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Makhmudova Marjona Makhmud kizi

1st year doctoral student at Bukhara State University

EFFICIENCY OF IMPLEMENTATION OF SOLAR COLLECTORS

Abstract. The article examines one of the ways to increase the energy efficiency of a building by using solar energy using a specific building in Bukhara as an example. It provides an assessment of the economic efficiency of using solar collectors to obtain thermal energy for hot water preparation in comparison with thermal and electrical energy.

Keywords: Bukhara city, solar collector, energy saving, energy efficiency, economic efficiency.

INTRODUCTION

One of the global problems of our time is the provision of humanity with resources, in particular energy. As the population grows, the number of energy-consuming installations also increases, while the natural energy resources of our planet do not have time to be replenished. Recently, in Uzbekistan, there has been increasing talk about reducing energy consumption by increasing energy efficiency. The main step aimed at a comprehensive solution to the problem of energy efficiency [1].

MATERIALS AND METHODS

One of the ways to solve the problem of rational use of resources is alternative energy sources. This article examines the active use of solar energy for the purpose of converting it into heat. The experience of many countries shows that alternative energy sources can be effectively used in various sectors of the economy. According to the report, there is a steady increase in the use of alternative energy sources. Solar energy consumption in terms of gross level is less than wind and hydropower, but the growth rate of its use is higher.

Systems using solar energy are very diverse in terms of the volume of energy generated and design features. These systems can be effectively used together with traditionally used heat supply systems. The article studies the use of solar energy for a relatively small object. This experience can be extended to a number of objects, such as resorts, sanatoriums and other medical and preventive institutions located in recreational areas, where the use of local boiler houses can lead to negative consequences. The solar collector system does not lead to deterioration of the aesthetic appearance of buildings, the energy obtained is environmentally friendly.

RESULTS AND DISCUSSION

For the conditions of Bukhara, a solar water heater with a vacuum collector was selected. This type is quite effective, although it is one of the most expensive. The solar water heater consists of an external unit, which is represented by vacuum collectors, and an internal unit consisting of a heat exchanger tank. In these systems, the collector coolant is usually water-glycol antifreeze. Heat exchangers transfer high temperatures from the primary coolant to water in tanks (heat accumulators). Closed-loop systems are widely used in areas with long-term negative temperatures, since they have good protection against defrosting. Due to the high temperatures during stagnation of the coolant during periods of maximum irradiation, a number of antifreezes are not suitable for use in solar systems.

Solar collectors convert direct and diffused solar rays into heat. Evacuated tubes are coated on the inside with a selective coating in several layers and a reflective layer. This coating ensures efficient energy absorption. The efficiency of the selective coating is measured by the absorption

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coefficient (α) of solar energy, the relative emissivity (ε) of long-wave thermal radiation and the ratio of the absorptivity to the emissivity (α/ε). An evacuated solar collector absorbs direct and diffused solar radiation in any weather. The energy absorption coefficient of collectors can reach 98%, but due to losses associated with the reflection of light by glass tubes and their incomplete light transmittance.

Due to the use of heat pipes in the design of vacuum collectors, higher efficiency is achieved when operating in low temperatures and low light conditions. At the same time, the use of an additional heat circuit leads to losses, therefore, at temperatures above +15°C, the efficiency of vacuum collectors is almost the same, and sometimes lower, than that of flat collectors. The presence of high-quality multilayer highly selective coatings and vacuum allows a modern solar collector to capture and transmit solar energy in a very wide radiation spectrum. For efficient operation, it is necessary to take into account a number of factors during installation and operation. Solar collectors are installed on the roof of buildings at an angle to the horizon equal to the geographic latitude of the area. The optimal angle of inclination in winter is 60°, in summer - 30°. The second parameter is the azimuth, which should not deviate from 0° (southern direction). Since there are architectural planning restrictions, a deviation from the southern direction of up to 45° is allowed.

Since the solar heater cannot be switched off, during periods of maximum solar radiation and low water consumption the temperature (stagnation temperature) in it can reach 300°C. Therefore, copper or stainless steel pipes should be used as piping for water heaters. It is also necessary to provide thermal insulation of the first circuit of the piping for water heaters to prevent burns and fires. The material of thermal insulation and fasteners must correspond to the specified temperature conditions. The stagnation temperature for a given model range is indicated on the collector housings.

The system primarily provides the load of the DHW boiler, with an intermediate coolant SSH (300 l) from solar collectors. When the DHW boiler is fully heated, the automation controller switches the three-way mixer to load the buffer storage tank PSX-GWT (1000 l) to accumulate excess thermal energy and maintain the heating system of the pools. For this purpose, it is possible to use the existing heat accumulator. The calculation of the efficiency of heat generation due to solar energy depends on the specific model of the collector used, the amount of solar radiation in the given area and is carried out according to (1). The amount of heat is determined according to (2). The calculation results are given in Table 1.

Table 1

Heat energy savings by day of the month, kW/day, and by month of the year, kW/month

Month	Changing the temperature of heated water, °C.	Amount of heat from solar energy, kW/day.	Amount of heat from solar energy, kW/month
January	15	31,78	985,33
February	23	48,74	1364,64
March	35	74,16	2299,12
April	43	91,12	2733,51
May	45	95,35	2956,00
June	49	103,83	3114,93
July	48	101,71	3153,07
August	39	82,64	2561,87
September	29	61,45	1843,53
October	18	38,14	1182,40
November	15	31,79	953,55
December	11	23,31	722,58

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When assigning the calculation horizon, the service life of the system of 15 years and possible changes in the field of development of alternative technical solutions are taken into account. The reliability of the forecast of the economic situation for energy resources is ensured by statistical studies that show a steady increase in tariffs for thermal and electrical energy. The average inflation index for thermal energy received from heating networks is 1.21. The average inflation index for electrical energy is 1.10.

The economic effect of generating 23.87 MW/year of thermal energy is determined for a calculation horizon of 5, 10 and 15 years, taking into account inflation in energy resources and discounting of capital costs. The discount rate is 0.12. For options that have income within the calculation horizon, the payback period is determined taking into account discounting.

CONCLUSION

The results of the study show that installations using solar energy for heating water with a vacuum collector pay for themselves over a significant calculation horizon. The payback period is commensurate with the service life of solar collectors specified by manufacturers.

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