

Extraction of Nd(III) by hydrophobic eutectic solvent BTMPPA/phenol from nitrate solution

Inna V. Zinov'eva (iz@igic.ras.ru), Yulia A. Zakhodyaeva and Andrey A. Voshkin
Kurnakov Institute of General and Inorganic Chemistry of the Russian Academy of Sciences

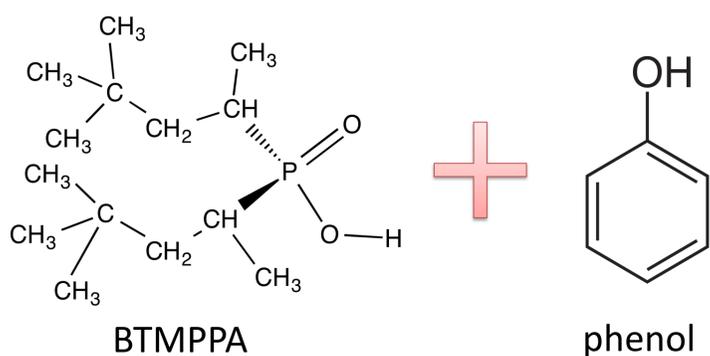
INTRODUCTION & AIM

Today, rare earth elements (REE) are used in the production of high-tech products, including permanent magnets lasers, computer equipment, etc. Recycling of NdFeB magnets is a promising REE resource, as the amount of waste spent magnets increases with increasing demand. Solvent extraction is an effective method in the hydrometallurgical processing of NdFeB magnets. Recently, researchers have been using alternative solvents in the development of new REE extraction processes. Deep eutectic solvents (DES) are increasingly proposed as promising extractants for a wide range of organic and inorganic substances.

The aim of the present work is to study the extraction of Nd(III) with a deep eutectic solvent based on di(2,4,4-trimethylpentyl)phosphinic acid (BTMPPA) and phenol.

METHOD

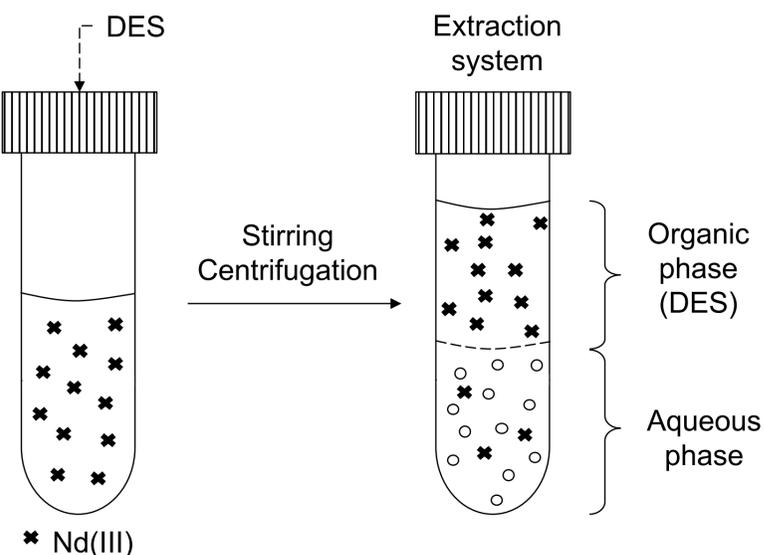
DES preparation: stirring, 60 °C, 1h, molar ratio 1:3



After mixing, a stable liquid phase was formed

Extraction experiments: $V_{org}/V_{aq}=1$, $[Nd]_{init}=0.01$ mol/L

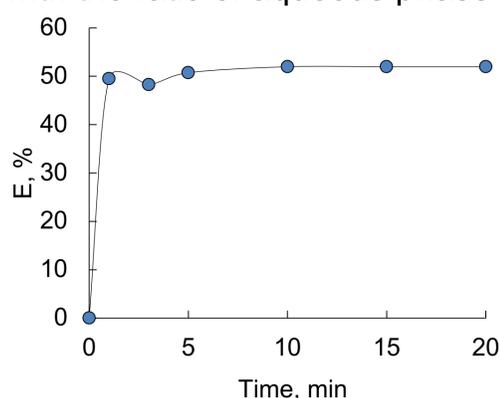
All extraction experiments were carried out at a temperature of 25 °C and an atmospheric pressure of ~100 kPa in graduated centrifuge tubes with a thermostatically controlled shaker.



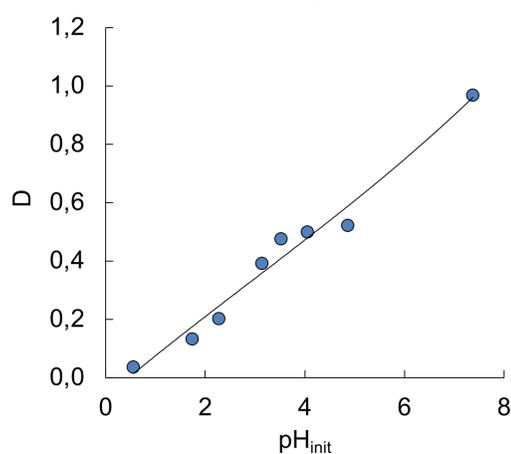
Determination of Nd(III) concentration in aqueous phases was carried out using titration with xylenol orange.

RESULTS & DISCUSSION

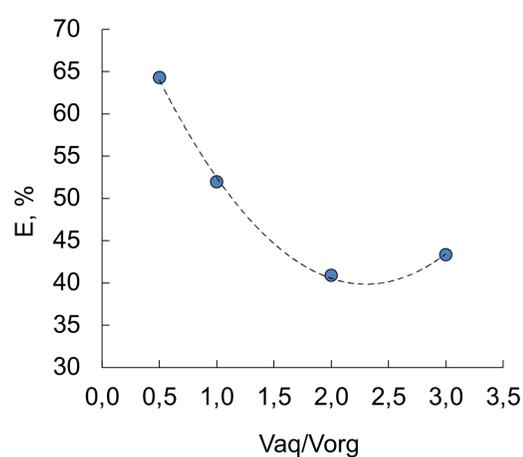
It was found that the distribution coefficient of Nd(III) is 0.43 with the ratio of aqueous phase and DES phase equal to 1:1.



The extraction kinetics are quite fast. The equilibrium in the system is established in 5 min.



The results showed the possibility of increasing the distribution coefficient of Nd(III) up to 0.97 with increasing pH.



Changing the volume ratio of the phases will allow the metal to be concentrated in the DES phase.

The study was supported by a grant from the Russian Science Foundation (project No. 24-29-00667), <https://rscf.ru/en/project/24-29-00667/>.

CONCLUSION

Phosphinic acid-based DES showed good extraction ability towards Nd(III) ions from nitrate media. The use of phenol as a hydrogen bond acceptor avoids the formation of insoluble extractable compounds (third phase). The obtained data can be used in the development of new effective hydrometallurgical processes of REE extraction from leaching solution of spent magnetic materials.

FUTURE WORK / REFERENCES

Work on studying the extraction of other REEs will be continued.

- Dehghani F., *Journal of Supercritical Fluids*, 1996, **9**, 263–272.
- Abranches D.O., Coutinho J.A.P., *Annual Reviews of Chemical Biomolecular Engineering*, 2023, **14**, 141–163.
- Basudev S., Emmanuel O.O., *Separation and Purification Technology*, 2011, **83**, 82–90.