



Metal ion removal by ultrafiltration of colloidal suspensions of organically modified silica

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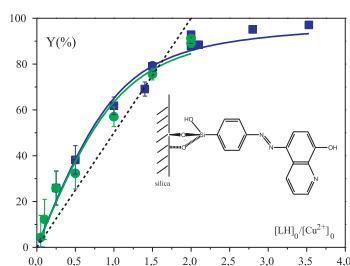
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HIGHLIGHTS

- ▶ Low metal ion concentrations extraction using colloidal organically modified fumed silica.
- ▶ High extraction yields and concentration factors are attained.
- ▶ The loss of extracting phase through the membrane is very low and non toxic.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:

Received 18 July 2012

Received in revised form 25 October 2012

Accepted 27 October 2012

Available online 6 November 2012

Keywords:

Metal ion extraction
Ultrafiltration
Colloidal silica particles
Organo-modified silica

ABSTRACT

Porous fumed silicas (FS) covalently grafted with 5-phenyl-azo-8-hydroxyquinoline (5Ph8HQ) are considered as extractants for copper(II) and nickel(II) at low concentration levels (10–50 μM). The separation of the extracting colloidal functionalized silicas particles from the bulk aqueous phase is achieved by means of the frontal ultrafiltration technique. The stability of the colloidal dispersion of the organically modified silica and of the covalent grafting itself is studied via the loss of silica or of 5Ph8HQ through the ultrafiltration membrane during the separation process. The effects of the anion nature, specific surface area, surface ionization state on the metal ions extraction are assessed. For the sake of comparison, the extraction of copper(II) by 5Ph8HQ solubilized in neutral Triton X-100 (TX-100) micelles has been studied in the most similar experimental conditions, as well as copper(II) extraction by the same ligand in a biphasic water–chloroform system. High copper extraction yields are attained, and taking into account the low volume of extracting phase of the dispersed colloidal silica, high separation factors are obtained. The stoichiometry of the formed complex is the same (1:1) in the two microheterogeneous systems considered here whereas a 2:1 complex is formed in the biphasic liquid–liquid system. The apparent stability constant is greater by a factor 10 in the micelles than for the silica bounded 5Ph8HQ systems but the true affinity of the ligand for copper is 5 times lower in the micelle than on the functionalized systems. Comparing to the literature, it is shown that the type of silica considered (colloidal fumed silica in this work versus silica gel in the literature) greatly influences the affinity of the ligand toward the copper. Finally, the apparent extraction constant in 5Ph8HQ modified silica is ten times higher for copper(II) than for nickel(II).

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1. Introduction

Many research works are devoted to the development of new solutions for the removal of heavy metal ions from industrial wastewater. Among the solvent free processes, various ways are still explored: micellar extraction coupled with ultrafiltration [1],

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