Geophysical Research Abstracts
Vol. 13, EGU2011-5934, 2011
EGU General Assembly 2011
© Author(s) 2011

Hydraulic and transport properties of a coarse grained unsaturated zone in an urban environment

Saska Mc Grath (1) and Barbara Čenčur Curk (2)

(1) IRGO - Inst. for Mining, Geotechnology and Environment, Department for groundwater, Ljubljana, Slovenia (saska.mcgrath@irgo.si), (2) Faculty of Natural Sciences and Engineering, Department of Geology, Ljubljana, Slovenia (barbara.cencur@guest.arnes.si)

Human activities in the urban areas threaten to degrade groundwater quality of the underlying aquifers. In order to determine their impact on the underlying groundwater a research project was launched, where transport of contaminants in the unsaturated zone of the urban environment is being studied.

The pilot area (scope) is situated on the gravel sandy aquifer of Ljubljana field which is a source of drinking water for nearly 300.000 inhabitants of the Ljubljana city and its vicinity. The plain area of Ljubljana field is a tectonic sink and consists of river sediments that can reach in thickness of more than 100 m in the deepest part. The bedrock consists of the impermeable permocarbonic clayey shale, mudstones and sandstones. The hydraulic conductivity of the saturated Ljubljana field sediments is very high, ranging from 10-2 m/s in the central part to 3.7•10-3 m/s on the borders of the plain. The Ljubljana field aquifer has two main waterworks: Kleče and Hrastje. Inside the Hrastje water wells several parameters of typical urban pollutants were detected. Herbicides and pesticides were detected as long term pollution parameters and mineral oils, degreasers and trichloroethene as occasional pollution parameters. That is the reason why the micro location of the performed investigations is situated on Hrastje catchment area.

The unsaturated zone of the Ljubljana field aquifer in the recharge area of Hrastje waterworks is approximately 20 m thick and is highly heterogeneous. A rough description of it would be that a thin top soil layer is overlaying a thick layer of coarse sediments. The top soil layer has not been formed on the location but in most cases has been introduced in order to produce a base for plants or for other purposes. This is also one of the main reasons why the physical properties of the top layers and underlying layers have varying compositions and therefore varying hydrogeological properties.

To determine the physical properties of the pilot area sample points have been randomly chosen based on the accessibly of the unsaturated zone. Samples (depth down to 8m) have been taken for a detailed characterization of the unsaturated zone where grain size analysis and retention properties (on particles 2mm and 8mm) determination was preformed. Also, in order to determine the rate of infiltration from the surface, double ring constant head infiltration tests and falling head single tube infiltration tests were carried out. Hydraulic conductivity changes with depth have been determined as a result of interpreting the infiltration tests.

The rate of infiltration from the precipitation is also dependant on the degree of evaporation. Thus, a detailed meteorological statistical analysis for the past 30 years was carried out with acquired meteorological information from the Environmental Agency of Slovenia. Results have been used to derive the actual amount of infiltration for the purpose of determining the flow regime and transport properties.

Results gained from the field and the meteorological statistical analysis served as input parameters for computer modelling where HYDRUS-1D was used as a tool to model the flow of water and solute transport.