ABOUT THE USAGE OF HELIO-SYSTEMS IN HEAT SUPPLY SYSTEMS ON FOOD MANUFACTURING FACILITIES

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Abstract: The article considers the possibility of introduction of helio-installations into the hot water supply system for primary heating of the product water. The calculation and selection of the SC (solar collectors), which are offered for introduction into the hot water supply system of a food manufacturing facility has been performed, taking bakery plant as an example.
Key words: solar collector, helio-installation, intensity of solar radiation, heat carrier, efficiency factor of SC, accumulator tank.

The existing tendency to the depletion of fuel and energy resources, rising prices for energy production and global environmental problems stimulate the need to implement the energy-saving technologies based on renewable ecological sources of energy. This is the area, on which the international programs INTAS and TASIS are focused. Interest in non-traditional forms of energy (NFE) is caused by the negative tendencies in the development of traditional energetic, based mainly on two factors: the rapid depletion of natural resources and the environmental pollution [3,4,5]. One of the technologies allowing to reduce fuel consumption and CO_2 emissions is the production of low-grade heat from solar energy.

In this work we consider the possibility to change a hot water supply system of the joint-stock company "Mariupol Bakery Plant" with a standard steam boiler to a mixed solar system of heat supply. According to the calculation, 1/4 of technological expenses of the bakery plant are spent on the boiler. At that we should remember the environmental aspect: boilers operate on natural gas - an exhaustible resource, which cannot be renewed.

In order to provide energy for technological needs, heating, ventilation and hot water supply of the concerned bakery, a boiler room was designed and commissioned as a part of the main building. The boiler room is currently equipped with two steam boilers of grade E-1.0-0.9Г-3 (one of them is doubling) with heating surface 31,6m^2 each and steam capacity 1,0 t/h. Natural gas is taken as a fuel, the estimated fuel consumption of this boiler is 83,5 m^3/h. One boiler in addition to other consumers supplies steam to heat exchanger, which is housed in a tank of hot water 16,2 m^3 in capacity.

After performing of the analysis of the construction of all solar collectors (SC), their advantages and disadvantages, as well as of the recommended area of application, we chose the plane one-glass liquid solar collectors of type SV1. Their efficiency depends on the meteorological conditions, working mode - temperature and heat consumption.

Calculation and selection of the SC was performed basing on the methodic described in [1], taking July as the month with the largest total solar radiation.

The results of the calculations show the following indices: the total area of SC F =72 m^2, effectively working area of collectors F_{ef}=67,5 m^2, the value of heat carrier temperature on the outlet of collector t_{out}=50°C.

The total coefficient of efficiency of the solar collector is determined by the formula:

$$\eta = 0{,}8\left[\theta - \frac{iU\left[0{,}5\left(t_{OUT} + t_{IN}\right) - t_O\right]}{\sum_j q_{red,j}}\right],$$

where: 0,8- is a coefficient, considering dusting and shading of the SC; θ - is an optical efficiency factor of the SC [1, tab.5.1]; U- is a coefficient of loss, W/(m^{2}K); $\sum_j q_{red,j}$ - sum of time intensity of solar radiation (heat flow density) with the highest total radiation over the entire monthly period of operation, W*h/m^2 ; t_{in} – is a temperature of heat carrier on the entrance of SVN, °C; t_0 – environmental temperature, °C; *U* — reduced heat transfer coefficient of SVN, W/m ^{0}C;

Then,

$$\eta = 0{,}8\left[\theta - \frac{14 \cdot 8\left[0{,}5 \cdot (50 + 25) - 26{,}5\right]}{6960}\right] = 0{,}47$$

The scheme of the offered mixed solar system of hot water supply is shown on the picture.

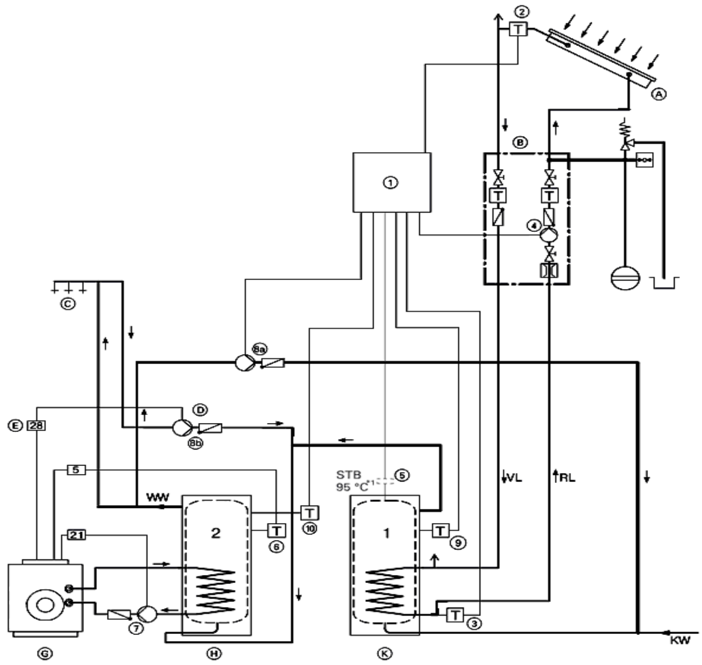

Fig. 1 Scheme of the mixed solar system of hot water supply: A – solar collector; B – pumping assembly of the collector circuit Solar – Divicon; C - water-supply points; D – circulation pipeline; E – outlet of the circulation pipeline on the controller or timer; G – steam boiler; H – hot water tank – 2; K - hot water storage heater – 1; (1)- controller; (2)- collector temperature sensor; (3)- hot water storage heater temperature sensor; (4)- circulating pump of the solar installation circuit; (5)- safety temperature restrictor; (6)- hot water storage heater temperature sensor; (7)- circulating pump of the hot water storage heater circuit; (8a)- transfer pump; (8b)- circulating pump for hot water storage heater; (9)- sensor in hot water storage heater 1; (10)- sensor in hot water tank 2.

Thanks to the use of a mixed system of solar hot water supply with forced circulation we reduce the consumption of gas by the steam boiler without reducing the volume of hot water supply for the production. Plane one-glass solar collectors VITOSOL of type SV1 made by the German company VIESMANN provide the pre-heating of water to $\Delta t = 25^{o}C$ (previously t_{in}=20°C, currently t_{in}=45°C), which further feeds the hot water tank. As the hot water storage heater we have chosen the accumulator tank Vitosell-B 100 by the German company VIESSMANN. It allows to save about 10 minutes in the average of every hour of boiler work, thereby reducing the consumption of natural gas. This also reduces the time of water heating in the hot water tank.

The reasonability of improvement of hot water supply on the bakery plant is confirmed by the economical calculations and the act of implementation.

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