Using Iron Oxide Coprecipitation to Treat Arsenic and Uranium Contamination in Drinking Water in Native American Communities

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Millions of people around the world depend heavily on groundwater as their source of domestic water use and clean drinking water is often only available through water treatment. This is especially true for communities who reside in rural places. Many Native American communities face greater health concerns compared to other population groups in the United States and part of the problem is access to clean water. On the Navajo Nation and other Native American communities, municipality supported public water supplies are often unavailable to rural households. Many of these residents rely on unregulated and usually unmonitored water sources. Often, this reliance results in people using water that is unfit for consumption. Arsenic (As) and uranium (U) are the two most widespread geogenic (naturally-sourced) contaminants that also are common contaminants associated with mining and other anthropogenic sources. Long-term exposure to even low concentrations of these metals can lead to adverse health effects on humans and the ecosystem. Effective mitigation methods for arsenic and uranium in drinking water sources need to be effective and sustainable to be used in rural areas. The goal of this study was to make a treatment media that can remove As and U from drinking water. We compared the efficacy of an iron-oxide based treatment medium made out of biologically-synthesized iron hydroxide with chemically precipitated media to treat synthetic water with a composition similar to contaminated water in Oglala Sioux Tribal Lands. The treatment media was prepared from a dissolved iron source that oxidized through a wide range of biologically-mediated processes. Iron oxides are efficient adsorbents in arsenic removal process and we tracked the creation of iron oxides in the treatment media, and their ability to remove phosphate as the model contaminant. We found that controls lacking iron experienced little phosphate removal, indicating that Fe additions were necessary for removal to be effective. Fe filings were an effective iron source; they produced iron oxides that removed phosphate effectively, particularly in biological reactors that were anaerobic and contained lactate. More complete removal of phosphate in anaerobic systems relative to chemically-precipitated iron oxides indicates that biological oxidation creates more effective sorbents than does rapid chemical oxidation, presumably by influencing the mineralogy of the resulting iron oxides.