt product after uranium chlorination reaction showed good products, as shown in Fig. 1. The distilled eutectic salt was transferred to a pelletizer through a pressurized transfer system to make the pellet type salt. The temperature of the tubing lines of the pressurized transfer system has to be maintained at about 500 °C. Added pressure in the transfer system was kept to be 3 bar/cm<sup>2</sup> using argon gas. The pellet type salt was made from the transferred salt at 90 - 130 °C, as shown in Fig. 2. And a pellet was easily separated from the mould of the pelletizer in the room temperature.



Fig. 1 Pellet-type LiCl-KCl-UCl<sub>3</sub> salt



Fig. 2 XRD analysis of LiCl-KCl-UCl<sub>3</sub> salt product

### 3. Conclusions

The experiment for making pellet type LiCl-KCl-UCl<sub>3</sub> salt was carried out using a chlorinator, Cd distiller, and pelletizer. The Cd concentration of the final salt products was 200ppm from results of the ICP and XRD analysis. Pellet type salt products were fabricated using the mould of the pelletizer at 90~130 °C.

#### **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