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First Geothermal Energy Utilization System Based on Medium Enthalpy Reservoir in Hungary

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ABSTRACT

Although there are some medium enthalpy reservoirs (120 °C < $T_{reservoir}$ < 180 °C) known in Hungary, geothermal energy utilization has been based only on low enthalpy ones so far. A comprehensive study and plans have been recently made analysing the possibility of establishing a geothermal heating and cooling system using a medium enthalpy carbonate geothermal reservoir near the town of Kiskunhalas. The reservoir was revealed by dry hydrocarbon holes during the 80's. According to the geological studies and model estimations, two production wells could supply 250 m^3/h 120 °C thermal water and cover the heating energy demand of local governmental institutes (mayor's office, kindergartens, schools, health centres, hospital, museums), block houses, horticultures and factories. Cooling at industrial consumers using by sorption chillers will be also part of the 19.5 MWth system. After the energetic use the thermal water will be re-injected into the same reservoir through two injection wells.

1. INTRODUCTION

Based on the data of hydrocarbon exploration wells of the area, a very high potential geothermal reservoir is located SE from the town of Kiskunhalas (Figure 1), which seems to be appropriate for supplying geothermal energy for the town's and the nearby village's (Zsana) local governmental institutes, residential houses, hospitals, factories and even some horticultures. The investment will be realized by the Zsana Geotherm Ltd. with the financial contribution of the Hungarian state.

2. GEOLOGICAL BACKGROUND

The geological structure of the region of Kiskunhalas is mainly known by hydrocarbon exploration. Several drillings were deepened mainly in the '70s and 3D seismic measurements were also conducted. Well testing results showed that the Middle-Triassic dolomite layers can be considered as geothermal reservoir rocks in the area. They can be found in a NE-SW setting as 2-8 km long blocks bordered by faults. The space between these blocks is filled by younger formations and Mesozoic is completely missing there. The targeted reservoir near Kiskunhalas is one of these most likely at all sides impermeable blocks with a width of 3 km and a thickness of above 500 m.

The area was subjected several times to various tectonics. The main tectonic and fault directions could be estimated by investigating surface outcrops of the same dolomite formation some 100 km far from Kiskunhalas.

2.1 Hydrogeological and geothermal parameters

Data obtained during well testing show that the reservoir rock has an average permeability of 2.89E-13 m^2 and an average porosity of 3.2 % with higher values at the upper part of the formation. The porosity is mainly secondary, associated with several fracture systems.

There were bottom-hole temperature measurements available for some wells in the area and they show a high geothermal potential of the targeted reservoir. Between 500 and 2500 m depth the geothermal gradient is 4.5 °C/100 m and therefore at 2500 m depth 130-135 °C temperature is expected. The outflow temperature can reach 120-125 °C. The thermal conductivity of the dolomite formation is 3.2-3.5 W/(mK), while those of the covering layers are significantly lower.

Based on model results the hydrodynamic breakthrough time between the injection and production wells with a production rate of 125 m^3/h from each well is in average above 35 years, which is high enough not to expect any cooling during the system's 50- year operation.

3. EXECUTION PLANS

A comprehensive feasibility study revealed all the possible utilization methods of the geothermal reservoir near to Kiskunhalas and Zsana. Because of the highest energy efficiency and the size of nearby heat consumers the most suggestible way is the heat utilization exclusively, based on thermal water and accompanying gas combustion. Nevertheless, in the future it is worth considering whether the realization of electricity production with gas engines in such an extent that could cover the energy demand if the geothermal system itself is advantageous or not. This question can be answered only after drilling the wells and analysing their hydrodynamic and water quality data. The prerequisite of the accompanying gas utilisation in gas engines for electricity production is that these parameters are rather persistent for a longer time span (2-3 years). Until ascertaining this, the gas content will be only burnt and the heat will be supplied to the district heating network in a geothermal station.

In the town of Kiskunhalas the geothermal energy yielded by two future 2300 m deep production wells with a total rate of 250 m^3/h and a temperature of 120 °C is planned to be used in a kindergarten, a school, several high schools, two museums, two hospitals, a library, a block house, a dormitory, two factories and the district heating station. In the village of Zsana the mayor's office, the kindergarten, the school, the cultural centre, the health centre, the retirement home and a horticulture will be part of the geothermal based district heating network (Figure 3). In both localities the energy demand of the heating and – in most cases – the domestic hot water supply can be covered in 100 % by geothermal energy. At two consumers some part of the cooling demand can be also supplied.

After utilising the energy of the thermal water and extracting its useful gas content, the thermal fluid will be fully re-injected into the same reservoir by two 2200 m deep injection wells.

4. PROJECT IN NUMBERS

The capacity to be installed at the geothermal station utilising 210 000 GJ/yr energy originating from the thermal water and the combustion of its gas content is 21.9 MW. By selling this energy, the project owner Zsana Geotherm Ltd. will realize 2 000 000 € proceeds a year, which makes the project's payback time to be as low as 12 years, while the consumers will observe 20 % fall in energy prices, meaning yearly 500 000 € savings.

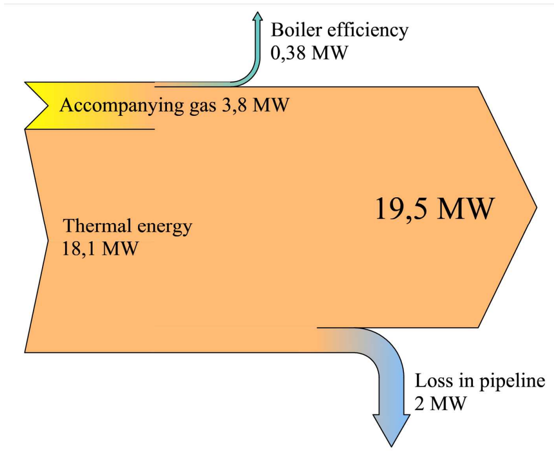

Figure 2: Installed and net capacities

Yearly more than 6 000 000 m^3 imported natural gas can be substituted by geothermal energy, which leads to a significant reduction in greenhouse gas emissions as well: 8 757 t/yr CO_2, 16.07 t/yr NO_x and 1.837 t/yr SO_2 emissions can be avoided.

Isolated steel pipes with a total length of 3.8 km will conduct the thermal water from the production wells to the geothermal station next to one of the injection wells together with 3.2-km total length HDPE pipes transmitting the separated and cooled accompanying gases.

The total length of the Kiskunhalas district heating network to be joined to the geothermal station is over 47 km, while the Zsana network exceeds the 16-km length.

5. FURTHER EXTENSION PLANS

Although the system has not been come true, there are already plans for its extension. It seems to be possible to supply yearly further 150 000 GJ energy by drilling new doublets in 5 years. Factories, hospitals, other local governmental institutes and several horticultures would come in for a share in geothermal energy, not counting the new arrivals attracted by the cheap energy.

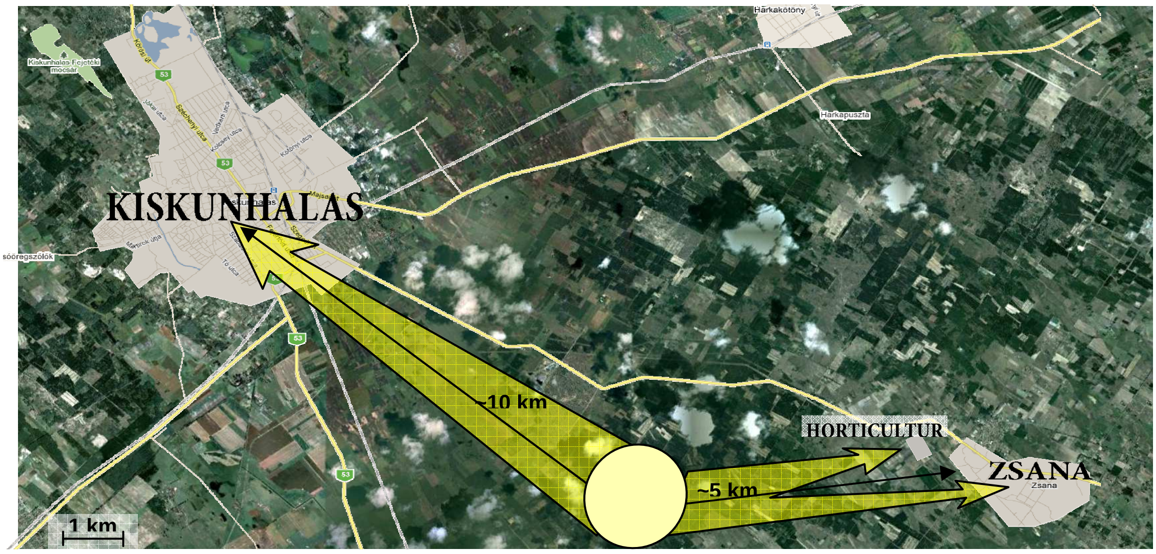

Figure 1: Location of the geothermal reservoir

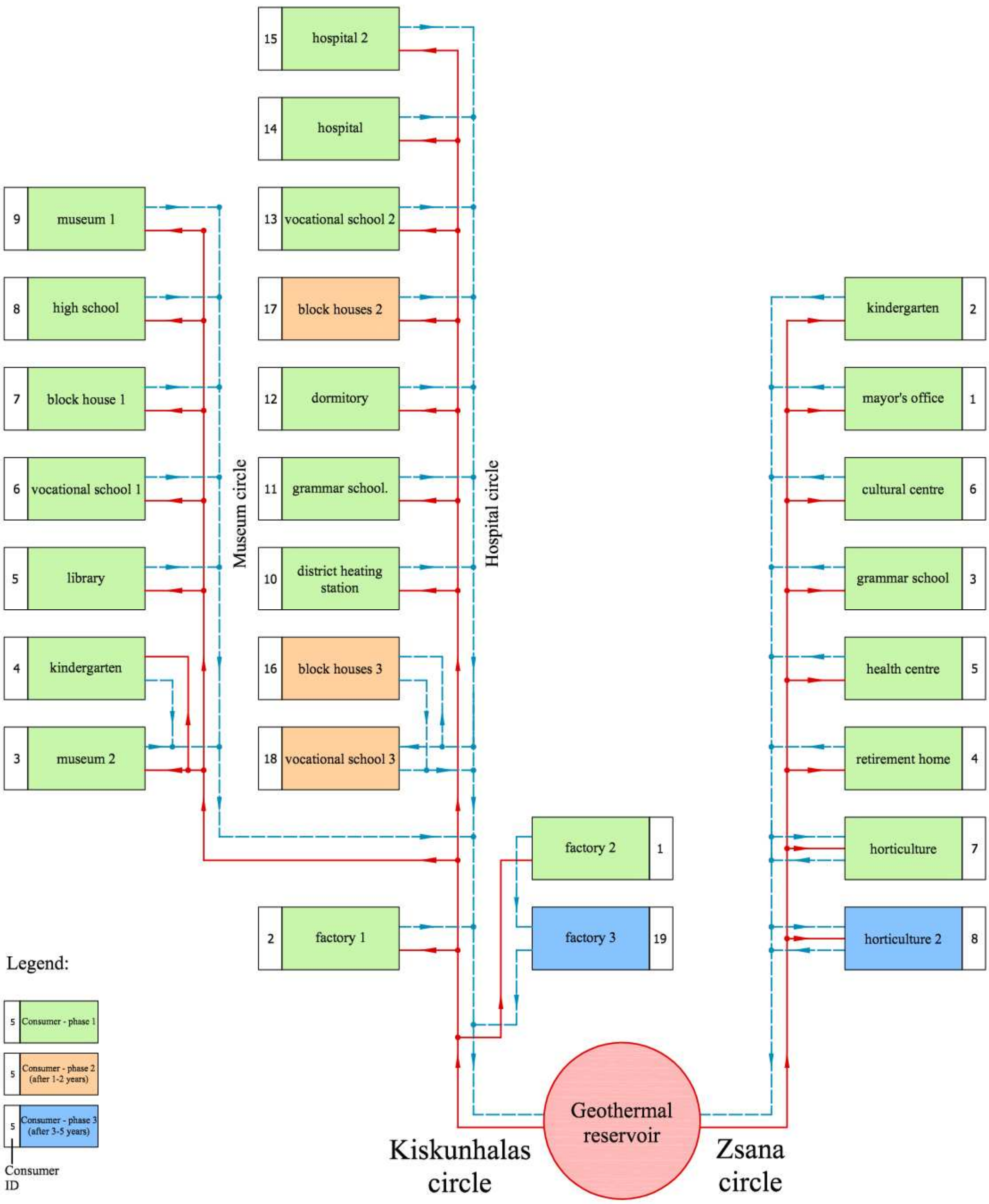

Figure 3: Scheme of geothermal consumer circles

REFERENCES

Gyarmati, J.: Geothermal Doublet on Pusztamérges NW structure *Hungarian]*, Kiskunmajsa, Hungary, (2007), pp 26

Porció Ltd.: Medium Enthalpy Geothermal Energy Utilization in Kiskunhalas and Zsana - Impact study *[in Hungarian]*, Budapest, Hungary, (2011), pp 73