The use of groundwater for cooling the "Lomonosov" supercomputer

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OBJECT

The supercomputer "Lomonosov" - supercomputer built by "T-Platforms" for Moscow State University.

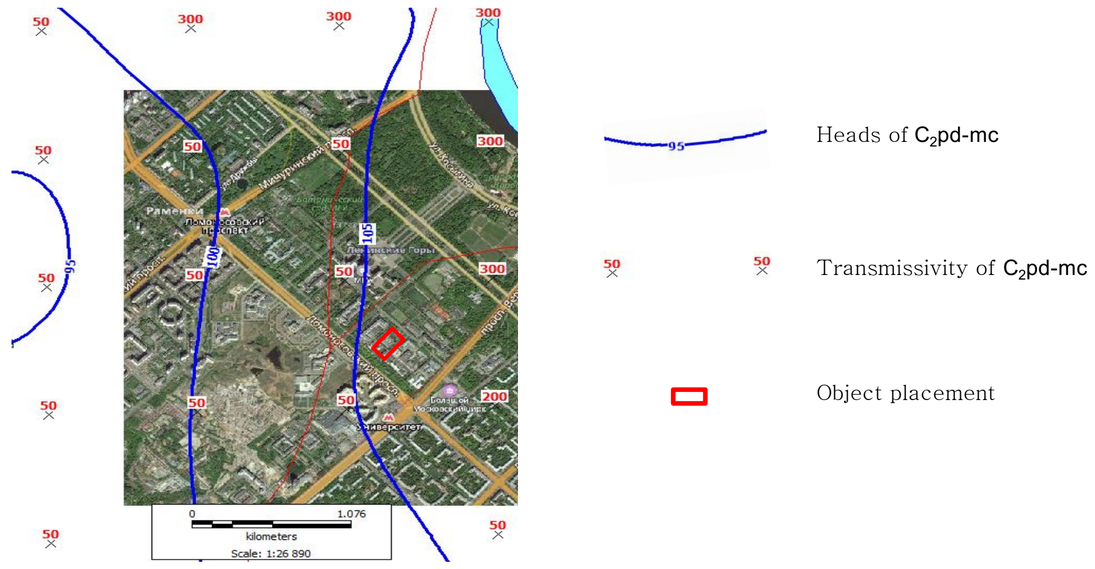
Parameter	Value
Heat consumption *H*	2,8 MW
Number of wells	2 (?)
Final temperature	20-25°C
Required flow rate Q	158 m^3/hour

$$Q = \frac{H}{\Delta T c_v}$$

where H – heat consumption , Δ T - the difference between injection and environment temperatures (15 °C), C_V - water heat capacity (4,180 J/L/K)

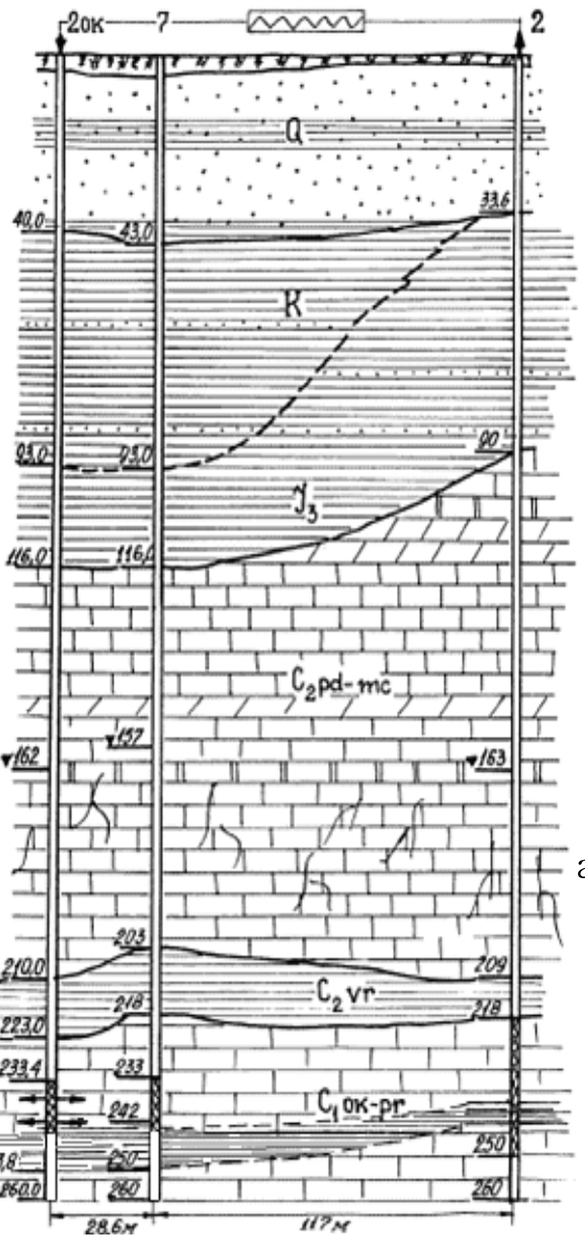
LOCATION AND CONDITIONS

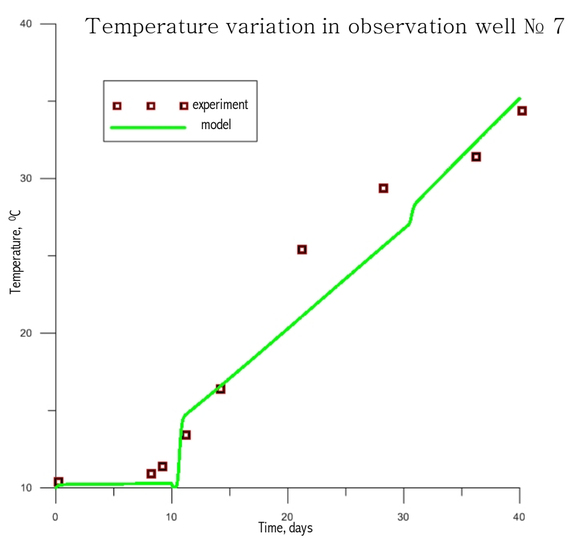
Object location on head distribution and conductivity scheme of C_2pd-mc

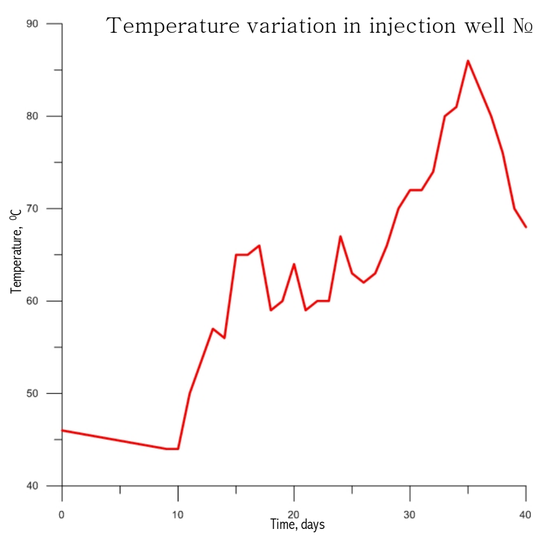


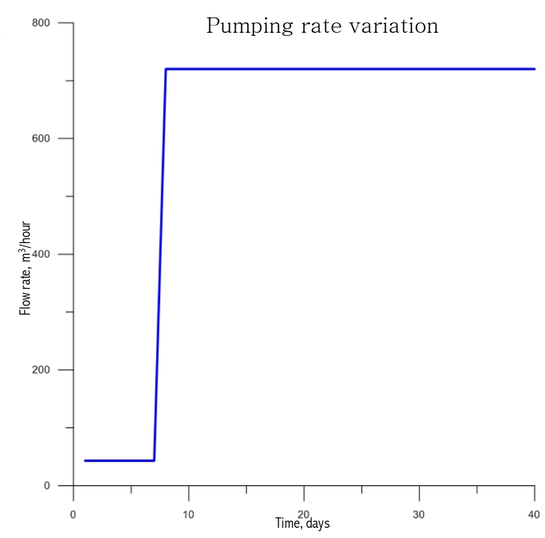
PARAMETER SELECTION BASED ON EXPERIMENTAL DATA

In the seventies and eighties of the last century the Institute of Bioorganic Chemistry named after M.M. Shemyakin was built. The designing organization GIPRONII AN USSR considered the use of groundwater as the main option for cooling technological equipment. The experiment lasted 3 months and was as follows. Groundwater was pumped from well № 2 with a flow rate of Q = 27-46 m^3/hour. At the same time, hot water with a temperature of 44 to 86 °C was injected into well № 20K located 117 m away from well № 2 with an injection flow rate of Q = Q = 27-46 m^3/hour. During the experiment, the temperature was observed in well № 7.

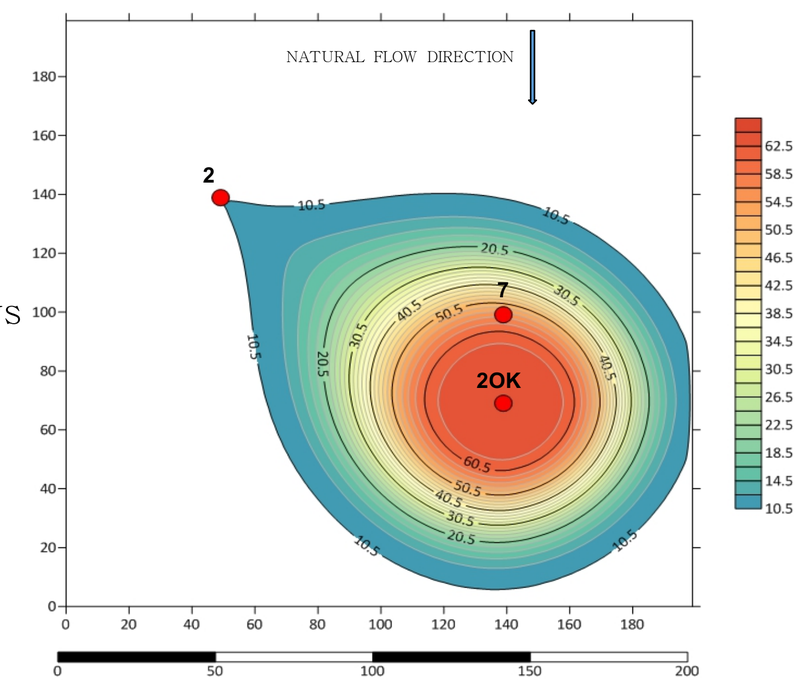








Spread of heat plume after 90 days of injection

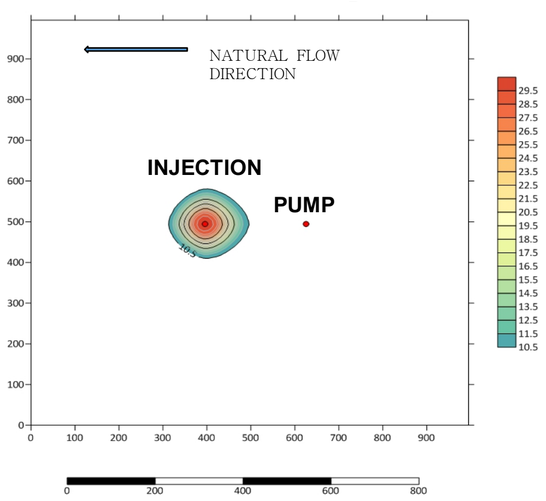


Parameter	Value
Distance between pumping and injecting wells, m	117
Distance between injecting and observation wells, m	28
Thickness of injection interval, m	24
Aquifer water temperature, ^{0}C	10,6
Injected water temperature, Tc [^{0}C]	58
Hydraulic conductivity, k [m/day]	4-6
Natural flow gradient, i [-]	0,001

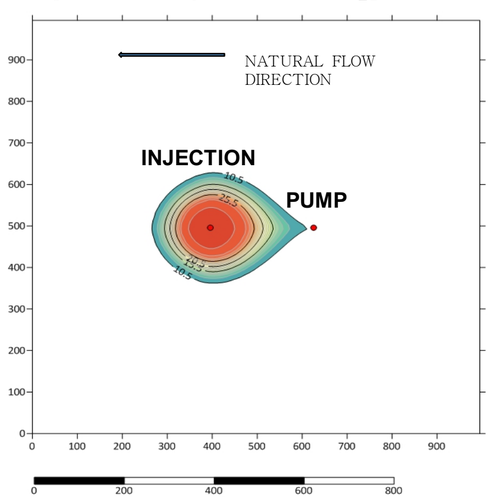
NUMERICAL-ANALYTICAL CALCULATION OF HEAT SPREADING IN PODOLSKO-MYACHKOVSKIY AQUIFER

The model is build using Fortran and contains 40000 blocks of 5 meters each. The calculation of the model was made with taking into account double porosity property of podolsko-myachkovskiy aquifer.

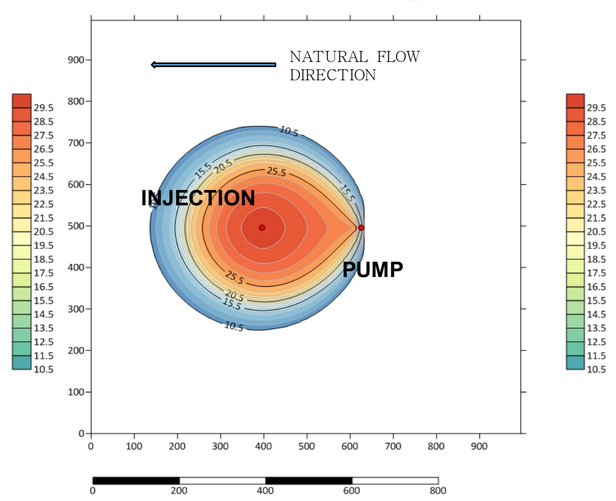
Spread of heat plume after **90 days** of injection in C_2pd-mc



Spread of heat plume after **1 year** of injection in C_2pd-mc



Spread of heat plume after **5 years** of injection in C_2pd-mc



PROJECT ECONOMICS

1. According to preliminary estimates, the system allows to reduce energy costs by 3-5 times, depending on the configuration.

2. Constant groundwater temperatures of the podolsko-myachkovskiy aquifer throughout the year increase cooling efficiency of supercomputer, especially during summer days due to high air temperatures and the presence of poplar fluff.

3. The efficiency of the system can be increased by using a water-to-water heat pump (CoP coefficient 6-7), which allows the use of heated water for building heating and hot water supply.

4. The use of such system as a backup allows to avoid overheating in times of accidents and unforeseen situations during the operation of the main cooling systems.