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

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The purpose of this scientific study was to design a novel, effective, and highly efficient immobilized ionic liquid CYPHOS® IL 104 (IL) approach towards removal of heavy metal(s) from an aqueous environment. The study was divided into three main parts: [1] testing the effects of different amounts of IL and different concentrations of initial Cu2+ aqueous solution with traditional liquid-liquid-extraction (LLE) approach, [2] creation and optimization of the immobilized IL system, and [3] design of an immobilized IL system to improve heavy metal(s) removal efficiency based on operation time and cost analysis. Gelatin and sodium alginate were selected to immobilize and stabilize IL in a polymer matrix. Different levels of each substance, gelatin, sodium alginate, and IL, were mixed in different combinations and the homogeneity and viscosity of each solution were evaluated. The optimized condition was identified through a DOE model as 0.33% gelatin (w/w), 0.33% sodium alginate (w/w), and 33% IL (w/w). The immobilized IL beads ultimately removed over 98% of Cu2+ from 6 mL of 50 mM Cu2+ solution. The immobilized IL beads were successfully stripped by 1N NaOH. The regenerated immobilized IL was able to remove over 98% of Cu2+ from 6 mL of 50 mM Cu2+ solution as well. There are several large benefits to this immobilized ionic liquid approach: [1] drastic reduction in overall processing time, [2] reduction of IL material lost during process, [3] reduction of the chance of IL contamination in the water, [4] significant reduction of the total cost from raw materials and operation, and [5] immobilized IL more portable and easier to handle (can be handled dry as well).