

Investigation of uranium and radium plant uptake from cover soil of uranium mining tailings ponds

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The only Hungarian uranium mine in the vicinity of Pécs (South Hungary) was shut down in 1997. During the former operation residue of the ore processing was placed in natural environment. This action has led to many environmental problems, first of all, it has created several environmentally unfriendly artificial formations. Such formations are the tailings ponds, which are potential sources of radioactive contaminants like uranium and radium. Uranium and ^{226}Ra contents of the pond water are 0.1 mg.l^{-1} and 5.2 Bq.l^{-1} , respectively; those of the solid phase of the pond material are 70 g.ton^{-1} and 12.7 Bq.g^{-1} , respectively. These contaminants may increase the radiation burden of population in this area via both aerial and terrestrial pathways. The partially dried-out tailings ponds are planned to be covered with different materials in order to reduce radon emanation and the plant uptake of the radioactive elements. Green plant cover is foreseen to reduce radionuclide release by wind and soil erosion. For this reason column experiments and pilot studies on the surface of the ponds have been carried out to find optimal solution for cover system. Environmental restoration of the uranium mining and milling sites will be performed on the basis of the results of those pilot studies. In spite of these actions, the radioactive materials may still reach the upper layers by long-time migration and become available for plants. Bio-availability of radionuclides in soil is influenced by their chemical form and asso-

ciation with different geo-chemical phases. Consequently, the bio-available part of the radionuclides may enter the terrestrial food-chain pathway. The presentation deals with the results of investigations of plant uptake of uranium and radium from the soil of the uppermost pond covering layer. The investigation was carried out in laboratory conditions. The soil was labelled with uranium and ^{226}Ra . Four species of plants were selected for the study: *Lolium multiflorum*, *Festuca rubra*, *Sinapis alba* and *Panicum miliaceum*. The amount of mobile form of radionuclide in soil was determined by parallel extraction. Two types of extractants were used to determine radionuclide association with readily exchangeable forms and carbonate phases. The total amount of radionuclide was determined after extraction with nitric acid. A set of concentration factors was calculated from the ratio of soil and plant activity concentrations, for various soil extractants and plant types. Values of radium concentration factors related to the total amount of radionuclide in soil varied between $1.3 \cdot 10^{-1}$ and $5.03 \cdot 10^{-1}$, whereas the uranium concentration factors were between $3.8 \cdot 10^{-1}$ and $1.2 \cdot 10^{-1}$. These values are one order of magnitude higher if the concentration factors are related to the bio-available amount.