Desalination and Water Treatment
www.deswater.com

28(2011)130–136
April

1944-3994/1944-3986
doi: 10/5004/dwt.2011.1628

Polymer enhanced membrane filtration of metals: retention of single and mixed species of metal ions based on adsorption isotherms

Fahad Mohammed Almutairi*, Paul M. Williams, Robert W. Lovitt

Centre for Complex Fluids Processing, Multidisciplinary Nanotechnology Centre, School of Engineering, Swansea University, Swansea SA2 8PP, UK
Tel. +44 7921253487; email: 170662@swan.ac.uk, Fahad4m@aol.com

Received 1 November 2009; Accepted 26 January 2011

ABSTRACT

The binding and retention of single metal ions and mixtures of metal ions with polyethylenimine (PEI) was studied using polymer enhanced ultrafiltration (PEUF). Using a highly branched chain form of PEI (Sigma Aldrich 181979) with an average molecular weight 750,000 and approximately 60,000, ultrafiltration experiments were carried out in the stirred dead-end ultrafiltration mode. The results of the binding studies show that the Langmuir isotherm offers a good description of the binding process. At pH 5.5, the maximum polymer binding (Q_{max}) and binding affinity constant (K_L) were determined according to Langmuir isotherms. It was observed that the maximum amount of metal ions bound to the polymer for Cu^{2+}, Zn^{2+}, Ni^{2+} and Cd^{2+} decreased substantially in solutions containing mixtures of metal ions when compared to the values obtained for single metal ion solutions. For Cr^{6+} and Co^{2+} no significant decrease was seen. These data indicate that the binding capacity of Cr^{6+} and Co^{2+} remain constant in competition while Cu^{2+}, Zn^{2+}, Ni^{2+} and Cd^{2+} show changes in both binding capacity and equilibrium constant. The effectiveness of the polymer enhanced ultrafiltration (PEUF) process was shown to be heavily dependent on the concentration of competing metal ions, influencing both capacity and selectivity of the polymer. These findings suggest that the effectiveness of metal binding needs to be determined in the specific water to be treated before the PEUF system can be designed.

Keywords: Polymer enhanced ultrafiltration; Metal ions binding; Polyethylenimine; Retention profiles; Langmuir isotherms

*Corresponding author.