

ALTERNATIVE METHOD FOR OPENING ROUND SEED COTTON MODULES

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Abstract

A new method and device for introducing round modules into the ginning process was developed by Cherokee Fabrication Company, Inc. of Salem, Alabama, and installed in a large commercial gin for the 2008 ginning season. A brief period of initial testing was required to optimize the sequence of operation and hydraulic settings. Timing data was collected and video recordings made for further analysis. Cherokee refers to this device as the Round-Up Module Unwrapper and now offers multiple configurations to accommodate many different module feeders and allow for some variation in site requirements.

Introduction

The much anticipated introduction of round seed-cotton modules created a need for opening and introducing these modules in cotton gins. While there are other existing options available, a set of needs not yet addressed in the market place presented an opportunity for new development. For gin plants operating at higher capacities, some degree of automation is required, but these gins need a system that is both fast and uncomplicated. Concerns were also expressed throughout the industry in regards to the possibility of wrap contamination finding its way into finished cotton bales. Staffing requirements and personnel safety concerns were also discussed, as were equipment costs and maintenance needs.

Materials and Methods

Proof of Concept

Round modules from the 2007 crop were delivered to Cherokee for testing. The first destructive test involved proving the concept that the wrap could be slid off of a round seed-cotton module without cutting the wrap. Four pads with pins on the face were constructed and fitted onto the forks of two forklifts. A round module was tipped over on its side with the openings facing up and down. The forklifts pressed into opposite sides of the module allowing the pins to puncture the wrap and the forks were raised on both at the same time. Surprisingly, the cotton was not lifted off of the floor and the wrap began to slide up off of the module. After moving only a short distance, the wrap began to tear near the pads. The forklifts were backed away and repositioned to another location and the process was repeated. It took a few cycles to completely strip the wrap off the module. It was decided that a larger pad and distribution of pins was needed.

A large frame with more pads and pins was constructed to completely surround the round module and allow the clamping force of the pins into the module to remain constant. As the frame was lifted, the wrap began to easily slide off of the module. To prevent the need for the laborious task of transferring the loose cotton into a truck, two forklifts were positioned beneath either side of the module to prevent the cotton from falling out when the frame was lifted. The module was then transported into an area with enough headroom to allow the module to be lifted up high enough to back the truck under it. After the forklifts were backed away, the frame was easily lifted off of the module, taking the wrap with it.

Early Design and Patent Application

Several different versions of the machine were proposed and a patent application was filed to cover each of these concepts. The version that appeared to be the simplest to operate and most affordable was chosen for a finished design. A three-dimensional conceptual computer model was created to help describe the unit, and further refine the design. A slide show of this model was shown to a few prospective customers after the patent filing. Adams Land Company in Blytheville, Arkansas, decided to buy the first unit.

In addition to the basic machine, the hydraulic power unit and control systems were also designed in-house at Cherokee. Self-supporting retaining walls were designed to contain the cotton after removal of the wrap. Several different pin designs were tested to insure that the wrap material would be pierced without cutting any pieces away from the parent material. If the module wrap design should ever change to a reusable material in the future, one of the non-destructive wrap gripper designs will be implemented.

Sequence of Operation

The basic preliminary operating sequence is shown in Figures 1 through 12 below. These images are taken from the conceptual computer model mentioned above.

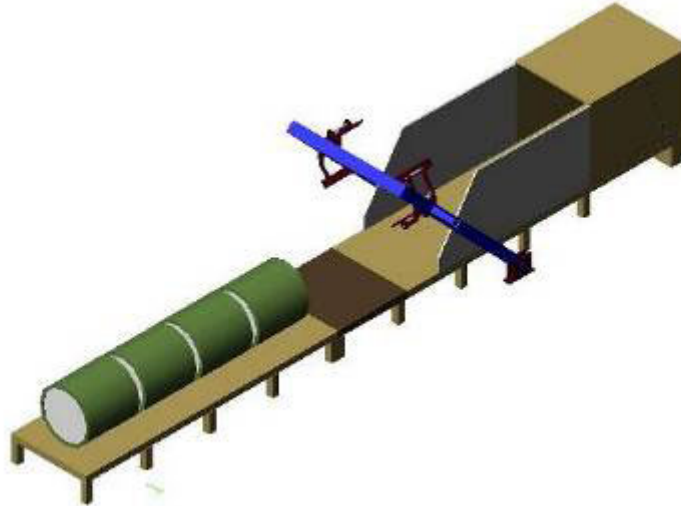


Figure 1.

In Figure 1, four round modules are shown on a module feeder bed. The gray colored walls were added to contain the cotton. The blue color shows the main moving structure of the device, and the burgundy color shows the clamps. The dark brown color represents the first portion of the bed preceding the disperser section with an independent drive system.

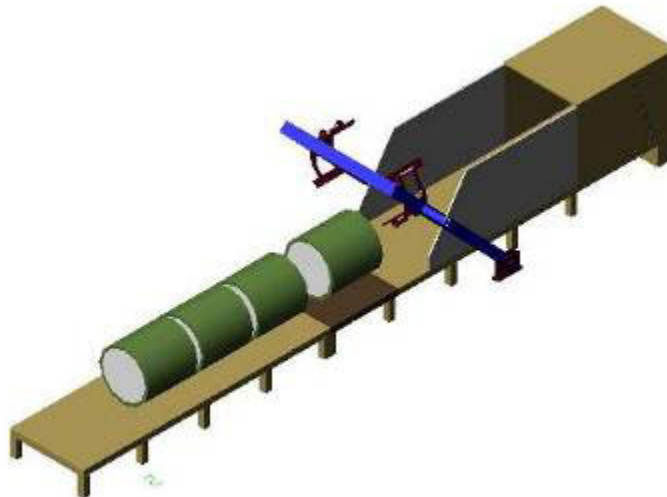


Figure 2.

Figure 2 shows the round module advancing to the pick-up point. The independent drive section allows a gap to be created between modules.

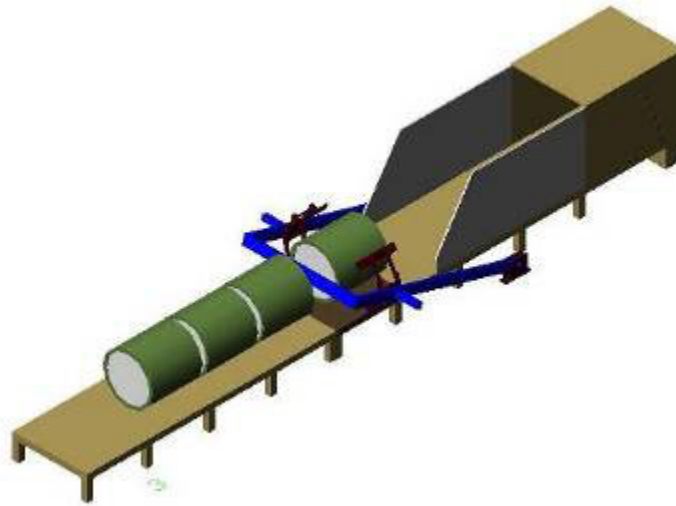


Figure 3.

Figure 3 shows the main structure member that joins the beams passing between the modules in the gap. The actual finished design does not require this gap for the structural connection.

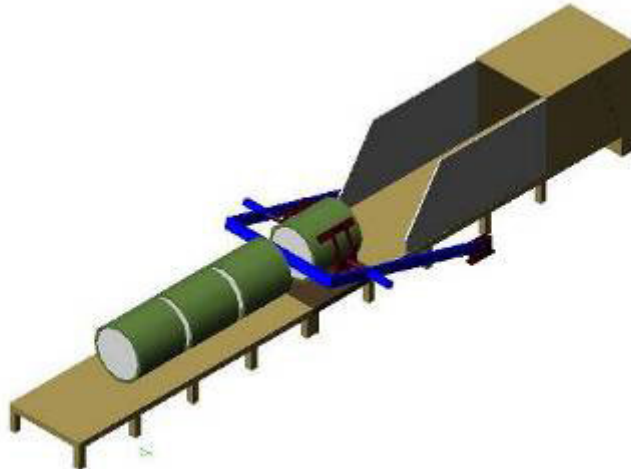


Figure 4.

Figure 4 shows the clamps being extended to make contact with the module.

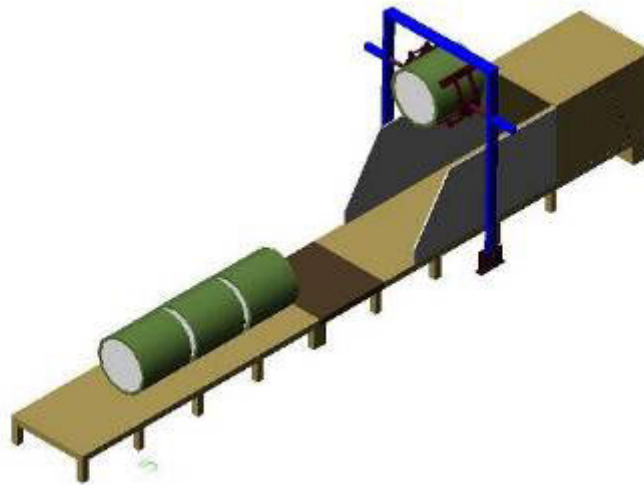


Figure 5.

Figure 5 shows the module being lifted up without changing the orientation of the module.

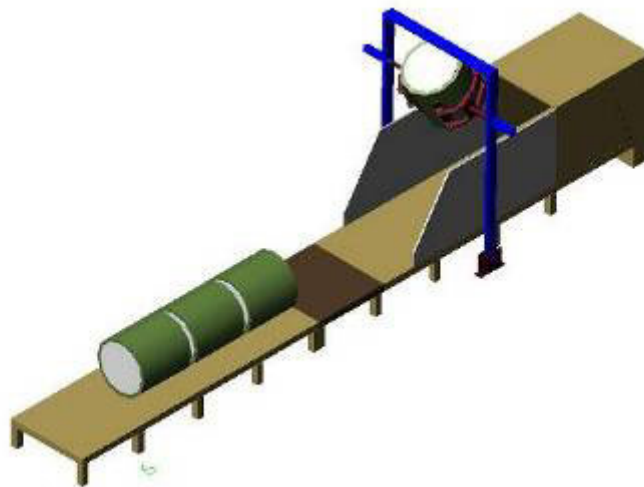


Figure 6.

Figure 6 shows the module being rotated out of the horizontal position without moving the main beam structure.

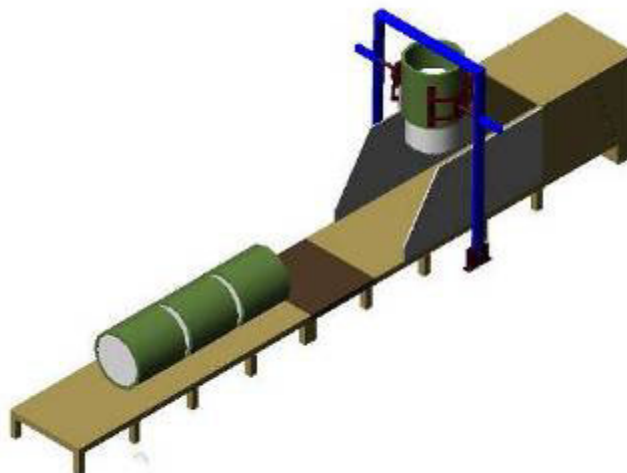


Figure 7.

Figure 7 shows the cotton sliding out of the wrap. This process tends to wipe the wrap clean as the cotton exits.

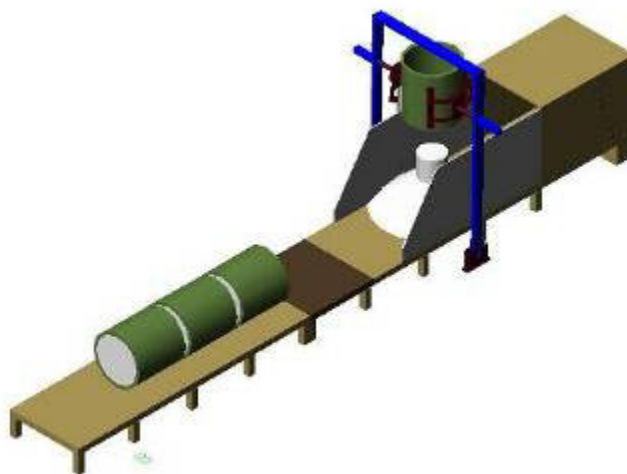


Figure 8.

Figure 8 shows the cotton on the bed of the module feeder and the empty wrap suspended above.

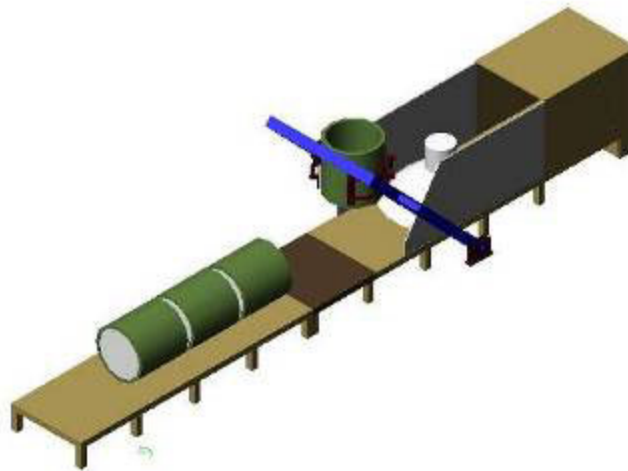


Figure 9.

Figure 9 shows the beam structure returning to a waiting position. The wrap maintains its orientation to allow any remaining cotton to fall from the wrap onto the bed.

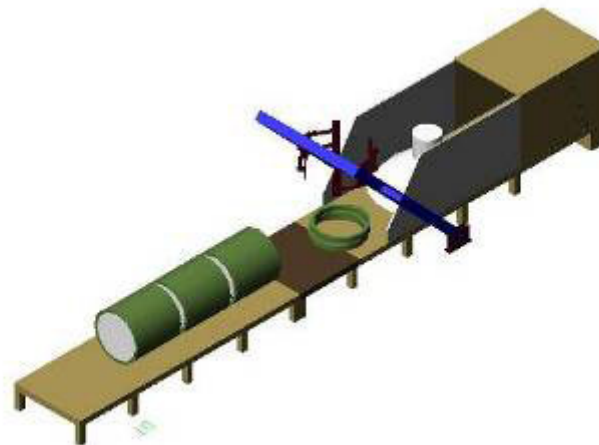


Figure 10.

Figure 10 shows the wrap being released from the clamps, allowing it to fall onto the empty section of the bed below.

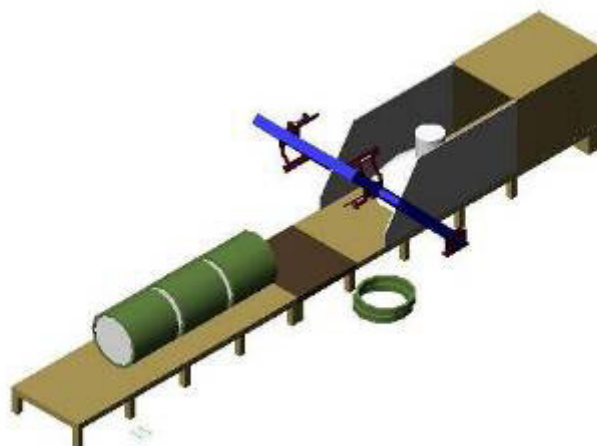


Figure 11.

Figure 11 shows the wrap being pulled from the bed onto the floor to complete the cycle.

Construction and Testing

The machine structure, hydraulic power unit, and control system were all manufactured in Cherokee facilities. During the summer of 2008, the first unit was constructed and assembled for testing at the Cherokee manufacturing facility in Salem, Alabama. Opportunities for refinement were availed during this testing phase and appropriate improvements were made. It also became apparent that the machine was able to move faster than was needed, so the hydraulic system capacity was adjusted accordingly. After completion of the testing, the unit was shipped to the customer immediately prior to the start of their ginning season.

Installation and Commissioning

Installation was provided by Roy Owens Construction Company of Malden, Missouri. Adams Land Company operates a double gin plant under one roof and can consistently produce 120 bales per hour. One of the two existing Cherokee module feeders in this plant was modified to accept the Round-Up Module Unwrapper. The feeder modifications included the addition of cotton retaining walls in front of the disperser head and the optional addition of an independent drive to break the first ten feet of the last complete roller bed prior to the disperser head.

After the first few modules were processed, the sequence of operation was refined and finalized, but some of the first modules were a little damp and occasionally showed a tendency to stick to the walls. Before the next batch of round modules were processed, the walls were modified to reduce friction and the rollers in this area were modified to improve traction. No more problems of this nature were observed afterwards.

Capacities

The initial cycle times were almost 2-1/2 minutes long, but with a little experience the operators easily learned to perform a complete cycle in less than 2 minutes. The round modules processed at Adams Land Company had an average weight of about 5000 pounds each. If 1/3 (by weight) of each machine-picked module finds its way into a 500 pound finished lint bale, then a 5000 pound round module contains about 3-1/3 bales.

$$\frac{5000lb}{3} \times \frac{1bale}{500lb} = 3.333bales$$

If it takes 2 minutes to complete each cycle, then conservatively speaking, these modules could be processed at 100 bales per hour.

$$\frac{3.333bales}{round\ module} \times \frac{1round\ module}{2minutes} \times \frac{60minutes}{1hour} = \frac{100bales}{hour}$$

If modules are greater than 5000 pounds, or finished bale sizes are less than 500 pounds, or if the unit is controlled by an experienced operator, the potential ginning capacity would be higher. The hydraulic power unit and control system design can be upgraded in the future if additional capacity is required.

Controls

The Round-Up Module Unwrapper is operated with two simple joystick controls. The uncomplicated operational sequence is short and can be mastered by a new operator in a matter of minutes. If the hydraulic power unit oil temperature or oil level should fall out of an acceptable range, the unit will stop and this information will be displayed on a small screen above the joystick controls. A button on the screen is used to advance the module into position at the beginning of each cycle. Another button is used to toggle the module feeder back into its original program for processing traditional rectangular modules. The main structural beam is parked out of the way in a vertical position prior to making this change.

Adams Land Company elected to build an operator platform, but the control pedestal could have been mounted at floor level instead, allowing the operator to also remove the wrap at the end of each cycle. If the wrap is so equipped, a bar code reader or a radio frequency identification (RFID) scanner can also be added at floor level to allow the operator to record each module as the wrap is removed. The used wraps at Adams Land Company were rolled up with the aid of a traditional tarp wrapping machine.

The main pump motor on the hydraulic power unit at Adams Land Company was 50 horsepower, but testing proved the unit capable of providing much more capacity than needed. The subsequent design includes a 30 horsepower main pump motor instead, with a 3 horsepower circulation pump motor and a 1/3 horsepower fan on the oil cooler.

There is no need to create gaps between the wrapped modules at any point in the process. However, gaps were created directly at the pick-up point since the optional independent conveyor drive system was used in the Adams Land Company installation.

Summary

The machine is easy to operate and leaves virtually no cotton inside the empty wrap, which can be easily and safely removed by a single operator. There were no plastic contamination issues reported. The machine did not change the operation or impede the flow of regular modules. The ginning capacity of the plant was not reduced when processing round modules. The machine met the needs and expectations of the customer and performed without any significant problems after the start-up issues were resolved. The Round-Up Module Unwrapper processed nearly 3000 round modules throughout the ginning season at Adams Land Company for the 2008 ginning season.

