A Novel Approach to Heavy Metal Removal Using Home-Based Superparamagnetic Iron Oxide Nanoparticle Enhanced BioSand Filters

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Heavy metal contamination of water is a problem that greatly affects millions of people around the world. Although heavy metal contamination is more prevalent in developing areas and Southern Asia, well developed areas in the United States are also feeling its effects. These heavy metals often occur naturally in soil and bedrock but may become more concentrated due to human activities such as mining and industrial work. Although various methods of heavy metal removal are available such as coprecipitation, membrane filtration, anion exchange, electrocoagulation, and reverse osmosis, they are often costly, difficult to implement, and are not always effective. In this work, superparamagnetic iron oxide nanoparticles were synthesized in a standard kitchen with commonly found household items. The home-synthesized nanoparticles were then integrated into a biosand filter, a commonly used filter already shown to have the capability to kill bacteria in water and remove other pollutants. Colorimetric analysis created Beer's Law curves for each chemical in order to find the concentration of treated solutions. The purpose of this experiment was to create a water filter that is easily made, green, cost efficient, and effective at removing heavy metals. The nanoparticle enhanced biosand filter removed more than 77.1% of copper, 75.2% of nickel, and 69.3% of cobalt from 0.1M solutions all while keeping costs under $15. Combined with the well-known antibacterial characteristics of the biosand filter, this project provides evidence that a nanoparticle enhanced filter has great potential for application in the future and may be a revolutionary, inexpensive, and sustainable method for water purification in areas devastated by heavy metal contamination and other forms of pollution.

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