Application of full factorial design to study the simultaneous removal of copper and zinc from aqueous solution by liquid–liquid extraction

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ABSTRACT

The aim of this study is to investigate the zinc and copper removal by liquid–liquid extraction using a statistical method. The study is carried out in two steps: (1) the preliminary extraction tests are performed in order to identify the adequate operational conditions, such as the equilibrium time (=15 min) and the pH range (4.5–6.5). (2) A full factorial design at two levels is applied; the effects of the initial solution pH, the initial concentration of metals, the concentration of extractant, the type of initial solution (sulphate or chloride) and the stirring rate on the removal of each heavy metal are investigated. A first-order-polynomial equation is established. The analysis of variance (ANOVA) method is applied to determine the significant level of the main and interaction effects. The initial concentration of Zn is the most influential parameter on the extraction yield and the concentration of extractant. Di-2-ethylhexyl phosphoric acid is the most used one for the Cu(II) extraction yield. The coefficients of determination, calculated for statistical models obtained, are \( R^2 = 0.908 \) and \( R^2 = 0.814 \), respectively, for Zn and Cu and their \( p \)-values are 2.26E–07 and 9.01E–07. The interaction graphs have provided valuable information on the interactions factors for each model.

Keywords: Liquid–liquid extraction; Full factorial design; D_{2}EHPA; Simultaneous removal of metals

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