Desalination and Water Treatment
www.deswater.com

doi: 10.5004/dwt.2017.0529

62 (2017) 273–281
February

Development of activated carbon from *Phoenix dactylifera* fruit pits: process optimization, characterization, and methylene blue adsorption

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Received 5 July 2016; Accepted 18 July 2016

ABSTRACT

Herein, Date Pit Char (DPC) was chemically activated by Alkaline Metal Hydroxides (AMHs) viz. NaOH and KOH. Impregnation ratio and activation temperature were optimized. Among AMHs, NaOH was selected for DPC activation achieving highest yield (56.77%) and maximum methylene blue (MB) adsorption (100 mg/g) for sample DPAC11 with impregnation ratio–3:1 and activation temperature–800°C. Textural properties, surface morphology, elemental content, and surface functional groups were explored to characterize DPAC11. The observed BET surface, total pore volume, and average pore size of DPAC11 were 377.63 m^2/g, 0.0275 cm^3/g, and 21.17 Å, respectively. Presence of both micro- and meso-pores on DPAC11 surface was depicted by N_2 adsorption/desorption isotherm. Batch mode MB adsorption studies were carried out. Results showed thermodynamically favorable adsorption, fitted to Langmuir isotherm and pseudo-second-order kinetic models with maximum monolayer adsorption capacities varied between 104.02 and 146.29 mg/g for temperature range 303–323 K, respectively. No significant effect of pH on adsorption was observed. The observed equilibration time for MB C_0 range 25–200 mg/L was in between 240 and 600 min, accomplishing 23% to 60% MB adsorption within initial 30 min. Hence, it could be concluded that DPAC11 is a potential adsorbent for rapid and effective removal of MB from aqueous phase.

Keywords: Activated carbon; Date pits; Adsorption; Methylene blue; Chemical activation

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