Geophysical Research Abstracts,
Vol. 11, EGU2009-12291, 2009
EGU General Assembly 2009

Determination of Transport Parameters in Unsaturated Zone by Tracer Experiment in the Porous Aquifer located at Ljubljana, Slovenia

S. Vidmar and B. Cencur Curk

IRGO - Institute for Mining, Geotechnology and Environment, Department for Groundwater, Ljubljana, Slovenia (saska.vidmar@irgo.si, +386 15341680)

The gravel sandy aquifer of Ljubljansko polje is the source of drinking water for nearly 300.000 inhabitants of the Ljubljana city and vicinity. There are two main waterworks: Kleče and Hrastje. The plain area of Ljubljansko polje is a tectonic sink and consists of river sediments that can reach in thickness more than 100 m in the deepest part. The bedrock is the impermeable permocarbonic clayey shale, mudstones and sandstones. The hydraulic conductivity of Ljubljansko polje sediments is very good, from 10-2 m/s in the central part to 3.7•10-3 m/s on the borders of the plain. The average groundwater level is 20 m below surface. A numerical groundwater flow model was established for the wider area of the Ljubljansko polje aquifer. The fore mentioned model was not calibrated on solute transport parameters but only on water levels and this lead to unreliability in the transport model and its predictions of pollution scenarios. The transport model needs to calculate reliable scenarios of pollution dispersion, which can only be achieved with the application of real transport parameters.

Human activities in the area of the Hrastje waterworks of Ljubljana threaten to degrade groundwater quality. For this reason several tracer experiments were carried out in the past. Despite a great risk, the experiments were performed on the catchment area of the Hrastje waterworks, inside the second water protection zone. During the experiments the water from Hrastje waterworks was still in use for drinking water supply. The tracer experiments were carried out in order to determine the solute transport parameters such as advection, dispersion and sorption. The research proved that the tracers could be used safely on sensitive area and that the researchers are capable and qualified to carry it out with a highest level of security.

Since none of the past tracer experiments, carried out in the same area, gave us any detailed information on pollutant spreading in unsaturated zone a new tracer experiment was performed. Uranine was used as a tracer with a single time injection (1 kg) directly into the unsaturated zone. To achieve no sorption on organic particles the top layer of the ground (approx. 1m) was removed. The concentrations of the tracer spreading were observed in the well which is down gradient (approx. 22m) from the injection point. The tracer experiment was monitored for 305 days with records recorded every 4 minutes. All major events observed from the breakthrough curve, corresponded to rain events with a different delay depending on the water content in the unsaturated zone. When the unsaturated zone contains water the response in the observation well was faster than when the unsaturated zone was dry. The obtained data have been used in an analytical method (Multi-Dispersion-Model (MDM)). This solution provided the following transport parameters: mean transit time, mean velocity, longitudinal dispersion and dispersivity. The obtained parameters from the analytical solution will also be verified in the numerical model. The final results should enable better knowledge of the solute transport parameters and thus a better understanding of pollution dispersion as a help for water supply management system including measures for pollution prevention and as an actions/measure scenario in case of pollution.