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Effects of Elastic Waves in the Primary Processing of Silkworm Cocoons

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Abstract: ***The article deals with the study of the effect of elastic waves in the primary treatment of silkworm cocoons. It was achieved the production of a quality silkworm product in the drying process at a temperature of 65^0C for 50 minutes, using a vibration of 1 m/s^2 for 2 minutes. Based on the obtained results, it can be concluded that the proposed technology makes it possible to obtain high-quality final products for use in the textile industry.***

Keywords: Vibration, Cocoon Silkworm, Silk, Infrared Radiation, Drying, Appeasement, Finished Product.

I. INTRODUCTION

Natural silk is in great demand in many countries. In consumer properties, it is higher than other textile fibers. Great strength, high elasticity, hygroscopicity, the beauty of fabrics, the irreplaceability of silk fiber in some technical industries, makes natural silk unique.

In China, Japan, India, Vietnam and some other countries of traditional sericulture, multiple, 4-8-fold feeding of silkworms is used. In Uzbekistan and other CIS countries, only one extra feeding takes place, which impedes the development of the industry. There are many reasons for this, for example, the lack of a prepared fodder base, mechanization and automation tools in most technological processes, underestimation of the importance and capabilities of the industry by decision-making bodies and, as a result, workers' disinterest in the effectiveness of unattractive, mainly hard manual work, generating income for only about three months in year.

The lack of technical means on the main processes in the field of grain production, harvesting and distribution of feed to silkworms, feeding, on the basis of primary processing of cocoons, an imperfect technology that does not take into account the introduction of new technology and much more does not allow raising sericulture to a higher level.

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Sericulture around the world to date remains the most weakly mechanized agricultural sector. The main reasons for this have always been the specifics of the industry, cheap labor in the countries of traditional sericulture and difficulties in creating technical means that ensure high-quality work with a living biological product.

One of the important ways to increase this value of the industry is the improvement of the technology for the production of silkworms and cocoons of silkworm based on the comprehensive mechanization of the main processes in silkworm cultivation. There are also many problems in world sericulture. These are periodic ups and downs in demand for natural silk products, and also a low level of mechanization of labor-intensive processes. The main producer of cocoon raw materials - China, does not have serious technical means on the basic technological processes. However, the unique industriousness of the Chinese, high-quality, strict implementation of technological requirements, allows them to maintain world leadership in the production of cocoons and raw silk. The same situation is with mechanization in Korea, Vietnam, India, Bulgaria, etc. This is another prerequisite for the need for widespread adoption of the equipment created by us and advanced technology, which will allow us to compete favorably with other countries.

In Japan (also one of the leading silkworm countries), there is currently a sharp decline in the production of cocoons and, as a result, raw silk. The reason is the same - the complexity of production, the departure of workers to other more popular sectors. Although the processes are somewhat better mechanized than in other countries. But this is mainly small artisanalization and it is also far from enough. The narrow seasonality, fragmentation, the complexity of technological processes, the lack of training bases for technical specialists and other reasons for the low level of mechanization and automation of sericulture. For such a short (15-30 days) operation period, it is inefficient and sometimes economically disadvantageous to purchase relatively complex and expensive machines, to keep in farms that carry out one feeding per year, the appropriate equipment that must be serviced by qualified specialists. The material and technical base of sericulture has not changed much over the past 40 years, and since the 90s of the last century has deteriorated even more. Therefore, the growth in the production of cocoons is not accompanied by a decrease in the cost of production and an increase in its quality, but rather, since these indicators are directly dependent on the level of mechanization of the industry [1]. Cocoons, which are the raw material for silk, are stained and treated with hot air or steam (at a temperature of 75-80 0C for 15-20 minutes) to kill the pupa and prevent it from turning into a butterfly, which spoils the cocoon, making an exit hole in it.

Frozen cocoons are dried for 2-3 months on shadow dryers (racks) so that they do not deteriorate during storage.

On the 10th day, the pupae turn into butterflies, which mate immediately after leaving the cocoon. Within 2-3 days, the females lay 500-700 eggs (grena) and die after some time. Production processes in sericulture.

- growing mulberry, which is the only fodder plant for silkworm caterpillars;
- production of grena;
- incubation of grena - revitalization of the testicles of the silkworm;
- feeding of caterpillars;
- primary processing of cocoons [2].

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 [3-4].

The process of processing silkworm cocoons is characterized by a number of parameters: the quality and quantity of raw materials and the finished product, the temperature and relative humidity of the environment, the residence time of the product in the installation.

For the primary processing of silkworm cocoons using low temperature using infrared radiation and vibration is one of the most innovative and more suitable drying methods. For primary cocoon processing, vibration can be used in combination with other core technologies in the process. Vibration affects the process as a physical factor, the action of mechanical energy from a vibration source. The main characteristics of vibration are the amplitude of the displacement, speed and its acceleration.

Vibration, as well as sound, infra- and ultrasound, shock waves, are constantly acting physical factors that accompany the evolution of life on earth, during which special structures, mechanoreceptors, appeared and improved in a living organism. The structures of living organisms, perceiving various types of mechanical energy, developed in two directions: the number of receptor endings per unit area increased and their sensitivity increased.

Vibration in the environment creates a kind of information field. Nature made sure that living organisms were able to use vibrational (vibrational) processes as information. Vibrations acting on biological objects are of a dual nature. In some cases, they stimulate life processes, and in others inhibit them. Researchers are paying special attention to the study of the physiological effect of infrasound vibrations on living organisms, which cause depression, causeless fear, panic, inadequate response to what is happening, etc.

Since in the general case, vibrations are a complex nonharmonic process, it is advisable to analyze the vibrations using a spectrum. Spectral analysis allows you to select the frequencies and amplitudes of the individual components of the vibration.

In many species of living organisms (birds, insects, reptiles, animals, etc.), vibration receptors are among the most important life support systems and vital functions. So, predatory fish, even with loss of vision, have the ability to accurately determine the location of the prey by the amplitude-frequency characteristics of the vibrations caused by the movements of the prey [5].

II. EXPERIMENTAL AND RESULTS PART

One of the possible options for creating vibrational movements for the primary processing of silkworm cocoons is the development of the vibromechanism of the pallets of a drying cabinet with infrared irradiators for heating products [6-7]. The Tashkent State Technical University has developed a mechanism for generating low-frequency oscillations due to an electromechanical drive to pallets. The laboratory of the department conducted a full-scale test for the primary processing of silkworm cocoons. Experimental studies are shown in table 1 "The results of the data obtained are the primary processing of silkworm cocoons" and in table 2 "The results of the data obtained are the primary processing of silkworm cocoons using vibration".

Table 1. The results of the data obtained are the primary processing of silkworm cocoons

№	Initial mass, g	Weight after processing, g	Weight after 10 days, g	Processing temperature, ^{0}C	Processing time, min
1	50.1	41.8	28.2	55	80
2	49.6	41.0	28.6	60	75
3	49.8	41.2	27.6	65	70
4	50.5	42.3	29.2	70	65
5	50.2	42.0	28.7	75	60
6	49.5	40.7	26.0	80	55

Table 2. The results of the data obtained are the primary processing of silkworm cocoons using vibration

№	Initial mass, g	Weight after processing, g	Weight after 10 days, g	Processing temperature, ^{0}C	Processing time, min	Vibration frequency m/s^2 (meters per second squared)
1	49.5	43.8	28.8	55	60	1
2	50.2	43.1	28.3	60	55	1
3	49.6	42.5	28.0	65	50	1
4	50.4	41.7	27.6	70	45	1
5	50.3	41.2	27.2	75	40	1
6	49.8	40.2	26.7	80	35	1

As can be seen from the tables, the primary processing of silkworms was faster using vibration. In addition, the weight of the cocoons of the same variants processed using vibration has been preserved relatively much more, and this suggests that heavier cocoons retained more moisture than the first version processed without vibration. Such raw materials in future use in the textile industry will give an effective result.

The results of the process of the effect of vibration on the primary processing of silkworm cocoons are shown in Fig. 1 "Dynamics of the vibration velocity used in the primary processing of silkworms".

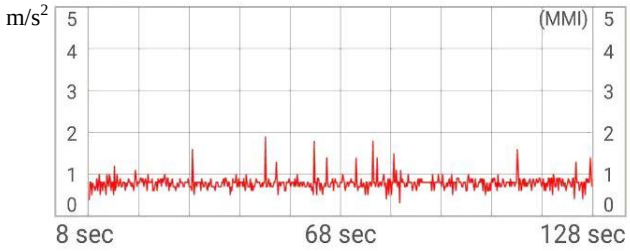

Fig. 1. The dynamics of the vibration velocity used in the primary processing of the silkworm

The figure shows the result of repeated experiments and the selected variation in the dynamics of vibration velocity that was supplied during the initial processing of the silkworm.

III. CONCLUSION

It was achieved to obtain a high-quality product when processing silkworms at a temperature of 65 °C for 50 minutes using a vibration of 1 m / s2 for 2 minutes.

Received recommendations for the use in the processing of infrared rays and elastic waves (vibration) to obtain a quality product, reduce the time of primary processing, and also save energy.

Based on the results obtained, it can be stated that further improvement of the installation developed by the authors and acceleration of the primary processing process using hot air at a temperature of 65 °C and with vibration combinations of 1 m/s^2 for 2 minutes creates the opportunity for good preservation of natural physical mechanical and technological indicators of the cocoon shell.

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