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GEOTERMAL ENERGY, USE OF EARTH TEMPERATURE AS AN EFFECTIVE ENERGY RESOURCE

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Annotation
The article describes the use of geothermal energy in the construction of geothermal power plants. For example, primary and secondary geothermal power plants and the petrothermal method of extracting geothermal energy for them.

Keywords: electric generator, turbine generator, earth's core, primary geothermal power plants, secondary geothermal power plants, heat exchange chamber, petrothermal power plants.

1. Introduction

One of the most popular methods of obtaining electricity on an industrial scale is to obtain it by rotating a generator turbine using a large stream of steam coming out of boiling water. Boiling of water in the reactors of nuclear power plants is provided by a controlled chain reaction of radioactive elements, while in thermal power plants it is carried out by burning coal [1].

2. Literary Review

A number of world scientists engaged in geothermal energy, including Popov MS, Maksimov I.G., Feofanov Yu.A., Yu.A. Feofanov, Alkhasov AB and others have conducted research in Russia on geothermal energy, alternative energy sources, geothermal power plants, geothermal energy resources and problems.
The use of geothermal energy is an energy-efficient form of generating electricity by rotating a generator turbine using a stream of steam. In most parts of the globe, boiling water comes out of the ground, so there is no need to heat water for power plants and other industrial production [2]. For example, in 1904, the Italian Pero Ginori Conti launched the first generator using natural geothermal sources. It should be noted that this geothermal power plant is still operating. For the operation of similar geothermal power plants, the temperature of the available water in the Earth's crust is 150-200°C is required to come to Earth in the form of boiling water or steam. At a depth of about 5,100 km toward the Earth's center, the temperature in the Earth's core's crust is about 6,000°S. As it approaches the Earth's crust, the temperature gradually decreases according to the following graph [4].

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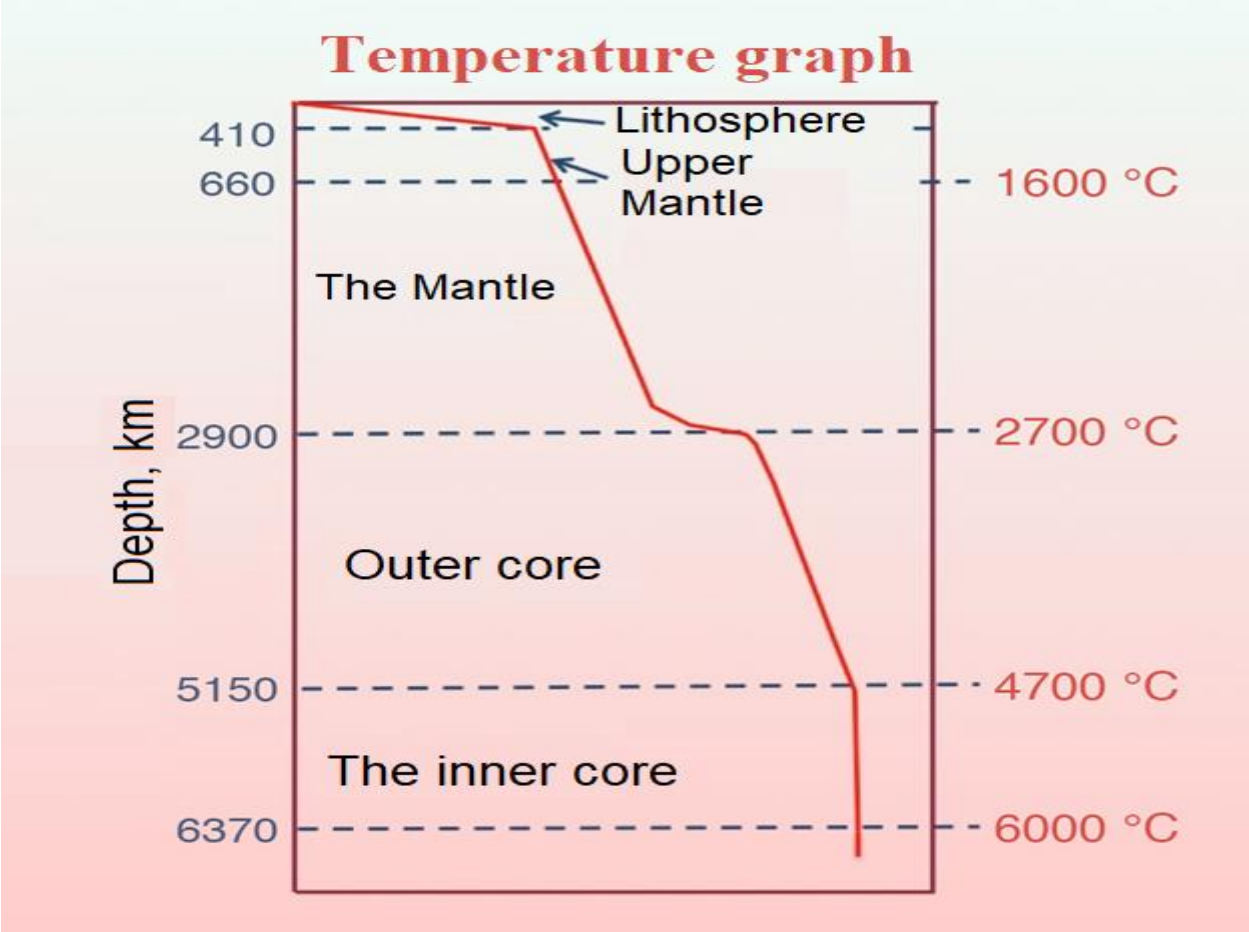

In other words, the average temperature is 3 for every 100 meters of depth°Rises to S. However, depending on the region, a change in temperature gradient is observed. For example, the Kolsk super deep well is 220 km at a depth of 12 km relative to the horizon°C temperature was determined. In areas where active volcanic and tectonic faults have formed on the planet, excavations from a few hundred meters to several kilometers, mostly 0.5-3 km, are sufficient to achieve the temperature required for geothermal power plants. In the American state of Oregon, the geothermal gradient is 150 per 1 km°S is 6 per 1 km in South Africa°S. From this we can conclude that there is no possibility to build demand-level geothermal power plants anywhere in the world.

3. Materials and Methods

A simplified scheme of primary geothermal power plants is shown below. According to him, steam rises from the ground and turns the generator turbine, thus generating generator current [2].

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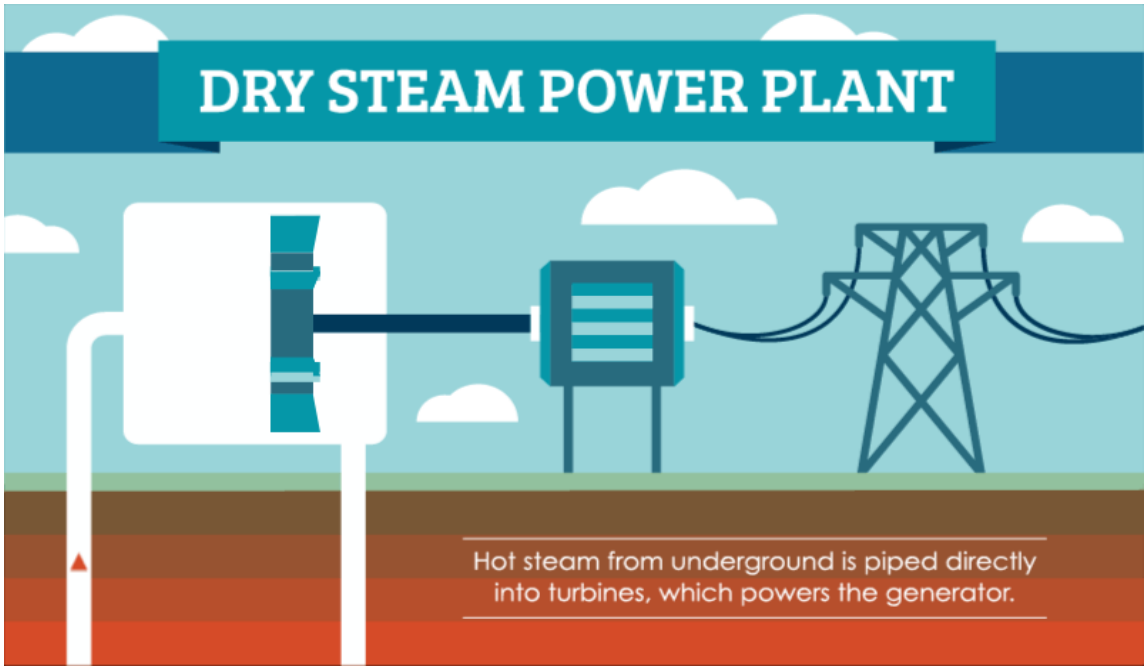
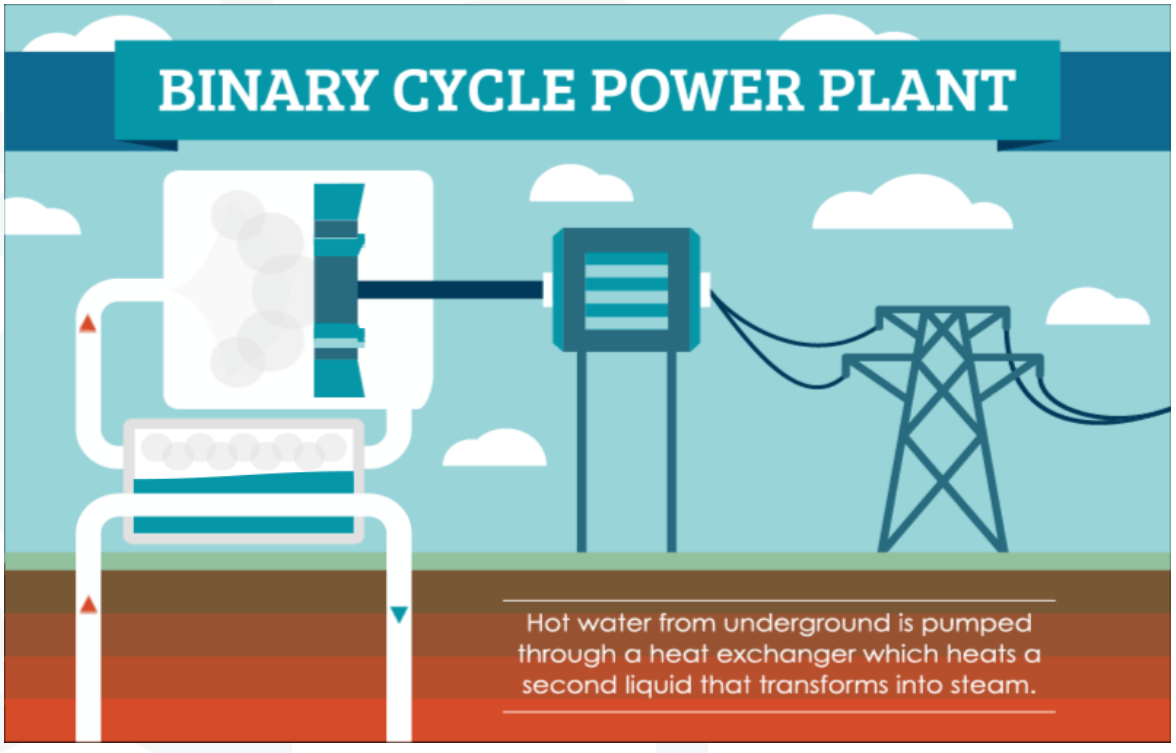


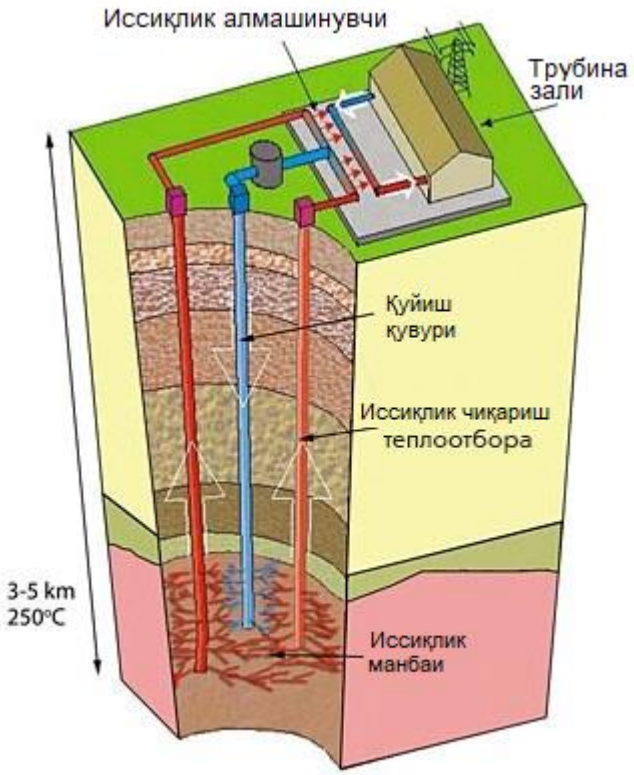
The fluid in a well is 100°If the temperature is below C, the construction of a secondary geothermal station is recommended. In this case, the liquid is not transferred from the well to the turbine, but rather transfers its heat to another secondary fluid in the heat exchanger. For the secondary liquid, a liquid with a much lower boiling point is selected. For example, the boiling point is 51.9°Freon belonging to the fluorochlorobromethane type C. Freon boils to a vapor state and turns the turbine. The steam used condenses and passes into the water state and into the heat exchange chamber [2].



4. Results and Discussion

Petrothermal power plants

Some of the underground sources do not contain liquid. Therefore, a different-petrothermal method of extracting the required geothermal energy for power plants is used.



According to him, the liquid from the surface is sent to a source of heated temperature in the depths of the earth, where the liquid passes into the vapor state, rises upwards through another pipe and turns the turbine.

In the petrothermal process, a single well provides a sufficient steam-water flow to produce an average of 3-5 MW of energy. So far, such systems have not been implemented anywhere at the industrial level, but work is underway, particularly in Japan and Australia.

5. Conclusions

Advantages of geothermal energy

The above considerations confirm that the use of Earth heat to generate electricity on an industrial scale is not cheap. But it is very useful for a number of reasons.

5.1. Not to be outdone. Fossil fuel power plants have a need to supply natural gas, coal, fuel oil and similar fuels. In addition, supply disruptions due to natural disasters or changes in the political situation lead to unplanned increases in raw material prices. Political turbulence in the Middle East in the early 1970s led to a fuel crisis that quadrupled oil prices. The crisis has given a new impetus to the development of electric transport and alternative energy sources. One of the advantages of using subsoil heat is that it is practically non-existent. The annual heat flow in the Earth's crust is about 400,000 TVt hours per year, which is 17 times more than the energy produced by all the power plants on the planet during this period. The temperature of the Earth's core is estimated at 6000 ° C, and the cooling rate is estimated at 300-500 ° C in 1 billion years. There is no need to worry that humanity is able to accelerate this process by drilling wells and pouring water into it - to reduce the core temperature by 1 degree, it needs to extract 21020 kWh of energy, which is millions of times more than the annual electricity consumption of all mankind.

5.2. Sustainability. The capacity of wind and solar power plants is highly variable, depending on the weather and the time of day. If there is no sunlight, production will stop, so the station will provide backup from batteries. Even when the wind is weaker, production will again be tied to batteries with unlimited power. Taking into account the technical processes for returning water to the well, the hydrothermal power plant will operate continuously 24/7.

5.3. Compactness and convenience for inconvenient areas. Providing electricity to remote areas where the infrastructure is isolated poses a challenge. This is even more complicated if the transport capacity in the area is difficult and the relief is not suitable for the construction of traditional power plants. One of the important advantages of geothermal power plants is their compactness: geothermal water is taken from the ground and a machine hall and cooling tower with a turbine and generator are built on the ground, and together they take up very little space.
A geothermal power plant with a capacity of 1 GW per year occupies an area of 400 m2 - even in the mountainous region of the Earth, the construction of a geothermal power plant will require a very small area and road. For a solar power plant with the same capacity will need 3240 m2, for a wind power plant - 1340 m2.

5.4. Environmental safety. A geothermal station is an environmentally friendly object: the amount of carbon dioxide released into the atmosphere is 45 kg of CO for the energy produced per 1 kW / h.$_2$ estimated. For comparison: 1000 kg of CO per 1

kW / h in coal-fired power plants$_2$, in oil refineries - 840 kg, in gas plants - 469 kg. However, nuclear power plants weigh only 16 kg - a minimum figure excluding radioactivity.

5.5. Possibility of parallel mining. Surprising, but the fact is that in some power units of geothermal power plants, in addition to electricity, they emit gases and metals dissolved in a vapor-water mixture coming from the ground. They can simply be returned together with the condensed steam used in the well, but given the size of the useful elements that pass through the geothermal power plant, it is reasonable to produce them in parallel. In some parts of Italy, every kilogram of steam coming out of wells contains 150-700 mg of boric acid. One of the local hydrothermal power plants with a capacity of 4 MW consumes 20 kg of steam per second, so the bar acid mining industry there is set up in parallel.

Problems of Geothermal Energy

As noted above, geothermal power plants do not generate additional toxic waste, but only emit less carbon dioxide than gas-fired power plants. However, this does not mean that groundwater and vapors are always pure substances similar to mineral drinking water. The vapor-water mixture in the earth's crust is saturated with gases and heavy metals specific to a particular region of the earth's crust. For example: lead, cadmium, arsenic, zinc, sulfur, boron, ammonia, phenol and others. A mixture of such active substances flows through pipes to a geothermal power plant, the addition of which to the atmosphere or water bodies leads to a local environmental catastrophe [3, 5, 6].

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