

UTILISATION OF GEOTHERMAL WATERS IN SLOVAK REPUBLIC

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ABSTRACT: Geothermal waters in the territory of the Slovak Republic largely occur in Triassic carbonates of Inner Western Carpathian nappes and, to a lesser extent, in sedimentary rocks of Neogene age – mainly sands, sandstones and conglomerates, or in Neogene andesites and related pyroclastics. These aquifers lie at depths of 200 – 5000 m, reservoir temperatures of geothermal waters range from 20 to 240 °C. The total amount of thermal energy potential of geothermal waters in prospective areas represents 5538 MW_t.

Key Words: renewable energy sources, geothermal waters, geothermal wells, prospective areas, geothermal energy utilisation

INTRODUCTION

Geothermal waters represent the only resource of geothermal energy in the Slovak Republic. Renewable energetic sources like small water power plants, utilisation of forest biomass, geothermal, solar and wind energy and biogas were included into the State Energetic Conception of the Slovak Republic. The energetic potential of these sources represents about 4 % of primary energetic sources utilisable in the period 2005 - 2010 that means 40 000 TJ/year. From the mentioned sources the utilisation of biomass (29 %) and geothermal energy (18 %) are the most important. Geothermal energy can be effectively used in the regions and localities as a local available source of heat in the case of lack of other energetic sources or increase of fossil fuels prices. In the case of favourable conditions geothermal energy can be also used as a source of the electric energy generation. According to the sustainable resources management and environmental protection, sources of geothermal energy were declared as one of the partial solutions, which can substitute for fossil fuels.

Low enthalpy (temperature in the range 15 °C - 100 °C), medium enthalpy (100 °C - 150 °C) and high enthalpy (higher than 150 °C) geothermal resources occur in territory of the Slovak Republic. The most frequent of these are low enthalpy and the least are high enthalpy geothermal resources. The Slovak Republic belongs to the countries where total geothermal

energy installation is over 100 MW_t. Obtained results and assumed possibilities create real conditions for the feasible geothermal energy utilisation in the territory of the Slovak Republic in the near and far future (Fendek et al., 1999).

UTILISATION OF GEOTHERMAL WATERS

The first utilisation of geothermal waters for energetic purposes is connected with space heating in spas and can be dated to the year 1958. Three systems of direct utilisation of geothermal waters were tested (Uhliarik, 1977):

- direct space heating in spas Piešťany, Kováčová, Sklené Teplice,
- utilisation of heat pumps in Piešťany and Turčianske Teplice,
- space-heating and heating of hot service water through heat exchangers in Piešťany, Turčianske Teplice and Kováčová.

These first steps created conditions for more extensive research in the field of geothermal waters utilisation for direct use in Slovak Republic.

Based on results of research and investigation in 70s and 80s of the last century, which were carried out by Dionýz Štúr Institute of Geology, 26 potential geothermal areas and structures were defined in the territory of Slovakia (Franko et al., 1995). Research, prospecting and exploration of geothermal waters has so far been carried out in 14 prospective areas. In the other 12 prospective areas, geothermal waters have not been verified by wells, but six of them have been geologically assessed for the purpose of prospecting and exploration for geothermal waters (Figure 1). The total amount of thermal energy potential of geothermal waters in the prospective areas (proven, predicted and probable) represents 5538 MW_t and is given in Table 1 (Franko and Fendek, 2000).

The first geothermal project - construction of reinjection plant in Podhájska, was finished in 1994. In 1996 the first geothermal heating plant, with capacity of 8 MW_t, in the Galanta town started to work. Space heating of a hotel and greenhouses started in Bešeňová in 1997. In 1998 the first three wells from the eight doublets were drilled in the Košice basin. An installation of 110 MW_t source that would be used as a thermal power plant for central heat supply for Košice town with overall capacity of 700 MW_t is considered. Feasibility studies are prepared for several localities (Franko, 1999) in the territory of Slovakia (Skorušina, Poprad, Liptov basin, etc.).

In spite of the high level of geological research and investigation studies, the effectiveness and technological level of geothermal energy utilisation is very low. The first

reason is the seasonal utilisation, the second one the low efficiency of geothermal installations.

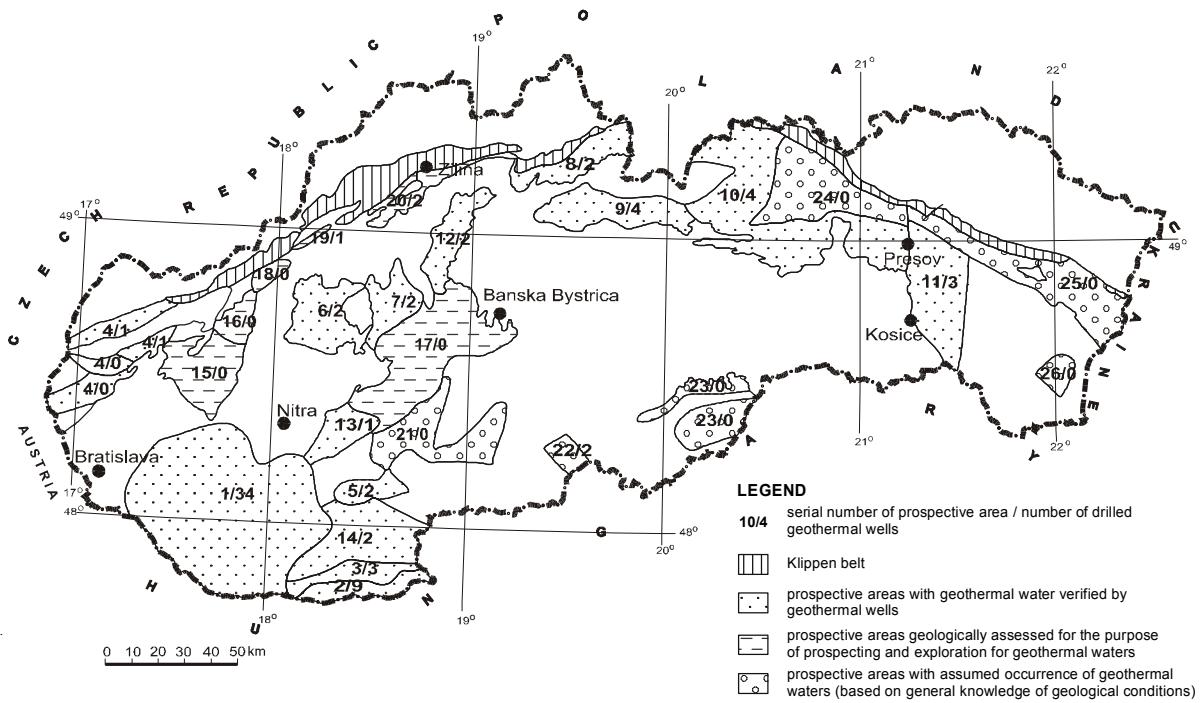


Figure 1 Exploration of potential geothermal areas and structures in the territory of the Slovak Republic (Fendek, 2000)

1-Danube Basin central depression, 2-Komárno high block, 3-Komárno marginal block, 4-Vienna Basin, 5-Levice marginal block, 6-Bánovce Basin and Topoľčany embayment, 7-Upper Nitra Basin, 8-Skorúšina Basin, 9-Liptov Basin, 10-Levoča Basin (W and S parts), 11-Košice Basin, 12-Turiec Basin, 13-Komjatice depression, 14-Dubník depression, 15-Trnava embayment, 16-Piešťany embayment, 17-Central Slovakian Neogene volcanics (NW part), 18-Trenčín Basin, 19-Ilava Basin, 20-Žilina Basin, 21-Central Slovakian Neogene volcanics (SE part), 22-Horné Strháre – Trenč Graben, 23-Rimava Basin, 24-Levoča Basin (N part), 25-Humenné ridge, 26-Beša – Čiārovce structure

Table 1 Thermal-energy potential of geothermal waters in the Slovak Republic

Resources [MW _t]			Reserves [MW _t]		
proven	predicted	probable	proven	predicted	probable
162.5	69.5	321.0	116.2	357.8	4511
		553		4985	
Total amount: 5 538.0 MW _t					

Geothermal water is used in 14 agricultural farms (greenhouse heating, soil heating), in six localities for heating of service buildings, restaurants or sport hall, in two localities for fish farming and on 30 localities for recreational purposes. The total amount of geothermal energy utilised in 36 localities represents thermal power of 132.30 MW_t and 846.4 l/s of geothermal water (Table. 2). Utilisation of heat in agriculture provides great possibilities for early production of vegetables (cucumber, tomatoes, peppers, aubergines, etc.) and flowers.

Use of fossil fuels is, however, too costly and geothermal water can provide an economic answer. The total area covered by greenhouses is about 27.6 ha. Capacity factor means the ratio of the geothermal energy utilisation on the whole year energy use.

Table 2 Geothermal direct heat uses (Fendek and Franko, 2000)

	Installed Capacity [MW _t]	Annual Energy Use (TJ/yr)	Capacity Factor
Space Heating	15.2	277.5	0.579
Greenhouse Heating	22.5	355.4	0.501
Fish Farming	2.3	36.2	0.499
Bathing and Swimming	90.9	1437.1	0.501
Subtotal	130.9	2106.2	0.510
Geothermal Heat Pumps	1.4	12.1	0.274
Total	132.3	2118.3	0.508

Recent developments in the application of the ground source heat pump over the world opened a new dimension in using the earth's heat, as heat pumps can be used basically everywhere. Stage of heat pumps utilisation in the Slovak Republic is shown in Table 3. COP in Table 3 means ratio of output thermal energy and input energy of compressor.

Table 3 Geothermal (ground-source) heat pumps (Fendek and Franko, 2000)

Locality	Water temperature (°C)	Typical heat pump rating or capacity (kW)	Number of units	COP	Thermal energy used (TJ/yr)
Podhájska	40	20	1	3.8	0.153
Bojnice	38	40	1	4.2	0.273
V.Ružbachy	19	778	2	3.7	6.845
Gbelany	9	23	1	4.0	0.115
Rajecké Teplice	34	489	3	4.5	4.725
TOTAL		1350	8		12.111

The spatial distribution of utilised sources in respective counties of Slovak Republic is documented in Table 4. It follows from this table that the highest amount of the utilised sources of geothermal waters is situated in Trnava county and represents 44.47 MW_t. The second highest amount is situated in Nitra county, representing 40.13 MW_t, and the third highest amount of utilised sources of geothermal waters is situated in Žilina county and represents 25.56 MW_t (Fendek et al., 1999).

Table 4. Distribution of utilised geothermal energy sources in counties of the Slovak Republic

County	Number of localities in utilization	Yield [l/s]		Thermal power [MW _t]	
		Total yield	Utilized yield	Total thermal power	Utilized thermal power
Bratislava	0	30.2	0.0	4.42	0.00
Trnava	11	332.2	211.2	72.27	44.47
Nitra	9	469.2	295.7	57.57	40.13
Trenčín	3	30.9	30.2	4.54	4.49
Zilina	5	312.6	184.0	35.25	25.56
Banská Bystrica	5	131.3	54.2	9.39	5.15
Prešov	2	172.6	70.5	26.87	11.16
Košice	1	195.6	0.6	33.54	0.01
Total amounts	36	1672.0	846.4	269.95	130.97

CONCLUSION

Geothermal energy is an environmentally friendly source of energy that contributes and will also contribute increasingly to stabilising energy supply in the future. In the world, geothermal energy ranks to the first place among the renewable energy sources with the 52 % ratio on electricity generation and 79.6 % on direct use (Fridleifsson, 2000).

In Slovakia, only 3 % of the total consumption of primary energy sources are covered by renewable energy sources. In comparison with countries of the European Union, the amount is higher than in Ireland (10th place in the rank of EU countries according to the share of renewable energy sources on the total energy consumption) and lower than in Italy. Really utilisable potential of renewable and secondary energy sources (forest biomass, small hydropower plants, geothermal, solar and wind energy, biogas from wastes, municipal and industrial waste, waste heat) should reach 6.5 % from the total consumption of the energy sources in 2010. It is noted in the Energetic Conception of the Slovak Republic, approved by the Slovak Government Resolution No. 562/1993 (Fendek and Franko, 2000). The number represents utilisable potential of 39,548 TJ (after subtraction of hydropower plants). Forest biomass will belong to the first (28.9 %) and geothermal energy to the second place (18.1 %). According to the installed capacity of 132 MW_t produced from geothermal waters (Fendek et al., 1999), Slovak Republic ranks to the 20th place in the world.

Geothermal wells verified 4.5 % of the total thermal-energy potential of the geothermal sources in Slovak Republic, but only 2.3 % of the total potential are utilised. From the proven thermal-energy potential only 53 % is utilised at present.

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