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Migration ability of plutonium and americium in the soils of Polessie State Radiation-Ecological Reserve

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One of the most important factors determining the radioecological situation in the terrestrial ecosystems is the radionuclide species in a soil medium. Radionuclide forms determine the processes of their entrance into the soil solutions, redistribution in soils, migration to the surface, ground and underground waters and spreading outside of the contaminated area.
The present work is devoted to investigation of physicochemical forms and migration ability of plutonium and americium in soils of Polessie State Radiation-Ecological Reserve (PSRER), where located the main part of alpha;-emitting radionuclides of Chernobyl origin.
The objects of investigation were mineral and organic soils sampled in 2008 with the step of 5 cm to the depth of 25–30 cm. The forms of plutonium and americium distinguishing by association with the different components of soil and by potential for migration in the soil medium were studied using the method of sequential selective extraction according the modified Tessier scheme. Activities of ²³⁸Pu, ^{239,240}Pu and ²⁴¹Am in the samples were determined by the method of radiochemical analysis with α-spectrometer radionuclide identification.
A vertical radionuclide distribution in soils and the total radionuclide reserves in the soil profiles were established. Intensities of vertical radionuclides'migration in the soils were estimated. It was shown that the main part of plutonium and americium is in the 0–20 cm soil layer, more often in 0-10 cm layer. Location of the radionuclide weighted mean quantity in the soils is at the depth of 3–15 cm from the soil surface. The average rate of vertical radionuclide migration of this quantity varies from 0.15 to 0.7 cm y⁻¹ and is practically the same for plutonium and americium.
The main part of plutonium and americium in soils is in immobile forms. Radionuclide portions in water soluble and reversibly bound forms do not exceed 9.4 % of radionuclide content in the soil. In mineral soil samples, the radionuclide portion in these fractions exceeds the corresponding portion in organic ones. In both mineral and organic soils, the portion of mobile americium is higher than plutonium. The portion of biological available forms of plutonium and americium is 2.7–29 % of total radionuclide content in the soils. The higher portion of biological available forms is characteristic for mineral soil (14–29 %) as compared with that in organic one (2.7–18 %). The reserves of mobile and biologically available radionuclide forms increase with the depth of soils. The increase of radionuclide portions in mobile and biologically available forms promotes the radionuclide entrance into the soil solution and enhancing the intensity of migration processes in the soil-plant system.
The main control factors of radionuclide migration in soils under consideration are water regime and presence of radionuclide in composition of fuel particles. These factors could be more affective than radionuclide solubility in the soil waters because of some part of radionuclide transfer with the particles.

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