The Utilisation of Geothermal Energy as Renewing Energy Source

(Presentation of the geothermal utility system in Hódmezővásárhely)

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Why is it worth to talk about geothermity?

When talking about energy nowadays we often associate on concepts such as environmentally friendly technologies, climate protection or renewable energy.
With the spread of fossil fuels (such as crude-oil derivatives, natural gas or hard coal) the carbon dioxide concentration of the Earth has increased by 25%, while the methane gas concentration by 50%. As a result green house effect emerges, the atmosphere overheats, the polar ice fields melt and a rise of the level of the seas can be anticipated, seaside cities and hereby 40% of the mankind run into danger.

Member states of the Earth declared at an agreement in Rio de Janeiro and Kyoto for the protection of climate, that the future of mankind is the stake and prescribed the reduction of the use of fossil fuels by 6% annually.
Carbon dioxide can be reduced by forestation, and the most obvious method for the reduction of methane is the replacement of the fossil fuels for environmentally friendly renewable energies.
In Hungary it can be biomass, solar, wind or geothermal energy.

From the current domestic energy necessity of 1,052 PJ only a couple of percentages are renewable energy. Its proportion was determined in 7.2% by government's long term energy policy. EU requirement for member states for 2010 is set at 12%.
And Hungary tends towards the EU!

From the domestic energy use only 0.3% (3.6 PJ) is thermal energy which is gained by 100 million m^3 of water exploited from about 800 operating thermal wells.
Why is it still worth talking about thermal energy in Hungary?
Because our basis – thanks to the relative thinness of the continental rock plate (24-26 km opposite to the world average of 33 km) and to the fact that the conductor ability of the residue is higher than the average (90 W/m^2 opposite to the 60 W/m^2 EU average) – are excellent and from a significant portion of the country fluid (between 50-100 ^0C) can be exploited from 1,000-2,000 m.
According to several opinions the back-stamping technology can assure the extraction of 380 million m^3 of thermal water annually, which could make possible 65 PJ heat utilization in case it was exploited at 40%. This is 6% of the national energy need!

It is worth talking about thermal also because domestic utilization has immense traditions: just think about the Turkish baths and those of the Roman era, or about the decennial extraction aiming therapy and agriculture. So we are in possession of significant experience concerning technologies relating to well building, extraction or utilization.

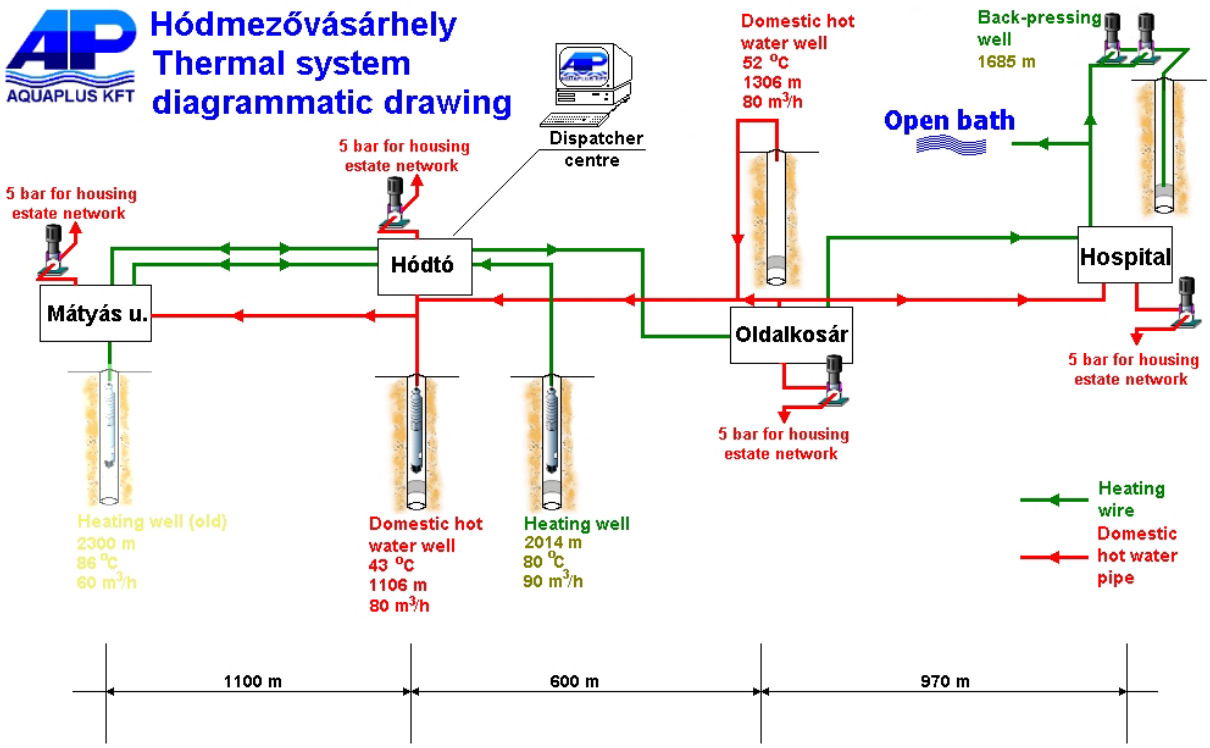
The geothermal utility system of Hódmezővásárhely

In virtue of traditions and former favourable experiences as the joint investment of the autonomous community of Hódmezővásárhely and the AQUAPLUS Ltd. a geothermal utility system was realized in 1994, which is unique in Central Europe. It is unique in its complexity and in making thermal energy a renewable energy. The whole project – with continuous installation – was ready in 1998.

Basically the utility system aimed heating works of four zones equipped with long-distance heating and practically it consists of two sections:

- consumer warm water supply network and
- heating energy system.

Thus the project has basically dual aim.
On the one hand – taking advantage of the possibilities provided by warm water by exploiting water of 43-52 ^{0}C temperature and of drinking water quality from 1,100-1,300 m – we would like to substitute the consumer warm water made from cold drinking water by natural gas, and on the other hand we would like to place the thermal water of about 80 ^{0}C exploited from 2,000 m (making widest possible use of its heat content to substitute natural gas) and then got cool, this way becoming unsuitable for further usage (useless even for urban lidos), close to the layers of exploitation



During the investment the followings were built:

- ✓ 4 thermal wells
  - Hódtó consumer warm water well (1,106 m),
  - Oldalkosár street consumer warm water well (1,306 m),
  - Hódtó heating well (2,014 m),
  - Back-stamping well (1,685 m),
- ✓ 150 m^3 of degasing-bin capacity,
- ✓ 7,500 rm of preinsulated ISOPLUS long-distance pipe,

- ✓ 6 pcs of GRUNDFOS pressure increasing pump system,
- ✓ 3 pcs of SWEP plate heat exchanger
- ✓ computerized remote monitoring process control system.

The system provides consumer warm water for the population and public institutions equivalent to 3,000 apartments and for public bodies (such as hospitals) through thermal water obtained from the consumer warm water wells through a network providing long-distance heat. The annual quantity of the thermal consumer warm water is approximately 200,000 m^3. The used water of the system is obviously placed in the urban sewage network.

The head of the heating system is the 2,014 m deep thermal well of Hódtó from which 60 m^3/h heating water can be drawn out in the winter period, and 25-30 m^3/h in the summer period according to the current needs.

We have taken into consideration the possibility of the cascade connection of the heating works when choosing „track" of the heating water: the secondary circuit of the heating grade scale of the housing estate of Hódtó is 110/90 ^{0}C, that one of the housing estate of Oldalkosár street is 90/70 ^{0}C, while the one of the hospital sector is 70/40 ^{0}C. This way the heating medium arrives to the heating work of Hódtó at 80 ^{0}C, where by reason of high heating scale „only" the circulating heat-loss of the consumer warm water of 1,600 apartments will be replaced.

The secondary water from the heating work arrives to the heating work of Oldalkosár street as primary energy carrier (at about 74 ^{0}C), where apart from compensating the heat-loss of the housing estates it also contributes to the heating in significant part of the heating period (starting at a -5 ^{0}C outer temperature).
The tertiary water coming out of this heating work arrives to the institutions of the hospital sector (Hospital, Mayoralty, Grammar School, Health Centre, Community House, etc.) again as primary energy carrier.

The end of the heating system is the territory of the urban lido where the used thermal water (37-39 ^{0}C at winter time, and even warmer in summer period) assures the replacement of some pools and the excess amount of water (30-35 m^3/h) gets to the buffer bin of the installed back-stamping system.

The thermal heating system assures about 40,000 GJ heat energy for the city.

At that time it was a novelty but nowadays it is natural that the plant of the system works automatically and its control is supervised by computer.

<u>Placing of the thermal water got cool</u>

The most common way of earth-heat utilization can be materialized through fluid exploitation.
The placing of the water after utilization happens traditionally:

- in utility sewage channels,
- in systems leading precipitation and inland waters,
- in other open-air channels (it can occur that through cooling lake), or
- directly in rivers (it can occur that in the twist)

From this environmental problems can originate, such as the harmful effect of the salt and heat load, or the sink of water level of the thermal wells (decrease of recourses).

So the major aspects of the optimal water placing problems are:

- maintain the mechanic equilibrium of the reservoir (layer pressure),
- water-supply management (encourage the natural replacement),
- environmental protection.

According to the above mentioned aspects the only suitable alternative is the BACK-STAMPING!

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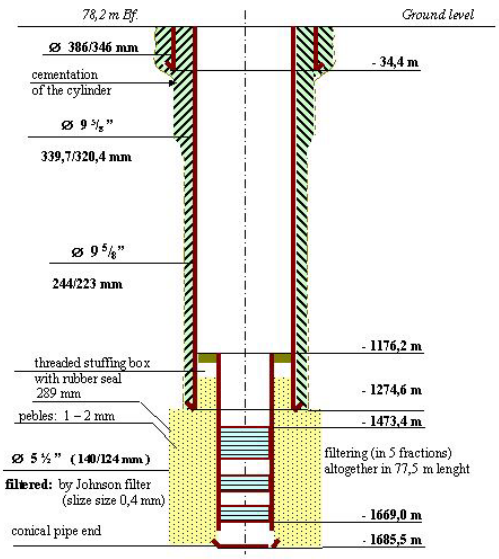
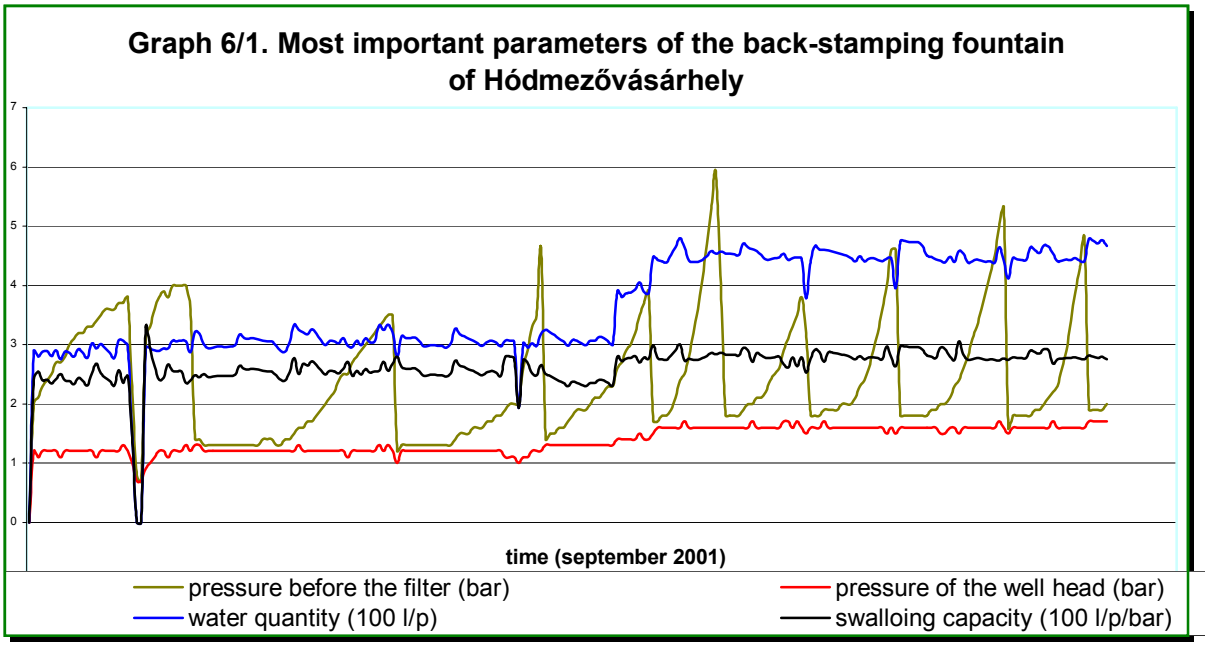
In professional surroundings it is a well-known fact, that the professional challenge of the thermal water exploitation and utilization is not the only usage of the excellent geothermal faculty of the Lowland, but also the environmentally friendly placing of the fluid got cool, and to make more effective of the thermal water replacement, i.e. the replacement of the water close to the layers of exploitation.

It can not cause problems in chapped limestone, or in karstic rocks, but there were no successful examples for tenacious and economical back-stamping in the Felsőpannon sandstone characteristic for this region, this way we had to be careful in the following aspects when planning, executing and installing the back-stamping project in Hódmezővásárhely:

- appropriate location selection. There should be interaction between the producing and back-stamping well, but its degree should be small.
- the well structure should meet the optimal energetic and hidrodinamic expactations;
- beside the superficial filtering (about 10 mikron), also the filtering technology is of highlightened importance: an approx. 10 cm thick cobble filter of good quality should be built around the JOHNSON filter mounted on the perforated tube;
- increased attention should be paid during the deepening of the well for minimizing the pollution of the providing and swallowing layers;
- application of a slow operating technology that spares the filter frame and avoids the hydraulic oscillation;
- for a long term and economic operation it is essential that the operating parameters (heat scale, quantity, pressures) are recorded continuously.

7.1. Tubing plan





In the back-stamping work put into operation in may 1998, 500,000 m^3 used thermal water has been back-stamped till now.

Operation costs of the back-stamping work:

- costs of electricity,
- costs of the superficial fabric filters,
- wage of filter replacement,
- costs of intermittent well maintenance and compression
- other costs (site maintenance, shock protection measures, etc.).

The cost of the back-stamping project in Hódmezővásárhely was HUF 27/m^3 in 2001. as fact, while in 2002 it was HUF 32/m^3 , but nowadays we can reach saving extras of water reserve of HUF 18/m^3.

Specific results of the project:

The investment cost of the geothermal utility system in Hódmezővásárhely was HUF 310 millions, from which HUF 107 millions were financed from credit, and HUF 33 millions are not refundable from KKA (Assistance of Central Environmental Protection).

The actual results of the project – after four years of operation experiences – can be summarized as follows:

- ✓ Application of local energy carriers → independence from the macro and micro environment, from economic and political relations and from import.
- ✓ Protection of the local cold drinking water supply → decrease of the burden of drinking water, use of the stocks of ineffective deep layers.
- ✓ Decrease of the air pollution in the inner-city → substituting 2 million m^3 of natural gas, decrease of the emission.

- ✓ Cost saving
  - cost of production of 1 GJ heat energy from thermal energy was HUF 348 in 2001. and HUF 410 in 2002 in Hódmezővásárhely (approximately the 1/3 of the actual natural gas price!)
  - cost of production of 1 m^3 of consumer warm water from thermal energy is was HUF 66 in 2001. and HUF 84 in 2002 in Hódmezővásárhely (the ¼ of the actual natural gas and cold water price!)
- ✓ The recovery period of the investment falls between 5 and 6 years.

To be able to perform these excellent results some conditions should have formulated favourably. As a conclusion, according to the experiences the optimal conditions of the utilization of geothermal energy is as follows:

- Good geological potential.
- A market as concentrated as possible.
- A multilevel use (access of a useful ΔT as huge as possible).
- Investing intent, financial possibilities (investment costs of utilization of 380 million m3/year thermal reserve are approx. HUF 46 billion).

These conditions can exist also close to Hódmezővásárhely and can be formed in green zone projects.

On the base of the example of Hódmezővásárhely it is indisputable that the geothermal natural resources of our country exist, it is environmentally friendly and renewable so we can count on it in the long run and last but not least it is economically utilizable.
It would be a pity not to take advantage of it!