Treatment of landfill leachate from Fez City by combined Fenton and adsorption processes using Moroccan bentonite clay

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ABSTRACT

This work deals with the study of the feasibility of landfill leachate treatment (Fez city, Morocco), using sequential processes combining Fenton and adsorption onto natural local bentonite clay. Thus, the operational conditions of the Fenton process were firstly optimized with 2,000 mg L\(^{-1}\) of Fe\(^{2+}\) and 2,500 mg L\(^{-1}\) of H\(_2\)O\(_2\) at pH = 3, which removed 73% of the chemical oxygen demand (COD) and 92% of the color from the raw leachate. Then, raw Moroccan bentonite was characterized by nitrogen adsorption–desorption, scanning electron microscopy-energy dispersive X-ray analysis, X-ray diffraction, and Fourier transforms infrared spectroscopy. The results indicate that the bentonite is characterized by a heterogeneous surface with irregular particle sizes and the presence of the montmorillonite as the major component. The bentonite presented characteristics of mesoporous material with Brunauer–Emmet–Teller (BET) surface area and total volume of pores of 51.7 m\(^2\) g\(^{-1}\) and 0.11 cm\(^3\) g\(^{-1}\), respectively. The natural bentonite clay was used as an adsorbent for the pretreated leachate (PL). The effect of adsorbent dosage, effluent pH, contact time, and temperature on the adsorption efficiency was investigated. Pseudo-second-order and Freundlich were the most suitable models to fit the experimental kinetic and the isotherm data of the adsorption, respectively. Therefore, 73% of COD and 96.5% of color removal were observed in Fenton treatment alone. The application of the Fenton process (2,500 mg L\(^{-1}\) of H\(_2\)O\(_2\), 2,000 mg L\(^{-1}\) of Fe\(^{2+}\), pH 3, and 1 h of contact time) coupled with adsorption (3 g L\(^{-1}\) of bentonite dosage, pH 5 and 5 h of contact time, and \(T = 35^\circ\)C) has achieved a total COD and color removal of 84% and 98%, respectively. This indicates that the combination process that involves Fenton followed by the adsorption process onto natural bentonite adsorbent would be an ideal option for leachate treatment.

Keywords: Landfill leachate; Fenton; Adsorption; Natural bentonite; COD

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