Desalination and Water Treatment
www.deswater.com
doi:10.5004/dwt.2019.23676

147 (2019) 343–361
April

Grafting of polyamidoamine dendrimer on polyacrylonitrile nanofiber surface: synthesis and optimization of anionic dye removal process by response surface methodology method

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Received 1 December 2017; Accepted 22 December 2018

ABSTRACT

In this paper, the surface of polyacrylonitrile (PAN) nanofiber was modified by polyamidoamine (PAMAM) and its dye removal ability was investigated. In this regard, PAN polymer was functionalized by diethylenetriamine (DETA), and the PAMAM dendrimer molecule was grafted to the surface of functionalized nanofiber by glutaraldehyde. The characterization of nanofibers showed that PAMAM molecules were attached to DETA through the formation of amine groups. Scanning electron microscope images of functionalized and surface grafted PAN nanofiber showed a rough surface and deposition of a dense layer on the nanofiber surface, respectively. Also, the surface average roughness of nanofibers increased from 42.4–46.4 nm and 68.6–81.9 nm for PAN-DETA and PAMAM grafted PAN-DETA compared to untreated PAN nanofiber, respectively. The result of the adsorption study showed that the adsorption process followed Langmuir isotherm and pseudo-second-order kinetic models. The dye removal conditions were optimized by the response surface methodology (RSM) model. The RSM result indicated that pH variable is more effective in dye adsorption. It was observed that the amounts of the dye adsorbed onto the prepared nanofiber were influenced by the initial pH, contact time, initial concentrations of the dye solutions, and ionic strength. The prepared nanofibers showed good regeneration ability and high adsorption capacities even after ten adsorption/desorption cycles.

Keywords: Polyacrylonitrile (PAN); Electrospinning; Polyamidoamine; Surface modification; Direct Red 80; Direct Red 23; Adsorption isotherm; Adsorption kinetic

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