Desalination and Water Treatment
www.deswater.com

doi: 10.5004/dwt.2019.24985

172 (2019) 158–166
December

Insights into nonlinear adsorption kinetics and isotherms of vanadium using magnetised coal-polyaniline

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Received 8 May 2019; Accepted 26 September 2019

ABSTRACT

Remediation of the polluted environment has become a major concern in the 21st century. Because of its cost-benefit, ease of application, and efficacy towards the removal of pollutants, the adsorption technique has gained acceptance. In this study, adsorption kinetics of vanadium onto magnetized coal-polyaniline (MC-PANI) are investigated under batch experiments. Isotherms and kinetics are assessed using average relative error deviation, Marquardt's percent standard error deviation, the hybrid fractional error function, chi-square (χ^2), Spearman, and the sum of the squares of the errors (SSE). Comparing all of the error functions, nonlinear models explain the adsorption of vanadium better than linear models. According to the Boyd model, the adsorption of vanadium occurs in two stages. The maximum adsorption capacity of MC-PANI is 66.20 mg V/g (C_0 = 50 mg/L, pH = 5, dose = 1.5 g/L, T = 25°C). Based on Freundlich's dimensionless constant, which determines the driving force of adsorption, adsorption was less favored during the adsorption of vanadium; both amine and Fe_3O_4 participated in the removal of vanadium through ligand or ion exchange.

Keywords: Error function; Conducting polymers; Batch adsorption; Wastewater; Polymerization

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Presented at the 4th International Conference on Recycling and Reuse 2018 (R&R2018), 24–26 October 2018, Istanbul, Turkey