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Utilization of Bathygenic Heat of the Earth for Heating and Hot Water Supply in Living Houses

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Abstract: The possible variants for the use of geothermal heat power plants in Russia were considered. The scheme of the use of the thermal energy of the upper layer of the earth for heating and hot water supply of residential houses was presented and recommendations for its possible use were given.

Key words: Bathygenic heat · Deposit occurrence · Heat power plan · Heating · Hot water supply · Heat pump · Refrigerant

INTRODUCTION

Due to the ever increasing in all sectors of the economy needs the fuel of great importance is the use of secondary energy resources. Therefore, all the more urgent becomes the problem of greater use of other energy sources, which include the deep warmth of the Earth.

Until recently, worldwide there were four known types of deposits of the deep heat of the Earth:

- Propertery (which include the fields of steam and flowing steam-water mixture);
- Thermal springs there (which include deposits flowing hot water);
- Thermoanalyse zones (which include deposits of warmth, with an increased temperature gradient);
- Petrogeothermal zones (which include the warmth of a mountain of dry rocks).

Only propertary and thermal springs there are the main sources of geothermal energy used to generate electricity at temperatures of steam-water mixture of more than 150 °C and thermal energy at temperatures of steam-water mixture ranging from 30 °C with up to 150 °C.

According to [1] at the end of the twentieth century, the installed capacity of geothermal heat power plants (GeoHPP) only in the world made up of 17,600 kWt. In Russia there is only one Geothermal power station with an installed capacity of 11 kWt.

The European part of the Russian Federation has vast deposits of geothermal energy sources, therefore, it is possible to build on this site a few geothermal heat power plants. For the production of electricity and heat energy in Geothermal power station you can use the so-called "circulating system". With their help, surface water, injected through wells with water vapor, displaces the vapor-air mixture from the existing underground porous reservoirs – reservoirs. In this case the injected surface water is heated and its displacement will be carried out already next portion of the injected cold surface water. As the injected water can be used water obtained from condensation of the steam after the turbine. The proposed circulation system will allow to receive water vapor from a depth of 3.5 – 4 km with temperature above 150 °C. due To the fact that over time the consumption of steam from the well will gradually decrease, the period of its operation will not exceed 15 years.

Most preferably, the geothermal energy use for electricity generation and for heating and hot water supply of residential houses. Already, more than 150 thousand inhabitants of the Caucasus and Kamchatka are using geothermal heat for heating and hot water.

For heating of residential buildings with leaky buildings can use geothermal warmth of the earth from shallow depths. It was established experimentally that the ground temperature at a depth of 1 – 2 meters from the ground surface throughout the year varies very slightly within a few degrees.

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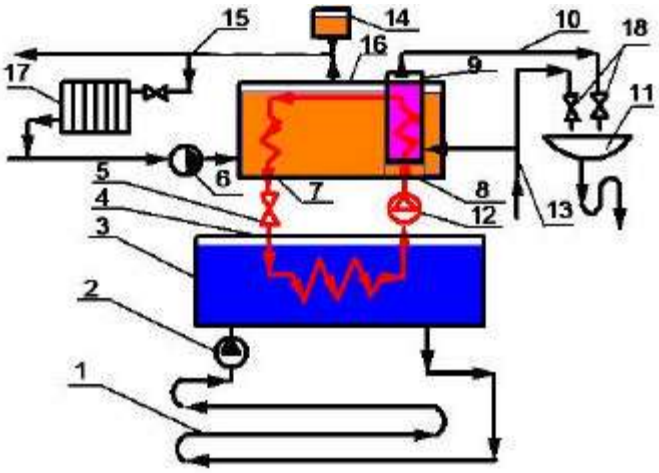

Fig. 1: Schematic of heat pump for heating and hot water supply of residential houses [3]: 1 – polyethylene pipes (d = 40 mm; l = 400 m; the depth in the ground 0.9 – 1.6 m); 2 – circulating pump antifreeze; 3 – vessel with antifreeze; 4 – evaporator; 5 – valve; 6 – circulating water pump for supplying water into the vessel No. 2; 7 – condenser; 8 – condenser; 9 – vessel No. 1 with water temperature of 60 °C for the hot water supply system; 10 – hot water piping; 11 – shell; 12 – compressor; 13 – the cold water pipe; 14 – expansion tank heating system; 15 – the pipeline of the heating system; 16 – vessel No. 2 with water with a temperature of 50 °C with for the heating system; 17 – the heating device (radiator section); 18 – mixer of cold and hot water.

For example, for Kazan (Tatarstan, Russia) the soil temperature at a depth of 1.6 m from the ground surface vary in the following range: lowest average monthly temperature during the heating period (winter) + 1,6 °C with the highest average monthly temperature in summer + 12,2 °C. Average temperature at a depth of 1.6 m for the year is about 6.3 °C [2].

To take away the heat from the soil at a depth of 1.6 m by using the heat exchanger system with heat pumps [3]. Figure 1 shows the scheme of installation with a heat pump for heating and hot water supply of residential areas [3].

The working fluid (antifreeze) in the soil heats up to + 4 °C in winter and till + 8 - +10 °C in summer. Gases of refrigerant heat pump (freon - R22) generated in the evaporator 4 is compressed by the compressor 12 to a pressure of 2.0 – 2.2 MPa and heated to a temperature of 70 - 100 °C. While passing through the condenser 8 the refrigerant heats the cold water in the first vessel 9 to a temperature of 60 °C with and he is cooled to 60 - 65 °C. The condensation of the vapors of freon - R22 will be completed in the condenser 7 at a temperature of 55 °C With according to the pressure of the freon after the compressor 12. In the process of condensation of freon water in the second vessel 16 is heated to a temperature of 50 °C and is placed into the heating system, and then returns to the second container of water 16.

The total capacity of the plant is presented in Figure 1 is 4.5 kWt, including power of the circulation pump 2 for supplying antifreeze 0.5 kWt, the power of circulating water pump 6 for supplying water to the second 16 of the heating system 0,4 kWt.

Field studies conducted in the work area, shown in Figure 1, showed that the specific capacity of the soil is 10 to 15 kW/m^2, that is, within hours it becomes possible to obtain 36 – 54 kJ of heat from the area of ground surface equal to 1 m^2.

Thus, the effective use of heat energy of the top layer of the earth it is vital to be solved in the near future as the reserves of nonrenewable energy resources (coal, oil and gas) on Earth is constantly decreasing. The considered system with a heat pump can be used not only for heating and hot water supply of residential houses, but also for areas of livestock farms and complexes.

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