



A novel thiocarbohydrazide derivative for preconcentration of copper(II), nickel(II), lead(II), and cadmium(II) in water samples for flame atomic absorption spectrophotometry (FAAS)

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ABSTRACT

A preconcentration procedure has been developed by using a thiocarbohydrazide derivative (1,5-bis(phenylthiocarbamoyl)thiocarbohydrazide) as a novel sorbent. The ligand was synthesized and used for preconcentration of Cu(II), Ni(II), Pb(II), and Cd(II) ions from water samples by batch and column procedures to enrich metal concentrations appropriate for flame atomic absorption spectrophotometry (FAAS). The optimum pHs for effective solid-phase extractions were 5 and 7 for Cu(II), and Ni(II), Pb(II) and Cd(II) adsorptions, respectively. The method detection limits 0.73, 0.05, 1.14 and 0.04 ng mL⁻¹; the method determination limits 2.4, 0.15, 3.76 and 0.13 ng mL⁻¹ and the enrichment factors 30, 65, 26 and 50 were found for Cu(II), Ni(II), Pb(II) and Cd(II), respectively. The sorption and desorption yields and overall recoveries of metals were almost quantitative except Pb(II) of which sorption yield was around 72% with relative standard deviation value around 1.8%. Langmuir, Freundlich and Temkin models were examined for the metal adsorptions. The Langmuir isotherm model provided a better fit with high correlation coefficients. Regarding the Langmuir parameters, the maximal adsorption capacities on 1,5-bis(phenylthiocarbamoyl)thiocarbohydrazide were 18.25, 7.99, 13.26 and 12.96 mg g⁻¹ for Cu(II), Ni(II), Pb(II) and Cd(II), respectively. The adsorption kinetics for the adsorptions of metals were studied by using linear forms of pseudo-first-order and pseudo-second-order kinetic models. Pseudo-second-order kinetic model fitted very well. The developed method has been successfully applied to the preconcentration of Cu(II), Ni(II), Pb(II) and Cd(II) in water samples (tap water, seawater and mineral water samples), and satisfactory and reproducible results were obtained in FAAS analysis.

Keywords: Preconcentration; Cu(II), Ni(II), Pb(II) and Cd(II) adsorptions; FAAS; Solid-phase extraction; Thiocarbohydrazide derivative; Water analysis

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