

Área: INO

Primary sludge from the paper industry as an alternative material for organic dye adsorption.

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Highlights

Paper sludge, both in its natural state and after acid and base treatments, was evaluated for its efficiency in removing Congo Red dye. The acid-treated sludge demonstrated notably superior adsorption performance.

Abstract

The Congo red dye is highly resistant to degradation and constitutes a significant pollutant in industrial effluents. This study evaluated the efficiency of removing this dye using paper sludge *in natura* form, as well as after acid and base treatments, as adsorbents. The acid-treated sludge achieved dye removal efficiency of up to 98%, while the natural and base-treated sludges removed approximately 24%. Kinetic analysis indicated that adsorption equilibrium was reached in 16 hours for the acid-treated sludge. Adsorption isotherms measured at 25, 40, and 55 °C showed a decrease in maximum adsorption capacity with increasing temperature (250.0; 220.76; and 25.06 mg/g, respectively). Characterization by X-ray diffraction revealed a significant reduction in crystallinity after acid treatment, resulting in a predominantly amorphous structure. Surface area evaluation indicated that, despite the larger area of the natural and untreated sludge, its lower adsorption efficiency may be related to the absence of adequate functional groups on the surface. Zeta potential analysis suggests that chemical modifications resulting from acid treatment may have increased the availability or reactivity of functional groups and active sites on the sludge surface, favoring interaction with the anionic dye. These results indicate that acidified paper sludge represents an efficient and sustainable adsorbent for the removal of persistent dyes from aqueous environments.

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