Desalination and Water Treatment
www.deswater.com

doi: 10.5004/dwt.2017.20499

70 (2017) 210–219
April

Optimization of Cd(II) removal from aqueous solution with modified corn straw biochar using Plackett–Burman design and response surface methodology

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Received 2 September 2016; Accepted 10 January 2017

ABSTRACT

Statistical optimization designs were used to optimize Cd(II) removal from aqueous solution with modified corn straw biochar in this study. Based on the results of a single-factor experiment under a Plackett–Burman design (PBD), we screened three main influencing factors for the Cd(II) adsorption process: pH, initial Cd(II) concentration, and biochar dosage. With the Cd(II) adsorption percentage as the response target, the Box–Behnken design optimization was performed for the three main factors of pH (3–7), the initial concentration (20–120 mg·L^{-1}), and dosage (2–8 g·L^{-1}). Then, with the obtained second-order model of the adsorption percentage, we determined the optimal conditions for Cd(II) adsorption experiments. The optimization results indicated that biochar dosage showed a significant interaction with initial Cd(II) concentration. With considering the cost, the optimal adsorption percentage was obtained under the following conditions: pH 5.52, the initial concentration of 20.00 mg L^{-1}, and the dosage of 3.05 g·L^{-1} according to the importance weight setting. The experimentally obtained maximum adsorption percentage was 90.05%, which was more economical and reasonable than the obtained conditions without taking the cost into consideration. The combined PBD and BBD method could be applied in the optimization of Cd^{2+} adsorption conditions and provide more reasonable and effective results.

Keywords: Biochar; Adsorption; Cd(II); Plackett–Burman design (PBD); Response surface methodology (RSM); Importance weight

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