Desalination and Water Treatment
Volume 57 | Issue 56 | 2016 | ISSN: 1944-3994 | E-ISSN: 1944-3986

Defluoridation studies with synthesized magnesium-incorporated hydroxyapatite and parameter optimization using response surface methodology

Poonam Mondal, Dhiraj Mehta & Suja George
Department of Chemical Engineering, Malaviya National Institute of Technology Jaipur, Jaipur, Rajasthan 302017, India

Abstract:
The severe impact of consumption of excess fluoride on human health has raised concerns for development of reliable materials for defluoridation of drinking water. This study deals with the synthesis of magnesium-incorporated hydroxyapatite (M-i-HAP) and evaluation of its defluoridation potential. Characterization studies revealed the bonding patterns, phase characteristics, and other microstructural details of the adsorbent synthesized, and the surface area was found to be 46.62 m2/g. Response surface methodology was used for optimization of fluoride adsorption on the adsorbent and development of the predictive model. The optimum conditions evaluated using central composite statistical design for fluoride removal were found to be 303 K, pH 7, 180 min contact time, and 10 g/L of M-i-HAP for treating fluoride solution of 10 mg/L. At these conditions, the actual removal experimentally achieved was 94.5% which was very close to the maximum removal predicted by the model (94.60%). The process followed pseudo-second-order kinetic model and the adsorption mechanism can be described by Langmuir isotherm with an adsorption capacity of 1.16 mg/g. The adsorbent was regenerated 91% using 0.1 M NaOH solution. Drinking water quality was assessed for various parameters and the treated water was found to be fit for consumption with all parameters such as pH, total dissolved solids, total hardness, alkalinity, and turbidity within permissible limit as per World Health Organization and Bureau of Indian Standards (BIS) guidelines.

Keywords:
Adsorption, Drinking water, Fluoride, Optimization, Response surface methodology

Link: https://www.tandfonline.com/doi/full/10.1080/19443994.2016.1167628