Desalination and Water Treatment
www.deswater.com
doi: 10.5004/dwt.2022.28397

258 (2022) 85–103
May

Efficient adsorptive removal of industrial dye from aqueous solution by synthesized zeolitic imidazolate framework-8 loaded date seed activated carbon and statistical physics modeling

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Received 12 December 2021; Accepted 9 March 2022

ABSTRACT

New adsorbents of DSAC@ZIF-8 (0.05:0.6) and DSAC@ZIF-8 (0.05:0.6) were prepared using date seed activated carbon (DSAC) loaded at zeolitic imidazolate framework-8 (ZIF-8). The obtained adsorbents DSAC@ZIF-8 (0.05:0.6) and DSAC@ZIF-8 (0.1:0.6) were characterized by Fourier-transform infrared spectroscopy, scanning electron microscopy, powder X-ray diffraction, nitrogen adsorption/desorption tests at 77 K revealed the surface area to be 460.23 m^2/g for DSAC@ZIF-8 (0.1:0.6). This material showed a high affinity for Gentian violet (GV) uptake from aqueous solutions: the maximum sorption capacity reached 638.99 mg/g at pH 9.0 and ambient temperature. Uptake kinetics and sorption isotherms were obtained and modelled using conventional and simple equations: the best results were respectively obtained with the pseudo-second-order rate equation and the Langmuir equation. The activation energy of absorption also was measured to be 15.87 kJ/mol, showing that the process of chemisorption is included. The distribution coefficient was obtained at different temperatures and the thermodynamic parameters have been calculated: the sorption is endothermic, spontaneous (especially at high relative temperature), and contributes to increasing the entropy (randomness) of the system. HCl (1.0 M) was used for GV desorption from DSAC@ZIF-8, and the sorbent could be efficiently recycled for a minimum of three sorption/desorption cycles. Therefore, sorbent could serve as a promising adsorbent for GV removal from industrial wastewater.

Keywords: DSAC@ZIF-8; Adsorption isotherm; Thermodynamics, Gentian violet; Statistical physics modeling

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