Application of silver-, iron-, and chitosan- nanoparticles in wastewater treatment

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ABSTRACT

Silver nanoparticles (Ag-NPs) play an important role in the electronic industry, whereas, Zerovalent iron (ZVI) has been widely investigated for environmental remediation due to its fairly strong reducing power and its ability to adsorb an array of important contaminants such as heavy metals and metalloids, while, chitosan nanoparticles (CS-NPs) have proven efficacy in removal of heavy metals, dyes and phenols from wastewater. In the present work, chemical methods have been conducted to prepare nanoparticles made from silver, iron, and chitosan. Ag-NPs were prepared from $AgNO_3$ as starting material then the particles obtained were coated on filter paper; also, a cellulose acetate (CA) membrane was prepared after mixing the casting solution with Ag-NPs, then both subjected to *Escherichia (E.) coli* bacteria for testing their ability to destroy the bacteria. The *E. coli* was prepared according to a standard procedure and the colonies counted before and after treatment with treated filter paper and membrane. It is noteworthy that the present work contains a simple new method to prepare Ag-NPs. Results proved that Ag-NPs destroy the *E. coli* bacteria completely at room temperature in both filter paper and CA membrane. Also, Nano iron (nZVI) was prepared by reduction of ferric chloride by sodium borohydride, then filtered and used to remove Cu(II) ions from aqueous solution. CS-NPs were prepared by two methods, first by preparation of low molecular weight chitosan (LWCS) followed by its degradation to CS-NPs using different concentrations of H_2O_2 solution. The second method was done by preparing CS-NPs using $AgNO_3$. The CS-NPs membrane was able to biosorb 70.68 and 42.1% of NaCl from a 9.38 and 15.2 g/L salt solution respectively, whereas biosorption of $CuSO_4$ was 59.8% from 12.5 g/L solution, due to the presence of numerous functional groups besides the amino and hydroxyl groups.

Keywords: Nanoparticles; Wastewater treatment; *Escherichia coli*; Nanosilver; Cupric ions; Nano-zero valent iron; Nanochitosan