EXTRACTION AND TRANSPORT OF Cd IONS THROUGH A POLYMER INCLUSION MEMBRANE CONTAINING TETRAALKYLPHOSPHONIUM IONIC LIQUID AS A CARRIER

Claudia Fontas[1], I. Ait Khaldoun[2], L. Mitiche[2], A. Sahmoune[2]
[1]University of Girona, Chemistry Department, Girona, Spain.
[2]Equipe de Recherche Matériaux et Procédés pour l'Environnement, Université Mouloud Mammeri Tizi-Ouzou, Algérie.
claudia.fontas@udg.edu

Keywords: Polymer Inclusion Membrane (PIM); tetradecyl(trihexyl)phosphonium chloride (TDTHPCl); plasticizers; Cd(II).

Introduction

Polymer inclusion membranes (PIMs) are chemically functionalized membranes that are commonly composed of an extractant (carrier), a base polymer (usually cellulose triacetate (CTA) or polyvinylchloride (PVC)), and a plasticizer. PIMs usually appear as flexible, thin and stable films that are simple and cheap to prepare. Moreover, they possess good mechanical properties (e.g. strength and flexibility) and are also versatile considering the diversity of target compounds that they can extract (Almeida et al. 2012). It is important to point out that the carrier has the central role in the PIM extraction process. It reactively complexes with the compound of interest, acting as the phase-transfer agent and thus extracting the compound from the aqueous phase into the membrane phase by forming a hydrophobic ion-pair or a complex. PIMs are interesting for metal extraction from aqueous media since this technology combines the extraction and stripping processes into a single unit operation. Several extractants and ionic liquids extractants/carriers have been used in the recovery of Cd(II) from acidic solutions such as tetraalkylphosphonium ionic liquid: tetradecyl)phosphonium bis(2,4,4-trimethylpentyl) phosphinate) (Cyphos 104) (Pospiech, 2015a) and trihexyl(tetradecyl)phosphonium chloride (Cyphos 101)] (Pospiech, 2015b).
In this study, we present the development of a PIM based on the IL trihexyl(tetradecyl)phosphonium chloride (THTDPCl) for the extraction and removal of Cd ions. Several parameters affecting the PIM have been investigated as well as the effect of feed and stripping phase composition.

Methods

All solutions were prepared using analytical reagent grade chemical and ultrapure water. The extractant THTDPCl, the polymer CTA, and the plasticizers were purchased from Aldrich. PIMs were prepared dissolving 0.2 g CTA in 20 mL chloroform and after 5h agitation the corresponding amount of THTDPCl and plasticizer were added. After 1 h agitation the solution was poured in a petri-dish and was let to evaporate.
The metal ion concentrations were determined in the aqueous phase (after dilution in pure water) by ICP-AES (Varian Liberty RL spectrophotometer).

Results

From previous results in solvent extraction studies it was found that THTDPCl quantitatively extracted Cd from NaCl solutions. For that, the feed phase was fixed as 10 ppm Cd in 2M NaCl. We investigated the effect the plasticizer in PIM using as stripping phase ultra-pure water (Pont et al. 2008). Results are presented in fig. 1. When no plasticizer was added (left) Cd was extracted in PIM but not transported. However, the addition of 20% 2-Nitrophenyl octyl ether (NPOE) allowed the quantitatively transport of metal (right).

Moreover other plasticizers were investigated and the transport of Cd after 24 h followed this trend: DBS (84%) > NPOE (82%) > FPOE (73%).

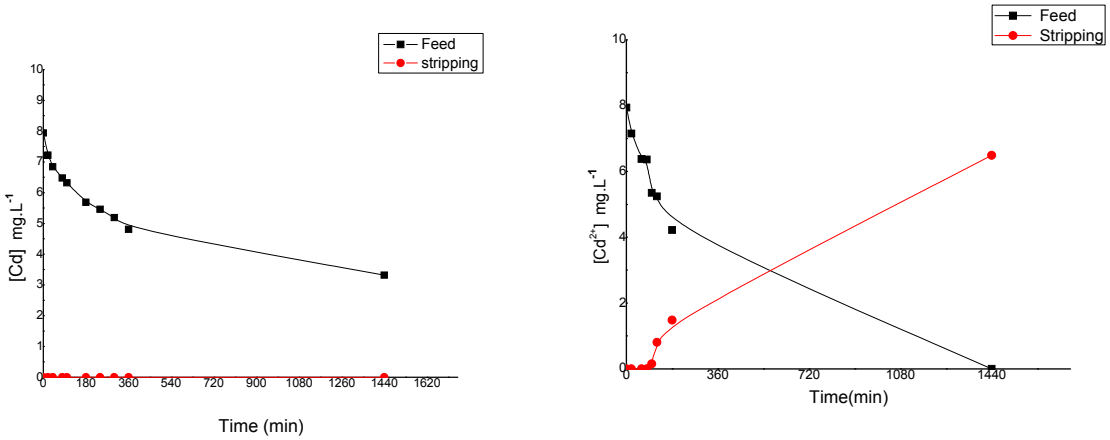

Figure 1. Cd transient concentration curves. PIM: 70% CTA+30% THTDPCl (left); PIM: 50% CTA+30% THTDPCl+20%NPOE. Feed phase: 10 ppm Cd in 2 M NaCl. Stripping phase: ultra-pure water.

Conclusion

A PIM containing the extractant trihexyl(tetradecyl)phosphonium chloride, the plasticizer NPOE and CTA as polymer, has shown its efficiency to quantitatively remove Cd from a chloride solution.

References

Almeida, M. I. G. S.; Cattrall, R.W.; Kolev S.D. (2012), Recent trends in extraction and transport of metal ions using polymer inclusion membranes (PIMs). *J. Membr. Sci*. 415-416, 9-23.

Pont, N.; Salvadó V.; Fontàs C. (2008), Selective transport and removal of Cd from chloride solutions by polymer inclusion membranes J. Membr. Sci. 318, 340-345.

Pospiech, B., (2015a) Studies on extraction and permeation of cadmium (II) using Cyphos 104 as selective extractant and ion carrier. *Hydrometallurgy*, 154, 88-94.

Pospiech, B., (2015b), Application of Phosphonium Ionic Liquids as Ion Carriers in Polymer Inclusion membranes (PIMS) for separation of Cadmium(II) an Copper(II) from Aqueous Solutions. *J. Solution Chem*. 44, 2431-2447.

The financial support of the Spanish Government (research project CTM2013-48967-C2-2-P) is acknowledged.