Arsenical pollutants in microbial mats and their contributions on the discharged underground water in Bangladesh

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The toxic metalloid, arsenic is a hazardous element for its widespread carcinogenic character, which is also responsible for mutagenic and teratogenic problems. Specially lung, skin and bladder cancer, gangrene and placental problem for unborn children (Banfield and Nealson, 1999; Islam and Tazaki, 2000; Lena et al., 2001). Most of these kinds of problems eventually be develop in those people, who drink water from tinted sources including arsenic polluted underground water. Arsenic is ubiquitous, found at trace levels in the biosphere including organisms and anoxic underground water. Recently the evidence of arsenical chronic poisoning has been reported in many parts of the world and has become a serious public health problem in some Asian countries like Bangladesh, India and Taiwan. Bangladesh are one of the most vulnerable countries of them where millions of people have been affected by drinking tinted underground water.

In contrast, some of the bacteria in microbial mats are metabolically active and capable of accumulating the toxic arsenic together with other heavy metals such as Fe, Mn, Cu, Zn, Cd, and Pb. In order to maintain osmotic stability the cellular systems actively transport ion through their membrane (Simkiss and Wilbur,1989). Bacteria selectively accumulates heavy metals as having their own niche in the same geo-aqua-echo-system (Ariza, 1998). In Bangladesh, currently, several kinds of filter is being used for the removal of As from water. However, the variety of such kinds of filter is still rather limited. It has also been reported that frequent use of these filters has caused to pollute water once again.

Present study has been conducted to estimate the contents of arsenic in microbial mats corresponding to the distance covered by polluted water flow and to clarify bacterial role in the removal of arsenic.

Discharged groundwater (tube-well water) and green, gray and black colored microbial mats were collected from three sites of Hazigonj, one of the highly polluted area in Bangladesh. To determine the concentration of As in the field water inspection has been carried out by Field test-kits. Besides these in the laboratory, microbial mats and water samples were analyzed by ED-XRF to identify the chemical components, XRD for mineralogy; optical and electron microscopy for the observation of bacteria in microbial mats.

The results suggest that the concentration of As in microbial mats is higher (average about 0.68 wt%, while water contains 3 ppm of As) in the samples nearest to the water flow point. Comparative lower concentrations (average about 0.05 wt%, while water contains 2.5 ppm of As) are noticed at a distance of about 2.5 m from the flow point. And finally, no significant traces of As has been detected at a distance of 6-7 m in the down stream where water contains 1.5 ppm of As. The results also indicate that microorganisms can accumulate As in different scales in different points. Therefore, as mentioned before it could be summarized that microorganisms or bacteria in microbial mats have their own way of accumulation in the geo-aqua-eco-system. Furthermore, optical and electron microscopic observations revealed the presence of filamentous, bacillus and coccus shaped bacteria in different samples of microbial mats. In addition, the SEM-EDX analysis showed that the bacteria in microbial mats were capable of accumulating As with other elements. Bacteria can produce macromolecules out side of their cell wall which is in agreement with Geesey and Jang(1990). Ledin (2000) also reported that Scene desmus pannonicus could accumulate As ions in presence of other ions.

Consequently, it might be considered that specific kinds of bacteria in microbial mats can contribute for cleaning As polluted water and assure the supply of arsenic free ground water for the sake of life.