Courses:

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

Homework #3/2019: ***Simulation of a pump & treat system – parallel transient flow and transport simulation***

Problem setting

A chloride contamination occurred at a given industrial site. The chloride is originated from a leakage due to recharge caused by dilution of chloride containing salts by natural precipitation and also from an underground pipe leakage. A pump & treat system is planned to be operated at the site, which consists of several wells and possibly infiltration trenches also. The task is to build the model of both the contamination and the remedial activities.

Hydrogeological conditions of the base model:

The simulated system consists of a sand aquifer (the parameters can be freely chosen) of 13 m thickness. There is a slow regional flow: the horizontal hydraulic gradient is 1 m/km. The groundwater level is approx 1-3 meters below the surface.

Chloride contamination occurred at a surface deposit of30×40 m area, where a kind of soluble salt was open air stored. The solubility of the salt is high, the solution has a chloride content of 300 000 mg/l. The contamination started in 1987. The chloride is hardly adsorbing and not degrading component. Another chloride contamination on the site is originated from a pipeline damage, where the loss of liquid was approx. 15 m^3/d. The concentration of chloride transported in the pipeline was 5000 mg/l during the period of 1965-2002, later (after 2002) it was reduced to 3200 mg/l due to change of the industrial technology. The first signs of losses during the pipeline transport were detected in 1992.

The location of the two contamination sources are different. The source of pipeline damage originated contamination is in 45 m down-gradient and 100 m side-gradient from the chloride contamination source. Both sources were eliminated in 2017.

Task 1.Build the flow model of the site. Determine the flow field (potential distribution) and pathlines starting from the sources until now and for another 15 years, please.

Task 2. Simulate the transport of the contaminant during the past and the in the future (for 30 years until 2047). Calculate with very slight (almost negligible) sorption (0,05 cm^3/g) and no decay for chloride. The longitudinal dispersivity is 8 m the transversal (lateral) dispersivity is 2 m. The effective diffusion coefficient is 5×10^{-10} m^2/s. The local contamination limit is 250 mg/l for chloride. All not mentioned flow or transport parameters can be freely chosen!

Task 3. A desalinization plant of 100 m^3/d capacity is to be installed at the site. Design a pumping well system and injection wells or infiltration trench(es) that efficiently helps the remedial activities of the plume. The total production rate is limited to the plant's treatment capacity. Calculate the concentration distribution after 1, 2.5, 5, 7.5, 10 and 15 years of operation. All treated and completely desalinated water is to be infiltrated. Determine the time needed to reach at least the remediation limit concentration, which is three times larger (750 mg/l) than the contamination limit.

Task 4. You are authorized to accelerate the remedial activities by the installation of a slurry wall shorter than 200 m. Please to simulate the effect of a slurry wall to the contaminant transport and determine the time needed to reach at least the remediation limit of 750 mg/l.

Materials to be presented:

In printed form a short report of the problem with
- the description of the models
- the details of the chosen data sets
- graphic presentation of the mentioned potential fields, drawdown and concentration distributions
- graphic presentation of pathlines at different scenarios
- the evaluation of results

Digitally (only at the end of semester)
- report in document form
- total dataset of all model variants
- plots in graphical form