RESEARCH PRIMARY PROCESSING OF LIVE OF SILK COCOONS IN A SOLAR INSTALLATION

Mirsaatov Ravshanbek Muminovich
Doctor of Technical Sciences, Professor,
Tashkent State Transport University, Republic of Uzbekistan

Abstract. This article presents the results of research to determine the main technical and economic indicators of a new installation we have created for marinating cocoons with the help of solar radiation energy.

The possibility of marinating cocoons both on sunny and cloudy days has been proven through direct and indirect use of the energy of solar radiation. The performance of the installation, the temperature inside the drying chamber and the time for complete marinating of cocoons were determined.

On the basis of the data obtained, it can be said that the installation provides complete of marinating cocoons and the use of this installation contributes to 100 percent savings in energy resources spent for freezing cocoons.

Key words: cocoon, pickling, solar radiation, chrysalis, drying.

INTRODUCTION

The Republic of Uzbekistan is a manufacturer and supplier of such an important strategic material as the mulberry cocoon, which has a huge export potential and the possibility of obtaining various types of products from it. To further increase the production of mulberry cocoons, improve their quality and reduce the consumption of fuel and energy resources for their soaking, along with other measures, the development and implementation of modern energy-saving technologies is required.

The amount of silk that can be obtained from the cocoon, that is, the maximum use of the cocoon shell, largely depends on the methods of cocoon soaking and cocoon drying. The method of pretreatment of the steps should allow preserving the natural properties of the cocoon, as well as providing valuable physical and mechanical properties of the cocoon thread.

Many scientists have dealt with the issues of harvesting and primary processing of silkworm cocoons. There are several ways to mork and dry live mulberry cocoons.

The cocoon-harvesting season in Uzbekistan coincides with the months of sunshine in the year, i.e. May and June. During these months, coconut dryers are widely used for brewing mulberry cocoons, working on the principle of convective heat and mass transfer. In all the leading silk-growing countries of the world, including in our republic, conveyor cocoon dryers are used for soaking cocoons, which process cocoons with hot air. Coconut dryers of the SK-150K type installed in our republic, 85-90 kg

of diesel fuel and 70-75 kW of electric energy are consumed to lure 1 ton of live cocoons.

One of the ways to reduce the consumption of fuel and energy resources for brewing mulberry cocoons in the conditions of our republic is the use of solar radiation energy.

The territory of the Republic of Uzbekistan is located in relatively favorable climatic conditions for the use of environmentally friendly and inexhaustible solar energy. The annual value of the radiant energy of the sun falling on 1 m of the horizontal surface of the earth in Uzbekistan averages 6.0 GJ, which is equivalent to the thermal energy obtained by burning conventional fuel in the amount of 0.2 tons.

In this regard, the creation of a prototype of an upgraded installation for soaking a cocoon using solar energy and the development of technology for drying starved cocoons is an urgent task.

OBJECT OF RESEARCH

The installation for of marinating cocoons with solar energy (Fig. 1) is a common heat-insulating chamber 1, which consists of an upper drying chamber 2 and a lower 3 for additional air heating, where electric water heaters are installed.



FIGURE 1. The installation for of marinating cocoons with solar energy

The upper part of the chamber serves as a receiver of sunlight and consists of two-layer glass 6 and 7, with an air gap of 20 mm. Loading and unloading of cocoons is carried out by cassettes 8. To maintain the light-receiving surface perpendicular to the sun's rays, a special device 9 is provided.

On sunny days, the sun's rays passing through the two-layer glass heat the air and the chrysalis inside the cocoon is marinated with the heated air. On cloudy days, air heaters are additionally turned on to increase the air temperature, which are powered by solar panels.

RESEARCH METHODS

As methods of research for complex systems approach to solving problems based on methods of study of complex systems, cause-and-effect analysis of various factors influence on qualitative indicators of live cocoons. When conducting research using mathematical modeling techniques, statistical methods and methods of comparative analysis.

METHOD FOR OBTAINING EXPERIMENTAL DATA

The main technical and economic indicators for marinating cocoons are the air temperature inside the chamber, the time of complete marinating of cocoons and the productivity of the installation.

The ambient temperature and humidity were measured using an Assmann aspiration psychrometer. To measure the temperature inside the chamber, thermoelectric meters - chromel - kopel thermocouples TChK were used. The thermoelectric power of thermocouples was measured with a V7-21 digital universal voltmeter, and the temperature inside the chamber was determined by this method.

In three places along the length of the chamber, in the middle of the thickness of the layer of cocoons, samples of cocoons were placed in gauze bags, 100 g of live cocoons each, to analyze the condition of the pupae. The state of pupae was determined by inserting the shell of cocoons, visually. The condition of the pupae was checked every 15 min until the pupae were completely marinated.

The experiments explored the possibility of using solar energy in three ways, i.e. with direct use, indirect use (using a solar battery) and the simultaneous use of direct and indirect methods. For an objective comparison of the quality indicators of processed cocoons with indirect use of solar energy, the temperature inside the chamber was maintained at the same level as with direct use of solar energy.

RESULTS AND DISCUSSION

The capacity of the solar installation is designed for the harvest of cocoons from one box of caterpillars and it is 65 kg. The obtained data of experimental studies are given in tables 1, 2 and 3.

Table 1. Of marinating of cocoons with direct use of solar energy (treatment time 90 min)

The thickness of the cocoon layer, cm.	Repetition	Final air temperature, ^{0}C		The number of cocoons in the sample, pcs.	Number of live cocoons, pcs.
		outdoor	inside the camera		
20-22	1	27	69	110	0
	2	30	75	110	0
	3	32	76	110	0
	4	34	78	110	0
	5	35	76	110	0

	6	36	75	110	0
	7	34	70	110	0
	8	32	68	110	0
	9	33	79	110	0

Table 2. Of marinating cocoons with indirect use of solar energy (processing time 90 min)

The thickness of the cocoon layer, cm.	Repetition	Final air temperature, ^{0}C		The number of cocoons in the sample, pcs.	Number of live cocoons, pcs.
		outdoor	inside the camera		
20-22	1	29	65	110	0
	2	30	69	110	0
	3	32	70	110	0
	4	33	72	110	0
	5	33,5	75	110	0
	6	35	76	110	0
	7	34	79	110	0
	8	33	79	110	0
	9	30,5	77	110	0

Table 3. Of marinating of cocoons with direct and indirect use of solar radiation energy (treatment time 60 min)

The thickness of the cocoon layer, cm.	Repetition	Final air temperature, ^{0}C		The number of cocoons in the sample, pcs.	Number of live cocoons, pcs.
		outdoor	inside the camera		
20-22	1	29	85	110	0
	2	32	88	110	0
	3	32	90	110	0
	4	33	93	110	0
	5	31	93	110	0
	6	29	83	110	0
	7	32	91	110	0
	8	34	93	110	0
	9	29	92	110	0

Analysis of the obtained data shows that the time for complete of marinating of cocoons both in direct and indirect use of solar energy is 90 minutes, hence the productivity of live cocoons is 45 kg/h.

The use of solar energy in direct and indirect ways at the same time reduces the time of marinating cocoons by 30% and is 60 minutes and, accordingly, the productivity increases to 65 kg / h. The use of this installation contributes to the complete saving of energy resources, which is an urgent problem at the present time.

CONCLUSIONS

According to the data obtained, the temperature inside the chamber is 75-80^{0}C, which ensures complete marinating of cocoons. When marinating cocoons with direct or indirect use of solar energy, the processing time is 90 minutes, the productivity of the installation is 45kg / hour of live cocoons, and when using two methods at the same time, the processing time is 60 minutes, the productivity is 65kg / hour.

Studies have shown the efficiency of using a solar installation for freezing cocoons, and the possibility of increasing the air temperature inside the chamber, using solar energy in an indirect way, shows the possibility of increasing the productivity of the installation in further studies.

REFERENCES:

1. Hendaw Y.T. Stifling Cocoons Silkworms Using Butane Gas Mechanical Dryer. J.Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 8(4):149 - 156, 2017

2. S. D. Burkhanov, R. M. Mirsaatov, S. B. Khudoyberganov and B. H. Kadyrov, in IOP Conference Series: Earth and Environmental Science, **677**(4), 042032 (2021) .

3. Patent UZ IAP 7903. Tut ipak qurti pillalarini bug‘lash qurilmasi/ R. M. Mirsaatov, G. Sh. Sultankhodjaeva // Rasmiy axborotnoma – 2025. - №6. https://im.adliya.uz/publications/ONE/2025/2?document=be495fd3-bc36-4070-8b80-1cafdba639cc

4. R. M. Mirsaatov, X. X. Djabborov, G. Sh. Sultanxodjayeva. Quyosh energiyasi yordamida tut ipak qurti pillalariga dastlabki ishlov berish / // Irrigatsiya va mellioratsiya. – 2024. – Vol. 10. Iss 2. – B. 43-47. (05.00.00; № 22). https://journals.tiiame.uz/IL/ru/issue/view/11/11

5. Р. М. Мирсаатов, Г.Ш. Султанходжаева. Первичная обработка коконов тутового шелкопряда с применением солнечной энергии / // АГРО ИЛМ. –2024. - №6 (104). – С. 91-94. (05.00.00; № 3). https://qxjurnal.uz/index.php/ai/issue/view/71/71

6. Р. М. Мирсаатов, С. Б. Худойберганов, Г. Ш. Султанходжаева. Математическое моделирование процесса термической обработки коконов тутового шелкопряда / // O‘zbekiston milliy axborot agentligi – 2026. №3 (77). – С. 152-163. (O‘zbekiston Respublikasi OAK Rayosatining 2019-yil 28-martdagi 263/7.1

va 263/7.4-son qarori). https://cdn.uza.uz/2026/03/ 12/16/22/ 4CAj9kzCYk6Lh0TWOTfDKX0oKsvd9Sts.pdf

7. Tut ipak qurti pillalariga dastlabki ishlov beruvchi quyosh qurilmasining ishonchliligini tadqiq etish / R. M. Mirsaatov, S. B. Xudoyberganov, G. Sh. Sultanxodjayeva // Ilm-fan va innovatsion rivojlanish xalqaro ilmiy-texnikaviy jurnal – 2025. Vol. 8. Iss 4. – B. 89-102. (O‘zbekiston Respublikasi OAK Rayosatining 2019-yil 28-fevralda gi 262/9.2-son qarori). https://ilm-fan-jurnal.csti.uz/articles/31276593-e7a1-41f2-ad34-cfb835f1b1c6

8. Simulation modeling of the thermal treatment process of mulberry silkworm cocoons / R. M. Mirsaatov, G. Sh. Sultankhojaeva, S. B. Khudoyberganov // Latin American Journal of Education – 2026. Vol. 6 Iss 2. – P. 523-532. ((12) Index Copernicus). https://zenodo.org/records/18880599

9. Solar energy in the primary processing of mulberry silkworm cocoons / R. M. Mirsaatov, G. Sh. Sultankhojaeva // Ilm-fan taraqqiyoti: muammo, yechim va istiqbollari II an’anaviy xalqaro ilmiy-amaliy konferensiyasi. Toshkent, 17-18 dekabr 2024 y. – B. 749-751.

10. G. Sh. Sultankhodjaeva. Development of technology for drying and complete drying of silkworm cocoons / R. M. Mirsaatov, G. Sh. Sultankhodjaeva // Proceedings of International Conference on Modern Science and Scientific Studies. Paris – 2024. ISSN:2835-3730. -P. 188-193.