UDC 004

SOLAR COLLECTOR CONTROL SYSTEM

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Flat and vacuum collectors of solar energy, their types and design and technical features are considered. The characteristic of basic parameters of basic elements of the device are presented. The main advantages and disadvantages of various types of solar energy collector designs are highlighted. The existing control system of the solar collector is analyzed. The prospects for the development of alternative sources of electrical energy, including wind, solar and water are considered. The article provides statistics on different countries and data from various sources on the current state of this area. The necessity of changes in the production of electricity is shown. The research results can be used to develop a solar collector control system.

Introduction. In connection with the development of production technologies and a significant deterioration of the ecological situation in many regions of the globe, humanity faced with the problem of finding new sources of energy. This formulation of the question led to the search for so-called alternative energy sources that meet the above requirements. Through the efforts of world science many such sources have been discovered. At the moment most of them have already been used more or less widely.

There are the following types of alternative energy sources:

– Energy of sun;
– Wind energy;
– Bioenergy;
– Tidal energy;
– Thermal energy of the Earth;
– Energy of atmospheric electricity and thunderstorm energy.

Helioenergetics is a branch of economy associated with the use of solar radiation for energy. Solar energy uses an inexhaustible source of energy, does not cause harmful waste and is environmentally friendly. There are various ways to convert solar radiation into heat and electricity. One such method is the use of a solar collector.

A solar collector is a device for collecting solar thermal energy carried by visible light and near- infrared radiation. By type of design, flat and vacuum solar collectors are most common in solar heating systems. Each of them has certain advantages and disadvantages that must be considered when designing control systems. Simple and cheap to make flat collectors consist of an element that absorbs solar radiation (absorber), a transparent coating and a heat-insulating layer. A collector of this type is capable of capturing direct and diffuse radiation and is usually installed permanently on the roof of a building.

Advantages of a flat solar collector:

– a large area of the absorber;
– low cost, ease of manufacturing;
– the possibility of implementing the mode of despotic defrosting of fallen snow by passing a hot heat carrier through a solar collector for several minutes;
– the ability to capture both direct and diffuse radiation;
– stationary installation without the use of solar tracking devices;
– the cost of solar installation can be significantly reduced by combining the roof structure with a flat solar collector.

Disadvantages of a flat solar collector:

– the fragility of the translucent sheet coating;
– low efficiency at high temperatures of the absorber;
– the possibility of coolant freezing in winter;
– low operating temperature (maximum operating temperature of the coolant (without stagnation) does not exceed 100 ºC);
– corrosion.

A vacuum solar collector consists of so-called heat pipes and resembles a thermos in its structure.

The outer part of such a tube is transparent, and on the inside of the tube a highly selective coating is applied effectively capturing solar energy. Between the outer and inner glass tube there is vacuum. Inside the tube there is a low boiling liquid or coolant.

Advantages of a vacuum tubular solar collector:

– high operating temperature;
– high efficiency;
– no probability of freezing (for condensed steam);
– the ability to capture both direct and diffuse radiation;
– stationary installation without the use of solar tracking devices;
– no conditions for corrosion.

Disadvantages of a vacuum tubular solar collector:

– the fragility of the translucent sheet coating;
– small absorber area;
– the ratio of the aperture area to the total area of a flat solar collector;
– high price;
– the impossibility of implementing the mode of despotic defrosting of fallen snow without the introduction of additional systems.

The principle of operation of the solar collector control system. Control systems are applied to increase efficiency and improve solar collector's work. A solar thermal microcontroller is a mandatory element of a solar system with despotic circulation of a coolant. The main purpose is to control the process of heating the coolant from the sun and the state of the solar heating system. The controller receives information from temperature sensors installed at the output of the solar collector in the storage tank and regulates the operation of the circulation pump.

There may be two or more temperature sensors. In addition to the standard functions, the controller can control the heating system. The efficiency and safety of the solar system largely depends on the controller: the correctness of the inherent algorithms of the solar system, the reliability of the elements.

The main advantages of microcontrollers are:

– Automatic control of the flow rate of the circulating pump: regulation of the flow rate of the coolant in the system circuit depends on the temperature difference between the solar collector and the storage tank.

– Stable operation of the solar system and a rapid achievement of set temperatures. By increasing the operating time of solar systems in morning and evening hours and in cloudy weather, additional heat energy generation is provided.

– Minimization of solar system electricity consumption by reducing the power consumption of the circulating pump.

– The possibility of using in systems for various purposes (heating, pool heating) due to versatility of controllers.

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