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Performance and mechanism of interaction of crystal violet with organohalloysite

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ABSTRACT

A series of new organic–inorganic nanohybrid materials were prepared by intercalating dimethylsulfoxide (DMSO) into the interlamellar space of halloysite at different contact times and DMSO/clay ratios. The X-ray diffraction and thermogravimetry/differential thermal analysis studies confirmed the insertion of DMSO into the interlayer space. The increase of the basal spacing to 1.12 nm was thus highlighted for an intercalation rate of 95%. All materials were used to remove crystal violet (CV) from aqueous media. We focused particularly on the mechanism of CV interaction with halloysitic nanohybrids by means of an infrared spectroscopy study. Understanding such an interaction is a fundamental approach for the effective use of halloysitic nanohybrids in wastewater sanitation. pH influence, kinetic, isotherm, and thermodynamic data have been examined. The equilibrium and kinetic data were appropriately adjusted, respectively, by the Redlich–Peterson, and pseudo-second-order models. The amount adsorbed by each nanohybrid depends on the intercalation rate. The larger the intercalated fraction, the better the amount adsorbed, so DMSO is involved in the CV adsorption. The mechanism would involve mainly a hydrogen bond between the electron lone pairs of oxygen of the sulfoxide function and the hydrogen of methyl bound to the tertiary amine of the dye molecule.

Keywords: Nanohybrid; Halloysite; Crystal violet; Mechanism; Hydrogen bond

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