NEW SELECTIVE EXTRACTION SYSTEM OF RARE EARTH METALS, URANIUM AND THORIUM FROM PHOSPHOGYPSUM WASTE

CONTACT DETAILS:

Research Results Transfer Office-OTRI
University of Alicante
Tel.: +34 96 590 99 59
Email: areaempresas@ua.es
http://innoua.ua.es

ABSTRACT

The Institute of Organic Synthesis and the Institute of Water and Environmental Sciences, both affiliated with the University of Alicante, have jointly developed a mixture extractant composed of a process ionic liquid (TSIL) and an ionic liquid (IL) that allows the selective and efficient extraction of rare earth metals, uranium and thorium compared with other metals from the s, p and/or d series.

This technology is characterised by the fact that the extractant mixture can be reused in new extraction cycles without loss of effectiveness, representing a major advance in sustainability and environmental protection. This novel formulation can mainly be applied to the treatment of phosphogypsum waste. After the separation of the mentioned metals, they could be used in the manufacture of electronic components and in energy generation, respectively. Additionally, a purified gypsum would be obtained, highly useful in the construction sector. Thus, sustainable recovery presents significant added value.

Other applications of this technology in areas such as mining, nuclear chemistry, nuclear medicine and the treatment of nuclear waste are potentially interesting.

Companies interested in acquiring this technology for commercial exploitation through patent licence agreements are sought.

ADVANTAGES AND INNOVATIVE ASPECTS

ADVANTAGES OF THE TECHNOLOGY

This novel extraction procedure has the following **advantages**:

1) Allows the **selective extraction of internal transition metals (f-block)**, especially those classified as **rare earths, uranium and thorium**, against metals belonging to the s, d and/or p blocks of the periodic table in a **highly effective manner**.

2) The extractant mixture is **reusable**: once the extraction procedure is complete, it is possible to fully recover the metal(s) complexed, allowing the extractant mixture to be used in new extraction cycles.

3) The extractant mixture has a low affinity for metals from the s, d and p series of the periodic table, so metals from these series are extracted with a low or negligible percentage.

4) The **recovery percentage of the extractant mixture** is, at least, **95%**, so it can be reused in **new extraction cycles** once the extracted metals have been released.

5) The extraction procedure is **environmentally friendly**.

6) The procedure is carried out under **mild reaction conditions** (temperature between 0°C–25°C and atmospheric pressure).

7) Both the **TSIL compound** and the solvent **CYPHOS NTf_2** are **commercially affordable** (or can be easily prepared via a simple ion exchange).

8) The procedure is **industrially scalable**, able to be adapted and implemented to meet the company's needs. It efficiently and sustainably recovers, separately, rare earth metals, uranium and thorium, and produces high purity gypsum.

In summary, the new extractant mixture is a revolutionary technology that **significantly improves current methods for extracting rare earth metals, uranium and thorium from waste generated in the phosphoric acid industry (phosphogypsum)**.

INNOVATIVE ASPECTS OF THE TECHNOLOGY

This **novel chemical composition** allows **selective and efficient extraction of rare earth metals, uranium and thorium** against other metals from the s, d and/or p series of the periodic table. In this sense, the primary interaction of internal transition metals with the TSIL, which acts as a selective chelator, occurs through the 1,3 dicarbonyl region.

Furthermore, once the extracted metals have been separated, the **original extractant mixture is recovered with a yield exceeding 95%**, allowing its subsequent **use in new extraction cycles**, making it a **sustainable and environmentally friendly procedure**. No other extraction system with these characteristics is available on the market that is reusable.

This methodology adapts exceptionally well to a separation process of rare earths, uranium, thorium and high quality gypsum from waste derived from the fertilizer industry that generates phosphoric acid (impurified phosphogypsum).

MARKET APPLICATIONS

This novel composition can selectively extract internal transition metals against other metals of the periodic table at pH=6.

The main **application sectors** for this novel technology are:

- Fertiliser industry that generates phosphoric acid.
- Mining.
- Nuclear chemistry.
- Nuclear medicine.
- Nuclear waste treatment.
- Scientific research.

With this technology, the problem of selective separation of the chemical elements belonging to rare earths, uranium and thorium, some of which are used as fuels in nuclear power plants, is solved. The selective separation of these metals relative to the rest of the metals collected in the periodic table is crucial, both in the extraction process of the initial **phosphogypsum waste** and in the treatment of **nuclear waste products**. Its application in various industrial sectors can have a positive impact on the **environment** and can contribute to improving global **energy sustainability**.

COLLABORATION SOUGHT

Companies interested in acquiring this technology for **commercial exploitation** through patent **licence agreements** are sought.

Desired company profile:

- Phosphoric acid derived industry.
- Mining.
- Chemical industry.
- Nuclear industry.
- Nuclear medicine.
- Nuclear waste treatment.