HYDROGEOLOGICAL MODEL OF THE BALTEZERS, REMBERGI AND ZAKUMUIZA WATER SUPPLY

HIDROĢEOLOĢISKAIS MODELIS BALTEZERA, REMBERĢU UN ZAĶUMUIŽAS ŪDENS IEGUVES KOMPLEKSAM

Aivars Spalvins, Janis Slangens, Romans Janbickis, Inta Lace, Talis Juhna
Riga Techncal University, Latvia

Summary: The Baltezers, Rembergi and Zakumuiza complex provides drinking water for the Riga city. In 2005 – 2006, the hydrogeological model of the complex was created and developed. Numerous objects endanger the water quality of the complex. The set of isochrones were computed for various water production regimes of the complex. The isochrones enable to evaluate travelling time of contaminant to production wells. The impact of sorption and degradation processes of contaminants is accounted for.

The Baltezers, Rembergi and Zakumuiza complex provides drinking water for the Riga city. The Quaternary sandy **Q** aquifer is the main groundwater source of the complex. Some part of groundwater is extracted from the Devonian sandstone aquifer **D3gj** at Zakumuiza. Hydrogeological conditions for the **Q** aquifer are so favourable that siphons are applied instead of pumps. To keep high production rates, the artificial groundwater recharge is applied for the Baltezers and Baltezers-2 siphons.

In 2005, the hydrogeological model (HM) of the water supply complex has been created by the Environmental Modelling centre (EMC) of the Riga Technical University. The model integrated available hydrogeological data regarding the Baltezers, Rembergi and Zakumuiza well fields. HM covered the 11.0 km × 10.45 km area and included the Quaternary (**Q**), upper Devonian (**D3gj2**) and lower Devonian (**D3gj1**) aquifers. The plane approximation step of HM was h=110 m. In this paper, the improved version of HM is represented. It has been applied for estimation of contamination processes endangering the water supply complex.

The plane approximation step h is reduced (110 m → 55 m), because h = 110 m is too large to simulate properly, even regionally, the system "recharge basins – siphons" (average distance between them is 100 – 150 metres).

For former HM, subregions containing finer grid (h = 11 m, h = 22 m) have been created. For improved HM, the telescopic mesh refinement procedure of the Groundwater Vistas system may be applied. The procedure enables to create automatically any subregions of HM, where chosen small h values (5 m – 10 m) are used. Such subregions are needed to simulate contaminant transport processes on the local scale, especially, for the areas including artificial recharge basins and siphons.

The area of water supply complex includes objects that may cause contamination endangering water quality of the unconfined aquifer **Q**. The most important objects are international highways, the railroad line, rivers, the M. Baltezers lake from which water is taken to feed recharge basins, the Garkalne village, housings and other objects.

The quality of M. Baltezers lake water is moderate. Its water is not cleaned before filling the recharge basins. Self–cleaning of water takes place during its migration (50 - 150 days) towards the siphons. Unfortunately, the quality of M. Baltezers lake water strongly depends on weather conditions and regimes of the Riga hydroelectrical power station.

To predict an impact on a siphon of contamination events, one should know the following main characteristics:

- the place and time of the event;
- travelling time of the water particle from the event place to a siphon;
- characteristics of the contaminant (name of substance, its initial and permitted concentrations, sorption and decomposition parameters, solvability in water);
- nature of the contaminant source (occasional spill, accumulated and constant at time, source volume and intensity at time, etc.).

It is shown in this paper, how isolines of a water particle travelling time (isochrones) are obtained for siphons by using the MODPATH system. The isochrones are computed for various siphon regimes.

The isochrones may be used as a rough estimate of the expected travelling time towards siphons. The distribution of isochrones enables to obtain the shortest travelling time (no sorption and decomposition of a contaminant) needed to reach a siphon. To estimate the time, one should use crosspoints of isochrones with a streamline of a water particle (it is orthogonal against the head isolines) that connects the contamination source with a siphon.

The travelling time, presented by the isochrones, does not account for the influence of the contaminant sorption and decomposition processes. Analytical expressions can be applied to account roughly for impact of these processes on the expected travelling time (it will enlarge) and on the concentration of contaminants.

To account for all factors, having influence on contaminant transport, the more complex MT3D system should be used for subregions of HM where fine plane approximation step (5 – 10 metres) should be applied. It is planned to apply HM in transitory regime when rapid changes of water supply regimes can be accounted for.

Aivars Spalvins
Riga Technical University, Faculty of Computer Science and Information Technology
Environment Modelling Centre,
Address: 1/4 Meza str., Riga, LV-1048, Latvia
Phone: +371 7089511
E-mail: emc@egle.cs.rtu.lv