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INVESTIGATION OF THE USE OF A HEATER WITH A CARBON FIBER HEAT-GENERATING FLEXIBLE MATERIAL AND A SOLAR STATION

Abstract. In remote areas, the premises of mobile dwellings are heated by traditional fuel stoves. This includes mobile homes for farmers and field workers.

However, a problem with the fuel supply may arise when the mobile home is located at a significant distance from the settlement.

Thus, it is possible to use solar energy for heating mobile homes. For space heating, a study was conducted using a heater with carbon fiber heat-generating flexible material and a solar station. Solar energy is used to generate electricity, which will be used to power the heating element. The aim of the study is to develop and implement a heating system using solar energy for mobile dwellings of workers in transhumance and crop production.

This space heating system is recommended for use on cool summer days and for heating in winter as an addition to the main traditional heating.

For further research, it is necessary to search for other heating devices with lower power consumption, the best option would be consumption in the range of 100 - 200 W. There is also the issue of upgrading solar stations to generate electricity on cloudy days.

Keywords. Premises, alternative energy source, solar energy, carbon fiber heat-generating flexible material, heating, farmer’s house

Introduction.

The number of buildings and structures around the world, as well as in Kazakhstan, switch to alternative energy sources every year, because the cost of standard energy resources is growing, as well as the fact that their use in most cases is harmful to the environment. that is why the integration and use of solar energy in all regions of our country is growing exponentially. Solar power plants are installed to provide electricity to residential and non-residential buildings, as well as to use solar energy in various industries [1].

In arid regions, a solar distiller can be used to produce drinking water, which makes it possible to produce water at a low cost. To increase the distillate from the solar distiller, beakers with metal fins filled with wax are used [2].

Renewable energy is suitable for heating. The possibility of improving the internal climate of a greenhouse with the help of a solar heating system with heat storage has been studied [3].

Various stoves are used in mobile dwellings for workers in transhumance and crop production. The problem of providing fuel can arise when the mobile home is located at a considerable distance from the settlement. Thus, the prospect for mobile dwellings for transhumance and crop production workers is solar energy. Solar energy has advantages - it is a safe and clean source of heat for humans and the environment, which does not require the use of traditional fuels.

Solar energy can be used to generate electricity that will be used to power the heating element.

The aim of the study is to develop and implement a heating system using solar energy for mobile dwellings of workers in transhumance and crop production.

Materials and method.

The development of highly efficient heating products with a high heating rate and stable heat release is still a challenge at this time. During the study, the works of other scientists were previously studied.

With a two-channel system of solar thermal storage walls, it is possible to reduce the cooling load throughout the day in summer and the heating load in winter [4].

By consuming the energy of super-energy fossil fuels, the comfort of the Passive Rhythm at Home (PSH) can be improved. At present, the solar energy absorbed by the outer walls is used inefficiently. This happens with the advent of FGHP, which is a house combined with the phenomenon of heat pipes with gravitational ejection [5].

For distributed heating of buildings, solar energy and stored electrical heat is a promising energy-saving technology. Through prototype experiments and numerical evaluations in buildings in use, the energy-saving characteristics of this technology have been extensively investigated. A feasibility study for an electrical heat storage system combined with solar energy was carried out in a 2,000 m2 three-storey office building in Tianjin, China. In order to predict the heat gain of a solar collector, it is necessary to adjust the amount of heat stored by the storage device in the long term. The results of studies in the range of 50–150 °C showed that the unit cost of operating this system during the entire heating season was 15.6 yuan (yuan)/m2/season. Savings on heating costs through the use of a distributed system of clean heating of buildings compared to centralized heating amounted to 61%. The use of electricity storage and solar energy for heat distribution in distributed heating of buildings has great potential [6].

A solar water heating system (SWH) is an environmentally friendly way to produce domestic and commercial hot water. The use of a carrier reduces the need for a booster unit for intermittent solar radiation. The study combines a device using a novel tritriacontane paraffin (solid-liquid PCM). The results showed an increase in the temperature of the fins up to 45% based on PCM [7].

Power supply using solar concentrating collectors, photovoltaic cells, double acting is applicable for buildings in winter and summer. At the same time, the savings in energy and costs in the hospital were 73.3% and 64.2%, respectively, the efficiency was from 1.22 to 1.65 in the heating mode [8].

After having studied all the arguments, a heater with a carbon fiber heat-generating flexible material was chosen. The basic principle of the device: radiation of long-wave infrared heat rays, which heat the surface of any object. Polymer film (polyester) with high dielectric properties is used in the manufacture of the product. It is heat-resistant and perfectly conducts infrared heat. Carbon (coal) paste is applied to a polymer film with a technological accuracy of less than 1 micron.

A solar station and a heater with a carbon heat-generating flexible material were installed in the trailer modular farmer's house with overall dimensions of 5000x2500x2200 mm (length x width x height), the walls of the house are made of basalt-based sandwich panels, 50 mm thick. The module frame is made of metal from a profile pipe 50x50x3 mm. Floor was made from a profile pipe 120x60x4, covering with a metal sheet - 2 mm, insulation 50 mm thick, OSB-12 mm panel (double layer), linoleum. The roof is made of basalt-based sandwich panels. The house is equipped with a solid fuel heating stove with a power of 8 kW.

Results and Discussion.

The farmer's house was equipped with 4 solar panels with a capacity of 400 W, 4 batteries with a capacity of 120 A h, and one carbon heat-releasing flexible material heater (Figures 1 and 2).

The heating system was also equipped with a day-night sensor and a battery heating system. The day-night sensor turns off the heater at night. Battery heating system ensures normal temperature conditions for battery operation.

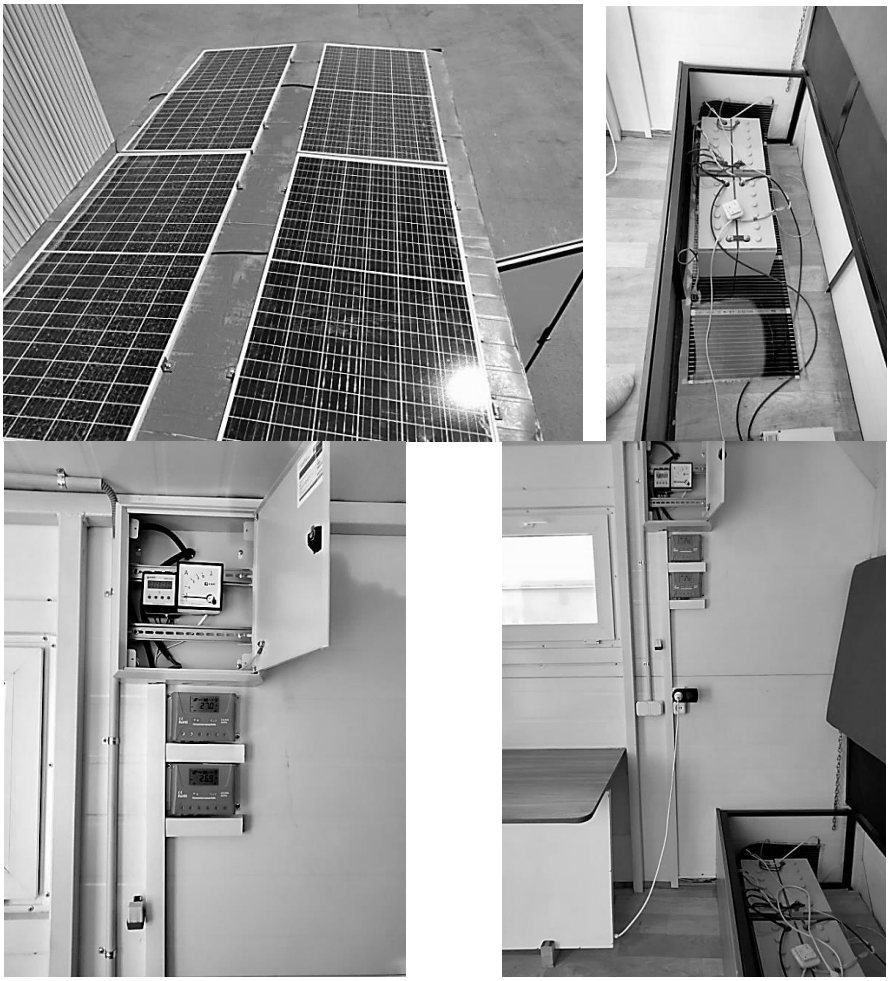

Figure 1 - Farmer's house with heating system installed

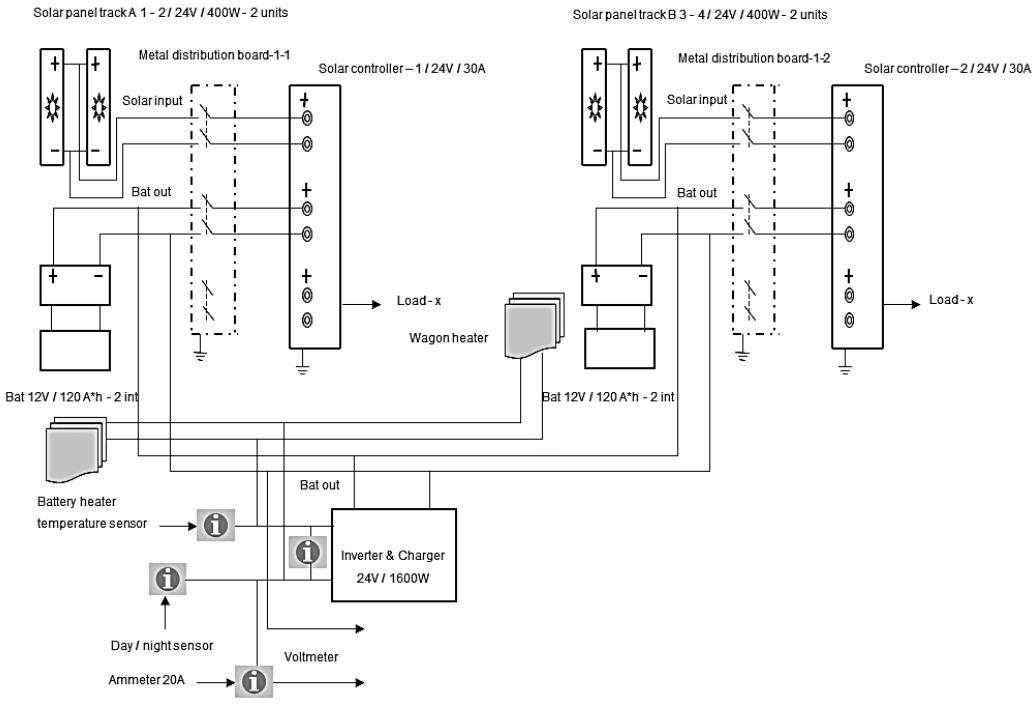

Figure 2 - Wiring diagram for connecting individual elements in the heating system

Studies of the operation of the heating system installed in the farmer's house were carried out in June and October 2021 (from October 1 to October 17). During the operation of this heating system in June, the daylight illumination value varied from 64*103 lux to 108*103 lux, depending on the time of day on sunny days (Figure 3); at the beginning of October - from 20*103 lux to 99*103 lux (Figure 4).

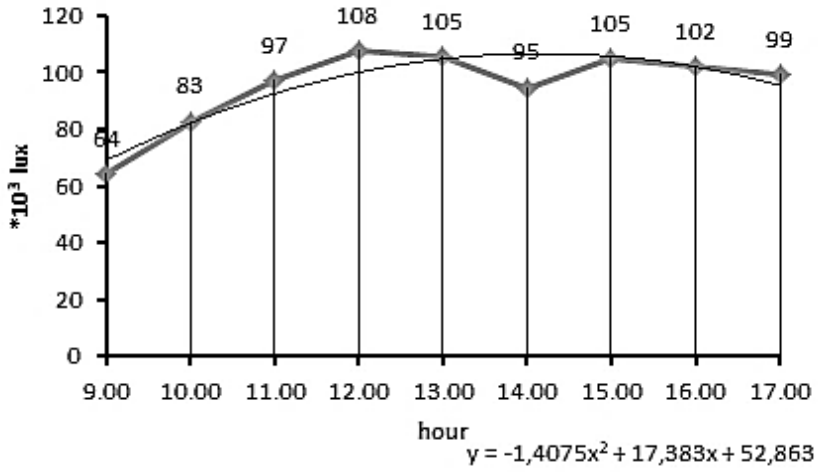

Figure 3 - The value of daylight illumination in June

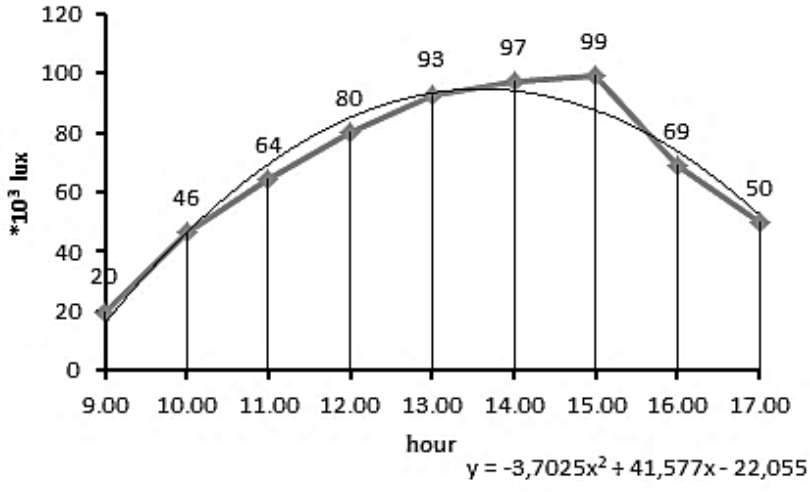

Figure 4 - The value of daylight illumination in October

Sunny days were observed in Kostanay in June: 57% were sunny days, 30% cloudy days, 13% grey days [9]; in the beginning of October - 12% were sunny days, 59% cloudy days, 29% grey days [10].

The highest daily temperature in June 2021 was 33°C while the minimum night temperature dropped to 7°C. Average daytime and nighttime temperatures during June were 23.3° C and 15.5° C, respectively. The highest daily temperature in October was 15°C while the minimum night temperature dropped to -4°C. Average daytime and nighttime temperatures in October were 10°C and 2.5°C, respectively.

The average wind force in June was 4.1 m/s; at the beginning of October - 5 m/s.

The average daily sunshine in Kostanay in June was 11.9 hours and 5 hours at the beginning of October.

On average, the heater with a carbon fiber heat-generating flexible material consumed 672 W of energy in the process (Figure 5); the maximum heating temperature was 870C on average (Figure 6).

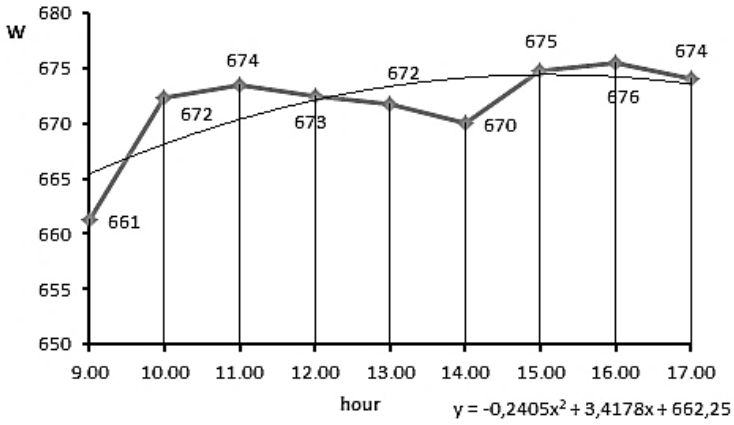

Figure 5 - Power consumption diagram

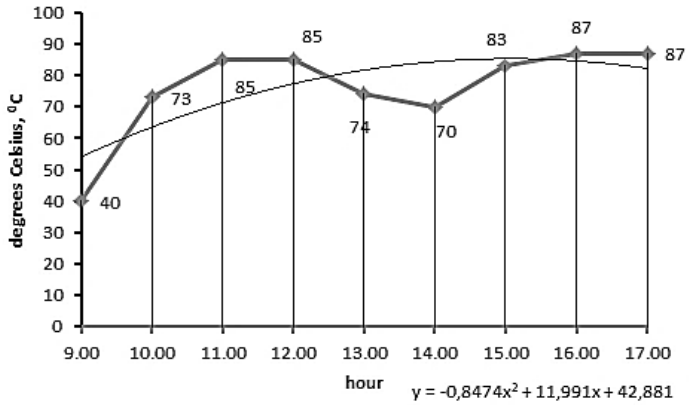

Figure 6 - Changing the heating temperature of a heater with carbon heat-generating flexible material

Changes in ambient temperature in October and indoors temperature of farmer's house are shown in Figure 7.

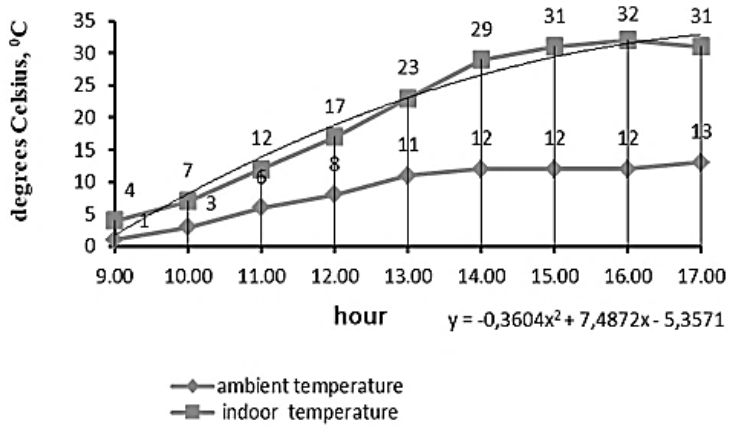

Figure 7 - Changes of ambient and indoor temperature

Conclusion.

Studies have shown that the proposed heating system for residential premises is efficient. It is recommended to use this room heating system on cool summer days and in the autumn-spring period to heat rooms of a small area, or in winter as an addition to the main traditional heating because the energy consumption of a heater with a carbon fiber heat-generating flexible material is 600-700 W. A solar station with a power of at least 1600 W is needed to provide such power, which affects the increased cost of all equipment.

The amount of electricity generated by a solar station directly depends on three factors. The sun emits more energy during the day, and sunny days are needed to generate as much electrical energy as possible. In addition, the number of panels that need to be installed to obtain a certain power directly depends on the geographic location. Because there is no sunlight at night, as well as on cloudy and rainy days, solar energy cannot serve as the main source of electricity.

The problem is the storage of the generated electricity, as the price of batteries is very high. The consumer receives energy from batteries, which is accumulated due to generation at solar stations. Batteries are quickly discharged during prolonged use and if not sufficiently charged. To prolong battery life, it is very important to avoid deep discharge. the use of discharged batteries leads to their frequent replacement. The depth of discharge is expressed as a percentage of the nominal capacity of the battery. It must be limited within 30-40%, which is achieved by disconnecting the load.

For further research, it is necessary to search for other heating devices with lower energy consumption, the best option would be a consumption in the range of 100 - 200 W There is also the question of modernizing solar stations in order to generate electricity on cloudy days.

To track the maximum output power and efficiency of a photovoltaic system, a method is used to track the maximum power point that provides the most power at the operating load [11].

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КАРБОНДЫ ЖЫЛУ БӨЛЕТІН ИІЛГІШ МАТЕРИАЛДАРЫ БАР ЖЫЛЫТҚЫШТЫ ЖӘНЕ КҮН СТАНЦИЯСЫН ҚОЛДАНУДЫ ЗЕРТТЕУ

Аңдатпа. Алыстағы объектілерде үй-жайларды жылыту дәстүрлі отынмен пешпен жүргізіледі. Бұған отарлы мал шаруашылығы мен егін шаруашылығы қызметкерлерінің мобильді үй-жайлары жатады. Алайда елді мекендерден едәуір алыстаған кезде отын жеткізуде проблемалар туындайды. Сондықтан мобильді тұрғын үйді жылыту үшін баламалы энергияны пайдалану мәселесі туындайды. Үй-жайларды жылыту үшін карбонды жылу бөлетін иілгіш материал мен күн стансасы бар жылытқышты пайдалану арқылы зерттеу жүргізілді. Күн энергиясы қыздыру элементін қоректендіру үшін пайдаланылатын электр энергиясын өндіру үшін пайдаланылады.

Зерттеудің мақсаты отарлы мал шаруашылығы және егін шаруашылығы қызметкерлерінің мобильді тұрғын үй-жайлары үшін күн энергиясын пайдалана отырып, жылыту жүйесін әзірлеу және енгізу болып табылады. Үй-жайларды жылытудың бұл жүйесі салқын жазғы күндері пайдалану үшін және негізгі дәстүрлі жылытуға қосымша ретінде қыста жылыту үшін ұсынылады. Одан әрі зерттеулер үшін тұтынылатын қуаты аз басқа жылыту аспаптарын іздеу қажет, оңтайлы нұсқа 100 - 200 Вт ауқымында тұтыну болады. Сондай-ақ бұлтты күндері электр энергиясын өндіру үшін күн станцияларын жаңғырту мәселесі тұр.

Түйінді сөздер. Үй-жайлар, баламалы энергия көзі, күн энергиясы, көміртегі талшықтарын жылу бөлетін иілгіш материал, жылыту, фермер үйі.

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ИССЛЕДОВАНИЕ ПРИМЕНЕНИЯ ОБОГРЕВАТЕЛЯ С КАРБОНОВЫМ ТЕПЛОВЫДЕЛЯЮЩИМ ГИБКИМ МАТЕРИАЛОМ И СОЛНЕЧНОЙ СТАНЦИИ

Аннотация. На удаленных объектах обогрев помещений производят печами на традиционном топливе. Сюда относятся мобильные помещения работников отгонного животноводства и полеводства. Однако при значительном удалении от населенного пункта возникают проблемы с поставкой топлива. Поэтому возникает вопрос об использовании альтернативной энергии для отопления мобильного жилого помещения. Для обогрева помещений было проведено исследование с использованием обогревателя с карбоновым тепловыделяющим гибким материалом и солнечной станции. Солнечная энергия используется для выработки электроэнергии, которая используется для питания нагревательного элемента.

Целью исследования является разработка и внедрение системы отопления с использованием солнечной энергии для мобильных жилых помещений работников отгонного животноводства и полеводства. Эта система отопления помещений рекомендуется для использования в прохладные летние дни и для отопления зимой в качестве дополнения к основному традиционному отоплению. Для дальнейших исследований необходим поиск других отопительных приборов с меньшей потребляемой мощностью, оптимальным вариантом будет потребление в диапазоне 100 – 200 Вт. Также стоит вопрос модернизации солнечных станций для выработки электроэнергии в пасмурные дни.

Ключевые слова. Помещения, альтернативный источник энергии, солнечная энергия, тепловыделяющий углеродные волокна гибкий материал, отопление, дом фермера.

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