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Development of High-temperature Molten Salt Transport Technology

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1. Introduction

Pyroprocessing technology is a promising technology for many advanced fuel cycle scenarios with favorable economic potential and intrinsic ploliferation-resistance [1,2]. The pyrochemical process, which has been developed by Korea Atomic Energy Research Institute (KAERI) since 1997, consists of processes such as pretreatment, oxide reduction, electrorefining, electrowinning, and waste salt treatment.

In pyroprocessing, high-temperature molten salt transport technologies are required because the molten salt used in an electrorefiner should be transported to next process, the electrowinning process to recover U/TRU/RE after the electrorefining process is finished. However, there have been few transport studies on high-temperature molten salt [2]. Therefore, in pyrometallurgical processing, the development of high-temperature molten salt transport technology is a crucial prerequisite.

In this study, three different salt transport technologies (gravity, suction pump, and centrifugal pump) were investigated. In addition, a Pride salt transport system for an engineering-scale salt transport was constructed and installed in an Ar cell, the second of the PRIDE (PyRoprocessing Integrated inactive Demonstration) facility for the development of a high-temperature transport technology for molten salt. In addition, the performance test of the apparatus in the system was then carried out.

2. PRIDE salt transport system

PRIDE (PyRoprocessing Integrated inactive D-Emonstration facility) is an engineering-scale pyroprocess demonstration facility with the world's largest capacity using non-irradiated materials.

The PRIDE salt transport system is an apparatus to transport the salt (about 300 kg of LiCl-KCl eutectic) used in an ER reactor to an electrowinner to recover TRU and RE (Rare Earth) after an lecrtorefining operation. This system consists of a salt ingot manufacturing apparatus, a salt ingot separation apparatus, and a salt ingot charging /transport apparatus.

The system has six ingot molds (capacity of 10 kg LiCl-KCl salt) on a turntable; In addition, about 10 kg molten salt is transported using suction, filling up 6 ingot molds consecutively using a turntable type. A Pride salt transport system was designed and installed in an Ar cell, the second of the PRIDE facility, as shown in Fig. 1.

3. Result and Discussions

Three different salt transport technologies were investigated. The suction pump transport method was selected as a method for high-temperature molten salt transport in KAERI owing to its flexibility.

To develop engineering-scale salt transport technology, the PRIDE salt transport system was designed and installed in the Ar cell, the second of the PRIDE facility.

All of devices and items of the system were designed and constructed to enable their disassembly and assembly remotely using remote control tools within the Ar cell such as MSM (Master Slave Manipulator), BDSM (Bridge transported Dual arm Servo-Manipulators) and a crane as shown in Fig. 2.

Performance tests of the heating and vacuum system were performed by increasing the temperature of the furnaces to 500℃ and reducing the pressure in the vacuum chamber to 100mtorr, and its performance was confirmed. The temperature profiles of the heating furnaces of the system for the heat-up process are shown in Fig. 3. Engineering-scale salt transport experiments will be performed in the future.

Fig.1 A Pride salt transport system in an Ar cell

Fig.2. Remotely control tools within Ar Cell

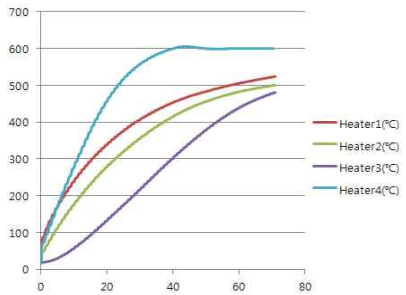

Fig. 3. Temperature profiles of the heating furnaces of the system for the heat-up process

4. Conclusions

After the electrorefining process, the molten salt used is transported to an electrowinning system to recover U/TRU/RE, and a high-temperature molten salt transfer technology by suction is now being developed.

To develope engineering-scale salt transport technology, a PRIDE salt transport system was designed and installed a Ar cell, 2nd of the PRIDE facility for engineering-scale salt transport demonstration, and its performance was confirmed from blank and performance tests for the PRIDE salt transport system. In addition, the engineering-scale salt transport experiments will be performed under several conditions in the future.

REFERENCES

[1] T.Koyama et al., Development of high temperature transport technologies for liquid cadmium in pyrometallurgical reprocess, J. of Power and Energy System, Vo.3,No.1,p170 2009.

[2] B. Hanson et al., “Pyrochemistry:A Program for Industrialization” Proceeding of GLOBAL 2003, New Orleans, Nov.