CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

S1016

Project Title

A Novel Method to Immobilize Ionic Liquid in Alginate-Gelatin Polymer Beads for Heavy Metal(s) Removal

Abstract

Objectives/Goals

The purpose of this scientific study was to design a novel, effective, and highly efficient immobilized ionic liquid approach towards removal of heavy metal(s) from an aqueous environment. It was predicted that increased amounts of ionic liquid would remove a greater proportion of the Cu2+ from the aqueous environment and that the system would be superior to traditional LLE in terms of efficiency, economic feasibility, and environmental impact.

Methods/Materials

The ionic liquid chosen was trihexyl (tetradecyl) phosphonium bis (2,4,4-trimethylpentyl) phosphinate (CYPHOS IL 104), a synthesized organic compound which consists of ions of both charges and is liquid at room temperature. For this study, copper ion (Cu2+) was selected as a model system to demonstrate the immobilized CYPHOS IL 104 concept. Gelatin and sodium alginate were selected to immobilize and stabilize IL in a polymer matrix.

Results

The optimized composition for the immobilized ionic liquid solution was identified through a DOE model as approximately 0.33% gelatin (w/w), 0.33% sodium alginate (w/w), and 33% IL (w/w). The immobilized IL beads ultimately removed a maximum of over 98% of Cu2+ from 6 mL of 50 mM Cu2+ solution. No extraction efficiency was compromised through immobilization. The immobilized IL beads were successfully stripped and regenerated by 1N NaOH and was able to remove over 98% of Cu2+ from 6 mL of 50 mM Cu2+ solution when used again.

Conclusions/Discussion

There are several large benefits to this immobilized ionic liquid approach: [1] drastic reduction in overall processing time, [2] reduction of CYPHOS# IL 104 material lost during process, [3] reduction of the chance of CYPHOS# IL 104 contamination in the water, [4] units more portable and easier to handle (can be handled dry as well), and [5] significant reduction of the total cost from raw materials and operation. This developed approach abides by many Green Chemistry principles.

Summary Statement

The purpose of this scientific study was to design a novel, effective, and highly efficient immobilized ionic liquid approach towards removal of heavy metal(s) from an aqueous environment.

Help Received

Father supervised while working at home