Desalination and Water Treatment
www.deswater.com
doi:10.5004/dwt.2017.21445

94 (2017) 211–221
October

Congo red adsorption on metal-organic frameworks, MIL-101 and ZIF-8: kinetics, isotherm and thermodynamic studies

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Received 20 May 2017; Accepted 12 September 2017

ABSTRACT

In this study, MIL-101 and ZIF-8, two typical highly porous metal-organic framework materials, were synthesized using the simple one-pot methods for the adsorption of aqueous Congo red (CR). The study found that highly efficient removal of CR at neutral pH can be achieved with short contact time. The CR adsorption behaviors of the two adsorbents were studied and found to follow Langmuir isotherm and pseudo-second-order kinetic models. The maximum CR adsorption capacities of MIL-101 and ZIF-8 were up to 2248 and 1381 mg g^{-1} at 298 K, respectively, significantly higher than most of the adsorbents previously studied. Especially, MIL-101 showed faster kinetics and higher adsorption capacity when compared to ZIF-8, which can be attributed to the larger porosity and pore size of MIL-101, and the direct coordination between the unsaturated metal sites in MIL-101 and CR. Thermodynamic studies suggested that the adsorption was a spontaneous and endothermic reaction. Additionally, MIL-101 and ZIF-8 showed good performance after regeneration. Therefore, as-prepared MIL-101 and ZIF-8 have great potential as adsorbents for wastewater treatment.

Keywords: Adsorption; Congo red; Metal-organic framework; MIL-101; ZIF-81

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