

## Development of interface technology between unit processes in E-Refining process

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### 1. Introduction

The pyroprocessing is composed mainly four sub-processes, such as an electrolytic reduction, an electrorefining, an electrowinning, and waste salt regeneration/solidification processes.

The electrorefining process, one of main processes which are composed of pyroprocess to recover the useful elements from spent fuel, is under development by Korea Atomic Energy Research Institute as a sub process of pyrochemical treatment of spent PWR fuel. The CERS(Continuous ElectroRefining System) is composed of some unit processes such as an electrorefiner[1], a salt distiller [2], a melting furnace for the U-ingot [3] and U-chlorinator (UCl<sub>3</sub> making equipment) as shown in Fig. 1.

In this study, the interfaces technology between unit processes in E-Refining system is investigated and developed for the establishment of integrated E-Refining operation system as a part of integrated pyroprocessing.

### 2. Electrorefining Process

The laboratory-scale CERS with a throughput of 20kgU/day is currently being developed and improved technically by conducting functional tests of equipment. The electrorefining system starts from the uranium deposition in molten LiCl-KCl salt with about 9 wt% UCl<sub>3</sub>. The reduced uranium metal at the electrolytic reduction system is fed into an anode basket in the electrorefiner. Uranium is recovered as a dendrite form on graphite cathodes, which are located in the core part of the reactor and then the

deposited uranium at the solid cathode fall spontaneously from the cathode, and is finally collected at the bottom of the electrorefiner. The collected uranium deposits are conveyed by a screw and transferred to a container. And the uranium deposits are fed into a salt distiller by the interface apparatus, and the salt-distilled uranium is melted and subsequently reformed to U-ingots. The CERS was designed to continuously operate with a capacity of 20 kgU/day.

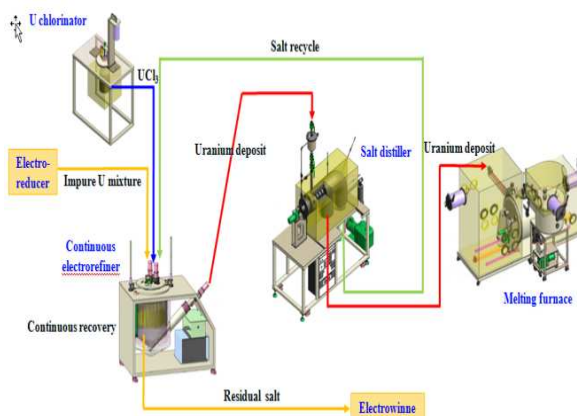


Fig. 1. Schematic diagram of unit processes in E-Refining system

### 3. Interface technology between unit processes in E-Refining system

Unit processes in E-Refining system consist of an electrorefiner, a salt distiller, a melting furnace, and U-chlorinator. Among four electrorefining processes, an electrorefiner and a salt distiller are installed in Ar cell of PRIDE facility, and a melting furnace and U-chlorinator are installed on the 1<sup>st</sup> floor of PRIDE facility. The interfaces technology between unit

processes in E-Refining system should be studied and developed for the establishment of integrated E-Refining operation system as a part of integrated pyroprocessing. Especially, the development of the interface technology for transporting U dendrite between an electrorefiner and a salt distiller is important because two unit processes are installed in Ar Cell and should be handled remotely.

The interface apparatus for U-deposit transport between electrorefiner and a salt distiller will be designed and manufactured as shown in Fig. 2, and then, the performance test will be conducted. The interface technology between electrorefiner and U-chlorinator for the transport of  $UCl_3$  and interface technology between a salt distiller and a melting furnace for the transport of the salt distilled U-deposit should be also examined.

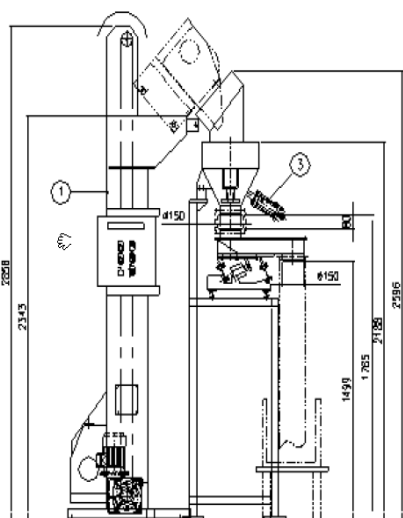


Fig. 2. Manufacture drawing of a apparatus for U deposit transport

#### 4. Conclusions

Some interfaces between unit processes in CERS are currently being developed for an establishment of an integrated operation of pyroprocessing. Especially, the interface between the electrorefiner and the salt distiller is important because both engineering-scale

processes will be located in Ar-cell and be handled remotely. For a transfer from the collected uranium deposits at the bottom of the electrorefiner to the salt distiller, the interface apparatus is planned to be constructed and will be tested for its performance.

#### REFERENCES

- [1] J.-G. Kim, S.-B. Park, S.-C. Hwang, Y.-H. Kang, S.-J. Lee, and H. Lee, The Development of U-recovery by Continuous Electrorefining, J. of the of the Korean Radioactive Waste Society, 8, 71, 2010.
- [2] S.-B. Park, K.-M. Park, W.-G. Jun, D.-W. Cho, S.-C. Hwang, Y.-H. Kang, J.-G. Kim and H. Lee, Study of the Formation of Eutectic Melt of Uranium and Thermal Analysis for the Salt Evaporation of Uranium Deposits, J. of the Korean Radioactive Waste Society, 8, 41, 2010.
- [3] Y.-S. Lee, -H. Cho, S. H. Lee, J.-K. Kim, and H. Lee, Uranium ingot casting method with Uranium deposit in a Pyroprocessing, J. of the Korean Radioactive Waste Society, 8, 71, 2010