Elimination of fluoride ions from aqueous solutions with an unmodified bentonite clay in batch reactor

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Abstract

The presence of excess fluoride ions in wastewaters generated by different industrial activities has been acknowledged as a major environmental problem worldwide. Groundwater is one the important sources of drinking water. The discharge of industrial wastewater containing such as pollutant into the surface water would lead to groundwater pollution. The consumption of this latter can be considered as the major path of human exposure. Various technologies have been reported in the literature for fluoride removal from wastewaters to conquer the hazardous impacts generated by fluoride ions on the environment and human health. In this study, the fluoride removal from wastewaters was carried out by adsorption on a local available bentonite clay obtained from the Northern part of Morocco using batch equilibrium experiments. The main aim of this study was on the one hand, the evaluation of the adsorption potential of the unmodified bentonite clay for wastewater defluoridation, and on the other hand, the identification of the mechanism involved in the fluoride adsorption process. The compositional, structural and textural characteristics of the natural bentonite clay were determined using accurate physicochemical and mineralogical characterizations. The contents of fluoride ions in wastewater were determined by the potentiometric method with a fluoride-specific ion electrode connected to a digital ion analyzer. Batch adsorption experiments were conducted at room temperature to optimize various operational parameters such as contact time, initial fluoride concentration, adsorbent dose and initial pH solution. It was observed that 30 min of contact time between the adsorbent and aqueous solution containing fluoride ions was sufficient for attaining equilibrium. The maximum wastewater defluoridation (52.2%) was obtained under acidic conditions (pH = 2), and for 5 mg L^{-1} and 2 g L^{-1} of initial fluoride concentration and adsorbent dose, respectively. The experimental data followed pseudo-second-order and fitted well into Freundlich adsorption, indicating multilayer adsorption with heterogeneous energetic distribution of active sites and with interaction between adsorbed molecules.

Key words —Defluoridation, Adsorption, Bentonite clay, Aqueous solutions, Batch reactor

Professional Biography

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Jihane Assaoui is a PhD candidate at Chouaïb Doukkali University (El Jadida, Morocco) and Graduate Scholar supported by the Ministry of Higher Education, Scientific Research and Professional Training (Enssup). Her research focuses on the treatment and purification of wastewater by adsorption on synthetic and especially natural materials that are recently considered as ecological solutions whose importance seems to increase with the awareness of environmental protection. Jihane holds a Master of Science Degree in Analytical Chemistry, and a Bachelor of Physicochemical Analysis Methods from Chouaïb Doukkali University. She presented her research in many countries including France and Morocco.

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