

Extractant Impregnated Membranes for Chromium(III) and Chromium(VI) by

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Abstract

An innovative sampling technique employing extractant impregnated membranes is presented for the selective sorption and stabilization of specific oxidation states of chromium. Polymer-based selective ion traps employing the extractants tricaprilmethylammonium chloride (*Aliquat-336*) and di-(2-ethylhexyl) phosphoric acid (*DEHPA*) were used for the selective removal and enrichment of the anionic forms of Cr(VI) and cationic forms of Cr(III), respectively. Results show Aliquat-336 and DEHPA effectively remove Cr(VI) and Cr(III) from aqueous solutions. Extraction efficiency is independent of source concentration from 1 <math>x> 50 ppm but is dependent upon time, pH of the source, ionic strength, extractant concentration, composition of source phase, and choice of stripping agent and stripping agent concentration. Optimum conditions for Cr(VI) and Cr(III) were determined to be 1 v/v% Aliquat-336 and 30 v/v% DEHPA; an extraction time of at least 3-5 days; source phase pH between 3-5; and 1 M NaOH/ 0.5 M HNO₃ as stripping agent for Cr(VI) and Cr(III) species, respectively. Batch extraction efficiencies of 97 +/- 3 % were obtained for the optimal conditions. Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES) was used for total chromium determination. UV-VIS spectrometry was used for Cr(VI) determination. Scanning Electron Microscopy revealed the physical structure of the polymeric supports and subsequent impregnation was evidenced by the SEM images. X-ray photoelectron spectroscopic results provided the elemental composition of the Versapor[®]-450 membrane to be 71.5% C, 7.0% O, 9.5% Cl and 12.0% N. The Whatman[®] PP membrane was 100.0 % C. Elemental composition of 1 v/v% Aliquat-336 on Versapor[®]-450 and Whatman[®] PP membrane was 92.3% C, 0.8% O, 3.6% N, and 3.3% Cl and 94.3% C, 3.3% N, and 2.4% Cl, respectively. Elemental composition of 30 v/v% DEHPA on Versapor[®]-450 and Whatman[®] PP membranes were 78.8% C, 3.4% P, 17.8% O and 76.3% C, 19.3% O, 4.4% P, respectively. Column studies under simulated groundwater conditions utilizing the extractant impregnated membranes showed no statistical difference in Cr(VI) recoveries from those obtained in batch experiments. Cr(III) extraction revealed a statistical difference in analyte recovery vs. batch experiments. This is attributed to the lowered pH and cationic interferences present in simulated groundwater.