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Effect of pH on the adsorption of Sunset Yellow FCF food dye into a layered double hydroxide (CaAl-LDH-NO_3)

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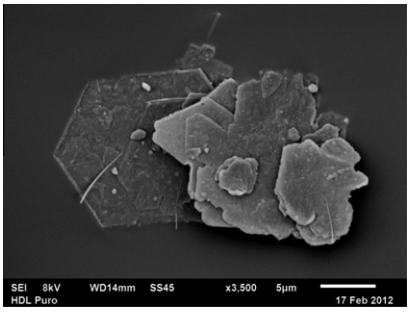
HIGHLIGHTS

- pH affects the adsorbent surface charge and the degree of anionic dye dissociation.
- CaAl-LDH-NO_3 is an effective adsorbent for the removal of Sunset Yellow FCF food dye from aqueous solutions.
- Lower pH potentially causes dissolution of the CaAl-LDH-NO_3.

GRAPHICAL ABSTRACT



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ABSTRACT

Effluents that are discarded by food industries are important sources of water pollution because they can contain large concentrations of organic matter and have intense color. The "batch" method for evaluating the adsorption of Sunset Yellow FCF food dye into a CaAl-LDH-NO_3 layered double hydroxide (LDH) system was investigated. The CaAl-LDH-NO_3 was coprecipitated at variable pH and characterized by X-ray diffraction, infrared spectroscopy and scan electron microscopy. Adsorption experiments were carried out as a function of pH, contact time and dye concentration. The results showed that pH affects the adsorbent surface charge and the degree of anionic dye dissociation. The effective pH range for dye removal was between 4.0 and 10. Lower pH potentially causes dissolution of CaAl-LDH-NO_3. The Langmuir equation adequately describes the equilibrium data. The best-fits showed a maximum adsorption of 398.41 mg/g or 0.88 mmol/g.

1. Introduction

Environmental changes due to human action have reached extremely worrisome levels. These actions result in a significant reduction in soil, air and water quality. Over the years, the problem of environmental pollution has become worse, which makes it a matter of public interest. Environmental pollution endangers the health of the community and of future generations. Thus, environmental pollution is identified as one of the largest problems of modern society [1,2].

Color is the most obvious water pollution indicator. Synthetic dyes represent a relatively large group of organic chemicals that are found in practically all spheres of our daily life. Annually, approximately 7×10^5 tons of dyes are produced, and approximately 7×10^4 tons/year are discarded by industries, including the textile, rubber, food, paper and plastic industries [1,3,4].

Because of their high organic matter concentrations and their intense colors, the effluents discarded by the food industry are an important source of pollution for water bodies. When discharged into streams, these effluents reduce the transmission of sunlight into the depleted dissolved oxygen zone [5–7] and may cause changes in aquatic biota (particularly near the release point). Thus, it becomes necessary to remove these materials before they are mixed with natural and unpolluted water bodies [3].

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