Experimental results of the improved cotton regenerator under production conditions

Abstract. The research article focuses on the application of an enhanced cotton regenerator in the Independence cotton cleaning technology within the TST AGRO cluster, presenting compelling results. The study assessed various key parameters related to cotton fiber quality to compare the performance of the improved cotton regenerator with the existing technology. Several crucial quality indicators were examined during the research, including the length uniformity index of cotton fiber (Unf), relative breaking strength (Str), the number of impurities in cotton fiber (Cnt), the amount of short fibers (SFI), and contamination with non-fibrous impurities. Additionally, changes in the color index (T) and quality aspects such as the degree of yellowness (+b) of the fiber were thoroughly investigated. The research findings revealed that the quality indicators of cotton fiber produced using the improved cotton regenerator surpassed those achieved with the existing regenerator technology. This suggests that the enhancements made to the regenerator positively influenced critical aspects of cotton fiber quality, including fiber length uniformity, breaking strength, impurity levels, and overall cleanliness. Moreover, the study examined color-related parameters, indicating that the improved regenerator contributed to maintaining or enhancing the fiber's color quality. The results of this research signify the potential benefits of implementing the improved cotton regenerator in the Independence cotton cleaning technology. This advancement has the capacity to positively impact the textile industry by delivering cotton fibers with superior qualities, thereby contributing to the overall improvement of cotton processing and manufacturing processes within the TST AGRO cluster.

1 Introduction

The use of cotton fiber in the world textile industry is 55-60% of the total amount of fiber. Consistent and stable development of the cotton ginning industry, introduction of modern tools and equipment in chain enterprises, increase in the level of effective and rational use of production capacity, production of competitive products in the world cotton market are considered the basis. In this regard, in the global cotton ginning industry, special attention is paid to the improvement of high-efficiency cotton ginning equipment and the creation of resource-efficient technologies.
Comprehensive measures are being taken to develop cotton-textile clusters, modernize and equip cotton ginning enterprises, increase the profitability of initial processing of raw materials, and, at the same time, increase the competitiveness of manufactured products, and certain results are being achieved.

In the new development strategy of Uzbekistan for the period of 2022-2026, among other things, "...continuing the industrial policy aimed at ensuring the stability of the national economy and increasing the share of industry in the gross domestic product, aiming to increase the production volume of industrial products by 1.4 times, in this case, the important tasks of increasing the volume of production of textile industry products by 2 times.

In the conditions of the market economy, great importance is attached to maintaining the initial quality indicators of fiber, seed, fluff and other products in order to ensure the competitiveness of the products produced in cotton ginning enterprises along with other industries in the world markets. This, in turn, requires the cleaning of the dust coming out of the enterprise and the release of clean air into the atmosphere so that it does not have a negative effect on the health of people working in the enterprise.

A cotton regenerator of a new construction was developed in the research work conducted by A. Djurayev and others [1]. Mechanical-dynamic characteristics of the electric motor, inertial and elastic characteristics of the transmission mechanisms, working parts of the regenerator and their indicators, taking into account the technological loads of the regenerated products, were determined in the research. The high efficiency of the regenerator has been confirmed in practical experiments.

A new 2RX-M type cotton regenerator was developed by the scientists of "Scientific center of cotton industry" JSC, in which, instead of 480 mm saw drums used in RX regenerators, 300 mm diameter saws from gin equipment were used with reopening of the teeth. In the experiments, it was found that the separation efficiency exceeds 99.2% and the amount of cotton particles in the waste is up to 0.8% when the installation angle of the plates of the rubber-plate separation drum is 50 and the rotation speed of the drum is 960 rpm.

The optimal parameters of the experimental regenerator were determined on the basis of full-factor experiments, the angle of installation of the blades on the disk was -7 degrees, the distance between the blades and the saw blade was 4 mm, the slope angle of the cover was 0.74 degree, and the productivity was 2 t/h. According to the results of experimental tests conducted under production conditions, the total cleaning efficiency of the technological process of cleaning the cotton obtained from the proposed 2RX-M regenerator is 2.3-3.4 percent higher than the existing technological process. and it was determined that the fiber obtained from processed cotton passed to a good grade.

In the research carried out by researchers [2-5], it was found that the structural composition of cotton is important in the cleaning process, it has a positive effect on improving the cleaning efficiency and maintaining the natural quality indicators of the product.

In a number of studies [6-13], research was conducted on improving the cleaning efficiency and maintaining product quality by improving the working parts of cleaning equipment.

2 Materials and methods
regeneration of cotton particles that have been added to impurities. The existing RX regenerator is powered by air. The improved cotton regenerator works mechanically.

Supplier 1; 2 supply rollers; 3 inlet throat; 4th circular guide; 5 transmitting brush drum; 6 saw drum; 7 smoothing brush; 8 column grid; 9 separating brush drum; 10th dirt conveyor; 11 purified cotton outlet throat.

Fig. 1. Scheme of an improved cotton regenerator.

Figure 2. General view of the supply section of the improved cotton regenerator.
On the upper part of the existing RX regenerator in the cotton cleaning technology, the supply part of the proposed design (Figure 2), the separator-conveying brush drum and the cotton exit throat and diverter (Figure 3) were installed. Cotton mixed with impurities from the UXK cleaning stream is transferred to the shaft of the RX equipment by means of an inclined belt conveyor. The cotton falling into the mine is transferred to the saw drum with the help of a pair of supply rollers, and the cotton pieces are attached to the saw teeth with a gluing brush.

After cleaning the cotton from the colostrum’s, the saw drum throws the cotton towards the conveying brush drum. The conveying brush drum in turn moves the cotton upward toward the rotating bevel guide. With the movement impulse received from the transmission brush drum, the cotton saw drum is moved along the length of it by an average of 250 mm and passes to the next part of the saw drum. In this way, the cotton is cleaned 5-6 times, moving in a spiral form through the saw drum and ribs. At the end of the regenerator, a cotton outlet is installed, and in this part, a guide is installed at the top of the transfer brush drum. The function of the guide is to move the cotton towards the exit hole. The cotton cleaned from the regenerator is mixed with the cleaned cotton in the UXK cleaning stream and sent to the ginning section.

In order to compare the results of the experiment, the quality indicators of the cotton produced in the technology with the existing RX regenerator were determined. Experiments were then carried out on the improved RX regenerator.

To determine the amount of moisture and dirt content of cotton, the methods specified in the state standards of UzDSt were used. Also, the quality indicators of cotton fiber were determined in the HVI system. Based on the results of the conducted studies, the schemes of the developed recommended cleaning technology are presented in Figure 4 below.

The recommended technological process works as follows (Figure 4): cotton is dried to the desired moisture content, sucked into the cleaning section using the SS-15A separator, and transferred to the UXK cleaning line, which is located in two rows, through the dividing screw ShRX. In the UXK cleaning line, small impurities are first cleaned in 1XK equipment (with 8 pile drums), and small and large impurities are cleaned in 4 consecutive UXK equipment. After that, it is once again cleaned from small impurities in the 1XK equipment. In the UXK equipment, the cotton pieces that have been mixed with impurities from the saw sections are transferred to the shaft of the RX regenerator for regeneration by means of...
3 Results and Discussion

3.1 Results and Discussion

In the experiments, the humidity of Sultan selection cotton was 8.3; 8.7% and pollution level 5.65; 7.3% of raw materials were used. Table 1 shows the results of experimental test analyzes in the HVI system conducted at an independent cotton ginning enterprise.

Analyzing the results of the experimental tests carried out in production, the uniformity index (Unf) of cotton fibers in the length of cotton fiber in the existing technology is 86.9% in the cotton gin, and 84.2% after the 1st line UXK cleaning line, 85.3% after line 2 UXK cleaning line, 84.0% in the cotton fiber added to impurities in UXK cleaning lines, 83.4% after RX cotton regenerator (14), and in the produced fiber it was 82.4%. After the improved RX cotton regenerator, the length uniformity index was found to be 84.0%, which was 0.6% higher than that of the unimproved RX (14).

1st line UXK cleaning line but 85.3% in the 2nd line UXK cleaning line, the main reason for this is that the cotton cleaned in the RX cotton regenerator is sent to the 1st line UXK cleaning line using a separator as a result of retransmission, the decrease of the lengthwise uniformity index of cotton fiber is observed in the 1st line UXK line. Also, in the improved RX cotton regenerator, the length uniformity index is 84%, and it is achieved that the cotton entering the regenerator does not have a negative effect on the length uniformity index.

According to current technology, the specific breaking strength (Str) of cotton yarn is 32.4 sN/tex, 32.0 sN/tex after 1st line UXK cleaning line, 31.8 sN/tex after 2nd line UXK cleaning line, UXK was 30.1 sN/tex in cotton with impurities added to it, 29.6 sN/tex after RX cotton regenerator, and 31.8 sN/tex in produced fiber (15, 16).

The stiffness of the cotton fiber cleaned in the improved RX cotton regenerator is 31.6 sN/tex, which is 2.0 sN/tex higher than the stiffness of the cotton fiber cleaned in the non-improved RX regenerator. We can observe that the specific breaking strength toughness of the fiber produced as a result of adding cleaned cotton to the general cotton flow in the cotton
Table 1. Results of experimental tests conducted in production.

<table>
<thead>
<tr>
<th>Technological stages</th>
<th>Len</th>
<th>Unf</th>
<th>Longitudinal homogeneity index</th>
<th>Str tensile strength</th>
<th>Elongation in Elg break</th>
<th>Sort by CG color</th>
<th>Rd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial quality indicators of cotton</td>
<td>1.140</td>
<td>86.9</td>
<td>32.4</td>
<td>9.1</td>
<td>31</td>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>1st row is the indicators after UXK</td>
<td>1.134</td>
<td>84.2</td>
<td>32.0</td>
<td>8.6</td>
<td>21</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>2nd row is the indicators after UXK</td>
<td>1.120</td>
<td>85.3</td>
<td>31.8</td>
<td>8.9</td>
<td>21</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>Cotton contained in the impurities from UXK cleaning lines</td>
<td>1.105</td>
<td>84.0</td>
<td>30.1</td>
<td>9.1</td>
<td>41</td>
<td>-3</td>
<td></td>
</tr>
<tr>
<td>Quality indicators of ginned cotton in available RX</td>
<td>1.089</td>
<td>83.4</td>
<td>29.6</td>
<td>8.1</td>
<td>41</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>Quality parameters of ginned cotton in improved RX</td>
<td>1.090</td>
<td>84.0</td>
<td>31.6</td>
<td>8.6</td>
<td>41</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>Quality indicators of a sample taken from a fiber bale</td>
<td>1.103</td>
<td>82.4</td>
<td>31.8</td>
<td>8.5</td>
<td>21</td>
<td>-1</td>
<td></td>
</tr>
</tbody>
</table>

Technological stages
+b degree of yellowness | T Notola mixtures | Cnt (number of impurity compounds) | Area (area of dirty mixtures) | SFI (short fiber index) | SCI |

Initial quality indicators of cotton | 7.8 | 6 | 32 | 1.07 | 5.04 | 149.7 |
| 1st row is the indicators after UXK | 8.5 | 2 | 13 | 0.22 | 7.9 | 143.6 |
| 2nd row is the indicators after UXK | 8.4 | 2 | 13 | 0.24 | 6.4 | 146.3 |
| Cotton contained in the impurities from UXK cleaning lines | 8.0 | 8 | 104 | 3.28 | 7.6 | 126.7 |
| Quality indicators of ginned cotton in available RX | 7.8 | 8 | 77 | 1.66 | 8.3 | 126.2 |
| Quality parameters of ginned cotton in improved RX | 8.2 | 7 | 41 | 1.38 | 7.9 | 131.0 |
| Quality indicators of a sample taken from a fiber bale | 8.5 | 3 | 30 | 0.27 | 9.3 | 131.5 |
UXK cleaning lines, 77 after RX cotton regenerator and 30 in produced fiber. In the improved RX cotton regenerator, it is 41 and 36 less compared to the unimproved RX.
The number of impurities in the cotton fiber added to the impurities from UXK cleaning lines is increasing from 13 to 104. The impurity count of 104 in the unimproved RX regenerator drops to 77 after cleaning, while in the improved RX it drops to 41. Therefore, compared to the existing RX regenerator, the improved RX regenerator achieves 1.87 times less impurities in the cleaned cotton fibers.

In current technology, short fiber content (SFI), i.e. fibers shorter than 0.5 in (12.7 mm), is 5.04% in cotton gin, and 7.9% after line 1 UXK cleaning line, 6.4% after line 2 UXK cleaning line, 7.6% in cotton added to impurities in UXK cleaning lines, 8.3% after RX cotton regenerator, and 9% in produced fiber. In the improved RX cotton regenerator, it is 7.9%, which is 0.4% higher than the unimproved RX. Short fiber content was 7.9% and 6.4% in UXK treatment lines 1 and 2, respectively, compared to 8.3% after the existing RX regenerator, and 7.9% in the improved RX regenerator. % shows a positive effect of the new regenerator on the amount of short fibers.

The rate of contamination with non-fiber impurities in the technological stages is 0.6% in cotton gin, 0.2% after the 1st line UXK cleaning line, 0.2% after the 2nd line UXK cleaning line, 0.8% in cotton added to impurities in UXK cleaning lines, 0.8% after RX cotton regenerator and 0.3% in produced fiber. In the improved RX cotton regenerator, it is 0.7%, and a reduction of 0.1% is achieved compared to the unimproved RX. Therefore, the improved RX shows that it works effectively in the cleaning of non-fibrous impurities in the cotton regenerator.

In the technological stages, the degree of yellowness of the fiber is 7.8 in the cotton gin, 8.5 after the 1st line of UXK cleaning line, 8.4 after the 2nd line of UXK cleaning line, and the content of impurities in the UXK cleaning lines was 8.0 in ginned cotton, 7.8 after RX cotton regenerator and 8.8 in produced fiber. The improved RX in the cotton regenerator is 8.2, which is 0.4 more than the unimproved RX. So, in the improved RX cotton regenerator, the degree of yellowness of the fiber is slightly increased due to 5-6 times cleaning in the drum with a cotton saw.

4 Conclusions

As a result of the researches, improved cotton regenerator RX, after cleaning the processed impurities, its quality indicators were determined in the HVI system. After the improved RX cotton regenerator, the lengthwise uniformity index of the cotton fiber is 84.0%, which is 0.6 higher than that of the unimproved RX, and the specific tensile strength (Str) of the fiber is 29.6 sN/tex. to be 2.0 sN/tex higher than the existing regenerator, the number of impurities in the cotton fiber (Cnt) and in the improved RX cotton regenerator, it was 41 and 36 less than the unimproved RX, short fiber content (SFI) and in the improved RX cotton regenerator, it is 7.9%, and it is 0.4% higher than the unimproved RX, the index of pollution with non-fiber impurities. and in the improved cotton regenerator, it is 0.7%, compared to the unimproved regenerator, it can be reduced by 0.1%, and the degree of yellowness of the fiber and in the improved cotton regenerator, it was found to be 8.2, which is 0.4 more than the unimproved RX.

References


3. Patent No. FAP 00708 RUz "Regenerator khlopka-sirsa".


