Chemical Papers 67 (4) 389–397 (2013)
DOI: 10.2478/s11696-013-0310-3

ORIGINAL PAPER

Pertraction of cadmium and zinc ions using a supported liquid membrane impregnated with different carriers

[a]Mohammad Peydayesh, [b]Gholam Reza Esfandyari, [b]Toraj Mohammadi*, [c]Eskandar Keshavarz Alamdari

[a]*Research Centre for Membrane Separation Processes, Faculty of Chemical Engineering, Iran University of Science and Technology (IUST), Narmak, 13114-16846 Tehran, Iran*

[b]*Department of Engineering, Islamic Azad University, South Tehran Branch, 11365-4435 Tehran, Iran*

[c]*Department of Mining and Metallurgical Engineering, Amirkabir University of Technology, Hafez Ave, 15875-4413 Tehran, Iran*

Received 14 August 2012; Revised 4 November 2012; Accepted 4 November 2012

An experimental study on the removal of Cd^{2+} and Zn^{2+} through a supported liquid membrane using a mixture of mono-(2-etylhexyl) ester of phosphoric acid (M2EHPA) and bis-(2-etylhexyl) ester of phosphoric acid (D2EHPA) as carriers is presented. Parameters affecting the Cd^{2+} and Zn^{2+} pertraction such as feed concentration, carrier concentration, pH of the stripping phase, and TBP (tributyl phosphate) concentration were analyzed using the Taguchi method. Optimal experimental conditions for Cd^{2+} and Zn^{2+} pertraction were obtained using the analysis of variance (ANOVA) after a 6 h separation with the initial feed concentration of 8.9×10^{-4} mol L^{-1}, carrier concentration of 20 vol. %, TBP concentration of 4 vol. %, and pH of 0.5. Then, under optimum conditions, a comparison of M2EHPA, D2EHPA, and bis-(2,4,4-trimethylpentyl)monothiophosphinic acid (Cyanex 302) was performed. Effective pertraction of Cd^{2+} and Zn^{2+} using these carriers was observed in the following order: mixture of M2EHPA and D2EHPA, D2EHPA, Cyanex 302. It was also found that the presence of one metal ion in the feed solution reduces the pertraction rate of the other one.

Keywords: supported liquid membrane, cadmium, zinc, M2EHPA, D2EHPA

Introduction

Many industries, mainly electroplating, battery, and plastic manufacturing release heavy metals such as Cd(II) and Zn(II) into the environment (Hasan et al., 2007). Cd(II) is naturally found as a low constituent of base metal ores and coal deposits so it is obtained commercially as a by-product in base metal refining. For instance, 95 % of Cd(II) comes as a by-product from Zn(II) hydrometallurgical processes (Kumbasar, 2009).

Cd(II) is a powerful neurotoxic metal, and its permissible limit in drinking water is 0.01 mg L^{-1}. For Zn(II), which is generally regarded as nontoxic, the recommended upper limit for discharge is about 5 mg L^{-1} (Haji Shabani et al., 2009; Kumbasar, 2009; Hasan et al., 2007).

Several technologies can be used to remove these toxic metals from liquid sewages, including solvent extraction, precipitation, ion exchange, electrochemical processes, etc. (Hasan et al., 2007). Among these techniques, solvent extraction is widely used in the separation and recovery of metals from aqueous solutions. A limitation of the traditional solvent extraction is that a large amount of solvent is required, especially when processing dilute solutions. Liquid membrane systems have recently become an alternative technique for metals separation from dilute solutions as they represent

*Corresponding author, e-mail: torajmohammadi@iust.ac.ir