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Analysis Of Scientific Research On The Use Of Renewable Energy Sources In The Heat Supply System

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ABSTRACT

The article analyzes the results of research conducted by scientists from foreign countries and schools of Uzbekistan on the use of solar energy in the heating systems of residential buildings and sectors of the economy. As a result of a brief analysis of scientific research, it is stated that there are problems with combined heat supply systems operating on the basis of solar energy in natural conditions that are suitable for the climatic conditions and solar energy potential of the southern regions of the country.

KEYWORDS

Renewable energy sources, solar energy, heat, concentrated solar energy, hot water floor, combined heat supply system

INTRODUCTION

Currently, the heat and electricity consumed in our country is mainly due to natural fuel and energy resources, and the energy consumption of the economy is much higher than the average of developed countries. The country is implementing a long-term strategy for the development of the oil and gas, electricity, coal, chemical and construction industries, aimed at ensuring sustainable economic growth and increasing the welfare of the population, continuous satisfaction of demand for fuel and energy resources [1].

In developed countries, the use of solar radiation is becoming increasingly popular. In particular, large investments are being made in the construction of "solar houses". By obtaining heat and electricity from the sun, 50-90% savings of traditional energy sources in the energy supply of homes will be achieved. Taking into account the advanced foreign experience, the complex organization of work on improving energy efficiency through the use of available resources and untapped potential, the widespread introduction of energy-saving technologies and renewable energy sources, a sharp reduction in energy consumption in the economy and social spheres is a priority in the near future. The task is to reduce the energy and resource capacity of the economy, the widespread introduction of energy-saving technologies in production, expand the use of renewable energy sources, increase labor efficiency [1,2].

The rapid development of techniques and technologies in modern energy systems is characterized by its demand for the use of energy and resource-saving technologies. In the world, including in our country, the application of energy and resource-saving technologies in all sectors of the economy is one of the most pressing issues today. The main tasks are the creation and implementation of energy-saving technologies based on the use of alternative energy sources, especially the efficient use of solar energy. Scientific research on the efficient use of solar energy is being successfully carried out in many countries around the world, including the Middle East and Asia, India, Greece, Sweden, Germany, Japan, Korea and China. They focus on solar energy opportunities, current status, development strategies and prospects, the use of photovoltaic collectors, FPC, PVT and FPC photovoltaic heat pumps, reducing dependence on fossil fuels and developing solar energy policy to launch solar power generation [3, 4, 5, 6, 7, 8].

The research on the selection of the optimal energy supply system for heating individual houses using solar energy devices is based on the fact that solar energy heating is an efficient, inexpensive and positive environmental impact system [5]. In general, the differences in primary energy use, emissions, and prices between the power systems analyzed are less dependent on the fuel used in the system than on the type of system selected. This is because research facilities rely on sunlight as a heat source, unlike traditional energy systems.

N.K. Sharma, P.K. Tiuari, Y.R. Studies by the courts have shown that renewable energy and technology can provide a solution to the long-term energy challenges facing developing countries [3]. Solar energy not only adds new capacity to the country’s energy, but also improves energy security, solves environmental problems, and provides leadership in the renewable energy market. Solar thermal energy (STE) as well as concentrated solar energy (CSP) is a new technology of renewable energy and is one of the future options for electricity generation.

Using solar energy to heat buildings and structures is an alternative way to reduce electricity and fossil fuel consumption from the grid. E.B. Christos, Ts.K. Mosxos, K.A. In the research work of Antonopolos, four solar heat pump heating systems were developed, modeled, energy and economically evaluated as the optimal solution. The use of air heat pump photoelectric collectors has been compared with the use of FPC, PVT and FPC photoelectric heat pumps. The analysis of the impact on the cost of electricity is carried out taking into account the diversity of these parameters in recent years. According to industry experts, the use of an air PV heat pump is a sustainable economic solution when energy consumption is up to 0.23 € / kWh, and the possibility of connecting a heat pump PVT to a water source in case of high electricity costs is another advantage of the system. If the cost of electricity is 0.2 € / kWh, a 20 m2 surface PV system will cover the energy cost of running an air heat pump at 67% per year from solar energy [4].

M. Naxera-Trexo, I.R. Martin Domingus, J.A. The research goal of the Escobedo-Bretado study was to determine the cost-effectiveness of a solar heating system used for hot water and floor heating [5]. In this study, a two-story house was modeled to calculate the heat load. In this study, system design and thermal analysis were performed using the TRNSYS software. Feasibility study was performed using Microsoft Excel. The optimal type, number and capacity of solar heat accumulators are determined on the basis of economic indicators. The optimal configuration of systems with vacuum pipes is based on the fact that 8 flat-plate collectors with a storage capacity of 40 l / m2, so the flat plate system consists of 12 collectors with a capacity of 50 l / m2. It has been found that the payback period is 9 years for a flat plate system and about 11 years for a vacuum pipe system [5].

To combat the negative impact on the environment and other problems associated with fossil fuels, as well as to meet the growing demand for energy, many countries are focusing on the study and use of renewable, environmentally friendly energy sources [6]. Solar energy is one of the renewable energy sources that has the least negative impact on the environment. Various countries have developed solar energy policies to reduce dependence on fossil fuels and to regulate production using solar energy. K.H. A study by Solanj et al analyzed different ways of using solar energy in the world [6]. Based on the analysis of the literature, it was determined that FIT, RPS and benefits are the most beneficial energy policies implemented in many countries of the world. This policy provides significant motivation and interest in the development and use of renewable energy technologies. The state of solar energy policy for the countries of the Asian region has also been studied and compared with the developed countries of the world [3, 4, 5, 6, 7, 8].

In many European countries, the use of solar systems for heat supply of residential buildings is widespread. This is because the average value of direct and scattered solar radiation incident horizontally when analyzed based on the climatic conditions of European countries proves that solar energy can be used efficiently for heating purposes. Researcher of the National Technical University of Belarus M.A. In Rutkovsky's research, climate connections were analyzed to determine the efficiency of solar systems, and based on the results of experiments, project calculations of the solar energy use system were presented [7].

Some researchers have proposed a method of using solar energy in the energy supply of small-scale energy-efficient residential homes. For example, Ya.A. Kungs et al proposed a system designed to heat a house using geothermal energy, generating heat and electricity from sunlight. For residential homes, this system is efficient, with low capital and operating costs. However, the fact that the system requires a very large initial capital investment prolongs the payback period of the system and increases the cost of energy produced [8].

C.V. Starovoytov's research examines the prospects for the use of solar energy in the Rostov region of Russia. In the hot water supply system, energy consumption is covered by the accumulation of solar energy in tank-batteries. Seasonal and year-round utilization of solar energy has been evaluated and the efficiency of flat collectors in regional conditions has been assessed [9]. The main disadvantage of the proposed system is that the efficiency of the use of solar energy falling on the flat collector surface is not sufficiently substantiated and summarized.

N.D. Shishkin and R.A. Ilin's research [10] has evaluated the effectiveness of the integrated use of solar collectors and solar water heaters. High-efficiency solar collectors are shown as collectors that retain their high energy efficiency when the heat loss increases sharply (when the optical f.i.k. of the collector decreases from 0.93 to 0.63). In tests and experiments, the energy f.i.k. Based on the fact that 0.54 - 0.57 and this figure is not less than the f.i.c. increase [10]. The main drawback of the work was that the researchers were limited only to the results of the experiment, a mathematical model of the process was not constructed, an industrial model was made, and the experiments were not summarized.

Z.X. In Zamaleev's research, the heliothermal heat supply of buildings was calculated on the basis of regional climate indicators and quantitative analysis of solar energy [11]. To do this, the traditional heating system of the building is designed hot water supply. As a result of the introduction of solar energy into the system, the combined heat supply of the building was provided for 26 weeks, but it was also noted that solar energy could not be used in the heating supply of the region (Tatarstan region of Russia) in winter. Based on the results of the study, it can be said that in the northern regions, the possibilities of using solar energy in winter are limited and it is practically impossible to obtain the necessary thermal energy.

O.S. Popel's research has scientifically analyzed autonomous power devices based on renewable energy sources [12]. The systems proposed in them promote the use of renewable energy sources such as solar energy, wind power plants instead of traditional energy devices and fuel-energy resources for autonomous power plants. O.S. Popel’s work is primarily based on the study of devices based on renewable energy sources, as well as mathematical modeling of processes.

Scientific studies by scientists from France, Indonesia, and Bali have led to the design of a solar alternating current system that includes the storage of variable materials for regions with stable climatic conditions in the tropics [14]. The main focus of this study was on the use of photovoltaic cells to reduce energy consumption in air conditioning and the use of solar panels instead of electric batteries in the use of steam-compression air heating and cooling systems (Figure 1).

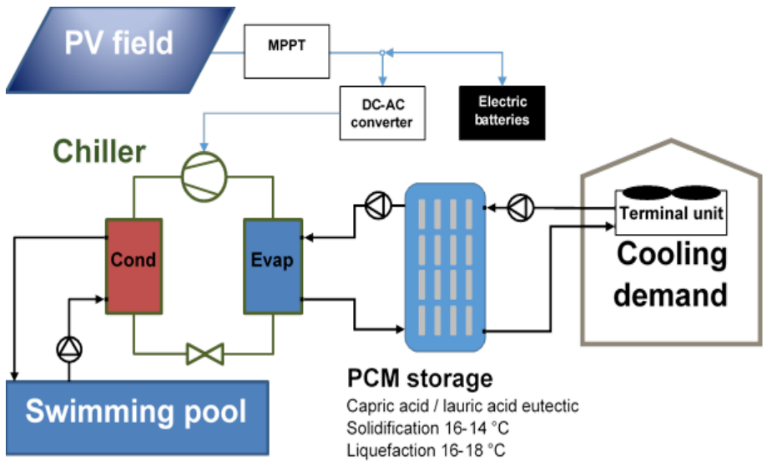

Figure 1. Technological process diagram of a steam-compression heat pump system using a photoelectric solar panel.

The main disadvantage of the proposed system is that the efficiency of the steam compression machine is not sufficiently substantiated. This is because the evaporating part of the heat pump does not take into account the volume of the building to be cooled when removing heat from the cooling system. Second, there are no technically and economically justified conclusions about the ability to heat the pool with heat from the condenser section. Thirdly, the selection of the photoelectric panel surface 25 m^2 used to start the heat pump compressor requires a large cost.

A study by scientists at the University of California, Berkeley, looked at the use of mini-channel solar water heaters made of aluminum in a variety of weather conditions throughout the year. The study identified the operating costs of water heaters, the advantages of using solar energy in order to reduce the consumption of natural gas, electricity in their use. In conventional solar water heaters, the design of attaching heat pipes to the absorber ribs has been considered to be effective. These devices used copper pipes with high heat transfer properties. However, other thermal designs also have the potential to use alternative materials with higher types of thermal performance. For this purpose, the researchers proposed a dimensional design of an aluminum-based mini-channel solar water heater shown in Figure 2 [13].

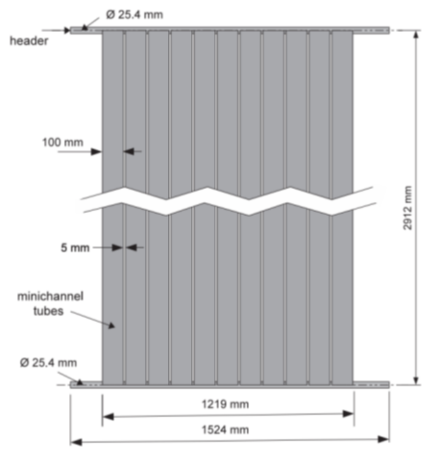

Figure 2. Dimensions of mini-channel water heater.

Based on the research, a schematic of the experimental band solar water heater described in Figure 3 was developed.

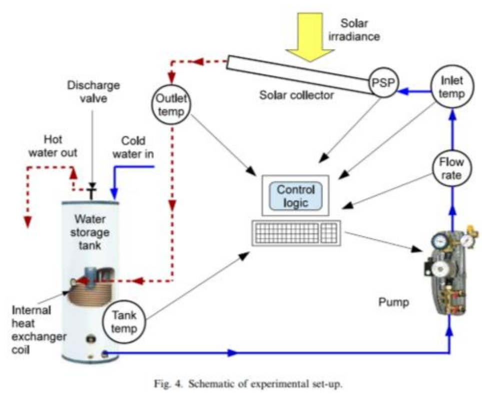

Figure 3. Experimental scheme of the device.

The proposed scheme evaluates the possibility of obtaining thermal energy in the form of hot water using solar radiation in all seasons, in different weather conditions [13].

Indian researchers have found that R.L. Shrivastava et al stated that modeling of solar water heaters using the TRNSYS (Transient System Simulation Tool) simulation program is one of the promising areas of research [14]. Using the software, the water heater was interpolated by the iteration method. The evaluation procedure was performed by adaptation to standard test conditions. A schematic representation of the device obtained as a result of modeling is shown in Figure 4.

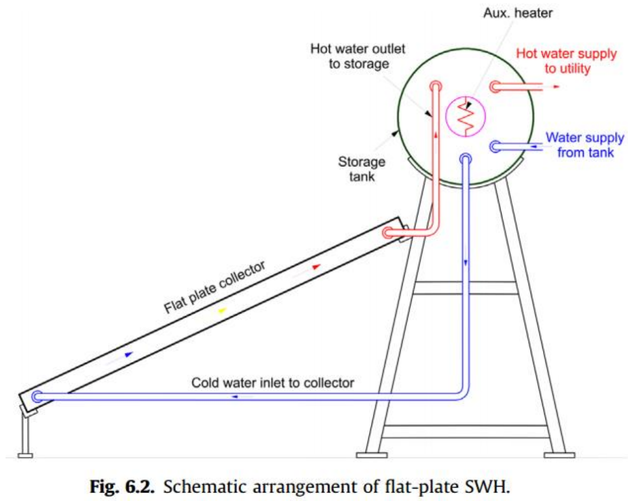

Figure 4. Schematic layout of a flat solar collector SWH

System error modeled using TRNSYS software is 5-10%. However, the fact that the study did not take into account extreme (accidental, e.g., windy, cloudy, foggy) conditions indicates the need for further research in this area.

B.Kanomoji and other scientists conducted an experimental analysis of the use of porous substances in solar water heaters. The aim of the study was to increase the thermal FIC of the system during the transfer of energy from the solar collector to the working fluid [15]. The experiment using a solar collector was conducted on a solar collector with crushed stone (Fig. 5).

Figure 5. Appearance of an experimental device.

The crushed rock layer absorbs and collects heat, then for a certain period of time the working body transfers it to the moving pipe. Experiments were conducted without a porous medium, and based on the determined temperature and heat parameters, an increase in the efficiency of the system was found [15].

According to the results of testing of two-circuit solar water heaters in the cold period of the year conducted by researchers of the Institute of Physics and Technology of the Academy of Sciences of the Republic of Uzbekistan, the thermal efficiency of two-circuit solar water heaters with intermediate batteries was determined [16]. The studies were conducted in a solar hot water supply system based on flat solar water heaters in the scheme shown in Figure 6.

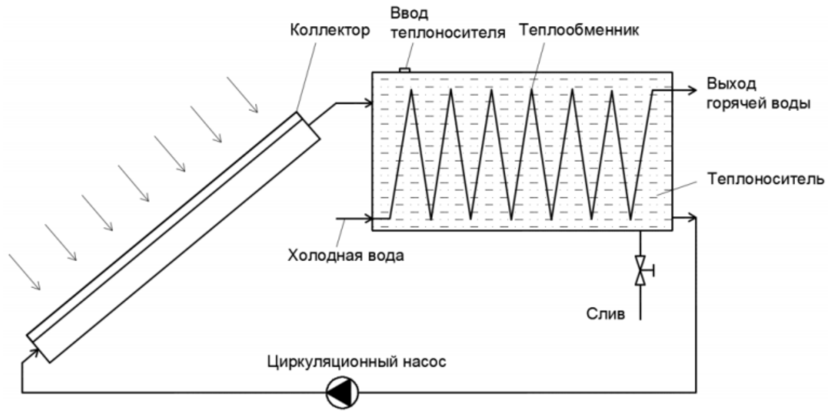

Figure 6. Schematic diagram of a two-contour solar water heater

The schematic diagram of a two-circuit solar water heater consists of a flat solar water heater and an intermediate tank (Fig. 6). The study was conducted in Tashkent, and the results of the experimental analysis were obtained for December 2016 and January-February 2017. Researchers have found that in Tashkent, when the ambient temperature is 5-9 ° C, it is possible to get hot water at a temperature of 40-52 ° C.

Flat sun used in hot water supply systems by Klichev Sh.I., Avezova N.R., Avezov R.R., Ruziev OS, Rustamov N.T., Vakhidov AU, Sulemanov Sh.I. a number of important results were obtained based on the study of the resource performance of water heating collectors [17, 18, 19, 20, 21]. Based on the resource performance of flat solar water heaters, it is based on the amount of conditional fuel saved annually through the use of solar energy, the cost of solar thermal energy in fuel equivalent, and its contribution to heat supply. The study was conducted in Tashkent on a flat solar water collector installed at an angle of 30 ° to the horizon. As a result of the research, average monthly and annual heat production figures were assessed.

Zahidov RA, Anarbaev AI developed solar heat and cold supply systems combined with heat pumps [22]. Based on the developed system, the use of a combined heat pump system using solar energy for heat and cooling supply of residential buildings is technically and economically justified. The schematic diagram of the proposed system is shown in Figure 7.

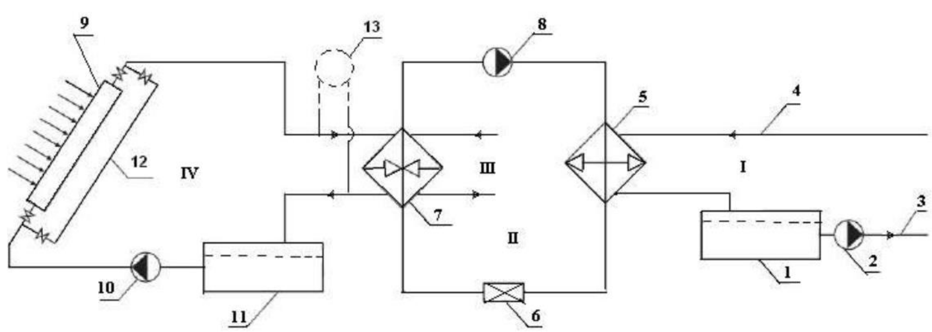

Figure 7. Schematic diagram of a low-temperature solar collector solar heat supply system combined with a heat pump: 1-accumulator tank; 2 circulating pump; 3.4 transmission and return heat pipes; 5-INQ capacitor; 6-throttle; Evaporator 7; 8-compressor; 9 low temperature solar collector; 10-pump; 11 ground heat exchanger for low temperature heat accumulation; 12 cold supply contour; 13

bypass pipe; I-heat carrier circulation circuit; Circulation contour of the refrigerant in II-INQ; Contour of water transfer from the ground accumulator III to the INQ evaporator; Solar energy utilization system with IV solar collector.

Avezov R.R., Qosimov F.Sh. and Ruziev O.S. studied the integrated coefficient of absorption of sunlight in the water layer in open evaporative surface tray solar water heaters and the results are presented in the form of graphical correlations [23].

A brief analysis of research on the use of solar energy in heat supply systems shows that combined heat supply (hot water and heating) systems operating on the basis of solar energy in natural conditions that are suitable for the climatic conditions and solar potential of the southern regions of the country. The feasibility and energy efficiency of the combined options of solar hot water floor and traditional heating systems are not sufficiently substantiated, optimal schemes of solar heat supply and traditional heating system, ie polyvalent heat supply systems have not been developed.

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