NEW APPROACHES FOR ESTIMATING STREAMBED INFILTRATION RATES

W. Macheleidt, T. Grischek, W. Nestler
Institute for Water Sciences, University of Applied Sciences Dresden, 01069 Dresden, F.-List-Platz 1, Germany
E-mail: mach@htw-dresden.de

Abstract: Direct quantification of infiltration rates and darcy velocities at bank filtration sites by field measurements has been done only at sites that are well equipped with monitoring wells and is mostly based on the observation of changes in chloride or oxygen-18 concentrations in surface water and infiltrate. The main determinants of the interaction between surface water and groundwater are the distribution of areas with different infiltration rates, the thickness of sediment layers and the hydraulic head gradient. These conditions determine the volume and velocity of infiltrating water which, together with the direction of water flow, are required to model the interaction processes. Usually, due to difficulties with measurement, only the direction of water flow is determined and boundary conditions are estimated from simplified assumptions.

Field techniques have now been developed to help characterise surface water/groundwater interaction. Results from field experiments using a percussion probe and a large-scale laboratory column experiment set up to simulate infiltration processes are presented.

Owing to its differing concentrations in groundwater and river water, the naturally occurring isotope Radon-222 (^{222}Rn) can be used as a natural tracer to determine the residence time of infiltrated water. The principle is based on the determination of ^{222}Rn activity at defined points along the flow path. Investigations performed in a large-scale laboratory column experiment showed that different effects considerably influence infiltration measurements. Local sedimentary stratification has a substantial influence on the equilibrium concentration of ^{222}Rn. Furthermore, investigations in zones with gas formation (e.g. in biologically active zones such as river beds) must consider diffusion of ^{222}Rn into the gas phase and the reduction of permeability because of gas within the pore space. The volume of gas in the saturated, upper zone of the aquifer has an important influence on the results of ^{222}Rn measurements.

Advantages and limitations of the use of ^{222}Rn measurements for the determination of infiltration rates are discussed based on results of laboratory experiments.

Key words: Infiltration, ^{222}Rn, gas, darcy velocity, river bank