Environmental Engineering and Management Journal

March 2020, Vol. 19, No. 3, 475-483
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu

"Gheorghe Asachi" Technical University of Iasi, Romania

EVALUATION OF MODIFIED FLY ASH BASED NAA-ZEOLITE: EFFECT OF CRYSTALLINITY ON CO_2 ADSORPTION CAPACITY

Muvumbu Jean-Luc Mukaba*, Alechine Emmanuel Ameh, Chuks Paul Eze, Leslie Felicia Petrik

Environmental and Nano Science Research Group, Department of chemistry, University of the Western Cape. Robert Sobukwe Rd, Bellville, Cape Town, 7535, South Africa

Abstract

NaA zeolite was successfully synthesised from fly ash through hydrothermal process. The synthesised NaA zeolite was modified with Li^+, Ca^{2+} and Mg^{2+} through ion exchange at a temperature of 60 °C and contact times of 1 h and 4 h. In this study the crystallinity of the synthesised NaA as well as its modified (LiA, CaA and MgA) was evaluated towards CO_2 adsorption capacity using temperature programmed desorption (TPD) process at low temperature (40-150°C) and high temperature (150-700°C). The mineral phase and structural characteristics of zeolites were examined using XRD and FT-IR. The results from XRD and FT-IR spectra revealed unique structural alterations influenced by the intrinsic characteristic of individual cation incorporated in NaA zeolite. Monovalent cations displayed highest crystallinity compared to divalent cations (downward order: NaA > LiA > MgA > CaA). Low and high temperature CO_2-TPD profiles were independent of the degree of crystallinity of the zeolites and a significant amounts of CO_2 desorption occur at low temperature indicating that physisorption is the most prominent adsorption mode in NaA, LiA, CaA and MgA zeolite.

Key words: adsorption, carbon dioxide, crystallinity, ion exchange, synthesis, zeolite

Received: April, 2019; Revised final: August, 2019; Accepted: October, 2019; Published in final edited form: March, 2020

* Author to whom all correspondence should be addressed: e-mail: 3258474@myuwc.ac.za, jeanlucmukaba@gmail.com; Phone: +27 219593878; Fax: +27 219593878