Flow and heat transfer numerical modelling in the Hainaut limestone geothermal reservoir: study at local and regional scales

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ABSTRACT

Nowadays, Europe needs to produce more sustainable energy. A possible solution includes geothermal energy. Many sites are already in activity for example in France, Germany or Italy. In Belgium, research is currently performed in the Campine Basin. In the Mons area (South-West Belgium), some wells have been exploited since the eighties. They were drilled in a deep limestone reservoir characterized by some highly permeable breccia levels. This reservoir has not been studied extensively, despite potentially important heat reserves.

In this context, the MOREGEO project has been initiated by the University of Mons and the IDEA (intercommunity active in the area) with financial support from the ERDF European program. The general objective of this project is to drill a new geothermal doublet to provide heat to the largest city hospital. Hot water will be pumped from a well and cold water will be reinjected in another one. Specific objectives of the project include: (1) Modelling heat transfers at the scale of the new geothermal doublet; and (2) Modelling the whole geothermal reservoir in order to provide an efficient management tool for the future development of additional geothermal wells.

The geothermal reservoir of Hainaut is mainly composed of limestone from the Carboniferous period, with breccia and evaporites levels (Licour, 2012). Three wells currently provide energy for the heat production to two hospitals, schools, station, housings and an economic area. The depth of the exploited layers is around 2000 meters and the pumping groundwater temperature is about 70°C.

A first numerical model has been developed at the scale of the future new geothermal doublet. Numerical models are implemented using Hydrogeosphere and Feflow. These calculation codes simulate fluid flow, solute and heat transport in porous and fractured media. The models aim at analysing the conditions of the exploitation, the longevity of the system, and the possible interactions with surrounding geothermal wells. An important challenge lies in the representation of the complex geology. The reservoir includes layers of anhydrites, partly or totally dissolved according to the location. Another challenge is to find a good setting for the border conditions of the model. This difficulty comes from the effect of the high temperature and pressure in the reservoir, which affect the value of the hydraulic head.

First simulations show that the parameters expected in the area allow the exploitation of geothermal wells to provide hot water for heating. Cold water injected at the reinjection well goes in the direction of the pumping well, located 1,400 m away. The longevity of the exploitation depends on the time taken by cold water to induce a decrease of temperature at the pumping well (Fig. 1). The first simulations show that a decrease of temperature at the pumping well is expected to be around 2°C after 100 years. A sensitivity analysis of the model parameters has also been carried out to see which parameters have the most important impact on the exploitation and the longevity of the geothermal doublet system. The first results show the influence of the

permeability of the exploited rock layer and the layers situated next to this one. The thickness of the layer and the rate of flow in the pumping and reinjected wells have also to be considered as important parameters.

REFERENCES

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