MODELLING AS AN IMPORTANT TOOL TO PERFORM CLEANUP OF THE BERNAU PLACE, GERMANY

MODELĒŠANA KĀ NOZĪMĪGS LĪDZEKLIS OBJEKTA ATTĪRĪŠANAI BERNAU AP-GABALĀ, VĀCIJĀ

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During 1935-1990, the Bernau place has been polluted with trichloretilen (TCE), which is the dense non aqueous phase liquid type substance. It sinks in groundwater until the nearest aquitard is reached. Due to this feature, the lateral motion of TCE is controlled both by the hydraulic gradient of groundwater and by the slopeward top surface of the aquitard. In 2001, the German hydrogeological company INGAAS GmbH has started a cleaning plant (CP) containing a reactor for in-situ remediation of contaminated groundwater in high TCE concentrations (75 - 300 mg/l). Groundwater to be cleaned may be taken out from aquifers by pumping from wells and or from horizontal drains. Reactive walls may be used as a part of CP.

Although general ideas of how CP should be built and controlled afterwards are clear enough, there are questions to be answered if practical details are considered:

- How will CP interact with the environment? What is the best choice of the groundwater pump-out and reinfiltration places and regimes?
- How does TCE spread out regionally? What are the optimal measures (drains, reactive walls, wells) to stop this contaminant migration and to clean the place?
- What factors do control productivity of the reactor?

To answer these questions, ample modelling has been accomplished by the Environment Modelling Centre of the Riga Technical University. Regional and local hydrogeological models (HM) for the contaminated place have been developed to simulate TCE migration in the groundwater flow (Spalvins et al, 2001). A mathematical model has been used for simulating dehalogenisation processes performed by the reactor.

In the Bernau area , two sandy Quarternary aquifers L2 and L3 are TCE – contaminated, and they are joined via the S2 aquitard. The Teufel pool presents there the main natural sink for the TCE transport in a groundwater flow for the upper L2 aquifer. The saturated thickness of the L2 aquitard is 5-8 metres. The permeability of the L2 and L3 aquitards are very heterogeneous both vertically and horizontally (5.2–45.0m/day and 7.0-28.0m/day for the L2 and L3 aquifers, respectively). The groundwater flow, in the L2 aquifer, is more intensive (hydraulic gradient ~0.0035) then for the lower L3 aquifer (hydraulic gradient ~0.001).

Regional and local HM cover, correspondingly, $1.2km\times0.8km=0.96km^2$ and $0.23km\times0.17km=0.039km^2$ areas. The HM approximation grid plane steps are 10 metres and 2 metres, accordingly, for regional and local HM. In HM, the L2 and L3 aquifers are split in four (L2a, L2b, L2c, L2d) and three (L3a, L3b, L3c) parts, respectively. Such a fine vertical schematization enables to account for heterogeneity of aquifers and to simulate in details the TCE-transport spatial picture.

The MT3D'99 code (Papadopulos, 1999) was used as the main tool for modelling of TCE-transport processes. The code was supported by HM of the area.

Regional modeling of drains, reactive walls and wells, as tools for remediation, has provided the following results (Spalvins et al, 2002):

- horizontal drains may be extensively used, because their regimes are easy to control; a system of drains may effectively remediate dissolved TCE of the L2 aquifer;
- reactive walls may serve as effective tools if their location is rightly chosen; otherwise, the cleaned water flow from the gate of the wall may unnecessarily dilute the part of the TCE plume which is located down gradient;
- for the deep L*3* aquifer, pumping from wells seems to be the only realistic remediation choice; to achieve the best TCE outcome, short term pumping from different wells must be accomplished;

The Transport, Biochemistry and Chemistry (TBC) program (Schafer et al, 2000) was applied to simulate the TCE dehalogenisation process performed by the CP reactor. The calibrated model now serves as the base to control the reactor under its changing regime (input and output concentrations of treated water, the residence time, etc.).

At present, no optimal solution has been found how to remediate the Bernau place, because more field information is needed, specially, about the regional spread out of the TCE migration.

References:

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