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Synthesis and characterization of nano-magnetic material based on (carbon nanotubes / nickel ferrite): Application for the removal of methyl orange dye from contaminated water

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ABSTRACT/RESUME

Abstract: *This work aims the synthesis of (DWNTCs / $NiFe_2O_4$) by refluxing process. Herein, the synthesized adsorbent was characterized via Fourrier Transform Infrared Spectroscopy (FTIR), X-ray diffraction (DRX), BET, zeta potential and transmission electron microscopy (TEM), where the adsorption of methyl orange on (DWNTCs / $NiFe_2O_4$) has been carried out by studying the adsorption kinetics, pH, mass and the initial concentration. The results indicated that the maximum adsorption rate is 7.77 $mg.g^{-1}$ at pH 5 with 100 mg of (DWNTCs / $NiFe_2O_4$), and an initial orange methyl concentration of 10 $mg.l^{-1}$. In addition, the adsorption process describes a second-order kinetic model, where the modeling of adsorption isotherms showed that the Freundlich one seem to be the adequat model describing the adsorption process with $R^2 = 0.97$.*

I. Introduction

Pollution of water by industrial and agricultural activities is a major concern on earth and especially in developed societies. Therefore, high potential of studies has been developed to reduce this pollution at the source or in effluents if it's necessary with appropriate treatments. Among these pollutants, dyes which are used in various fields of industries for various purpose. As a result, large quantities of colored waste water are produced, and the presence of these dyes in water, even at very low concentrations, is highly undesirable and the need for disposal is indispensable [1]. However, various techniques have been developed for decontamination purposes, such as adsorption, degradation, coagulation, precipitation, filtration, electrodialysis, membrane separation and oxidation. However, adsorption process seems to be among the most effective methods yielding therefore to remove dyes from aqueous environments [2], while several studies have already been done in this field using several materials as adsorbents. Indeed, the performance and the efficiency of this adsorption technique depend generally and preponderantly on the nature of the support used as adsorbent.

Thus, nickel-ferrite is a soft ferrite with good magnetic properties and high electrical resistivity [3]. In another side of view, double walled carbon nanotubes shows good mechanical, electrical properties and especially a large surface area [4, 5].

Prior to this, carbon nanotubes are nanomaterials which have undergone considerable development in recent years due to their remarkable potential for nanoscale applications, with a fibrous form, large external surface accessible, and a well-developed mesopore. As a starting point as an hypothesis, the combination of magnetic properties and adsorbent properties within the same material is an interesting challenge that could overcome the problems of recovery of adsorbents loaded with pollutants.

Due to the simplicity of the nanocomposite synthesis composed of double walled carbon nanotubes / nickel-ferrite (DWNTCs/ $NiFe_2O_4$), and