



OPTIMIZATION OF CONDITIONS FOR DETERMINATION OF BOTTOM SEDIMENT SORPTION CHARACTERISTICS

ABSTRACT

An option of this study was to optimize conditions of distribution coefficients determination in the water-sediment system. The study results will be applied in the task A research on influence of Temelín Nuclear Power Plant accident on the Vltava and Labe water environment contamination to the border profile Labe – Hřensko. After finding optimal conditions for sorption experiments, these will be applied on the experiments using real sediment samples and corresponding surface water extracted from different localities of Vltava River, Labe River respectively.

A goal of the whole project is to contribute to creation of a crisis scenario of potential accident of Temelin Nuclear Power Plant and its impact on Vltava and Labe water environments. Above all, the aim is to answer the question which processes would take place in dams and basins during the contamination by fission and activation products, whether and which products would be preferably adsorbed and would consequently settle down and which would supposedly be transported to the lower parts of the watershed.

The practical part of the diploma thesis consists of several partial experiments, where mainly ^{137}Cs and ^{60}Co were used as representatives of fission and activation products. These experiments were based on a batch test method. The aim of batch tests is finding of appropriate conditions for the system under study and empirical determination of characteristic distribution coefficients. Distribution coefficients are related to equilibrium state between solid and liquid phase. First of all, the time to reach equilibrium was determined for consequent distribution coefficient determination to be conducted under equilibrium state. Sorption kinetics and the time required to reach the equilibrium state were experimentally determined for 7 time intervals. The time to reach the equilibrium state was determined is as follows: 6,4 h for ^{60}Co on the Vltava – Doubrava sediment, 7,1 h for ^{137}Cs on the Vltava – Doubrava sediment and 10,4 for both radionuclides on the Vltava – Chrást sediment. However, in other experiments and consequent batch tests the contact



time is always longer (16 or 24 hours). These values could be recommended in terms of confidence in reaching the equilibrium state as well as in terms of operation of laboratory. Results of distribution coefficients determination are further influenced by solid to liquid phase ratio. Therefore, the experiments were carried out with 9 different solid to liquid phase ratios. It was confirmed that the system behavior corresponds to Langmuir isotherm. The ratio of 1:10, 100 g/l respectively, was recommended and will be used in consequent batch tests. For selection of radionuclide initial concentration, it is recommended to choose at least several values from the concentration range which could potentially occur under real conditions. Within the frame of this study, experiments were carried out with 6 concentrations of spiked radionuclides. Two adsorption models were compared – distribution coefficient and Langmuir isotherm.

Furthermore, experiments were carried out comparing 5 methods of sediment conservation. The method was sought during the course of which there will be minimal changes in structure of sediments and consequently minimal changes in their sorption characteristics. It was shown that the sediment kept in fridge corresponds best to freshly extracted sediment. Despite this method being least practical it was recommended for consequent batch tests with newly extracted sediments.