YTTRIUM RECOVERY FROM A SOLID-LIQUID EXTRACTION PROCESS WITH D2EHPA AND TBP FUNCTIONALIZED RESINS

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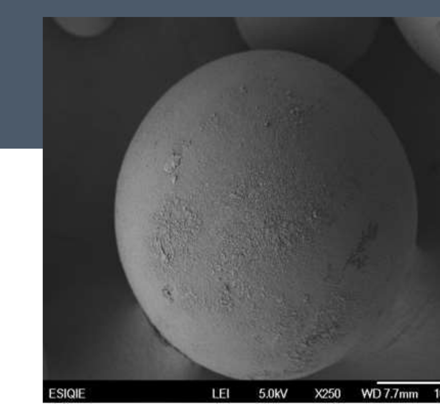


INTRODUCTION

- Rare earth elements, particularly yttrium, have become critical elements due to their high demand in the application of technological products. The level of recycling is very low, in particular less than 1% of fluorescent lamps are recycled worldwide.
- It is estimated that for this year, the phosphorous residues of the lamps that are stored will contain around 25,000 tons of rare earth in greater quantity yttrium and europium.

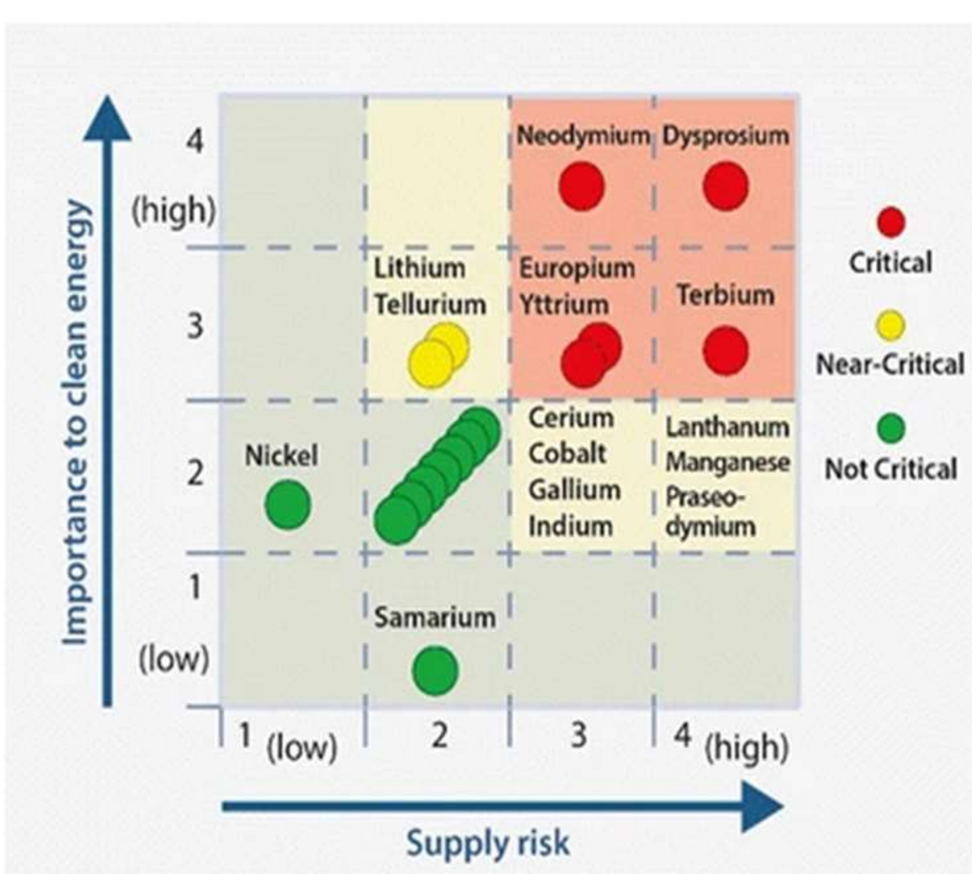
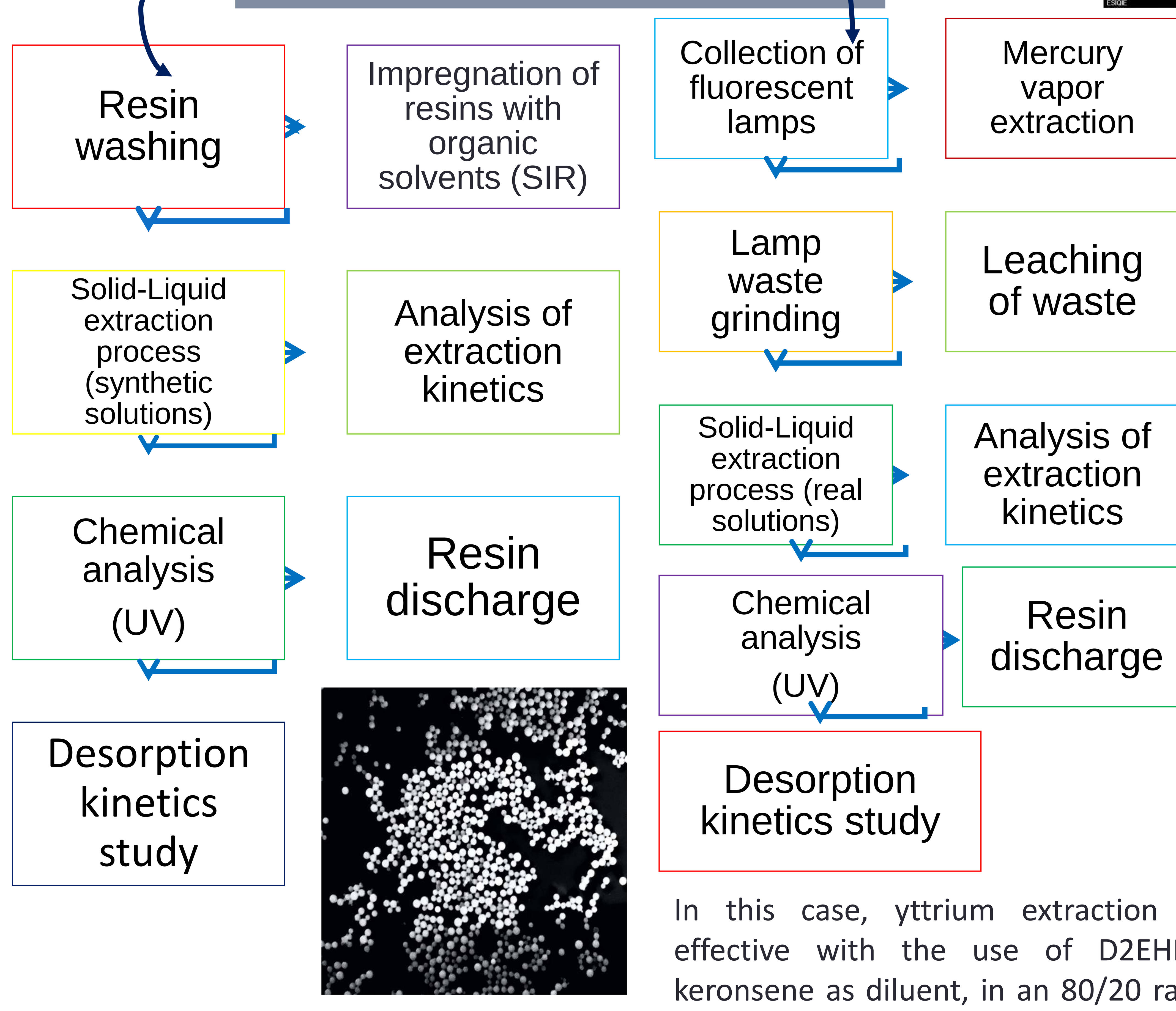


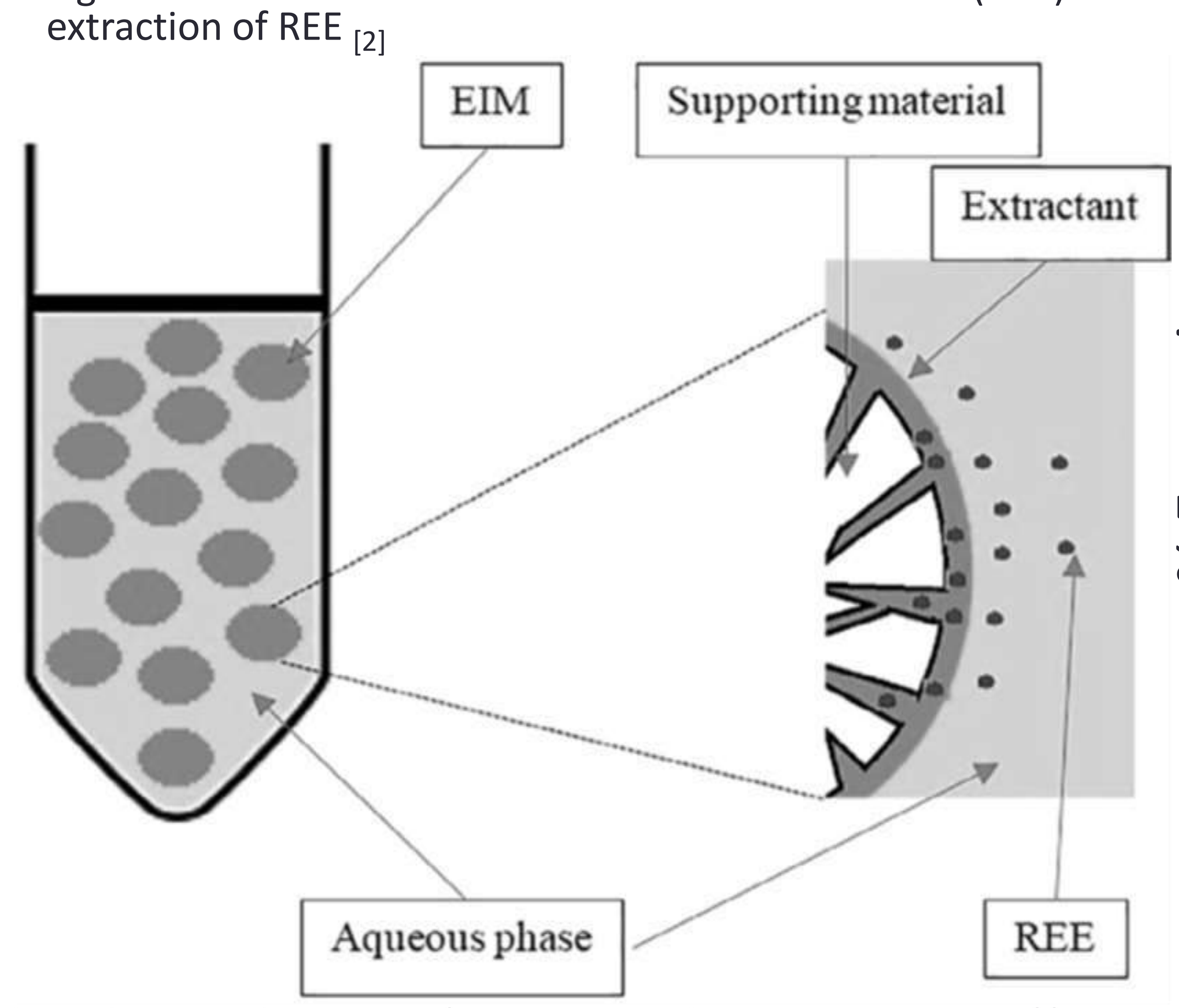
Fig.1 The Department of Energy of U.S. (DOE) medium-term (2015–2025) criticality matrix, showing the five most critical rare-earth elements (Nd, Eu, Tb, Dy, and Y). [1]

- The recovery of yttrium is proposed from the recycling of fluorescent lamps, through the solid-liquid process.
- The solid-liquid process increases the contact area between extractant and metal ions, prevents the formation of a third phase, as occurs in traditional processes such as liquid-liquid, and achieves a reaction equilibrium in less time.

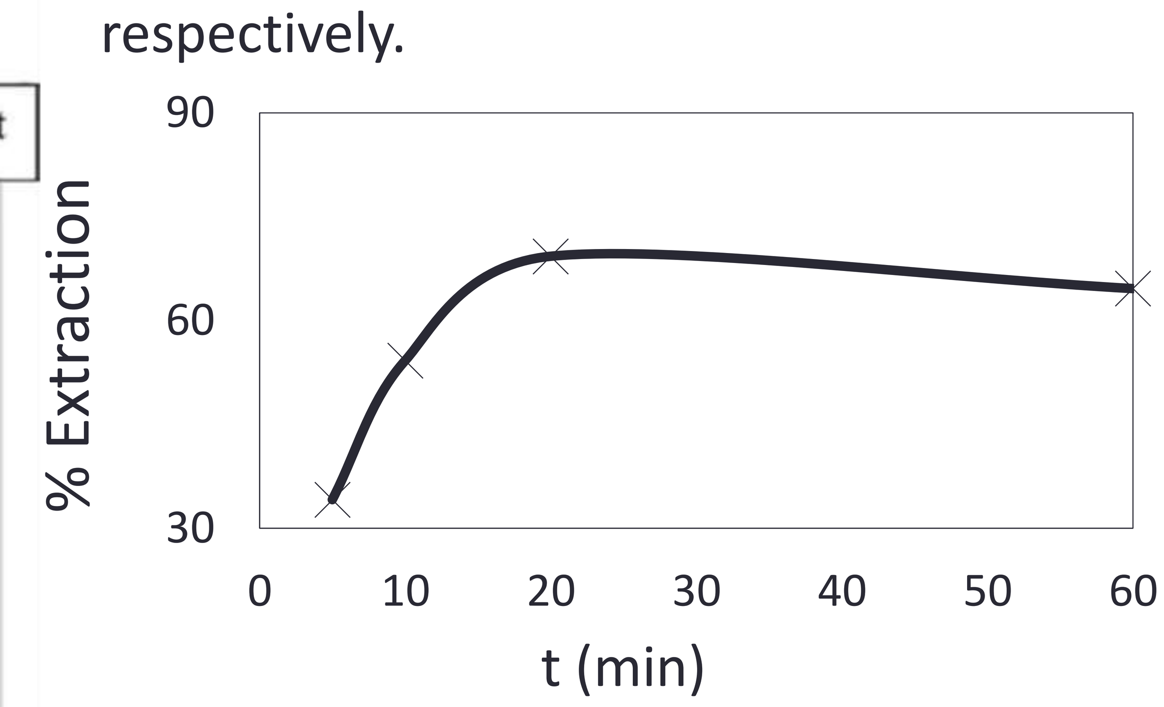
METHODOLOGY



- Fig. 2..Ilustration of Extractant Immobilised Material (EIM) in extraction of REE [2]



In this case, yttrium extraction is highly effective with the use of D2EHPA, using keronsene as diluent, in an 80/20 ratio. With 89.74% recovery, over the 77.29 and 78.91 obtained with 30% and 10% of D2EHPA, respectively.



Extraction kinetics, where the reaction equilibrium is reached in 20 minutes, with more than 60% recovery under normal temperature conditions. with 0.5 g of functionalized resins, and an initial concentration of yttrium of 0.1 g/L pH=1.5

RESULTS

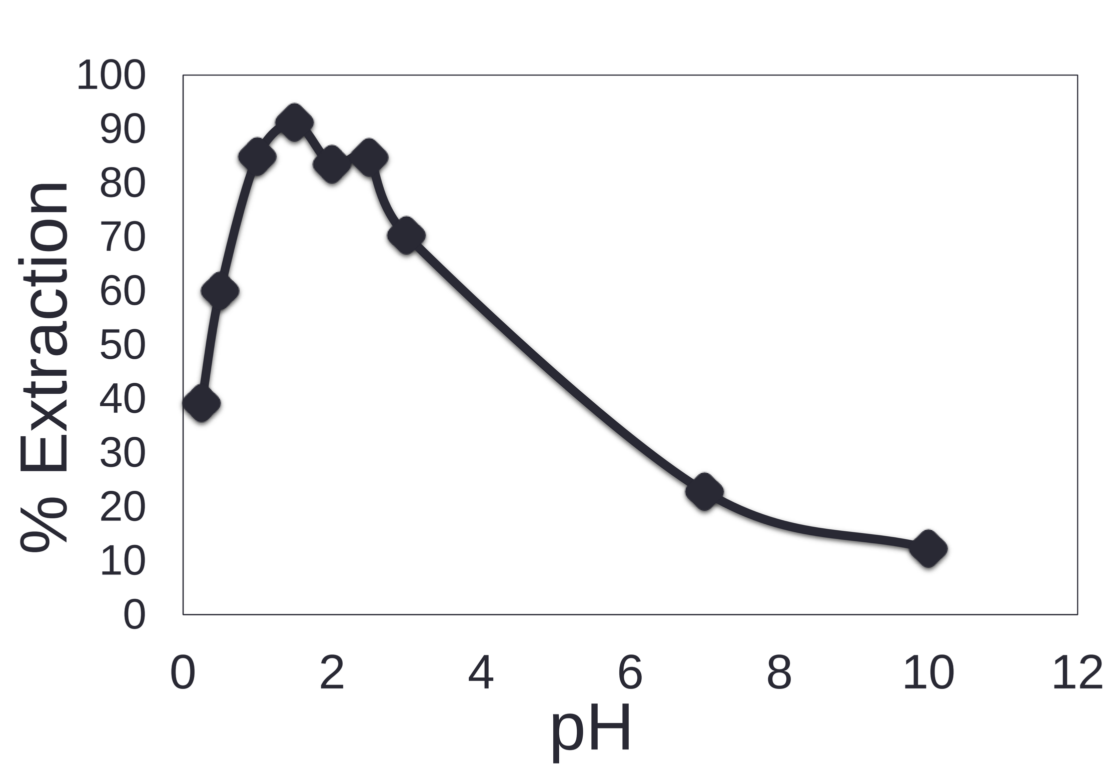
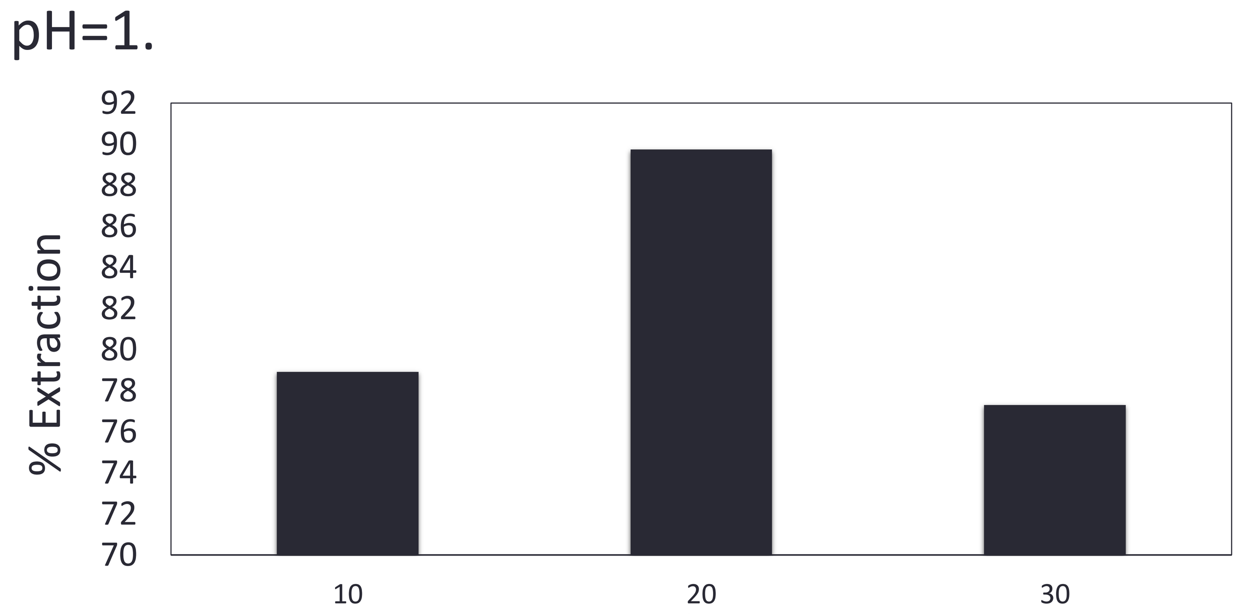


Fig.3.-Yttrium recovery behavior varying the pH. The extractions were performed at 60 minutes, with 0.5 g of resins functionalized at 20% with D2EHPA, and an initial yttrium concentration of 0.1 g/L.

The dependence of rare earth extraction efficiency on pH value may be associated with changes in H+, concentration released by acid extraction. Therefore, in order to favor the high extraction percentage, additional experiments were kept at pH=1.



Yttrium recovery behavior varying the percentage of extractant in dilution with kerosene. Where the highest recovery was 89% with 20% extractant. The tests were carried out at 60 minutes, with 0.5 g of functionalized resins, and an initial concentration of yttrium of 0.1 g/L.

CONCLUSIONS

- D2EHPA-impregnated resins have been successfully obtained.
- XAD-7 resins have been found to be functional for a solid-liquid extraction process with good extraction and desorption results; and show no wear after a duty cycle.
- Equilibrium of the reaction was reached in 20 min. Under normal conditions, this beats the traditional process which according to the literature reaches equilibrium in up to 40 min.

[1] Binnemans, K., Jones, P. T., Blanpain, B., Van Gerven, T., Yang, Y., Walton, A., & Buchert, M. (2013). Recycling of rare earths: a critical review. Journal of Cleaner Production, 51, 1–22.

[2] Sakshi Batra, Anjali Awasthi, Muzaffar Iqbal, and Dipaloy Datta. Solvent impregnated resins for the treatment of aqueous solutions containing different compounds: a review. Reviews in Chemical Engineering. 07 Aug 2020