Environmental Engineering and Management Journal

January 2022, Vol. 21, No. 1, 125-135
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu

"Gheorghe Asachi" Technical University of Iasi, Romania

OPTIMIZATION OF Pb(II) REMOVAL FROM AQUEOUS SOLUTIONS BY FLY ASH USING BOX-BEHNKEN DESIGN

Soumitra Maiti[1*], Basheshwer Prasad[2], Ashwani Kumar Minocha[3]

[1]EST Group, CSIR-CBRI, Roorkee, Uttarakhand 247667, India
[2]Department of Chemical Engineering, IIT Roorkee, Uttarakhand 247667, India
[3]EST Group, CSIR-CBRI, Roorkee, Uttarakhand 247667, India

Abstract

This article explores the possibility of using flying ash, a byproduct of coal-fired thermal power plants, as a low-cost adsorbent for adsorption of lead ions (Pb(II)) from an aqueous solution. A 3-factor, 3-level Box Behnken design (BBD) technique was used to investigate the interactive effects of fly ash dosage (5-25 g/L), initial concentration of Pb (II) (10-20 mg/L), and pH (2.5-5.5) on Pb (II) removal efficiency. The interactive effects of process parameters were examined using a second-order quadratic equation. The analysis of variance (ANOVA) implies that the quadratic model developed in this study is very significant. The proposed model possesses a high correlation coefficient R^2 equals to 0.9964, indicating that all of the terms represented were extremely significant. At optimal conditions, 97.6% removal efficiency was achieved using an initial Pb(II) concentration of 10 mg/L, a pH of 5.3, and a fly ash dosage of 18 g/L. The second-order kinetic model has a coefficient of correlation that is closer to unity ($R^2 = 0.98$) than other kinetic models. The adsorption data was fitted to different isotherm models, and it was found that the adsorption process follows both the Langmuir and Freundlich isotherms. This research shows that fly ash may be utilized as an unconventional low-cost material to adsorbed Pb (II) from aqueous solutions.

Key words: fly ash, kinetic study, optimization, RSM, thermodynamics

Received: January, 2021; Revised final: June, 2021; Accepted: October, 2021; Published in final edited form: January, 2022

[*] Author to whom all correspondence should be addressed: e-mail: soumitra@cbri.res.in; phone: +911332283216: Fax: +911332272272