COTTON MOISTURE CONTENT SENSING FOR GINS USING RESISTANCE

R. K. Byler and W. S. Anthony
US Cotton Ginning Laboratory
Stoneville MS

Abstract

Sensors were installed in a gin to measure the moisture content of cotton on the bottom of the module and of samples from the interior of the module while ginning. The module bottom sensor was designed to detect conditions when cotton on the module bottom was much wetter than the cotton in the interior. Good harvesting conditions precluded any modules with naturally wet bottoms. The bottoms of two modules were artificially wetted and the modules ginned. The resulting data verified the basic operation of the sensors as the wet bottom was detected while the lower moisture content of the module interior was also measured.

Introduction

Resistance-based experimental cotton moisture content (mc) sensors were installed at two locations in Burdette Gin in Leland, MS, and used for several years. One seed cotton sampler and multi-channel resistance meter was installed in the head of the module feeder for the 1996 crop year and a second one was installed for the 1997 crop year (Byler and Anthony, 1999). These meters take a small portion of the cotton being removed from the module by the module feeder cylinders and press it against the stainless steel sensor probes in each meter. The mc data were then used for drying control. During testing of the drying system a problem was encountered for some modules because they had extremely wet bottoms but the majority of the module contained relatively dry cotton. The samples were fairly representative of the whole module but cotton from the module bottom could be missed, especially if it was heavier than normal, as was the case when it was wet. In addition, the wet cotton represented a small percentage of the whole module; therefore, a representative sample would produce an average, which would be fairly dry. The automatic control system correctly sensed that the cotton in the module was relatively dry and therefore turned the drying temperature down, sometimes to the minimum allowed. The extremely wet cotton from the module bottom passed to the gin stand with almost no drying and caused problems there. The ginner had to manually override the drying control system in order to gin satisfactorily.

As a possible solution, a roller in the module feeder floor was isolated electrically from the rest of the module feeder and used to sense the mc of the bottom of the module, Figure 1, as described by Byler and Anthony, 1999.

The purpose of this study was to determine if a simple isolated roller in a module feeder bed could be used to detect wet-bottomed modules. This sensor was used during the 1998 ginning season, but hardly any rain occurred during the harvest and no naturally occurring modules with wet bottoms were encountered. In 1999 several modules were artificially wetted and ginned. Some of the data collected during the 1999 season with these meters are described in this paper.

Discussion

Data were collected during the 1999 ginning season with the module bottom sensor and the two sensors in the module feeder head. The module bottom mc sensor gave a continuous indication of mc and, in addition to the mc measurement, the device produced a digital "tick" for each half-foot movement of the module. The data represented by the top line in Figures 2, 3, 5, and 7 show the mc measurement at half-foot increments in module movement smoothed with an exponential filter. The readings from the two mc measurement stations in the module feeder were averaged on an approximately half minute interval. Those averages are represented by the bottom line in Figures 2, 3, 5, and 7 for the same time periods as the mc data for the module bottom also smoothed with an exponential filter.

Figures 2 and 3 are for two different two-hour periods when untreated modules were being ginned, which may be "typical" conditions. This gin would process roughly 2 modules per hour. At time approximately 16.3 hours in Figure 2 there was a change of modules. The module bottom mc dropped from about 10.4% to about 9.5% and the measured mc of the interior of the module increased from about 6.5% to 8.5%. The ginning of that module ended at about 16.7 hours (about 24 minutes later) when the module bottom mc increased slightly but the module interior mc dropped noticeably. Figure 3 shows a period of time where less noticeable changes were measured in the module interior and module bottom mc.

By early October it became apparent that because of the dry weather during the harvest period no modules with wet bottoms were likely to be available for testing. Because of the lack of naturally wet cotton two approaches were used to simulate the effects of a wet harvest season on the moisture content of the bottom of the module. One module was prepared by first removing the floor of a module hauler at the front and back, see Figure 7, then sprinkling the bottom of the module with water continuously for more than 24 hours. In the handling of the module, one end of the module collapsed. Ginning the module began at about 12.2 hours, as shown in Figure 5, and the measured module bottom mc increased from

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about 8.6 to 9.2%. From about 12.3 hours to 12.4 hours the center of the module was being ginned and the module bottom mc returned to about 8.6%. From about 12.4 hours to 12.5 hours the wet portion of the module bottom was again measured then the mix portion of the module that had collapsed. Figure 5 also records the measured mc of the contents of the module that shows relatively little relation to the module bottom mc.

The approach of sprinkling water on the module bottom did not produce an adequate increase in the module bottom mc so the next approach was to place the module in a low portion of a paved lot, Figure 6. Then water was run into the low place continuously for four days. Figure 7 was produced from data collected while ginning this module on October 29. Unfortunately a fire occurred shortly before the module was finished so ginning, and the module feeder, was stopped for about an hour. The top line in Figure 7 shows the measured module bottom mc, which increased by about 2% from the previous module. There was no new data for the period during cleanup after the fire and the module bottom mc decreased soon after ginning was resumed. Figure 7 shows that the interior mc for this module was about 6%. This module also collapsed on the module feeder and produced more variable mc readings than normal at a little over 14 hours.

Seed cotton samples were taken from the module bottom and interior of the module during the test on October 29. It is difficult to collect representative samples from either the module bottom or the interior of a module of cotton. The samples were placed in sealed metal cans and returned to the lab where the mc was determined by oven methods. The samples from the module bottom varied from 7.0% to 19.8% wet basis with a mean of 13.2%. The samples from the module interior varied from 5.5% to 6.0% and had a mean of 5.9%. These data agree reasonably well with the measurements made by the instruments in the gin observed in Figure 7.

Summary

Moisture measurement stations were installed in the module feeder head and on the module feeder bottom to measure the mc while ginning. The devices operated throughout the 1998 and 1999 ginning seasons. Because of the dry harvest conditions in the fall of 1999, cotton sufficiently wet to really test the system was not encountered. Data from two modules that were artificially wetted were evaluated. These data indicated that the sensors could detect the mc of the bottom of the module and thus would be useful in drying control.

References

Byler, R.K. and W. S. Anthony. 1999. Wet-Bottomed Modules-Moisture Content Measurement and Dryer Control. Proc. Beltwide Cotton Prod. Res. Conf., National Cotton Council, Memphis, TN. pp 1419-1423.

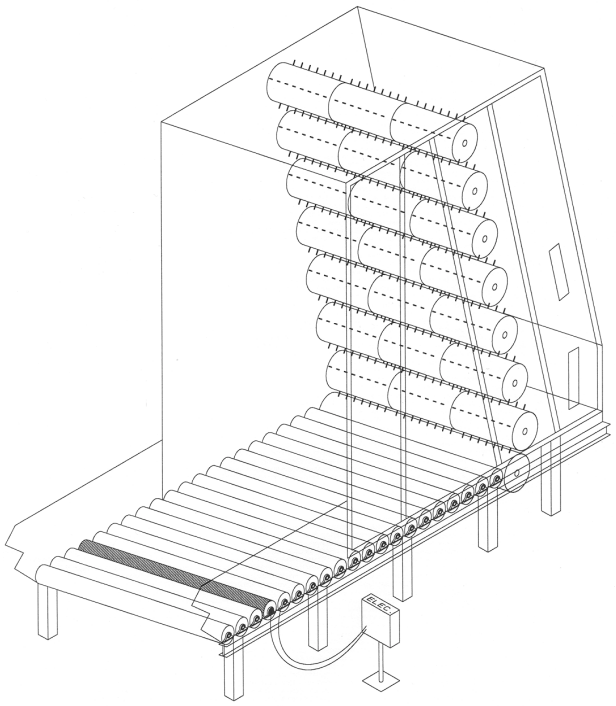

Figure 1. Schematic showing the electrically isolated roller used as part of the module bottom moisture meter in the module feeder.

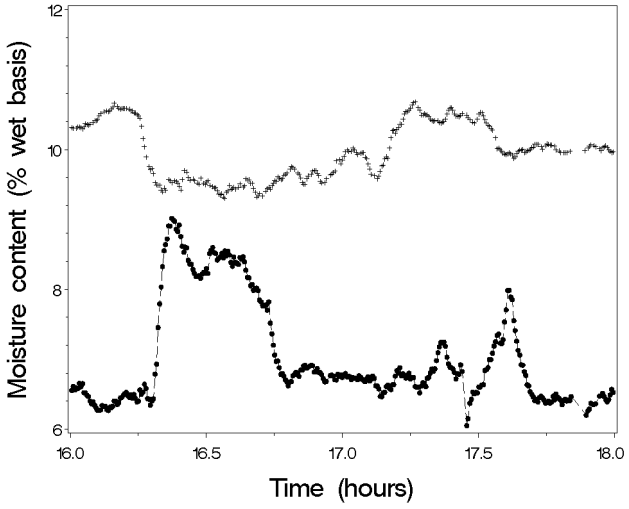

Figure 2. Plot of the moisture content of the bottom of the module, top line, and the cotton in the module feeder head, bottom line, measured while ginning on October 7, 1999.

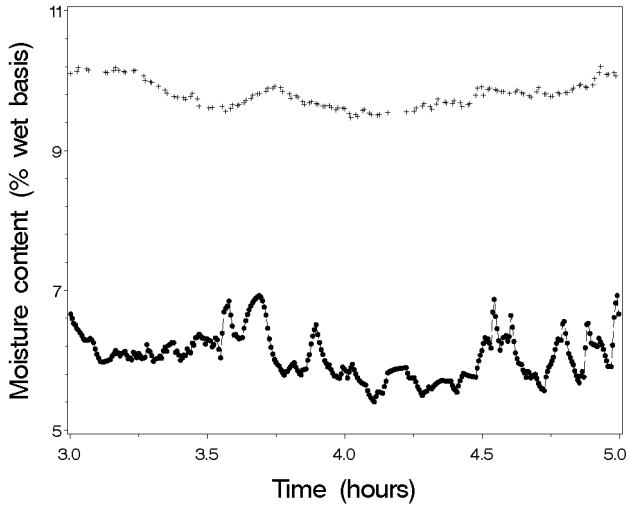

Figure 3. Plot of the measured moisture content of the module bottom, top line, and interior of the module, bottom line, measured while ginning on October 29, 1999.

Figure 4. Floor of module hauler showing section removed so module bottom can be wetted.

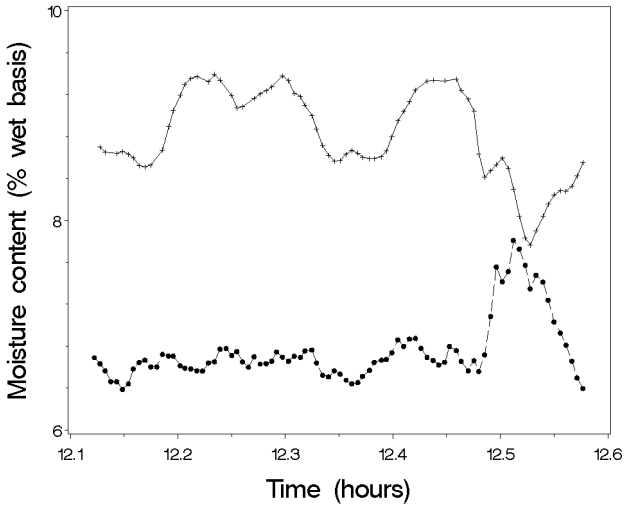

Figure 5. Measured moisture content of the cotton on the module bottom, top line, and in the module head, bottom line, for a module which had water sprayed onto the front and back portions while it was on a module hauler.

Figure 6. Cotton module being wetted by soaking on a paved lot.

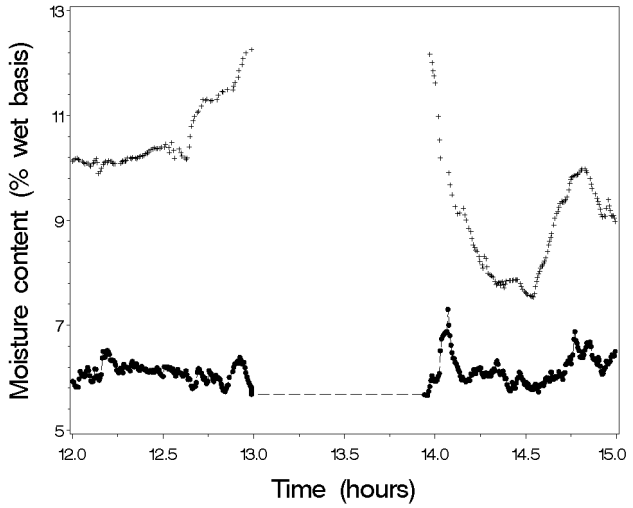

Figure 7. Moisture content of the bottom of a module, top line, and interior of the module, bottom line, measured while ginning on October 29, 1999 for a module that was artificially wetted, ginning was stopped for approximately one hour.