Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.16164

Removal of pesticides using surfactant-modified zeolites and zeolitic composites: adsorption and regeneration of adsorbents

MAGDALENA ANDRUNIK, MATEUSZ SKALNY AND TOMASZ BAJDA

AGH University of Science and Technology

Presenting Author: magtuch@agh.edu.pl

The environmental effects of pesticides describe the broad series of consequences not just in the area of application. Runoff and pesticide drift can carry pesticides into distant aquatic environments, fields, or grazing areas. One of the most popular methods for pesticide removal from the environment is adsorption. Zeolites and zeolite-based composites are particularly in demand as they possess highly ordered systems with pores, which, along with high specific surface and negatively charged framework, enable the adsorption of different phases.

The present work aims to investigate the adsorption behaviour of four pesticides: 2-(2,4-dichlorophenoxy)acetic acid (2,4-D) and 2-(4-chloro-2-methylphenoxy)acetic acid (MCPA), 6-chloro-2-N,4-N-diethyl-1,3,5-triazine-2,4-diamine (simazine) and methyl N-(1H-benzimidazol-2-yl)carbamate (carbendazim) on zeolites and zeolite-carbon composites modified with a cationic surfactant (hexadecyltrimethylammonium bromide (HDTMA-Br)). Adsorption experiments involved the influence of initial concentration and pH, kinetics, co-adsorption of pesticides and regeneration of adsorbents.

The results show that the modification with a cationic surfactant increased the adsorption of MCPA and 2,4-D but decreased the adsorption of simazine and carbendazim, while a nonionic surfactant slightly increased the adsorption of simazine. The pH of the pesticide solution has a minor impact on the adsorption efficiency. Moreover, it is a very rapid process - most of the pesticide present in the solution was adsorbed during the first 60 seconds of the experiment. Co-adsorption of MCPA, carbendazim, and simazine exhibit that adsorption of MCPA on unmodified samples and samples modified with a nonionic surfactant is higher when other pesticides are present. Regeneration of adsorbents may be performed with the use of an ethanol or by heating at 350 °C. X-C-H with adsorbed MCPA and 2,4-D can be effectively regenerated with the use of ethanol, while thermal regeneration is not applicable. On the contrary, adsorbents with simazine and carbendazim may be regenerated both thermally and with ethanol.

Results indicate that fly ash-based zeolites and zeolite-carbon composites have great potential for the removal of pesticides from water due to their rapid adsorption and effective adsorbent regeneration.

Acknowledgement

The POIR.04.04.00-00-14E6/18-00. project is carried out within the TEAM-NET programme of the Foundation for Polish Science co-financed by the European Union under the European Regional Development Fund.