

## Decontamination of alkali chloride baths containing nuclear material by precipitation and distillation techniques

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### 1 Introduction

By the pyro-reprocessing of spent fuel, uranium can be electrochemically recovered using molten salts. Since waste salt generated from pyro-reprocessing test contains uranium can easily capture moisture from the air and corrode equipment and piping material, further treatment technology for decontamination and waste stabilization should be required. The aim of this study is to develop a simple separation method for decontamination of salts. A two-step process has been considered. In the first step, oxides are added as oxygen donor in the melts, and then uranium is separated from the salt as precipitates. In the next step, melt bath components are evaporated by a vacuum distillation.

In this study, LiCl-KCl eutectic and NaCl-2CsCl salts were used as melt baths, lithium oxide was used as a precipitant, and cerium chloride was used as uranium surrogate for testing the precipitation process. The amount and the procedure of addition of the precipitant and reaction condition has been optimized by the aid of evaluation of chemical status of cerium in the precipitation.

### 2 Experiment

5 g of salts and 5 wt% of cerium chloride were added to a quartz cell and melted in an electric furnace in the argon circulated glove box in the controlled area of the Atomic Energy Research Lab, TCU. The temperature was set at 700 °C for LiCl-KCl eutectic and 800 °C for NaCl-2CsCl salt, respectively.

Next, a continuous addition test was conducted in which lithium oxide was added chemical stoichiometric amount of Ce in 50% increments up to 200%, and allowed to keep for 1.5 hours each time, and using a sampling tube, collected the supernatant bath salt. Batch tests were conducted in which oxides were added in advance in amounts of 50%, 75%, 100%, 150%, and 200%, respectively.

After the precipitation test, the supernatant was subjected to ICP-OES and ion chromatography analysis, and the precipitation was subjected to XAFS analysis. XAFS measurement was carried out at Energy Accelerator Research Organization Photon Factory BL-27B, in transmission mode, using Ce-L<sub>3</sub> absorption edge.

### 3 Results and Discussion

As shown in Fig. 1, the valence of the cerium in precipitates generated is equivalent to 3. As shown in Fig. 2, it is considered that oxychloride was formed by the

similarity in EXAFS oscillation pattern, as already reported in literature [1]. Amount of the precipitates increased with increasing the amount of oxide, thus recovery ratio of cerium must potentially depend on solubility of oxychloride into the bath salts.

In the future, we will conduct distillation experiments and a detailed study of the evaluation of mass balance in each steps and the introduction for efficient salt recovery system in distillation equipment will be carried out using uranyl chloride sample for mockup examination.

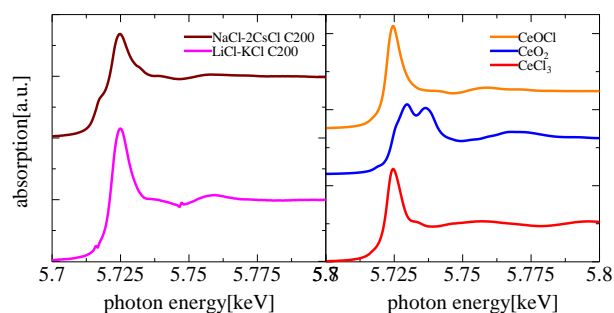


Fig.1 XANES of the cerium in precipitates generated and comparative chemical compounds

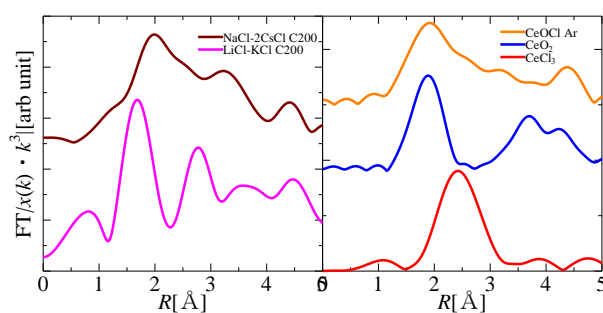


Fig. 2 EXAFS structural function of precipitates generated and comparative chemical compounds

### References

[1] Yoshiharu Sakamura et al., Central Research Institute of Electric Power Industry Research Report T96073 (1996) p.7

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