A NONTRADITIONAL METHOD OF CLEANING PIMA FIBER

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Abstract

An experimental roller gin/lint cleaner was built and tested. The experimental machine combines the ginning and lint cleaning functions into one unit, with lint cleaning being done using a cylinder-type cleaner. Because the roller-ginned lint tufts fall directly onto the cleaning cylinder, a feed works assembly is not needed. The feed works associated with cleaning cylinders is what usually causes fiber damage. The experimental treatment consisted of the roller gin/lint cleaner using a standard spiral-wrapped saw cylinder for lint cleaning, while the control treatment bypassed the cleaning cylinder for lint cleaning and instead used two mill-type/air-jet cleaners. Test results show that lint from the experimental treatment contained more trash than lint cleaned by the mill-type cleaners, but the extra trash was not enough to affect grade. There is more lint loss in the trash of the experimental machine, but turnout remained higher. Also, nep content was lower in the experimental machine. Future tests will include different types of cleaning cylinders. Both the spinning potential and industry acceptance of roller ginned fiber which has been cleaned by nontraditional means is not known at this time.

Introduction

Most roller ginning plants nowadays use incline, impact and air-jet cleaners for their lint cleaning. Hughs (1) reported that during the 1990-91 ginning season, all but four of the U.S. roller ginning plants used some combination of these types of cleaners. The remaining four plants used mill-type lint cleaners (beaters) which do not have the capacity of inclines and impacts, but are more efficient.

Interest has again arisen in cleaning pima cotton lint with machines other than inclines, impacts, and air jets. Research on alternative pima lint cleaning was first done in the 1970's when Kirk and Leonard (3) showed that a standard saw-type lint cleaner which used a modified feed bar did not adversely affect the fiber quality or spinning performance of the fiber. They also suggested cost and capacity advantages of the modified saw-type lint cleaner when compared to mill-type cleaners. The results of Kirk and Leonard were supported in a more recent test of another modified saw-type lint cleaner that was used in an Arizona roller gin (2). That test found that 1st-pick pima retained its high quality, but more interestingly, 2nd-pick pima, which usually has lower grades, also returned the same manual class grades as 1st pick. However, the 2nd-pick pima was not suitable for the mill end use indicated by its grade.

Both of the modified saw-type lint cleaners just discussed handled lint from several gin stands (bulk system), the same way that inclines and impacts now do. There is a cost advantage of a bulk system, but this also means that the lint must be handled at high processing rates which may damage the fiber. This has led researchers at the USDA-ARS Southwestern Cotton Ginning Research Laboratory in Mesilla Park, New Mexico to investigate combining the roller ginning and lint cleaning operations into a single operation, thereby allowing use of a cylinder-type cleaner, but not needing a feed or control bar to set the lint on the saw. It is generally agreed upon that the feed works is what causes fiber damage. Although there is a cost disadvantage with a unit system (one lint cleaner is needed for each gin stand), there may be advantages of improved quality. For example, the cleaning cylinder speed can be reduced which will decrease the forces on the fiber and possibly lessen the damage to the fiber. Also, by having some flexibility on cylinder speed, variable processing rates are possible.

As mentioned earlier, 2nd-pick pima which was cleaned with a modified saw-type lint cleaner was not suitable for mill end use, and this brings up the important issue of marketing pima which has been lint cleaned by a nontraditional method. When textile mills purchase cotton, they are expecting a particular quality. If the mills receive cotton that is of lower or different quality than they paid for, the integrity of the pima industry could be jeopardized, and this cannot be allowed to happen. Therefore, research in this particular area must be done with caution. This paper describes the first results obtained from an experimental unit roller gin/lint cleaner.

Equipment Setup and Test Description

Figure 1 shows a side view of the experimental roller gin/lint cleaner. The roller gin stand was originally a 40-inch Hardwicke-Etter, but the frame has been completely redesigned to allow for the cleaning cylinder and doffing brush. After being ginned, the lint is directed onto the cleaning cylinder which is surrounded by grid bars. The lint is then taken off of the cleaning cylinder with a doffing brush and passed through a lint flue to the press.

Figure 2 is a side view of the experimental machine in bypass mode which allows ginned lint to detour around the cleaning cylinder. A piece of sheet metal has been placed

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in front of the cleaning cylinder, directing the lint into a different lint flue, then transported to the mill-type lint cleaners and on to the press.

The formal test consisted of comparing the experimental machine completely operational (the treatment) versus the machine bypassing the cleaning cylinder and instead using two mill-type/air-jet lint cleaners for lint cleaning (the control). The test was replicated five times using bale-sized lots of pima S-6. Seed-cotton conditioning included a tower dryer with a setpoint of 225° F, two 6-cylinder cleaners, and one stick machine. Gin stand conditions included using the automatic feed control set at 30 percent, roller speed was 119 rpm, rotary-knife speed was 469 rpm, rotary-knife clearance was 0.015 inch, and roller pressure left and right was 89 and 87 psi, respectively.

For this test, the treatment consisted of a standard spiral-wrapped saw-type lint cleaning cylinder. The saw-type cylinder used in the test retains the principle of constraining and conveying the lint as it is whipped across the grid bars, but in this case the lint coming off of the roller gin stand consists more of tufts which fall directly on the saw and therefore a controlled batt or feed works is not needed.

Results and Conclusions

Table 1 shows the trash contents, lint loss, cleaning efficiency, turnout and fiber quality means. The table includes the observed significance level of the means, and for values less than 0.0501, the means are considered significantly different. Initial seed-cotton trash content was about 10 percent and was not different between treatments. The amount of trash in the lint (Shirley visible) was higher in the experimental machine, averaging 2.12 percent versus 1.44 percent in the control. The experimental machine had a higher lint loss, averaging 1.37 percent versus 0.28 percent in the control. Lint cleaner efficiency averaged 54.9 and 65.4 percent for the experimental machine and control, respectively. And turnout was slightly higher with the experimental machine, averaging 34.4 and 34.0 percent for the experimental machine and control, respectively.

With the exception of neps content, there were no significant differences in the fiber properties between the experimental machine and the control. Color and leaf grades were high (manual classing), averaging about 2. Micronaire was about 39.7, and length was 47.2 staple. Strength, uniformity, and color were at acceptable levels. Short fiber content averaged 3.8 and 3.5 percent for the experimental and control treatment, respectively. Nep content was significantly different, with the higher count being on the control treatment. Nep content was still at acceptable levels, averaging 21.4 and 24.6 per 100 in^2 of web for the experimental machine and control, respectively.

Since the fiber properties of both the experimental roller gin/lint cleaner and control were the same and at acceptable levels, this indicates that the experimental machine does no more damage than the control. The lint from the experimental machine contained more trash, but the extra trash was not enough to affect grade. Lint loss is higher in the experimental machine, and although this may be an area that needs work, turnout remained higher. The experimental machine had fewer neps than the control, and this is favorable since saw-type cleaning tends to make neps.

Future work on the experimental roller gin/lint cleaner will include cylinders not necessarily of the saw type, less-aggressive grid bars, and possibly varying the cylinder speeds to obtain different loadings. Also planned is a spinning test where several bales from the experimental machine will be sent to a mill for processing. The results from the spinning test may also give some hint of whether or not the industry wants roller ginned fiber that has been cleaned by nontraditional methods.

Acknowledgments

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Table 1. Foreign matter content, lint loss and cleaning efficiency, and fiber properties of the roller gin/lint cleaner.

Measurement	Control treat.	Exp. treat.	Observed significance
Initial trash content, %	11.40	9.97	0.2160
Shirley visible, %	**1.44**	2.12	0.0388
Lint loss, %	**0.28**	1.37	0.0001
Lint cleaner efficiency, %	**65.4**	54.9	0.0314
Turnout, %	34.0	**34.4**	0.0366
Color grade, index	2.0	2.2	0.3739
Leaf grade, index	2.0	2.2	0.3739
Micronaire, reading	39.6	39.8	0.6213
Length, 100 inch	136.4	136.8	0.6702
Staple, 32nd inch	47.2	47.2	0.9999
Strength, g/tex	40.6	41.2	0.3336
Uniformity, %	86.8	87.2	0.3739
Color reflectance, %	69.0	69.0	0.9999
Color yellowness, units	116.0	116.4	0.8523
Short fiber by wt. %	3.54	3.78	0.4263
Neps content, per 100 in^2 web	24.6	**21.4**	0.0251

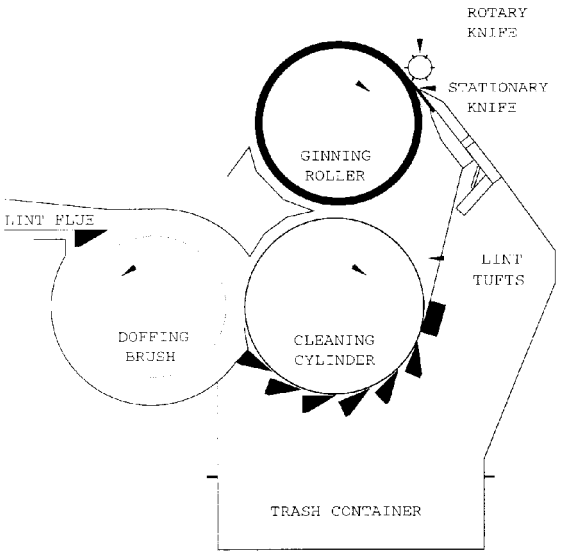

Figure 1. Side view of experimental roller gin/lint cleaner.

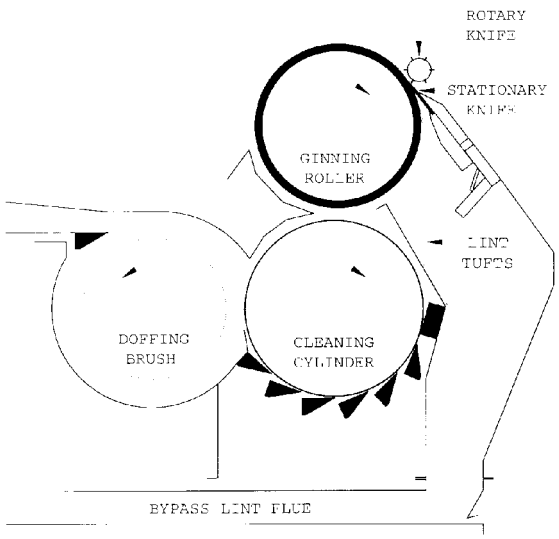

Figure 2. Side view of experimental roller gin/lint cleaner in bypass mode.