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Facile synthesis of polyaniline nanoparticles; its adsorption behavior

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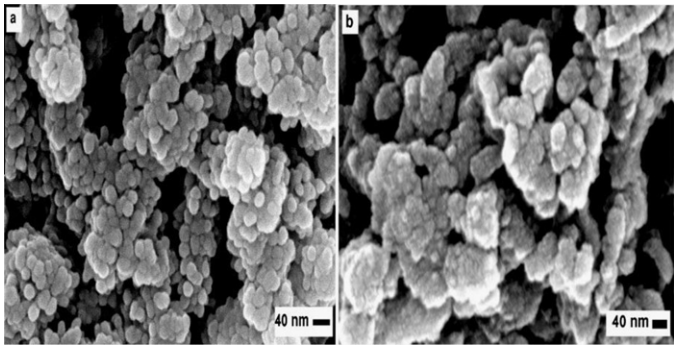
HIGHLIGHTS

- Polyaniline nanoparticles (PANI NPs) as adsorbent.
- A new route for synthesis of PANI NPs is developed.
- The pseudo-second order kinetic model described the adsorption process.
- The polymer could be used as an efficient adsorbent for methylene blue dye from water.

GRAPHICAL ABSTRACT



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ABSTRACT

Polyaniline (PANI) nanoparticles in the bulk solution were synthesized by the oxidative polymerization of aniline and ammonium peroxodisulfate as an oxidant in aqueous medium without the aid of any acid. The scanning electron microscopy showed PANI nanoparticles with average diameters in the range of 20 ± 5 nm. Characterization of the prepared PANI nanoparticles by UV–visible spectroscopy, X-ray diffraction and Fourier-transform infra-red spectroscopy have been carried out. In addition, the thermogravimetric analysis and morphology using scanning electronic microscope are analyzed. The adsorption of a cationic dye, methylene blue (MB) using the PANI nanoparticles and conventional PANI was studied and discussed. The kinetic models: pseudo first order, pseudo-second order and the intraparticle diffusion models were applied to the experimental data. It was observed that pseudo-second order kinetic model described the adsorption process better than any other kinetic models. Results obtained indicate that PANI NPs base could be employed as an efficient adsorbent much more than the conventional PANI powder for dye removal.

1. Introduction

The π-conjugated polymer composites with nanoscale dimensions [1] are in great demand over the years. Polyaniline (PANI) is one of the most versatile conducting polymers [2] with many unique advantages, like ease to prepare, good environmental stability, enhanced conductivity, suitable for making composites with different types of binders and diverse color changes corresponding to oxidation levels [3–6].

Polyaniline powder was chemically synthesized by oxidative polymerization of aniline using ammonium peroxydisulfate (APS) in the solutions of strong acids. Granular powders were produced that are insoluble in common solvents. The solubility is needed to meet the requirement of processability and applications. One of the recent solutions to solve this problem is to synthesize PANI as nanostructures [7–11]. There are various synthesis methods for nanostructured PANI including: induced self-assembly of nanostructures [7], the use of nanostructured seeds [8], electrochemical methods [9], electrospinning [10] and chemical methods [11–13].

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