Desalination and Water Treatment
www.deswater.com

doi:10.5004/dwt.2019.24393

164 (2019) 192–205
October

Preparation of functionalized CuO nanoparticles using *Brassica rapa* leave extract for water purification

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Received 15 August 2018; Accepted 13 May 2019

ABSTRACT

The functionalized-CuO nanoparticles were synthesized by following an eco-friendly, green route using Brassica leaf extract. The prepared monoclinic crystals of functionalized-CuO nanoparticles have size around 50 nm with point of zero charge at pH 7.7. The EDX investigation indicated that the functionalized-CuO NPs possessed C (18.50%), Cu (28.33%), and O (53.16%) elements by weight, the presence of content clearly indicated the formation and functionalization of CuO NPs. The prepared nanoparticles of smaller size have high surface area, the primary criteria for a good adsorbent, were used as an adsorbent for Amaranth, Congo red, and Bismarck brown dyes, however, the detailed studies were carried out for Amaranth dye only. The batch adsorption experiments were performed to optimize the pH, Amaranth dye concentration, reaction time, dose of functionalized-CuO NPs, and temperature, to get maximum adsorption and then performed actual experiments. The study has shown that more than 90% adsorption of Amaranth dye from its solution, having 10 mg L^{-1} concentration, was achieved with 2.0 g L^{-1} of dosage of functionalized-CuO NPs. For determining the adsorption capacity of these nanoparticles for Amaranth dye, and to propose mechanism of the adsorption process the data adsorption was fitted into non-linearized Langmuir, Freundlich, and Dubinin-Radushkevich isotherms. The Langmuir capacity of CuO NPs decreased from 55.33 to 33.17 mg g^{-1} when the temperature of the reaction mixture was raised from 27 to 45°C. The thermodynamic study showed that the process was feasible and endothermic in nature. The reaction kinetics revealed that the Amaranth dye adsorption followed pseudo-second order.

Keywords: Biogenic; CuO; Wastewater; Dye; Amaranth; Adsorption

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