



Modeling Carbamazepine and Caffeine transport and attenuation in a carbonate aquifer

Noam Zach Dvory (1,2), Michael Kuznetsov (1), Yakov Livshitz (3), Guy Gasser (4), Irena Pankratov (4), Ovadia Lev (5), Eilon Adar (1), and Alexander Yakirevich (1)

(1) Ben-Gurion University of the Negev, Zuckerberg Institute for Water Research, J. Blaustein Institutes for Desert Research, Israel (nzd@etgar-eng.com), (2) Etgar A. Engineering Ltd., (3) Israel Hydrological Service, Israel Water Authority, (4) Water Monitoring Laboratory, Israel Water Authority, (5) The Hebrew University, Israel

The Western Mountain Aquifer (Yarkon-Taninim) of Israel is one of the country's major water resources and flows partially through a karst system. During late winter in 2013, maintenance was performed on a central sewage pipe which then caused sewage to leak into a creek located in the study area. Carbamazepine (CBZ) and Caffeine (CF), both frequently found in sewage, were monitored in groundwater and used as tracers to monitor sewage leakage. The goal of this study was to develop a mathematical model for quantifying the transport of pharmaceuticals and their attenuation in the karst/fractured-porous unsaturated zone and groundwater. A quasi-3D dual permeability numerical model was developed. The model represents the 'vadose zone – aquifer' system by a series of 1D vertical flow and transport equations solved in a variably-saturated zone and by a 3D-saturated flow and transport equation for groundwater. The model was used to simulate transport and attenuation of CBZ and CF, as conservative and reactive tracers, respectively. Most model parameters were estimated by using a CBZ breakthrough curve from an observation well, while a 1st order decay and linear sorption coefficients were assessed for CF. The estimated half-life and the partition coefficients of CF were 7.6 days and 0.1 L/kg, respectively. The results of the simulation showed that by the end of year, significant amounts of CBZ were retained in the porous matrix of the unsaturated zone below the creek, and tens of meters downstream in the groundwater; while all the Caffeine was degraded soon after leakage stopped.