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BOOK OF ABSTRACTS

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Optimization of Sr-ion extraction from the contaminated soil using Box-Benken design

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Among the factors that affect the degradation of soil quality, contamination with radioactive substances has gained significance due to the fast development and exploitation of nuclear energy. The remediation measures based on physical, chemical and biological principles aim to reduce the adverse effects of ionizing radiation on the ecosystem as a whole, either by radionuclide separation from the soil matrix or by their solidification/stabilization. The selection of suitable method is carried out for each individual case of contamination, as it depends on the soil type, the pollutant type, distribution, and the level of contamination, area that needs to be treated, overall cost, etc. In order to develop a site-specific treatment, optimization of the method performance is required through the extensive research on the effects of a large number of variables. In such cases, experimental design methodology (DOE) represents a useful approach for the comparison of different treatments and their optimization. In contrast to the conventional strategy of varying one factor at the time, DOE implies a simultaneous variation of all factors in order to disclose the most influential factors, the significant interactions between the factors, and the optimal levels of the factors. In the present study, the problem of soil contamination with ^{90}Sr was addressed. Previous investigations on Sr-ions distribution in the soil have revealed their preferential association with the ion-exchangeable sites, regardless of the soil type, contamination level and aging time. High mobility of Sr in the soil is, therefore, the property that makes the separation by chemical extraction a simple and economical option since the effects can be achieved using solutions of competing cations. The soil, sampled at the site of the Vinča Institute of Nuclear Science and the Public Company Nuclear Facilities of Serbia, was artificially contaminated with Sr-ions. The Box-Benken design was used for the analysis of soil remediation efficiency using $Ca(NO_3)_2$ as an extracting agent. Reagent concentration, soil/liquid ratio and contact time were considered as process variables, whereas the amounts of extracted cations and the final pH values were monitored as the response functions. The applicability of different mathematical models, with the inclusion of linear or quadratic terms, was tested for the description of experimental results. Analysis of variance of the chosen responses showed that Sr extraction efficiency was primarily affected by the variation of the reagent concentration. By proper selection of the levels of investigated factors, complete removal of Sr was achieved. Furthermore, DOE enabled the prediction of system responses, which makes it a significant tool in practical applications.

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