Setting Cocoon Washing Parameters And Determining The Quality Indicators Of The Produced Raw Silk

Xaitova Zumradxon Rakhmatullaevna
Margilan Technical School No. 4
Republic of Uzbekistan, Fergana
E-mail: Xaitova.001@gmail.com
Mo'minova Moxinur Dilshodjon qizi
Margilan Technical School No. 4
Republic of Uzbekistan, Fergana
E-mail: monamuminova.001@gmail.com

Abstract
This article studies the current state of cocoon washing equipment, the working process, mechanical cocoon washing machines and automatic cocoon washing machines. It is determined that the current technologies of raw silk production consist of four stages, namely, preparation, preparation, washing and control-collection. The development of specific recommendations for cocoon washing and the introduction of its technology are presented**.**
Keywords: KMS-10, KS-10 (Uzbekistan), SRM-10 (Italy), RM-320 SK–5, SKE-4VU KM – 90 (Uzbekistan), Gunze, Keinan, Tama (Japan), D-01, D-300B, FY 2000 EX, FY 2008 NT (China), KSS-RS-100 (South Korea) cocoon washing machines. SK-5, KM-90, SKE-4VU, KMS-10, KS-10, Gunze cocoon machines D-301, D-300B, FY 2000 EX, FY 2008 NT, KSS-RS-100

In order to ensure the continuous operation of technological processes and obtain high-quality raw silk, it is necessary to establish separate washing regimes for cocoons grown in different climatic conditions of our republic. During our research, alternative regimes were developed by studying the physical, mechanical and technological properties of cocoons grown in both regions.
Cocoons grown in different climatic conditions and brought to the PDI bases were sorted, and after killing the cocoon inside the cocoon, raw silk was spun from the cocoons in the cocoon spinning workshop.
To produce raw silk that meets the requirements of the state standard UzDSt 3313:2018, cocoons of 15.0 kg each were taken from the cocoons of Local hybrids grown in the Fergana regions, prepared for spinning in the recommended method, spun at the enterprise, and high-quality raw silk with a thread count of 2.33 was produced. The quality indicators of raw silk have been determined in accordance with the requirements of the UzDSt 3313:2018 state standard. The first-level quality indicators of raw silk include the unevenness of the linear density of the thread, the deviation of the linear density, and the cleanliness of major defects. The second-level quality indicators of raw silk are the ability to rewind, the elongation at break of the threads, the relative breaking strength, the cleanliness of minor defects, the condition of the threads, and the tightness of the threads [1.].
The purpose of cocoon spinning is to obtain high-quality raw silk of a given linear density, that is, strong, elastic, tight, and clean. This process is carried out by spinning several cocoon threads together. The cocoons are spun depending on the length of the threads, and therefore the time they are held in the bundle also varies [2.].

The following formula was used to calculate the selected linear density: $T_{ber} = T_{pil} \cdot n$ (1)

T_{pil} - average linear density of cocoons in the bundle;

n - The average number of cocoons in the bundle.
The number of cocoons at the base of the bundle during cocoon washing was n = 7-8 pieces in 2.33 tex.
In the calculation of the alternative washing speed in the FY-2008 NT automatic cocoon washing machine, separate cocoon washing speeds were set for both areas. The remaining machine parameters were kept the same. In this case, the washing powder temperature was 42-45 °C, the temperature in the drying cabinet was 40-42 °C, the length of the cocoon body was 8-10 cm, and the angle of exit of the yarn from the cocoon was α=85 °C degrees.
The cocoon washing speed in the automatic cocoon washing machine affects the productivity and silk quality. If the cocoons are washed faster than the set speed, the number of breaks in the cocoon yarn increases and affects the quality of the raw silk.
The maximum utilization of the cocoon shell during spinning is reduced by the following factors: silkworm breed, hybrid, rearing conditions, geometric characteristics of the cocoon shell, various external influences and processing processes. In general, evaporation represents the passage and absorption of water through the shell. Uneven passage of water along the cocoon shell leads to a decrease in its spinning properties and raw silk yield. In the research work, spinning parameters were established for cocoon hybrids (Table 1).

Cocoon washing modes

№	Parameters	Indicators
1	Water temperature in the steaming pot, 0C	 93-95 91-93
2	For new cocoons	75-78
3	For old cocoons	42-45
4	Water temperature in the shaking pot, °C	40-42
5	Temperature in the washing powder, °C	8-10
6	Temperature in the drying cabinet, °C	85

In order to extract high-quality raw silk from cocoons, the total length of the threads, the length of continuous twisting, the unevenness of the thread in terms of linear density, and the mechanical properties of the thread are of great importance. The quality of the raw silk to be extracted is affected by such indicators as the breed of silkworm, the total and continuous twisting lengths of the cocoon threads, the fineness of the thread in terms of length, the elongation at break, the breaking strength, and the linear density of the cocoon thread.
The alternative spinning speed in the FY-2000 NT automatic cocoon spinning machine is determined by the following formula [3].

$$v = \frac{N \cdot l_{u.u} \cdot T_{p.p}}{T_{x.i} \cdot m} \cdot K \qquad (2)$$

N - cocoon spinning rate per minute per skein (N=28 for 2.33 tex raw silk)
-length of cocoon thread that can be spun without breaking, m; -average linear density of cocoons in the batch, tex; -given average linear density of raw silk, tex; -number of hangers in the skein-20; -coefficient of speed loss due to slippage (0.95) and thread breakage (0.9),
In the research work, we found an alternative spinning speed in laboratory conditions for Chinese hybrid spinning cocoons grown in 2022. For this, samples were taken from the cocoons, steamed in a steamer, and spun in an automatic cocoon spinning machine. 8 cocoons were spun under the skein. The parameters of the spun raw silk were as follows.

Table 2
Technical parameters of spun raw silk

№	Technical indicators of spinning and raw silk extraction	Values
		Fergana
1	Number of cocoons thrown under the skein for 30 min, pcs	8-9
2	Cocoon spinning speed on the loom, m/min	90
3	Total length of yarn hitting the reel, m	1020
4	Average number of cocoons under the hook, pcs	7-8
5	Continuous spinning length	655
6	Alternative spinning speed, m/min	111
7	Specific cocoon consumption, kg	2,9
8	Linear density of raw silk, tex	2,33
9	Linear density of cocoon yarn, tex	0,33
10	Raw silk yield, %	34,5

After the cocoons from both regions were cooked and the ends were found using the recommended method, raw silk with a thread count of 2.33 tex was spun on the FY-2000 NT cocoon spinning machine. During the spinning process, the calculated alternative spinning speed for the Chinese hybrid cocoons grown in the Surkhandarya region was 111 m/min. The calculated alternative spinning speed for the cocoons grown in the Republic of Karakalpakstan was 95 m/min. The raw silk yield was determined using the following formula:

$$B_{ш.с} = \frac{g_{ш}}{Q_{к}} \cdot 100\% \quad (3)$$

In accordance with the requirements of the state standard UzDSt 3313:2018, the quality indicators of raw silk obtained from Chinese hybrid cocoons in the control and experimental variants were determined. Tests were conducted based on the requirements of the technical conditions UzDSt 3313:2018 “Raw silk”. The quality indicators of raw silk were determined in the laboratory of TTESI “Centexuz”.

The quality indicators of raw silk obtained from Chinese hybrid cocoons grown in the control and experimental variants are presented in Table 4.

Table 4

Quality indicators of raw silk

Indicators Linear density, tex	UzDSt 3313:2018	Uzttiti		Nurli tong silk	
		Supervisi	Experience	Supervision	Experience
	“3A”	“2A”	“3A”	“2A”	“3A”
Linear density deviation (tex)	2,33	2,33	2,33	2,33	2,33
Unevenness 1	0,15	0,17	0,16	0,17	0,18
Unevenness 2	170	180	165	175	160
Cleanness from large defects in %, minimum	17	20	17	20	16

Cleanness from small defects in %, minimum	95	93	94	92	94
Rewindability, number of breaks	92	90	90	90	90
Relative breaking strength, cN/tex	10	10	10	10	10
Breakage at elongation, (%)	30	30	30	30	30
Glue, number of carriage passes	18	18,0	18,0	18	18,5
Indicators	60	60	61	60	63

The quality indicators of raw silk obtained during our experiment correspond to the requirements of the state standard UzDSt 3313:2018, class “3A”. The samples were kept in a laboratory at a temperature of 20±2 °C and a relative humidity of 65±5% for 10 hours in accordance with the standard.

Conclusion

The general methodology for conducting the research mainly included the technical characteristics of the breeds and hybrids studied in the research work, the technical parameters of the FY-522 cocoon steaming and FY-2008 cocoon washing machines studied in the research work. The practical processes in the research were mainly the planning of modern cocoon cooking and washing experiments, analysis and mathematical statistics, modern computer programs, standard and non-standard methods for determining the quality indicators of cocoon yarn and raw silk.

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