

The Results of Geothermal-Energy Harnessing Activity in Ukraine

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ABSTRACT

Practical harnessing of geothermal resources in Ukraine have been in progress starting from early ninetieth. Nine geothermal heat-supply systems with total rated capacity of 10.9 Mw have been commissioned in this period. During the year 2003 alone the systems generated 33,000 MWh of heat and made it possible to save 5 thousand tons of conditional fuel and reduce CO₂ emissions by 10.5 thousand tons. The particular emphasis in the development of Ukrainian geothermal power engineering was laid on the development of geothermal heat-supply systems as well as on the construction of cogenerating units based on geothermal fields with gas-containing thermal waters. The above-mentioned activity is financed within the framework of the State R&D Program "Environmentally Friendly Geothermal Power Engineering of Ukraine" which is focused on the development of scientific and technical foundation of and material basis for the introduction of geothermal energy in the National Fuel & Energy Complex. Specifically, the following research activities are under way:

1. Study and assessment of the geothermal power engineering resource base
2. Development of environmentally-friendly technologies for the extraction and utilization of geothermal energy
3. Construction of demonstration pilot-plant systems of heat supply and air conditioning of individual dwelling houses and entire settlements
4. Development of advanced technologies and equipment for the utilization of geothermal energy in agriculture (drying of grains, air cooling in vegetable store-houses, heating of greenhouses, etc)
5. Development of thermal-water-based medical treatment methods of certain deceases
6. Development of new technologies for the recovering of valuable chemical components from thermal waters.

1. INTRODUCTION

Geothermal energy in Ukraine is presented by thermal and superheated waters, and by the heat of dry rocks. Resources of thermal and superheated waters are formed and circulate on depths over 1000 meters within the artesian basins. There are four large artesian basins with the industrially significant resources of thermal and superheated waters: Zakarpatye's, Predkarpatye's, Dneprovsko-Donetskyi's and Prichernomorskyi's artesian basins. According to the State Committee on Geology of Ukraine the potential resources of geothermal waters of these basins make 27.3 million m³/day with the average temperature 70°C. It is necessary to note, that within the limits of the listed artesian basins there are territories where (on depths over 3500 meters) superheated waters with temperature from above 170°C are

prolate. The analysis of results of search drilling and of tests of prospecting wells has shown that, first of all, the extraction of superheated waters can be organized on the following areas: Zalugskaya (the Zakarpatye area), Novomechbilovskaya (the Kharkov area), and Tarxankutskaya (AP Crimea).

The overwhelming majority of the heat, accumulated by dry rocks, is concentrated in Ukraine on territory of the following platform structures: the Ukrainian crystal shield and a part of the Voronezh crystal massif. The potential resources of heat of these structures make 322.7*10¹²GJ.

One of the important features of geothermal energy is economic inexpediency of the transportation of thermal waters on distance above 3-5 km. Geothermal energy is a local energy-source and it is necessary to use it in places of extraction. By virtue of this circumstance, the potential resources of geothermal energy cannot be used in full in near future.

For an estimation of geothermal resources, which can be really used in the near future, it is necessary to see the concrete consumers. The basic consumers of thermal waters with temperature up to 100°C can be systems of a household heat supply of settlements, cities and the industrial enterprises. The significant amount of thermal waters can be used in agriculture, the food and local industry and balneology.

We used the facts received during the studying of the thermal waters fields with the purpose to estimate their forecast's resources. From this we have executed the calculation of operational resources of geothermal energy in Ukraine, which can be really mastered in immediate prospects. During the performance of this calculation the basis was a data on concrete existing consumers of geothermal energy, namely their thermal capacity, schedules of consumption of heat and standard of energy carriers. Thus the following basic assumptions were made: you use figures, place them within the body of the paper, unless they are too large for a single column, in which case they should be put at the end of the paper.

1. Operational resources of thermal and superheated waters of artesian basins and heats of dry rocks are appreciated up to depths of 5 km, which are accessible to mass operational drilling.
2. Resources were taken into consideration for non-polluting technology of the operation the geothermal fields with the back pumping of the exhausted heat-carrier.
3. During calculation the well-known methods and techniques of calculation of the thermal and superheated waters, the heat-content of dry rocks were used.

4. It was accepted the conformity of the area of thermo-hydro-fences, the areas of settlements for which the systems of a geothermal heat supply are created.

5. The energy potential of operational resources is defined with taking into account the features of the creation and operation of the equipment, which uses the geothermal energy. Thus the energy potential was understood as quantity of heat or electric energy, which is possible to receive by using the geothermal energy on heat or electric-generative equipment. This equipment has the coefficient of efficiency typical for today in view of a degree of the loadings of generating capacities.

Let's note that a degree of loading of the generating capacities depends on number of business hours for a year of geothermal power plants.

As a result of calculations of the number of operational resources of geothermal energy in all 25 areas of Ukraine, it was established that no more than 15 % of forecast's resources of geothermal energy can be really mastered in the near future. At the same time, the number of these resources is great enough. The systems of the geothermal heat supply created on their basis will allow the consumption of organic fuel in household sector of Ukraine to reduce to 20...25 %. The most perspective areas of development of operational resources of geothermal energy are: Autonomous republic Crimea, the Zakarpatye, Odessa, Nikolaev, Kherson, Donetsk, Lvov, Kharkov, Poltava areas.

CONCLUSION

Now the Government of Ukraine takes effective steps directed on industrial development of resources of geothermal energy. The State scientific and technical program "Non-polluting geothermal energy of Ukraine" is

developed, is financed and realized. A number of geothermal objects were set in industrial operation and work stably (table1). Thanks to the works executed within the framework of the mentioned program, and also to the efforts of the Ukrainian experts, Ukraine accumulated the certain practical experience how to use the geothermal energy. More than ten years some plants of a geothermal heat supply in Crimea and in Zakarpatye area are in constant operation. Total capacity of working geothermal systems of a heat supply in Ukraine makes 20 Mw. It is necessary to note, that the Ukrainian experts have developed new technology and the equipment for joint development of heat and the electric power with the help of gas-saturated thermal waters. In 2002 the first (in Ukraine) experimental block of geothermal thermoelectric power station "Sivashskaya-1", which uses the thermal waters, has been set in experimental operation in Crimea. The heat capacity of the plant is 0.8 Mw, the electric capacity is 60 Kw. The content of combustible gas makes in one cubic meter of water - one cubic meter of gas (basically methane). The isolation of the gas from water occurs in a special separator, then the water moves in the heat exchangers, and the gas moves in the diesel engine-generator.

The lead researches have shown, that perspective resources of geothermal energy in Ukraine for industrial Active Geothermal objects in Ukraine

Development made: thermal waters > than 300 thousand m³/ 24 hours, superheated waters > 1 million m³/ 24 hours. Realization of the energy potential of these resources will be allow to receive on thermal energy more than 50 million MWt-hour/year, on electric energy about 2.5 million MWt hour/year, to reach significant economy of fuel and to lower the emissions CO₂ for 15-20 million t/year.

Table 1: Active Geothermal objects in Ukraine

Geothermal object	Year of introduction in operation	Thermal (electric) capacity (MWt)	Annual economy of fuel
1. System of the geothermal heat supply of the Beregovsky's sport center. Beregovskiy area, Zakarpatskaya region.	1978	2,1	1215
2. System of the geothermal heat supply of the sanatorium "Kosyno". Beregovskiy area, Zakarpatskaya region.	1998	1,2	860
3. System of the geothermal heat supply of the sanitary complex "Latorytza". Mukachevskiy area, Zakarpatskaya region.	1985	0,2	210
4. System of the geothermal heat supply of the settlement Yantarnoe. Krasnogvardeyskiy region, AR Crimea	1991	4,6	2700
5. System of geothermal power supply of the objects of budgetary sphere in the settlement Changar. Khersonskaya region	1998	1,0(0,1)	900
6. System of geothermal power supply of children's establishments and of the social cultural household spheres of settlement Medvedevka, Dzhankojsky area, AR Crimea	2002	0,8(0,06)	650
7. System of the geothermal heat supply of the objects in the settlement Zernovoe. Sakskiy area, AR Crimea	1997	0,4	355
8. System of the geothermal heat supply of the objects of municipal economy of settlement Piatykhvatky. Krasnogvardeyskiy area, AR Crimea	1996	0.3	300
9. System of the geothermal heat supply of the objects in the settlement Nizinnoe. Sakskiy area, AR Crimea	1998	0,3	300
Total		10,9(0,17)	7470