"The State of the Art -
Ginning in the Next Decade"

Proceedings of the
conference on cotton gin technology
sponsored by the
Texas Cotton Ginners' Association
April 9, 1986 / Lubbock, Texas

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THE STATE OF THE ART - GINNING IN THE NEXT DECADE
A Technical Conference for the Texas Cotton Ginners' Association Convention
April 9, 1986 at the KoKo Palace, 50th and Avenue Q, in Lubbock

10:00 - Introduction - Roy Baker, conference chairman

Welcome by J.O. Williams, President
Texas Cotton Ginners' Association

- "New Ways to Dry Cotton" - Ed Hughes, Research Director
  USDA ARS Southwestern Ginning Research Laboratory
- "Research on barking cotton" - Roy Baker, Research Director
  USDA ARS Cotton Production and Processing Unit, Lubbock
- Harvesting developments - Alan Brashears, engineer
  USDA ARS Cotton Production and Processing Unit, Lubbock
- Gin stand developments - Dr. Lambert Wilkes, engineer
  Texas A&MU Agricultural Engineering Department
- Electric power from gin trash - Dr. Wayne LaPori, engineer
  Texas A&MU Agricultural Engineering Department

11:40 - Lunch

12:20 - Quality demands on ginned cotton
  C. Carl Cox, Director, Moderator,
  Natural Fibers & Food Protein Commission
  Mill requirements - Jim King, Cone Mills
  Market requirements - Raymond Cooper, Cooper, Volkart, Taylor

Afternoon session - R.T. Bob Newton, Vice President
Texas Cotton Ginners' Association

1:15 - Resolving gin problems by innovation - Doug Moses, Moderator, Wharton
  - Product liability insurance - Raymond Adams, Bush Hog/Continental
  - Quality measurements - Donald Van Doorn, Lummus Industries
  - Gin stands by Bob Faris, Elbow Gin
  - Labor training by T.J. Taylor, Associated Growers Gin
  - The woman manager by Phyllis Moore, Progresso Coop Gin
  - Making gin records pay by Jerry Webb, Long S Gin
  - Computerized gin trouble shooter - Wayne Supak, TAMU engineering student

2:30 - Afternoon break

2:45 - Ginning Industry Developments - Gene Beck, Moderator, Lubbock
  - Multi-saw lint cleaning - Russell Sutton, Horn Gin Machinery
  - Cottonseed cleaning - Bob Stanley, Murray-Carver
  - Burners - Sam Jackson, Samuel Jackson Mfg.
  - UD press for small gins - James Renfroe, Bush Hog/Continental

3:30 - Review of afternoon session

3:45 - Presentation of participation certificates, adjourn
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NEW WAYS TO DRY COTTON AND MEASURE MOISTURE

By S.E. Hughes, Agricultural Engineer, USDA-ARS
Southwestern Cotton Ginning Research Laboratory
Stanley Anthony, Agricultural Engineer, USDA-ARS
Stoneville, MS, Cotton Ginning Research Laboratory
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South Plains Pest Control Laboratory
Bob Curley, Agricultural Engineer, USDA-ARS
Don Glaes, Engineer, Applied Instrumentation

INTRODUCTION
Cotton moisture content from harvest through ginning has a great effect on cotton lint quality in the bale. Storing seed cotton at too high a moisture content can lower yield, increase boll damage, and may even reduce lint yield. However, seed cotton that is below 12-percent moisture content can be stored indefinitely without any quality degradation.

Seed cotton whose lint moisture is above 8 percent must be dried for efficient gin processing. However, drying with excessively high temperatures is suspected of causing fiber to become brittle and may even cause irreversible chemical changes to the fiber. It is desirable that drying air not exceed 160 degrees F. However, many ginners feel that for seed cotton that exceeds 12-percent moisture content, a tower dryer has too short an exposure time at these temperatures for adequate drying. As a result, multiple tower dryers have come into common use with mixpoint temperatures that sometimes reach 350 degrees F or higher.

The recommended fiber moisture content for ginning with minimum fiber damage is between 6.5 and 8 percent. Ginning below 5-percent moisture may cause reduced staple length, increased short fiber content below one-half inch, decreased yarn strength and decreased appearance index (1). Also, low moisture cotton may cause processing problems such as jamming and buildup which causes chokes in the ginning equipment.

One problem facing cotton producers and ginners is having the means to adequately monitor and efficiently control the cotton moisture content. The effects of moisture on cotton quality, but existing means of field and gin monitoring are either too slow, highly subject to operator error, or have other problems. Another problem is motivating the improvements of present conditioning and transport systems.

Research is going on across the cotton belt on less expensive, more energy efficient methods to condition cotton and on faster, more reliable methods to monitor cotton moisture content both in the field and in the gin. This paper is a summary report on the status and results of that work.

SEED COTTON CONDITIONING

Crossflow and Counterflow Drying Background
A modified crossflow process was the first drying system developed, patented, and used to artificially dry a bale of machine-stripped cotton. This system occurred in 1926 and was the first research accomplishment after the federal government established an engineering research program to develop practical artificial drying methods for seed cotton. Crossflow and counterflow drying never caught on in the cotton ginning industry because very early in the development of gin systems pneumatic conveying became the predominant method of cotton transport. Pneumatic conveying is a very simple system and was adopted in dryers to produce concurrent (flow) or modified concurrent flow (big reel, jembo, thermo, trough) drying systems.

There are inherent advantages to crossflow or counterflow drying methods which include increased drying on very wet cotton and decreased energy requirements for pumping the air. Present drying methods are inadequate for drying cotton when moisture content exceeds about 12 percent or wet seed or cotton is present. Additional exposure time seems to be the best solution to this problem. Providing additional exposure time is difficult to accomplish with pneumatic transport because the travel speed in the dryer is fixed. As the dryer is increased and the power required to pump the air can be greatly reduced if pneumatic transport is not used. Mechanical conveying methods allow slower transport and increased contact time between the cotton and drying air.

Crossflow System Development
The module system has made available the opportunity for the South Plains Cotton Ginning Research Laboratory to develop a crossflow drying system in conjunction with belt conveyors for moving cotton from the module into a gin. A suction unloading system does not normally have a drying function. Some ginners have converted the unloading system into a drying system by dropping the cotton from the module dryer into a hot air tube. This push system still has a high power requirement because it uses air to transport the cotton. However, it saves some energy because it eliminates one pneumatic circuit from the total system. A crossflow drying system using hot air on an inclined wire belt can replace two circuits -- the suction unloading and first drying systems. This replaces two high pressure, high power requirement pneumatic circuits with a low power requirement belt transport system incorporating a low pressure, long exposure time drying function.

A crossflow dryer-belt transport system can provide a continuous stream of conditioned cotton to the gin plant. A crossflow system can be instantly stopped with a heavy cotton load with no worry about choking or restart. A belt system could be equipped with variable feed rate and speed drive controls which provide a much broader range of adjustment of the drying process than that which can be accomplished with temperature controls on conventional gin dryers. This type of dryer can be tied into a gin system along with a second stage of counterflow drying, with all of the drying controlled by a microprocessor. This would lend itself to an automated sensing and control system capable of handling moisture contents up to 20 percent with high energy utilization efficiency.

Preliminary Results and Discussion
Conveying: Tests have shown that the belt conveyor has the potential of handling any capacity that a gin might require, can elevate cotton as high as needed, and will fit within the space typically found in module feeder and gin plant installations.

Drying: The conveying belt runs through an enclosure where heated air can be forced either upward or downward through the seed cotton on the belt. Tests consisted of a 60-second drying time on machine-stripped seed cotton whose initial moisture content was 10.5%. Drying temperatures of 100, 170, and 240 degrees F. were used with both upward and downward air flow through the seed cotton. A push-pull system was used to control air pressure to provide a zero pressure point within the cotton on the belt. This provided accurate control of air temperature and the high volume of air through the cotton inlet or outlet. Airflow rate was 18.5 c.f.m./lb seed cotton.

Table 1 gives the results of the drying tests:

<table>
<thead>
<tr>
<th>Seed Cotton</th>
<th>0.2</th>
<th>1.1</th>
<th>1.7</th>
<th>0.1</th>
<th>0.4</th>
<th>0.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Direction and Temperature</td>
<td>Down</td>
<td>Up</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed Cotton</td>
<td>1.1</td>
<td>2.3</td>
<td>3.2</td>
<td>0.7</td>
<td>1.4</td>
<td>1.9</td>
</tr>
<tr>
<td>Seeds</td>
<td>0.2</td>
<td>1.1</td>
<td>1.7</td>
<td>0.1</td>
<td>0.4</td>
<td>0.6</td>
</tr>
<tr>
<td>Trash</td>
<td>0.8</td>
<td>3.2</td>
<td>4.1</td>
<td>1.1</td>
<td>1.6</td>
<td>2.1</td>
</tr>
<tr>
<td>Lint</td>
<td>3.8</td>
<td>4.2</td>
<td>5.4</td>
<td>1.4</td>
<td>3.5</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Air forced downward through the seed cotton gave better drying results than air forced upward. Channels tended to form in the seed cotton with upward air so that all cotton was not evenly exposed to the drying air. However, seed cotton that is above 12-percent moisture content can be stored indefinitely without any quality degradation. Considering that the initial moisture content of each seed-cotton component was around 10.5 percent, all downward air flow temperature treatments dried the lint to within or below the recommended USDA moisture range for ginning.

Table 2 shows the progress of the drying front through an 18-inch thick bed of seed cotton. After 64 seconds, the entire depth of seed cotton has been dried to approximately the same moisture content. Initial air temperature was 240 degrees and air-to-cotton ratio was 18 cubic feet per minute per pound of cotton. Aeration was downward, and the initial moisture content of the machine-
stripped cotton was 10.5 percent.

Possible Advantages to the Industry:
1. The 25-hp belt conveyor portion of the system re-places a 200-hp suction system.
2. The drying portion of the system equivalent to a tower dryer system can be provided on a belt at much lower air pressure, replacing 120-hp fan system with 60 hp and the same Btu burner.
3. New drying processes, such as using preheat, may evolve to give better energy utilization efficiency.
4. A more flexible control of the drying process is possible, because cotton flow rate and drying air flow rate are independent.
5. A longer drying time is possible without sacrificing throughput rate.
6. Conveying cotton in a stationary condition on the belt may help reduce nipping and static electricity problems.

Counterflow System Development
Figure 1 shows a schematic of the experimental counterflow dryer model that was built at the Southwestern Cotton Ginning Research Laboratory. The dryer consists of 14 spiked cylinders, each approximately 16 inches in overall diameter and 50 inches long. These cylinders are similar in design to cylinders used in commercial 6-cylinder seed-cotton cleaners. The spiked cylinders are mounted horizontally in an enclosed chamber, and, in addition to Figure 1, rotated counter-clockwise at 500 r.p.m.

Seed cotton is fed into the dryer through a vacuum-dropper at the right end of the experimental dryer. The rotating cylinders move the seed cotton through the dryer and the cotton flow and drying air flow dryer on the left and moves through the dryer against the seed-cotton flow and exits out the right. Flow retarding plates are mounted above the cylinders from the roof of the dryer. These plates are used to retard the flow of seed cotton through the dryer which increases the seed-cotton's exposure time to drying air.

Several preliminary trials were made to determine what range of air flow rates and temperatures to use. An average air flow rate of 4400 c.f.m. was selected with air temperatures of 150 and 200 degrees F.

Experimental Dryer Performance
A total of 16 random test runs were made using seed cotton whose moisture content varied between 13.0- and 17.5 percent dry base. Eight runs were at an air inlet temperature of 150 degrees F. and eight at 200 degrees F. The cotton was fed into the experimental dryer at 2 pounds per second for approximately 30 seconds. Initial and final cotton fiber moisture contents were determined.

In all 16 tests, the seed cotton was in the dryer approximately 1.5 seconds. (The air stream moving in the opposite direction at a speed between 1100 and 1200 feet per minute. The 150 degree F. tests dried lint from an average moisture content of 8.14 percent. The average moisture content is 8.98 percent. 200 degree F. tests dried lint from an average moisture content of 7.25 percent. The average moisture content is 7.43 percent.) In the 200 degree F tests, however, the final lint moisture was below 8 percent in seven of the eight tests.

Conclusions
An experimental counterflow dryer was built and tested of this unit show that a 200 degree F. air stream will dry the lint fraction of 13- to 17.5-percent seed cotton down to an average 7.4-percent moisture content in 14 seconds, which is 30 percent of the mean of the recommended ginning range for cotton lint.

Possible Advantages to the Industry
1. The counterflow system shown in Figure 2 has the potential of conveying, drying, and clearing in one compact operation.
2. A possible cut in the total horsepower requirements of present seed-cotton cleaning and drying systems by 1/3 to 1/2.
3. An experimental system can be built out of machinery components that are presently being utilized so that manufacturing, general adjustments, and maintenance requirements would not be greatly changed.

MOISTURE SENSING TECHNOLOGY

Field Sensing Technology
Objectives and Procedures
A field research project on moisture sensing began in 1983 by the California Cooperative Extension Services and has continued for three harvest seasons. The project was prompted by grower concern over reductions in lint and seed quality that have occurred in module cotton, particularly during late, wet harvest seasons. The objectives were 1) to learn more about the effect of seed-cotton moisture, temperatures, and storage time on lint and seed quality, and 2) to evaluate the accuracy of meters which are used to determine the moisture content of seed cotton.

General testing of cotton moisture content have been evaluated. These include: 1) a hand-held seed-cotton meter which utilizes a small cup for the sample and is commonly used by growers in the field, 2) a hand-held meter designed for module cotton, and 3) an infrared meter by L-6-inch cylinder for the sample and doesn't have a manufacturer's calibration for cotton, 3) experimental and prototype versions of an automated mounted on the tramp foot of the module builder, and 4) multiple probes for the hand-held meter referred to in (1) above.

Results
Hand-held meters - Test results for 1983 and 1984 have shown the forage meter to be more accurate than the hand-held seed-cotton meter for determining seed-cotton moisture. These data have been used to develop preliminary calibration charts for the forage meter for both hand-harvested and spindle-picked seed cotton. Calibration charts will also be developed from lint samples and cotton moisture samples that have been dried in the gin.

It should be emphasized that electrical measurements, unlike oven measurements, depend on the density of the module and lint which to some extent on the history of the sample. For this reason, a calibration for spindle-picked seed cotton with moisture recently added by the picker (where the lint is likely to be much drier than the seed cotton) and for seed cotton leaving the dryer in the gin (where the lint is likely to be much drier than the seed). Because of the normal variability that exists in the module and lint moisture contents, it is imperative that the sampling technique and the number of samples provide a representative average. For example, a single handful of cotton cannot be expected to provide a representative moisture content of the contents of a module, regardless of the moisture sensing method used.

Field tests were conducted by Salyer American during the 1985 season to determine the feasibility of mounting an automated moisture meter on a module builder. This resulted in the development of a field meter which utilizes a small cup for the sample and is commonly used by growers in the field, and reading them in the forage meter, 2) probing the module from the side in six locations using a probe designed for seed-cotton meters, and 3) taking several moisture samples from various locations in the module during the building process. Data show that the forage meter results provided much closer agreement with oven moisture results than the probe meter.

Automated meter - Information was collected during the 1985 season to determine the feasibility of mounting an automated moisture meter on a module builder. This resulted in the development of a field meter which utilizes a small cup for the sample and is commonly used by growers in the field, and reading them in the forage meter, 2) probing the module from the side in six locations using a probe designed for seed-cotton meters, and 3) taking several moisture samples from various locations in the module during the building process. Data show that the forage meter results provided much closer agreement with oven moisture results than the probe meter.
Packaging and mechanical mounting difficulties. Excellent results were obtained in 1985 with the electronics as well as the pressure measurements. The pressure measurement was made directly on the cotton rather than by measuring oil pressure in the hydraulic line as in 1984. The original packaging proved to be too light and difficult to mount on the module builder. A new mounting arrangement was needed. Be the time spent debugging the new version of the instrument, less data have been collected this year than had been expected.

There are some limitations with the experimental, automated unit that hope to be overcome:

1) Moisture readings aren't taken on the first 2 or 3 feet of cotton in the module because the ram is too short and compact the initial lay or cotton. This could be overcome by extending the module ram.

2) Life of the sensor plate that contacts the cotton has been shorter than expected due to abrasive wear which is probably caused by use of the tramper to move cotton in the module hopper. These plates are expensive and easy to change; however, a new design is being developed that will last at least a full season.

3) The automated sensor, as currently configured, reads moisture up to the 12-percent range but does not read above 14 percent. Provision was made in the original design for a high and low moisture range. The high range is now being implemented and tested. The software within the unit will automatically switch from the more accurate low range to the high range when the moisture exceeds 14 percent.

Conclusions

There is an old belief that fast, accurate measurement of seed-cotton moisture is an important part of any effort to control the effect of seed-cotton moisture on lint and seed quality. Cotton stored in modules is very susceptible to quality degradation if the moisture level is excessive.

The hand-held forage meter (when properly calibrated) and the automated meter for the module builder have the potential for improving the moisture measurement process for growers and ginners. Future work will be directed toward in-line meters for the gins and research on remote meters for bales or modules.

The field work reported here has been conducted in cooperation with Salyer American, Corcoran, California, Ranchers Cotton Oil Company, Cotton Incorporated, and California Cotton Planting Seed Distributors.

INFRARED SENSORS FOR MEASUREMENT OF COTTON MOISTURE

Methodology

A non-contact, infrared-type of moisture meter manufactured as a Model MM4 Infragage by Infrared Engineering of Waltham, Mass. was evaluated for use in a cotton gin by the U.S. Cotton Ginning Research Laboratory (Anthony, 1985). The instrument has a "gated" capability, which means that it will not accept input from the sensor when major changes occur such as when seed-cotton is being viewed.

Calibration for Lint Moisture

The instrument was initially calibrated statically with seed cotton that had been conditioned over saturated salt solutions to provide different humidity levels (NES Circular 512, 1951). ASTM procedure D2495 (Standard Test Method for Moisture in Cotton by Oven Drying) was used to determine the reference moisture content of each sample (ASTM Book of Standards).

Since variations in the texture of the cotton, the distance between the sensor and the cotton, or the glass thickness change the calibration substantially (Anthony and Griffin, 1984), those factors were held constant. The MM4 was located 8 inches from the surface of the cotton during all calibration processing and viewed the samples continuously through a 2.4-inch diameter slot cut in the wall of the feed control hopper which was covered with a single-pane glass 1/8-inch thick. The sensor was installed at an angle of 20 degrees to the cotton to prevent spectral reflection.

A dynamic calibration was performed at the feed control hopper of the microgin at the Stonewall laboratory. The feed control hopper of this 400-bale gum was filled with seed cotton at a depth of about 3 feet above the sensor. In commercial gins, cotton depth at this point would be at least 6 to 9 feet. The density and uniformity of the seed-cotton sample should increase with the greater depth which should improve the accuracy of the instrument.

Procedures and Results

Three separate studies were conducted — two studies in the microgin and one study in the full-scale gin at the Stonewall laboratory. Samples for moisture were taken during gin processing, and the associated MM4 readings were taken as the seed cotton moved past the sensor at speeds of 0.7 to 2.0 feet per minute.

Study 1 — Microgin Feed Control

Results were evaluated using regression analyses. The lint moisture was related to the MM4 reading by the following equation:

\[ \text{Lint Moisture, percent} = 2.764 + 0.658 \times \text{MM4} \]

The regression model was significant at the 5-percent level. Accuracy of the MM4 was assessed by considering the standard deviations of the MM4 readings at three widely different moisture levels (Table 1). At MM4 readings of 3.2, 5.6, and 9.8, the standard deviations were 0.30, 0.35, and 0.45, respectively. This means the MM4 predicts lint moisture within approximately 0.5 percentage points by extending the seed-cotton range which contains both lint and seed-cotton. The standard deviation of the MM4 readings at three lint moisture levels was 0.30 percent. When the seed-cotton moisture for the data points shown in Table 1 were duplicated five or more times.

The mean and standard deviation for the calculated lint moisture of lint cotton by viewing the seed-cotton mass was 7.50 percent, and the standard deviation was 0.33.

For the higher moisture 3-bale study, the oven lint moisture and MM4 readings averaged 8.29 and 8.45 percent, respectively. The lint moisture levels had standard deviations were 0.52 and 0.46. The instrument performance at these two moisture levels was comparable in the full-scale gin and microgin facilities since the standard deviations were almost equal.

An infrared-type moisture meter is suitable for use in full-scale ginning systems, but care must be exercised to ensure uniformity in the surface density of the seed cotton during calibration and gin processing. Time constants of 10 to 20 seconds will average the measurements and provide suitable readings. The meter can estimate the moisture of lint cotton by viewing the seed-cotton mass with sufficient accuracy for control of the gin drying system.
1. Cocke, J.B. and W.E. Garner. 1972. Effect on ginning adequacy of the current software operating system. On-line cotton lint. The bridge is sensitive over a range of densities have shown an equivalent measurement performance. The system has been tested with good results on seed cotton (Waldie, et al, 1984) and cotton lint (Waldie, et al, 1983). Over a seed-cotton moisture range of 9 to 19 percent, the sensor measured the current moisture to within plus-minus 1.1 percentage points. On ginned lint with a moisture range of 6.5 to 12 percent, the sensor measured to within plus-minus 0.4 percentage points of the moisture content as determined by the laboratory oven method. This performance is quite adequate to measure and control cotton moisture, provided that the sensor was presented cotton at a controlled or a known bulk density. The problem arises in that in a gin environment it is very difficult to control the bulk density of seed cotton or cotton lint. Therefore, it was necessary to develop a means of measuring the bulk density of cotton in front of the sensor plate and relating that to the sensor measurement to determine moisture content. The bulk density measurement is very important since for a given moisture, sensor response can vary by as much as 22 percent as bulk density of lint goes from 0.8 to 2.2 pounds per cubic foot (Waldie, et al, 1983). A pneumatic bridge has been developed during the past 2 years for measuring the bulk density of either seed cotton or cotton lint. The bridge is sensitive over a range of 0.5 to 3.5 pounds per cubic foot. Several table top instruments have been built which incorporate the pneumatic bridge and the current impedance moisture sensor. Laboratory use of the instruments using varying bulk densities have shown an equivalent measurement performance for lint and the lint fraction of seed cotton as when measurements were made on controlled bulk densities. The design of the instrument is such that it can operate in the normal temperature range found in the laboratory or a commercial cotton gin. It will also self-compensate for varying ambient air pressure conditions from atmospheric to plus-minus 20 or 30 inches of water such as might be found at various places in a gin plant.

Two table-top instruments have been given to other laboratories for testing. Data will be obtained on durability, reliability, and repeatability as well as the adequacy of the current software operating system. On-line models of the sensor have been built and will be tested under actual ginning conditions for measurement response to the moisture content of cotton lint and the lint fraction of seed cotton.


PROJECT RESULTS

Reports have been given earlier of the design and development of a microprocessor-based cotton moisture sensing system (Waldie, 1983). This system has been tested with good results on seed cotton (Waldie, et al, 1984) and cotton lint (Waldie, et al, 1983). Over a seed-cotton moisture range of 9 to 19 percent, the sensor measured the current moisture to within plus-minus 1.1 percentage points. On ginned lint with a moisture range of 6.5 to 12 percent, the sensor measured to within plus-minus 0.4 percentage points of the moisture content as determined by the laboratory oven method. This performance is quite adequate to measure and control cotton moisture, provided that the sensor was presented cotton at a controlled or a known bulk density. The problem arises in that in a gin environment it is very difficult to control the bulk density of seed cotton or cotton lint. Therefore, it was necessary to develop a means of measuring the bulk density of cotton in front of the sensor plate and relating that to the sensor measurement to determine moisture content. The bulk density measurement is very important since for a given moisture, sensor response can vary by as much as 22 percent as bulk density of lint goes from 0.8 to 2.2 pounds per cubic foot (Waldie, et al, 1983). A pneumatic bridge has been developed during the past 2 years for measuring the bulk density of either seed cotton or cotton lint. The bridge is sensitive over a range of 0.5 to 3.5 pounds per cubic foot. Several table top instruments have been built which incorporate the pneumatic bridge and the current impedance moisture sensor. Laboratory use of the instruments using varying bulk densities have shown an equivalent measurement performance for lint and the lint fraction of seed cotton as when measurements were made on controlled bulk densities. The design of the instrument is such that it can operate in the normal temperature range found in the laboratory or a commercial cotton gin. It will also self-compensate for varying ambient air pressure conditions from atmospheric to plus-minus 20 or 30 inches of water such as might be found at various places in a gin plant.

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Ginning to Minimize Bark Penalties

By Roy Baker, Research Leader
USDA-ARS South Plains Ginning Research Laboratory
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INTRODUCTION

Official grade standards for U.S. cotton do not contain discernible quantities of bark. Consequently, bark in ginned lint is considered to be "extraneous matter" by the classer, and a lint sample containing appreciable amounts of bark in ginned lint would not reflect this special condition (10). The same rule also applies to grass, spindle twists, sand, dust, oil, parts of seeds, motes, stems, etc. The amount of cotton penalized because of excessive bark contamination is considered to be very small, and this practice is not very noteworthy. The bark penalty is very costly for the producer since downgraded cotton is often discounted $20 to $25 per bale in the marketplace. Also, some cotton spinners are concerned about possible adverse effects of bark on spinning performance and end product quality. Thus, barks is a problem of considerable magnitude, particularly for those producers who use the stripping method of harvesting and bear the economic brunt of the bark problem in the marketplace.

Botanical identification of the bark present in lint samples has shown that most barklike strands consist of phloem fibers from the outside layers of the bark and stem of the cotton plant (9). The phloem tissue often begins to separate from the woody core of sticks and stems prior to mechanical harvesting, especially if the plant has undergone an extensive amount of weathering in the field. Bark, therefore, is removed from sticks and stems during harvesting, seed cotton cleaning, and ginning (8, 13). This bark material then becomes thoroughly entangled in the cotton lint. Sticks containing bark, being fibrous in nature, are extremely difficult to remove from the cotton by conventional cleaning techniques.

Numerous research studies have been conducted in an effort to determine the amount of bark that can be eliminated or reduce theark penalty that is so costly to producers of stripper cotton. Unfortunately, no magic cure has been found at the cotton gin. Instead, several partial remedies have been identified that allow the elimination of bark in ginned lint, and under many conditions reduce the number of bales penalized because of excessive bark content. Also, ongoing research to fine-tune cultural practices and to improve the performances of harvesters, stick extractors, lint cleaners, and trashers show considerable promise for significantly reducing the magnitude of the bark problem in the future.

STICK EXTRACTION

Harvesting and ginning research studies have shown that a close relationship exists between the stick content of cotton and the level of bark in ginned lint (8,11,12). Field observations of sticks being broken and stripped of their bark in subsequent cleaning and handling operations. The importance of this point can be illustrated by referring to the results of a cleaning study conducted at the Lubbock Ginning Laboratory a few years ago (13). In this study we evaluated two stick extraction systems. One system was composed of a gin harvesting machine, and an extractor-feeder. We replaced the bur machine with another stick machine for the other system. Cotton from the bur machine system contained more sticks than that from the stick machine system after the first stage of extraction. Subsequent extraction has apparently damaged some of the sticks and increased the amount of bark in the cotton. The loose bark content in cotton cleaned by the bur machine system was consistently higher than that in cotton cleaned by the stick machine system, and these differences were reflected in the classer's bark evaluation. Eighty-nine percent of the lint samples (after two lint cleaners) from the bur machine system and 50 percent of the lint samples from the stick machine system were penalized because of excessive bark (1).

Subsequent studies have shown that a relatively new combination bur/stick machine is just as effective as the conventional stick system in removing barks and slightly more effective for removing barks. For these reasons, and because of its durability, we recommend the combination bur/stick machine for the first stage of extraction. A modern two-saw or three-saw stick machine will adequately fulfill the requirements for the second stage of extraction. This machine is often employed directly ahead of the conveyer distributor. The third stage of stick extraction is normally provided by modern extractor-feeders that utilize the stick machine principle for stick and bark removal.

While three stages of extraction are adequate for most stripper cotton, additional extraction can be beneficial in certain situations. Several combinations of the already mentioned various amounts of stick extraction during tests using extremely trashy cotton. A system composed of four stages of extraction produced lint samples that graded 45 percent better in the next season compared to similar samples that were all downgraded because of bark (3). Thus, the addition of another stage of extraction is an option available to the ginner and would be a wise choice if the climate of the area frequently exceed normal levels.

Generally, our research data has clearly shown that efficient stick extraction during seed cotton cleaning can accomplish a reduction in the amount of bark content in the lint, but stick extraction, however, will not completely solve the barky cotton problem. This point can be illustrated more clearly by referring to the results of an experiment conducted several years ago at Lubbock (1). In this study we manually removed all sticks from small batches of very trashy cotton to simulate perfect stick extraction. The lint from this cotton contained less bark than that from similar cotton which had been cleaned in the normal manner but that was not cleaned in the stick extraction system. Laboratory results illustrate that under many conditions enough bark can be entrained in the cotton during harvesting and handling to produce bark penalties in the gin and to a reduction in number of bary bales.

LINT CLEANING

Even though bark is difficult to remove from ginned lint, its removal is not impossible. Conventional sawtype lint cleaners are reasonably effective in reducing the bank content of ginned lint. In several studies we have recently evaluated the feasibility of improving stick machine performance by using more efficient saw cylinder and grid designs, and by improving the loading characteristics of the cleaning cylinders (5). These improvements increased the operating efficiency of a stick machine by about 10 percent. Thus, there is a potential for further improvements in stick machine performance. As these and other developments continue, ginners can look forward to better control of stick content at the gin and to a reduction in number of bary bales.
Recent studies conducted at Lubbock during the 1980-83 crop years have provided additional evidence that lint cleaning at the gin does reduce the number of bark penalties for moderately contaminated cotton. Thirteen of the 20 test cottons studied during this period contained enough bark before lint cleaning to be penalized to some degree by the classer. Seventy-eight percent of the 385 samples collected before lint cleaning (from the 13 cottons) were penalized because of bark. The percentage of samples penalized after 1, 2 and 3 stages of lint cleaning averaged 39, 33, and 32 percent, respectively.

While the above percentages illustrate the broad average effects of lint cleaning on bark, a more detailed analysis reveals substantial differences between test cottons. Three of the test cottons from the 1981 crop year were heavily contaminated with bark, and lint cleaning did not significantly affect bark penalties for these cottons. Over 90 percent of the samples from these cottons were penalized because of bark regardless of the amount of lint cleaning employed. Ten of the test cottons apparently contained only moderate amounts of bark after lint cleaning had been performed. For these ten cottons, percentage bark penalties before and after 1, 2 and 3 stages of lint cleaning averaged 74, 23, 16, and 14 percent, respectively. Thus, one and two stages of lint cleaning were highly effective in reducing bark penalties for cottons containing moderate amounts of bark. The effects of the third stage of lint cleaning on bark penalties was minimal.

Several research and manufacturing groups are presently involved in research and development activities that could, in the future, improve lint cleaning processes at the cotton gin. Our research group is involved in a cooperative research project with Cotton Incorporated to evaluate the feasibility of using carding techniques at the gin to remove bark and improve lint cleaner performance (6, 7). Also, we are cooperating with the ARS Cotton Quality Research Station in Clemson, SC, on research designed to evaluate various textile-type cleaning principles to determine their suitability for use at the gin. In this work we are particularly interested in techniques that remove large pieces of foreign matter such as stick fragments that contribute to the bark level of the lint. This research, and that by other research and manufacturing groups, holds great deal of promise for achieving further reductions in the barkiness of lint from stripper harvested cotton.

**SUMMARY**

Efficient cleaning systems at the cotton gin are effective in reducing the number of bales downgraded because of excessive bark content. The benefits of efficient gin cleaning systems are readily apparent when processing cottons of moderate stick and bark content. For some cottons, however, the benefits of efficient cleaning may be obscured by an extremely high initial stick and bark content. In these cases enough bark is entrained in the cotton during harvesting and handling to produce a bark penalty regardless of how well the gin's cleaning system is performing. While the gin is not able to control with these extreme cases at this time, continued research to improve stick extraction and lint cleaning systems should provide us with better tools for controlling this problem in the future. In the meantime, the ginner can make meaningful contributions to a solution of the problem by employing state-of-the-art cleaning systems and by following established guidelines for efficient, quality ginning.

**LITERATURE CITED**

COTTON HARVESTER DEVELOPMENTS

By Alan D. Brashears
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Lubbock, Texas 79401

Cotton harvesting has developed from hand picking and hand pulling of the 1920's and 1930's to the high capacity 4 row units of today. Despite the depressed cotton economy during the mid-1980's manufacturers of cotton harvesters continue to make improvements. The early objectives of cotton harvester development was for increased harvesting efficiency and increased capacity. The trend in developments today are toward less foreign matter in the seed cotton, low maintenance for equipment and maintaining or increasing the throughput of cotton. The introduction of cotton harvester modifications has had a significant effect on the cotton harvesting operations.

The fall of 1987 saw the introduction of a new Case International 1844 picker that has provided the producer with a high capacity tractor mounted stripper that also reduces time and effort in removing trash from the tractor.

The introduction of a modified picker, a stripper and a stripper with field cleaner found higher grade, cleaner seed cotton, and elimination of extraneous foreign material. The "barky" problem associated with cotton strippers include high foreign matter content, barky grades and maintaining lint quality from the field to mill processing.

The production of Deutz-Allis cotton strippers is on hold until the return to production in the near future. The producers' desire to deliver clean seed cotton to the gin and reduce ginning costs has created considerable interest in field cleaners.

Research at Lubbock to modify stripper rolls has found that reducing the width of paddles on an alternate brush rubber paddle stripping roll by 1 inch would decrease bulk rice stick content by 30-40%. The reduced stick content resulted in a decrease in the number of barky grades by two thirds. Additional research is being conducted on spacing and synchronization of the stripper rolls.

The future of cotton harvesting will bring further changes. These changes will include higher harvesting capacity, cleaner seed cotton, and elimination of extraneous foreign material. The "barky" problem associated with cotton strippers will require the use of less foreign material and excess oil in lint.

References to a company or trade name does not imply approval or recommendation by USDA-ARS.

2 References to a company or trade name does not imply approval or recommendation by USDA-ARS.
GIN STAND DEVELOPMENTS
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Agricultural Engineering Department
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W.F. Lalor
Senior Director of Agricultural Research
Cotton Incorporated, Raleigh, North Carolina 27612

Research is being continued on the evaluation of a new process of removing the lint cotton from the seed. This process is presently referred to as selective ginning since the concept is to remove the longer fibers from the seed without removing the shorter fibers that will remain on the seed. The shorter or remaining fibers are removed by a conventional saw gin after the seed cotton has been processed through a selective gin.

The laboratory model of the selective gin was developed in a cooperative project between Cotton Incorporated and the Agricultural Engineering Department of the Texas Agricultural Experiment Station (Wilkes et al., 1984). The gin consists of a series of 3/4 inch (1.9 cm) rollers mounted on the outer surface of a circular, rotating cage. Air that is drawn into the center of the cage between the cage rollers causes seed cotton to adhere to the outer surface of the rollers. The lint is removed from the seed by the airflow. Variations in the roller pinches the lint and pulls it from the seed. The close spacing between the cage rollers prevents the seed from being pulled through to the interior of the cage with the lint.

The selective ginning process has been evaluated with several varieties of cotton (Wilkes, Watkins, and Lalor, 1985). The quality of the lint removed was determined by subjecting replicated samples to the standard Suter Web fiber array tests and the High Volume Instrument (HVI) classification system. A sample of the lint obtained from each of the gin treatments was analyzed. The lint was carded at the rate of 12.5 pounds (5.68 kg) per hour in the laboratory model of the selective gin. The lint obtained from each of the gin treatments was sent to the USDA Agricultural Marketing Service, Test Section, Clemson, S.C. for testing. The lint was analyzed for fiber length, fiber strength, fiber uniformity, fiber width, and fiber maturity.

The results showed the selectively ginned lint to be of higher quality than the lint ginned with the conventional saw gin. The residual fiber was slightly longer and stronger. It was also more uniform. A much greater difference between the two systems of ginning was shown when comparing the data obtained in the fiber array tests. This data showed that the selectively ginned lint contained a significantly lower percent of short fiber (less than one-half inch) when compared with conventional saw ginned lint. The coefficient of variation was significantly lower and the mean length as well as the upper quartile were significantly longer for the selectively ginned cotton as compared with conventional saw ginned lint.

The variability of the lint when compared with conventional saw ginned cotton is lower for the selectively ginned lint. The lint remaining on the seed after selective ginning is not severe affected with any of the two varieties. One major difference between the two varieties was the number of neps in the ring spun yarn.

The effects of the selective ginning process as compared with conventional saw ginning with cotton varieties GSA 71 and Paymaster 404, as indicated by measurements obtained on the lint, are given in Table 1. The staple length and the uniformity ratio of the lint removed by the selective gin were greater than the saw ginned lint for both varieties. The length and uniformity were slightly lower for the residual lint for GSA 71, but approximately the same for Paymaster 404 with the saw ginned lint. The most noticeable differences among the ginning treatments for both varieties were in the weight of the lint removed. For selectively ginned lint especially with Paymaster 404. These data also indicates that the lint remaining on the seed after selective ginning is not severe affected with any of the two varieties. The quality of the lint removed was determined by subjecting replicated samples to the standard Suter Web fiber array tests and the High Volume Instrument (HVI) classification system. A sample of the lint obtained from each of the gin treatments was analyzed. The lint was carded at the rate of 12.5 pounds (5.68 kg) per hour in the laboratory model of the selective gin. The lint obtained from each of the gin treatments was sent to the USDA Agricultural Marketing Service, Test Section, Clemson, S.C. for testing. The lint was analyzed for fiber length, fiber strength, fiber uniformity, fiber width, and fiber maturity.

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Summary

The new ginning process in which the lint is pulled from the seed by a pinching action of two smooth surface rollers can produce lint of higher quality than the conventional saw ginning process. The lint is longer and more uniform. As shown in Table 1, the staple length and uniformity ratio of the lint removed by the selective gin are greater than the lint from the saw gin. The results of the tests indicate that the yarns produced by the selective gin are of higher quality than the yarns produced by the saw gin. This is true for both the ring and open-end spinning processes. There are also fewer neps in the yarn produced by the selective gin than in the yarn produced by the saw gin.

References


Table 1. Fiber quality as measured by HVI classing system as affected by ginning treatments with two varieties.

<table>
<thead>
<tr>
<th>Ginning Treatment</th>
<th>Saw</th>
<th>Selective</th>
<th>Residual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variety - GSA 71</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fineness (Micron)</td>
<td>3.53</td>
<td>3.32</td>
<td>3.52</td>
</tr>
<tr>
<td>Length (Inches)</td>
<td>.95</td>
<td>.97</td>
<td>.93</td>
</tr>
<tr>
<td>Uniformity Ratio</td>
<td>79.33</td>
<td>80.83</td>
<td>76.25</td>
</tr>
<tr>
<td>Strength (GM/Tex)</td>
<td>25.75</td>
<td>26.25</td>
<td>25.00</td>
</tr>
<tr>
<td>Variety - Paymaster 404</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fineness (Micron)</td>
<td>3.13</td>
<td>2.85</td>
<td>3.12</td>
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<tr>
<td>Length (Inches)</td>
<td>.99</td>
<td>1.03</td>
<td>.99</td>
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<tr>
<td>Uniformity Ratio</td>
<td>78.50</td>
<td>79.92</td>
<td>78.17</td>
</tr>
<tr>
<td>Strength (GM/Tex)</td>
<td>25.92</td>
<td>25.92</td>
<td>26.08</td>
</tr>
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Table 2. Fiber quality as determined by fiber array analysis as affected by ginning treatments with two varieties.

<table>
<thead>
<tr>
<th>FIBER MEASUREMENTS</th>
<th>Saw</th>
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<th>Residual</th>
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</thead>
<tbody>
<tr>
<td>Variety - GSA 71</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length (Inches)</td>
<td>.84</td>
<td>.90</td>
<td>.80</td>
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<td>Upper Quartile</td>
<td>1.07</td>
<td>1.11</td>
<td>1.02</td>
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<tr>
<td>Coefficient of Variation</td>
<td>35.84</td>
<td>31.17</td>
<td>36.65</td>
</tr>
<tr>
<td>Percent of Fiber</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 1/2 inch</td>
<td>16.7</td>
<td>11.2</td>
<td>18.2</td>
</tr>
<tr>
<td>More than one inch</td>
<td>34.9</td>
<td>44.1</td>
<td>29.2</td>
</tr>
<tr>
<td>Variety - Paymaster 404</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length (Inches)</td>
<td>.84</td>
<td>.94</td>
<td>.85</td>
</tr>
<tr>
<td>Upper Quartile</td>
<td>1.10</td>
<td>1.17</td>
<td>1.10</td>
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<tr>
<td>Coefficient of Variation</td>
<td>38.43</td>
<td>33.86</td>
<td>30.70</td>
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<tr>
<td>Percent of Fiber</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 1/2 inch</td>
<td>19.0</td>
<td>12.1</td>
<td>17.0</td>
</tr>
<tr>
<td>More than one inch</td>
<td>37.2</td>
<td>49.8</td>
<td>38.4</td>
</tr>
</tbody>
</table>

Table 3. Results of spinning tests for GSA 71 variety with three ginning treatments.

<table>
<thead>
<tr>
<th>YARN PROPERTIES</th>
<th>Saw</th>
<th>Selective</th>
<th>Residual</th>
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</thead>
<tbody>
<tr>
<td>Carded Yarn - Ring Spinning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strength - 14s</td>
<td>177</td>
<td>189</td>
<td>170</td>
</tr>
<tr>
<td>- 22s</td>
<td>101</td>
<td>109</td>
<td>100</td>
</tr>
<tr>
<td>Break Factor (Avg.)</td>
<td>2354</td>
<td>2523</td>
<td>2289</td>
</tr>
<tr>
<td>Yarn Neps - 14s</td>
<td>32</td>
<td>20</td>
<td>24</td>
</tr>
<tr>
<td>- 22s</td>
<td>61</td>
<td>56</td>
<td>67</td>
</tr>
<tr>
<td>Carded Yarn - Open End Spinning (22s)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strength</td>
<td>57</td>
<td>65</td>
<td>52</td>
</tr>
<tr>
<td>Break Factor</td>
<td>1261</td>
<td>1423</td>
<td>1147</td>
</tr>
<tr>
<td>Yarn Neps</td>
<td>11</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Waste-Percent Picker and Card</td>
<td>6.91</td>
<td>6.14</td>
<td>6.57</td>
</tr>
</tbody>
</table>

Table 4. Results of spinning tests for Paymaster 404 variety with different ginning treatments.

<table>
<thead>
<tr>
<th>YARN PROPERTIES</th>
<th>Saw</th>
<th>Selective</th>
<th>Residual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carded Yarn - Ring Spinning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strength - 14s</td>
<td>184</td>
<td>200</td>
<td>182</td>
</tr>
<tr>
<td>- 22s</td>
<td>106</td>
<td>114</td>
<td>104</td>
</tr>
<tr>
<td>Break Factor (Avg.)</td>
<td>2653</td>
<td>2653</td>
<td>2618</td>
</tr>
<tr>
<td>Yarn Neps - 14s</td>
<td>148</td>
<td>150</td>
<td>149</td>
</tr>
<tr>
<td>- 22s</td>
<td>297</td>
<td>283</td>
<td>278</td>
</tr>
<tr>
<td>Carded Yarn - Open End Spinning (22s)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strength</td>
<td>66</td>
<td>75</td>
<td>63</td>
</tr>
<tr>
<td>Break Factor</td>
<td>1445</td>
<td>1650</td>
<td>1386</td>
</tr>
<tr>
<td>Yarn Neps</td>
<td>25</td>
<td>19</td>
<td>72</td>
</tr>
<tr>
<td>Waste-Percent Picker and Card</td>
<td>7.04</td>
<td>6.71</td>
<td>7.06</td>
</tr>
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</table>
The product liability crisis has become one of the most important issues facing gin machinery manufacturers today and, if the present trend continues, it may become the most important in the near future. Product liability and other forms of general liability have indeed become a nightmare which must be better understood by businessmen in every industry, including the cotton industry. Today, cotton gin machinery manufacturers and cotton gin owners could easily be put out of business because of the high cost of legal defense and many run-away jury awards. Cotton farmers won't be able to afford the increase in cotton raw product charges and the gin plant owners will not be able to purchase insurance at any price. Gin plants won't be able to purchase repair parts, service or new machinery if there are no companies to service and supply them with the products they need.

In recent years, most discussions and papers written on this subject have primarily concentrated on ways to reduce insurance costs, with some but not enough emphasis on safe working conditions for our employees. These same discussions and the most important of these is that the insurance crisis was forcing companies to raise prices and reminding all of us that we as consumers of products and services must eventually pay the bill for this increased cost of insurance. The current cost that may have been a fact ten years ago, is not today.

The product liability crisis is continuing to force companies to raise prices or accept smaller profits, but now manufacturers are having to do both purely in managing cotton gin facilities. Product liability and other forms of general liability have indeed become a nightmare which must be better understood by businessmen in every industry, including the cotton industry. Today, cotton gin machinery manufacturers and cotton gin owners could easily be put out of business because of the high cost of legal defense and many run-away jury awards. Cotton farmers won't be able to afford the increase in cotton raw product charges and the gin plant owners will not be able to purchase insurance at any price. Gin plants won't be able to purchase repair parts, service or new machinery if there are no companies to service and supply them with the products they need.

For example, Cessna Aircraft stopped making five types of small airplane last year because product liability had driven the prices of new models beyond the reach of most customers. Multi-million dollar judgments, multi-million dollar insurance premiums and multi-million dollar insurance deductibles can bring even the largest companies to their knees. The ginning industry is not large enough nor profitable enough to survive if the increased cost of insurance and consider elimination of certain high-risk products and services. Most smaller companies have or will soon be facing four to seven fold increases in product liability insurance costs. The ginning industry which historically absorb high insurance costs, are facing the most serious problem of potentially not being able to purchase coverage at any price.

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Moreover, manufacturers are now being held responsible for any injuries related to products they introduce into commerce, and they are now being held responsible for injuries caused by the misuse of the products they need. This is entirely different from the age-old view of the common law that with few exceptions there was no absolute liability in cases in which no negligence was shown. In most cases, where negligence exists, it might be an easy way for them to make a good living at the expense of the manufacturers and the consumers of the products they need.

In conclusion, I would like to say that we need three things. Product liability reform on the National level to provide uniform laws in all states and reform to allow us to return to a fair standard which will hold those responsible for the accidents accountable and not allow the courts to roam through a gin plant exposing themselves to potential injury while at the same time exposing the gin plant, its employees, insurers and vendors to the unnecessary risk of paying for that injury.

In 1979, the Commerce Department put forth the Uniform Product Liability Act which was to be a model for product liability reform statutes to be considered by legislatures in the fifty states and the District of Columbia. It was known at that time that this country needed more uniformity of its product liability laws. Unfortunately, although product liability reform statutes have been enacted in a majority of the states, no two states are alike, and most of them failed to address the principle issues which arise in product liability cases. If anything, there is less uniformity today than there was in 1979.

It is against this background of expanding liability, expanding damages and indeterminate science that insurers must operate. All these factors must be taken into account in their actions to advise our customers. Our modern liability system is now so standardless and it operates in such total absence of standards that numerous observers have suggested that the majority of the dollars spent winds up in the pockets of attorneys and not the victims, the injured. Whereas that may have been a fact ten years ago, it is not today.

There is, however, one thing more important than legislative reform of product liability laws. It is, in fact, the obligation of the manufacturers and the consumers of the equipment and products which they need. It is the obligation of the manufacturers and the consumers of the products they need. It is the obligation of the manufacturers to provide incentive for improvement in products and behavior. The current state of the law is such that there are few absolute standards against which behavior can be measured and that has led to a system that devotes most resources purely to the cost of litigation. Our modern liability system is now so standardless and it operates in such total absence of standards that numerous observers have suggested that the majority of the dollars spent winds up in the pockets of attorneys and not the victims, the injured. Whereas that may have been a fact ten years ago, it is not today.

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Yes, product liability is my nightmare, and I believe it could become the nightmare of all gin plant operators. The ginning associations must play a bigger role than they have in the past in communicating this message to their members. I never thought the day would come when I as a manufacturing executive could be so overwhelmingly in favor of OSHA inspectors doing their job. The ginning associations have fought to keep OSHA out of the cotton gins but, if we don't clean up our act and create safer working conditions for our employees, then I believe OSHA should play a larger role. Even our President, Ronald Reagan, who is definitely against increasing the power of the Federal Government has acknowledged the problems related to product liability because he understands how serious it is.

Finally, I hope that you have heard my message and will take positive steps to do something about the product liability crisis before it also becomes your nightmare.
Today's theme is "The State of the Art - Ginning in the Next Decade." But before we start with the factors let us take a brief look back over the past few decades. I think those of us who have been associated with the ginning industry can be proud of what has been accomplished.

Over the past 40 years the production capacity of cotton gins has increased about 7-fold. This has contributed to the ability to harvest cotton quickly while it is at its peak quality before it is weather damaged from remaining in the field. In the field, the cotton gins of the past had to have high volume instrumentation systems for classing raw lint cotton. Modern ginning machinery has reduced the trash content in the lint so drastically that the grade standards for trash content have been significantly altered to reflect this improvement. The improvement in the overall fiber length distribution of the lint have been considerably enhanced, which is rewarded handsomely by the existing marketing systems.

Modern cotton gins also produce a bale package that is much improved over the bale packages generally produced several years ago. Bale packaging material and labor costs have also been reduced. Not only has the bale package been improved, but also the density of the bales has been increased and made more uniform. Bale packaging, handling, and transportation cost reductions from the gin to the textile mills have resulted from the improved bales. The improved bales also aid in the automation of the opening of the bales at textile mills. The present day cotton gins are not only more practical by removing the trash and moisture that accompany mechanical harvesting. The modern cotton gin is a much safer place to work, and it is a healthier place to work. The area surrounding the cotton gin also enjoys a cleaner environment. Automation and controls in modern cotton gins further reduce labor and provide more consistent operation. The modern cotton gin has dramatically reduced overall labor costs.

Cotton gins have indeed made great strides in light of the economic needs presented to our industry. The economic incentives today are simply to produce the highest grade lint cotton without an offsetting monetary loss due to shortened staple or turnout. But now let us look into the future. The theme of this meeting, "The State of the Art - Ginning in the Next Decade," is certainly a very relevant theme. All evidence indicates that we are on the threshold of some major changes in our industry that should come to fruition within the next decade. For several years now, research has been confirming that the present method of placing a value on raw lint cotton does not correlate with the true value of cotton in the textile mills. (See Fig. 1) Our present classing system places a value on lint cotton based on three factors only: grade, staple and micronaire. Micronaire is grades possible without an offsetting monetary loss due to increased or undirected will be unleashed when these new lint quality measurements as they are introduced, because they will help cotton to be more successful in the long run.

We can expect in the next decade to have instrumentation that can detect this fiber degradation. Hopefully, premiums will be paid for cotton that is not abused as a result of our efforts toward improving the product we supply to our customers, the textile mills. Cotton gins in the 1990s, will have drying systems that will dry gently and only to the proper level for optimum true quality ginning. There will be more lint cleaners in the 1990s that will not only produce clean appearing cotton, but also cotton that is free of neps and other damage that reduces the yarn quality and productivity.

While we here today are primarily concerned with matters involving cotton gins, another major impact of the introduction of new true cotton quality factor measurements in the marketing system is that all the other segments of the industry preceding the gin will also be provided monetary incentives to cause them to bring about raw lint cotton fibers that more truly meet the needs of the textile mills. Cotton breeders will have additional incentives to develop cultivars with fiber characteristics to optimize textile mill use. Producers, harvesting machinery suppliers, etc., will also have increased incentives to deliver lint that will yield lint with higher value to the textile consumers. A large reservoir of talent that in now either misdirected or undirected will be unleashed when these new lint quality measurements are introduced. Hopefully, what we call "the green card class," cotton will slowly slip into a secondary role. None of us want to see this happen.

These new "true" quality factors will allow those of us who are cotton machinery suppliers to direct our research efforts toward machinery improvements that will benefit cotton quality. There are very few restraints in the raw cotton marketing system to discourage abuses of true cotton quality, at least insofar as the USDA "green card" classing is concerned. We who are attempting to serve the industry have been aware for some time that certain abuses can take place at the cotton gin that will enhance the green card class, while at the same time true spinning qualities may suffer. Because of the dominance of this factor, cotton quality and processibility may suffer. Because of the dominance of this factor, cotton quality and processibility may suffer.

New instruments to accurately measure these more significant quality factors are being introduced as a result of these tests showing the importance of these additional raw lint fiber qualities. Already we have High Volume Instrumentation systems designed and built by various companies, however, we do not significantly alter the classing factors that have been used for a number of years that are based on conditions that existed perhaps over 100 years ago.

Cotton is in a critical battle with synthetic fibers that also possess excellent qualities, especially for the new high speed textile processes. Cotton's comfort and other qualities make it still the best overall fiber, but each year synthetic fibers are improved. Unless we do our utmost to produce raw lint cotton with the best true fiber quality for the textile mills, the present "green card," cotton will slowly slip into a secondary role. None of us want to see this happen.

These new "true" quality factors will allow those of us who are gin machinery suppliers to direct our research efforts toward machinery improvements that will benefit cotton quality. There are very few restraints in the raw cotton marketing system to discourage abuses of true cotton quality, at least insofar as the USDA "green card" classing is concerned. We who are attempting to serve the industry have been aware for some time that certain abuses can take place at the cotton gin that will enhance the green card class, while at the same time true spinning qualities may suffer. Because of the dominance of this factor, cotton quality and processibility may suffer. Because of the dominance of this factor, cotton quality and processibility may suffer.
Does Cotton Price Reflect Use Value?

The price of cotton, based on spot market premiums and discounts for grade, stapl, and Micronaire, reflects use value very poorly, the USDA found in a study designed to see if quality measurements can be used more effectively by Franklin E. Newton, Samuel T. Burley, Jr., and Preston E. LaFerny.

For many years, cotton has been bought and sold on the spot market, with premiums and discounts being based on quality measurements such as grade, staple, and Micronaire. However, the USDA found that the price of cotton does not accurately reflect its use value. This study was conducted to determine if other quality measurements, such as yarn strength and appearance, could be used to more accurately reflect the value of cotton.

FIG. 1

**Effects of gin drying on lint grade, yarn strength, and yarn appearance**

Fig. 1 shows the effects of gin drying on lint grade, yarn strength, and yarn appearance. Gin drying is a process used to remove excess moisture from cotton, and it can have a significant impact on the quality of the final product. As shown in the graph, gin drying improves lint grade, yarn strength, and yarn appearance.

FIG. 2

**The effects of number of lint cleaning stages on neps**

Fig. 2 illustrates the effects of the number of lint cleaning stages on neps. Lint cleaning stages are used to remove impurities from cotton, and the number of stages can affect the final quality of the cotton. The graph shows that increasing the number of lint cleaning stages can reduce the number of neps, or broken threads, in the final product.

FIG. 3

**Effect of seed-cotton cleaners on lint grade and yarn strength**

Fig. 3 demonstrates the effect of seed-cotton cleaners on lint grade and yarn strength. Seed-cotton cleaners are used to remove impurities from the seed cotton, and they can have a significant impact on the final quality of the cotton. The graph shows that seed-cotton cleaners can improve both lint grade and yarn strength.

FIG. 4

**Overhead cleaning cylinders**

Fig. 4 shows the effects of overhead cleaning cylinders on yarn strength and appearance for hand-picked and machine-picked cotton. Overhead cleaning cylinders are used to remove impurities from the cotton, and they can significantly affect the final quality of the product. The graph shows that overhead cleaning cylinders improve both yarn strength and appearance.

FIG. 5

**NO. OF LINT CLEANING STAGES**

Fig. 5 presents the effects of number of lint cleaning stages on neps. The graph shows that increasing the number of lint cleaning stages can reduce the number of neps in the final product, indicating improved quality.

FIG. 6

**BREAK FACTOR**

Fig. 6 displays the effect of lint-cleaning stages on the average break factor (CSP) and average appearance index for the two standard yarn numbers (22s and 50s) spun. The graph shows that increasing the number of lint-cleaning stages can improve both the break factor and appearance index, indicating better quality.

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*For many years, cotton has been bought and sold on the spot market, with premiums and discounts being based on quality measurements such as grade, staple, and Micronaire. However, the USDA found that the price of cotton does not accurately reflect its use value.*
Before the introduction of the combing lint cleaner in the 1950s, loose roll ginning was a must in order to produce a smooth sample. And a smooth sample was all important in order to avoid a price penalty. With the loose roll gin there was little that could be done to increase the per saw capacity of the gin stand. The industry was turning to more saws, higher saw speeds, larger diameter saws, closer spaced saws, etc. But significant increases in capacity could only come from higher density seed rolls which generally produced a rough "pappy" sample.

Once the combing lint cleaners came into use, we could turn up the feed, tighten the seed rolls and get some increase in capacity, and let the lint cleaners take care of the smoothness. However, we quickly encountered that old problem of getting rid of the seed at a rate consistent with the rate the lint could be removed from the seed. This is the primary reason the Vandergriff Capacity Booster Roll Box Conversion became so popular. The main feature of this conversion was the angle of the lower front section of the roll box. This steeper lower section allowed the seed roll to approach the saw at an angle of twenty degrees off vertical on all gins except the Murray, which had a ten degree approach angle.

This steeper approach angle caused the seed roll to have a more drastic sag as it made the turn between the seed fingers and the gin rib. Since practically all of the seed in the roll are fully ginned except for a thin layer on the outer surface, this surface must be ruptured in order to free the ginned seed. It is this sag as the seed roll makes this turn that ruptures the surface of the seed roll and releases the ginned seed. And the more drastic this rupture, the more rapidly the seed are discharged. If the rupture is too severe, partially ginned seed may be discharged.

This roll box conversion, with its improved seed discharge, permitted the gin to operate with a tighter seed roll, which removed the lint faster, and thus increased capacity. In order to remove the lint faster it is necessary to have enough pressure to hold the seed against the saw teeth points, otherwise the seed will escape this action without being ginned, at least they will have to make more passes to get the lint removed.

I mentioned that a ten degree approach angle was used on the Murray gins. The reason for this is that the saws are spaced closer together on the Murray than other gins so a steeper angle could be used and still get a good capacity. The Continental 120-12" Saw Gin has the widest saw spacing of any, being .787" vs. the Murray of .71875". The other manufacturers are somewhere in between, at least they were until recently when closer saw spacings came into use.

It is well known that Vandergriff was involved in the development of the Lumrus High Capacity Gin with the agitator in the seed roll in the late 1950s, actively participating in the experimental work and final development. The patent No. 3,090,001 was issued to Vandergriff and Pease.

This agitator cylinder was located only three fourths of an inch off the saw, and as the seed roll passed between the serrated discs of the agitator and the surface of the gin rib, with the saw blades projecting into the dense mass, the seed hardly had a chance to escape the action of the saw teeth. Thus the lint was readily removed from the seed. In this case the pressure against the saw was equivalent to a very dense seed roll, while the revolving powered cylinder was moving the mass over the saws. The pressure exerted in this way could not be duplicated without the rotating cylinder positioned close to the saw. Since this cylinder was made up of serrated discs set on a shaft at an angle so that, as the cylinder rotated, the discs wobbled back and forth across the saws, it is claimed that the agitator powers the seed roll, and there is little doubt that it does help the seed roll turn. But none of the explanations as to the benefit from powering the roll are very convincing. Neither is the argument that shifting the seed roll by the action of the wobbling discs presents fresh fibers to the saws very convincing. However, there is no question about the superior capacity of the gin, but it is, as already stated, the result of the pressure of the mass against the saws at the ginning point, and the agitator a very convenient and successful means of providing this.
pressure. The argument that it helps load the saws is also not very convincing because it is quite obvious the saws will load up with whatever amount of cotton that is presented to them in the huller breast and take it into the gin.

The next logical question regarding the Lumus seed roll is how the rapid seed discharge is accomplished. It is primarily a function of the steep sag angle provided by the seed roll box scroll, which is a roll box scroll driven by the 76 rpm motor on the saw shaft. As can be seen from the patent drawing, the lower front of the seed roll box is vertical. This step approach essentially reduces the surface of the roll as it makes the turn over the saws. This results in a very rapid seed discharge to raise the lint removal capacity resulting from the high pressure at the ginning point.

So, it is this pressure against the saws and the good seed discharge that is primarily responsible for the excellent cotton cleaning. It hasten to add that this beneficial pressure which is such an aid to the capacity has an adverse affect on the smoothness of the sample. The results are similar to tight roll ginning, except much worse. And, without lint cleaning the samples are not at all acceptable. Also this added pressure applies the disc brakes sufficiently to require more than one half horse power per saw. Actually this pressure can be reduced almost one horsepower per saw, but I never like to use more than one half horsepower per saw.

The success of this gin for over twenty five years speaks for itself. It has been a major factor in the success of Lumus.

As further background on the developments in gin stand capacity, probably the next most significant development was the reduced saw spacing. All gins were encountering problems which too much residual lint was the use of the normal spacing of about three fourths of an inch. While at Boswell, Vandergriff insisted that Continental Gin Co. supply a closer saw spacing for the 119 saw gin. After considerable engineering effort we continued our efforts to develop a fabricated rib. The season of 1977 was spent experimenting with some crude methods of getting seed out of the core of the seed roll. The season of 1978 saw the gin stands ginning with the breast support track on top of it took some time but this proved to be complicated mechanically for our resources so we went back to the idea of getting the seed out of the core of the seed roll through a tube. The gin was put into production with absolutely no change was made in the seed tube components. A slight change was made in the top roll box scroll to accommodate the relocation of the upper end of the new ginning roll. Some vanes were added to the lower front of the roll box where the seed fingers would normally be, and the seed fingers could still be used if desired. These vanes proved to be an aid in breaking the bottom of the seed roll as it makes the turn, since the closer spaced gins tend to hold the roll up as it makes contact with the saws. These vanes also aid in the selectivity of the seed from a regional lint standpoint.

Note that the huller ribs are merely short pieces of three sixteenth inch flat bars with one forty-five degree faces. The space between the upper end of the flat bars and the bottom of the plate holding the vanes permits a free flow of the cotton into the seed roll.

We got a set of the necessary parts made up in time to install them on one stand late in the 1984 season. These parts included new ginning ribs, new top and bottom rib rails, new fabricated huller ribs and the lower huller rib rail, a new saw shaft, saws and space blocks, and a new top roll box scroll.

The gin was put into production with absolutely no problems. It performed up to 10 bales per hour with a 75 hp motor on the saw shaft, and the residual lint was at least one and one half percent less than before the conversion.

We did not change the angle of the Vandergriff roll box fronts, which are still twenty degrees off vertical, however with this saw spacing we will get better results with a ten degree approach angle. We made no change in the Model 30 Huller front of the gin.

This performance justified the conversion of the other five stands for the 1985 season. If you have any questions about what kind of problems we had, I think they can be answered by recapping the ginning record for the
season. In 78 days, 67,600 bales were ginned for a daily average of 866.67 bales per day. This is an average of 36.1 bales per hour for every hour of 78 straight days. The best 24 hour run was 1,042 bales, for an average of 43.4 bales per hour for the entire 24 hours.

Keep in mind that these gins are 1959 Models, and we believe that with the modifications we have made they are about competitive with any gins in use today, new or old. The fact that two of these six stands do not have seed tubes may be of some interest to the reader. The conversion procedure for these is exactly the same as those with the tubes. The operating results are very good, except of course, at a lower capacity. How much less? Probably two bales per hour.

The plant does not gin modules. The cotton all comes into one 8 foot wide separator, then into a 6x12 Hot Shelf Dryer, a 10 foot-6 cylinder cleaner, another 6x12 Hot Shelf Dryer, and then splits into two lines. The original two sets of 6 foot inclined and impact cleaners are still feeding the distributor.
AMSC: An Automatic Microcomputer Sensing and Control System to Monitor Choke-Ups in Cotton Gins

W.A. Supak, Texas A&M University

In 1963, Texas cotton gins processed over 2,500,000 bales of cotton and spent nearly $37 million on processing operations (Agricultural Statistics, 1964). Furthermore, Tony Price of the Texas Cotton Ginners' Association has indicated that during peak ginning periods, Texas cotton gins were maintained at full capacity for only 60% of the time. This by conservative estimates represents a loss in excess of $3 million when an efficiency loss of $1.40/bale is applied (Williams, 1982). These losses are of substantial magnitude and, in some cases, are resulting in gin closures.

Rising electrical costs play a significant role in the financial difficulties encountered by ginners. The effects are amplified when it is noted that the electrical rates charged to ginners is based on their peak fifteen minute demand period of every month (Farnell and Price, 1985). This charging system implies that one extreme demand period can result in considerable losses.

The primary source of electrical demand within the cotton gin is the pneumatic conveying system. Furthermore, maximum pneumatic demand is encountered not when fans are fully loaded but when blowing air, a situation often occurring during choke-ups. With this knowledge, a logical concept for saving money has been developed - shut the gin down upon detection of a choke-up and reduce electrical rate being charged for a month. This concept was selected as the focus for AMSAC.

Due to the complex nature of this project and time constraints encountered, the scope was limited to a thorough analysis of the pertinent factors surrounding implementation of a microcomputer-based control system. Economics, system components, sensor type and location, synchronization of shutdown, and the human factor were all considered. The final goal was to establish a base for further research into the possibility of automated process control in cotton ginning and hopefully promote technological advancement in cotton processing.

AMSC DESIGN CRITERIA

In order to approach the problem of designing a control system for cotton gins, it was felt there was a need to establish certain parameters concerning design decisions. Four criteria were deemed critical for the design.

The first of these is that the design should adapt to the ginning operation and its environment. This parameter is of utmost importance in choosing sensing and controlling equipment capable of withstanding the dust associated with ginning and the vibrations found in machinery and ducting. It also has an influence on microcomputer and related component placement.

The next consideration is one of flexibility. Since nearly all cotton gins are different from one another, it seems imperative that the system developed be as generic as possible. Another factor emphasizing flexibility is the acknowledgement that ginners frequently increase ginning capacity by adding machinery. Consequently it is believed that the system developed must be able to expand with gin growth.

Cost is also included as a parameter. A composite cost analysis to justify that the proposed design be paid for by itself within a reasonable period of time (five years), has been declared a necessity. Desired also is that the cost analysis include prices for specific components selected through comparison measures as recommended ANSAC equipment.

The last parameter, but one possibly more important that the latter three, is the human factor. Being cognizant of the fact that technology for electronic gin control has been in existence for some time, care was taken to examine why similar systems were not being utilized. It was deduced that this denial is the result of neglect by those responsible, perhaps the gin operator to monitor gin status and manipulate the gin manually. Thus, AMSAC incorporates a microcomputer for purposes of communicating the gin status to the operator. With this addition, ginners will have on hand a tool which allows them to add their own expertise into the AMSAC system with a minimum of training.

AMSC DESIGN PRINCIPLE

AMSC operation is intended to improve cotton ginning by that it can be used under a number of and human proficiency. This will be accomplished by including a system override accessible by the ginner if so desired. Three levels of system operation are incorporated into AMSAC: smooth, caution, and crises.

A screen display will be present on the microcomputer monitor at all times, purpose being to serve as a constant source of information on ginning status. The ginner can view any portion of the gin, be it the rate being charged, the efficiency of the gin, the electrical rate being charged each month. The ginner can also view the time. This by conservative estimates represents a loss in excess of $3 million when an efficiency loss of $1.40/bale is applied (Williams, 1982).

AMSC operating levels are specified in the system software and are based on the individual parameters being monitored. The individual aspect should be stressed at this point for they will be considered in the establishment of new, and the human factor will have the own range of smooth and good operation. These ranges must be set by the ginner since he is the person who best knows his equipment.

Through these means, the "human factor" has been included in AMSAC, not simply to make the system more attractive for those skeptical of sophisticated equipment, but to make for a more complete, better system. A detailed description of AMSAC components and their functions will be given in the following sections.

AMSC COMPONENTS

Just as the letters in AMSAC stand for, the system is one of sensing and control. To best outline AMSAC components and their function, it is easiest to break AMSAC down into its two distinct phases - sensing and control.

THE SENSING CYCLE

The sensing cycle consists of the collection of signals sent from sensing devices located throughout the gin. The cycle is comprised of the following components:

1. sensing devices,
2. signal transmission wire,
3. voltage to current converters,
4. interface system,
5. microcomputer.

SENSING DEVICES

For total gin control, it has been determined that gin parameters of pressure, shaft speed, temperature, and relative humidity must be monitored. The pressure transducers used will measure air flow through gin ducting. The transducers will emit a signal to the microcomputer based on this pressure measurement. The accuracy of this signal is the variable in the software programming which determines AMSAC action. Due to the fast response of a choke-up and the large pressure drop within a gin, a decision has been made to place a pressure sensor in ductwork between all machines.

Shaft speed transducers will operate under the same principle as the pressure transducers. If a choke-up occurs within a machine, the drive shaft will bind and consequently has a reduced speed. Since the machines are tied together via a common coupling that is placed on the main driveshaft of every machine within the gin, an indirect advantage of using this many shaft speed sensors is the possible use of the recorded readings in a maintenance program.

Tower driers are to be the location of the temperature sensors. These are incorporated into AMSAC because most gins are already using some form of temperature regulator within their tower driers. By utilizing these sensors,
the ginner can be made aware of how his tower driers are heating and if he is losing money by decreasing the cotton grade with too much heat (Griffin, 1977).

Finally, a relative humidity sensor will be located in air ducting before the tower driers and immediately after should the drier have a moisture restoration system. Since the condition of the cotton is so critical for smooth ginning, it is felt that a humidity sensor should be used with the intention that a moisture regulating system could be added.

A better depiction of sensor location can be seen in Figures 2,3. For this typical gin, a total of twenty-four sensors will be implemented. This may seem like a large number, but when the low sensor cost, compared to ANSAC cost and the machine wear maintenance benefit from shaft speed sensors is considered, the number is felt essential. It should be added that transducers do not necessarily have to be limited to the selected types. If a ginners desires to monitor other parameters, motor amperage for purpose of motor maintenance perhaps he should be able to do so with little difficulty.

Signal Transmission Components

Each of the sensing devices described emits a signal in the form of a voltage. These signals must travel through long distances of signal wire (22 to 28 AWG) to eventually arrive at the microcomputer. Several considerations warrant attention in choosing signal transmission components due to this fact.

Since the wire in which the signals are sent has a resistance, voltage drops are incurred during transmission, and these drops increase linearly in relation to the length of the wire. If left unheeded, severe distortion of the signal will occur; and in the case of very small (micro-volt) signals, the message can be completely obliterated.

To remedy this condition, voltage to current converters (current loops) have been implemented. The current loop device used in ANSAC can be the 2120 produced by Analogue Devices. This is the unidirectional current loop, which is a 2-wire device that utilizes a single conductor for signal transmission. An added benefit of using the 2120 is that the operator can see whether a low reading is a result of an impending choke-up or a sensor failure. With this choice of transmission, a sensor failure can be detected and replaced immediately, with the control system still in operation.

Interface System

Before the current signal can travel into the microcomputer for interpretation, it must be changed into digital code. Thus, some form of interface device must be implemented. Since many different sensor lines need to arrive at the computer, the interface system used in ANSAC has to have the capability of multiplexing the signals sending the signals into the computer in orderly form. Expandability is also a primary concern in choosing an interface system.

Serving as the interface in the ANSAC system is the Micro-Mac 4000 series by Analogue Devices and distributed by Omegadyne Engineering. It consists of a master board with 80-pin terminal connectors for up to twelve sensors and a variety of expander boards for more sensor connections. ANSAC consists of twenty-four sensors and thus, requires an expander board — the Micromac 4010. Each board has four plug-in modules which serve as signal conditioners. Since all incoming signals are of the 4-20mA range, only one module model (the OMX0) is utilized. This simplifies expandability and allows for a capacity of 160 sensors if six expander boards are connected in series.

The Microcomputer

The Micro-Mac interface also provides all multiplexing needs necessary for sequential signal flow to the microcomputer. An added benefit is that all analog signals that the Micro-Mac has on-board power supplies to provide all power required by the sensors for their voltage emissions.

Once the signals from the interface box have been submitted to the microcomputer, the sensing cycle is complete and the control cycle is started.

The Control Cycle

The control cycle is the decision-making and action-taking portion of the ANSAC system. It consists of the following components:

1. microcomputer and software
2. interface system
3. sensor expander boards
4. decoder/multiplexers
5. triacs.

The actual method of control in ANSAC is by digital signals rather than voltage signals.

Microcomputer and Software

Once the conditioned signals enter the microcomputer, the software program responsible for deciphering the signals is initiated. The signals are processed into the microcomputer several times per second as the main program calls the individual subroutines. Each signal is then compared to the parameters set within the program.

Control Interface

The select lines, they are processed through the same interface system as was used in the sensing cycle. With eight digital outputs, a one master board system can send up to sixty-four different messages (easily exceeding the needs of a typical ANSAC system). These messages, expressed in binary code, then leave the interface box via select lines.

Select Lines

The select wires carrying the codes are in the form of a ribbon as seen in Figure 3. This ribbon runs throughout the gin where it is connected with similar lines connecting to the motors (Nay, 1985). Decoder/Multiplexers

Decoder/multiplexers analyze the signal for a shutdown message and are individually set to correspond to these messages. In the event that a code sent from the computer matches the setting of the decoder, a charge is emitted from the decoder/multiplexer to its corresponding triac located at the motor.

Triac

The triac is the on-off relay wired into the power wire connected to the motor. The charge sent to the triac activates the device, at which time, the power circuit is opened and the motor is turned off.

Synchronized Shutdown

A word should be mentioned about the manner in which the gin is to be shut down. An instant shutdown of the entire gin is not a desirable feature, since if a machine in shut down while fully loaded and processing cotton, there is a very real possibility that the gin will choke-up immediately upon start-up. ANSAC must have the capability to wait until after a machine has finished processing the cotton within it when the choke-up occurred. This is excluding the piece of machinery experiencing the choke-up and the fans and machines upstream - all of which will be shut down immediately.

ANSAC Feasibility Study

The rapid rise in electrical energy costs over the past fifteen years has created a need for energy management programs in cotton ginning. ANSAC attempts to satisfy this need by focusing on the pneumatic conveying system - the primary source of energy consumption in ginning. From there, we see that when a choke-up occurs, fans and air are left in operation, power usage increased by 125% (Williams, 1982). This excess consumption is the cost ANSAC is designed to eliminate.

For comparison purposes, the feasibility study conducted makes use of a typical Texas cotton gin selected through analysis of the 1983 Southwestern Public Service energy report. This gin produces 5000 bales per season at
an energy cost of $0.10/kw-h. In addition, the gin has an average requirement of 74 kw-h per bale which exceeds by 14 kw-h the consumption of an efficient gin (Parnell, 1985). The critical phase of this study is whether the benefits of implementing AMSAC outweigh the costs. The benefit associated with AMSAC is the difference between the power demand during choke-up and the next highest demand period occurring at start-up. Choke-up peak demand for the sample gin is 1200 kw-h with a start-up surge of 1100 kw-h lasting for ten minutes before a normal consumption rate of 790 kw-h is reached.

Upon making the calculations shown in the appendix, a net savings of over $27,000 per year is seen to result from AMSAC installation. When this savings is extended over a ten year period, a profit exceeding $300,000 is observed. This number has incorporated into it a yearly maintenance cost computed as 10% of the initial AMSAC investment. The payback period for the initial cost of $19,558 is seen to be less than one year.

It may be argued that although AMSAC is saving money, is not the number of shutdowns going to drastically increase with the system in operation? This, however, should not be the case since a study by Gordon Williams indicates that cotton gins are already experiencing downtime every two hours. Also, the ginners have at their disposal the system override. The override feature allows a minor problem to be fixed without having to shut down the gin.

SUMMARY AND CONCLUSIONS

The AMSAC concept has been proposed as a means of reducing cotton ginning costs by lowering peak electrical demand. This peak demand is commonly associated with increased pneumatic demand during choke-ups; and, consequently, AMSAC shuts down cotton gins upon detection of choke-ups.

Equipment employed to perform this function includes: a microcomputer, an interface board, signal conditioning modules, decoder/modules, triacs, and sensors.

Implementation of this system is estimated to save over $27,000 per year, with a ten-year savings of over $300,000.

For AMSAC to become a reality, further research will be required in the following areas: additional parameters to monitor, ideal sensor location, alternative means of control, physical assembly of AMSAC, and industry acceptance.

Ideally, AMSAC would not simply shut down gin operations but adjust fan and motor outputs to avoid choke-ups. However, the expense associated with such a system and the modifications required were of such extremes as to deem this idea infeasible. Possibly, future progress in the ginning industry could change the status of this concept.

This paper was developed in conjunction with a senior level design class at Texas A&M University. The subject was selected from alternatives presented at the beginning of the fall semester, 1985. Introducing the problem and serving as chief consultant for all project work was Mr. Tony Price, executive vice-president of the Texas Cotton Ginners Association. The design team consisted of three members, and the final product was a result of equal contributions from the team. Fellow team members were Sherri Clements and Ed Hansalk.

REFERENCES

29. Willcutt, M.H. Cotton Gin Operational Efficiency Measurement Via a Microprocessor-Controlled Data Acquisition Unit. 1978. Transactions of the ASAE.

EQUIPMENT SPECIFICATIONS

SENSORS
- Pressure
  - Omega PX 126-005D-V, silicon transducer, 50 mv output.
  - Cole-Parker, proximity transducer, 5v output.
- Temperature
  - Omega CPS-316-12, copper constantan thermocouple, 20 mv output.
- Relative humidity
  - Thunder Scientific FC-2101, solid

COMPUTER
- IBM PC/XT (color machine).

VOLTAGE TO CURRENT CONVERTERS
- Analogue Devices 2120B, nominal input range 0-10v, 4-20 ma output.

DECODER/MULTIPLEXERS
- Texas Instruments 54/74 Family 150, 1 of 16 Data Selectors/Multiplexers, 4 input wires.

TRIACS
- Square D Co. or Westinghouse Electric Corp. 40, 200v/25a 600v.

INTERFACE
- Analogue Devices Micro-Mac 4000 (or Micro-Mega distributed by Omega) masterboard.

INTERFACE SOFTWARE
- Analogue Devices - Q8001 (6).
- Analogue Devices - IBM personal computer software support package ACPI222.

ENERGY CONSUMPTION
OF PRESENT GINNING SUBSYSTEMS

Figure 1. Subsystem energy consumption.

Figure 2. Gin schematic

Figure 3. Sensing layout

Figure 4. Select wires

Figure 5. Triac connection.

Figure 6. Synchronization example.
START-UP DEMAND CURVE

SPS report on a 1100hp gin
905 KW - 15 minute average

Figure 7. Typical start-up consumption.

AMSAC GINNING SYSTEM

AVERAGE START-UP DEMAND (FROM FIG. 6) 946 KW/H
NORMAL DEMAND 792 KW/H

\[
\text{(946 KW/H) x (10 min) / (60 min/hr) = 157.67}
\]

\[
\text{(792 KW/H) x (5 min) / (60 min/hr) = 66.67}
\]

\[
\text{four 15 min. periods/hr} \times 4 = 223.67
\]

\[
\text{\$ .10 / kwh} \times 0.10 = 8.94.67
\]

\[
\text{hrs / ginning season} \times 906 = 810.82
\]

\[
\rightarrow \text{COST/YR} = \$81059.82
\]

PRESENT GINNING SYSTEM

CHOKE-UP DEMAND 1200KW/H

\[
\text{(1200 KW/H) x (15 min) / (60 min/hr) = 300}
\]

\[
\text{\times 4 = 1200}
\]

\[
\text{\times 0.10 = 120}
\]

\[
\text{\times 906 = 108720.00}
\]

\[
\rightarrow \text{COST/YR} = \$108720.00
\]

Figure 8. Cost comparison.

COMPONENT

| Sensing Devices | 9 | 369.00 |
| Pressure Transducers | 2 | 56.00 |
| Thermocouples | 2 | 200.00 |
| Humidity | 10 | 640.00 |
| Angular Shaft Speed | 15 | 80.00 |
| Cable (1000ft) | (8) | 320.00 |
| Triacs | 15 | 23.00 |
| Data Selector/Multiplexer | (8) | 560.00 |
| Circuit Loop | (10) | 800.00 |
| Analog/Digital Interface | (1) | 3510.00 |
| Microcomputer | (1) | 8000.00 |
| Implementation | | 5320.00 |

\[
\rightarrow \text{TOTAL} = \$19558.00
\]

Figure 9. AMSAC system cost.

CASH FLOW DIAGRAM

\[
F = -19558 \left( \frac{F}{P, 7, 10} \right) + 27660.18 \left( \frac{F}{A, 7, 10} \right)
\]

\[
F = \$343680.50
\]

Figure 10. 10-Year return on AMSAC investment.
The Introduction of the Multisaw Lint Cleaner
By Russell Sutton and Larry Horn
Engineer & Production Control Manager
Horn Gin Machinery Co., Lubbock, Texas

Abstract
Due to the concern from the Ginning Industry of an increase in bark and grass reductions, along with poor grades, Horn Gin Machinery realized the need for a New Lint Cleaner which would increase the cleaning efficiency without affecting overall turn-out. The development of the Multisaw Lint Cleaner began in the fall of 1981 with the same objective as previous lint cleaners with the addition of a second saw cylinder. After 2 1/2 years of research, in April 1984 the first unit was field tested, and since then approximately 200,000 bales have been processed on 37 machines with the current season not yet complete. Performance tests indicate outstanding results without damaging the fiber quality below present levels which are now being accepted from conventional tandem lint cleaning systems.

Introduction
Cotton gins have been using Lint Cleaners out of necessity since the early 19050's. The gins must be able to process the fiber quickly and at a high speed in order to deliver the highest price for his product. Marketing trends have fluctuated, moving the premium prices paid for certain grades up and down the scale each year. Considering the market price and loan price each year the goal is almost always for the gins to deliver the best grade possible to give the highest return to the producer. The need for a better lint cleaner led Horn Gin Machinery to develop a machine which would make the cleaning process more efficient without lowering turnout and not affecting the quality of the fiber. In April 1984, the first unit was successfully field tested and since then approximately 200,000 bales have been processed through 37 machines. The basic operation, important features, general performance characteristics, and tests and results for the Multisaw Lint Cleaner are presented here to help define the overall performance.

Basic Operation
The Multisaw Super "86" Lint Cleaner basically combines two conventional stages of lint cleaning into one machine with the addition of several new cleaning features. The fiber is prepared for the saw unit in exactly the same way as previous Horn Lint Cleaners, by passing through a condenser which forms a batt of cotton. The cotton enters the feed bar arrangement and onto the top saw cylinder. Seven grid bars are placed opposing the top saw and handle the fiber in the same manner as five grid bars in the past. This closer spacing has saved a significant amount of fibers lost without sacrificing cleaning efficiency. After the cotton passes around the top saw, the fiber is transferred to the bottom saw cylinder and seated to the saw by a patented transfer arrangement (Figure 1). The bottom saw will rotate the fiber to the lower cylinder, slightly higher rim speed on the lower cylinder enables the fiber to thin out and is theoretically turned over to gain more exposure to the cleaning points. The cleaning section on the bottom saw contains the equivalent of six grid bars and incorporates three coming bars to facilitate the removal of bark and grass. Once the fiber leaves the bottom saw it is doffed with a brush cylinder and is removed from the machine. The Brush Chamber was redesigned from our old style lint cleaner to better doff the saw and virtually eliminates recirculation on the bottom saw and brush cylinder.

Located behind the top saw cylinder is a suction nozzle which removes any fiber that remains on the saw past the transfer point. This lint is returned into the system through the inlet hood on the condenser. An analysis on the fiber shows that the lint is composed of fibers consisting of less than 1% of all the cotton processed. The fiber return nozzle also keeps this lint from building up behind the feed works and causing potential problems if pulled through the boulter.

Trash particles removed by the machine are pulled through two separate trash hoppers, one off the top saw and one off the bottom saw. A double 30" fan is supplied for these hoppers to pull approximately 3,000 CFM on each side, to have adequate air wash on the grid bars. This increase in air velocity helps keep trash from being pulled back into the cleaned fiber.

Important Features
During the research and development stage of the Multisaw Lint Cleaner, as mentioned earlier, the main objectives were to improve cleaning efficiency and minimize emergency stoppage. While keeping cost minimal was important as well as maintaining a clean fiber. When the finished product was complete the result was a lint cleaner that met and exceeded all its expectations. The capacity of the Multisaw remained equal to previous Horn Lint Cleaners with the addition of a second saw cylinder. The Multisaw sweater cleaner is less than twice the size of previous lint cleaners which bolts directly to the gin stand with two sets of legs to support both units. The Multisaw can easily be adapted to present systems both behind the gin stand or in a battery installation. In the event the Multisaw replaces two conventional lint cleaners, there will be a decrease in the amount of sheet metal required due to only one exhaust fan, one by-pass valve, and being able to position closer to the lint flue due to having only one machine. With two machines making lint, instead of two stages of cleaning, there will also be a decrease in pollution control devices as required for a particular area.

Performance Characteristics
Lint cleaner performance can be discussed in a variety of ways, and is focused primarily at three major groups. Producers, gins, and textile mills each have different objectives all concerning the end result. While gathering information on the Multisaw lint cleaner, data was obtained to show each of these groups how the performance characteristics are beneficial. Tests were conducted under controlled conditions at the factory and also during normal ginning. After almost two complete seasons, data has shown substantial improvements in grades based on county averages against gins within those counties. Results of tests comparing tandem lint cleaning to a single Multisaw System, show on the average equivalent or better results having a decrease in the amount of sheet metal required due to the addition of a second saw cylinder and seat to the saw by a patented transfer arrangement. Tests were conducted to show improving cotton quality over conventional lint cleaners. Even one lint cleaner before a Multisaw, show only slight differences in cleaning points. The cleaning section on the bottom saw contains the equivalent of six grid bars and incorporates three coming bars to facilitate the removal of bark and grass. Once the fiber leaves the bottom saw it is doffed with a brush cylinder and is removed from the machine. The Brush Chamber was redesigned from our old style lint cleaner to better doff the saw and virtually eliminates recirculation on the bottom saw and brush cylinder.

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Tests and Results
Specific tests have been made and data has been gathered from various gin locations. The purpose of these tests are to analyze the performance of the Multisaw lint cleaner as outlined before. Due to the nature of all gin installations having unique differences, tests were chosen and
Comparative Testing

The gin was also used for a comparison test between tandem lint cleaning vs. a Multisaw Lint Cleaner was Elbow Enterprises, Visalia, California. This particular installation has a split stream overhead feeding a double battery gin. One press has tandem lint cleaning, the other has Multisaw. A test was run for each of the three stages. All of the lint cleaners in the gin are Horn Gin Machinery equipment. Comparison tests of cleaning efficiency were made using the same load of cotton and samples taken at the same gin, same saw cylinders, grid bar configurations, combing bar arrangements and a special transfer and seating technique, this new lint cleaner can handle adequate capacity and deliver premium results. Test results show increase in grade of gins with these lint cleaners, along with very small amounts of usable fiber loss. Spinning data shows the Multisaw does not reduce the fiber qualities which are important to textile mills no more than conventional tandem lint cleaning.

After completion of spinning all three samples, no preference of one particular method of lint cleaning was expressed by the operators, with no apparent differences in spinning performance. While conducting these tests the Textile Research Center had no indication of how each of the three samples had been processed or where they were taken. Several gins took the Multisaw, one single lint cleaner with a Multisaw Lint Cleaner has no more effect on spinning than two conventional stages of lint cleaning.

Other spinning test and fiber testing have been conducted at Elbow Enterprises, with the option of determining the effects on strength, length, neps, uniformity, short fiber, etc. Early tests were conducted to show difference in each of these categories before and after the Multisaw lint cleaner. Identical spinning test samples were sent to Clemson University School of Textiles and to Texas Tech and tests were run as close to the same as possible. At this point differences from before and after lint cleaners are not significant and no standard deviation for these results can only be analyzed by experts from the textile industry. If any conclusions can be made, it can only show the differences between the three samples follow no set pattern, and that anything the three stages of cleaning, with one single saw lint cleaner with a Multisaw Lint Cleaner has no more effect on spinning than two conventional stages of lint cleaning.

When discussing lint cleaner waste the terms fiber loss and turn-out are always mentioned. To give the best indication of the two items mentioned above for the Multisaw, a test was run at New Tex Gin, Plains, Texas. This gin has a new system which gives the option of one, two, or three stages of cleaning through Horn Gin Machinery equipment. The trash from all the lint cleaners are taken through a set of collectors and then pressed into a mote bale with no cleaning on the mote. A single 475 lb. bale was ginned and processed through one Multisaw. The Multisaw alone is the only lint cleaner used (Table 6). The total weight of trash removed from this bale weighed 40.5 lbs. A Shirley Analyzer test was run on this sample of trash and showed 24.8 lbs. of pure trash and 15.7 lbs. of lint. A Peyer AL101 Short Fiber Test was run on the 15.7 lbs. and showed only 1.6 lbs. of lint out of the total trash removed from that bale was the staple length or longer. This helps document the lint savings of the Multisaw Lint Cleaner and also shows a lint efficiency of 70.24%. The efficiency is figured as a ratio of the non-lint content removed from the sample to the non-lint content as it enters the lint cleaner.

Actual Gin Performance

Success of the classing office is one true indication of the effectiveness of a lint cleaning system. Shown in Table 7, are six weekly totals from the Lubbock USDA Classing Office and also the same weekly totals from Lubbock Cotton Growers (LCG), Lubbock, Texas. This six week ginning period reflects approximately 12,000 bales ginned and processed through one Multisaw. The grade distribution for LCG shows the majority of grades falling into the Strict Low Middling Light Spot (52) and a lower percentage of Low Middling Light Spot (52) than the classing office average. During the same six week period, figures in Table 8 show the comparison of Mesa Gin, Lamesa, Texas to the weekly totals from the Lamesa USDA Classing Office. The grade distribution for Mesa Gin shows the majority of grades falling into the Strict Low Middling Light Spot (52) category with the remainder primarily in the Strict Low Middling Light Spot (52). The averages from the classing office show very few Middling Light Spot (32) with the majority falling into the Strict Low Middling Light Spot (52) and Low Middling Light Spot (52) categories.

Both of these gins have Multisaw Lint Cleaning Systems which help keep them very competitive in their area. Analysis of the tables show each gin having lower bark percentages, lower average trash indexes, and having higher percentages in the preferred grade categories.

Summary

The Multisaw Lint Cleaner was developed to meet the needs of the industry and utilize all possible features which could be incorporated to make this machine as efficient as possible. By using one condenser, and two saw cylinders, grid bar configurations, combing bar arrangements and a special transfer and seating technique, this new lint cleaner can handle adequate capacity and deliver premium results. Test results show increase in grades of gins with these lint cleaners, along with very small amounts of usable fiber loss. Spinning data shows the Multisaw does not reduce the fiber qualities which are important to textile mills no more than conventional tandem lint cleaning.

Horn Gin Machinery would like to express appreciation and special thanks to the following individuals who have cooperated in the accumulation of data during the past two years. Texas Tech, Jim Parker, Harry Arthur, Edwin Foster, and Marvin Smith; Clemson University School of Textiles and Clarence Rogers; Elbow Enterprises and Bob Paris; Lubbock Cotton Growers and Ocho Gin and Wayne Mixon; Mesa Gin, Jerry Harris and Ron Brown; New Tex Gin and Cale Craft; and Jerry Hartman, Producer, Plains, Texas.
Table 1. Comparison of Horsepower Requirements

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Tandem Multisaw</th>
<th>Lint Cleaners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saw Unit</td>
<td>1-40 Hp. or 50 Hp.</td>
<td>1-40 Hp. or 50 Hp.</td>
</tr>
<tr>
<td>Condenser</td>
<td>2-40 Hp. (1 per mach.)</td>
<td>1- 5 Hp.</td>
</tr>
<tr>
<td>Total</td>
<td>120 Hp.</td>
<td>85 Hp. or 90 Hp.</td>
</tr>
</tbody>
</table>

1/ 40 Hp. for stripper areas, 50 Hp. for picker areas.

Table 2. Fiber Quality Comparison

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Any L/C</th>
<th>Lint Cleaning</th>
<th>Lint Cleaner</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVI DATA</td>
<td>1.15</td>
<td>1.14</td>
<td>1.14</td>
</tr>
<tr>
<td>Uniformity Ratio</td>
<td>83.23</td>
<td>82.35</td>
<td>82.21</td>
</tr>
<tr>
<td>Strength, in. x Tex</td>
<td>28.87</td>
<td>29.01</td>
<td>28.46</td>
</tr>
<tr>
<td>Micronaire Value</td>
<td>4.16</td>
<td>4.04</td>
<td>4.12</td>
</tr>
<tr>
<td>Grade Index</td>
<td>94.75</td>
<td>98.38</td>
<td>100</td>
</tr>
<tr>
<td>Non-lint content, %</td>
<td>4.32</td>
<td>1.77</td>
<td>1.70</td>
</tr>
<tr>
<td>% S.F. less than 1/2</td>
<td>N.A.</td>
<td>14.6</td>
<td>11.0</td>
</tr>
</tbody>
</table>

1/ Same Cotton, identical conditions, ginned at same location.
2/ Average of 32 replications.
3/ Average of 16 replications.
4/ Results from Peyer AL101, TTURC.

Table 3. Spinning Data thru 1 - Multisaw

| Micronaire            | 4.17    | 4.17          | 4.17         |
| 2.5% Span             | 1.085   | 1.085         | 1.085        |
| Pressley "O" Gauge    | 99.09   | 99.09         | 99.09        |
| Uniformity Ratio      | 43.5    | 43.6          | 43.6         |

1/ Spinning Test Performed by Texas Tech University Textile Research Center, Lubbock, Texas
2/ All variations, same cotton, identical conditions, ginned at same location.

Table 4. Spinning Data thru 1 - 86" Lint Cleaner and Multisaw

| Micronaire            | 4.02    | 4.02          | 4.02         |
| 2.5% Spale Research Center, Lubbock, Texas |

Table 5. Spinning Data thru Tandem Lint Cleaning

| Micronaire            | 4.07    | 4.07          | 4.07         |
| 2.5% Spale Research Center, Lubbock, Texas |

Table 6. Spinning Data thru 1 - Multisaw

| Micronaire            | 4.17    | 4.17          | 4.17         |
| 2.5% Span             | 1.085   | 1.085         | 1.085        |
| Pressley "O" Gauge    | 98.91   | 98.91         | 98.91        |
| Uniformity Ratio      | 43.8    | 43.8          | 43.8         |

1/ Spinning Test Performed by Texas Tech University Textile Research Center, Lubbock, Texas
2/ All variations, same cotton, identical conditions, ginned at same location.
Table 6. Breakdown of Trash Content

<table>
<thead>
<tr>
<th>Breakdown of Trash Content</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bale Weight</td>
<td>475 lbs.</td>
</tr>
<tr>
<td>% Non Lint Before Multisaw</td>
<td>8.40% or 39.9 lbs.</td>
</tr>
<tr>
<td>% Non Lint After Multisaw</td>
<td>2.50% or 11.8 lbs.</td>
</tr>
</tbody>
</table>

This shows a removal of 28.1 lbs. of non lint

Total Trash Weight - 40 1/2 lbs.

| % non lint of trash | 61.26% or 24.8 lbs. |
| % of lint in trash  | 38.74% or 15.7 lbs. |

Fiber length 1/ breakdown of lint in trash

<table>
<thead>
<tr>
<th>Fiber length</th>
<th>Less than 3/8&quot;</th>
<th>24.7% or 3.9 lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Less than 1/2&quot;</td>
<td>42.4% or 6.7 lbs.</td>
</tr>
<tr>
<td></td>
<td>Less than 5/8&quot;</td>
<td>55.8% or 8.8 lbs.</td>
</tr>
<tr>
<td></td>
<td>Less than 3/4&quot;</td>
<td>68 % or 10.7 lbs.</td>
</tr>
<tr>
<td></td>
<td>Less than 7/8&quot;</td>
<td>80 % or 12.6 lbs.</td>
</tr>
<tr>
<td></td>
<td>Less than 1&quot;</td>
<td>89 % or 14 lbs.</td>
</tr>
<tr>
<td></td>
<td>Less than 1 1/8&quot;</td>
<td>95.7% or 15 lbs.</td>
</tr>
<tr>
<td></td>
<td>Less than 1 1/4&quot;</td>
<td>99.1% or 15.6 lbs.</td>
</tr>
</tbody>
</table>

Staple Length of Bale = 1.0175

89% or 14 lbs. of the lint in the trash was less than the staple length

1/ Results from Peyer AL101 Texas Tech University

Textile Research Center

Table 7. Lubbock Cotton Growers vs. USDA Classing Office, Lubbock, Texas

<table>
<thead>
<tr>
<th>Avg. Bark</th>
<th>Trash</th>
<th>% 32</th>
<th>% 42</th>
<th>% 52</th>
<th>Staple Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USDA</td>
<td>LCG</td>
<td>USDA</td>
<td>LCG</td>
<td>USDA</td>
<td>LCG</td>
</tr>
<tr>
<td>11-8 to 11-14</td>
<td>18</td>
<td>7</td>
<td>4.27</td>
<td>3.98</td>
<td>50</td>
</tr>
<tr>
<td>11-15 to 11-21</td>
<td>20</td>
<td>11</td>
<td>4.23</td>
<td>4.00</td>
<td>50</td>
</tr>
<tr>
<td>11-22 to 11-28</td>
<td>19</td>
<td>10</td>
<td>4.16</td>
<td>3.95</td>
<td>53</td>
</tr>
<tr>
<td>11-29 to 12-6</td>
<td>25</td>
<td>15</td>
<td>4.21</td>
<td>4.05</td>
<td>50</td>
</tr>
<tr>
<td>12-7 to 12-13</td>
<td>25</td>
<td>15</td>
<td>4.18</td>
<td>4.15</td>
<td>50</td>
</tr>
<tr>
<td>12-14 to 12-20</td>
<td>26</td>
<td>24</td>
<td>4.17</td>
<td>4.13</td>
<td>51</td>
</tr>
</tbody>
</table>

Table 8. Mesa Gin vs. USDA Classing Office, Lamesa, Texas

<table>
<thead>
<tr>
<th>Avg. Bark</th>
<th>Trash</th>
<th>% 32</th>
<th>% 42</th>
<th>% 52</th>
<th>Staple Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USDA</td>
<td>LCG</td>
<td>USDA</td>
<td>LCG</td>
<td>USDA</td>
<td>LCG</td>
</tr>
<tr>
<td>11-8 to 11-14</td>
<td>25.5</td>
<td>23.87</td>
<td>4.17</td>
<td>3.65</td>
<td>6.1</td>
</tr>
<tr>
<td>11-15 to 11-21</td>
<td>29.2</td>
<td>32.0</td>
<td>4.24</td>
<td>3.30</td>
<td>5.4</td>
</tr>
<tr>
<td>11-22 to 11-28</td>
<td>20.4</td>
<td>12.4</td>
<td>4.03</td>
<td>3.10</td>
<td>8.0</td>
</tr>
<tr>
<td>11-29 to 12-6</td>
<td>24.0</td>
<td>14.0</td>
<td>4.13</td>
<td>3.29</td>
<td>4.7</td>
</tr>
<tr>
<td>12-7 to 12-13</td>
<td>15.0</td>
<td>10.0</td>
<td>3.92</td>
<td>3.29</td>
<td>9.4</td>
</tr>
<tr>
<td>12-14 to 12-20</td>
<td>18.0</td>
<td>18.0</td>
<td>3.96</td>
<td>3.43</td>
<td>6.9</td>
</tr>
</tbody>
</table>
MURRAY CARVER HIGH CAPACITY TWO STAGE SEED CLEANER

By Michael A. Mizer, Director of Engineering and
Bob Stanley, Director of Domestic Sales

SCOPE
This seed cleaner addresses an area that has long been a problem in the West Texas Region where mechanical stripping and high capacity ginning has made a compromise to quality clean seed that is currently being sold to an oil mill for processing.

"The seed cleaner needs to be economically feasible where the ginner is being docked for foreign material in his seed. This foreign matter constitutes a high percentage of stem, sticks, fly lint, hull pepper, and immature or bad seeded seed (commonly referred to as pops)."

In the design of this seed cleaner, sand, rocks, tramp metal and other high density foreign material has been ignored so as not to complicate the objective of removing the highest volume of foreign material, with a minimum of expense for maintenance, space required, and power consumed.

DESIGN AND FLOOR
The design of the seed cleaner takes into consideration the space available in a standard gin layout and can be installed anywhere along the main seed and trash conveyors coming from under the gin stands to the seed scales. Please refer to layout diagram, H5-8500300-IM. A simple loop can be provided from the seed conveyor to the mechanical lift where the seed is metered into the seed cleaner and, after cleaning, can be spouted right back into the same seed conveyor down stream. The trash is divided into two groups:

1. Fly lint, hull pepper, light leaf, and pops are air lifted in the first stage and collected commonly over the ginners existing trash bin.

2. Sticks, stems and large trash are conveyed mechanically out discharge spouts to existing trash conveyor normally running parallel with the seed conveyor.

Further consideration has been given to the design of the seed cleaner in consideration of safety, and maintenance. The cleaner comes completely enclosed on all sides except the front using a combination of metal and plastic paneling to protect the worker from rotation, and mechanical hazards. This design also allows the removal of air from the front of the machine to the rear for the requirement necessary on the 1st stage cleaning. This drafting places the entire enclosure in a slight negative vacuum which prevents dust and air borne particles from escaping to the working area.

Eight large moulded inspection doors are located on either side of the cleaner for easy access to the screen and alternate maintenance areas. These doors can be lifted off in light inspection conditions. The top enclosure acts as a platform for inspection on the first stage cleaner which mounts above.

OPERATION
The high capacity seed cleaner makes a break with traditional seed cleaning normally found in an oil mill.

The standard practice of seed cleaning normally takes the flow of incoming seed directly to a shaker of some description where screening of sticks, rocks, and large trash are scalped off the top screen. Then the seed is sized and rides across the intermediate or middle area and the small trash, sand and dirt, etc., is evacuated across the bottom. The ginned seed is then fed into an air classification chamber where the light density lint, pepper, hull, leaf, etc. is lifted away from the clean seed.

This standard method of seed cleaning seems to be in wide use and does a remarkably good job but has a major problem in capacity. Since the seed is being fed directly to screens much of the lint and hull has not yet been separated and tends to collect over the screens, rapidly choking the perforations, causing a slow down in capacity and requiring constant cleaning and maintenance.

The new high capacity two stage seed cleaner air washes the incoming seed husband to a shaker of some description where screening of sticks, rocks, and large trash are scalped off the top screen. Then the seed is sized and rides across the intermediate or middle area and the small trash, sand and dirt, etc., is evacuated across the bottom. The seed is then fed into an air classification chamber where the light density lint, pepper, hull, leaf, etc. is lifted away from the clean seed.

The high capacity two stage seed cleaner has successfully run seed at a ginning rate of around 20-22 bales per hour, with seed running approximately 900-950 pounds per bale. This compares to a capacity of around 250 tons of seed per 24 hour day.

The connected H.P. requirements are as follows:

1. 48" Steel Roll Feeder with variable speed control .75 H.P.
2. Two 60" wide Split Stream Shaker 3.0 H.P.
3. #40 Material Wheel Fan 15.0 H.P.
4. 12" Notor Lift Seed Elevator 7.5 H.P.
Total H.P. Connected 26.25 H.P.

FIELD OPERATION
A high capacity two stage seed cleaner was installed at Liberty Co-op Gin in Lubbock, Texas in September of 1985 and was operated for the full ginning season under the direction and supervision of the gin manager, Mr. Wayne Harris.

During the 1985 ginning season Liberty Co-op successfully ginned over 22,000 bales of cotton of which 12,000 bales were processed with the seed cleaner running. To evaluate the effect the seed cleaner had on grade and foreign material, the seed cleaner was shut down periodically and a comparison was made of the analysis at the oil mill, in combination with individual laboratory analysis of samples taken during operation. Through Mr. Harris' cooperation we are able to offer the following information:

1a. With seed cleaner running the seed loads were showing dockage of 2-3% per load. With 1% foreign matter allowable with no penalty, this indicated 1-2% actual foreign material.
1b. With seed cleaner running an increase of 4,000-5,000 lbs weight increase was obtained on each load, indicating a loss of empty seed (pops). fly lint, and light trash making for a higher density pack.

2a. With seed cleaner shut-off the seed loads were showing dockage of 2-3% per load. With 1% foreign matter allowable with no penalty, this indicated 3-4% actual foreign material.
2b. With seed cleaner running the seed loads were showing lower dockage charges in the 0-1% range. With the 1% allowable foreign matter, this indicated total foreign matter was in the 1-2% range.

ECONOMICS
The following example is presented to illustrate the economic advantage to the gin that may be obtained through operation of the seed cleaner. For purposes of simplification the following assumptions are made:

1. Base seed price is $100 per ton, based on 100 grade seed.
2. Seed weight (after cleaning) is 800 pounds per bale.
3. With seed cleaner running an increase of 45 pomts in grade indicates higher oil content which compares favorably with observation 1, indicating the loss of foreign material has been removed from the seed.
4. Gin in this example gins 10,000 bales per year and operates 24 hours per day at a capacity of 15 bales per hour.
The above example indicates an increase in revenue to the gin of $16,000, less power costs for seed cleaner operation of approximately $1,000. This $15,000 net revenue increase amounts to $1.50/bale for our fictitious gin. This per bale figure does compare favorably however with figures obtained from Liberty Co-op. Mr. Harris estimates increased revenue of $1.25 to $1.50 per bale from operation of the seed cleaner during the 1985 season. The seed cleaner should enable the grower to pay a more accurate price to the farmer for cleaner seed at the gin and allow the grower to deliver a higher quality product to the oil mill. With the higher stick and trash contents in cottonseed we have seen in past seasons, the seed cleaner may be an important addition to the modern cotton gin.