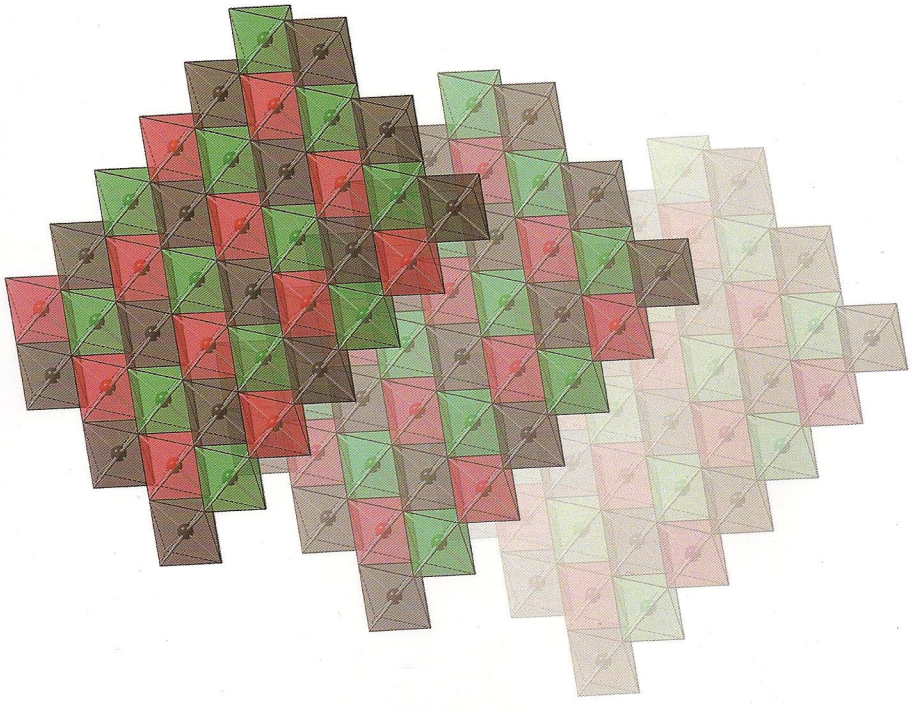
SORBENTY MINERALNE 2019

Surowce, Energetyka, Ochrona Środowiska, Nowoczesne Technologie

REDAKCJA NAUKOWA
TOMASZ BAJDA



Wydawnictwo Naukowe AKAPIT
Kraków 2019

Recenzenci:

prof. dr hab. Aleksandra Badora (**Uniwersytet Przyrodniczy w Lublinie**)
prof. dr hab. inż. Krzysztof Bahranowski (**AGH w Krakowie**)
dr hab. inż. Tomasz Bajda, prof. AGH (**AGH w Krakowie**)
prof. dr hab. Leszek Czepirski (**AGH w Krakowie**)
prof. dr hab. inż. Jean Bernardt Diatta (**Uniwersytet Przyrodniczy w Poznaniu**)
dr hab. Łukasz Drewniak, prof. UW (**Uniwersytet Warszawski**)
dr hab. inż. Małgorzata Franus (**Politechnika Lubelska**)
prof. dr hab. inż. Wojciech Franus (**Politechnika Lubelska**)
prof. dr hab. Zbigniew Hubicki (**Uniwersytet Marii Curie-Skłodowskiej w Lublinie**)
prof. dr hab. Zenon Kłapyta (**AGH w Krakowie**)
prof. dr hab. inż. Izabela Majchrzak-Kucęba (**Politechnika Częstochowska**)
dr hab. inż. Maciej Manecki, prof. AGH (**AGH w Krakowie**)
dr hab. inż. Jakub Matusik, prof. AGH (**AGH w Krakowie**)
prof. dr hab. Robert Pietrzak (**Uniwersytet im. Adama Mickiewicza w Poznaniu**)
prof. dr hab. inż. Marek Pronobis (**Politechnika Śląska**)
dr hab. inż. Alina Pruss (**Politechnika Poznańska**)
dr hab. inż. Grzegorz Rzepa (**AGH w Krakowie**)
dr hab. inż. Jolanta Warchoł, prof. PWr (**Politechnika Wrocławska**)
dr hab. inż. Magdalena Wdowin, prof. IGSMiE (**Instytut Gospodarki Surowcami Mineralnymi i Energią PAN**)

Redakcja naukowa: Tomasz Bajda

Projekt okładki i strony tytułowej: Jakub Matusik

ISBN 978-83-65955-37-1

SKŁAD I DRUK:

Wydawnictwo Naukowe „Akapit", Kraków
Tel. 608 024 572
e-mail: wn@akapit.krakow.pl; www.akapit.krakow.pl

Sponsorzy

PGE Górnictwo i Energetyka Konwencjonalna S.A.

Trzuskawica
A CRH COMPANY

Partner

GRUPA TAURON
KOPALNIA WAPIENIA CZATKOWICE

Characterization of hydrotalcite/pyroaurite-like anion adsorbents derived from magnesite and dolomite

Karolina Rybka[1,*], **Jakub Matusik**[1]

[1] *AGH University of Science and Technology, al. Mickiewicza 30, 30-059 Krakow, Poland*
**krybka@agh.edu.pl*

Water pollution is considered a worldwide issue due to the rapid development of industry. Out of all wastewater treatment methods, adsorption techniques are most effective, easy and economically viable. With a large group of cheap and known cation adsorbents, there is still a high demand for the anion adsorbents of low price and high effectiveness. Layered double hydroxides (LDH), usually called 'anionic clays' or 'hydrotalcite-like minerals' possess anion exchange properties and despite they are relatively rare in nature, the synthesis in laboratory conditions is very easy. This makes them promising materials for the anions removal from wastewaters.

LDH represent a large class of phases which exhibit a brucite-like structure intercalated with anions. According to the general formula $[M^{II}_{1-x} M^{III}_{x} OH_2]^{x+} [A^{n-}]_{x/n} \cdot y\ H_2O$, the LDH structure consists of divalent (M^{II}) and trivalent (M^{III}) metals that form positively charged layers where the charge is balanced by hydrated interlayer anions. Minerals discussed in this work belong to the hydrotalcite (Mg/Al) and pyroaurite (Mg/Fe) groups of LDH. The goal of this research was to synthesize Mg/Al and Mg/Fe LDH via transformation of minerals instead of using chemical reagents. This can result in reduction of the final cost of adsorbents production.

Mg/Al and Mg/Fe LDH were obtained by the transformation of magnesite [M] and dolomite [D]. These minerals were sources of M^{II} (Mg^{2+} and Mg^{2+}+Ca^{2+}, respectively) and $AlCl_3$ or $FeCl_3$ were used as a source of M^{III}. In order to release the M^{II} cations, a $AlCl_3$ hydrolysis process was used in the case of Mg/Al LDH, and dissolution in HCl was performed in the case of Mg/Fe LDH. The solution containing M^{II} and M^{III} was added dropwise to the 2 M NaCl solution with the pH=10 set by an aqueous NaOH and controlled constantly during the synthesis. The obtained slurry was aged for 2 h, washed with water and dried at 60°C overnight. Samples of pure LDH from chemicals were synthesized in analogical conditions as a reference materials. Several variations of LDH in terms of M^{II}/M^{III} ratio and ageing times were obtained.

The XRD confirmed presence of LDH in all samples as compared to the ICDD standards of hydrotalcite and pyroaurite. In Mg/Al LDH samples derived from minerals additionally gibbsite and calcite were formed. The LDH morphology was depicted by the SEM and showed characteristic agglomerated layered particles clearly differing from the starting

minerals. Samples were also characterized by FTIR, Raman and XPS spectroscopy which showed differences in interlayer carbonates species and structural vibrations.

All materials were tested towards As(V) removal in a single-system aqueous solution. They showed similar or slightly lower affinity towards As(V) in comparison with the LDH synthesized from chemical reagents. Bearing in mind that the cost of LDH materials derived from minerals is significantly lower and that the obtained materials are showing similar properties to conventional LDH, they may be considered for future use in the wastewater treatment.

This research was supported by the National Science Centre, Poland under the project no. 2017/27/B/ST10/00898.