

Modelling tools in managed aquifer recharge

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Managed aquifer recharge (MAR) is used to purify water for household use. The main purpose of MAR is to reduce the content of dissolved organic carbon (DOC). At Virttaankangas in southwestern Finland, a MAR site is producing potable water for the Turku region with approximately 285 000 inhabitants. The infiltrated water is derived from the Kokemäenjoki River, 30 km north of the MAR plant and it is infiltrated into the sediment through infiltration ponds. Groundwater flow modelling with MODFLOW is used to control the flow directions and velocities between the infiltration and well areas. The purpose of this study was to investigate the beginning and the amount of DOC decomposition and the effect of time and high pH environment on the functionality of the MAR site.

Oxidative decomposition due to microbial activity is one of the principal processes reducing the concentration of DOC in recharged water. This can be monitored by examining the isotopic composition of dissolved inorganic carbon (DIC) in the artificially recharged groundwater. At Virttaankangas, dissolution of calcite also produces DIC with a different isotopic composition. Therefore, to deduce the amount of oxidative decomposition of DOC, instead of direct mass balance calculation, geochemical modelling using PHREEQC was used. The mean residence time of the infiltrated water was established by fitting a sinusoidal function into the variations of the isotopic composition of oxygen in the MAR water by using the least squares fitting method. It was evident from the results, that oxidative composition of DOC was delayed at Virttaankangas, but once begun, it was even more effective than at other MAR sites. The mean residence time of the water was directly linked to the amount of DOC decomposition, but not necessarily to the shortest travel times given by the flow model.