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Removal of acid orange 10 by calcined Mg/Al layered double hydroxides from water and recovery of the adsorbed dye

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HIGHLIGHTS

- Calcined MgAl layered double hydroxide with different textural properties were prepared to remove the dye acid orange 10.
- Adsorption of acid orange dye is studied on calcined LDHs at different temperatures.
- Calcined MgAl layered double hydroxide displays a maximum adsorption capacity (665 mg/g of AO10 at 30 °C and C_i = 1000 mg/L).
- The thermodynamic parameters for the adsorption process is estimated.
- Recuperation of the total amount of adsorbed dye from the adsorbent is possible.

GRAPHICAL ABSTRACT

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ABSTRACT

This work considers the removal of the acid orange 10 (AO10) water contaminant on different calcined MgAl-layered double hydroxides (MgAl-LDHs). A precursor MgAl-LDH was submitted to hydrothermal treatment and grinding before calcination in order to obtain mixed oxides (MgAl500, MgAlHT500 and MgAlM500 respectively) with different surface characteristics. Adsorption experiments were carried out using different parameters such as pH of the solutions, contact times, temperature and initial dye concentrations to determine optimal adsorption conditions. Adsorbents and adsorption products were characterized by several physicochemical techniques. The kinetic study indicated that the adsorption of AO10 on MgAlHT500 was almost instantaneous and the maximum adsorption was reached in 2 h, while it was more gradual for the other two adsorbents. In all cases, the adsorption was higher at a higher temperature (30 °C), being more favorable for MgAlHT500: for initial dye concentration of C_0 = 2.2 mM, the amounts of AO10 removed from the solution per gram of adsorbent were C_s = 1.47 mmol/g for MgAlHT500 *vs.* C_s = 0.9 mmol/g for MgAlM500 and C_s = 0.64 mmol/g for MgAl500. The DRX technique analysis suggests the intercalation of AO10 into the LDH due to an increasing in the basal spacing from 7.7 Å which corresponds to carbonate containing LDH, to 17.7 Å. This could be ascribed to AO10 anions vertically oriented respect to the layers for a high initial dye concentration.

1. Introduction

The rapid growth of the world economy has caused environmental disorder with a huge pollution problem. The demand for water has increased tremendously in agricultural, industrial and domestic sectors. This has resulted in the generation of large amounts of wastewater containing a high number of contaminants. Many industries such as textiles, paper and plastic use dyestuffs in

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