Development of High Temperature Transport System for Molten Salt

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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 electror-efining process, one of main processes which 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 technol-ogies are required because a molten salt should be transported from the electrorefiner to electrowiner after the electrorefining process.

Therefore, in pyrometallurgical processing, the development of high-temperature molten salt transport technologies 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 transport techn-ology for molten salt, and the performanance test of the apparatus was performed. And also, pre-dissolution test of the salt was carried out using the reactor with furnace in experimental apparatus.

2. Experimental apparatus

A experimental apparatus was designed and constructed for the suction transport experiments.

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

3. Result and Discussions

Three different salt transport technologies (the gravity, the suction pump, and the 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 the performance test of the apparatus was performed by increasing the temperature and reducing the pressure in reactor.

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

The theoretical pump head was evaluated by using Equation 1.

$$H_{th} = \frac{10.2}{\rho}\left(101 - \left(\frac{PV_V + 101V_T}{V_V + V_T} + P_{salt}\right)\right) \qquad (1)$$

Where, H_{th}: Theoretical pump head [cm], ρ: Salt density [g cm^{-3}], P: Pressure in vacuum tank [kPa], V_V: Volume of vacuum tank [dm^3], V_T: Volume of suction tube [dm^3], P_{salt}: Vapor pressure of salt [kPa].

From the result of 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.

The physical properties of LiCl-KCl molten salt at 500℃ was shown in Table 1.

Table 1. physical properties of molten salt at 500℃.

Molten salt	LiCl-KCL eutectics
Melting point(K)	625
Density(g cm^{-3})	1.621
Viscosty(cp)	2.231
Pumping Temp.(K)	773

4. Conclusions

After electrorefining, the residual molten salt is transported to electrowinning system in order 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. The performance test of the apparatus was carried out, and the theoretical pump head was evaluated. And also, pre-dissolution tests of the prepared LiCl-KCl salt using the experimental apparatus was carried out. From the result, it was found that prepared LiCl-KCl eutectic salt was dissolved well at 500℃. The high temperature molten salt system is currently being developed.

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Fig.1 Apparatus for suction transport experiment

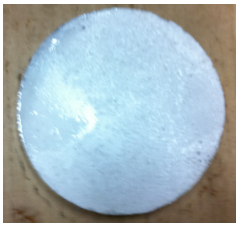

Fig.2. Salt-Ingot prepared at 500℃

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).

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