**Solvent extraction of La(III) complex using [bmim][Tf2N] and a β-diketone as extractant and its stripping with supercritical carbon dioxide.**

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**Highlights**

* Solvent extraction La(III) complex using ionic liquid
* Stripping of La(III) complex using carbon dioxide

**1. Introduction**

Lanthanide elements are comparatively abundant in the earth's crust than other commonly exploited elements but are not sufficiently concentrated to make them easily exploitable. This is due to the similarity in their ionic radio, which makes them interchangeable in most minerals, and are very difficult to separate. In recent decades, lanthanide tris- β-diketones, Ln (β-diketone)3 have attracted a lot of attention because of their spectroscopic properties (Binnemans, 2005). Lanthanum was chosen as an exemplifier of the rare earth (REE) series in this study because it is the most abundant trivalent REE that is found in major host rocks for REE minerals, and it also shows the closest match with respect to trivalent actinides among the other REEs in terms of ionic radio in 6-fold coordination (e.g., rLa 1.13 Å and rAc 1.18 Å) (Fricker, 2006). Solvent extraction (SX) is the most effective method to enrich metal ions, including rare earth. The counter current extraction process permits the separation of substances with different distribution coefficients (Mekki et al., 2006). Since the toxic and flammable characteristics of many organic solvents are detrimental to the environment, eco-friendly substitutes have been investigated. As an example, ionic liquids (ILs). The ionic liquids (ILs) have been considered as alternative solvents for solvent extraction processes because of their properties such as low volatility, low flammability, good chemical stability and adjustable miscibility and polarity (Kikuchi, Matsumiya, & Kawakami, 2014). The synergistic enhancement of the extractability depends largely on the type ligand, in this case, trioctyphosphine oxide (TOPO) was used. The chemical structure TOPO is responsible for its properties. Its strong coordinating abilities result from the presence of a single oxygen atom within the molecule (Anitha, Ambare, Singh, Singh, & Mohapatra, 2015).

There are some studies reported in literature on the extraction of metal ions using supercritical fluids (Wang, 1997) and ILs coupled to supercritical fluids (Mekki et al., 2006). In our previous contribution (Sepúlveda et al., 2017) we have tested an extraction technique to recover Cu(II) from aqueous solutions based on the use of an organic phase formed by an imidazolium-based ionic liquid as solvent and a β-diketone as extractant agent. In this framework, the aim of this work involves the improvement of the extraction and stripping of complex La(III) from an aqueous solution using [bmim][Tf2N] as solvent containing a fluorated β-diketone as extractant and dense carbon dioxide as stripping phase. This study is focused on the effect of the concentration of extractant, phase contact time, volumetric Organic/Aqueous (O/A) ratio and overall volume of dense CO2 on the whole process efficiency.

**2. Methods**

The organic phase was prepared with ionic liquid [bmim][Tf2N], as the solvent and β-diketone (HFOD) as the extractant. The aqueous solution was prepared by dissolving 1.0 g/L of La in deionized water (18.2 mΩ). The desired concentration of the salt was reached by using an analytical balance. The pH of these solutions was measured before and after extraction test using a pH meter. The removal of La(Beta-diketona)3 complex from the aqueous solutions was carried out by means of the same procedure reported in our previous work(Castillo et al., 2014; Sepúlveda et al., 2017). The solvent extraction experiments were conducted by contacting 3 mL of aqueous solution with 3 mL of organic phase, where the phases were mixed in a horizontal mechanical shaker (Jin Yi ® model Hj-4B) at 140 rpm for 40 minutes. Then, the phase separation was achieved by centrifugation (Gemi Industrial Corp® model PLC-01) at 1000 rpm for 40 minutes. After phase separation, the final values of pH in the aqueous phase were measured. All the experiments were conducted at room temperature (25°C). Once these phases were completely separated, the concentration of the La(III) in the aqueous phase was quantified by means of Atomic Absorption Spectrophotometry (AAS) (GBS® Scientific Equipment model SensAA dual beam, equipped with a 4mA lamp (single element) Photron International ®). All the experiments were realized with duplicate samples.

The removal of La(III) complex from the aqueous solutions has been carried out by means of the same procedure reported in our previous work(Castillo et al., 2014). Thus, solvent extraction tests were achieved by contacting 2 mL of aqueous solution with 2 mL of organic phase formed by [bmim][Tf2N], beta-diketone and TOPO for 45 min in order to reach the equilibrium conditions. After phase separation the final values of pH and the concentration of La(III) complex in the aqueous phase were measured with a pH-meter and by AAS, respectively. From the results previously reported in literature (Castillo et al., 2014), it has been verified that the extraction of La(III) complex from an aqueous phase using [bmim][Tf2N] as diluent and beta-diketona as extractant is governed by the following reaction, which describes the cation exchange with formation of a neutral complex La(β-diketone)3TOPO.

 La+3 + 3(β-diketone) + 1 TOPO La(β-diketone)3TOPO + 3H+ (1)

**3. Results and discussion**

This research is still being studied, we do not have data.

**4. Conclusions**

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