Co-precipitation Synthesis of Magnetic Nanoparticles for Efficient Removal of Heavy Metal from Synthetic Wastewater

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ABSTRACT

The emergence of magnetic nanoparticles (MNP) has proven to be useful as a tool or catalyst in many industrial usages such as in biomedical, drug delivery, catalysis, and the environment. Due its size, MNP has a greater surface area compared to larger particles that makes it more reactive to some other molecules. The highlight of this study is to focus on the usage of MNP on the environmental issue, which related to the discharging of the heavy metal from industrial effluents. Conventionally, the removal of heavy metals from the wastewater stream is by using chemical reactions, electrodialysis, and membrane separation. However, the drawback is expensive due to energy consumption and membrane fouling as well as resulting in the generation of toxic byproducts. Therefore, the aim of this study is to synthesis MNP with smaller size to entrap heavy metal ions to a complex, thus easily removed by magnetic drive. The MNP was synthesized using different factors such as temperature (25ºC, 50ºC, 70ºC), bases (NaOH, KOH, NH4OH), and surfactant (CTAB) added into solution containing iron(II) and iron(III) to obtain different size and morphology. The efficiency of MNP removal was tested on solution containing Cr, Ni and Cu then analyzed using AAS. The characterization of the MNP was done using TEM, FTIR and XRD. From the result, 90% of the Cr removal is found to be with the MNP that been synthesized with NH4OH at 70˚C and without CTAB addition. Due to the smallest size (9nm) of the MNP, thus adsorbing more Cr ions. The presence of CTAB during MNP synthesis has negligible effect on the heavy metal removal especially Ni ion. As a conclusion the strong base gives the MNP of lowest dispersion and addition of surfactant provide less adsorption of heavy metal, however stronger resistance to oxidation. This work has provided an insight on the feasibility of the MNP as an alternative method to heavy metal ion removal.

Keywords: Magnetic Nanoparticles; Efficient Removal; Synthetic Wastewater