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Obszar wiedzy: Obszar Nauk Ścisłych

Dziedzina: Nauki Chemiczne

Dyscyplina: Ochrona Środowiska

Tytuł rozprawy: Ocena sorpcji i mobilności wybranych leków przeciwnowotworowych w środowisku glebowym

Streszczenie w języku angielskim

The main goal of the doctoral thesis was to evaluate behavior of the anticancer drugs (ACDs) residues in the soil environment. The sorption and mobility of ACDs in soils, in view of different physicochemical properties and experiment conditions were investigated. The laboratory experiments on soil leaching tests were carried out in accordance to the standardized OECD and DIN guidelines. The results obtained during the doctoral studies complete the previously unknown information on the distribution potential of ACDs in the environment and constitute a significant contribution to the environmental risk assessment of these drugs. Within the research tasks the analytical tools for analysis of ACDs were developed. Additionally, the acid dissociation constants of the studied drugs, has been determined by several reference methods, which enabled precise interpretation of the sorption mechanisms in varying pH and ionic strength. Finally, the preliminary biodegradation tests were investigated by measuring the loss of degraded ACDs.

The theoretical part presents the general overview and scale of the cancer diseases, as well as their production and consumption data. The information available in the scientific literature on the occurrence of anticancer drugs in the natural waters and wastewaters confirm their, so-called, emerging pollutants character. The method of describing experimental data obtained as a result of sorption tests was also presented. The two-parameter models of sorption isotherms were presented, as well as the influence of physicochemical parameters of sorbents and sorbates. This part of the dissertation was summarized with a set of selected analytical methods used for analyzes in biological and environmental samples. The process of biodegradation and environmental risk assessment posed by these biologically active chemicals is also discussed.

In the experimental part, information about analytes, chemical reagents, equipment used was systematized and all stages of the laboratory work were described. The method

of preparation of standard solutions was presented. The stages of development of methods for the final analytical determination of anticancer drugs by liquid chromatography were presented. The experiments carried out to determine the pK_a of the analytes have been also described, taking into account the pH gradient chromatography, calculation methods, potentiometric titration and nuclear magnetic resonance. The leaching tests in static and dynamic mode were presented. The preliminary biodegradation tests of anticancer drugs were also addressed. As a part of the results and conclusions, the physicochemical parameters with soil classification were first identified and their significance in the interpretation of the sorption processes and mobility on soils was indicated. In addition, the selected optimal conditions for final determinations were presented using LC-MS / MS and HPLC-UV / Vis techniques along with the determined validation parameters. The pK_a values of the tested compounds were determined with a detailed description of the chemical forms of the compounds along with varying pH.

The most probable acid-base equilibria were proposed. In turn, the obtained data from sorption and mobility studies was described by means of the K_d coefficient and adjustment of Freundlich, Langmuir, Dubinin-Raduszkiewicz and Temkin isotherm models. Parameters describing each of the isotherms were also determined and probable mechanisms of sorption in the state of equilibrium of the studied systems were presented. The effect of variable pH and ionic strength on anticancer drugs sorption to different soils was also described, and the influence of other co-contaminants (inorganic and organic) was checked. Finally, preliminary results including the assessment of the biodegradation and sorption to sewage sludge of anticancer drugs were presented.