Methacrylic acid functionalized magnetite nanoparticles for the removal of Toluidine blue

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Due to the importance of water and the growing need to the clean water, different chemical and biological methods have been developed to purify it. Adsorption methods are considered as one of the effective methods for elimination of many of pollutants water and wastewaters. In this study, magnetite nanoparticles (MNPs) were chemically synthesized by addition of ferric and ferrous salts (2:1) to ammonia solution under N2 gas current and stirring at temperatures higher than 80 0C. The synthesized nanoparticles were functionalized by methacrylic acid to improve its adsorption ability. Characteristics of synthesized MNPs were done using FESEM, FT-IR, DRS, XRD, and VSM instruments. The effects of experimental variables affecting the removal of toluidine blue including contact time, pH, adsorbent dose and ionic strength were evaluated using Taguchi orthogonal array method. The optimum conditions for toluidine blue dye removal were obtained as pH=7, contact time: 30 min, adsorbent dose: 0.1 g and ionic strength: 0.05 M. Pseudo first order, pseudo second order, intraparticle and Elovich kinetic models as well as Langmuir, Freundlich and Tempkin isotherm models were investigated. The results showed that the experimental data were correlated with Langmuir adsorption isotherm (R2 = 0.972) and pseudo-second order kinetic (R2 = 0.998) models. The amount of absorption capacity for the toluidine blue color was obtained at 7.02 mg g-1 To evaluate the efficiency of the method in removal of toluidine blue, three different real samples including tap water, sea water and well water were examined and the results showed removal efficiencies higher than 95%. The results showed magnetite nanoparticles functionalized by methacrylic acid have the potential to remove toluidine blue dye aqueous solutions. Also, their separation the solution is fast and simple using an external magnetic field. For repeated use of adsorbent for 10 consecutive use, the results of removal exceeded 95%. Compared with conventional separation methods,

magnetic separation techniques have advantages such as high removal rate, high efficiency and simplicity of the procedure.

Keywords : Magnetite nanoparticles, Methacrylic acid, Removal, Toluidine blue, iron oxide.