RECOVERY OF HEAVY METALS FROM MINING LEACHES AND WASTE STREAMS WITH SILICA-POLYAMINE COMPOSITES: A GREEN CHEMISTRY PERSPECTIVE

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The use of solid phase adsorbents for the removal and recovery of metal cations and oxoanions from industrial and mining waste streams has been gaining in popularity due to the greater efficiency and environmental friendliness of this method relative to bulk hydrometallurgy or solvent extraction. In general, the solid phases of choice have been lightly cross linked polystyrene or methylmethacrylate polymers. In cases where dilution of a waste stream is not practical, or in the case of waste streams containing valuable metals, ion exchange offers a viable method for offsetting the price of environmental remediation using relatively simple and safe process designs. Moreover, the increased use of oxidative pressure leaching and bioleaching for metal extraction from sulfide ores in the mining industry is even more compatible with ion exchange than with solvent extraction because it avoids the use of flammable solvents and takes metal concentrations to lower effluent values. The polymer based matrices, however, are not particularly well suited to these large scale applications because they often involve the use of hot solutions and wide swings in pH where the shrink-swell properties of the polymers lead to shorter life times which decrease the economic viability of the method. There has been significant activity of late to find alternatives to these purely organic matrices using both inorganic and hybrid materials. In order to overcome these disadvantages we have turned to amorphous nano-porous silica gel-polyamine composites. These materials do not shrink or swell, can be used at higher temperatures and have much longer usable lifetimes than their polystyrene counterparts.[8-13] Furthermore, the polar nature of the silica polyamine surface also makes for better mass transfer kinetics in the case of aqueous solutions and the polyamine can be easily modified with metal selective functional groups, without the use of swelling solvents, to form robust carbon nitrogen bonds.

The lecture will cover the synthesis, structural design and characterization of this novel class of composite materials.[1] Applications to actual mining and industrial waste streams will be presented as well as direct comparisons with conventional ion exchange and chelator resins.[2]

1. M. Hughes and E. Rosenberg "Characterization and Applications of Poly-Acetate Modified Silica Polyamine Composites," *Sep. Sci. and Tech.***42** (2007) 261.
2. M. Hughes, Paul Miranda, D.Nielsen, E. Rosenberg, R. Gobetto, A.Viale, S. Burton "Silica polyamine composites: new supramolecular materials for cation and anion recovery and remediation," in *Recent Advances and Novel Approaches in Macromolecule-Metal Complexes*, Eds. R. Barbucci, F.Ciardelli, G. Ruggeri) Wiley-VCH (Macromolecular Symposia 235), Weinheim, 2006, p 161.