PLANNING SANITATION OF THE POLLUTED INCUKALNS AREA BY APPLYING HYDROGEOLOGICAL MODELLLING

SANĀCIJAS PLĀNOŠANA INČUKALNA APKĀRTNEI AR HIDROĢEOLOĢISKĀS MODELĒŠANAS PALĪDZĪBU

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Summary
In 1998, a hydrogeological model for the contaminated Incukalns place has been created and rough prognoses of SO_4 and surface active components migration in groundwater have been obtained. In 2004-2005, this model has been considerably improved, in order to find the best methods of stopping pollution plumes and of lessening their impact on local environment. The improved model is described and new results obtained are presented.

From 1956 to 1981, the Oil Processing Factory of Riga created annually about 16,000 tonnes of highly toxic waste. This sludge consisted of tar, asphalthens, H_2SO_4, sulphuric acids and other hazardous substances. The waste was discarded into two abandoned sand – pits located at the Incukalns village. The pits become waste pools, each covering about 1.3 ha. The pools were informatively named the Northern and Southern ones, which were formed during 1956 – 1965 and 1964 – 1981, accordingly. In 2005, the pools still acted as hazardous contamination sources and their pollution plumes were expanding.

The waste from the pools leaked downward from the sandy Quaternary aquifer *Q* into the Devonian sandstone aquifer *D3gj2*. There dissolved waste components were migrating downgradient towards the Gauja river. Fortunately, for both pools, contaminated areas of the *Q* aquifer now are limited and practically motionless. In centres of the still expanding plumes of the *D3gj2* aquifer, Ph is 3 – 4, SO_4 and surface active components (SAC) reach 4,500 mg/l and 100 mg/l, respectively.

The plume of the Northern pool is approaching the Gauja river and will reach it after ~ 25 years.

In 1998, a hydrogeological model (HM) for the contaminated Incukalns place has been created and rough prognoses of SO_4 and SAC migration have been obtained. In 2004 – 2005, this HM has been considerably improved, in order to find the best methods of stopping pollution plumes and of lessening their impact on local environment.

Main tasks to be solved were, as follows:

- to evaluate current parameters for SO_4 and SAC components of contamination plumes of the *D3gj2* aquifer;
- to obtain prognoses for the worst no sanitation scenarios;
- to test effectiveness of various sanitation methods.

Three methods were considered:

- withdrawal from the D3gj2 aquifer of polluted groundwater, its cleaning and reinfiltration into the aquifer;
- blocking of the infiltration flow for the pool areas, in order to reduce the waste dissolution rate;
- excavation of the waste pools.

Table 1
Current parameters (year 2005) for the SO_4 and SAC plumes in the *D3gj2* aquifer

Nr.	Parameters	Northern pool	Southern pool
1.	existence time of pool [years]	50	40
2.	after what time will contamination reach Gauja river [years]	25	65
3.	mean migration speed till 2005 [m/year]	28	44
4.	mean migration speed from 2005 till 2030 [m/year]	50	46
5.	contaminated area [ha]	148	139
6.	volume of contaminated groundwater [m^3]	$17.65 \cdot 10^6$	$18.73 \cdot 10^6$
7	mass of SO_4 [kg]	$9.1 \cdot 10^6$	$24.8 \cdot 10^6$
8.	mean concentration of SO_4 [mg/l]	515	1320
9.	mean outflow of SO_4 from pool [kg/day]]	500	1700
10.	mass of SAC [kg]]	$1.06 \cdot 10^5$	$1.31 \cdot 10^5$
11.	mean concentration of SAC [mg/l]	6	7
12.	mean outflow of SAC from pool [kg/day]]	18	20

Table 2

Contamination parameters accounting for remediation of the Incukalns place

Nr.	Parameters	Northern pool	Southern pool
1.	mean SO_4 concentration for first inflow into river (no sanitation) [mg/l]	500	300
2.	mean SAC concentration for first inflow into river (no sanitation) [mg/l]	2.0	0.15
3.	pumping – infiltration rate stopping contaminant migration [m^3/day]	3000	3000
	mean SO_4 recovery rate during first three years [kg/day]	1700	5200
4.	mean SAC recovery rate during first three years [kg/day]	40	30
5.	reduction of contaminant outflow from pool if its infiltration flow is		
6.	blocked [times]	1.3	1000

The main results obtained are presented in Table 1 and Table 2. The following conclusions can be drawn:

- the Northern pool plume is a real danger to the Gauja river, the migration speed of the plume will increase during the next 25 years;
- it is possible to stop migration of the both contaminant plumes;
- blocking of the infiltration flow for the Southern pool may considerably reduce the waste dissolution.

The obtained results are preliminarily. The model may serve as a tool helping to solve many problems arising during of sanitation of the Incukalns place.

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