SYNTHESIS OF MAGNETITE (Fe_3O_4) NANOPARTICLES AND THEIR APPLICATION OF NITRATE REMOVAL IN WATER

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Nitrate contamination of surface water and groundwater in many parts of the world has become severe environmental problem. To separate many contaminants that are dissolved in waters requires sophisticated and expensive technologies such as reverse osmosis. Magnetite nanoparticles (Fe_3O_4, MNPs) have been studied extensively as novel applications in adsorbent with large surface area, high magnetic susceptibility, biocompatibility and biodegradable properties for the removal of toxic chemical pollutants from waste water such as dyes, nitrates and gases. In this study, method of co-precipitation which is economically worthwhile and convenient method was employed to synthesize MNPs from aqueous Fe^{2+}/Fe^{3+} with salt solutions in the presence of ammonium hydroxide. Surface modification process is introduced to prevent aggregation of the particles with cellulose acetate and green tea extract. Nature and properties of both bare particles and modified nanoparticles with cellulose were investigated by varying pH. Modified MNPs with green tea extract was studied using different volumes of green tea extract. This process yields low aggregated MNPs with average particle diameter of 6.52 ± 0.02 nm which is less than both bare particles (10.01 ± 1.78 nm) and cellulose base MNPs. The characterizations of the particles were supported by the results from X-Ray diffraction (XRD), Attenuated Total Reflection-Fourier transform infrared (ATR-FTIR), Scanning Electron Microscope (SEM) and the adsorption of nitrate was monitored by nitrate ion selective electrode. Iso-electric point of these particles was observed at pH = 3.2. It was found that both unmodified and modified magnetite nanoparticles can be used to reduce nitrate ions in water with the removal efficiency of nitrate is increased with acidic to basic conditions. The actual mechanisms involved at the surfaces yet to be studied with more experiments as well as with theoretical models.

Keywords: Magnetite nanoparticles, Cellulose, Surface modification, Nitrate removal