Geophysical Research Abstracts
Vol. 16, EGU2014-12171, 2014
EGU General Assembly 2014

Longitudinal dispersion modeling in small streams

Pavla Pekarova (1), Jan Pekar (2), and Pavol Miklanek (1)

(1) Institute of Hydrology SAS, Racianska 75, 831 02 Bratislava, Slovakia (pekarova@uh.savba.sk), (2) Dept. of Applied Mathematics and Statistics, FMPI CU Bratislava, Slovakia

The environmental problems caused by the increasing of pollutant loads discharged into natural water bodies are very complex. For that reason the cognition of transport mechanism and mixing characteristics in natural streams is very important. The mathematical and numerical models have become very useful tools for solving the water management problems. The mathematical simulations based on numerical models of pollution mixing in streams can be used (for example) for prediction of spreading of accidental contaminant waves in rivers. The paper deals with the estimation of the longitudinal dispersion coefficients and with the numerical simulation of transport and transformation of accidental pollution in the small natural streams.

There are different ways of solving problems of pollution spreading in open channels, in natural rivers. One of them is the hydrodynamic approach, which endeavours to understand and quantify the spreading phenomenon in a stream. The hydrodynamic models are based on advection-diffusion equation and the majority of them are one-dimensional models. Their disadvantage is inability to simulate the spread of pollution until complete dispersion of pollutant across the stream section is finished. Two-dimensional mixing models do not suffer from these limitations. On the other hand, the one-dimensional models are simpler than two-dimensional ones, they need not so much input data and they are often swifter. Three-dimensional models under conditions of natural streams are applicable with difficulties (or inapplicable) for their complexity and demands on accuracy and amount of input data. As there was mentioned above the two-dimensional models can be used also until complete dispersion of pollutant across the stream section is not finished, so we decided to apply the two-dimensional model SIRENIE.

Experimental microbasin Rybarik is the part of the experimental Mostenik brook basin of IH SAS Bratislava. It was established as a Field Hydrological Laboratory in 1958. Since 1986 started a chemical program in the basin.

The total area of the Rybarik basin is 0.119 km2. The length of the stream from spring to closing profile is 256 m, the mean slope of the stream is 9.1%, and the mean slope of the basin is 14.9%. The elevation is from 369 to 434 m above the sea level. The geological conditions in the Rybarik basin are characterized by flysh substrates (altering layers of clay and sandstones). The basin is from 2/3 cultivated by the state farm, private farmer covers the rest of the area. The forest coverage during the period 1986–2004 was approximately 10%, rest of the land is arable.

NaCl (10-30 g) was injected to the Rybárik brook at different water levels and in different seasons. The electric conductivity was measured 100 and 250 m downstream the injection point. The samples were taken for Cl-concentration analyses during the first cases. The Cl and EC waves were identical. Coefficients of the longitudinal dispersion were estimated by trial-error method in the Rybárik brook using model SIRENIE. Coefficients were in range of 0.2 – 0.7 m2.s-1.

Acknowledgement: This work was supported by project VEGA 0010/11.