Synthesis of Mg/Al layered double hydroxides from a sub-bituminous coal ash and their application in hexavalent chromium removal from aqueous solution

Dong-Xue Guo*, Yun-Peng Zhao*, Hui-Duo Yang*, Shi-Feng Li*, Xing Fan*, Xian-Yong Wei*

*Key Laboratory of Coal Processing and Efficient Utilization (Ministry of Education), China University of Mining & Technology, Xuzhou 221116, China, Tel. +86 516 83885951, email: 704937207@qq.com (D. Guo), Tel. +86 516 83885951, Fax 86 516 83591093, email: zhaoyp@cumt.edu.cn (Y. Zhao), Tel. +86 516 83885951, email: 1063966026@qq.com (H. Yang), fanxing@cumt.edu.cn (X. Fan), wei_xianyong@163.com (X. Wei)

College of Chemical Engineering, Shenyang University of Chemical Technology, Shenyang 110142, China, email: li.shi.feng@163.com (S. Li)

Received 25 February 2018; Accepted 15 October 2018

ABSTRACT

An Mg/Al layered double hydroxide (LDH-A) for hexavalent chromium Cr(VI) removal was successfully synthesized from a sub-bituminous coal ash. For comparison, another Mg/Al-LDH (LDH-B) was also synthesized from an analytically pure chemical reagent using a similar method. Their characteristics were analyzed by Fourier transformed infrared (FT-IR) spectroscopy, X-ray diffraction (XRD), scanning electron microscopy, and N₂ Brunauer-Emmett-Teller surface area measurement. A batch of experiments were conducted to investigate the effects of the initial pH value, adsorption time, adsorbent dosage and initial Cr(VI) concentration on the adsorption capacities of Cr(VI) onto the LDHs in an aqueous solution. The adsorption capacity of Cr(VI) onto LDH-A was similar to that onto LDH-B, and the maximum adsorption capacity of Cr(VI) onto LDH-A was more than 66 mg/g at a pH of 3. The kinetics and isotherms of Cr(VI) adsorption onto the LDHs can be described with a pseudo-second-order kinetic model and a Freundlich isotherm, respectively.

Keywords: Layered double hydroxides; Chromium removal; Adsorption; Equilibrium; Kinetic

*Corresponding author.