Arsenic Removal from Water using Iron Oxide Ceramic Membranes

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Abstract

Within the past ten years, research has been conducted on iron oxide membranes and their ability to remove heavy metals from water. Research showed that arsenate and arsenite adsorb to an iron oxide surface. Norman, Oklahoma currently purchases drinking water from Oklahoma City for $3.10 per 1000 gallons. The city purchases water from Oklahoma City because the water wells that previously supplied residents now experience arsenic concentrations between 1 and 42 parts per billion (ppb). The World Health Organization's allowable arsenic concentration in drinking water is 10 ppb. The proposed solution to treat the contaminated water wells was a steel support holding 2.8 inch diameter iron oxide membranes. The support diameter and number of membranes on the support was varied to reduce required work of a pump as well as increase saturation time of the system. The optimum support diameter is 36 inches and composed of 84 membranes. The total capital investment to construct a plant to create enough membranes to treat all of the Norman wells is $78,000. The production cost for a year is $328,000. The cost to Norman for the membranes and their replacement for a year is $550,000. The electricity for pumping water from the well, through the membrane, and to the holding tanks located throughout Norman is $264,000. The total cost to Norman, including a 15 percent product mark up, to use the membranes for a year is $820,000. This is $0.70 per 1000 gallons. Norman saves roughly $2.7 million year. For the membrane production company, the return on investment after 10 years, with Norman as the sole consumer, is 276 percent with a net present worth of $900,000.