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Nano-silica sorbents immobilized hydrophobic ionic liquids for enhanced adsorptive extraction of cadmium from acidic aqueous solutions

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DESALINATION AND WATER TREATMENT

Volume: 49 Issue: 1-3 Pages: 348-358

DOI: 10.1080/19443994.2012.719464

Published: NOV 2012

[View Journal Impact](#)

Abstract

A method is described for adsorptive removal of cadmium from acidic solutions (pH 1.0) via implementation of nano-silica particles physically impregnated hydrophobic ionic liquids (ILs). Two hydrophobic ILs, [Emim(+)-Tf(2)N(-)] and [Omim(+)-Tf(2)N(-)], were used to modify the surface of nano-silica amine sorbent [Nano-Si-NH₂] for the formation of [Nano-Si-NH₂-Emim(+)-Tf(2)N(-)] and [Nano-Si-NH₂-Omim(+)-Tf(2)N(-)], respectively. The highest cadmium adsorption capacity values (1,100-1,200 mmol g⁻¹) were identified in acidic solutions with pH 1.0, while the lowest mmol g⁻¹ values (0,200-0,350) were characterized in solutions with pH 6.0-7.0. Adsorption of cadmium was monitored and optimized under the influence of several operational controlling conditions and factors such as reaction pH, reaction time, sorbent dose, initial cadmium concentration, interfering ions, and hydrophobicity of ILs. [Nano-Si-NH₂-Omim(+)-Tf(2)N(-)] sorbent was characterized by higher capacity values compared to [Nano-Si-NH₂-Emim(+)-Tf(2)N(-)] sorbent and this behavior was correlated to the more incorporated hydrophobic character in [Omim(+)-Tf(2)N(-)] than [Emim(+)-Tf(2)N(-)]. The two modified nano-silica sorbents were successfully implemented for removal of cadmium from acidic (pH 1.0) drinking tap and industrial wastewater with percentage extraction values of 97.78-99.00 +/- 2.65. The determined percentage extraction values (93.44-96.87 +/- 2.84) were also identified from water samples adjusted to pH 7.0 after three stages of elution in microcolumn approach.

Keywords

Author Keywords: Nano-silica; Hydrophobic ionic liquids; [Emim(+)-Tf(2)N(-)]; [Omim(+)-Tf(2)N(-)];

Adsorption; Cadmium

KeyWords Plus: SOLID-PHASE EXTRACTION; ABSORPTION SPECTROMETRIC

DETERMINATION; WATER SAMPLES; HEAVY-METALS; STATIONARY-PHASE; ANION-EXCHANGE; REMOVAL; LEAD; PRECONCENTRATION; ADSORBENTS

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Categories / Classification

Research Areas: Engineering; Water Resources

Web of Science Categories: Engineering, Chemical; Water Resources

Document Information

Document Type: Article

Language: English

Accession Number: WOS:000311453400037

ISSN: 1944-3994

Other Information

IDS Number: 042EC

Cited References in Web of Science Core Collection: 40

Times Cited in Web of Science Core Collection: 2

