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ANALYSIS OF SOLAR THERMAL SYSTEMS

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Annotation

Today, renewable energy sources are widely used to meet the demand for thermal energy. This article presents an analysis of today's perspective projects of solar heat supply systems.

Key words

solar radiation, solar house, solar heating systems, hot water supply.

Systems based on the use of solar radiation energy for heating and hot water supply are called solar heat supply systems. The term "sun house" first appeared in the 1930s in the United States, when large south-facing windows were used to allow the sun's low winter rays to enter the room. Since then, scientific and practical research is being conducted on the use of solar energy for heating and hot water. Research in this field began to develop widely in the 60s and 70s as an alternative energy solution to energy and environmental issues.

Currently, a lot of experience has been accumulated in the world practice of using solar energy for heating and providing hot water to residential, public and industrial buildings, and the main theoretical, technical and architectural problems have been solved. "Solar houses" are used in many countries. The largest number of facilities with solar heating systems are used in the USA, France, Germany, Israel, Japan, China, India and other countries. Effective projects in this field have been developed and are being used in our republic.

The effectiveness of the practical use of solar energy for heat supply is based on the following principles:

1) Connection to a specific object, taking into account its function, structural, construction and architectural features;
2) Specific characteristics of heat load, radiation-climatic and geographical conditions;
3) Economic and technical capabilities, availability of other energy sources;
4) Possibilities of using combined, alternative heat supply systems;
5) Social and household conditions, national and local traditions.

Regardless of the number of types of solar heating systems, they can be divided into two groups, i.e. passive and active groups .

Solar energy is the greatest resource available to mankind. Like other stars, the sun is a superheated gas. Its composition consists of 82% hydrogen, 17% helium and 1% other elements. In the center of the Sun there is such a high-pressure zone that the temperature there is 15-20 million degrees Celsius. One of the biggest problems with using solar energy is that most of the energy is generated in the summer , and the highest energy demand is in the winter.

Modern techniques and technologies open the prospects of using renewable energy sources. Directing scientific and practical work in this direction will help to reduce the consumption of organic fuel.

Sunlight is all the light and various energies that come from the sun. The electromagnetic spectrum separates the different types of light waves emitted from the sun. They are like the waves you see in the ocean , moving up and down, from one place to another. The spectrum of solar research can be of different intensity .

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passing through the atmosphere and located on the Earth's surface provides energy in various forms. Check out the different ways to transfer it for comparison :

1. Conduction is the transfer of energy from direct contact.
2. Diffusion is the transfer of energy through a current in a liquid . It can also be a gas , but the process is still the same. When a liquid is heated, the molecules change , spread out and become less dense, so they rise. After cooling, they gather again and form a cellular flow path [1].

3. When energy is transmitted in the form of electromagnetic waves . Think about how nice it is to sit by the fireplace and feel how the pleasant warmth from it radiates to you - this is radiation. Radio waves are light and can travel from one place to another without the aid of any material.

Solar energy is light and heat. Contents:

- 6-7% UV rays
- 42% k ' visible light rays
- 51% infrared rays

Uzbekistan, solar energy comes with an intensity equivalent to 1 kW per hour per square meter. Almost half of the radiation is in the visible short-wave part of the electromagnetic spectrum. The other half is in the near-infrared and a little in the ultraviolet [2].

The rapid development of solar energy all over the world has aroused great interest in this field. Over the past 10 years, state support policies have enabled the start-up of the photovoltaic industry in Ukraine and the achievement of large volumes in terms of total installed capacity. Thus, at the beginning of 2021, almost 7 GW of solar power plants were installed across Ukraine. In addition, the share of large commercial systems was about 89% of this capacity [3].

Solar energy technologies are constantly being developed and improved. There are many different configurations and differences in the solutions that have been used and are being used to generate clean solar electricity . We will focus only on solar power plants based on the principle of direct photovoltaic conversion of solar radiation energy into electrical energy, and we will discuss technologies such as concentrator (tower, plate, parabolic, electricity-based) of solar power plants. We will explore Sterling Engine, Thermal Solar Collectors and more.

According to the method of placement of solar modules, all photovoltaic systems are divided into the following types [4]:

- Rooftop solar power plants (located on flat, roof and other types of roofs)
- Facade solar power plants
- BIPV solar power plants
- Sun sheds and parking lots
- Floating solar power plants
- Mobile (portable) solar power plants

show the most common options for installing solar panels, on the Types of Solar Power Plant page. By the end of 2020, surface solar power plants will be built mainly in Ukraine with the placement of photovoltaic modules at a fixed angle, which will allow for the largest generation of electricity in one year. Due to recent regulatory and legislative changes in our country, rooftop solar power plants are gradually becoming more popular. The segment of commercial rooftop solar power plants, which are used by enterprises in various business sectors to replace part of their electricity consumption, is particularly promising [5-7].

According to monitoring systems of solar power plants, they are divided into the following [8]:

- Stationary solar power plants with solar panels on stationary supporting structures
- Sun-tracking solar power plants mounted on single-axis solar trackers with a variable tilt angle relative to the Earth's surface (the tilt angle of the solar PV modules is automatically or

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mechanically adjusted several times a season)

• Sun-tracking solar power plants mounted on single-axis sun trackers of the "East- West " type (the tilt angle of the solar PV modules is automatically adjusted during the day)

• Sun-tracking solar power plants in two-axis solar trackers (inclination angle and azimuth of solar PV modules are automatically adjusted during daylight hours)

Photovoltaic systems are divided into the following types according to the possibility of working together with existing electrical networks (parallel) [9]:

• Grid solar power plants (can be built on the basis of both wired and central solar inverters)

• Autonomous solar power plants of alternating current (AC)

• Autonomous solar power plants of direct current (DC)

• Hybrid and off-the-shelf solar power plants

• Solar-diesel hybrid power plants

The main options for how solar energy solutions work in relation to the electricity grid can be different. Grid-type solar power plants are the most common type of grid-type solar power plants, which can operate at 0.4 kV internal grids without electricity flow to the external grid and transmit all the energy generated in the grid at high voltage. In some cases, buildings and structures have solar power plants that are connected to their internal power grids and run to meet their own electricity needs. In some cases, selling the produced electricity to other consumer companies, and at the same time, the production of electricity with the help of solar panels is often geographically separated from the consumption and requires additional transportation to the required distance [10].

According to the type of technology used to convert solar energy into electricity , photovoltaic systems are divided into [11-15]:

• Crystalline silicon solar power plants (the most common are solutions based on monocrystalline and polycrystalline silicon solar modules)

• Solar power plants in amorphous silicon

• Thin film solar power plants based on CdTe compounds

Depending on the design of solar panels, the following systems are distinguished:

• One-way solar power plants (on the roof and on the ground)

• Double-sided solar panels

• Transparent solar power plants (often used as BIPV solutions)

of application, photovoltaic systems are divided into the following:

• Solar power plants at home

• Commercial solar power plants

Depending on the method of further use of the produced electricity, photovoltaic systems are divided into [16]:

• solar power plants for sale of produced electricity according to the "green" tariff b ' (depending on the peculiarities of local legislation, both all produced energy and the difference between produced and consumed electricity can be sold)

• solar power plants to sell generated electricity using an auction system

• Solar power plants that generate electricity for their own consumption, without selling excess energy to the grid [17].

• Balancing solar power plants turn, commercial photovoltaic systems are divided into the following types

• Solar power plants for industrial enterprises

• Solar power plants for rural enterprises

• Solar power plants for logistics enterprises

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- Solar power plants for shopping and entertainment centers
- Solar power plants for restaurants
- Solar power plants for hotels
- Solar power plants for offices
- solar power plants for residential buildings and structures
- Solar power plants for service stations and gas stations
- Solar power plants for greenhouses

The use of solar energy technologies for business and home is the most common . Solar panels are widely used in industry, agriculture, commerce and many other areas of the economy, as well as in the private sector. For decades, solar technology has been able to generate cheap and clean electricity and significantly reduce recurring utility bills. The profitability of investments in a solar power plant depends on various factors, the most important of which is the market value of electricity produced using conventional, exhaustible energy sources. Every year, the attractiveness of building a solar power plant is increasing, and the payback period is decreasing. Solar power plants. Currently, most countries use solar energy for heating, and very few countries have wind generators as a source of electricity. At the same time, 2·1017 W of sunlight reaches the earth. This is 30 thousand times more than all the energy used by mankind on earth. Solar photovoltaic panels placed on the roof of the building of the pumping station differ mainly in two ways of using solar energy: physical and biological [18].

In the physical version, solar energy is focused through special windows and installed in collectors or accumulated using semiconductor solar cells. In the biological option, organic substances (usually wood) are produced in the process of photosynthesis from solar energy collected in plant tissues [19].

This option is convenient for countries with large forest reserves. For example, in Australia, in the coming years, it is planned to cover 35% of the total income for the generation of thermal energy by burning the fuel oil to produce pistachio coal or to sell it completely. For such purposes, Great Britain has 1 million unfit for agricultural crops. He is building a forest on a hectare of land . In order to achieve the goal in the short term, special varieties of poplar with fast growth characteristics are being planted. These poplars grow to a height of 4 meters in 3 years, and the stem thickens to 6 cm. In recent years, the problem of using renewable and non-conventional energy sources has become urgent. Although these technologies require a large amount of money, they offer great benefits [20-24].

In February 1983, the world's first American company "Arka Solar" started using a solar power plant with a capacity of 1 MW. Electricity produced in solar power plants is much more expensive than electricity produced in conventional power plants. For example, if a solar power plant capable of supplying 10,000 household consumers with electricity (with a capacity of 10 MW) is built, it will cost an average of 190 billion. dollars spent. It is four times more expensive than a solid fuel thermal power plant and three times larger than a nuclear or hydroelectric power plant. But despite this, according to the experts conducting research on solar energy, with the development of solar energy technologies, the prices will also decrease. It is very likely that the future of energy will be based on solar and wind energy.

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