Methyl orange dye removal from wastewater by novel developed chitosan Schiff bases

S. Aboulhadeed, H.M. Ahmed, R.E. Khalifa, A.M. Omer, T.M. Tamer, A. Abdelkhalek, M.S. Mohy-Eldin

Polymer Materials Research Department, Advanced Technologies and New Materials Research Institute, City of Scientific Research and Technological Applications (SRTA-City), New Borg El-Arab City, P.O. Box: 21934, Alexandria, Egypt, Tel. +2034593414; emails: mmohyeldin@srtacity.sci.eg (M.S. Mohy-Eldin), s.a.aboulhadeed@gmail.com (S. Aboulhadeed), malak.scientist@gmail.com (H.M. Ahmed), randaghonim@gmail.com (R.E. Khalifa), amomar@srtacity.sci.eg (A.M. Omer), tmahmoud@srtacity.sci.eg (T.M. Tamer)

Plant Protection and Biomolecular Diagnosis Department, ALCRI, City of Scientific Research and Technological Applications (SRTA-City), New Borg El-Arab City, P.O. Box: 21934, Alexandria, Egypt, email: aabdolkalek@srtacity.sci.eg

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Abstract

The impact of synthetic dyes from wastewaters decreases using various methods developed to remove these dyes via a clean and safe process. The current work aimed to modify the chitosan structure as a linear cationic polymer to improve its behaviour via preparing two different cross-linked chitosan Schiff bases hydrogels using a glutaraldehyde crosslinker. The chitosan was coupled with succinimide (Ch/Su) and 1-methyl-2-pyrrolidinone (Ch/Mp). The Schiff bases hydrogels properties such as water uptakes and ion exchange capacity were examined. Fourier transform infrared spectroscopy (FT-IR), scanning electron microscopy (SEM), and thermal analysis (DSC and TGA) were used to investigate the change in their properties. The adsorption of methyl orange (MO) dye from aqueous solutions by the prepared crosslinked chitosan Schiff bases (Ch/Su) and (Ch/Mp) was carried in dynamic batch mode compared to crosslinked chitosan native (Ch). The effect of contact time, initial dye concentration, temperature, system pH, agitation rate, dye concentration, and adsorbent dosage on the MO adsorption was investigated. A rapid MO adsorption process for chitosan derivatives was observed, and the equilibrium reached after only 40 min while the chitosan adsorbent reached equilibrium after 120 min. Typical steady high MO adsorption (%), around 90%, was observed at a wide pH range of the chitosan Schiff bases adsorbents; from 4.0 to 8.0 of Ch/Su and from 4.0 to 9.0 of Ch/Mp adsorbents. The maximum adsorption capacity for the chitosan, Ch/Su and Ch/Mp, at 20ppm MO, was found 8.867, 10.0, and 7.2 mg/g, respectively. Furthermore, statistical analyses of the impact of the adsorption conditions on the MO dye removal (%) were performed.

Keywords: Chitosan; Schiff base; Hydrogel; Anionic dye; Methyl Orange.