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

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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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