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Removal Of Fluoride Ions From Aqueous Solution By Waste Mud

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Fluoride is one of the most essential ions for living organisms at low concentrations. The World Health Organization (WHO) has specified the tolerance limit for fluoride content in drinking water as 1.5 mg/L [1]. Low concentrations of fluoride in drinking water have been considered beneficial to prevent dental carries. Chronic intake of excessive fluoride can lead to severe dental and skeletal fluorosis. Fluoride is attracted by positively charged calcium in teeth and bones due to its strong electronegativity, which results in fluorosis and associated health problems, children as well as adults [2]. Therefore, low-cost and technologically feasible methods for removal of fluoride ions from drinking water are needed to control fluorosis. Fluoride removal from drinking water can be achieved by chemical precipitation, adsorption, membrane process and ion exchange. Adsorption process is found to be effective, environmental friendly and economical.

Waste mud was used as an adsorbent for removal of fluoride ions from drinking water in the presented work. Waste mud was obtained from Cu-Zn mine in Çayeli, Rize-Turkey. The chemical composition of waste mud is 11.7% SiO_2, 8.9% Al_2O_3, 48.4% Fe_2O_3, 0.7% ZnO, 0.7% CuO and 29.6% other constituents. The fluoride removal potential of waste mud was investigated as a function of pH, contact time, initial fluoride concentration and adsorbent dose. The three different forms of waste mud were tested for their fluoride removal performance: i) original waste mud (*o*-WM), ii) acid-treated waste mud (*a*-WM), and iii) precipitated waste mud (*p*-WM).

Batch sorption studies were performed. The sorption experiments were carried out by adding 0.01–0.2 g of adsorbent in 10 mL of synthetic fluoride solutions in polyethylene centrifuge tubes. The tubes were agitated up to equilibrium on a mechanical shaker. The solid was separated by filtration through nitrocellulose membrane, and the fluoride concentration in the supernatant was analyzed electrochemically using a fluoride ion-selective electrode. Maximum removal was achieved at pH 5 for all type of waste mud, but *p*-WM exhibited greater performance than the others (*o*-WM, *a*-WM). The removal of fluoride by *p*-WM was 83.7% and the final concentration was 16.3 mg/L at optimum condition from the synthetic solution having initial fluoride concentration of 50 mg/L (10 g/L adsorbent suspension). The experimental data were evaluated using Freundlich and Langmuir sorption isotherms. Results of this study demonstrated the effectiveness and feasibility of WM for removal of fluoride ions from aqueous solution.

References

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