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Solvent extraction of lanthanum (III) using PC88A extractant diluted in kerosene

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Background

Lanthanum (La) occurs in nature with other rare earth elements in numerous minerals, including bastnäsite ($(Ce,La,Y)CO_3F$) and monazite ($(Ce,La,Nd,Th)PO_4$), and has several industrial applications (Jordens, Cheng and Waters, 2013). Recently, domestic production of rare earth elements has been promoted due to potential supply risk, economic benefits and environmental concerns (Binnemans et al., 2013), making it desirable to develop highly efficient extraction techniques that are cost effective and environmentally friendly.

Research aim

This study focused on the solvent extraction of La from aqueous media. We systematically investigated the effects on the solvent extraction of La of aqueous equilibrium pH; various acid media, including sulfuric acid (H_2SO_4), hydrochloric acid (HCl) and nitric acid (HNO_3); extractant (PC88A) concentration; initial lanthanum concentration; and temperature. The most promising experimental conditions were identified. A molecular modeling approach was also used to understand the metal ion-organic extractant interaction.

Materials

The extractant used was 2-ethylhexyl phosphonic acid mono-2-ethylhexylester, or PC88A. Reagent grade kerosene was used as the diluent for the organic extractant. Lanthanum oxide (La_2O_3) with 99.99 perent purity was used for the preparation of stock solutions of La (III) in different acids.

Results

At initial pH of 7, almost complete extraction – about 98 percent for H_2SO_4 and HNO_3 and about 92 percent for HCl – was obtained from all three acids. Modeling results show that three molecules of PC88A interact with one molecule of lanthanum, which was confirmed by the slope analysis method from experimental data.

Conclusions

Based on the experimental results, HNO_3 and HCl were found to be the preferred aqueous media for the solvent extraction of La. Experimental results were in complete agreement with the molecular modeling results.

References

Jordens, A., Cheng, Y.P., and Waters, K.E., 2013, "A review of the beneficiation of rare earth element bearing minerals," *Minerals Engineering*, Vol. 41, pp.97-114.

Binnemans, K., Jones, P.T., Blanpain, B., Van Gerven, T., Yang, Y., Walton, A. and Buchert, M., 2013, "Recycling of rare earths: a critical review," *Journal of Cleaner Production*, Vol. 51, pp.1-22.

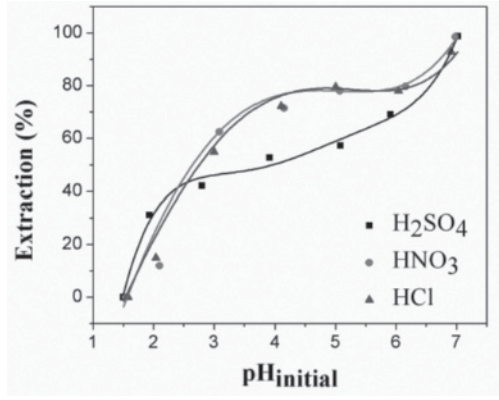

Figure 1 — Effect of initial pH on extraction of La (III).

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