The Removal of Arsenic (III) from Contaminated Drinking Water using Iron Oxide and 3D Printed Beads

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Arsenic is an odorless and tasteless chemical that leaches into ground water, and this contamination is found in the major water sources affecting the health of over 200 million people worldwide. According to the Environmental Protection Agency, drinking water with 0.01 milligrams per liter, 10 parts per billion (ppb), is considered to be the unsafe level of arsenic in drinking water. Thus, the purpose of our research is to reduce levels of arsenic in water samples by creating a re-useable, cheap, and efficient filter. Initial data collection using inductively coupled plasma optical emission spectrometry (ICP) showed that 3.5 grams of iron oxide would completely eliminate the presence of 10 ppm arsenic (III) in a 10 milliliter contaminated sample. Based on the initial results beads were designed and 3D printed using the 3D CAD software Inventor. The bead contained 0.5 grams of iron oxide and ICP analysis showed that as the number of beads in the water sample increased, the level of arsenic in the water source exponentially decreased (y=6.8087e^-1.284x) . Five beads containing a total of 2.5 grams of iron oxide essentially eliminated 10 ppm of arsenic from the water sample. Using this bead as a prototype, the bead was redesigned and tested using a mesh to trap all of the iron-arsenic precipitate and grooves and lock system for re-usability and easy removal. Through commercial production a single bead with iron oxide would cost $0.03, and a single water sample would require only five beads for arsenic elimination in a ppb range. The beads show that they are effective as an arsenic removal filter at a ppm exponential rate. This means underdeveloped countries could have a cheap and efficient filter that they can re-use for the remainder of their lives.

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