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Study on the Transport System for High Temperature Molten Salt Transport

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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 electrorefining 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 technologies 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, three different transport technologies for molten salt transport were investigated to select the most suitable salt transport method. And an apparatus for suction transport experiments was designed and installed and the theoretical pump head was evaluated.

2. Experimental apparatus

A experimental apparatus was designed and installed 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 transport technologies (the gravity, the suction pump, and the centrifugal pump) were investigated. Among the molten salt transport methods, the gravitation transport is the simplest transport method, however the transport capacity would strongly depend on the design of equipment, and also, a transport method using the centrifugal pump is favorable for controlling the flow rate and the head. However, very few companies manufacture the molten salt transport pump at high temperature above 500℃ due to material corrosion by molten salt (LiCl-KCl eutectic). Recently, A centrifugal pump (MAE-V) for high temperature LiCl-KCl molten salt transport was manufactured by Sanwa-hydrotech Co. in Japan asa joint study with the Central Research Institute of Electric Power Industry(CRIEPI) in Japan over about 3 year. A high-temperature molten salt pump manufactured by Wenesco, a company in USA is shown in Fig. 2.

Considering the difficulty of manufacturing the centrifugal pump and the characteristics of the electrorefining system, the suction pump transport

method was selected for the molten salt transport from the electrorefiner to electrowinner.

For basic suction transport experiments, An experimental apparatus was designed and installed.

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].

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

Three different transport technologies (the gravity, the suction pump, and the centrifugal pump) were reviewed in order to select the most suitable method for molten salt transport. Considering the difficulty of procuring the centrifugal pump and the characteristics of the electrorefining system, the suction pump transport method was selected for molten salt transport. An apparatus for suction transport experiments was installed and the performance test of this apparatus will be performed.

Fig.1. Apparatus for suction transport experiments.

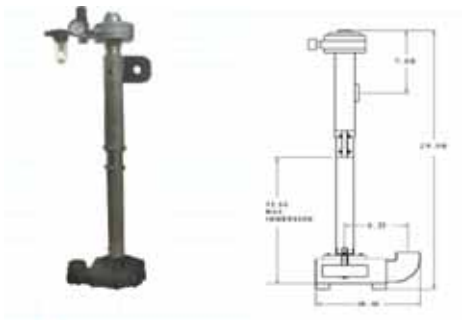

Fig.2. Wenesco's high-temperature molten salt pump.

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