ABSTRACT

Arsenic contamination in groundwater and its health impact on human body is a well known global issue. Groundwater contamination due to arsenic in the Bengal Delta region of Bangladesh and West Bengal (India) is considered as the biggest natural calamity in the 21st century. Several methods have been studied to remove arsenic from water. Most of the methods are costly and yet to be implemented in the arsenic affected rural areas.

Adsorption now plays an important role in environmental protection engineering, because of its simplicity in operations. Arsenic adsorption from contaminated groundwater (CGW) collected from affected tube wells (South 24 Parganas, West Bengal, India) is investigated using three adsorbents e.g., raw laterite (RL), acid activated laterite (AAL), and acid-base treated laterite (TL). RL samples are collected from different locations with varying inorganic composition. The relation between adsorption capacity and inorganic composition of RL is evaluated. Acid activation and acid-base treatment methods are optimized in order to get the best adsorbent.

The adsorption kinetic data are fitted successfully to the theoretical model. The mass transfer coefficient (K_f) and pore diffusivity (D_e) for arsenic-adsorbent systems are evaluated based on shrinking core model. The pore diffusivity of arsenic in TL is much higher than other adsorbents.

The adsorption performance of treated laterite is standardized based on inorganic constituents of raw laterite samples collected from various locations. Inorganic composition of RL has greater influence on arsenic adsorption behavior of TL. The fixed-bed arsenic adsorption from CGW on TL-bed is more effective compared to RL and activated alumina bed. A household column filter of ~2 L TL-bed (15 cm bed depth) can treat ~2000 bed volume (~4000 L) of CGW at breakthrough arsenic concentration of less than 8 µg/L from the initial arsenic concentration of 1027±60 µg/L. The performance of fixed-bed and household-column filters proves the suitability of treated laterite for real field application.

Keywords: Treated laterite, Arsenic removal, Adsorption kinetic modeling, and Arsenic contaminated ground water.