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Arsenic in groundwaters of rural India: its geochemistry and mitigation approaches

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During the last few decades, arsenic (As) has been recognized as the most threatening contaminant in natural waters (especially groundwater). It has become a menace to the health of millions of people worldwide. Many large and small communities experience As contamination in groundwater and/or drinking water supplies in south-east Asia and the problem is grave in West Bengal and Bangladesh (Bengal Delta Plain, BDP) both in terms of human exposure as well as spatial coverage. It is frequently observed that As concentration in contaminated wells exceeds both WHO guideline value (10 mg/l) and stipulated National standard (50 mg/l) for both Bangladesh and India. Dissolved forms of As in the BDP water include arsenite (∼50–70%), arsenate (∼30–50%) and ultra-trace amount of monomethylarsonic acid and dimethylarsinic acid. Arsenite and arsenate species can interchange depending on redox potential (Eh), pH and biological processes. The prevailing local geomorphological features (surface water, sanitation, agricultural activity) can also influence the mobilization of As in addition to the dominant geological factors. Therefore, the local sedimentology and hydrogeology should also be given importance prior to implement or consider any policy to mitigate the As contamination of groundwater. Conventional treatment techniques to remove As from groundwater are costly and difficult to practice in rural areas of the BDP. There are several techniques available for groundwater As removal. Iron and Alum coagulation, softening [mediated by calcite or Mg(OH)2 formation], by reverse osmosis, using zero-valent iron and nanoparticulate zero-valent iron, several natural/synthetic metal oxides, naturally found minerals like siderite, hematite, using iron doped activated carbons, development of bio-physicochemical techniques, using granular TiO_2 adsorbent are some of the many proposed removal techniques investigated by various researchers. Instead of using hazardous chemicals (e.g. chlorine, ozone in conventional method) As from groundwater can also be removed by exposure to sunlight (solar oxidation) in presence of dissolved iron (Fe) and a chelating agent (citrate, naturally available) followed by filtration with cloth or simple decantation. The technique is user friendly, low cost and easy to perform by the rural mass of the BDP.