Ceramic Water Filters Impregnated with Silver Nanoparticles for the Removal of Lead and Chromium Ions from Water

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Abstract
Ceramic Water Filters (CWFs) have been fronted as a socially acceptable, low-cost, and effective household water treatment alternatives. CWFs have been widely studied to prove their effectiveness in removal of physical and biological contaminants. However, there is limited research on their application in removal of heavy metals. This work examined the ability of CWFs impregnated with silver nanoparticles (AgNPs) to remove Lead and Chromium ions from water. It assessed the effects of the addition of silver nanoparticles, application method of silver nanoparticles, initial water temperature, and initial metal ion concentration on the performance of the different sets of filters. It was observed that relative amounts of Lead and Chromium ions removed in filters with AgNPs were higher (12.58% and 15.43%) than in filters without AgNPs (control filters) (5.64% and 7.40%), implying that addition of AgNPs improved the adsorption capacities of the CWFs. The study also found that the adsorption of Lead was higher in the Paint-method filter (14.45%) than in the Dip-Soaked filter (12.58%), whereas the adsorption of Chromium was higher in the Dip-Soaked filter (15.43%) than in the PaintMethod filter (14.22%). The effect of initial water temperature, over the examined range (24 °C-84 °C) was insignificant. Further, initial metal ion concentration was found to have significant impact on the adsorption capacities of the CWFs. Surface morphology studies further revealed excellent surface binding between clay particles and AgNPs. The study thus proves that CWFs impregnated with AgNPs are a low-cost, practical, and effective alternative for removal of heavy metal ions at household levels.
Keywords: Adsorption; ceramic water filters; chromium; heavy metal ions; lead; silver nanoparticles