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MODELING OF THE POLLUTED GROUNDWATER FLOW INTO CONFINED WATER IN THE FOREST ECOSYSTEMS BY THE EXAMPLE OF THE KALUGA REGION IN THE RADIOACTIVE CONTAMINATION ZONE[1]

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The purpose of this article is to study the migration processes of various pollutants, including radionuclides, from poorly sorbed to highly sorbed ones, in the groundwater and confined water, using the method of mathematical modeling. The object of the study is the part of the Kaluga Region that was affected by the accident at the Chernobyl Nuclear Power Plant the most.

The modeling of contamination processes in the groundwater and confined water in the radioactive contamination zone was carried out according to 3 scenarios of the development of such processes. We took into account various pollutants and mass transfer processes, using the mathematical MT3D program, and made a series of numerical experiments. Scenario 1) groundwater contamination with highly sorbed pollutants; scenario 2) contamination with highly sorbed pollutants and radioactive pollutants; scenario 3) contamination with poorly sorbed pollutants.

Besides, an unfavorable option for the ecological condition of confined waters was considered, due to the impervious horizon being insufficiently impermeable to the polluted waters, flowing from the aquifer. This situation was probably caused by the natural lithological structure (interlayers, sand lenses, sandy loams, insufficient depth) and industrial factors (poorly insulated holes, wells and other structures that open the aquifer). All the factors listed above are the "fast migration routes" that make it possible for a lot of pollutants to penetrate the confined aquifers, where the fresh water is contained.

To study the pollutants migration in the previously created MT3D model, we selected two profiles. They were located along the lines of groundwater flow, stretching from the watershed to the area of discharge, i.e. the rivers. The ecological situation was analyzed for 4 calculation periods of 30, 60, 100 and 300 years (to link it to the half-lives of radionuclides), for 4 coefficients of sorption distribution (C_d) of pollutants: 6, 26, 200 and 1000 l/kg for radionuclides with decay and other toxic, strongly sorbed pollutants without it; 0.5, 1.0 and 3.0 l/kg for poorly sorbed pollutants. We assessed the ecological situation in the first layer (groundwater), the second one (watershed layer and pore solutions) and the third one (confined water).

In addition, several spots were selected for the analysis of the ecological situation.

The modeling resulted in a comparison of all development scenarios of the pollution processes and analysis of the factors that determined them. In addition, we studied the capabilities of the

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process of pollutant diffusion and its impact on pollutant migration. Therefore, the main factors to form the processes of pollutant migration are their radioactive decay, their sorption characteristics, and the hydrodispersion of groundwater flows, which depends on the geological and hydrogeological conditions of the studied territory. Aside from this, diffusion plays an insignificant role in their migration as well.

Keywords: groundwater, confined water, migration processes modeling, pollutants, radionuclides, sorption, molecular diffusion, radioactive decay.

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