Fe(0) filters for arsenic removal in remote settings in West Africa: field and laboratory findings

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The presence of arsenic in drinking water is a widespread problem in parts of West Africa that has, as yet, received little attention from the scientific community. The suitability of low-cost, low-tech Fe(0) filters using locally available materials was tested in a remote setting in northern Burkina Faso, where total As concentrations in wells were between 400 and 1200 µg/L. The household filters were based on the design of the successful SONO filter (Bangladesh), with small iron nails being the source of Fe-oxides for As adsorption and co-precipitation.

Initial results showed that only between 50 – 70 % of As was removed in the filters. Subsequent column experiments in the laboratory with As-spiked groundwater revealed that this is due to reduced water-nail contact time, caused by trapped air in the nail layer and resulting in preferential flow paths. By ensuring that the nail layer stays permanently saturated (e.g., lifting of the column outlet), As removal in the columns consistently remained between 95-98% over 6 months despite high inflow As concentrations (500-1000 µg/L), and independent of whether As(III) or As(V) was added. Only pH-values > 8 (compared to 6.5-7.5 in the field) led to decreased As removal due to reduced Fe(0) corrosion, less available Fe(III)-oxides for As co-precipitation, and possible precipitation of $CaCO_3$ on the nail surfaces. Following the laboratory insights, the field filters were modified to ensure permanent saturation of the nail layer. Arsenic removal increased to 70 - 85% after modification, but still fluctuated strongly. This is attributed to field conditions that are difficult to control and that could contribute to lower removal efficiencies (e.g., irregular filter use, manipulation of taps to increase flow rates, fluctuating inflow As concentrations, and higher probabilities for preferential flow paths in filters with larger diameters). Nevertheless, this pilot study showed that Fe(0)-based filters can significatly reduce As exposure when other mitigation options are not viable.