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MECHANICAL DAMAGE TO COTTON FIBER DURING PRIMARY PROCESSING OF RAW COTTON

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Abstract
The article presents analyses of mechanical damage to cotton fiber and its impact on quality during technological transitions at a cotton ginning plant.

Keywords: Cluster, cotton, raw materials, fiber, pile, UXK line, raining, pressing, standard O'zMSt, HVI, length, strength.

Introduction

The Decree of the President of the Republic of Uzbekistan dated 17.01.2025 No. UP-7 "On Measures for the Consistent Continuation of the Application of Market Mechanisms in the Production and Sale of Raw Cotton" defines a number of tasks in order to adapt the financing system for the production and sale of raw cotton to market mechanisms, optimize the cost of raw cotton, bring the sale of raw cotton through exchange trading to a new level, as well as increase the material interest of farms and processors [1].

In the 2019-2020 cotton harvest, 25.92 million tons of cotton were produced worldwide, and the United States of America ranks 3rd in the world in cotton production after India and China. According to the International Cotton Advisory Committee, it produced 4.37 million tons of cotton fiber during this period[2].

9.41 million tons of fiber produced in the world were exported, of which 38.2% or 3.59 million tons were exported by the USA and ranked first in the world in cotton exports. Also, 82 percent of the fiber produced in the USA was exported. During this period, 734 million tons of cotton fiber were processed in the USA. Therefore, studying the experience of a developed country in the production of cotton fiber is of great importance.

U.S. raw cotton is not sold, so there are no standards for raw cotton. Raw cotton is processed as a mill at cooperative, company-owned or private cotton ginning plants, the processing costs are usually covered by the produced cotton seeds, but can also be paid in currency **[2].**

When accepting raw cotton in the Republic of Uzbekistan, it is sorted by selection and industrial grade, class, length, and placed in bales. In the USA, raw cotton is stored in small modules in cotton fields after harvesting.

While certification is not mandatory for cotton fiber, the produced fiber is fully evaluated by testing laboratories within the USDA of the U.S. Department of Agriculture, with testing laboratories equipped with approximately 240 HVI systems.[2]

At the cotton-textile cluster enterprises of our country, it is advisable to obtain high-quality and minimally damaged fiber and finished products using international experience and scientific achievements.

MAIN PART

In the processes of cotton harvesting, transportation, storage, and processing, maintaining the natural length and strength of the fiber is one of the important tasks. The use of a large number of mechanisms at these stages leads to mechanical damage to the fiber and a shortening of the initial natural length due to the breaking of the damaged areas.

An important characteristic of raw cotton is its mechanical structure: elasticity, strength, plasticity, elasticity, and relaxation properties. These properties determine the resistance of raw cotton to deformations and impact during drying and processing.

In practice, it has been established that exceeding the established norm of heat supplied to raw cotton during the drying process negatively affects the mechanical properties of the fiber and seeds. This leads to the emergence and development of various defects in subsequent processes, namely cleaning, fiber separation, pressing, and spinning and weaving processes.

In cotton processing, drying and fiber separation are extremely harmful processes, and due to the application of high temperatures in the drying drum, the upper shell of the fiber loses moisture relatively quickly (3-5%) compared to the inner layer, cracks appear in the upper wall of the fiber, and the ends of the fiber dry and break, and due to the incorrect spacing between the working bodies of the gins, fiber breakage occurs. If the amount of damage to cotton fiber increases, the quality of the fiber and products obtained from it also deteriorates, that is, the amount of mechanical damage leads to a decrease in the breaking strength and length of the fiber, and the amount of short fibers increases. This leads to significant economic damage for the enterprise [4].

In order to obtain high-quality raw materials at cotton ginning enterprises, optimal options should be determined for the adjustment of each technological process, starting from the storage of raw cotton in bales. In the test work of foreign scientists, it was found that the fiber breaks at the damaged point. After fiber breakage, the fiber length decreases, which leads to a deterioration in fiber quality indicators.

Today, various types of cotton ginning lines are used at cotton ginning enterprises of cotton-textile clusters in our country. If we look at the example of Namangan region, cotton cleaning lines that have been used for many years at cotton ginning enterprises in the region, as well as cotton processing lines imported from the People's Republic of China and India, are used in various factories. Due to the fact that the technology and equipment used in them, as well as the operating principles, are different, it is natural that the degree of fiber damage also varies.

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The article aims to test the capabilities of these various technological lines, that is, to analyze their impact on fiber properties and determine the possibility of spinning enterprises obtaining high-quality fiber with minimal damage and losses.

TESTING AND ANALYSIS

In this scientific study, first, as an experiment, the capabilities of traditional cotton ginning lines used for many years at cotton ginning enterprises in our country were studied, and scientific tests and analyses were conducted.

In the experiment, in March 2025, samples of cotton fiber were selected from each stage of the production process from the cotton ginning line manufactured and installed by the "Pakhtamash" plant at the Chust cotton ginning enterprise under "Chust Galla Klaster" LLC in Namangan region [5] that is, from seed cotton to the stages of finished fiber pressing, and these samples were tested and analyzed under laboratory conditions using the international testing method - the "HVI-900 SA" device [6]. Selection variety of cotton "Namangan-34."

The test results of samples taken from cotton bales at the cotton ginning enterprise, samples taken after passing through the UHK (cotton ginning) line, and samples taken after ginning and baling processes are presented in Table 1.

Table 1.

No	Quality indicators	**Test sample 1** (Sample taken from a cotton bale)	**Test sample 2** (Sample taken after passing the UHK line)	**Trial sample 3** (Sample taken after harvesting and packaging processes)
1.	Type, *(Type)*	3.	3.	4.
2.	Staple Code, *(Staple)*	39.	38.	37.
3.	High mean length, *(UHML), inches*	1.22	1.18.	1.16.
4.	Micronaire Index, (*Micronaire*)	4.1.	4.2.	4.2.
5.	Specific breaking load, *(Strength), gf/tex*	32.8	32.1.	31.6
6.	Reflection Coefficient, *(Rd), %*	72.9	71.7	70.2.
7.	Yellowing degree, *(+b)*	7.4.	7.5	7.3.
8.	Dirty code, *(Trash), T=Area*10*	7.0	6.0	6.0
9.	Short fiber index, (SFI), %	1.0	2.8.	3.6.
10.	Longitudinal Uniformity Index, *(Uniformity index), %*	85.4	8.3.1.	82.8
11.	Extension at break, *(Elongation), %*	6.6.	6.3.	6.3.

When determining the quality of fiber, it was evaluated based on the requirements of the O'zDSt 604-2016 standard.

UzMSt ASTM D 5867:2024 "Cotton fiber. Using the national standard "Standard Testing Methods for Measuring Physical and Mechanical Properties Using Instruments for Cotton Fiber Classification," the HVI 900 SA system was calibrated and tested in the laboratory with adjusted climatic conditions [8,9,10].

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CONCLUSION

As can be seen from the analysis of the research results, the greatest damage to the fiber under the influence of aggregates at the cotton ginning plant corresponded to the indicators of length and strength, while this important physical and mechanical indicator of the fiber significantly decreased, and the amount of short fibers increased.

In particular, **The upper average fiber length** in the initial state was 1.22 inches, after passing the UHK line it was 1.18 inches, and after ginning and baling processes it was 1.16 inches, which decreased by **100% → 96.7% → 95.1% ,** respectively.

Fiber characteristics by length indicators [7].

Type	High Average Length (UHML)		Staple length (Staple)	
	mm @@35 inches	1a		
from 33.7 to 34.3	from 1.33 to 1.35	1-11/32	43.	1b
from 32.9 to 33.6	from 1.30 to 1.32	1-5/16	42.	1.
from 32.2 to 32.8	from 1.27 to 1.29	1-9/32	41.	2.
31.4 to 32.1	31,4 dan 32,1 gacha	from 1.24 to 1.26	1-1/4	40.
3.	from 30.7 to 31.3 from 29.9 to 30.6	from 1.21 to 1.23 from 1.18 to 1.20	1-7/32 1-3/16	39. 38.
4.	from 28.9 to 29.8 from 28.1 to 28.8	from 1.14 to 1.17 from 1.11 to 1.13	1-5/32 1 - 1/8	37. 36.
5.	from 27.4 to 28.0 from 26.6 to 27.3	from 1.08 to 1.10 from 1.05 to 1.07	1-3/32 1-1/16	35. 34.
6.	from 25.8 to 26.5	from 1.02 to 1.04	1-1/32	33.
7.	from 25.1 to 25.7	from 0.99 to 1.01	1.	32.

Specific breaking load (strength) in the initial state was 32.8 gf/tex, after passing the UHK line 32.1 gf/tex, and after ginning and packaging processes 31.6 gf/tex, respectively, the strength indicator decreased by **100% → 98.9% → 96.3%.**

Specific breaking load (Strength, gf/tex) characteristic [8].

Specific breaking load range of the fiber (Str, gf/tex)	Fiber strength
less than 23.0	Very weak
23.0-24.9	Weak
25.0-26.9	Below average
27.0-28.9	Basic strength
29.0-30.9	Above average
31.0-32.9	Strong
33.0 and more	Very strong
Note - the values of the specific breaking load are given on the SITC (HVI) dynamometer scale.	

The proportion of **short fibers** in the fiber composition was **1%** in the initial state, **2.8%** after passing the UHK line, and 3.6% after ginning and baling processes, and the amount of short fibers unsuitable for spinning increased [10].

REFERENCES

1. Decree of the President of the Republic of Uzbekistan dated January 17, 2025 No. UP-7.
2. Uzagroinspektsiya, Department for Control over the Use of Raw Cotton and Products of its Processing. https://agroinspeksiya.uz/oz/news/paxta-tolasi-ishlab-chiqarish-va-tola-sifatini-nazorat-qilishda-amerika-tajribasi**.**
3. Resolution of the President of the Republic of Uzbekistan dated 06.03.2020 No. PP-4633.
4. Decree of the President of the Republic of Uzbekistan dated 23.10.2019 No. UP-5853.
5. E.Z.Zikriyoev, A.K.Kalimulin, A.A.Sultanhodzhaeva, Candidate of Historical Sciences, Prof. A.P.Parpiev, "Preliminary Processing of Cotton," Tashkent - "Mehnat" - 1999, 396 pages.
6. O'z DSt 581:2002 Cotton processing. Terms and definitions.
7. UzSt 424:2024 Cotton fiber. Sampling methods.
8. UzMSt ASTM D 5867:2024 Cotton fiber. Standard test methods for measuring the physical and mechanical properties of cotton fiber using classification instruments.
9. O'zDSt 604-2016 Cotton fiber. Technical specifications.
10. Uzbek Center for Certification of Cotton Fiber "Sifat." "Determination of cotton fiber quality indicators in the HVI 900-SA measuring system." Methodological Guide. Tashkent-2004.

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