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RESULTS OF AN EXPERIMENTAL STUDY OF THE CARRIAGE AND DRYING OF COCONS OF TOTAL SILKINS (Bombyx mori)

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The article discusses the results of an experimental study of the process of carrots and drying of silkworm cocoons. The study examined the possibilities of primary processing, i.e. silkworm cocoons and drying using elastic waves with infrared radiation. A mechanism for generating low-frequency oscillations due to an electromechanical drive to pallets has been developed at TashGTU. In the laboratory of the department, a full-scale test was conducted for carrots and drying of silkworm cocoons. It was revealed during observations that silkworm cocoons processed in the temperature range 65-70 0C using vibration waves were euthanized within 3-5 minutes and the cocoons were dried to 10-12% humidity for 10 days at a temperature of 38-42 0C. The use of elastic waves in the processing of cocoons flowed 5-10% lower compared to processing methods using vibrational waves.
Key words: drying, carrot, vibration, infrared radiation, elastic waves.

Silkworm (Latin *Bombyx mori*), or silkworm - caterpillar and butterfly. Mulberry silkworm is the only fully domesticated insect not found in nature in the wild. Females even “forgot how” to fly. An adult insect is a thick butterfly with whitish wings up to 6 cm wide. The caterpillars of this silkworm eat only the leaves of mulberry, or mulberry tree. Silkworm caterpillars curl cocoons, the shells of which consist of a continuous silk thread 300-900 m long and up to 1500 m in the largest cocoons.

Cocoon is a product of central mechanisms tuned by the external and internal environment. In the field of constructing a structure and its formation, a number of scientific studies have been carried out [1-3]. Kaise and his colleagues [3] proposed some computational models for modeling the pattern of head movement of the larva and the stretching, bending, and swinging of his body to form a cocoon. E.Musayev [4] considered some technological parameters of cocoons using optoelectronic methods, for example, spectral characteristics describing the absorption and reflection of light of cocoons at different wavelengths. Using thermogravimetry, differential thermal analysis and infrared absorption spectrometry with Fourier transform, H. Zhang, J. Magoshi and others [5] studied the color, size and shape of the shells of Bombyx mori cocoons after heat treatment with increasing temperature. It was found that the size decreased with increasing temperature, and weight was lost from the shell of the cocoon. M.Tsukada and others [6–9] studied the behavior of thermal decomposition of secorin cocoons and also structural changes in silk fibers caused by heat treatment.

The cocoon shell plays a significant role in the transformation from silkworm and pupa to an adult butterfly. Studies of the physico-mechanical properties of this kind of natural polymer composite materials will be of particular importance for a deeper understanding of the evolution and physiology of silkworms, the processing system of natural polymers, and will be of interest for the biomimetic design of artificial structures [10-11]. However, to date, there are no results of studies of the mechanical properties and microstructures of silkworm cocoons. Hong-Ping Zhao [12] studied systematic experimental studies of silkworm cocoons, which can be considered as layered biomaterial bound by sericin, a cocoon shell constructed by the larva of the Chinese silkworm, B. Mori. He studied the modulus of elasticity and strength of the cocoon and the quality of the resulting composite material. Their changes along the thickness direction were also measured by artificial peeling of the cocoon to thinner layers. It should be noted that both the elastic modulus and strength change in the direction of the thickness in such a way that the cocoon can effectively withstand not only external static forces, but also dynamic shock loads [13-15].

Pupae can be stained by placing cocoons in containers with hot air, steam, gas, etc. The main requirements are the brevity of the process, high productivity, maintaining the quality of the shell of cocoons (technological indicators), adhering to safety and environmental regulations [16-19].

In the work of K.R. Avazov, the improved available SK-150K unit with a new device using infrared rays is considered. At present, on the primary processing bases, live cocoons are pre-treated with hot air. The main active part of the coconut dryer is the SK-150K unit, which is used in the mode of pickling (under drying) at a temperature of 110-120 0C for 1.5-2.0 hours. As a result of preliminary research by scientists K.R. Avazovyh, it was found that a suitable option for carrots cocoons is the effect of infrared rays [20-23].

In the work of K.R. Avezov, a thorough literature review and initial experiments were carried out, which showed that it was necessary to create a maximum wavelength of 1.1 μm for the primary processing of silkworm cocoons. A new device was created for cocoon carrots using, based on the influence of the same wavelength, ICZ, which is widely used today [20-23].

Today, more than 80 million linear plantations and 51 thousand hectares of mulberry plantations provide for the feeding of 450 moth silkworm caterpillars and the production of about 26 thousand tons of silkworm cocoons. To cover the deficit, 230-250 thousand boxes of silkworm grena are imported annually - up to 50% of the needs of the industry.

Particular attention in the decree was paid to the production of grain and cocoons, their preparation and primary processing through the introduction of highly productive breeds and hybrids of silkworm, modernization of existing and creation of new capacities for the production of raw silk, as well as the organization of deep processing of cocoons.

It is expected that by 2021 the total share of processing volumes of silkworm cocoons will be increased by 50%, with the creation of new jobs and an increase in the flow of foreign exchange funds due to export of products [24].

This paper discusses the possibilities of primary processing i.e. silkworm cocoons and drying (*Bombyx mori*) using elastic waves and infrared radiation [25-26].

The Tashkent State Technical University has developed a mechanism for generating low-frequency oscillations due to an electromechanical drive to pallets. In the laboratory of the department, a full-scale test was conducted for carrots and drying of silkworm cocoons. The results of the data obtained carrots and drying cocoons of silkworm are shown in table 1-4.

Table 1

Experimental results of carrots and drying of living cocoons (*Bombyx mori*) with the number of one hundred pieces by infrared rays, the effects of vibration and elastic elastic waves (the distance between the tube distributing infrared rays and raw materials is 10 cm, the duration of the process is 5 minutes)

Experiment numbers	The initial weight of cocoons, g	Weight after processing with infrared rays, g	Weight after processing with infrared rays and vibration, g	Weight after processing with infrared rays and the influence of elastic waves, g	Weight after treatment with IR rays after 10 days, g	Weight after treatment with infrared rays and the influence of vibration after 10 days, g	Weight after processing with infrared rays and the influence of elastic waves through 10 days, g	Processing temperature, °C
1	108,2	102,8	98,5	100,1	93,1	89,8	92,5	55-60
2	110,6	104,0	101,8	103,4	94,0	90,7	92,9	55-60
3	115,2	106,0	103,7	104,8	100,2	96,8	99,6	55-60
4	112,8	106,0	103,8	105,5	99,3	94,8	98,1	55-60
5	117,0	108,8	106,5	107,6	101,8	99,5	101,2	55-60
	112,7	**105,5**	**102,8**	**104,3**	**97,7**	**94,3**	**96,9**	**55-60**

Table 2

Experimental results of carrots and drying of living cocoons (*Bombyx mori*) with the number of one hundred pieces by infrared rays, the effects of vibration and elastic waves (the distance between the tube distributing infrared rays and raw materials is 10 cm, the duration of the process is 5 minutes)

Experiment numbers	The initial weight of cocoons, g	Weight after processing with infrared rays, g	Weight after processing with infrared rays and vibration, g	Weight after processing with infrared rays and the influence of elastic waves, g	Weight after treatment with IR rays after 10 days, g	Weight after treatment with infrared rays and the influence of vibration after 10 days, g	Weight after processing with infrared rays and the influence of elastic waves through 10 days, g	Processing temperature, °C
1	117,2	107,8	105,5	107,8	84,4	79,7	84,4	60-65
2	112,8	100,4	97,0	101,5	85,7	81,2	81,2	60-65
3	116,5	107,2	104,9	104,9	87,4	83,9	85,0	60-65
4	109,6	107,4	107,4	106,3	84,4	80,0	82,2	60-65
5	111,0	102,1	101,0	102,1	86,6	79,9	82,1	60-65
	113,4	**105,0**	**103,2**	**104,5**	**85,7**	**80,9**	**83,0**	**60-65**

Table 3

Experimental results of carrots and drying of living cocoons (*Bombyx mori*) with the number of one hundred pieces by infrared rays, the effects of vibration and elastic waves (the distance between the tube distributing infrared rays and raw materials is 10 cm, the duration of the process is 5 minutes)

Experiment numbers	The initial weight of cocoons, g	Weight after processing with infrared rays, g	Weight after processing with infrared rays and vibration, g	Weight after processing with infrared rays and the influence of elastic waves, g	Weight after treatment with IR rays after 10 days, g	Weight after treatment with infrared rays and the influence of vibration after 10 days, g	Weight after processing with infrared rays and the influence of elastic waves through 10 days, g	Processing temperature, °C
1	114,6	106,6	103,1	104,3	83,7	77,9	82,5	65-70
2	115,4	103,9	99,2	100,4	83,1	79,6	80,8	65-70
3	111,2	103,4	100,1	101,2	84,5	81,2	83,4	65-70
4	112,1	109,9	107,6	108,7	83,0	78,5	80,7	65-70
5	114,2	106,2	102,8	105,1	85,7	77,7	80,5	65-70
	113,5	**106,0**	**102,6**	**103,9**	**84,0**	**79,0**	**81,6**	**65-70**

Table 4

Experimental results of carrots and drying of living cocoons (*Bombyx mori*) with the number of one hundred pieces by infrared rays, the effects of vibration and elastic waves (the distance between the tube distributing infrared rays and raw materials is 10 cm, the duration of the process is 5 minutes)

Experiment numbers	The initial weight of cocoons, g	Weight after processing with infrared rays, g	Weight after processing with infrared rays and vibration, g	Weight after processing with infrared rays and the influence of elastic waves, g	Weight after treatment with IR rays after 10 days, g	Weight after treatment with infrared rays and the influence of vibration after 10 days, g	Weight after processing with infrared rays and the influence of elastic waves through 10 days, g	Processing temperature, °C
1	109,5	104,0	102,9	102,9	82,1	76,7	81,0	70-75
2	115,6	102,9	99,4	100,0	82,7	79,8	80,9	70-75
3	112,3	102,2	99,9	101,1	83,1	80,9	83,1	70-75
4	110,0	107,8	106,7	106,7	82,5	77,0	79,2	70-75
5	116,4	105,9	102,4	104,8	85,0	76,8	80,3	70-75
	112,8	**104,6**	**102,3**	**103,1**	**83,1**	**78,2**	**80,9**	**70-75**

Experimental work was carried out to pacify and dry live silkworm cocoons of the silkworm (*Bombyx mori*) of the Musaffo Tola cultivar grown in the summer season. Studies were carried out to determine the parameters as the temperature and time of drying and carving of the silkworm in 5 times repetition. The study revealed that, as the silkworm cocoons processed in the temperature range at 65-70 °C using vibration waves were moderate for 3-5 minutes and for 10 days at a temperature of 38-42 °C the cocoons continued to dry to 10-12% of the cane humidity. The use of elastic waves in the processing of cocoons proceeded 5-10% lower relative to the processing using vibratory waves. Experiments to determine the optimal distance from the tube distributing infrared rays to raw materials showed 10 cm

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