

## **AUTOMATION OF THE CHEROKEE FABRICATION ROUND-UP MODULE UNWRAPPER**

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### **Abstract**

Cherokee Fabrication Company of Salem, Alabama, introduced a method and device for unwrapping round modules immediately prior to ginning in 2008. This patent pending design has since benefited from the addition of an innovative automation system. In addition, mechanical improvements have further streamlined the previously simple sequence of operation. This version was installed at a high capacity commercial gin for use during the 2009 crop season. In response to customer requests, our plans for the future include the introduction of the Round-Up II for the 2010 crop season.

### **Introduction**

The rapid increase in quantities of round seed cotton modules being processed at gin plants has created a need for handling and introducing this cotton package into the ginning process. At the 2009 Beltwide Technical Conference, Cherokee presented the results from the successful first season of the Round-Up Module Unwrapper. The wrap is not cut in the process, which offers gins the unique advantage of easy processing without risking plastic contamination in the finished bales. A version of the video presented at that time is available for viewing on line at [www.cherokeefab.com](http://www.cherokeefab.com). The ASABE (American Society of Agricultural and Biological Engineers) named the Cherokee Fabrication Round-Up Module Unwrapper a 2009 AE50 Outstanding Innovation Award winner. In 2009, the ASABE published the recipients of this award in the June issue of RESOURCE Magazine. Today, we are presenting results from the second season version of the Round-Up Module Unwrapper, as installed at Sandy Ridge Cotton Company in Malden, MO. We will also introduce an additional product for handling round modules in gin buildings with lower overhead clearance.

### **Materials and Methods**

#### **Review of 2008 Version**

The general sequence of operation from 2008, at Adams Land Company, Leachville, AR, can be seen in Figure 1.



Figure 1. Sequence of Operation for 2008 Version.

A mixture of round and traditional modules were processed throughout the season, and the changeover from round to traditional module simply required the operator to park the Round-Up in the vertical position and push a selector switch on the control panel to switch back into traditional module mode. With the 2008 version, the operators easily learned to perform a complete cycle in less than 2 minutes. The round modules processed in 2008 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.

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

### **2009 Version Changes**

For this year, the wrap stripper hydraulic cylinders were removed and the wrap removal process occurred automatically at the end of the sequence when the clamps were completely opened. This change removed one step from the already short sequence of operation and also simplified the electrical and hydraulic circuits. The hydraulic power unit was simplified and the power requirements were reduced from 50 to 30 horsepower for the main pump. This power unit also includes a 3 horsepower pump for filter and cooling of the oil and a 1/3 horsepower motor on the oil cooler fan. Another change for 2009, included a slight reduction in height of the retaining walls immediately prior to the disperser head of the module feeder. The installation at Sandy Ridge Cotton Company in Malden, MO, can be seen in Figure 2.



Figure 2. Installation of 2009 Version.

### **2009 Version Performance**

Even with the smaller hydraulic power unit, early testing of the automatic mode completed the cycle in almost 2 minutes. Shortly after the season began, the round module pickers this year were modified to produce larger modules than the previous year. At Sandy Ridge the modules soon averaged about 4.1 bales per round module. The Round-Up worked just as well on these as it did for the slightly smaller modules processed at the beginning of the season. For round modules averaging 4.1 bales per module, gin feeding rates of over 110 bales per hour can easily be achieved.

$$\frac{4.1 \text{ bales}}{\text{round module}} \times \frac{1 \text{ round module}}{2.22 \text{ minutes}} \times \frac{60 \text{ minutes}}{1 \text{ hour}} = \frac{111 \text{ bales}}{\text{hour}}$$

The Round-Up was in place and ready for operation prior to the start of the ginning season for Sandy Ridge, which is a complete Cherokee plant including three Cherokee 170 Majestic Gin Stands and a Cherokee Elite Press. The Round-Up processed nearly 3000 round modules and fed the gin at whatever ginning rate was required. The entire gin is capable of running at about 55 bales per hour maximum under the best of conditions, but under normal conditions the gin typically ran at a more relaxed pace of about 48 bales per hour.

The operator control panel was located on the floor near the point where the empty wrap was released, which allowed the entire process to be handled by a single operator. Even though the capacity of the Round-Up greatly exceeded the capacity of the gin, this provided a considerable buffer of time for the operator to perform his duties at the Round-Up and also to fold the empty wrap and place it in the baler located beside the control panel.

### **Additional Automation**

Shortly after the ginning season began, Sandy Ridge allowed Cherokee to install and test experimental modifications that made the entire control sequence run in automatic. When the unit ran in automatic mode, the operator only needed to push one button one time to initiate each cycle after removing the empty wrap from the previous cycle. After the module size increased early in the season, the automatic feature did not always operate reliably, but sensor changes were made shortly afterwards to accommodate the larger modules and the experimental automatic mode ran well throughout the remainder of the season.

### **Field Comments**

As we visited customers throughout this season, we were surprised to hear there was a rumor circulating that pouring the cotton from the Round-Up onto the module feeder bed caused damage to the rollers. This simply is not true. There has been no damage whatsoever. All of the rollers and bearings beneath the Round-Ups were inspected at the end of both seasons, and none were damaged or replaced.

Some of the gin managers planning to process round modules for the 2010 crop season, told us they preferred the more cost effective non-cut Cherokee approach to automatically removing the plastic wrap, but lacked the 25 feet of overhead clearance required to install a Round-Up.

### **Plans for the 2010 Season**

In response to customers whose needs include lower overhead clearance requirements, Cherokee will also offer the Round-Up II for the 2010 ginning season. This system uses the same patent pending, non-cutting and non-contaminating concepts as the original Round-Up, but will operate in a much smaller space and stand at a height of less than 20 feet tall. The Round-Up II will use the same hydraulic power unit as the 2009 Model Round-Up, use retaining walls that are only 3 feet tall, and operate at a capacity of only slightly less than the original. Additional advantages to gin customers who choose the Round-Up II for automatic wrap removal; will be inclusion of the automatic cycle feature plus an even lower cost of ownership.

Figure 3 shows the conceptual model used to demonstrate the Round-Up II. Figures 4-7 show the sequence of operation for the Round-Up II. In step 1, the modules are advanced toward the pick up point at high speed. In step 2, the first module continues to the pick up point while the remainder of the modules wait their turn. In step 3, the arms clamp the module. In step 4, the module is raised up off the bed for rotation clearance. In steps 5 and 6, the rotation is completed. In step 7, the clamping pressure is released enough to allow the cotton to begin to ooze out until it reaches the roller bed 2 to 3 feet below. In step 8, the arms slide the wrap up off the cotton. In step 9, the

arms lower slightly for rotation clearance. In steps 10 and 11, the arms complete the rotation and open to release the wrap. In step 12, the empty wrap is removed and the cycle is complete.

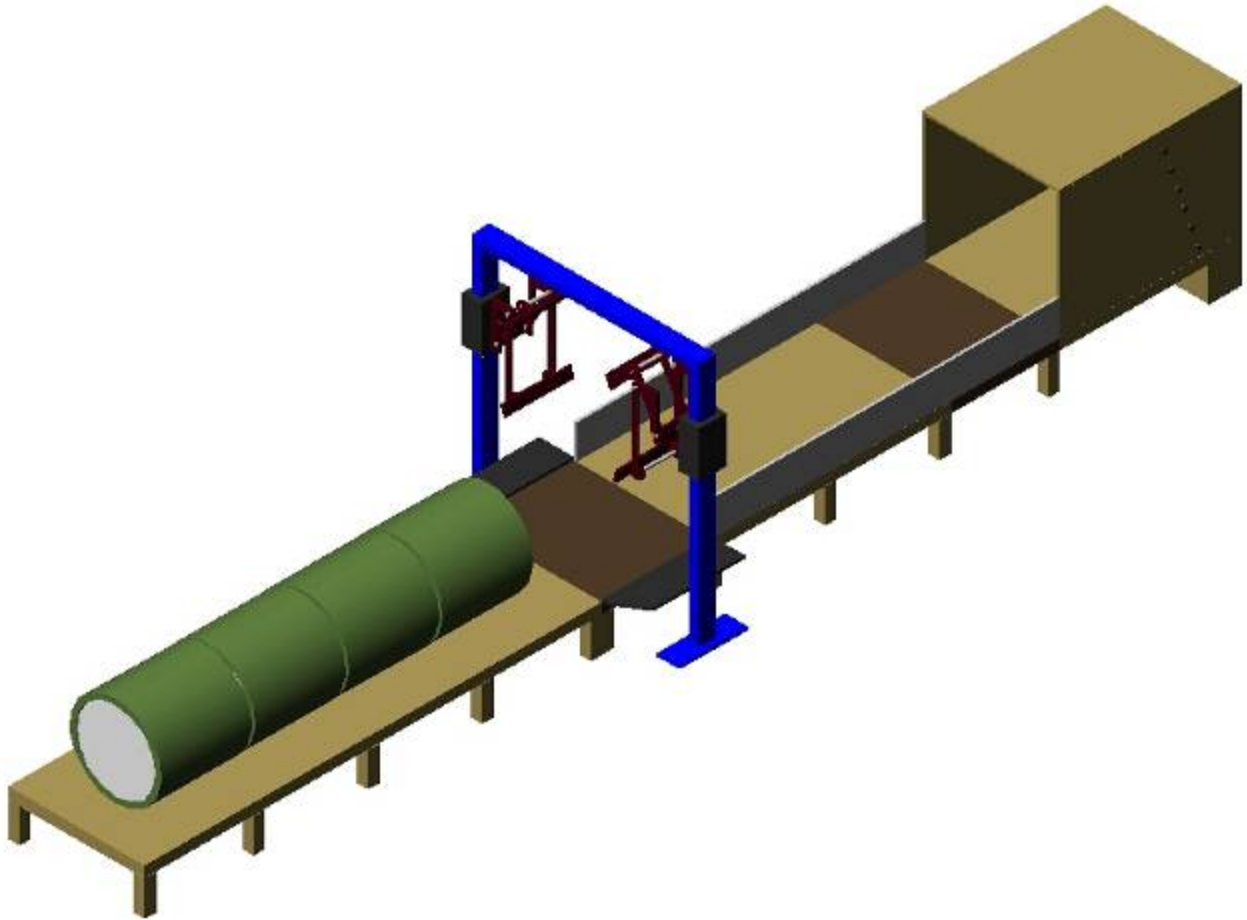


Figure 3. Conceptual Model of Round-Up II.

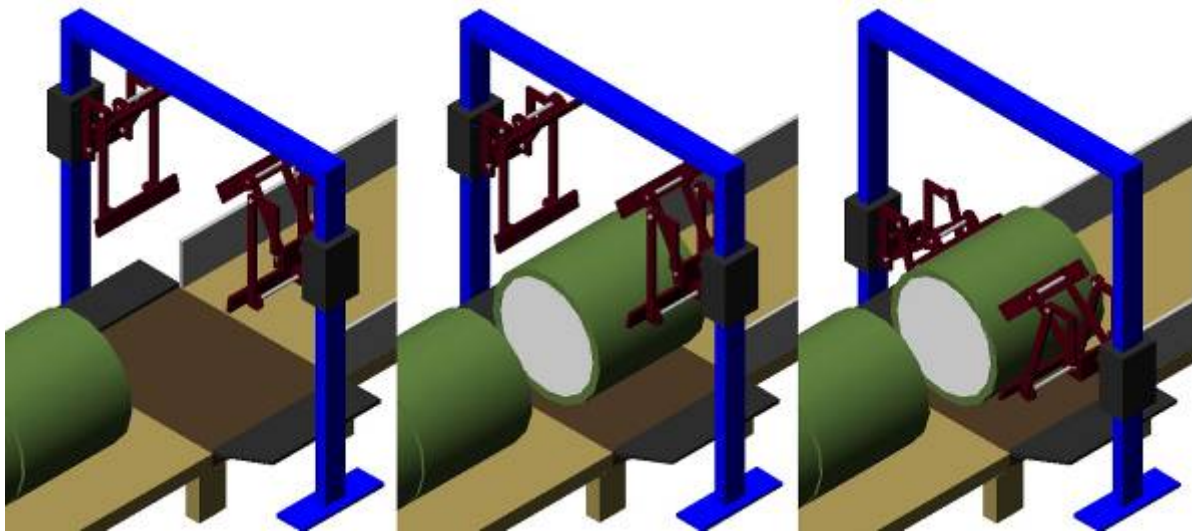


Figure 4. Steps 1-3 in Sequence of Operation for Round-Up II.

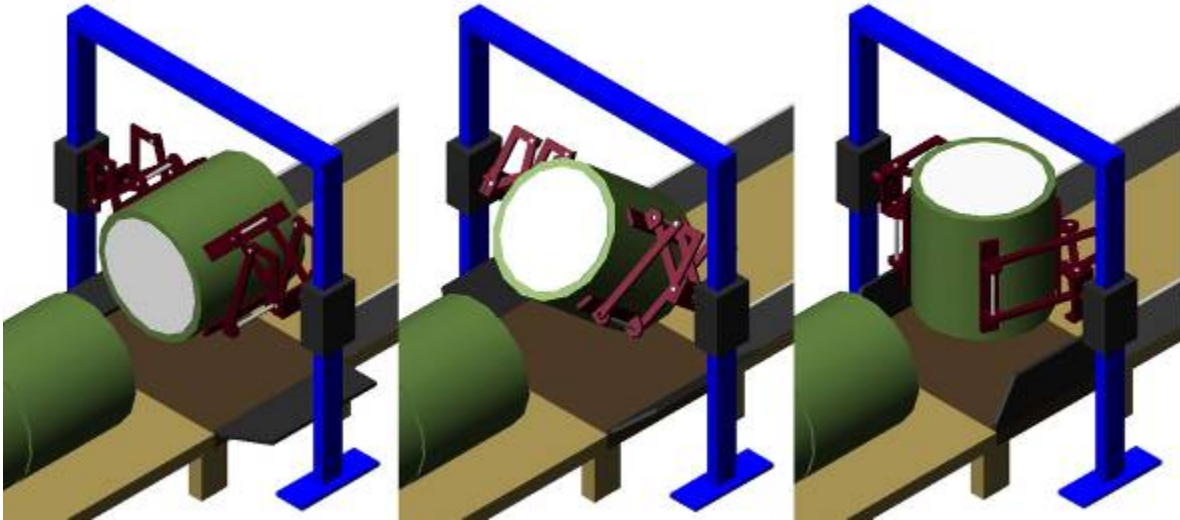


Figure 5. Steps 4-6 in Sequence of Operation for Round-Up II.

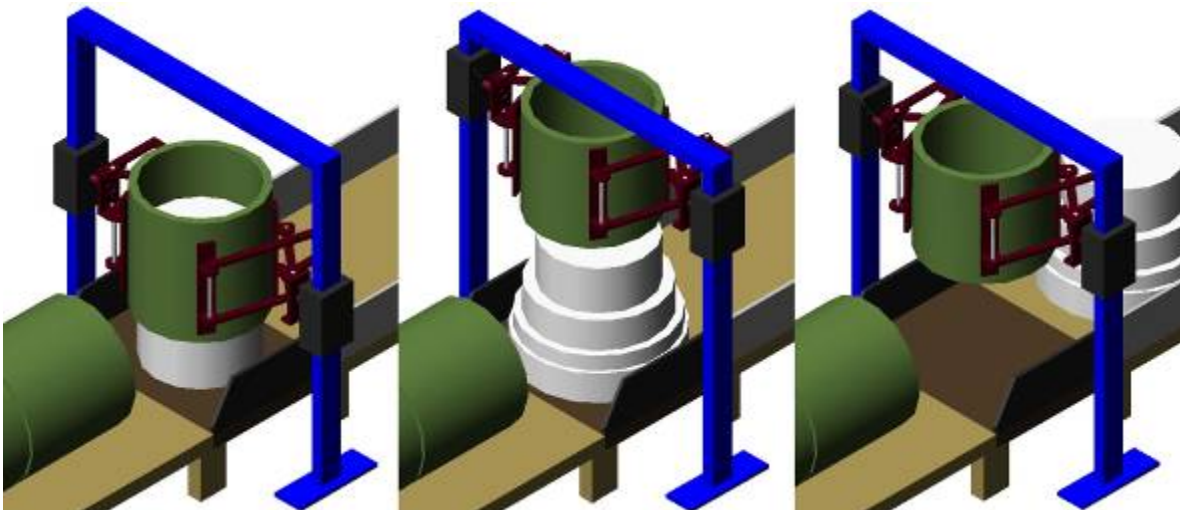


Figure 6. Steps 7-9 in Sequence of Operation for Round-Up II.

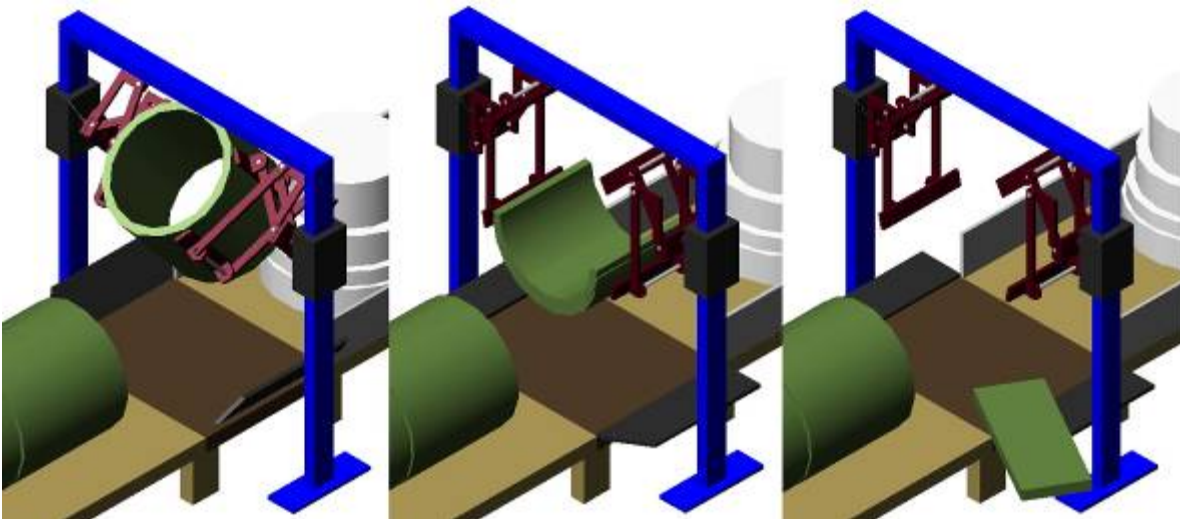


Figure 7. Steps 10-12 in Sequence of Operation for Round-Up II.

**Review of 2007 Concept Testing**

The first 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 at all, but 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, as seen in Figure 8.



Figure 8. Early Testing of Round-Up Concept in 2007.

Several different pin designs were tested to insure that the wrap material would be pierced or punctured without cutting any pieces away from the parent material. The replaceable pin design chosen resembles the shape of the sharpened end of a pencil. Scientific testing by a large independent equipment manufacturer has confirmed our conclusion that this pin design leaves no plastic contamination in the module. If the module wrap design should ever change to a reusable material in the future, one of our non-destructive wrap gripper designs will be implemented.

**Conclusions**

An important advantage to the Cherokee approach is the fact that the plastic wrap used to contain the round modules is not cut, thus eliminating the risk of leaving cut wrap material in the module and causing plastic contamination in finished bales. Another important advantage is the ability to easily sustain the feeding capacities required for high volume gin plants in a cost effective manner. 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. The uncomplicated operational sequence is short and can be mastered by a new operator in a matter of minutes. Nearly 3000 round modules were processed each year in 2008 and 2009, with this technology with out any damage to the module feeder beds. An overhead clearance of 25 feet is needed to operate the original Round-Up Module Unwrapper.

As an additional product offering for 2010, the Round-Up II will operate in a manner similar to the early testing in 2007, and will fit in most gins with height restriction limits. The Round-Up II will include the automatic cycle feature and be easier for medium and small capacity gins to afford.