Environmental Engineering and Management Journal

March 2018, Vol.17, No. 3, 537-544
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu

"Gheorghe Asachi" Technical University of Iasi, Romania

REUSE OF MAGNESIUM WASTES IN HYDROTHERMAL SYNTHESIS OF A MAGNESIUM BORATE MINERAL: ADMONTITE

Azmi Seyhun Kipcak, Fatma Tugce Senberber, Emek Moroydor Derun*, Sabriye Piskin

Chemical Engineering Department of Yildiz Technical University, Istanbul, 34210, Turkey

Abstract

Magnesium wastes are among the gradually ascending and therefore challenging metal wastes, which are produced by many industrial activities. The purpose of this study is the usage of magnesium waste, a raw material in magnesium borate production by hydrothermal synthesis. Boron sources (boric acid (H_3BO_3) and boron oxide (B_2O_3)) react with magnesium wastes in order to synthesize the magnesium borate mineral of admontite ($MgO(B_2O_3)_3 \cdot 7(H_2O)$). In addition to the synthesis from waste magnesium, magnesium oxide (MgO) and B_2O_3 are also used to produce magnesium borates, in order to compare the results. Techniques of X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR), Raman spectroscopy and scanning electron microscopy with energy disperse (SEM-EDX) are used for further characterization analysis. The products' boron oxide contents and overall yields are also calculated. According to the results, synthesized minerals are identified as admontite ($MgO(B_2O_3)_3 \cdot 7(H_2O)$), mcallisterite ($Mg_2(B_6O_7(OH)_6)_2 \cdot 9(H_2O)$) and magnesium borate hydrate ($MgB_6O_7(OH)_6 \cdot 3(H_2O)$). It is seen that magnesium borates could be obtained as a mixture of different types of magnesium borate minerals or pure magnesium borate. A pure magnesium borate mineral of admontite is synthesized at the reaction temperature of 100ºC and the reaction time of 240 minutes using magnesium waste (W) and both H_3BO_3 (W) and B_2O_3 (B). B_2O_3 content and overall yields of pure admontite for the W-H were found as 51.15 ± 0.52% and 81.45 ± 3.20%, respectively. Similarly, pure admontite synthesized from W-B have the 51.72 ± 0.52% of B_2O_3 content and 74.56 ± 3.20% overall reaction yield.

Key words: admontite, hydrothermal synthesis, magnesium borate, magnesium waste, overall yield

Received: May, 2013; Revised final: July, 2014; Accepted: July, 2014; Published in final edited form: March 2018

* Author to whom all correspondence should be addressed: e-mail: moroydor@gmail.com, moroydor@yildiz.edu.tr; Phone: +90 212 383 4776; Fax: +90 212 383 4725