Enhancement of Adsorption Efficiency of Methylene Blue on Co$_3$O$_4$/SiO$_2$ Nanocomposite

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ABSTRACT

Single and well-crystalline Co$_3$O$_4$ phase imbedded in an amorphous SiO$_2$ matrix has been obtained by novel aqueous solution method. The structural and morphological properties are investigated using X-ray diffraction, Fourier transform infrared spectrometer, and N2 adsorption–desorption techniques. The apparent crystallite size for Co$_3$O$_4$ was found to be about 13.5 nm, which elucidates the rule of poly ethylene glycol in preventing particle’s agglomeration; moreover, the pours structure of the composite enhances its adsorption ability. Co$_3$O$_4$/SiO$_2$ has a high ability to absorb methylene blue from an aqueous solution. The removal percent of Methelene blue (MB) by Co$_3$O$_4$/SiO$_2$ has reached 95.7%. The effect of various experimental parameters, such as initial dye concentration, contact time, and dose were investigated. Co$_3$O$_4$/SiO$_2$ nanocomposite shows high adsorption capacity of 53.87 mg g$^{-1}$, which is larger than the adsorption capacity of MB on other materials. Both of Langmuir and Freundlich models were used to analyze the equilibrium adsorption data. The pseudo-second-order model was found to be the most appropriate model to represent the present data. Co$_3$O$_4$/SiO$_2$ nanocomposite material is proposed as a potential adsorbent for water treatment.

KEYWORDS: Cobalt Oxide/Silica; Nanocomposite; Adsorption; Methylene blue

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