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Author: Salwa A. Ahmed Ezzat M. Soliman

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Silica coated magnetic particles using microwave synthesis for removal of dyes from natural water samples: synthesis, characterization, equilibrium, isotherm and kinetics studies

Salwa A. Ahmed*, Ezzat M. Soliman

Chemistry Department, Faculty of Science, El-Minia University, El-Minia, 61111, Egypt

salwa_kasem2003@yahoo.com

Abstract

Monitoring pollutants in water samples is a challenge to analysts. So, the removal of Napthol blue black (NBB) and Erichrome blue black R (EBBR) from aqueous solutions was investigated using magnetic chelated silica particles. Magnetic solids are widely used in detection and analytical systems because of the performance advantages they offer compared to similar solids that lack magnetic properties. In this context, a fast, simple and clean method for modification of magnetic particles (Fe_3O_4) with silica gel was developed using microwave technique to introduce silica gel coated magnetic particles (SG-MPs) sorbent. The magnetic sorbent was characterized by the FT-IR, x-ray diffraction (XRD), and scan electron microscope (SEM) analyses. The effects of pH, time, weight of sorbent and initial concentration of dye were evaluated. It was interesting to find from results that SG-MPs exhibits high percentage extraction of the studied dyes (100% for NBB and 98.75% for EBBR) from aqueous solutions. The Freundlich isotherm with r^2= 0.973 and 0.962 and Langmuir isotherms with r^2= 0.993 and 0.988 for NBB and EBBR, respectively were used to describe adsorption equilibrium. Also, adsorption kinetic experiments have been carried out and the data have been well fitted by a pseudo-second-order equation r^2= 1.0 for NBB and 0.999 for EBBR. The prepared sorbent with rapid adsorption rate and separation convenience was applied for removal of NBB and EBBR pollutants from natural water samples with good precision (RSD%= 0.05-0.3%).

Keywords: magnetic particles, Napthol blue black, Erichrome blue black R, real water samples