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PRODUCTION TECHNOLOGY FOR RAW SILK MEETING QUALITY CLASS 4A REQUIREMENTS IN ACCORDANCE WITH INTERNATIONAL STANDARDS

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Abstract
This article presents the results of research work carried out at the Uzbek Research Institute of Natural Fibers in the field of improving the quality of cocoons from local silkworms, increasing the yield and improving the quality of raw silk that meets the requirements of quality class 4A according to the criteria of international standards. New methods of receiving, transporting, storing and preparing cocoons for unwinding are also presented, ensuring high quality raw silk and reducing the specific consumption of cocoons during their production. The results of industrial testing of new methods in production enterprises are also presented.

Keywords: Agricultural technology, technology, cocoons, cocoon thread, vacuum steaming, pressure, filling with water, sericin, fibroin, unwinding, thread tension, cocoon reeling, raw silk, quality.

Introduction

Natural silk is the most expensive and valuable raw material of the textile industry. The Republic of Uzbekistan is one of the leading countries in the world producing and processing natural silk. He is currently ranked fourth in the world. In recent years, the silk industry has further developed, especially in light of recent decisions by the top leadership of our state.

A number of Decrees and Resolutions of the President of the Republic of Uzbekistan define the tasks of improving and strengthening the silk-winding industry. For this purpose, it is planned to expand the food supply of silkworms by additional planting of linear plantations and mulberry plantations, organizing the production and procurement of high-quality silkworm cocoons. It is necessary to improve the primary processing and processing of cocoons, modernize existing and create new facilities for the production of raw silk and silk yarn, and organize deep processing of silkworm cocoons. It is necessary to improve the effective organization of work to increase production volumes and improve the quality of finished silk fabrics, develop its most popular assortments, increase the export potential of the industry, and ensure standardization that meets international requirements.

Today, on the territory of the republic, in the systems of the Uzbekipaksanoat (Uzbekshelkprom) association, there are more than 40 silk-winding enterprises, where more than 100 series (400 catchers in each series) of high-performance coco-winding machines FEIYU 2000 EX, FEIYU 2008 NTD-301, D are installed -300, KSS-RS-100 and others made in China, South Korea, Vietnam. The total capacity of silk reeling enterprises equipped with

imported equipment is 38,800 catchers. However, there is a relatively high specific consumption of cocoons, despite the high level of mechanization and automation of technological processes, and raw silk meeting the requirements of quality class 4A according to international standards is significantly lower than expected. Therefore, improving the quality of the produced raw silk and reducing the specific consumption of cocoons is an urgent task facing the silk industry of the Republic.

PURPOSE OF THE STUDY

The goal of the work is to produce raw silk of quality class 4A which meets the norms and requirements of international standards, ensuring the production of high-quality raw silk with minimal energy and labor costs. This goal is achieved by introducing a new agricultural technology for growing mulberries and cocoons, creating a new suitcase-type container for receiving, transporting and storing cocoons, as well as a universal vacuum-steaming device for forced filling of the internal cavity of cocoons with process water of a certain temperature.

RESEARCH METHODS

Theoretical and experimental research methods were used in the work. The methodological basis of the research was the work of scientists in this field and methods of mathematical analysis. The results of experimental studies were processed using the methods of mathematical statistics.

MAIN PART

It is known that the quality of raw silk primarily depends on the technological and quality indicators of the cocoons used in cocoon reeling. It's no secret that the technological and quality indicators of cocoons made from imported grain (Japanese, Chinese) significantly exceed the technological and quality indicators of cocoons from local grain. Therefore, the breeding scientists of our republic are creating new breeds and hybrids of local cocoons, some of which exceed the quality of even their imported counterparts.

In order to determine qualitative and quantitative indicators in the experimental area of UzSRI, (Sericulture Research Institute) a trial feeding of several new hybrids created at the Scientific Research Institute of Sericulture was carried out using the new agricultural technology created by UzSRI for growing mulberries and feeding silkworms. After collection The grown cocoons were subjected to comprehensive testing of the cocoons in the conditions of the testing laboratory of the institute using the methods of current standards.

The qualitative and quantitative indicators of cocoons largely depend on the method of receiving and primary processing of living cocoons. Currently, live cocoons are received from silkworm breeders using the old method, pouring cocoons in bulk; silkworm breeders bring cocoons in improvised means, i.e. in bags, in baskets, in pieces of material, etc. In this method of accepting cocoons, there is a very high probability of increasing the number of rejected cocoons, especially in the form of crumpled and spotted cocoons. Therefore, in order to improve the quality of receiving live cocoons, a pilot batch of a new design of "suitcase" type containers for receiving, transtorting and temporary storage of live cocoons was created and manufactured

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at the Andijan Mechanical Engineering Institute together with specialists from Uzbek Research Institute of Natural Fibers.

In Fig. Figure 1 shows a general view of the developed container for receiving, transporting and storing cocoons.

Fig.1. General view of a new "suitcase" type container for receiving, transporting and temporary storage of living cocoons

The new container for receiving, transporting and storing cocoons consists of a metal frame and a cover covered with it. The cover is made of high-strength fabric with good breathability. In Fig. Figure 2 shows a diagram of the metal frame of the container for receiving, transporting and storing cocoons.

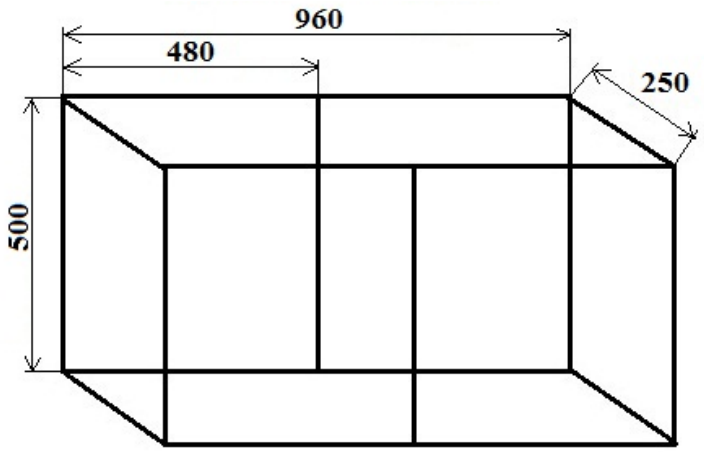

Fig.2. Diagram of the metal frame of the container for receiving, transporting and storing cocoons

As can be seen from Fig. 2, the diagram of the metal frame is very simple, convenient for manufacturing, all elements of the frame are removable, i.e. collapsible frame. The frame can be easily disassembled and assembled easily. The weight of the container is no more than 2.5

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kg, the container capacity is 16-20 kg of live cocoons. The manufactured batch of new containers was tested at several cocoon procurement points.

The quality of the produced raw silk largely depends on the preparation of the cocoons for unwinding. In this case, special attention should be paid to the process of steaming cocoons, since all the quality indicators of the produced raw silk depend on this technological operation. The purpose of steaming cocoons is to fill the internal volume of the cocoons with process water and soften the sericin to relax the sericin adhesion force. Without performing this operation, it is impossible to unwind the cocoons. With automatic cocoon reeling, steaming of cocoons is carried out on steaming units of various types, and with mechanical cocoon reeling, this process is carried out manually on individual steaming boilers. Therefore, there are two methods of cocoon reeling: individual and centralized methods of steaming. When steaming cocoons using individual and centralized methods, filling the internal volume of the cocoons occurs in a steam-water environment, due to the creation of a pressure difference inside the shell of the cocoons. These methods are used on mechanical coco-winding machines of the KMS-10, KS-10 type and on cocoon-winding units of the KZ-150-ShL or Chiba-D type.

However, in recent years, enterprises in the republic have been using a vacuum method of filling cocoons with water, and softening the sericin in the cocoon shell is carried out directly by finding the ends of the cocoon threads on cocoon shaking machines. With existing technologies used in cocoon-winding enterprises of the republic, the internal volume of cocoons should be filled with process water at least 97%, since unwinding cocoons produces a submerged state.

The essence of the vacuum method for processing cocoons is that the cocoons are placed in a chamber, from which the air is then pumped out with a vacuum pump. As the air in the chamber decomposes, water begins to flow inside the cocoons. However, when using this method, the filling of cocoons with water varies widely, since the filling of cocoons is somewhat influenced by technological indicators, for example, the geometric dimensions of the cocoons, the density of the shell, the linear density of the cocoon threads, etc. Our experiments to determine the degree of filling cocoons with process water show that the cocoons are filled gradually. After 2 minutes, the process of filling with water slows down, despite the fact that the vacuum pump continues to operate; it takes at least 20 minutes for the cocoons to be filled with water to 97% of the internal volume. This is the main disadvantage of foreign-made vacuum devices.

In order to eliminate this drawback of the method, we have proposed a new method and a new domestic universal vacuum steaming installation for filling cocoons with process water. The essence of the new method is that after the air starts to be pumped out, the chamber lid is opened for 2 minutes, the cassettes with cocoons are pulled out and left in the air for 1.0 minutes. During this time, air penetrates inside the shell and the pressure inside the cocoon becomes equal to atmospheric pressure. After this, the cassettes with cocoons are placed in the chamber, the chamber lid is tightly closed and air is pumped out of the chamber for 1.5-2.0 minutes. During this time, the internal volume of the cocoons is filled with process water; the duration of filling the internal volume of the cocoon is 5-7 minutes. Figure 3 shows a technological diagram of a new universal vacuum steaming installation of domestic production.

The technological process on the created vacuum-steaming device is carried out as follows: a basket with 3 kg of dry cocoons is placed on the vacuum-steaming chamber -2, after which the

chamber lid is hermetically closed. After this, the vacuum pump -1 is turned on and air is sucked out of the chamber through pipelines and warm water, previously prepared in the water treatment tank -3, is supplied to the chamber. Depending on the method of unwinding the cocoons, on the quality indicators of the cocoon shell being steamed, taking into account the loading and unloading of the chamber, the weight of the steaming cycle lasts 6-8 minutes. The cocoons steamed in this way are transferred to a shaken machine for further processing. One of the main advantages of the created universal vacuum steaming installation is that the installation is small in size and can be used when steaming small batches of cocoons for complex laboratory tests, as well as when establishing technological parameters for processing new batches of cocoons. In Figure 3 shows a general view of the created universal vacuum-steaming installation.

Fig.3. General view of the universal vacuum steaming unit

The developed method for receiving cocoons in new containers and a universal vacuum steaming installation were tested in the production conditions of a cocoon winding factory. An experimental unwinding of a batch of cocoons was also carried out, prepared for unwinding according to the proposed method on a universal vacuum steaming installation. Indicators of production testing of the proposed method are given in table 1.

Table 1. Indicators of cocoon unwinding during production testing of the proposed method in the conditions of a cocoon winding enterprise

№	Name of technological indicators of cocoon unwinding	Research options	
		Experience	Control
1	Filling of cocoons with water,%	not less than 98	55-57
2	Average silk content of cocoons, %	52,58	50,60
3	Length of continuously unwinding cocoon thread, m	925	730
4	Total length of cocoon thread, m	1005	985
5	Linear density of cocoon thread, tex	0,275	0,280
6	Metric number of cocoon thread	3636	3571
7	Unwinding of the cocoon shell, %	89,96	82,12
8	Yield of raw silk, %	37,85	31,15
4	Specific consumption of cocoons, kg/kg	2,64	3,21
5	Number of unwound cocoons, kg	100,0	100,0

Analysis of the data given in table 1 shows that unwinding cocoons prepared according to the proposed method gives better results in all main technological indicators due to better preservation of the shell during acceptance, transportation and storage, as well as better filling of the internal volume of the cocoons with process water.

After producing a pilot batch of cocoons, a comprehensive laboratory test of the resulting raw silk was carried out according to the methods and requirements of the O'zDSt 3313:2018 standard for determining grade, the results of which are given in Table 2.

Table 2. Results of comprehensive laboratory tests of raw silk of the experimental and control batches in the conditions of the testing laboratory of Uzbek Research Institute of Natural Fibers

№	Signs	Research options					
		Experience – 2,33 tex			Control – 2,33tex		
		in fact according	to the standard	grade	in fact according	to the standard	grade
1	Deviations in linear density (tex):	0,12	0,13	4A	0,19	0,22	A
2	Disagreement 1	145	150	4A	195	210	A
3	Disagreement 2	-	10	4A	28	37	A
4	Cleanliness for major defects, % no less	96	95	3A	95	95	3A
5	Cleanliness for minor defects, % not less	95	94	4A	89	90	2A
6	Worst purity, % no less	91	90	4A	85	83	2A
7	Maximum deviation, tex	0,29	0,35	4A	0,51	0,60	A
8	Disagreement 3	-	0	4A	4	6	A
9	Rewinding capacity, number of breaks, no more	-	4	4A	8	10	2A
10	Relative breaking load, cN/tex	34	30 or more	4A	30	30 or more	2A
11	Relative breaking elongation, %	19	18 or more	4A	19	18 or more	2A
General grade				3A			A

Analysis of the data given in Table 2 shows that the quality indicators of the raw silk of the experimental version meet the requirements of quality class 3A, although absolutely many indicators of the raw silk of the experimental version correspond to quality class 4A. According to the requirements of the O'zDSt 3313:2018 standard, the grade of raw silk is determined by the worst indicator. For this reason, the produced raw silk is rated quality class 3A, and the raw silk of the control variant is rated quality class A.

Thus, the introduction into production of the created new agrotechnology for growing mulberries and feeding silkworms, as well as a new method of receiving, transporting and storing cocoons, preparing them for unwinding using a universal vacuum steaming installation

allows for a sharp improvement in the quality of the produced raw silk, at the same time significantly reducing the specific consumption of cocoons.

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