Journal of Higher Education and Academic Advancement
Homepage : https://journal.antispublisher.id/index.php/EJHEAA
Email : admin@antispublisher.com

e-ISSN : 3032-1123
JHEAA, Vol. 1, No. 12, December 2024
Page 25-30

Determination of the Direction of Research on the Development of Fiber Waste Cleaning Technological Equipment

Muminov Ulugbek Mamitbekovich[1], Muminova Guzalkhan Usupjonovna[2]
[1,2]Andijan machine-building Institute

DOI : https://doi.org/10.61796/ejheaa.v1i12.1111

Sections Info

Article history:
Submitted: December 01, 2024
Final Revised: December 02, 2024
Accepted: December 05, 2024
Published: December 06, 2024

Keywords:
Fibrous waste
Cleaning
Improvement
Equipment
Efficiency
Auger-pile
Technical solution
Conveyor

ABSTRACT

Objective: *The study aims to develop an efficient fiber waste cleaning equipment design for the cotton processing industry. This design seeks to address current challenges, such as the inconsistent density of raw cotton and the resulting high levels of impurities in the fiber waste.* ***Methods:*** *A systematic approach is adopted, involving a literature review of existing cleaning systems, identification of key issues, and the development of a cleaning equipment design using a screw conveyor mechanism. The study optimizes operational parameters, including auger pitch, pile length, and mesh configuration, and evaluates the feasibility of the proposed equipment.* ***Results:*** *The research identified that inconsistencies in raw cotton density were a major cause of fiber defects. Existing cleaning machines were found to be ineffective in achieving complete impurity removal, often resulting in fiber loss. The proposed design, featuring a screw conveyor and mesh net, is expected to enhance cleaning efficiency by optimizing these parameters.* ***Novelty:*** *The study introduces a new approach to cotton fiber waste cleaning by using a screw conveyor design, which improves the separation of small impurities. The research also explores the feasibility of using a belt conveyor for waste transfer, contributing to more effective cotton waste management.*

INTRODUCTION

In the technological process of initial cotton processing, in addition to the main products—cotton fiber, cotton seeds, and fluff—a significant amount of fiber waste is generated (including gin waste, linter waste, small fiber fragments, and fiber waste from cotton ginning equipment). Processing this waste yields raw materials suitable for textiles and other industries [1].

The amount of fiber waste from gins and fiber cleaners at standard spacings and alignments depends on the selective and industrial grades of the processed raw cotton. When processing first-grade cotton, the amount of dead fiber can range from 0.2% to 0.3%, while in lower grades, it can reach 0.5% to 0.6%, and in some cases, up to 1.5%.

Companies such as Rieter (Switzerland), Trutzschler (Germany), and Marzoli (Italy) [2] offer equipment systems for processing fibrous waste and low-grade cotton. These systems have a high cleaning efficiency, as they use needle, saw-type working bodies, and aerodynamic cleaners. The cleaning effect of these systems is almost identical. However, a common drawback is that absolute cleaning is never achieved, and some fibers are removed along with foreign impurities, resulting in secondary waste. To achieve high efficiency, they often adjust the parameters of the corresponding machine.

RESEARCH METHOD

The study follows a systematic approach to develop a cleaning equipment design for fiber waste. The key steps are as follows:

1. **Literature Review**: The research begins by reviewing existing literature on fiber waste processing, particularly focusing on the challenges of removing impurities such as dust, dead fibers, and seed husks. Various cleaning systems, including those offered by companies like Rieter, Trutzschler, and Marzoli, are analyzed to understand their efficiencies and limitations, especially in terms of secondary waste generation.
2. **Identification of Key Issues**: Based on the literature review and studies conducted at TSNIIXprom and TITLP, the primary cause of defects in the fiber (such as dirt, dead fibers, and seed husks) is identified as the inconsistent density of the raw cotton in the gin chamber. The research further establishes that current cleaning systems, although effective, do not achieve absolute cleaning and lead to some level of fiber loss.
3. **Design Concept Development**: The development of the cleaning equipment design uses a screw conveyor mechanism. This design is selected to address the inefficiencies of current cleaning machines, particularly in separating small impurities and improving the cleaning of fiber waste. The design also includes a mesh net and stakes to optimize the cleaning process.
4. **Parameter Optimization**: The study focuses on determining optimal operational parameters for the cleaning equipment, including the pitch of the screw auger, the length and spacing of the piles, the configuration of the mesh net, and the rotation speed of the auger. These parameters are crucial for maximizing the efficiency of waste separation and improving the cleaning performance.
5. **Feasibility Study**: In addition to design optimization, the feasibility of the proposed equipment for processing cotton waste is evaluated. This includes assessing the practicality of using a belt conveyor for waste transfer and removal, along with the possibility of manual loading options.
6. **Prototype Development**: Working drawings for the proposed equipment are being developed to create a prototype. The prototype will allow for experimental testing and validation of the design's efficiency in cleaning fiber waste and improving overall performance.
7. **Testing and Validation**: Once the prototype is developed, it will undergo testing to validate its effectiveness in removing various types of impurities from cotton fiber waste. The results of these tests will provide valuable insights into the efficiency of the cleaning process and guide further improvements if necessary.

RESULTS AND DISCUSSION

As a result of numerous studies conducted at TSNIIXprom and TITLP [3], it was determined that the main cause of gin defects in the fiber is the inconsistent density of the raw material in the gin chamber. Consequently, after ginning the cotton raw material, the amount of defects in the fiber, such as dirt, dead fibers, and seed husks, is significantly higher than the calculated standard due to the increased breakage of seeds.It is known that the OVM-A-II auger-pile cleaners for fiber waste are installed after the fiber material condenser (Fig. 1) [4], [5].

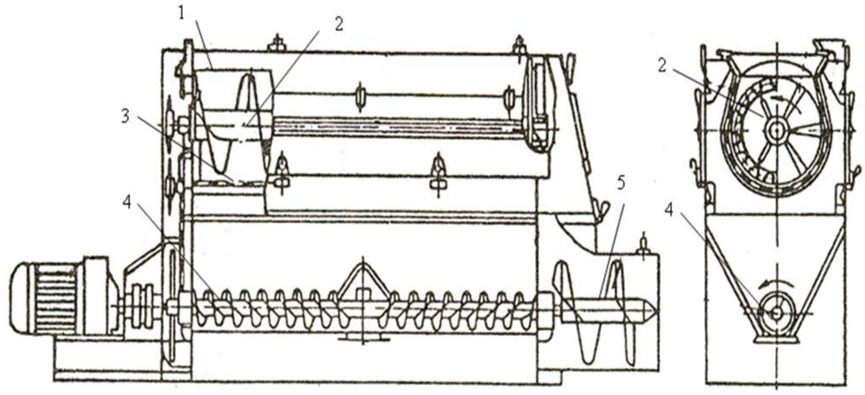

Figure 1. Scheme of the OVM-A-II fiber material cleaner 1 - Mine; 2 - Pile-screw drum; 3 - Mesh surface; 4 - Waste auger; 5 - Fluff screw.

Kuzyakova S.V. [6], [7] conducted both theoretical and practical research on the preparation of fiber waste for the weaving-spinning process and studied the types of fiber waste and their properties.

In his scientific work, he recommended the use of improved ON-6-P type cleaners to remove dust and other impurities contained in fiber waste.

The main reason dead or fluff cleaning machines are not widely used in production is their insufficient efficiency. Firstly, most of these machines have a low cleaning efficiency (15-20%), while those with higher efficiency are often inconvenient for production use due to their complex construction. Additionally, they are difficult to maintain and result in significant product loss [8].

Pile and pile screw cleaners are known for their simplicity and ease of operation. However, due to their structural features, they are not effective at separating impurities, particularly small ones.

At the “Pakhtasanoat Scientific Center” JSC, a design for the working part of the OVM-A-1 type cleaner was developed, featuring a saw cylinder and a colosnik grating to clean cotton from seeds and large impurities. The saw cylinder's tooth rotation angle relative to the axis is 150°, the angle between the saw teeth is 38°, the tooth height is 5.1 mm, the tooth pitch is 6.0 mm, and the saw contains 160 teeth.

1VP fiber cleaner gaskets are used for sealing between the saw blades. However, this improvement was only somewhat effective in separating seeds and large impurities from the fluff [8].

Uniform distribution of the fluff (the fiber product to be cleaned) across the surface of the cleaning bodies, along with combing, increases the intensity of cleaning the fluff from small dirt. The efficiency of separating dirty mixtures is characterized by a decrease in the degree of adhesion to the material being cleaned. This is influenced by the structural parameters of the machine. It is known that the degree of contamination of the material being cleaned and the conditions under which it is delivered to the cleaning zone, as well as more effective distribution and proper direction of the cleaning process with combing, play a crucial role [9].

A review of literature in the field of technology for cleaning fibrous waste from impurities indicates that this area is underdeveloped [10]. In-depth theoretical and experimental studies are needed to develop an effective design for cleaning machines that meet industrial requirements [11]. A large amount of fiber waste is separated after cyclones in cotton gin systems, and developing effective equipment for their cleaning remains one of the pressing challenges today.

Based on the above, the development of a cleaner design that ensures effective cleaning of fibrous waste was chosen as the direction for scientific research.

The essence of the technical solution developed for the fiber waste cleaning equipment, which uses a screw conveyor design, is shown in Fig. 2.

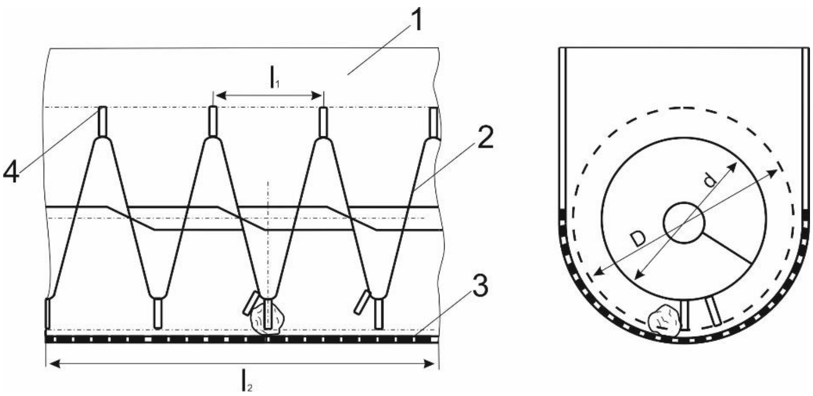

Figure 2. Schematic diagram of fiber waste treatment equipment 1 – Case, 2 - Screw auger, 3 - Net mesh, 4 – Stakes.

To effectively separate mineral, organic, and other wastes contained in fibrous waste, the recommended length of the equipment can range from 8 to 16 meters.

As a result of the scientific research, the study aims to determine the optimal pitch of the screw auger, the length and spacing of the piles, the ideal net mesh configuration, and the appropriate speed of rotation for the auger's working body. Additionally, the feasibility of the proposed equipment for processing cotton waste is also being evaluated. The transfer and removal of waste to the equipment via a belt conveyor (for loading into transport) is considered, along with options for manual loading. Currently, working drawings are being developed to prepare a prototype of the equipment.

CONCLUSION

Fundamental Findings : The study identifies that fiber waste generated during cotton processing, such as gin waste, linter waste, and small fiber fragments, poses significant challenges. The amount of waste varies based on cotton grade, with higher waste generation in lower-grade cotton. Existing equipment systems, while effective, fail to achieve absolute cleaning, leading to secondary waste. The main cause of defects in the fiber is the inconsistent density of raw cotton during ginning, which increases fiber impurities. **Implications :** This research highlights the need for improved fiber waste cleaning systems. The proposed screw conveyor design aims to optimize impurity removal, offering higher cleaning efficiency while addressing the limitations of current equipment. The study's findings can influence the development of more effective systems for processing fiber waste, enhancing cotton processing efficiency in the textile industry. **Limitations :** The study faces limitations in terms of achieving absolute cleaning with existing and proposed equipment. Despite improvements in design, secondary waste is still generated, and some fibers may be removed along with impurities. The complexity of the machinery and maintenance challenges also hinder widespread use of advanced cleaning systems in production environments. **Future Research :** Future research should focus on refining the design of the cleaning equipment to improve efficiency and minimize secondary waste. Further studies are needed to explore alternative mechanisms or modifications that could lead to more effective fiber waste separation, particularly for small impurities, and to ensure ease of maintenance and operation in industrial settings.

REFERENCES

[1] G.D. Djabarov et al., *Pervichnaya obrabotka klopka*, Moscow, 1978, 430 p.

[2] V.M. Dzhanpaizova, J.U. Myrkhalykov, R.S. Tashmenov, A.A. Turganbaeva, and S.O. Doskaraeva, "Issledovanie vozmozhnosti vyrabotki pneumomekhanicheskoy pryaji s ispolzovaniem v smesi otkhodov proizvodstva," *Mezhdunarodnyi zhurnal prikladnykh i fundamentalnykh issledovaniy*, no. 8-2, pp. 209-212, 2015.

[3] S. Fazildinov and R.M. Kattakhodzhaev, "Snizhenie porokov volokna pri pilnom djinirovanii klopka-syrtsa," *Khlopkovaya promyshlennost*, no. 7-8, 1981.

[4] T.M. Kuliev et al., *Handbook of Cotton Preprocessing*, Nodirabegim Publishing House, Tashkent, 2019, 471 p.

[5] R.Sh. Sulaymanov, D.M. Mukhammadiev, and Sh.J. Bobokhanov, "Analyz tekhnologicheskikh parametrov ochistitelya voloknistogo materiala tipa OVM-A-I," *Problemy meniki*, no. 6, pp. 54-56, 2008.

[6] S.V. Kuzyakova, *Razrabotka effektivnogo sposoba ispolzovaniya voloknistykh otkhodov v pryadenii*, Diss. Nor soisk. Candy. Tech. Nauk, 2007, 210 p.

[7] S.V. Kuzyakova et al., "Ustroystvo dlya ochistki voloknistogo materiala," Patent and utility model R.F. Xo54046.

[8] B.A. Baikhanov, R.K. Djamalov, and V.G. Rakipov, *Development and Research of an Improved Fluff Cleaning Machine Based on the OVM-A-1 Fiber Material Cleaner*, ITX, JSC "Cotton Industry Scientific Center", Tashkent, 2014, 30 p.

[9] S.Sh. Sulaymanov, *Creation of Rational Technology of Cotton Seed Processing and Cleaning Lint*, Diss. doc. nauk (DSc), Tashkent, 2019, 188 p.

[10] U. Muminov and G. Muminova, "Types of Fibrous Waste and Their Cleaning Equipment," *Scientific and Technical Journal of Machinery*, www.andmiedu.uz, no. 1, 2023.

[11] N.M. Sahibjanovna and S.N. Sohibjamolovna, "Application of virtual laboratories on the

course 'Design of measuring instruments'," *ACADEMICIA: An International Multidisciplinary Research Journal*, vol. 12, no. 7, pp. 187-192, 2022.

***Muminov Ulugbek Mamitbekovich (Corresponding Author)**
Andijan machine-building Institute

Muminova Guzalkhan Usupjonovna
Andijan machine-building Institute