Tungsten recovery and arsenic removal from secondary resources - DES in the electrodialytic process

J. Almeida[1], A. Rosário[1], R. Craveiro[2], E. P. Mateus[1], A. Paiva[2], S. Barreiros[2] & A. B. Ribeiro[1]

[1]CENSE, Departamento de Ciências e Engenharia do Ambiente, Faculdade de Ciências e Tecnologia, Universidade NOVA de Lisboa, 2829-516 Caparica, Portugal
[2]LAQV@Requimte, Departamento de Química, Faculdade de Ciências e Tecnologia, Universidade NOVA de Lisboa, 2829-516 Caparica, Portugal
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Presenting author email: js.almeida@campus.fct.unl.pt or abr@fct.unl.pt

Electrodialytic (ED) technology is a clean-up process commonly applied to contaminated liquid and solid environmental matrices. The process is based on the application of an electric current density of the order of milliamps per square centimeter to the cross-sectional area of a matrix between the electrodes, producing electric potential drops in the order of volts per centimeter. Due to the electric field the contaminants are removed from the matrix and driven towards one of the electrodes, from where they may be collected. ED treatment has proved to be efficient on the removal of organic and inorganic contaminants.

Deep eutectic solvents (DES) are composed by at least two components, a hydrogen bond acceptor and a hydrogen bond donor, able to self-associate to form a new mixture characterized by a melting point lower than that of each individual component. Many of the DES applications that are currently employed involve the dissolution of metal ions in the liquid. There is a growing interest in DES and their use as alternatives to conventional organic solvents and ionic liquids. DES have economic, practical and environmental advantages.

In order to make ED technology more competitive on its removal efficiency, namely in mining sources remediation, a rejected fraction from the sludge circuit (that is directly pumped to the dam) from Panasqueira mine (Covilhã, Portugal) was used to test DES addition to the ED scheme. The target elements of the present work are arsenic (As) and tungsten (W).

W is a transition metal commonly used for cemented carbide production, alloys and steels. W primary source, ore bodies from scheelite and wolframite, are becoming gradually limited, being W included in the 2017 EU list as one of the 27 Critical Raw Materials. Additionally, As can be found in this kind of sources. As is a metalloid that is harmful to the environment and to public health because of its toxicity. Since millions of tons of mining rejected fractions are deposited in open air impoundments it makes sense to treat them to minimize its potential risk for the surrounded ecosystems and to empower a safe further reuse of this secondary resource. Thus, sustainable strategies to recover W and to remove As from secondary resources are gaining importance.

In this sense, to develop a working system of ED remediation with DES acting as adjuvants, several parameters were analyzed such as voltage, pH and conductivity. The set-up selected for the experiments was a 2 compartment ED- cell with a cation exchange membrane (CEM) interposed. The aim of this work is to understand if the addition of DES to the ED process improves the removal and the recovery rate of the target elements/compounds.

The definition of the best system design and the improvement of the electro-based technology scheme was obtained through experimental tests carried out at the laboratory for 10 days. Preliminary results show that in 10 days it is possible to remove 94% of As and to recover 49% of W from mining process rejected fractions when DES are added to the matrix solution during the ED treatment with a current intensity of 100 mA.

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