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Removal and recovery of heavy metals from aqueous solution using β-cyclodextrin polymer and optimization of complexation conditions

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ABSTRACT

Removal of heavy metal contaminants from spent streams can be done in many ways using conventional and membrane techniques. Recovering the heavy metal contaminants is very important to prevent recontamination as well as to realize the potential value. Ultrafiltration (UF) has the potential to offer a simple solution in conjunction with size enhancement of the species to be removed referred to as size-enhanced ultrafiltration in literature. The present study focuses on the use of functionalized cyclodextrin, that is, carboxymethyl β-cyclodextrin (CM-β-CD is a derivative of natural material which is easily available) which not only enables the removal of heavy metal contaminants but also amenable for recovering back the contaminant species and the chelating agent for reuse. The experimental studies were conducted using the ultrafiltration system equipped with 50 kDa MWCO (molecular weight cut-off) PES membrane. The design of experiments was done using central composite design of response surface methodology (RSM). The experiments were conducted as per the statistical design to analyze and optimize the process conditions, such as initial pH of the feed, polymer to metal loading rate and initial concentration of the feed solution. The optimization study was done to maximize the rejection, performance index of the membrane (PFI) and recovery of metal. The analysis of variance was performed to examine the developed regression models. Our studies indicated that the CM-β-CD could remove the heavy metal species as well facilitate the recovery of heavy metal species. The experimental values were consistent with the predicted values, which confirm the good validity of the models developed by RSM.

Keywords: Ultrafiltration; Heavy metals; SEUF; Cu(II); Ni(II); Cyclodextrin

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