# RESEARCH OF LOW-TEMPERATURE, HARMONIZED HEATING SYSTEMS USING SOLAR ENERGY FOR BUILDINGS

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**Abstract**
In the world, special attention has recently been paid to increasing the scale of practical use of renewable energy sources, as well as saving hydrocarbon fuel and energy resources and rational use of energy resources by increasing the efficiency of heat generating equipment. Currently, in developed countries, "the production of thermal energy based on renewable energy sources is growing by 6% per year, of which the share of solar energy is 58%."1 From the point of view of achieving these indicators in the implementation of energy saving programs in the field of construction of buildings and structures, the development of engineering approaches aimed at rational use of energy, as well as the transition to renewable energy sources, becomes an important task.

**Keywords**: Solar heating systems, active system, passive system, translucent fences, solar energy, energy efficiency.

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**Аннотатция**
В мире, в последнее время уделяется особое внимание вопросам увеличения масштабов практического использования возобновляемых источников энергии, а также экономии углеводородных топливно-энергетических ресурсов и рационального использования энергоресурсов путем повышения эффективности теплогенерирующих оборудований. В настоящее время, в развитых странах, "производство тепловой энергии на основе возобновляемых источников энергии растет на 6% в год, из которых доля солнечной энергии составляет 58%"[1]. С точки зрения достижения данных показателей при реализации программ по энергосбережению в области строительства зданий и сооружений, разработка инженерных подходов, направленных на рациональное использование энергии, а также на переход к возобновляемым источникам энергии, становится важнейшей задачей.

**Ключевые слова:** Системы солнечного отопления, активная система, пассивная система, светопрозрачных ограждений, солнечная энергия, энергоэффективность.

## Introduction

Scientific research aimed at significantly improving the quality of solar heat supply in our republic, in particular, the wide use of passive and active solar heating systems, the use of renewable energy sources and the optimization of thermal technical parameters, increasing energy efficiency and reducing the consumption of traditional energy resources. is going In this direction, research on obtaining maximum thermal energy from solar energy in heating systems and providing buildings and structures with standard heat, multi-parameter modeling of thermal processes occurring in active solar heating systems with a heat-accumulating tank accumulator is considered a priority.

Increasing energy efficiency, including reducing energy consumption in the network by using solar energy as a heat source for heating residential buildings, communal and social facilities, and in turn, preserving hydrocarbon reserves for future generations and improving the environmental situation wide-ranging measures are being implemented and certain results are being achieved.

In the new development strategy of Uzbekistan for 2022-2026, among other things, it is important to increase the energy efficiency of the economy by 20% by 2026 and the volume of harmful gases released into the air by 20% by actively introducing "green economy" technologies into all sectors. tasks are defined2. The selection of low-temperature active solar heating systems, justification of their schemes and optimization of thermal performance are becoming important in the heating supply system of buildings and structures.[2].

## The purpose of the study

It consists in the development and justification of low-temperature combined (passive and active) solar heating systems with optimized parameters and operating modes for buildings.

Types of passive and active solar heating supply systems (ITT) are classified and compared in terms of important energy, technical and economic indicators, and according to thermal-





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technical, ecological and economic indicators, and the coefficient of recovery of natural fuel resources. were compared (Table 1).

**Table 1** ***Classifications of low-temperature solar ITTs***

| Low Temperature Solar ITT | Coefficient of fuel economy in systems | Achievements of the system | Disadvantages of the system | Advantages of the system | Risk aspects of the system |
|---|---|---|---|---|---|
| *Low temperature passive Solar ITT* | 35-45% | 1. There are design solutions for using the proposed system. 2. No large expenses are spent on the construction of buildings and structures | 1. It is not always possible to concentrate and direct the excess heat. 2. Must be planned during the design period | The service life of the system is the same as the service life of the building, so no extra costs are incurred | The system is less likely to provide heat on cloudy cold days without an additional heat source (doubler). |
| *Low Temperature Active Solar ITT* | 20-35% | The design of solar-fuel ITTs will increase the fuel efficiency of the system, and it is a widespread system, with many years of experience in designing, building, and operating. | 1. Solar water heating collectors, heat storage tank accumulator and other equipment require a lot of money and space. 2. ITT engineering solutions based only on solar energy are not enough, because solar insolation is insufficient in the heating season and is not always economically justified | Ease of operation of the system (start-up, shutdown, adjustment) availability of a backup system, heating indicators for objects in the cold season of the year are suitable for beam-panel heating systems (30-350S) | The system requires constant monitoring during the operation period, and optimal operation modes depend on the predictions of climate indicators. |
| *Low-Temperature Coherent Solar ITT* | 60-80% | It provides guaranteed heat energy during the heating season, while it is possible to create an autonomous heating system in the republic's climate. Energy saving and economic efficiency are high | The initial cost of the system is high | With the use of modern techniques and technologies, it is possible to design it as an ITT with an autonomous and backup system, and there are opportunities for system automation and control. | It is designed based on the predictions of climate indicators and the difficulty of making changes to the system without a qualified expert. |

The results of the analysis showed that the ITTs of combined (harmonized) use of passive and active solar heating systems with optimal performance can save up to 60-85% of fuel. At the same time, the existing legal documents and the main requirements stated in them for the use of passive and active solar ITTs were studied.[3,6].





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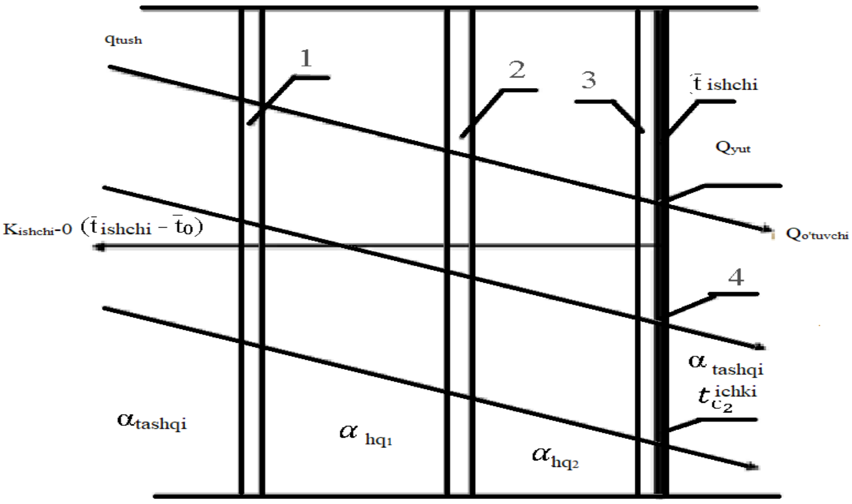
The thermal protection property of any transparent barrier (SHT) intended for passive solar ITTs, including, is determined by the difference between the total solar radiation (QN) entering the heated room and its heat losses through the SHT (Figure 1).




**1 – picture.** The calculation-heat principle scheme of the heat balance of the partially light-absorbing film coating of the inner surface of the inner layer of the three-layer ShT. 1, 2 and 3 – outer, middle and inner layers of the three-layer SHT, respectively; 4-partial light-absorbing variable film coating; ahq1 and ahq2-closed air layers between the outer and middle and middle and inner layers of the wall, respectively

The stationary heat balance equation of the processes of converting solar energy into heat in insolation passive solar ITTs is given in the formula (1):

$$Q^{\Sigma}_{tush_{oyna}} = Q^{\Sigma}_{kayt_{oyna}} + Q^{\Sigma}_{yut_{oyna}} + Q^{\Sigma}_{yut_{pq}} + Q^{\Sigma}_{o'tuv_{oyna}} \qquad (1)$$

the amount of heat energy falling on the window; the amount of heat returning from the glass; the amount of heat absorbed by the glass; the amount of heat absorbed by the film coating; the amount of heat passing through the glass; $Q^{\Sigma}_{tush_{oyna}} - Q^{\Sigma}_{qayt_{oyna}} - Q^{\Sigma}_{yut_{oyna}} - Q^{\Sigma}_{yut_{pk}} - Q^{\Sigma}_{o'tuv_{oyna}} -$

The non-stationary heat balance equation (2) of the processes of converting solar energy into heat in insolation passive solar ITTs is defined according to the expression:

$$(\rho SV)_x \frac{dt_x}{dz} = Q^{\Sigma}_{o'tgan_{oyna}} + Q^{r}_{r-x} + G_f - Q^{devor}_{iy} - Q^{pk}_{iy} - Q^{shift}_{iy} - Q^{eshik}_{iy} \qquad (2)$$

in which the processes of converting energy of QN into heat; the amount of heat passing through the glass; QN flow energy entering the heated room through T; the total convective and radiant heat flux falling on the surface of the light-absorbing film layer installed on the inner layer of the three-layer SHT in the pushed room; heat loss from vors; heat loss from film coating; heat loss from the ceiling; heat loss through doors $(\rho SV)_x \frac{dt_x}{dz} - Q^{\Sigma}_{o'tgan_{oyna}} - Q^{r}_{r-x} -$ SH$G_f$ – is $Q^{devor}_{iy}$ – de $Q^{pk}_{iy} - Q^{shift}_{iy} - Q^{eshik}_{iy}$ –[1,3].

The surface of the poly is 15m2, the volume is 45m3, and the surface of the SHT is 3.75 m2 and the specific heat property is 1.2 W/(m2·$^{0}$For the experimental building with C), the melting temperature is 18.6oC, the latent heat of fusion is 173 kJ/kg, the specific heat capacity (in the liquid state) is 1.97 kJ/(m2·$^{0}$C) and the result of computational research to determine the specific mass of a short-term phase-transition battery based on (SN3)2SO with a density of 1100 kg/m3 is presented in Table 2.

**Table 2 The result of computational research on determining the specific mass of a short-term phase-transition battery based on the given conditions**

| Calculated quantities | Calculation result |
|---|---|
| Cumulative QN flux during the day (8 hours) falling on the surface of the SHT under consideration | 11000 kJ/m2 |
| Daily average thermal efficiency of the ST | 0.6 |
| Average daily value of outdoor air temperature | +50C |
| Normalized air temperature of the heated room | +180C |
| Calculated value of the total daily heat loss from the heated room | $Q_{iy}^{ix} = 1,2 \cdot 45(18-5) \cdot 8 \cdot 3600$=*20217*.6 kJ |
| Daily heat generation capacity of SHT | $Q_{foy}^{sht} = 0,6 \cdot 11000 \cdot 3,75$=24750 kJ |
| Excess QN value in the room where the energy should be concentrated | $Q_{foy}^{sht}$-*24750-0217,6=4532*,$Q_{iy}^{ix}$ =4 kJ |
| For the object under consideration, the mass of phase-transition IA air used in a passive solar ITT is 400C at the exit from the air outlet and 350C at the inlet to the liquid-state battery. | $M_{akk} = \frac{4532,4}{173+1,97(35-20)} = 22,4\ kg$ |
| Specific mass of IA | max=22.4/3.75=6 kg/m2 |

Based on the results of calculations for five months of the heating season, as a result of solving the temperature regime change equation of an object with a passive solar heating system with a three-layer phase-passing IA for the Tashkent climate, using numerical methods, in the cold months of the year ( (December, January, February) from 10:00 a.m. to 4:00 p.m., the air temperature of the heated object is equal to or higher than the design temperature (18°C), and the conventional heating system is turned on for six hours. 'allows you to save in the disabled state. In November and March, the traditional system can be turned off for ten hours (from 8:00 a.m. to 5:00 p.m.)[7,12].

## Conclusion

BNew engineering approaches for joint use of insolation passive and active solar heating systems for heating systems of buildings and structures were proposed, and stationary and non-stationary mathematical models of heat processes occurring in them were developed, as a result of using these heating systems, the building's energy the fuel coverage ratio can be increased from 60% to 85%. As a result of the use of the developed seasonal heat-accumulating active solar heating system in the heating system of buildings and structures, the relative heat consumption is 33.4%, 39.79%, and 47%, respectively, for the building with the first, second, and third-level thermal protection layer. it was found that it is possible to reduce to





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