

Abstract

In the present work, carbon nanotubes (CNTs) were synthesized by catalytic chemical vapor deposition (CCVD) method at 740 °C for 60 minutes, using acetylene gas as a carbon source, argon as carrier and inert gas and two types of catalysts (iron and nickel) supported on zeolite.

The carbon nanotubes produced are thermally treated to remove amorphous carbon deposited on catalyst particles and then purified by 6M HCl with ultrasonication to remove impurities such as metal catalyst and then functionalized by treating with 69% HNO₃ under reflux.

The X-ray diffraction test shows the hexagonal graphite structure formation of CNTs prepared at 26.1°. The observation by Atomic Force Microscopy (AFM) shows that the CNTs grown on Fe catalyst have a larger diameter and a broad diameter distribution compared with Ni catalyst. Characterization of prepared CNTs by Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) shows that CNTs have cylindrical shapes and hollow structure and the range of external diameters is 20-80 nm. The specific surface area measurement by Brunauer, Emmett and Teller (BET) technique of CNTs is 166 m²/g. Fourier Transformed Infrared Spectra (FT-IR) of modified CNTs exhibited stretching and bending vibration absorption peaks of the C=O groups at ~1741.78 cm⁻¹ while free hydroxyl groups at ~3742.03 cm⁻¹, and the peak at ~3439.19 cm⁻¹ can be assigned to the O-H stretch from carboxyl groups (O=C-OH and C-OH).

The CNTs are used in removal of basic orange and methyl violet dyes and studying the effect of four variables: pH (3-10), contact time (5-40) min., CNTs dosage (50-300) mg/l and concentration of basic orange and methyl violet dyes (5-30) mg/l. The removal percentage of both dyes

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is proportional to the contact time, CNTs dosage and pH, and inversely proportional to the concentration of both dyes.

The results show that the time to reach equilibrium is 20 and 30 min. for basic orange and methyl violet dyes respectively and the maximum removal percentage for all dyes concentrations is at pH=8.5 and CNTs dosage of 0.25 g/l and 0.3 g/l for methyl violet and basic orange dye respectively.

The adsorption isotherm obtained by plotting experimental data shows that the correlation coefficient of Freundlich model is higher than Langmuir model for both dyes, indicating that the Freundlich model is more appropriate to describe the adsorption characteristics of dyes onto CNTs.