

# Removal of Pesticides from Waters with Zeolites and Zeolite-Carbon Composites

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## Extended Abstract

The presence of pesticides in water, soil, and air has been recognized as a major environmental problem. Only a small part of the applied amount of a pesticide is active. Most of them are distributed in the environment. Inactive pesticides remain attached to the soil or dust particles, are leached out, migrate into the groundwater, and are distributed by surface runoff. A certain quantity reaches the air and can diffuse over long distances [1]. There are few technologies for the removal of pesticides. Physical remediation, based on the process of adsorption, is one of the most widely applied methods for water purification due to its efficiency, capacity, and applicability on a large scale.

In present work, we aimed to prepare and investigate unmodified and surfactant-modified fly ash-based zeolites and zeolite-carbon composites as adsorbents 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). Adsorbents were modified using cationic surfactant (hexadecyltrimethylammonium bromide (HDTMA-Br)). Structural and textural properties of adsorbents before and after modification was analysed using Fourier transform infrared (FTIR), scanning electron microscopy (SEM), and thermogravimetric analysis/differential thermal analysis (TG/DTA). The influence of initial concentration, pH of the pesticide solution and kinetics of adsorption of pesticides were tested under static conditions. The concentration of each pesticide in water samples was analysed using high-performance liquid chromatography with a UV detector.

The occurrence of new bands on the FTIR spectra and peaks related to the decomposition of surfactant on the thermal analysis graphs prove the effective modification. The amount of surfactant used for modification as equal for the 1 external cation exchange capacity (ECEC) of each zeolite or composite samples. It should result with the formation of a pseudo-single layer of surfactant [2]. Modification is limited only to the external surface of adsorbents because the surfactant's molecules are too large to enter the channels and modification occurs on the solid surface.

The adsorption of pesticides was performed on modified and unmodified samples. 2,4-D and MCPA are acids and in aqueous solutions appear as anions. Therefore, HDTMA-modified adsorbents have higher adsorption capacities compared to unmodified ones. On the other hand, for carbendazim and simazine, unmodified zeolite-carbon composites seem to be more suitable. pH value of the initial solutions does not have an impact on the amount of pesticides adsorbed. This may be explained by the characteristic of the adsorbents, which exhibit good buffer properties. Moreover, for all pesticides, adsorption is a very fast process. During first 30 sec. of adsorption, up to 90% of pesticides are adsorbed, and equilibrium is reached during less than an hour. A detailed study of the adsorption of 2,4-D, MCPA, carbendazim and simazine is the topic of forthcoming works.

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## References

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