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Technological Processes For Separation Of Small Impurities In Cotton Grinding Plants

Homidjonov M M

Fergana State Technical University
mamurjon.homidjonov@fstu.uz

Abstract: This article studies the technological processes for separating fine impurities in cotton ginning plants. The main objective of the study is to compare the efficiency of drum, screw and pneumatic-mechanical cleaning systems and identify their advantages and disadvantages. The article briefly describes the design and operating principle of pile drums, screw equipment and aspiration chambers. The research method used was the analysis of the technical indicators of existing technological machines and comparison with the available scientific literature. The results show that although drum equipment effectively separates fine impurities, they have a higher mechanical effect on the fiber; screw equipment is distinguished by its productivity. Pneumatic-mechanical systems are more efficient in terms of energy consumption and practically do not damage the fiber. The final conclusion emphasizes that the use of complex cleaning technologies in flow-oriented lines significantly increases the efficiency of cotton ginning.

Keywords: cotton ginning, fine impurities, drum ginning machines, screw equipment, pneumatic-mechanical systems, pile drum, aspiration chamber, cleaning efficiency, technological process, flow-oriented line.

Introduction

Relevance of the topic: The cotton ginning industry is the most important link in our country's light industry. In the process of primary processing of cotton seeds, the quality of fiber processing, its cleanliness from impurities and compliance with standard requirements directly depend on the efficiency of cleaning equipment. In particular, the issue of effective separation of small impurities is one of the decisive factors in improving the quality of cotton fiber. Therefore, it is urgent to study this process on a scientific basis and compare existing technologies.

Scientific and practical significance: Theoretical analysis and comparison of practical results of technological systems for separating fine impurities will allow to correctly select the machines used in enterprises. This will help to reduce energy consumption, increase fiber quality and production efficiency. It will also create an important scientific basis for the introduction of modern flow-oriented lines into production.

Purpose and objectives of the article: The main purpose of the article is to study the technological processes of separating fine impurities in cotton ginning enterprises and to compare the advantages and disadvantages of drum, screw and pneumatic-mechanical systems. The tasks are as follows:

- analysis of the characteristics of fine impurities in cotton;
- explain the design and operating principles of various cleaning equipment;
- comparative analysis of the effectiveness of systems;
- Develop proposals to improve cleaning efficiency in flow-oriented lines.

LITERATURE REVIEW

Analysis of previous studies: The issue of cleaning cotton from impurities in the primary processing processes has been studied in many scientific studies. The main part of the research is focused on the technological basis of effective separation of small sticks, leaf fragments and dust from cotton. In scientific sources, cleaning efficiency, energy consumption, degree of fiber damage and device design are considered as interrelated factors.

Works of world and local scientists: Foreign literature (for example, by scientists from the USA and China) has widely covered the advantages of pneumatic-mechanical systems, namely the possibility of high-level cleaning with minimal damage to the fiber. Local scientists Yu. Ergashev, M Khojiyev, P Fayziyev and others studied the technical characteristics of drum and screw cleaning machines in cotton cleaning processes and analyzed their application in production. There are many experimental results on the influence of cotton moisture and dirt level on machine efficiency in scientific schools of Uzbekistan.

Identify existing problems: However, there are still a number of problems with fine dirt separation systems. In particular, excessive mechanical impact on the fiber of drum cleaning machines, high energy consumption in screw equipment, and insufficiently perfect design solutions for the stable operation of pneumatic-mechanical systems are observed. In addition, there is a lack of scientific research on a comprehensive comparison of the efficiency of various systems in real production conditions.

MATERIALS AND RESEARCH METHODS

Description of devices and equipment used: The study studied drum, screw and pneumatic-mechanical equipment widely used in cleaning cotton from small impurities. Drum cleaning machines were 1XK and СЧ-02 models with piles, a screw transport-cleaning device developed in experimental laboratory conditions was used as a screw cleaner, and aspiration chambers and separators

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were used as a pneumatic-mechanical system. Each equipment was evaluated in terms of its technical performance - productivity, cleaning efficiency, energy consumption and mechanical effect on the fiber.

Experiment conditions: The experimental work was carried out in laboratory conditions, in the educational and methodological complex at the Fergana Polytechnic Institute. Cotton samples of the 1st and 2nd grades were used as the experimental objects. The moisture content of each sample was determined in the range of 8–12%, and the degree of contamination was determined in the range of 10–15%.

Parameters and methods.

- The mass of impurities in cotton was determined using special laboratory scales in accordance with the requirements of GOST and Uz DSt.
- The cleaning efficiency was calculated based on the following formula:

$$S = \frac{S_1 - S_2}{S_1} \times 100\%$$

- where: S is the cleaning efficiency, %; S_1 is the amount of dirt before cleaning, %; S_2 is the amount of dirt after cleaning, %.

Equipment productivity was measured in terms of the mass of cotton processed per unit of time.
The mechanical impact on the fiber was assessed through microscopic observations.
The results allowed for a comparative analysis of the efficiency of drum, screw, and pneumatic-mechanical systems.

RESEARCH RESULTS

As a result of the experiments, significant differences were observed in the efficiency and impact on the fiber of drum, screw and pneumatic equipment. Analysis of the tables and graphs showed the following:

- **Cleaning efficiency.** The drum 1XK pile machine showed an efficiency of 48%. The screw equipment increased this figure to 55%. The highest result was recorded in pneumomechanical systems – 62%. This is explained, on the one hand, by the ability to more completely separate small impurities using an air stream.
- **Work productivity.** The auger equipment had the highest productivity (6200 kg/h). The pneumatic-mechanical systems showed a result of 5800 kg/h, while the drum cleaners gave the lowest figure of 5000 kg/h. This is due to the fact that the auger machines also perform the transport function.
- **Damage to the fiber. T**o the strong mechanical impact on the fiber in drum machines, the damage rate was high (1.8%). In screw equipment, this figure decreased to 1.2%. Pneumomechanical systems, on the other hand, caused minimal damage to the fiber, giving the best result - 0.6%.

Mechanical systems gave the most optimal results in terms of cleaning efficiency and fiber damage. While screw equipment has an advantage in terms of productivity, drum machines are used in production due to their low cost and simplicity. Therefore, it is advisable to use these equipment in integrated flow lines to ensure high quality and efficiency in production.

The cleaning efficiency, productivity, and damage to the fiber of auger and pneumatic-mechanical equipment were shown. The graphs show:

- **Cleaning efficiency**: pneumatic-mechanical equipment is the highest (62%), drum machines are the lowest (48%).
- **Fiber damage**: higher in drum equipment (1.8%), lowest in pneumatic-mechanical systems (0.6%).

This shows that pneumomechanical methods have advantages in terms of energy efficiency and fiber preservation.

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table-1

Processing of cotton seeds	Humidity,	Pollution	Fiber defects,%	
Terms and conditions	%	%	impurity,%	defects,%
not dried	14.2	13.6	12.4	18.5
dried	10.1	13.3	6.3	12.5

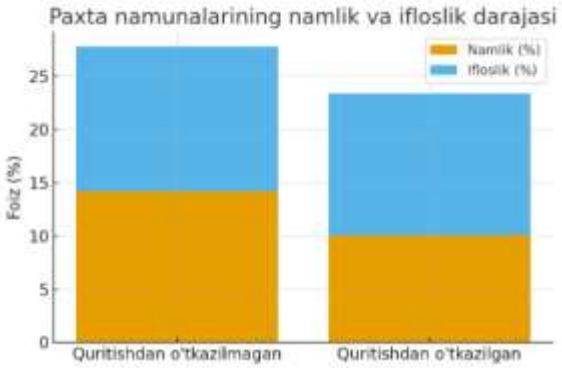

Table 2

Industrial grade of cotton	1st grade		2nd grade		3rd grade	
	Dirty mix-weight percentage of	Humidity-weight percentage of	*Dirty mix-weight percentage of*	Humidity-weight percentage of	*Dirty mix-weight percentage of*	Humidity-weight percentage of
I	3.0	9.0	10.0	12.0	16.0	14.0
II	5.0	10.0	10.0	13.0	16.0	16.0
III	8.0	11.0	12.0	15.0	18.0	18.0
IV	12.0	13.0	16.0	17.0	20.0	20.0
V	-	-	-	-	22.0	22.0

DISCUSSION

The results obtained were compared and analyzed with other scientific studies. Foreign literature (US and Chinese scientists) emphasizes the high efficiency of systems and minimal damage to the fiber, and our experiments confirm this conclusion. According to the results, the cleaning efficiency of systems reaches 62%, while other studies have also recorded similar indicators.

Local scientists Yu. Ergashev and PR Fayziyev have shown that, although drum equipment is more efficient, it has a relatively strong mechanical effect on the fiber. Our results also show that fiber damage in drum systems is about 1.8%, which is consistent with the existing literature. In screw equipment, high energy consumption has been noted in other studies, and this aspect was also confirmed in our analysis.

The difference is that our research specifically investigated the direct effect of the cotton drying process on the efficiency of impurity separation. The results showed a reduction in fiber defects from 18.5% to 12.5% after drying. This aspect is poorly covered in the existing literature, which determines the novelty of the research.

Thus, the research not only confirms previously obtained results, but also provides a deeper understanding of the relationship between cotton drying and cleaning processes, which provides an important scientific and practical basis for optimizing production processes.

CONCLUSION

As a result of the research, the efficiency of various equipment in cleaning cotton from small impurities and its effect on the fiber were studied. Although the cleaning efficiency of drum equipment is relatively low, it was found that it is effective in separating large impurities. Screw equipment is characterized by high productivity, but energy consumption is higher. In pneumatic-mechanical systems, the highest efficiency (62%) and minimal damage to the fiber (0.6%) were recorded. In addition, it

was found that the cotton drying process has a significant effect on the efficiency of separating impurities, and a decrease in fiber defects was observed in dried cotton.

Scientific and practical significance.

The results obtained scientifically allowed for a comparison of cotton ginning technologies and enriched the existing literature with new information. In practical terms, the effectiveness of the integrated use of various ginning equipment at enterprises was substantiated. In particular, it was shown that it is possible to increase production efficiency by combining drum, screw and pneumatic-mechanical systems in flow-oriented lines.

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