ARSENIC SEQUESTRATION BY RUSTING IRON NAILS

by

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Abstract

The objective of this study was to sequestrate inorganic arsenic from groundwater using 6 mm rusting iron nails. Maximum adsorption capacity of arsenic per unit mass of nail and rate constant for arsenic adsorption on the nails at different stages of rusting was determined through batch studies. Experiments were carried out with both As(III) and As(V) in both oxygenated and anoxic conditions. Maximum adsorption capacity for As(III) and As(V) under anoxic and oxygenated conditions were found as 528, 488, 531 and 516 μg per gm of nail respectively. W-Scanning Electron Microscope (W-SEM) and Energy Dispersive X-Ray Spectroscopy (EDS) results showed evidence of surface deposition of arsenic on iron nails. XPS results showed the formation of different oxides with arsenic on the iron surface. A 7 cm diameter and 11.5 cm long column containing 1500 gm rusting nails was employed to examine the practical applicability of rusting iron nails to sequestrate arsenic from water. Ground water obtained from a deep tube well was spiked with arsenic and used as the eluent for this purpose. 380 liters of water containing As(III), 240 liters containing As(V) and 280 liters containing 1:1 total arsenic of 100 μg/L was passed through the column at flow rate of 32-40 ml/min before outlet concentration from the column exceeded 10 μg/L arsenic standard for drinking water adopted by WHO. The average concentration of iron in outlet sample from the filter was measured using Microwave Plasma-Atomic Emission Spectroscopy (MP-AES) after passing 25, 300 and 860 liters of water were 0.151, 0.168 and 0.381 mg/L respectively. The turbidity of outlet samples was below 10 NTU even after treating 820 lit of arsenic contaminated water by that column. Actual retention time in the column measured after the conclusion of the experiments through tracer study was 5.33 min. This was somewhat lesser than theoretical retention time of 7.39 min for the flow rate of 34 ml/min. It was concluded that this type of filter can provide 10 liter of arsenic free water every day for 3 months.