COTTON GINNING

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QUALITY OF COTTON FIBER

The fiber quality depends on the following factors:

– Plant material
– Production conditions
– Storage
– Ginning process
– Transportation

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- Length, uniformity index, short fiber index
- Tenacity, elongation
- Fineness, maturity ratio
- Color grade

- Characteristics required by the spinners varying with the employed technic. The spinners appreciate the cohesion and regularity of yarn.
- Preservation of fiber quality is depending on a control of the fibers water level inside the seedcotton, in the fiber, by using operation of drying and humidifying.

ABOUT GINNING PROCESS

Ginning could be manual, mechanical with a roller or with saws.

Steps of ginning process:

- Suction- opening modules
- Feeding regulation
- Seed cotton drying
- Seed cotton cleaning
- Seed cotton humidifying

Gin Stand

The modern gin plant typically has multiple gin stands.

- Cotton enters the gin stand through a huller front.
- The saws grasp the cotton and draw it through widely spaced ribs known as huller ribs.
- The locks of cotton are drawn from the huller ribs into the bottom of the roll box.
- The actual ginning process takes place in the roll box of the gin stand.
- The ginning action is caused by a set of saws rotating between ginning ribs.

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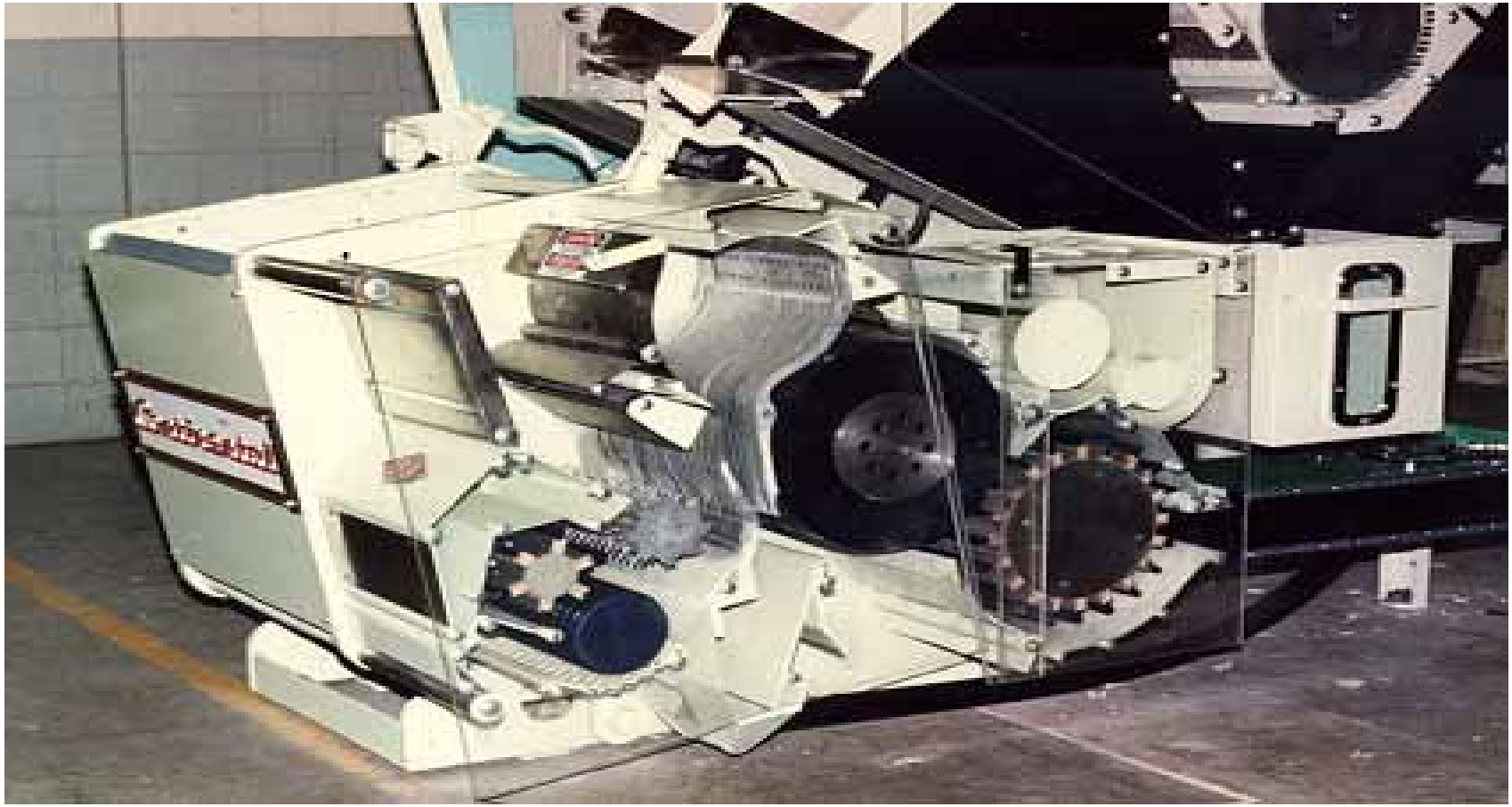
•The saw teeth pass between the ribs at the ginning point.
•Here the leading edge of the teeth is approximately parallel to the rib, and the teeth pull the fibers from the seed, which are too large to pass between the ribs.
• Ginning at rates above those recommended by the manufacturer can cause fiber quality reduction, seed damage, and chokeups.
•Gin stand saw speeds are also important. High speeds tend to increase the fiber damage done during ginning.

Gin Stand

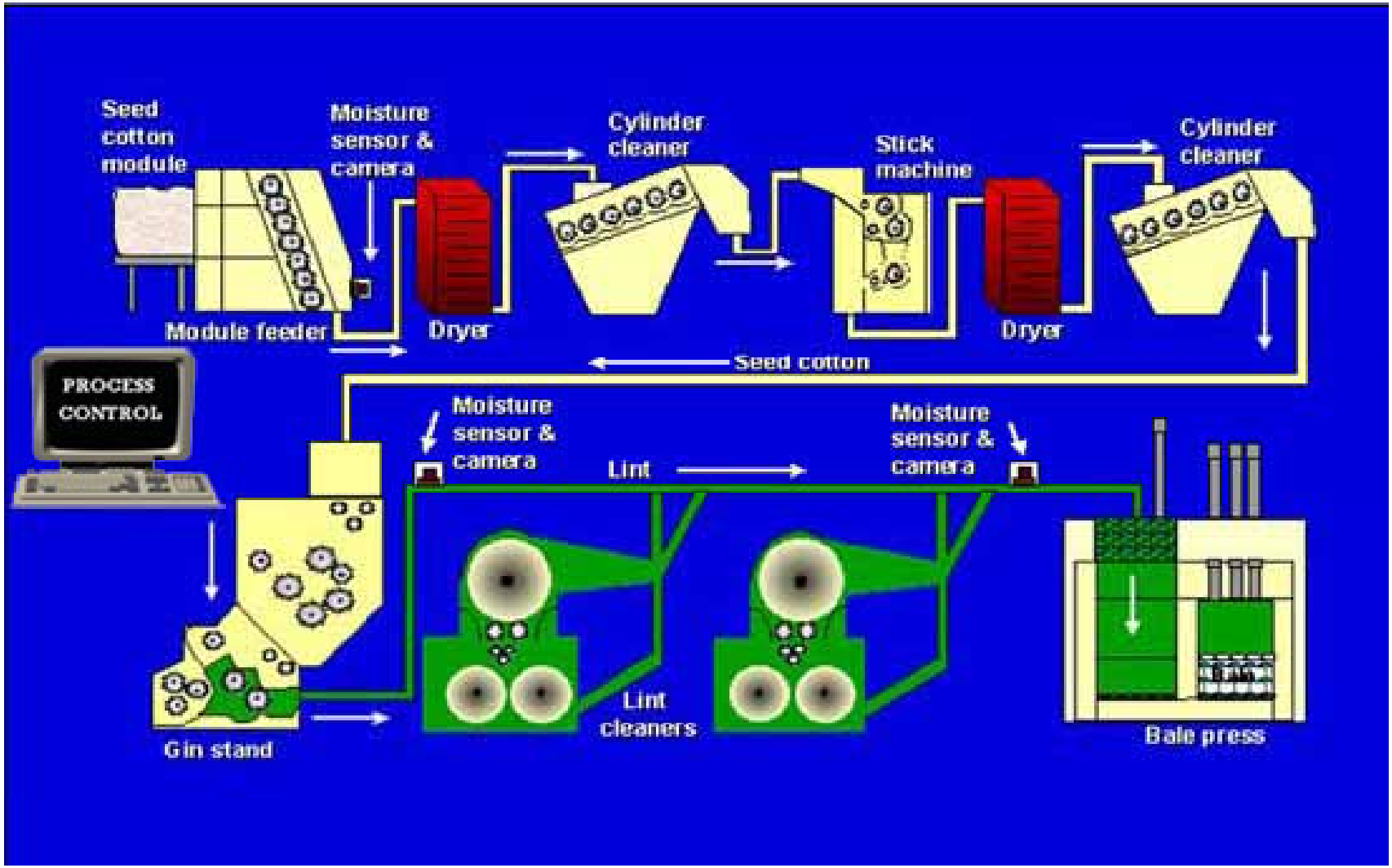


Process Control

Cotton ginning systems consist of several different types of processing machines and each is designed for specific tasks.

- Each machine influences several physical properties of the cotton fiber and many of those properties must be measured with complex laboratory instruments.
- The decision about the use of an individual machine involves a tradeoff, i.e. a cleaning machine will remove foreign material but also removes some valuable cotton and does some damage to the remaining fiber.
- A computerized process control system can optimize fiber quality by "prescription" processing the cotton.

Stages of Cotton ginning



Fiber Improvement by Process Control

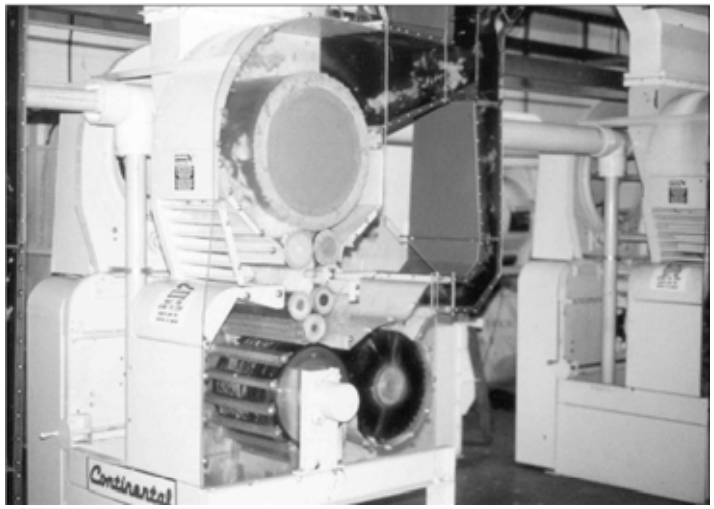
Control of the cotton ginning process minimizes machinery usage as well as drying. Obvious benefits result both in monetary rewards and fiber quality. Control of fiber moisture will:

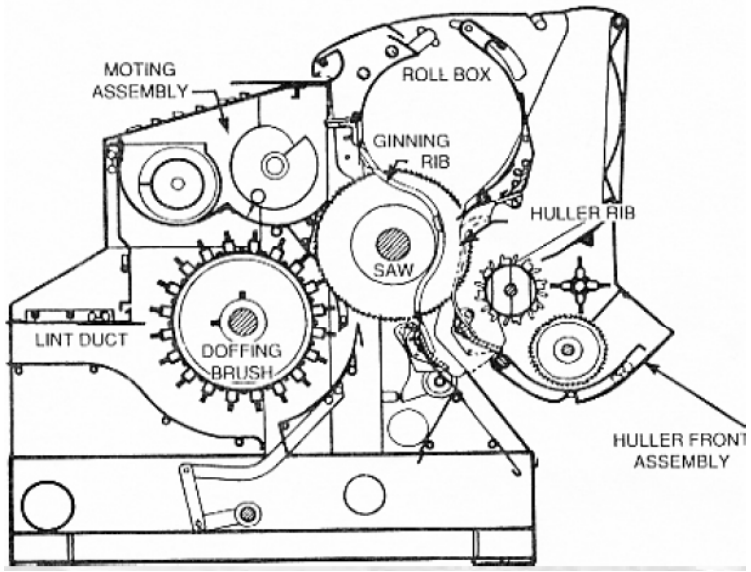
1) increase length about 4%,
2) reduce short fibers about 47%,
3) increase seed-coat fragment size about 18% and improve removabiliy at the textile mill,
4) decrease the number of seed-coat fragments about 36%,
5) increase measured strength by 5%, and
6) increase fiber yield about 3%.

Cotton Ginning

- Cotton Ginning can be optimized by computerized process control system
- Fiber loss reduction up to 25% is possible
- Fibre length reduction
- Fibre trash / pepper trash

- Research on Ginning e.g. by Stanley Anthony, USDA
- Presentation by J.L. Chanselme on the Bremen Conference





Feed Control And Drying

•Gins need feed control systems to meter cotton uniformly into the system.
•The efficiency of drying, cleaning and conveying systems increases as uniformity of flow increases.
•This is especially true in large, high capacity gins.
Cotton can be dried in reel-type, tower, tower hybrid, fountain, hi-slip, combination drier-cleaners, and belt-type drying systems.
•Improperly used, any of these systems can seriously over-dry cotton, thus reducing quality.
•Drying at low temperatures is much less harmful than drying at high temperatures. Larger volumes of drying air allow drying at lower temperatures

Feeder

The stationary head feeder employs a dispersing head with spiked rollers for breaking apart the module..
The advantages of module feeding are as follows:
•It increases ginning capacity by 10-25 percent by providing a consistent, uninterrupted flow of cotton to the gin plant.
• It eliminates suction telescope labor.
• It frees the module truck for long hauls by enabling continuous ginning of two to six modules.
• It blends wet cotton in the module with dry cotton.
• It extracts trash thereby not only reducing the amount of trash entering the gin but also increasing fan and piping life.

Dryer

In the first stage of drying, heated air conveys the cotton through the shelves for 10-15 sec.

- The temperature of the conveying air is regulated to control the amount of drying.
- To prevent fiber damage, the temperature to which the cotton is exposed during normal operation should never exceed 180-185 °C.
- Temperatures above 145 °C can cause permanent physical changes in cotton fibers.
- Dryer-temperature sensors should be located as near as possible to the point where cotton and heated air mix together.
- If the temperature sensor is located near the exit of the tower dryer, the mixpoint temperature could actually be 40-80 °C higher than the temperature at the downstream sensor.
- The temperature drop downstream results from the cooling effect of evaporation and from heat loss through the walls of machinery and piping.

Dryer

Seed cotton moisture content

- Seed cotton moisture content is very important. When cotton with high moisture content enters the gin stream, it should be exposed to as little machinery as possible before reaching the drying system.
- High moisture cotton does not clean or gin properly, nor does it separate easily into single locks, but forms wads that may choke gin machinery or entirely stop the ginning process.
- High moisture cotton also forms tight twists known as "fish hooks" that remain in the ginned lint and degrade appearance.

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- Fiber dried to very low moisture content becomes brittle and is damaged by mechanical ginning processes.
- Dry cotton requires more force and power to compress than does moist cotton. When pressing and baling such low-moisture cotton, achieving desired bale weight and density is often difficult.

Regulating Moisture Content

•Atmospheric conditions, particularly relative humidity, must be considered when harvesting seed cotton.
•Cotton can be dried at gins by using either ambient or heated air. Most gins dry cotton with heated air.
• As air and seed cotton move through a dryer, the air temperature drops because heat is lost, heat is used to increase the cotton's temperature, and moisture is vaporized from the cotton, which by far causes the greatest temperature drop.
• Also, cotton transport between machines with moist or dry ambient air changes fiber moisture content significantly.

- Ginning cotton below 5 percent moisture decreases yarn strength and appearance and increases short fibers in the card sliver.
- Increasing drying to improve trash removal by lowering fiber moisture below 6 percent reduces most yarn qualities, although up to a point yarn appearance improves with drying because of increased foreign-matter removal.
- From the textile mill perspective but not from a market perspective, the effect of increased short-fiber content resulting from over drying outweighs the benefits of foreign-matter removal.
- Many classing systems offer premiums for low trash and smooth appearance features, but these incentives may also encourage over processing at the gin, which produces additional neps and short fibers.

Bale Press

The cleaned cotton is compressed into bales, which must then be covered to protect them from contamination during transportation and storage.

- Three types of bales are produced: modified flat, compress universal density, and gin universal density.
- These bales are packaged at densities of 14 and 28 lb/ft3 (0,225 and 0,45 g/cm3) for the modified flat and universal density bales, respectively.
- In most gins cotton is packaged in a "double-box" press wherein the lint is initially compacted in one press box by a mechanical or hydraulic tramper; then the press box is rotated, and the lint is further compressed to about 20 or 40 lb/ft3 (0,32 or 0,64 g/cm3) by modified flat or gin universal density presses, respectively.
- Modified flat bales are recompressed to become compress universal density bales in a later operation to achieve optimum freight rates.

Gin Press

Following Best Ginning Practices

Designed to convert seed cotton into marketable commodities such as lint, seed and motes, gins are focal points of cotton communities, and their location, resources and economic contributions are critical to the cotton industry.

A ginner's two objectives are;
1) processing lint of satisfactory quality for the producer's classing and market system, and
2) ginning cotton with minimum reduction in fiber spinning quality to meet the demands of ultimate users, spinners and consumers.

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- Successful, efficient ginners should also be concerned that the fibers's spinning quality is reduced as little as possible.
- This requires knowledge of the latest technologies in raw cotton fiber testing that evaluate such qualities as short fiber content and neps.
- Ginners must also know about new gin technologies that impact fiber quality and value.
- A "best ginning practice" does not exist. Each lot of cotton requires careful assessment to determine which ginning practices best meet its particular needs.

Handling And Storing

In order that cotton may be harvested quickly before weathering reduces quality, adequate storage facilities are essential.

•So long as it is protected from weather damage and ground moisture, seed cotton may be piled on the ground or stored in sheds, trailers or modules.

• When seed cotton is consolidated for storage, it should be in a weatherproof facility or covered with high-quality tarpaulins

Quality Changes During Storage

•Some color degradation (spotting) occurs in seed cotton stored at moisture levels above 11 percent.

• At high moisture levels, bacterial action causes temperature increases within 48 hours, resulting in discoloration.

•High moisture content causes yellowness to increase sharply at levels above 13-14 percent, especially when the storage period exceeds 45 days.

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•High temperatures accelerate yellowing. The rate of lint yellowing increases sharply above 13 percent moisture and can increase even after module temperatures drops.
•For long storage periods, moisture should remain below 12 percent.

•A temperature rise of 15 degrees Fahrenheit (F) or more, or temperatures above 120 degrees indicate the need for immediate ginning to minimize quality degradation

- Because drying cotton at high temperatures may damage fiber, it should be dried at the lowest temperature that produces both acceptable market grades and satisfactory gin operation.
- Cotton scorches at 230 °C, ignites at 260 °C, and flashes at 315 °C. In no case should the temperature in the drying system exceed 175 °C because irreversible damage may occur.
- Temperatures over 90 °C damage dry fiber. Efforts required to control moisture in each gin process will pay dividends in gin operating efficiency and market value of baled cotton.
- Static electricity may cause cotton with too low moisture content to stick to metal surfaces and cause machinery to choke and stop.

•Seed moisture content is considerably less important from a ginning standpoint than fiber moisture content.
•For satisfactory ginning, seed moisture content should not exceed 12 percent.
•To preserve fiber quality, dryers should be adjusted to supply the gin stand with lint having a moisture content of 6 to 7 percent.
•At this moisture level cotton is more able to withstand ginning stresses without breaking.
•However, cotton at 5 percent moisture content will result in better cleaning and a smoother appearance, which is erroneously preferred by many classing and marketing systems.
•Gin cleaners remove more trash at moisture levels below 6 to 7 percent.
•Fiber moisture higher than 7 percent preserves fiber length, but results in ginning problems and poor cleaning

Short Fiber Content

•Overheating causes increased fiber breakage from the mechanical action of cleaning in gins and textile mills.
•Fiber length preservation can best be attained with fiber moisture from 6.5 to 8 percent; however, higher moistures reduce both cleaning efficiency and ginning rate.
•As a compromise, 6 to 7 percent moisture contents are feasible. Ginning below 5 percent moisture can cause serious fiber damage, while ginning above 8 percent may produce rougher lint, decreased gin capacity and less effective cleaning.
• For a given cotton, fiber lengths of 30, 29, 28,5 and 28 mm might result from processing at 9.4, 7.4, 4.9, and 3.7 percent fiber moisture, respectively. For each 1 percent reduction in fiber moisture below 5 percent, the number of short fibers increases by almost 1 percent.

3- Conclusion

- Ginning process has an important influence on fibers parameters, seed - coat fragments, preparation, short fibers and neps content.
- The needed actions to preserve the quality during ginning are:
- Mill diagnostic which include settings observation, humidity control, products inspection, take samples
- Technological diagnostic: seed and fiber analysis, qualitative evaluation
- Training sessions, pedagogic aids

In summary, implementation of the technologies by the ginning industry simply requires support of the textile industry in the marketing process.

Thank you
for your attention