DESIGN AND IMPLEMENTATION OF A TREATMENT SYSTEM FOR ARSENIC REMOVAL FROM GROUNDWATER IN BOLIVIAN HIGHLANDS AND VALLEYS

Ramiro Escalera, Omar Ormachea, Mauricio Ormachea, José Luis García, Jesús Suso, María Eugenia García, Fernando Pérez, Jorge Hornero, Oscar Fernandez, Ana Zelaya, Lizángela Huallpara

ABSTRACT

The presence of elevated concentrations of arsenic found in drinking water at two geographically distant sites in Bolivia, has required the design, construction and implementation of an arsenic removal system in order to obtain safer water for consumption. One of the sites is in an educational unit in the peri-urban area of the city of Cochabamba and the other is in a rural school in the town of Quillacas in the department of Oruro within the Bolivian Altiplano area. The system consists of two arsenic removal processes that work in series: i) the RAOS process that requires an aeration and dosing stage of ferrous sulfate and sodium citrate automatically controlled with the flow of water, 6 photoreactors equipped with high-quality acrylic tubes transmittance placed in Fresnel-type solar collectors with a collecting capacity of 17.5 soles) and ii) the IHE-ADART process using iron oxide-coated sand filters, IOCS, followed by microfiltration with 5 and 1 micron polypropylene filters arranged serially. The system is capable of removing total arsenic (particulate and dissolved) to concentrations lower than that required by the WHO guide and the Bolivian standard NB 512 (10 µg/l) in both educational units, even when the hydrochemical characteristics of the treated waters were substantially different. The characteristics of the well water in Cochabamba favor the removal of arsenic up to around 75% by both processes, especially the pH, the oxide-reduction potential and the low concentrations of competing anions (chlorides, sulfates and nitrates) for the adsorption sites that are on the surface of the ferric hydroxide microflocks or the ferric oxide layer that covers the sand in IOCS filters. On the other hand, the high concentrations of chlorides, borates and sulfates present in the well water used by the Quillacas educational unit and its high salinity do not significantly affect the adsorption capacity of the IOCS sand, allowing high removal efficiencies of arsenic (greater than 90%). In conclusion, the system is technically adequate for the removal of natural arsenic present in groundwater in the lower Cochabamba valley and in the southern area adjacent to Lake Poopó in the Bolivian altiplano.

Keywords: Arsenic Removal Processes, SORAS, Iron Oxide Coated Sand, IOCS, Groundwater, Fresnel-type, Fotocollectors.

DOI: 10.23881/idupbo.020.1-2i