Desalination and Water Treatment
www.deswater.com

doi: 10.5004/dwt.2019.24087

157 (2019) 100–109
July

Fluoride removal from synthetic groundwater by electrocoagulation process: parametric and energy evaluation

Amel Chibani[a], Afef Barhoumi[a], Sana Ncib[a], Wided Bouguerra[a,b,*], Elimam Elaloui[a]

[a]*UR Materials, Environment and Energy, Faculty of Science of Gafsa, University of Gafsa, Campus Sidi Ahmed Zarroug, Gafsa 2112, Tunisia, emails: bg_wided@yahoo.fr (W. Bouguerra), amel_chibani1989@yahoo.fr (A. Chibani), afefebarhoumi@yahoo.fr (A. Barhoumi), sana_ncib@yahoo.fr (S. Ncib), limam_aloui@yahoo.fr (E. Elaloui)*
[b]*Common Services Unit for the Research, Faculty of Science of Gafsa, University of Gafsa, Campus Sidi Ahmed Zarroug, Gafsa 2112, Tunisia*

Received 24 April 2018; Accepted 10 March 2019

ABSTRACT

This study investigates the effect of several parameters on the electrocoagulation process has been studied in order to optimize the evolution of the fluoride removal percentage and the energy consumption. Optimum experimental conditions of fluoride removal were determined as: pH_i = 6, J = 0.27 mA/cm^2, t_{EC} = 30 min, [NaCl] = 0.5 g/L, d_i = 1 cm, S/V = 7.2 m^{-1} and Stirring speed = 300 rpm with two aluminum electrodes. These operating conditions are allowed to achieve fluoride removal of over 85% in a relatively short operating time with low energy consumption (0.0396 kWh/m^3). The results fitted with the Langmuir and Freundlich equations showed that fluoride removal was achieved by a monolayer adsorption, with a finite number of identical sites. To study the rate-limiting step, the kinetic data of fluoride were analyzed using first-order and second-order kinetic models. Under optimal conditions with 10 and 20 min treatment, fluoride was completely removed for initial concentration of 3 and 6 mg/L respectively. Moreover, for fluoride initial concentration of 10 mg/L, it is possible to reach a residual concentration under the limit recommended by WHO for fluoride concentration in drinking water (1.5 mg/L) with lowest consumption of electricity.

Keywords: Drinking water; Fluoride removal; Aluminum electrode; Electrocoagulation; Energy consumption; Kinetic study; Adsorption isotherm

* Corresponding author.