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Characterization of As remotion mechanisms in a natural limestone filter

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Abstract

The present work proposes an effective methodology to remove arsenic (As) present in groundwater for human consumption. Column experiments carried out with limestones outcropping in a groundwater As-rich area were found to effectively remove As, and have been considered as a sustainable treatment option. The study is focused on the aquifers at Zimapán town, Hidalgo, México, where the As concentrations rises values up to 1.2 mg/l, that surpass up to 48 times the permissible limit according to the Mexican regulation for drinking water (NOM-127-SSA1-2000) and 120 times the reference value according to the World Health Organization (WHO) [1,2]. The limestone material was characterized by means of X-ray diffraction (XRD) and X-ray fluorescence (XRF). Batch tests were performed using CaCO3 (reagent grade) with different arsenic solutions (50 ppm, 300 ppm, and 12000 ppm) as reference standards and testing experiments. Accordingly, it was necessary to apply high-resolution techniques such as synchrotron light radiation, specifically X-ray absorption spectroscopy (XAS) to unsolved involved mechanisms. These XAS spectra at As K-edge were collected in the Elettra Sincrotrone Trieste for references and experimental columns. Linear Combination Analysis results showed that in all samples, the main As removal mechanism is adsorption, with more than 90%; and less than 10%, we find: (1) precipitation of As with Ca, (2) with Na, and (3) retained As associated with Fe. Overall, the experiments indicated that home-filters based on these limestones may be developed to use as an alternative to avoid population exposure, mostly in isolated small communities.

About

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