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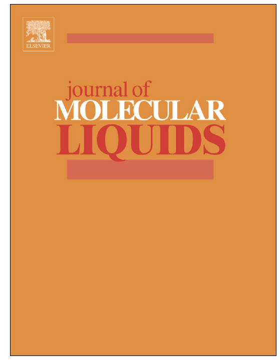

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Process optimization and adsorption modeling of Pb(II) on nickel ferrite-reduced graphene oxide nano-composite

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ABSTRACT: The presence of toxic heavy metals such as Pb(II) in aqueous environments is causing adverse health risks to human beings, motivating researchers to develop efficient techniques to remove pollutants from potable and effluent water. Adsorption was found to be an efficient technique among the various pollutant removal techniques. Efficiency of the adsorption process depends on the adsorbent and its nature. In this regard, a synthesized nickel ferrite-reduced graphene oxide (NFRGO) nano-composite is developed and utilized as an adsorbent to remove heavy metal ions. Since the performance of the adsorption technique depends on independent process variables, the influence of parameters such as the initial solution concentration, adsorbent dosage, and contact residence time on the removal of Pb(II) by NFRGO using a batch adsorption process are systematically studied in this work. Based on the design of experiments approach and central composite design (CCD), twenty experimental runs are performed with each process variable segregated in the experimental range. The optimal values of the independent process variables to achieve maximum removal efficiency are examined using conventional response surface methodology (RSM). A quadratic model, which consists of a first-order and second-order degree regressive model is developed using the analysis of variance (ANOVA) and RSM - CCD framework. Based on the desirability index, the optimum values were found to be an initial concentration of 18.38 mg/L, an adsorbent dose of 0.55 g/L, and a contact residence time of 83 min in order to achieve 99% removal of Pb(II) ions with 0.953 desirability.

Keywords: Differential evolution optimization; Response surface methodology; Pb(II) adsorption; Nano-composite; Design of experiments; Process modeling