

ADSORPTION OF ARSENIC BY SMECTITE

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No matter what the sources of arsenic and the mechanisms of release to drinking water are, ensuring the supply of As-safe and pure drinking water for millions of people in rural areas of Bangladesh is of great importance. In order to ensure arsenic-safe drinking water, research to mitigate the problem is in progress with some relative success⁽¹⁾ although a low cost technique for reducing arsenic content in drinking water particularly below the WHO limit is yet to be explored.

Joardar *et al.*⁽²⁾ found a significant positive relationship between the adsorption of arsenic and clay content of some selected soils and similar trend of arsenic adsorption by soils and clay fractions in those soils. Arsenic adsorption on goethite, gibbsite,^(3,4) hematite, kaolinite⁽⁵⁾ and illite⁽⁶⁾ have also been studied. Leaching of arsenic contaminated water through a clay mineral for certain period of time may determine the capacity of that clay to reduce the arsenic content in supplied water. From the viewpoint of exploring arsenic remediation technique, the adsorption phenomenon of clay minerals may be taken into account since clay minerals occur naturally as a component of soils and soils are regarded as a sink of arsenic.⁽⁷⁾

The cost of arsenic remediation using the adsorption phenomenon of clay mineral depends on the availability of clay minerals in soils of the concerned area. If identified as principal input of arsenic remediation technique, the clay minerals that occur in Bangladesh soils could be explored for a low cost remediation technique.

Floodplain soils of Bangladesh consist of different clay minerals belonging to the smectite group.⁽⁸⁾ In this perspective, the adsorption capacity of 'smectite' was studied along with its capacity of removing arsenic from supplied water containing dissolved arsenic above allowable limit.

A laboratory based column leaching experiment was done with smectite. It was a pure clay mineral (dust) and was obtained from the University of South Australia, Adelaide, South Australia. The experiment was carried out with three sets of glass columns of different diameters (3.68, 3.3 and 2.67 cm). The columns were denoted as C1 (maximum diameter, 3.68 cm), C2 (medium diameter, 3.3 cm) and C3 (minimum diameter, 2.67 cm), respectively. There were three replications for each set.

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At the bottom of the column a piece of coarse textured greycloth was attached to prevent the smectite sliding out of the column and to filter the solution. This type of cloth can be a cheap alternative for membrane or porous porcelain filters. The bottom part of each of the columns was filled with 100 g acid-washed coarse sand (0.1 - 0.2 mm in diameter). For each column 10 g smectite was used and this amount was thoroughly mixed with 100 g acid-washed fine sand (0.05 - 0.1 mm in diameter) to make the bulk sample porous so that the solution could leach without being clogged. The smectite-fine sand mix was poured into the glass columns. The column height containing smectite-sand mixes were 8, 10 and 14 cm for the columns C1, C2 and C3, respectively. Solutions containing 100 ppb As per liter (simulated with tap water) was passed through the columns; the solution was prepared from sodium meta arsenite. The solution was poured into the column on a daily basis and the leachates were collected 2 h after the columns were charged. The leachates were collected three times a day, then the columns were kept empty till the following day when the leaching was repeated; this maneuvering continued for ten consecutive days.

The total arsenic in the collected leachate was analyzed by Hydride Generation Atomic Absorption Spectrometer (HG-AAS) as described by Portman and Riley.⁽⁹⁾ The average of three leachates for each day are presented in Fig. 1. The native As content of smectite was < 0.002 ppb. Reagent blanks and internal standards were used where appropriate to ensure accuracy and precision in the analysis of arsenic. Each batch of 20 samples was accompanied with reference standard samples to ensure strict QA/QC procedures.

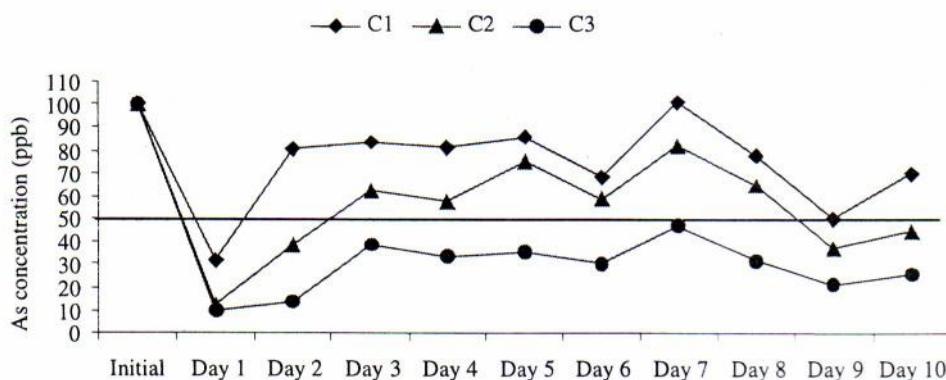


Fig. 1. Concentration of arsenic in the leachates of the three columns at different days.

The results showed that the column (C3) performed better. The solution concentration was 100 ppb and the leachate contained below 50 ppb in all the cases. At the beginning of the experiment the leachate concentration was below 50 ppb for

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all columns. The reason could be attributed to the contact time and column length. Column 3 allowed more time to leach the solution. All the columns contained same amount of smectite but the length of column 3 was the maximum because of smaller diameter. Our findings indicate that smectite could be used as an efficient adsorbent for As in drinking water because of its high adsorbing capacity and its easy availability and cheap cost. However, further research is emphasized at the field level before it is recommended for extensive use.

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