

GEOTHERMAL DEVELOPMENT IN HUNGARY

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ABSTRACT

The main subject of the paper is the concept of geothermal energy utilization in Hungary developed for power generation and direct use.

The main thermal water reservoir systems of Hungary are the Mesozoic carbonate-karstic basement rocks and the Pliocene-Upper Pannonian porous sedimentary formations with more than 1200 thermal water wells, mostly in the low to medium temperature range (30°C to 120°C). The thermal water management (water supply, balneological applications etc.) and the direct energy use (agricultural utilization, space heating, SHW etc.) has to be in harmony with the possibilities and the requirements of the protection of water resources and the environment.

1.0 INTRODUCTION

Hungary is well-known as a country of favourable conditions in terms of thermal and mineral water resources with a geothermal gradient higher than the World average. As a consequence of the abnormally thin lithosphere the heat flux is above the average for the continent and the mean geothermal depth-step of 20 m/°C is steeper than the normal 30-33 m/°C value.

Hungary has one of the biggest underground water reserves and geothermal energy potential of low and medium enthalpy in Europe. The utilisation of underground water reserves and geothermal energy has to be in harmony with the geothermal and hydrological possibilities of supplying of underground waters and the protection of hydrological reserves and the requirements of the environmental protection. The main types of the thermal water bearing formations and the conceptual geothermal model of the country is shown in Fig. 1.

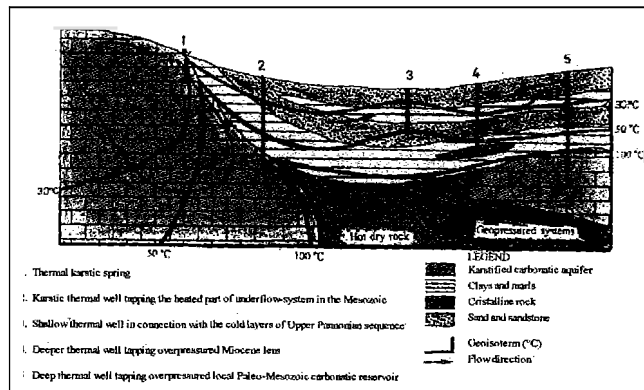


Figure 1. The main types of the thermal water bearing formation in Hungary.

2.0 BACKGROUND

The traditional thermo-mineral springs feeding the most notable spas are at the foothills of the Mesozoic carbonate mountains, representing the natural tappings of the karstic underflow-heat convection-systems. The hottest thermal water wells (with 70-100°C outflow temperature) were drilled to the Mesozoic basement rocks of the basins surrounding the Transdanubian Central Range, the Mecsek, Villányi, Bükk mountains and to the other carbonatic Mesozoic belts with 1000-3000 meters depth. These Ca-Mg bicarbonate type thermal karstic waters are used mainly for balneological applications.

The major geothermal reservoir (87% of the utilised thermal water resources) is located in the Pliocene - Upper Pannonian sandstone formations, the depth of which reaches 2800 meters. The temperature of the outflowing water obtained from this reservoir may have ranging from 30 to 99°C depending on the aquifer depth

effects (e.g. surface water pollution) in Hungary is also most desirable the reinjection. Thermal water wells with double function (geothermal doublets) were built successfully in the southern part of the Great Hungarian Plain; in the Little Plain only in Mosonmagyaróvár for experimental purpose so far.

The summarized data of geothermal energy utilization in Hungary are given in Table 2.

The present official governmental policy in Hungary promotes the alternative energy resources for the country, based on the idea of full economic cost recovery from users. This governmental policy is fairly new.

Geothermal energy is recognized as a nonpolluting energy source by the EU. Energy prices are being gradually adjusted by the Government to reflect cost recovery.



Figure 5. The Turkish bath "Király" of XVIth century, Budapest.

Table 1. Temperature and utilization of thermal wells in Hungary (1996).

Temperature (°C)	30-39,9	40-49,9	50-59,9	60-69,9	70-79,9	80-89,9	90-99,9	100<	total	
	Utilization (Number of wells)								%	pc
filled-up	102	18	6	11	0	0	1	0	11,5	138
spa	51	89	39	29	8	3	4	0	18,5	223
industrial	26	12	12	10	4	1	1	0	5,5	66
communal	0	2	2	1	3	1	5	1	1,25	15
shutted off	115	38	21	20	10	7	7	0	18,0	218
	60	14	14	15	18	28	28	1	14,75	178
reinjectional	0	1	2	4	0	2	0	0	0,75	9
watersupply	157	24	6	0	0	0	0	0	15,5	187
observation	38	29	13	4	1	1	0	0	7,0	86
multipurpose	11	17	12	28	14	1	0	0	7,0	83
Number of wells	560	244	127	122	58	44	46	2		1203
total (%)	46,4	20,2	10,5	10,1	4,8	3,3	3,8	0,2		100
Flow-capacity (m ³ /min)	393,12	209,67	120,68	120,47	75,02	55,70	65,86	3,65		1044,3
Flow-capacity (%)	37,6	20,1	11,6	11,5	7,2	5,3	6,3	0,3		100

Hungary (1997).

Reserves of thermal water				Thermal water production	Type of thermal water utilisation	Percentage according to the type
Static volumetric reserves, cu.km		Dynamic reserves, (at A T40 °C)				
Pannonian	Mesozoic	Volumetric Mcu.m/a	Heat content, PJ/a	Mcu.m/a (kg/s)		∅
1	2	3	4	5	6	7
3800	200	380	63,5	113,15 (3587,9)	1. Balneology 2. Drinking water supply 3. Agriculture 4. Space heating and SHW	36,7 29,9 29,6 3,8

30 THE ROLE OF OIL INDUSTRY

The Hungarian Oil and Gas Company (MOL Co.) started a programme in 1995 to promote the development of geothermal energy.

MOL Co. has pursued to compile a pre-feasibility study of the following geothermal pilot projects (Table 3.). Because none of the project areas have been associated so far with a specific use of the known occurrence of geothermal energy, project objectives are initially to define pilot projects for each location and to examine opportunities for utilisation that could range from direct heat exchange system to integrated energy cascade systems. The goal is to conduct feasibility studies, involving pilot experimentation, in order to obtain information on appropriate technology and design suitable for the reserves at a given geothermal reservoir location.

A corollary objective of the project is to evaluate the economics of each application, including rate of return and cash flow analyses, together with investment scenarios, financing and co-financing and related topics.

Table 3. The main data of geothermal pilot projects in Hungary.

Parameters	Pilot projects		
	1. Andrásida doublet	2. Mélykút doublet	3. Nagyszénás-Fábiánsebestyén
1. Type of reservoirs	low enthalpy		medium enthalpy "geopressured"
wells (abandoned CH-wells)	submersible	artesian	
2. Water production	pumps		
3. Results of short-time flow tests			
3.1. Yield of geothermal brine, cu.m./d	2600	2650	1900
3.2. Well-head temperature during production, °C	92	110	171
3.3. Well-head pressure, bar			
static	-	10	450
dynamic	-	3	45
3.4 Timelife of project, years	25		

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