Breakthrough Characteristics and Flow-Rate Interaction in Water Defluoridation with a Bauxite-Gypsum-Magnesite Composite Filter

By

Bernard Thole., Felix W. Mtalo., & Wellington R.L. Masamba

Abstract

Water defluoridation in a fixed bed column may be optimized through choice of flow rate. This, however, affects breakthrough characteristics. In any fixed bed system an understanding of flow rate and breakthrough interactions is therefore important to guide choice of design velocity. Consequently interactions between flow rate and break through characteristics were determined in a fixed bed column in defluoridation with a composite filter of bauxite, gypsum and magnesite. This was an attempt to optimize defluoridation with the three materials. Lower flow rates obtained longer service times but higher residual concentrations of sulphates and chlorides. Higher flow rates registered lower residual sulphate and chloride concentrations but obtained lower service times. There were no significant differences in residual concentrations of aluminium, iron, calcium and magnesium among the different flow rate regimes. Adsorbent exhaustion rates and critical bed depths increased with increase in flow rates, indicating that lower flow rates offered better technical system performance. Critical bed depths ranged from 5.23 to 10.89 cm for flow rate range of 0.68 to 1.25 ml/s. Operating lines were polynomic with generic form $\delta = C_1 t^2 - C_2 t + C_3$, where $\delta$is adsorbent exhaustion rate and t is empty bed residence time. Choice of flow rates, in this system requires a balance between service-time optimisation and water quality.

Keywords

Adsorption, bauxite, defluoridation, gypsum, magnesite, critical bed depth