APPLICATION OF MANGANESE-DOPED IRON OXIDE NANOPARTICLES AS ADSORBENTS FOR DYES REMOVAL: PRELIMINARY STUDIES

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Abstract

The unprecedented development of textile industrial activities has led to the generation of colored polluted waters, which threaten the aquatic environment, but also human health. [1,2]. Among the techniques applied for the removal of colored contaminants from wastewater, adsorption has proven to be a simple and accessible method [1]. In recent years, research on iron oxide nanoparticles has received increased attention due to their high potential as adsorbent materials and their magnetic properties, which ensure easy and efficient separation [3]. In this work, composite materials based on iron oxide and manganese were synthesized and applied as adsorbents for removal of dyes from aqueous solution.

Iron oxide and manganese-doped iron oxide nanoparticles were synthesized by the co-precipitation method, at 80˚C, under mechanical stirring 400 rpm, for 30 min. Manganese-doped iron oxide nanoparticles were synthetized by gradually replacing the Fe^{2+} with Mn^{2+}, in different ratio: Mn_xFe_{1-x}, where $0<x>1$ (0.1, 0.25,0.5, 0.75,1). The influence of the dopant content upon adsorption properties of the synthetized nanoparticles was investigated. The synthetised materials were characterized by X-ray diffraction (XRD) analysis, FT-IR spectroscopy, and the specific surface area was evaluated using BET method.

The obtained nanoparticles were applied as adsorbents for the removal of dyes from aqueous solutions. Two cationic dyes: Kresyl Violet (KV) and Blu Metil (BM) were selected as potential pollutants. The concentration of dyes was determined by UV-Vis spectrophotometry at a wavelength set at 553 nm for KV and at 587.5 nm for BM.

The results obtained in adsorption studies indicated that removal percentages reached up to 93% for KV and 97% for BM within 180 minutes, under normal working conditions. The removal efficiencies increase from S1 to S5, in accordance with the increase in the amount of manganese in the material composition. Also, the adsorption capacity of iron oxide nanoparticles increased with the level of Mn doping. Fourier transform infrared spectroscopy (FT-IR) was used to investigate the surface functional groups, before and after adsorption studies. Fitting the data obtained at certain time intervals showed that the pseudo-second-order kinetic model best describes the adsorption process.

Preliminary results obtained working under normal conditions revealed that the obtained manganese-doped iron oxide materials are promising adsorbents for the removal of dyes from aqueous solutions.

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References

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