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Extended Abstract

Synthesis and characterization of bioactive composite material comprising silver nanoparticles and activated carbon to produce bacteria free potable water

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Abstract

Composite material of silver nano-particles (SNPs) and activated carbon was synthesized by wet chemical method. Morphology and particle size of SNPs were investigated by Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and X-ray powder diffraction (XRD). Particle size obtained from XRD data analysis using Debye Scherer formula comes out around 14nm while crystalline structure of SNPs was investigated as face centred cubic (fcc). Morphology of SNPs in activated carbon was studied using SEM. It shows well distributed, circular shaped SNPs and their agglomerates in pores of activated carbon. Presence of silver in the nano-composite was confirmed through Energy Dispersive X-ray (EDX) analysis. TEM shows majority of nanoparticles lying in the range between 10 to 20 nm while presence of metallic phase (fcc) of silver was further confirmed through electron diffraction studies. Microbiological activity of composite as antibacterial was examined through flow method, using open source water infected by Gram-negative (E. coli). One (1) gm. of Nano-composite was found effective in sterilizing up to 55L of infected water. Antibacterial efficacy of the Nano- composite was further verified against B. Subtilis and E. coli using disk diffusion method. Overall results show that composite material is a promising candidate for purification of open source water.

Introduction

Effectiveness of functional material is directly related to its surface area which can be increased tremendously by using Nano technology. Nano-technology is a branch of science, which is well equipped with new research methods, modern techniques and latest instruments. It is being used to explore properties of material at atomic and molecular level. Such properties of material can't be investigated and studied in its bulk form.

In recent years, development of metallic Nano-particles have provided suitable solutions to cope with today's challenges in several different areas like solar energy, medicine, chemical synthesis, protection of humans, animals and structures from hazardous environmental effects. Provision of large surface area is an important parameter of Nano-scale material. Usually particle size of Nano-scale material lies in the range from 1 to 100nm. Nano- technology is a scientific art and modern technique which contributes effectively to reshape our future by synthesizing advanced materials.

Silver and its compounds have strong back ground related to inhibition of bactericidal effects and antimicrobial ability for fungi, and virus as well. Versatile usage of silver has been reported in literature, for example in medicine, it is used to decrease infections in burn treatment, arthroplasty and to prevent bacterial growth on prostheses. Moreover as compared to other metals, silver is toxic to microorganisms but less toxic to mammalian cells and due to this factor silver is considered as nontoxic metal. Silver is also known since long time owing to its applications; however its wide spectrum usage as antimicrobial has been established in last two decades.

Actual mechanism as antimicrobial of SNPs on bacteria is still unknown, however possible mode of action has been proposed according to chemistry and structural changes in bacterial cell. SNPs may target bacterial membrane, respiratory chain and cell division that end to the cell's death. Another view is that SNPs may also enter inside the bacteria and damage its phosphorus and sulphur-containing compounds such as DNA. Minute quantity of SNPs may not have an acute impact on human health.