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Electrochemical removal of lead in water with multi-wall carbon nanotube filters

Benjamin M. Stryker, Sol Park, and Zhi Zhou
School of Civil Engineering, Purdue University

ABSTRACT

Heavy metals, such as lead, are highly toxic and typical removal techniques are costly for household applications; causing serious public health risks and economic burdens. Previous studies using electrochemical filtration showed that singe-wall carbon nanotube membranes (SWCNTs) were effective at removing lead, but the use of less expensive multi-walled carbon nanotubes (MWCNTs) has not been fully explored. Therefore, there is a critical need to determine if MWCNTs are cost-effective for the removal of lead in water. The removal efficiency of lead(II) ions in an aqueous solution was evaluated in a flow-through filtration system over 50 minutes at 1.5 mL/min. Calcium ions were added to simulate the actual hardness in tap water to evaluate the potential competition and effect on removal efficiency in real drinking water. The effects of natural organic matter (NOM) were also evaluated. Removal efficiency of lead alone in nano-pure water achieved 77% at an applied potential of -1.0 volts. With the presence of calcium, competition between calcium and lead ions reduced lead removal efficiency to 44%. Removal efficiency of lead decreased significantly with in the presence of NOM and the lowest removal efficiency was only 15%. These results indicated that MWCNTs have great potential for cost-effective removal of lead in drinking water distribution systems or household point-of-use systems. Further studies are needed to minimize the competition of calcium ions and NOM.

KEYWORDS

Nanotechnology, filtration, membrane, divalent, electrochemical, MWCNT, NOM, lead, calcium