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Preliminary Study on the High Temperature Transport System for Molten Salt

S. H. Lee*, H. S. Lee, J. G. Kim
Korea Atomic Energy Research Institute, P.O. Box, 105, Yuseong, Daeejon 305-353, Korea
* *Corresponding author: shlee6@kaeri.re.kr*

1. Introduction

Pyroprocessing technology is one of the the most promising technologies for the advanced fuel cycle with favorable economic potential and intrinsic proliferation-resistance [1]. The electrorefining process, one of main processes is composed of pyroprocess to recover the useful elements from spent fuel, is under development at the Korea Atomic Energy Research Institute as a sub process of the pyrochemical treatment of spent PWR fuel.

High-temperature molten salt transport technologies are required because a molten salt should be transported from the electrorefiner to electrowiner after the electrorefining process.

Therefore, in pyroprocessing technology, the development of high-temperature transport technologies for molten salt is a crucial prerequisite. However, there have been a few transport studies on high-temperature molten salt [2].

In this study, an apparatus for suction transport experiments was designed and constructed for the development of high temperature molten salt transport technology. Suction transport experiments were performed using LiC-KCl eutectic salt.

2. Experimental apparatus

A experimental apparatus with a glove box for suction transport experiments was designed and constructed.The apparatus consists of two reactors and a transport tube with a heating furnace, a vacuum chamber,vacuum pump, and control panel, et al.. The apparatus is shown in Fig. 1.

3. Result and Discussions

Three different salt transport technologies (gravity, suction pump, and centrifugal pump) were investigated. Among the molten salt transport methods, the suction pump transport method was selected for molten salt transport. An apparatus for suction transport experiments was installed and a performance test of the apparatus was performed by increasing the temperature and reducing the pressure in the reactor.

Before suction transport experiments, predissolution tests of the salt using the experimental apparatus was carried out. LiCl-KCl eutectic salt was prepared by mixing 99.0% LiCl and KCl and drying in a convection dry oven at 200℃ for 1hr.

From the resultd of the pre-dissolution of salt, it was found that prepared LiCl-KCl eutectic salt was well dissolved at 500℃. After the dissolution test of 500g salt, a salt ingot was shown in Fig. 2.

Several suction transport experiments using molten salt (LiCl-KCl eutectics) were carried out. After about 2kg LiCl-KCl eutectic salt was prepared, and put into melting reactor for the experiment, a molten salt transport experiment was carried out at a temperature of 500℃, and a vaccum pressure range, 10mtorr- 10torr.

The molten salt transportation is driven by the vacuum pressure reduction of the reactor vessel through a vacuum pump and maintaining the temperature above the melting point.

From the experimental results, about 1.82 kg of salt was transported through the transport tube from the melting reactor to the receive reactor. Considering residual salt, about 0.18kg at the bottom of melting reactor due to the conical type of the melting reactor, most of the molten salt in the melting reactor was transported by the suction transport method. The transported salt in salt mold vessel is shown in Fig. 3

Fig.1 Apparatus for suction transport experiment

Fig.2. Salt-Ingot prepared at 500℃.

Fig. 3 Transported salt in mold vessel.

4. Conclusions

After electrorefining, the residual molten salt is transported to an electrowinning system to recover U/TRU/RE, thus high temperature molten salt transfer technolgy by suction is now being developed. An apparatus for suction transport experiments was designed and constructed. Also, pre-dissolution tests of the prepared LiCl-KCl salt using the experimental apparatus was carried out. From the results, it was found that the prepared LiCl-KCl eutectic salt was dissolved well at 500℃. Several suction transport experiments using molten salt (LiCl-KCl eutectics) were carried out, and from the experimental results, most of the molten salt without about 0.18kg at the bottom of melting reactor due to conical type of the melting reactor was transported by the suction transport method. High temperature molten salt transport experiments are currently being performed for the development of a high temperature molten salt transport technology.

REFERENCES

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