APPLICATION OF MgCuAl-LAYERED DOUBLE HYDROXIDE-BASED ADSORBENTS FOR THE ORGANIC DYE REMOVAL

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ABSTRACT

Layered double hydroxides (LDHs) are most commonly classified as stacked hydroxide layers with charge-balancing anions in the interlayer. The properties of these materials can be tailored by the variation of numerous synthesis methods and parameters. Additionally, thermal treatment of LDHs causes the collapse of the layered structure and the formation of non-stoichiometric metastable mixed oxides with suitable textural, structural, specific acid-base and redox properties. Considering the on-going problems occurring from numerous industries that generate and release organic dyes into the environment leading to severe health and environmental hazards, rapid and efficient approach for the dye removal from water is of great interest in this field of research. The motivation for this study was to investigate the adsorption properties of MgCuAl-LDHs and their derived mixed oxides related to adsorption of Methyl Orange (MO). For material characterisation (synthesized MgCuAl-LDH and MgCuAl-C mixed oxides), structural (XRD), and textural (low temperature nitrogen adsorption) were conducted. The MgCuAl-LDH synthesized materials were dried at 100°C, whereas MgCuAl-C mixed oxides were calcined at 500°C. Experiments were carried out in an open cylindrical pyrex reaction vessel containing 100 ml of solution (C_{MO}=20 mg/L) and 50mg of powdered materials. In order to eliminate the solar light influence, the adsorption experiments on MO removal were conducted in the dark. The MO removal efficiency was determined from the MO concentrations that were measured at defined time intervals using UV-VIS spectrophotometery at 463.9 nm. The results showed that both samples (MgCuAl-LDH and MgCuAl-C) had very promising adsorption properties, considering that after only 30 min, the MO removal efficiency for MgCuAl-LDH reached 80% and for MgCuAl-LDH up to 93.5%. Higher adsorptive capacity detected for the calcined sample (complete decolourisation of MO solution) could be explained by the more favourable textural properties since after thermal treatment the surface area increases.

This study showed that MgCuAl-layered double hydroxide-based adsorbents possess unique properties and could be considered to be promising materials for further research and application in the field of environmental protection, regarding the removal of organic dyes from water solutions.

Key words: adsorption, layered double hydroxides, organic polutants, enviromental protection

Acknowledgements: The authors are thankful for the financial support provided from Provincial Secretariat for Higher Education and Scientific Research (Contract No. 142-451-2341/2021-01/02) and from the Science Fund of the Republic of Serbia, program IDEAS Ø-Waste-Water (Contract No.7737365)