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Retention behavior of chromium(VI) from water using tetrazolium chloride-Ag nanoparticles chemically treated polyurethane foam sorbent

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A highly selective and rapid method has been established for chromium(VI) sorption from aqueous HCl media using tetrazolium chloride $[TZ+.Cl^-]$ nanoparticles (Ag NPs) chemically impregnated polyurethane foams (PUFs) solid sorbent. The method was based upon formation of chlorochromate $(CrO_3Cl)^-$aq anion in the test aqueous HCl solution and subsequent extraction by $TZ^+.Cl^-$ - Ag NPs-treated PUFs sorbent. The sorption of $(CrO_3Cl)^-$ aq ions by the used biosorbent was subjected to kinetics and sorption models. The $(CrO_3Cl)^-$ aq retention followed second order rate equation model. The thermodynamic parameters ($\triangle$H, $\triangle$S and $\triangle$G) of the chromium(VI) uptake were critically determined. The data suggest that the sorption was spontaneous and an exothermic process. Sorption of $(CrO_3Cl)^-$ aq is mainly dominated by absorption related to "solvent extraction" and an added component for "surface adsorption". Nanosized Ag NPs-treated PUFs sorbent packed column was tested for pre-concentration of trace concentrations of the $(CrO_3Cl)^-$aq species in various water samples. The retained chromium(VI) species were successfully recovered with dilute NaOH (1.0 mol L^{-1}) and subsequently analyzed by ICP-OES. Thus, the proposed sorbent packed column provides efficient removal of traces of the $(CrO_3Cl)^-$ aq ions from water samples. The developed method could be extended for on line pre-concentration of ultra-trace chromium species from large samples onto PUF packed column and subsequently analyzed. Indeed, the developed method could be satisfactorily applied to the determination of trace Cd ions in natural water.