Comparison of Different Biosorbents on Hardness Reduction from Groundwater

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Abstract: Though Reverse Osmosis (RO) provides excellent filtration of cations from drinking water, it has several drawbacks; significant water wastage as RO brine, high energy consumption, and substantial capital costs. Additionally, RO removes beneficial minerals from water. To address these limitations, biosorbents were explored as a sustainable alternative to remove hardness from groundwater. This preliminary study aimed to compare the effectiveness of raw and phosphoric acid-activated fruit peel biosorbents for the removal of total hardness from groundwater in the Vavuniya district, specifically for potable use. The hardness was measured by EDTA titration, and the groundwater sample had a hardness of 650±20 ppm. Preliminary experiments were conducted using a biosorbent dose of 2g/L, with a contact time of 360 minutes and a shaking speed of 200 rpm. Five different biosorbents—beetroot, lemon, orange, banana, and pomegranate peels were tested under identical conditions in both their raw and activated forms to evaluate their hardness removal efficiency and adsorption capacity. For the raw biosorbents, the hardness removal efficiencies were 15.4%, 21.5%, 15.4%, 13.9%, and 26.2%, respectively, with corresponding adsorption capacities (mg/g) of 5.0, 7.0, 5.0, 4.5, and 8.5. For the phosphoric acid-activated biosorbents, the removal efficiencies increased to 57.4%, 60.3%, 48.52%, 50.0%, and 66.18%, respectively, with adsorption capacities (mg/g) of 195.0, 205.0, 165.0, 170.0, and 225.0. The results indicated that pomegranate peels achieved the highest removal efficiency, followed by lemon peels in their raw form at a contact time of 360 minutes. The phosphoric acid activation significantly enhanced the performance of all biosorbents. Further studies are needed to assess the longevity, reusability and potential release of organic contaminants from the biosorbents. This study would help to develop a cost-effective water filter by incorporating biosorbents for small families in rural communities, embracing a "waste to resource" concept.

Keywords: Biosorbents, Groundwater, Hardness, Phosphoric acid, Pomegranate

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