

## Removal of Eutectic Salt from Precipitate by Vacuum distillation

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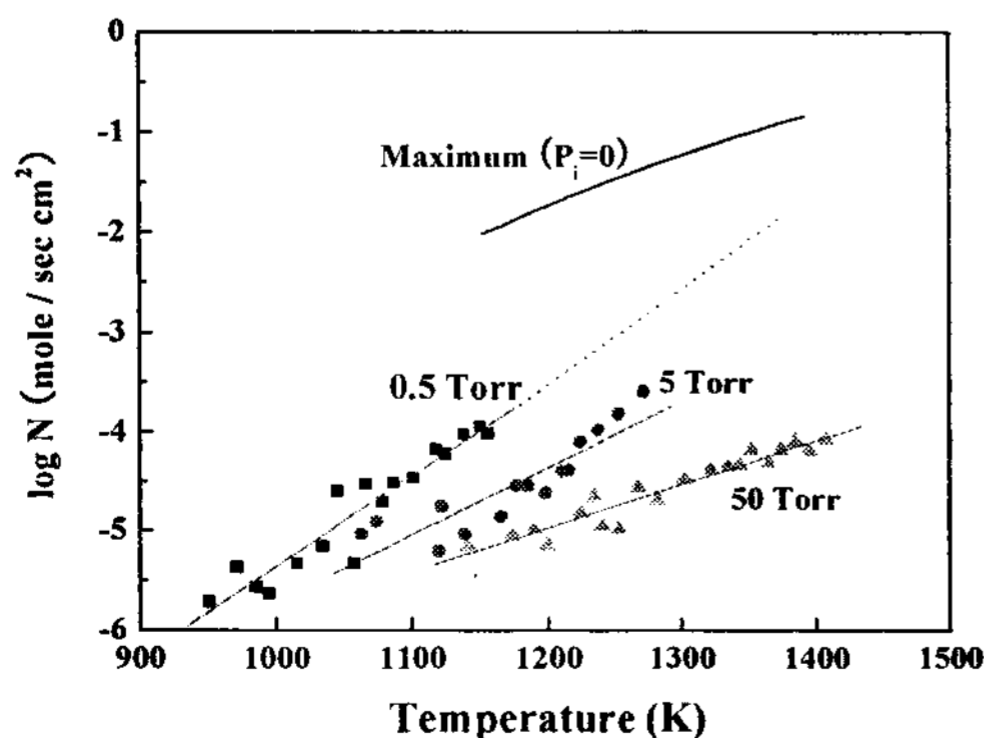
### 1. Introduction

Distillation of eutectic salt from RE precipitates originating from the oxidative precipitation process was investigated. This work is divided into two parts. The distillation behavior pure eutectic salt under different vacuums at high temperatures was investigated by using thermo-gravimetric furnace system. The results were compared with the theoretical maximum distillation rate derived from the Hertz-Knudsen's classical kinetic theory of gas. In the second part, we tested the removal of eutectic salt from the RE precipitates by using the laboratory vacuum distillation furnace system. Investigated variables were the temperature, the degree of vacuum and the time.

### 2. Methods and Results

#### 2.1 Distillation rate of pure eutectic salt

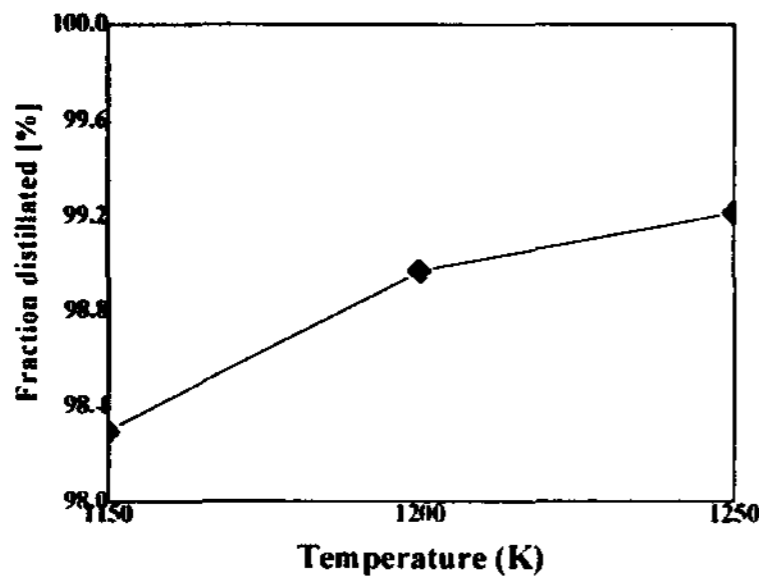
Distillation rates of pure eutectic salts as a function of temperature were determined from the weight loss obtained from non-isothermal TG analysis. In Fig. 1, obtained distillation rates of 0.5, 5 and 50 Torr were compared with the maximum distillation rate in absolute vacuum. Increasing effect of the temperature increase becomes greater as the vacuum increases. Vary fast distillation rate higher than  $10^{-3}$  mole/cm<sup>2</sup>.sec can be obtained at higher temperatures above 1300 K and vacuums less than 0.5 Torr. Salt distillation operation with a moderated distillation rate of  $10^{-4}$ - $10^{-5}$  mole/cm<sup>2</sup>.sec is possible at temperatures less than 1300 K and vacuums of 5-50 Torr.



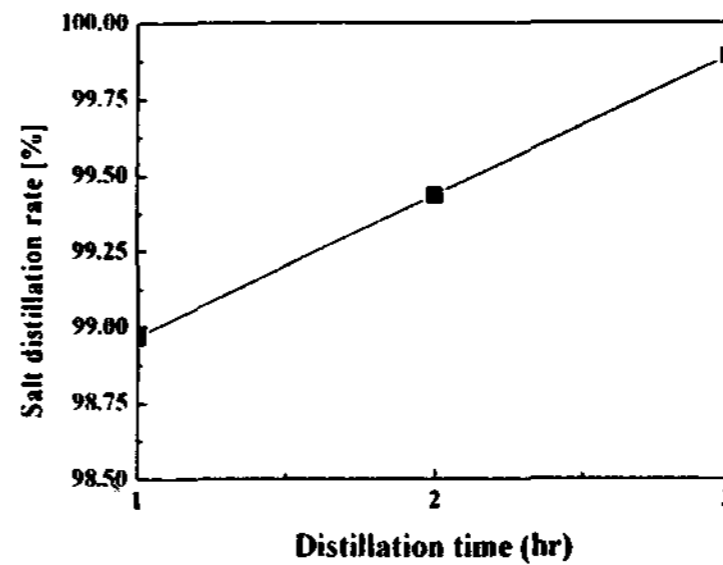
#### 2.2 Salt removal from precipitates

The precipitates obtained from the RE oxidative precipitation process, which simulated the compositions of REs in the spent LiCl-KCl salt from electro-refining process, was used in this second part study. The precipitate is composed of about 85-90% of salt and 10-15% REs. Investigating variables are the distillation temperature, time and vaporizing surface area of melted salt. Tested distillation temperatures were 1150, 1200 and 1250 K. The degree of vacuum

Fig. 1 Salt distillation rates under different vacuums. wasn't varied and it was



(a) With furnace temperature



(b) With distillation time (temp.=1200K)

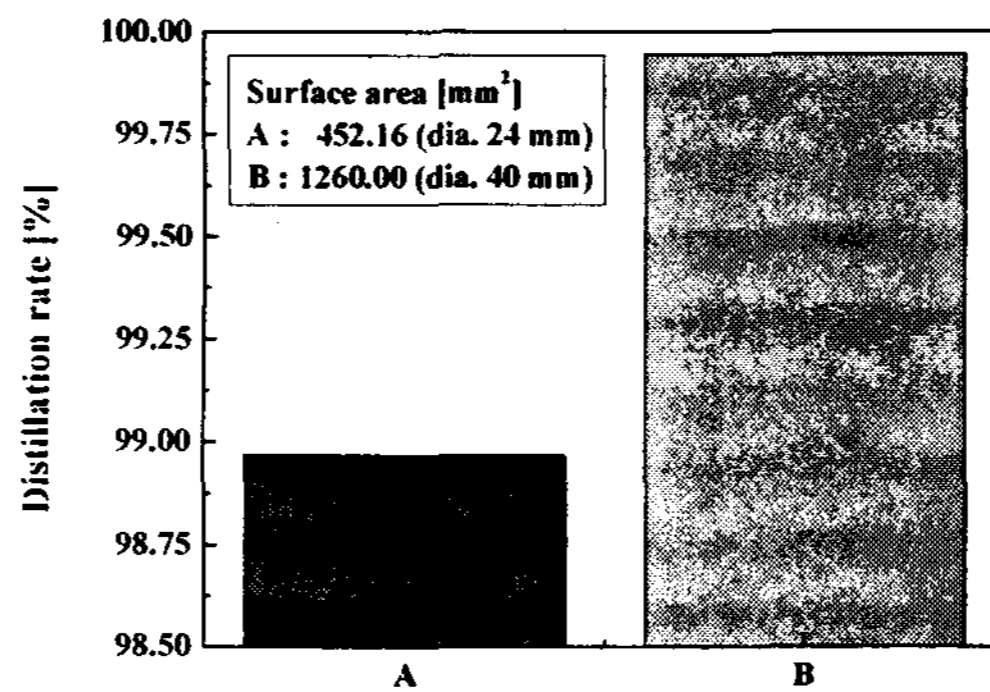


Fig. 2 Salt distillation efficiency (Pabs=50 Torr)

fixed at 50 Torr throughout all the tests. The test results of salt removal from precipitates are shown in Fig. 2. As shown in Fig. 2(a), 99% of salt distillation efficiency was obtained after an hour at the temperature above 1200 K. After two-hour additional distillation operation, 88% of remaining salts was distilled and a total 99.88% of distillation efficiency was obtained after 3 hours (see Fig. 2(b)). Over 99.9% of the total distillation efficiency was obtained for 1-h distillation operation at same temperatures by increasing the inner surface area from 4.52 cm<sup>2</sup> to 12.56 cm<sup>2</sup> (see Fig. 2(c)).

### 3. Conclusion

Salt distillation operation with a moderated distillation rate of 10<sup>-4</sup>-10<sup>-5</sup> mole/cm<sup>2</sup>.sec is possible at temperatures less than 1300 K and vacuums of 5-50 Torr, with minimizing the potentials of RE particle entrainment. An increase in vaporizing surface area is relatively effective for removing residual salt in the remaining particles, when compared to that in vaporizing time. Over 99.9% salt was removed by increasing vaporization surface area under 50 Torr at 1200 K.

### REFERENCES

- [1] H. C. Yang, J. H. Kim, W. Z. Oh, H. S. Park, Y. C. Seo, "Behavior of hazardous and radioactive metals in a laboratory furnace and a demonstration-scale incinerator", Environ. Eng. Sci., Vol. 15, No. 4, 299-311 (1998).