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THE USE OF SOLAR ENERGY IN HEAT-MOISTURE PROCESSING SYSTEMS (EXAMPLE OF HELIOGREENHOUSES)

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Annotation: The article presents how the system of helioheating for processing heat-humidity into the air introduced into the greenhouse and the results of the experimental study are presented. A combined heat-moisture treatment system with a solar collector is proposed in which the air is heated, cooled and humidified, and serves to heat and irrigate the greenhouse from below ground.

Keywords: air humidification, air temperature, solar collector, solar greenhouse, solar radiation, temperature mode.

Globally, the cost of traditional energy has been steadily increasing due to the dwindling of hydrocarbon fossil fuel reserves. The analysis of energy strategies of developed countries shows that they pursue public policies by increasing energy efficiency, saving traditional energy resources, diversifying the structure of fuel and energy balance through the development of renewable sources (RES), and introducing innovative energy-saving technologies in various sectors of the economy.

The use of renewable energy sources is becoming increasingly important in the world, as traditional energy sources (coal, oil, natural gas) are limited and their use in heat and electricity generation is causing great damage to the environment. In this context, solar energy, which is used to generate clean heat and electricity for the environment, is becoming increasingly important. The use of solar energy for heat supply allows replacing from 20 to 60% of the heat load of agricultural facilities, depending on the climatic location. Now the energy intensity of growing fruits and vegetables in greenhouse complexes is very high, even in conditions of Central Asia. More than 50% of all operational costs are applied through the heat supply to greenhouses.

In order to provide the population with highly efficient vitamin products, agricultural protected land facilities are being built, and new modern energy-saving greenhouse complexes are being built to reduce the energy intensity of greenhouse products. The country's leadership has set tasks on development and implementation of energy-efficient greenhouse complexes based on solar installations [3]. Therefore, the creation of greenhouse complexes and protected ground structures with solar heating systems is a scientifically and technically urgent task.

Heat and humidity purification systems (HWS) in greenhouses are used to heat, cool and humidify the internal air and create the required thermal maintenance regime. The use of TVs in greenhouses allows you to regulate the temperature and humidity in the air. Creating

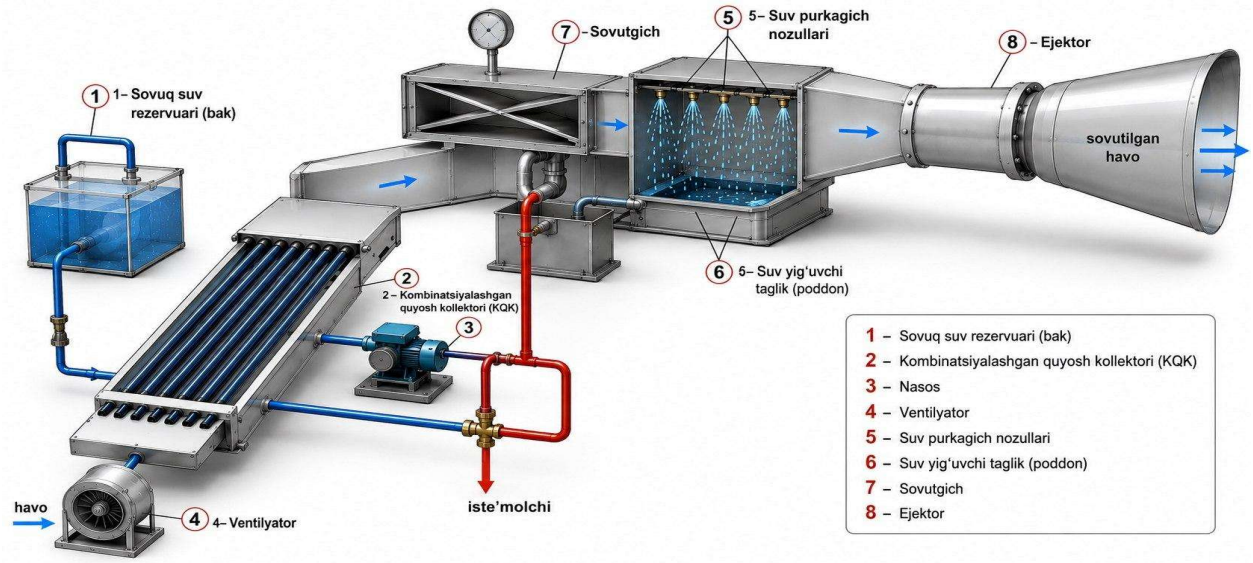
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optimal temperature and humidity regimes of ventilation systems and greenhouses requires a certain consumption of energy and water resources. The application of the TVOV system in greenhouses also solves the problems of removing overheating.

In practice, evaporation and humidification systems are used in the spring (March-May) in greenhouses to eliminate overheating and to humidify the air. Structurally, these systems are manufactured similarly to a sprinkler system, i.e. water spraying with a nozzle using the sprayer of precipitation. The intervals between feedings depends on the intensity of solar radiation. During the operation of this system, the air temperature in the greenhouse can be lowered to 2-4 ^{0C} and the temperature of the plant leaves to 10-12 ^{0C}. However, this system does not allow air heating and is dependent on traditional energy sources.

There is also a well-known device for air-water evaporation system for heat and moisture purification, designed by M.S. Ilyushin. The proposed system consists of a centrifugal ventilator, an irrigation chamber with a nozzle, an ejector and a gas burner. The disadvantage of this system is that natural gas is burned in the device of the gas stove, which is not always available and is harmful to the environment.

Figure 1. Solar heating system for heat and humidity treatment in greenhouses



1 - cold water tank (tank), 2 - combined solar collector (CSC), 3 - pump, 4 - ventilator, 5 - nozzles, 6 - pan, 7 - cooler, 8 - ejector.

Based on the above shortcomings, in order to save traditional fuels and energy sources from renewable energy sources, we have developed a solar heating system (HFS TVOV) to purify heat and moisture and proposed to provide thermal engineering mode for greenhouses.

The proposed system (Figure 1) consists of a cold water tank 1, an integrated solar collector 2, a water pump 3, an air fan 4, an irrigation chamber (nozzles 5), an air cooler 7, and an ejector 8.

The proposed installation uses an integrated solar collector (CSC) that simultaneously heats water and atmospheric air. The proposed system will be used for heat and humidity treatment of the supply air to the greenhouse which provides air heating, cooling, drying and humidification, and also for underground heating and irrigation of the greenhouse with hot water is available.

In the mode of heating removal, water from KSK 2 is delivered to the watering chamber through the pump 3, and the nozzles 5 are cut with a saw, cooled in an adiabatic process, the cooled air mixture enters the ejector 8 and is successfully combined with a strong

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heat and mass exchange between the air and the water. Then the cooled air enters the inside, thereby maintaining the required humidity regime of the greenhouse. In the air heating mode, the water pump 3 and the cooler 7 are turned off, the heated atmospheric air enters the greenhouse in the ICS and maintains the temperature mode. Thus, the STS TVOV developed by us provides significant savings in traditional energy resources (natural gas, coal, firewood) in greenhouse complexes and the cultivation of environmentally friendly products.

The main structural element of the proposed system is the CSC. To determine the parameters of CSC, a thermal engineering calculation was performed using the following method [8,9].

KSC is a combined version of an air and water solar collector, each of which heats air and water at the same time. The efficiency of a solar air collector (ICS) is η, i.e., the ratio of the amount of useful energy received in the collector to the amount of energy from solar radiation on the surface of the ICS absorber, and is determined by the following formula [8,9]

$$\eta = \frac{Q_{пол}}{Q_p} = \frac{Q_{пол}}{q_p^{\Sigma} \cdot F_{кол}}, \qquad (1)$$

where the amount of useful energy is W; - The amount of solar energy coming to the surface of the ICS, W; - the total radiation intensity on the surface of the ICS; - the radiation-receiving surface of the ICS,

$$Q_{пол} Q_p q_p^{\Sigma} \frac{Вт}{м^2} F_{кол} м^2$$

The useful thermal energy (heat output) of the ICS is equal to,

$$Q_{пол} = G_w \cdot \rho_в \cdot c_p \left(t_{в2} - t_{в1}\right), \ Вт \qquad (2)$$

Bulky airflow here, ; - air density; - a special isobaric heat capacity of air; and that's the inlet and output, and the air temperature in the ICS. $G_w \frac{м^3}{сек} \rho_в \frac{кг}{м^3} c_p \frac{Дж}{кг \cdot с} t_{в1} t_{в2}$

Thermal balance of ICS.

$$Q_p = Q_{пол} + Q_{пот}, \qquad (3)$$

or

$$q_p F_{кол} \cdot \alpha_п \cdot \tau = Q_{пол} + Q_{пот}, \qquad (4)$$

here

- $\alpha_п$ absorption capacity of the absorber, - transparent barrier (glass) permeability; – ICS heat energy losses, W.$\tau Q_{пот}$

Heat loss is determined by the following formula,

$$Q_{пот} = Q_{кон} + Q_{рад} + Q_{конд}, \text{ W} \qquad (5)$$

where $Q_{кон}$ — loss of heat energy through convective heat exchange, W; — value of radiation losses, W; – loss of thermal energy through thermal conductivity, W. $Q_{рад} Q_{конд}$

If we consider it equal to the total heat transfer loss, then$Q_{пот}$

$$Q_{пот} = Q_0, \qquad (6)$$

or

$$Q_{пот} = k \cdot F_{общ}(t_{ср} - t_{ос}), \qquad (7)$$

Here is the coefficient of heat transfer ; - the total area of heat exchange with the environment; - Average air temperature inside the ICS; - Ambient temperature, $k \frac{Вт}{м^2 \cdot °C} F_{общ} м^2 t_{ср} °C t_{ос} °C$

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Computational and experimental studies to determine the thermotechnical parameters of ICS were performed according to the popular method [8,9,].

The experiments measure the total intensity of solar radiation, wind speed, outdoor air temperature, air temperature at ICS inlets and outlets, and airflow. The total intensity of solar radiation is measured with an actinometer and the airspeed is measured with an anemometer. The KSP-4 package uses XK thermometers for measuring temperature.

The results of the computational and experimental studies are presented in Figures 2, 3, and 4.

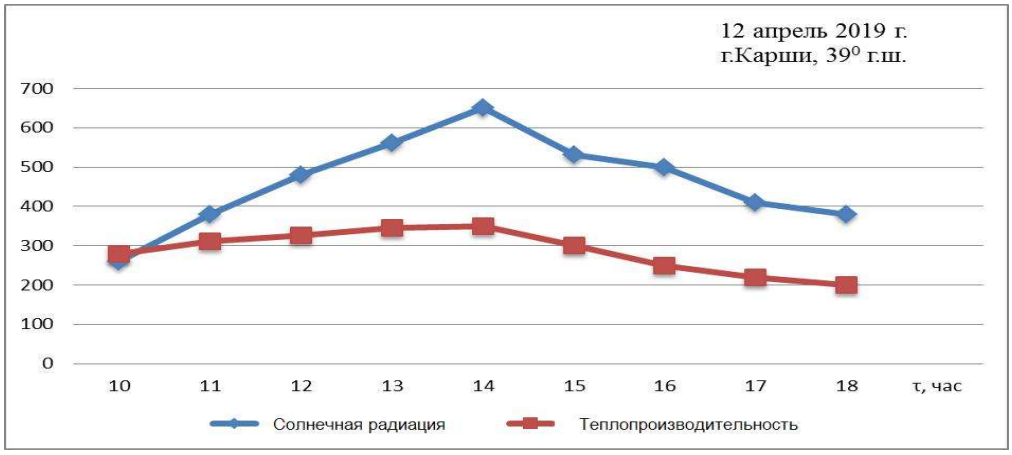


Figure 2. Dynamics of daily variations in total solar irradiation and heat capacity of CSC (through airborne).

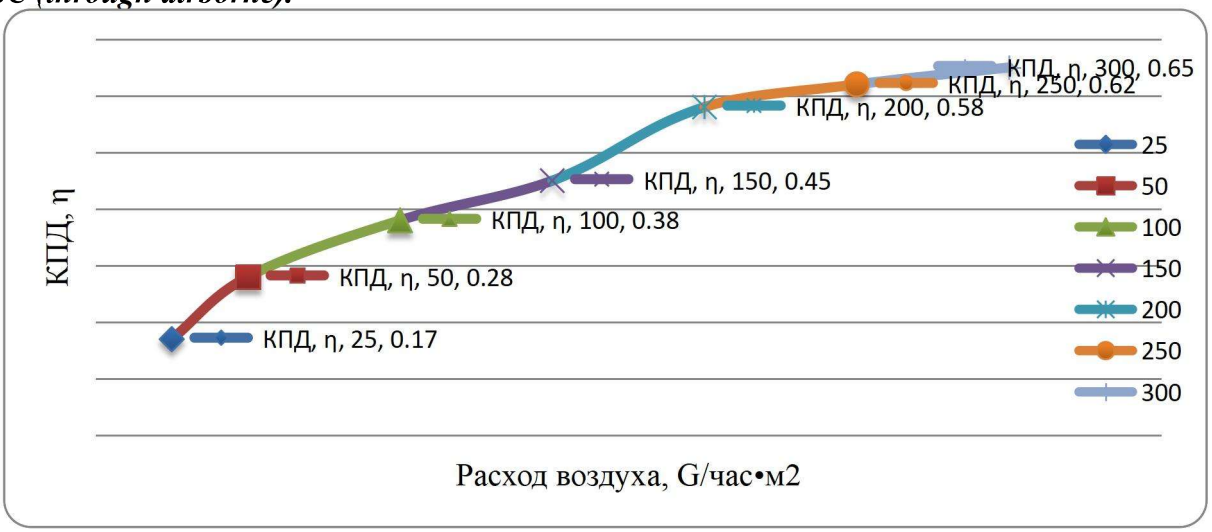


Figure 3. The variation in the effectiveness of the CCP depends on the rate at which the air is being pumped (through the air).

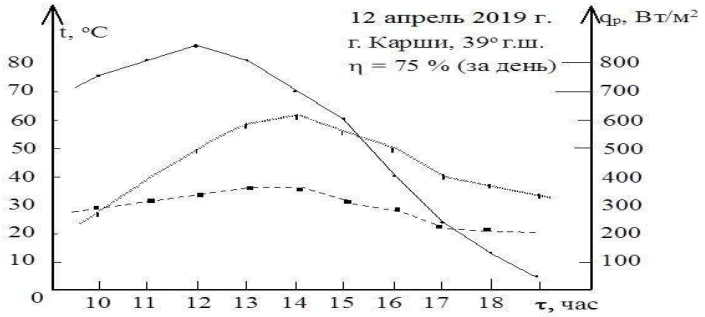


Figure 4. The daily water heating process in SC depends on the outside temperature (tnv) and total solar radiation (qp).

▌ - Variation of water temperature at SC outlet; ■ – temperature variation; ● – Changes in general solar radiation.

Conclusions

An analysis of the experiments and data is presented in Figure 2. and 3 of the proposed KSC TVOV solar heater systems will allow for supply air and water heating at the same time.

Under karshi conditions, the total annual amount of solar radiation on the horizontal surface is 4320-5000. Analysis of climate data shows that Karshi radiation, heat, and humidity conditions allow for the efficient use of solar energy in heat and moisture purification systems in solar greenhouses. $\frac{МДЖ}{м^2}$

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