CURRENT RESEARCH AND DEVELOPMENT IN BIOTECHNOLOGY ENGINEERING AT IIUM

VOLUME IV

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Ma'an Alkhatib
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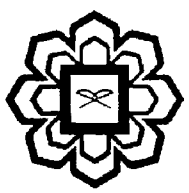
Faridah Yusof

Department of Biotechnology Engineering
Faculty of Engineering
International Islamic University Malaysia



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CHAPTER 6

CARBON NANOTUBES TO REMOVE CHROMIUM

Abdullah Al Mamun, Ma'an Alkhatib, Aishah Jamaluddin Ahmad

Department of Biotechnology Engineering, Faculty of Engineering, International Islamic University Malaysia, Gombak, 50728 Kuala Lumpur, Malaysia.

ABSTRACT

Adsorption experiments were carried out, in this study, to evaluate the performance of carbon nanotubes (CNTs) grown on powdered activated carbon (PAC) to remove chromium from aqueous solution. The effects of pH, CNTs dosage, contact time and initial Cr concentration were studied at 25° C and with a constant agitation of 150 rpm. Adsorption study has demonstrated that the highest removal of Cr ions is 98.48%. The statistical optimization of the experimental conditions was carried out by using central composite design (CCD) to develop the regression model to determine the optimum operating conditions and the data were further evaluated to discuss the interaction between the parameters involved. From this study, it was determined that the optimum conditions for maximum Cr removal are pH 5, initial chromium concentration of 0.08 mg/L, contact time of 80 minutes and impregnated CNTs dosage of 200mg/L to achieve minimum residual Cr concentration of 0.0021 mg/L.

Keywords: adsorption, carbon nanotubes, chromium, wastewater, powdered activated carbon.

INTRODUCTION

Nanotubes are all carbon, crystalline macromolecules that resemble strands of rope or string. They are built around one of the strongest bonding forces in nature: the covalent bond between carbon atoms. Rolled into a seamless cylinder of carbon atoms and bonded in a repeating hexagonal lattice, nanotubes can grow up to microns or more in length but are only about one nanometer across. They exhibit remarkable symmetry with slight variations in regards to the angle upon which the graphene sheets line up along the tube's axis (Dresselhaus, 2001).

In the research field concerning environmental issues, CNTs were initially used in remediation process and end-of-pipe treatment technologies. Nanotechnology applications that would result in improved treatment options might include removal of the minute concentrations of contaminants from water and air and "smart" materials or reactive surface coatings that destroy or immobilize toxic compounds (Feng, 2005). Substances of significant concern in the remediation of soils, sediment and ground water include heavy metals and organic compounds. The adsorption of heavy metals by nanotubes has been studied which showed exceptional adsorption capability and high adsorption efficiency for the removal of heavy metals from water (Li et al., 2003).

The objectives of this study were (1) to remove chromium (Cr) from aqueous solution