

Courses:

- **GW Flow and Contaminant Transport Modeling (Msc in EnvE &HgE)**
- **Geothermal Systems and Transport Modeling (MSc in PGE)**

Homework #1/2019: Determination of breakthrough time of a well doublet of injection and production wells vs. well distance

Hydrogeological conditions:

There is a shallow sandy gravel, gravelly sand aquifer suitable to establish fully penetrating wells. The shallow aquifer is phreatic (unconfined) with horizontal groundwater flow. The hydraulic parameters of the aquifer can be freely chosen but the different parameters (horizontal and vertical hydraulic conductivity, effective porosity) should be coherent to each other. The thickness of the aquifer is also up to the student but at least 2/3 of the aquifer must be saturated, so the groundwater level is to be determined to keep this condition. The horizontal hydraulic gradient is 2 m/km, the seepage direction is parallel to the line determined by the two wells.

Hydraulic problem:

There are two wells installed to supply an open water to water heat-pump system. To make the proper operation of the system possible a given break-through time is to be assured, therefore it is to be calculated. Please determine the function describes the trend of breakthrough time vs. injection to production wells distance. Install wells into different distances and determine the breakthrough time. Based on the data calculated at 5-6 different well distances the function is to be plotted. Determine the function in both two possible cases when the production well is installed upgradient or downgradient to the injection well.

Materials to be presented:

In printed form a short report of the problem with

- the details of the chosen data
- graphic presentation of potential fields, pathlines
- breakthrough-time vs. well distance function
- the description and evaluation of results

Digitally (only at the end of semester)

- report in document form
- full dataset of the model
- plots in graphical form