REDUCING SEED INTENSITY BY OPTIMIZING THE TECHNOLOGICAL PARAMETERS OF THE LINTER MACHINE

Kamola Insopaliyevna Ortiqova,
doctoral student (DSc), Department of Textile Industry Technology, Namangan State Technical University, Uzbekistan
+998 97 426 50 55 ortiqovakamola1990@gmail.com
Inamova Maftuna Dedamirza qizi,
doctoral student (DSc), Department of Textile Industry Technology, Namangan State Technical University, Uzbekistan
+998945026233 inamova93@mail.ru
Rustamova Navbahor Muzaffar qizi,
Independent researcher,
+9989500054196 rnavbahor63@gmail.com

Annotation. This article investigates the fuzziness level of seed cotton exiting the linter machine and explores possibilities for its reduction. The research proposes a technology that independently controls the rotational speeds of the saw cylinder and the beater components using variable frequency drives (VFDs). Through this approach, the linear speed of each working unit is synchronized, and an optimal speed ratio between them is maintained. The results indicate that the proposed control technology significantly reduces seed fuzziness and enhances seed quality.
Keywords: Linter machine, seed cotton, fuzziness level, variable frequency drive, seed quality, beater, saw cylinder.

Introduction. In collaboration with the “Scientific Center of Cotton Industry” JSC, a regulatory and legal framework was developed for the proper execution of processes involved in the collection, storage according to standards, and initial processing of seed cotton. Additionally, procedures were established for adjusting equipment in seed cotton processing enterprises according to defined standards. Continuous analysis of the most advanced practices and significant results in cotton and seed breeding is recommended, along with the introduction of high-yield cotton varieties and hybrids into the country and the transfer of innovative technologies relevant to the industry [1].

Materials and Methods. Defuzzing seeds used for sowing is an important agrotechnical requirement. Complete removal of lint contributes to better germination in the soil, improves the growth process, and accelerates seedling development.

Therefore, proper organization of the lintering process not only increases the efficiency of cotton cultivation and processing industries but also enhances the overall quality of production. In order to adjust the technological equipment used in cotton processing for separating lint from seed, technical cotton is first processed, and the level of fuzziness and mechanical damage to the seeds is analyzed [2].

Lintering, one of the crucial steps in the cotton industry, removes the residual fibers on the surface of technical cotton seeds. This not only yields an additional product—lint—but also improves the quality of seed cotton. The process is carried out using linter machines. Especially in the case of seed processing, proper operation of the linter machine is of great importance. The cleanliness, fuzziness level, mechanical integrity, and germination capacity of the seeds used as planting material directly affect subsequent agrotechnical treatments and seedling quality. Determining the fuzziness level of the seeds processed by the linter machine, monitoring this process, and optimizing technological settings when necessary are critical steps in improving seed quality. This research evaluates the effectiveness of the linter machine's operating parameters by analyzing the level of seed fuzziness and proposes ways for improvement [4].

To determine the amount of residual fiber in seed cotton depending on changes in the rotational speed of the beater and saw cylinder in the working chamber of the linter machine, experiments were conducted on a 5LP-160 model linter machine at the lintering department of the main building of the cotton processing plant under “NT Chust Wheat Cluster” LLC (see Figure 1). The tests were conducted on hand-picked cotton of the Namangan-34 variety, 1st generation R-1, with a moisture content of 7.8% and an impurity level of 3.0%.

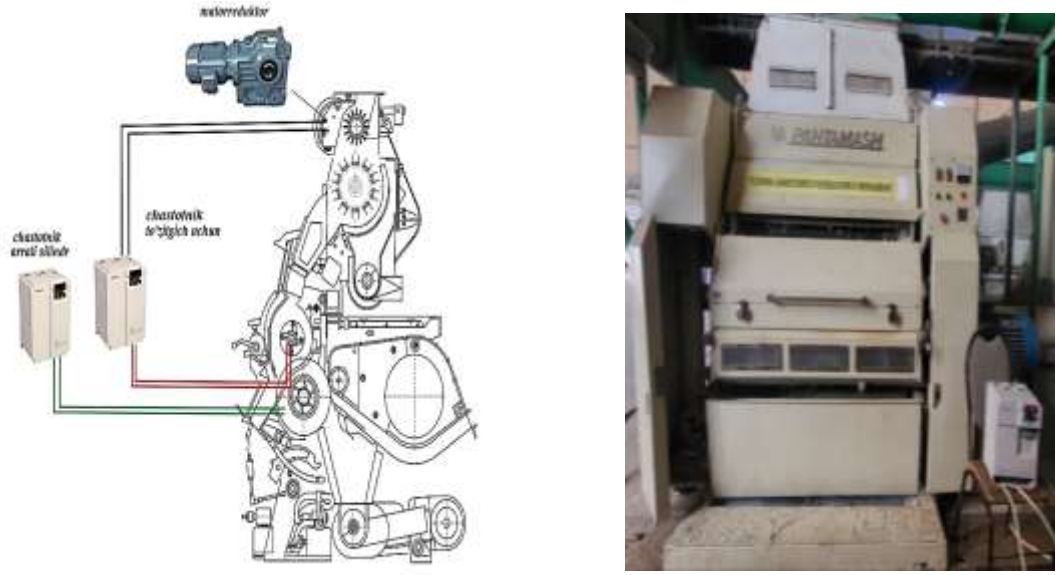

Figure 1. Newly Developed Automatically Controlled Linter Machine

During the research, the rotational speeds of the saw cylinder and beater components of the linter machine were independently controlled using variable frequency drives (VFDs). This allowed the linear motion of each working unit to be synchronized and maintained the optimal speed ratio between them. As a result of this technological approach, a significant reduction in seed fuzziness was observed. Compared to conventional control methods, the proposed control approach drastically reduced the level of fuzziness, i.e., the amount of residual fiber left on the seed surface decreased. The seeds appeared visibly cleaner, smoother, and more uniform in appearance. The lintering process controlled by VFDs not only reduces mechanical damage to the seeds but also enables better control over fuzziness levels [5].

Results and Discussion. To determine the fuzziness level of seed cotton, the Uzbek national standard O‘z DSt 601-2008 is used [6]. In this study, the OCX-1 seed defuzzer laboratory device was utilized to assess seed fuzziness (see Figure 2). The fuzziness level of seed cotton is determined by calculating its mass fraction (O), expressed as a percentage, using the following formula:

$$O=\frac{M_2-M_2}{M_2}*100$$

When containers made of fired porous clay are used

$$O=\frac{1{,}06*(M_1-M_2)}{M}*100$$

Here: M – mass of the sample for testing, in grams; M_1 – mass of the seed with fuzz, treated in hydrochloric acid vapors, in grams; M_2 – mass of the defuzzed seed, in grams; 1.06 – correction factor for moisture content.

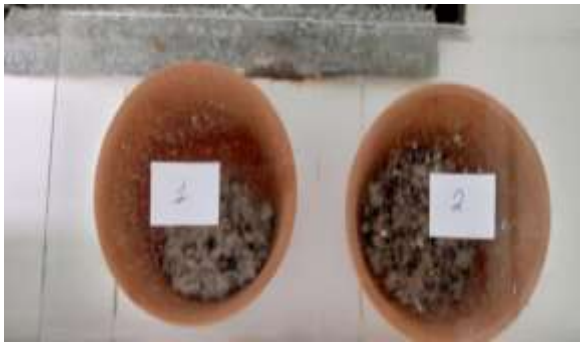

Figure 2. Clay Container and OCX-1 Seed Defuzzer

A 30-gram sample of seed cotton is weighed and treated with hydrochloric acid, then placed into the device with 130 grams for 30 minutes. After 30 minutes, the sample is removed, placed into a special cloth bag, and thoroughly rubbed. The defuzzed seeds are then weighed, and the values are applied to the formula for calculation.

Figure 32. Appearance of Defuzzed Cottonseed

Table 1.

Experimental Data on Determining the Fuzziness of Seed Cotton from the Linter Machine

№	Conducted Experiments		Mass Fraction of Seed Cotton Fuzziness (%)
	M_1 (g)	M_2 (g)	O (%)
1	29.72	29.48	0.8

2	29.80	29.53	0.9
3	29.88	29.59	1.0

As part of the study, three repeated experiments were conducted to determine the fuzziness level of seed cotton. In each trial, a 30.00 g seed sample was taken, treated in hydrochloric acid vapor, and then defuzzed. According to the results, the fuzziness levels were 1.0%, 0.9%, and 0.8%, respectively (see Table 1).

Based on the results of the three experiments, the average fuzziness percentage was calculated as follows:

$$\text{Average} = \frac{1{,}0\% + 8{,}0\% + 0{,}9\%}{3} = 9\%$$

Conclusion. The experiments showed that the fuzziness level of seed cotton exiting the linter machine significantly decreased due to the proposed technological solution. Previously, the average fuzziness level on a 5LP-160 type linter machine was about 1.2%. However, with the new technology — involving separate control of the rotational speeds of the saw cylinder and the beater using variable frequency drives — this indicator was reduced to a range of 0.8–1.0%.

The new control method balanced the linear velocity ratio (V_1/V_2) between the working components, which prevented residual fibers from remaining on the seed surface. Consequently, this improved seed quality, enhanced germination capacity, and increased suitability for further technological processing. Moreover, this approach reduces the likelihood of repeated processing of seed cotton during production, optimizes energy consumption, and improves overall technological efficiency.

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