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Roasted-modified Date Pits In Remediation Of Bromide Ions From Desalinated Water: Kinetic Studies

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Abstract

Disinfection of drinking water is one of the extreme public health activities in Qatar. Chlorination, ozonation, ultra-violet, chloramination, and others are the most important treatment processes used and they can cause the formation of toxic by-products. The existence of bromide (Br-), for example, in water sources might cause in formation of brominated toxic by-products.
Up-to-date drinking water treatment methodologies are challenged to successfully eliminate Br- before final consumption. Remediation onto activated carbons has a number of restrictions. Date pits are suitable as raw remediating adsorbent for preparing various modified adsorbents, because particular surface functional groups and the micro-pore structures can be attained by active modifications. The overall objective of this study was to develop an economical and environmentally acceptable process to safely eliminate the levels of Br- from desalinated water.

Roasted date pits (RODPs) and activated charcoal (AC) (used as a control) were crushed and sieved with four different particles size ranges. The percentage of Br- removal was also studied under different experimental conditions such as pH, sorbent mass and initial concentration. In addition, surface characterization was also investigated. Experimental date analyses were investigated using different isotherm and kinetic sorption models.

The modification of the date pits surface enhanced the Br- removal capacity at high initial concentration of bromide (200 ppm) by 27%. Using scanning electron microscope (SEM), the date pits surface images showed a different in pore sizes upon modification. Removal capacity of RODPs reached 39% at pH 4. In this study the heterogeneity of adsorbing mechanisms and the fitting with pseudo second order model and inter particulate diffusion models were concluded, and more than 35% of Br- removal efficiency was achieved within the RODPs at the first hour of contact time.
The adsorption Br- onto RODPs was not fitted well with the pseudo-first order model. It was found that the kinetics of Br- adsorption was followed the pseudo-second order. It was also observed fluctuations in the removal efficiency for smaller particle sizes; indicating heterogeneity of adsorption/desorption and potential chemical bindings, this particular behaviour was not observed and investigated elsewhere in the literature (Figure below). The surface of RODPs contains oxygen functional groups such hydroxyl; hence the presence of such functional groups on the surface of date pits considerably influences on the adsorption mechanism of organic and inorganic compounds on the RODP.
Economically RODPs are successfully used to remove Br-, comparing to AC. However, both adsorbents have nearly the same removal efficiency after one hour contact time. Apparently, the removal efficiency of both systems was quite significant. This may cover the way for the cheap and widely available date pits to be used as an adsorbent in water purification process.