

CIRRUS COTTON CONDITIONER:
A NEW METHODOLOGY FOR MOISTURE ADDITION PRIOR TO BALING

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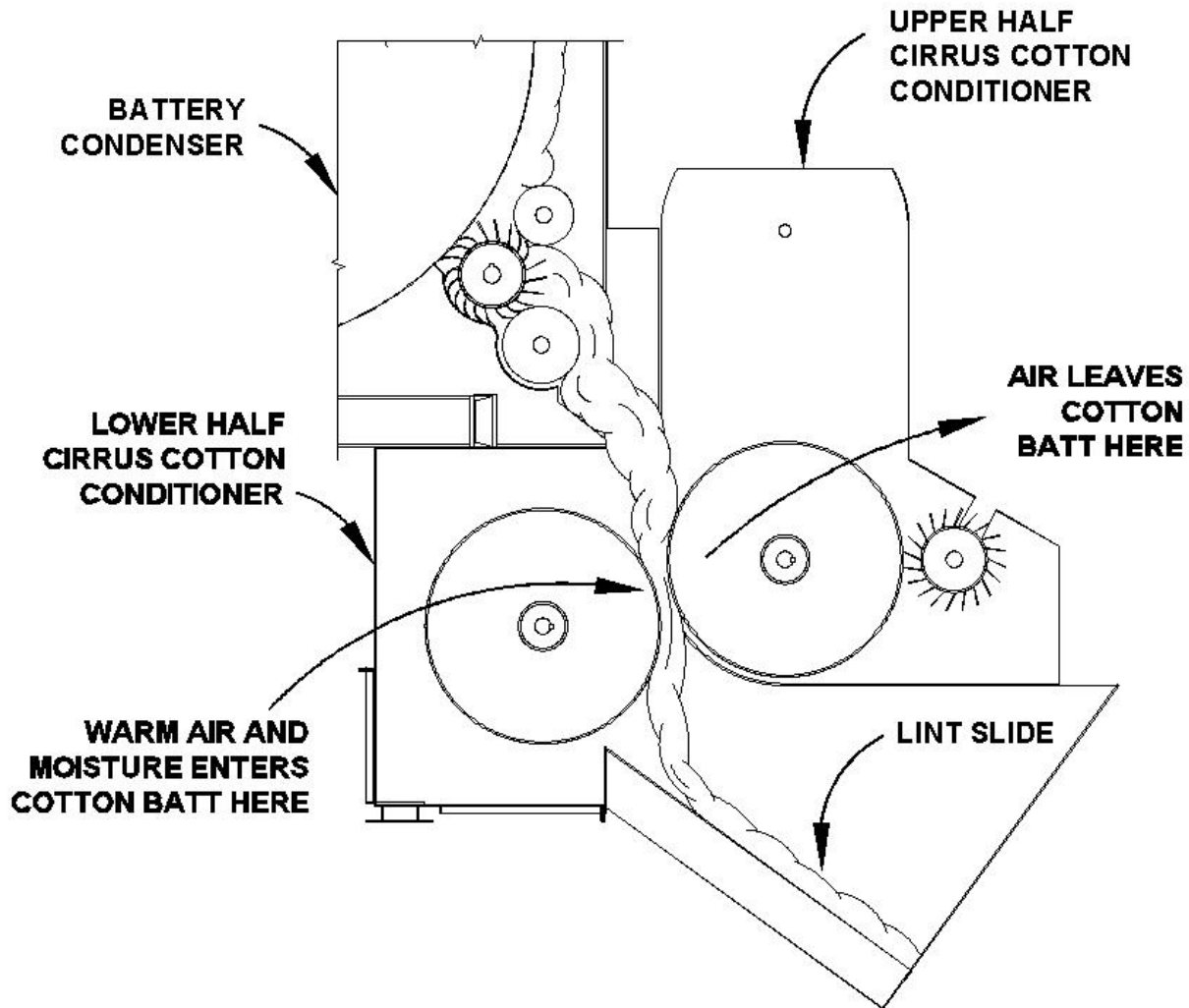
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It is well understood within the cotton ginning industry that addition of moisture to lint cotton prior to baling is desirable, and many different methods have been used to this end. The methods that force warm, moist air through the cotton seem to offer the greatest advantages. With this in mind, Cherokee set out to develop a better system, and the resulting patent pending device is called the Cirrus Cotton Conditioner.

Our design goals included evenly adding moisture throughout the batt, and tightly controlling the finished bale moisture. We wanted batt compression to reduce the bulkiness of the batt. We also wanted to put all of the moisture right where it's needed. A desire for a minimum of moving parts and maintenance also made the list, and a by pass option is almost always an attractive feature in gin machinery.

The prototype was designed and built in 2006 at Cherokee in Salem, Alabama, and installed at Sandy Ridge Cotton Company in Malden, Missouri. The Sandy Ridge Cotton Company facility includes a state of the art 30+ bale per hour Cherokee gin plant originally installed in 2005 by Roy Owens Construction Company. In addition to the installation of the Cirrus, an expansion was added to the equipment line for 2006 increasing the plant capacity to 45+ bales per hour.

In August of 2006, about ten modules from the 2005 season were ginned to test the expanded equipment line prior to the new ginning season. In mid October, samples were collected for moisture testing. Sandy Ridge went on to gin over 66,000 bales throughout the 2006 crop season.



The machine is designed to fit between the battery condenser and the lint slide, and is made up of two halves. Each half of the machine contains one drum. The lower half is attached to the battery condenser and also forms the top of the lint slide. The upper half is suspended from a pivot point and has a boot-shaped profile. The trajectory of the batt leaving the battery condenser is aimed slightly above the nip point between two counter-rotating drums. Warm, moist air passes from the lower drum through the batt, and excess air leaves the batt through the top drum. Each of the drums is exposed to hot air after releasing the batt to prevent carryover.

Each drum is powered by an independent variable speed gear motor. The doffing roller is chain driven from the opposite end of the upper drum shaft. The pivoting action of the upper half allows for variations in batt thickness. Air cylinders are extended to lift the upper half for easy inspection. These air cylinders also pull the upper half down to create batt compression force between the drums. With the air cylinders unpinned, a hoist can be used to rotate the upper half up and out of the way to by pass the machine.

Looking down into the top of the upper half, the batt can be observed as it leaves the battery condenser and enters the nip point between the drums. The lower half has a sample door which can be used to view the batt leaving the nip point.

The moisture unit was originally installed in 2005 as part of a lint slide louver system supplied by Cimco of Lubbock, Texas. A new lint slide without louvers was installed with the Cirrus for 2006, and the PLC (programmable logic controller) was upgraded in the moisture unit to allow communication with the gin plant

console. A small secondary burner was also installed to supply the hot air to dry the back side of each drum in the Cirrus. Samples taken prior to conditioning came from floor level through an air inlet slot in the lint riser below the battery condenser.

Two different methods were used to measure sample moisture content. The first device was a Strandberg Digital Moisture Meter, model M-400. This meter and calibration instructions were also supplied by Cimco of Lubbock, Texas. The contents of the sample jars were tested using the disc shaped WS-20 probe. The corresponding bales produced when the samples were taken were also tested with the Strandberg unit, but using the double speared SP-20 probe instead. The meter offered results in less than a minute, and a carrying case was included for storage.

The second device used for testing was a Radwag Moisture Analyzer, model WPS 110S. This device was supplied by Data Support Company of Van Nuys, California. The unit has a built-in balance, heat source, thermometer, and programmable controls. This device must be properly leveled and used in a laboratory or office environment. The equipment and procedure used in these tests were adapted from ASTM D 2495-01, Standard Test Method for Moisture in Cotton by Oven-Drying. All samples were stored in air-tight containers, and testing began within 24 hours. The sample basket was constructed from perforated metal with a wire lid. The oven temperature displayed on the front of the unit was observed to maintain 105 degrees C, within plus or minus 1. The oven balance capacity of 110 grams and sensitivity of 0.001 grams exceeded the ASTM requirement, but the sample mass was smaller due to the size of the oven. In order to maintain a desirable sensitivity-to-mass ratio, an effort was made to keep all oven samples above 2 grams.

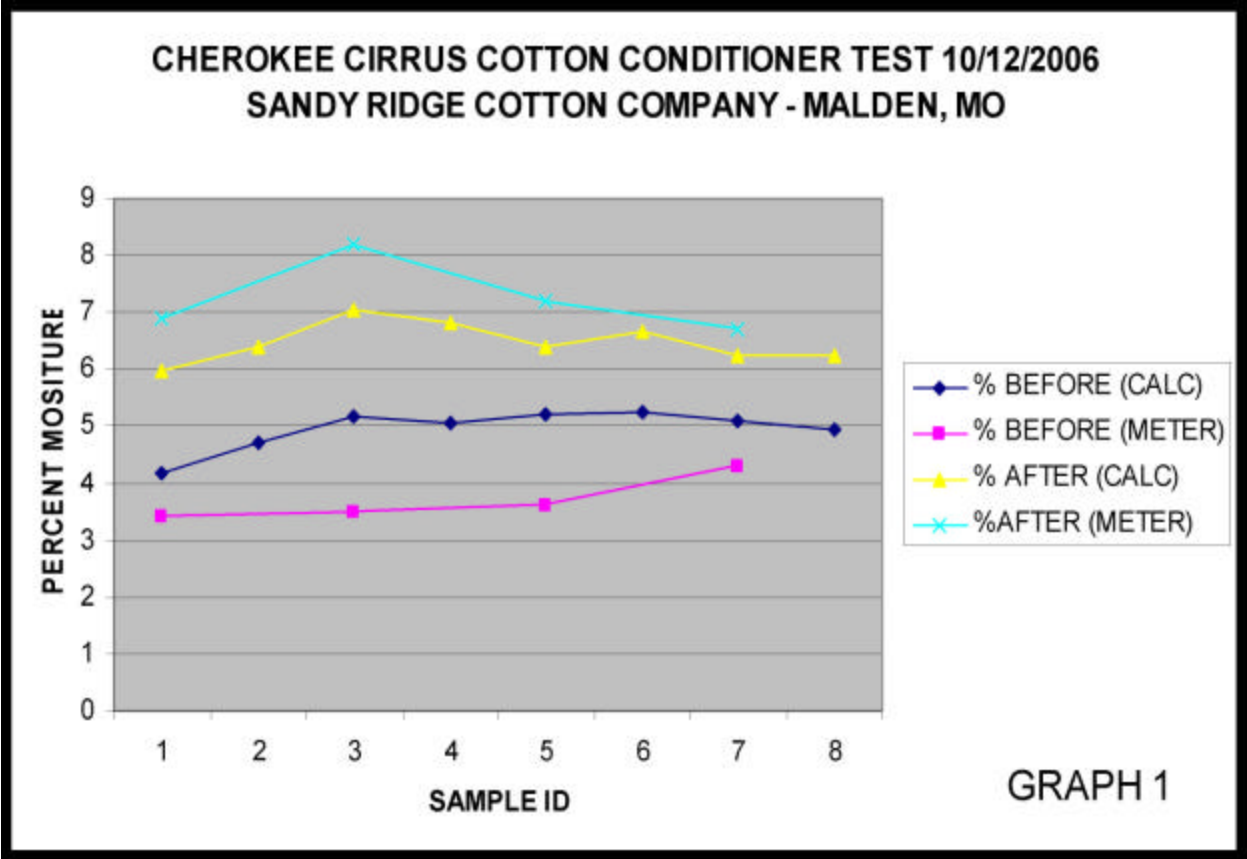
The before and after samples were taken concurrently and immediately sealed in pre-labeled jars. The samples sharing the same sample ID number used in each test method came from the same jar, and were tested at the same time. The first samples were taken on October 12, 2006 at 11:10 AM with an ambient temperature of 51 degrees F and a ginning rate of 38 bales per hour. The second set of samples was taken on October 13, 2006 at 9:45 AM with an ambient temperature of 67 degrees F and a ginning rate of 27 bales per hour. The last set of samples was taken on October 15, 2006 at 4:30 PM with an ambient temperature of 66 degrees F and a ginning rate of 43 bales per hour.

**CHEROKEE CIRRUS COTTON CONDITIONER TEST DATA
(10/12/06) SANDY RIDGE COTTON COMPANY – MALDEN, MO**

BEFORE CIRRUS									AVG	SD
SAMPLE ID (10/12/2006)	1	2	3	4	5	6	7	8		
Start Mass, g	3.651	3.120	2.153	2.715	3.020	2.941	2.626	2.536		
Finish Mass, g	3.498	2.973	2.042	2.578	2.863	2.787	2.492	2.411		
% Moisture (calc)	4.19	4.71	5.16	5.05	5.20	5.24	5.10	4.93	4.95	0.35
% Moisture (meter)	3.4		3.5		3.6		4.3		3.7	0.4
AFTER CIRRUS										
SAMPLE ID (10/12/2006)	1	2	3	4	5	6	7	8		
Start Mass, g	3.584	3.526	3.710	3.342	3.352	2.293	3.485	4.092		
Finish Mass, g	3.370	3.301	3.449	3.114	3.138	2.140	3.268	3.836		
% Moisture (calculated)	5.97	6.38	7.04	6.82	6.38	6.67	6.23	6.26	6.47	0.35
% Moisture (meter)	6.9		8.2		7.2		6.7		7.3	0.7
% Moisture Added (calculated)	1.78	1.67	1.88	1.77	1.18	1.43	1.13	1.33	1.52	0.29
% Moisture Added (meter)	3.5		4.7		3.6		2.4		3.6	0.9

TABLE 1

Table 1 is a listing of the eight samples taken on October 12, 2006. The top of the table shows samples taken before the Cirrus. The middle area shows samples taken after the Cirrus. The bottom section shows totals for the difference between the two, or percent moisture added. As an example, we can look at the figures in the upper left corner below the Sample ID 1 column. The sample mass before drying was 3.651 g, and the mass after drying was 3.498 g. The percent moisture (calculated) is 4.19 percent. Directly below, the moisture content as determined with the meter was 3.4 percent. Meter values were recorded for only every other sample for this date. The average and standard deviation values appear in the columns to the right. The highlighted 1.52 value is the average percent increase per the oven test method. The average increase per the meter was 3.6 percent.



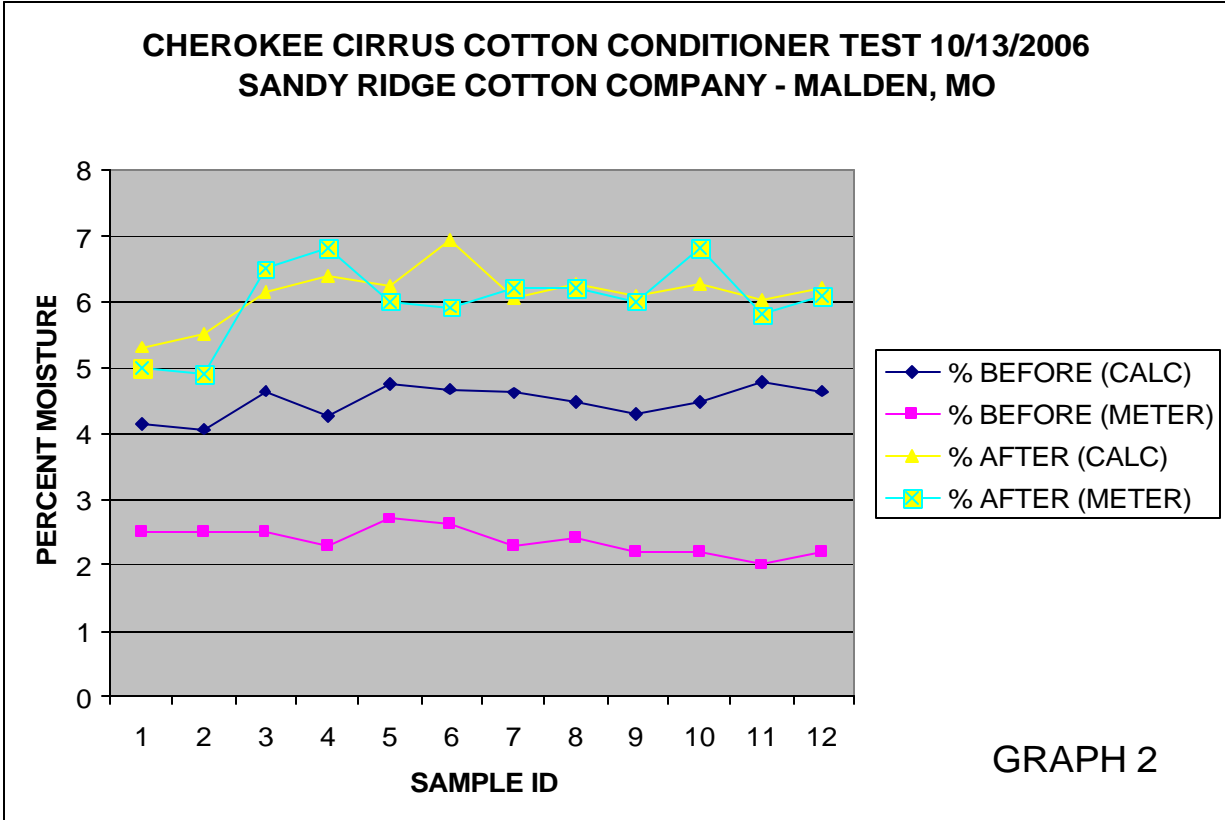
Graph 1 is a representation of each sample from Table 1. The sample identification appears horizontally across the bottom, or X axis. The scale for percent moisture appears vertically to the left, and makes up the Y axis of the chart. The legend on the right shows which colors represent each condition. Dark blue represents the samples before conditioning using the oven balance procedure. Dark pink represents the samples taken from the same jar using the meter. Yellow represents the samples taken after conditioning using the oven balance procedure. Light blue represents the samples taken from the same jar using the meter.

**CHEROKEE CIRRUS COTTON CONDITIONER TEST DATA
(10/13/06) SANDY RIDGE COTTON COMPANY – MALDEN, MO**

BEFORE CIRRUS													AVG	SD
SAMPLE ID (10/13/2006)	1	2	3	4	5	6	7	8	9	10	11	12		
Start Mass, g	2.174	3.124	2.497	2.821	2.403	3.327	2.099	2.060	3.137	2.969	2.222	2.579		
Finish Mass, g	2.084	2.997	2.381	2.701	2.289	3.172	2.002	1.968	3.002	2.837	2.116	2.459		
% Moisture (calc)	4.14	4.07	4.65	4.25	4.74	4.66	4.62	4.47	4.3	4.45	4.77	4.65	4.48	0.24
% Moisture (meter)	2.5	2.5	2.5	2.3	2.7	2.6	2.3	2.4	2.2	2.2	2.0	2.2	2.4	0.2
AFTER CIRRUS														
SAMPLE ID (10/13/2006)	1	2	3	4	5	6	7	8	9	10	11	12		
Start Mass, g	4.041	2.879	3.059	3.503	2.951	2.413	3.506	3.074	3.162	2.989	3.208	2.712		
Finish Mass, g	3.827	2.720	2.871	3.280	2.767	2.246	3.294	2.882	2.969	2.802	3.015	2.544		
% Moisture (calculated)	5.30	5.52	6.15	6.37	6.24	6.92	6.05	6.25	6.10	6.26	6.02	6.19	6.11	0.41
% Moisture (meter)	5.0	4.9	6.5	6.8	6.0	5.9	6.2	6.2	6.0	6.8	5.8	6.1	6.0	0.6
% Moisture Added (calculated)	1.16	1.45	1.50	2.12	1.50	2.26	1.43	1.78	1.80	1.81	1.25	1.54	1.63	0.33
% Moisture Added (meter)	2.5	2.4	4.0	4.5	3.3	3.3	3.9	3.8	3.8	4.6	3.8	3.9	3.7	0.7

TABLE 2

Table 2 is a listing of the twelve samples taken on October 13, 2006. This table is set up like Table 1. The highlighted 1.63 value is the average percent increase per the oven test method. The average increase per the meter was 3.7 percent.



Graph 2 displays values from Table 2, and is set up like the previous chart.

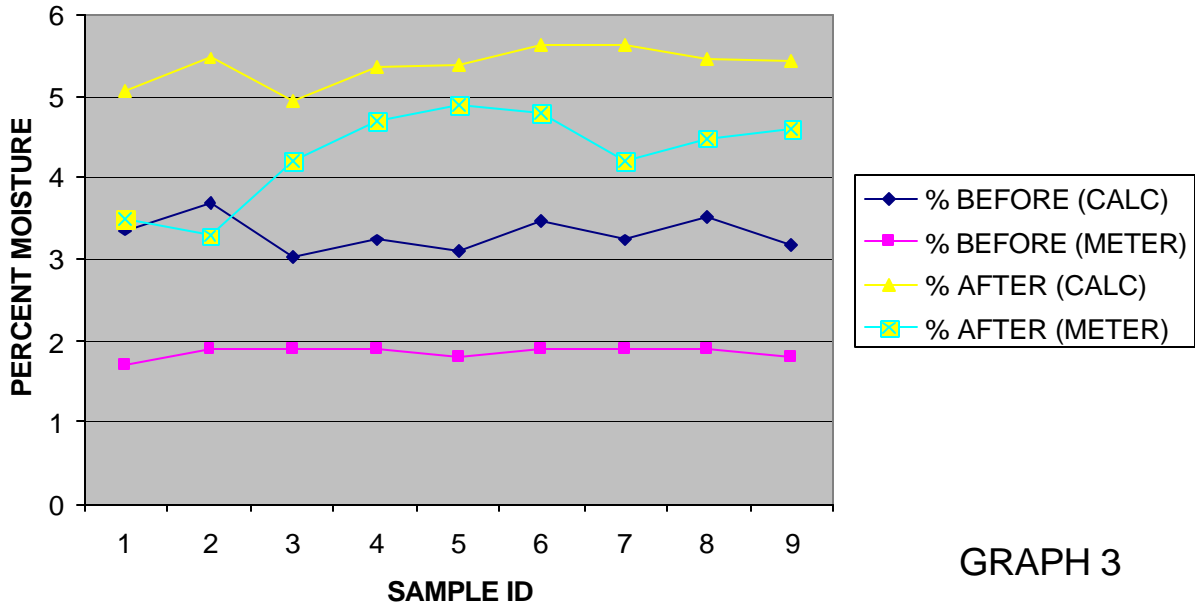
**CHEROKEE CIRRUS COTTON CONDITIONER TEST DATA
(10/15/06) SANDY RIDGE COTTON COMPANY – MALDEN, MO**

BEFORE CIRRUS										AVG	SD
SAMPLE ID (10/15/2006)	1	2	3	4	5	6	7	8	9		
Start Mass, g	2.560	2.512	1.681	3.290	2.938	2.536	2.536	2.716	2.428		
Finish Mass, g	2.474	2.419	1.630	3.183	2.847	2.448	2.454	2.620	2.351		
% Moisture (calc)	3.36	3.7	3.03	3.25	3.1	3.47	3.23	3.53	3.17	3.32	0.22
% Moisture (meter)	1.7	1.9	1.9	1.9	1.8	1.9	1.9	1.9	1.8	1.9	0.1
AFTER CIRRUS											
SAMPLE ID (10/15/2006)	1	2	3	4	5	6	7	8	9		
Start Mass, g	3.183	3.175	3.032	3.527	4.316	3.135	3.125	3.814	2.616		
Finish Mass, g	3.022	3.001	2.882	3.338	4.084	2.958	2.949	3.606	2.474		
% Moisture (calculated)	5.06	5.48	4.95	5.36	5.38	5.65	5.63	5.45	5.43	5.38	0.23
% Moisture (meter)	3.5	3.3	4.2	4.7	4.9	4.8	4.2	4.5	4.6	4.3	0.6
% Moisture Added (calc)	1.70	1.78	1.92	2.11	2.28	2.18	2.40	1.92	2.26	2.06	0.24
% Moisture Added (meter)	1.8	1.4	2.3	2.8	3.1	2.9	2.3	2.6	2.8	2.4	0.6

TABLE 3

Table 3 is a listing of the nine samples taken on October 15, 2006. The highlighted 2.06 value is the average percent increase per the oven test method. The average increase per the meter was 2.4 percent.

**CHEROKEE CIRRUS COTTON CONDITIONER TEST
10/15/2006 SANDY RIDGE COTTON COMPANY**



GRAPH 3

Graph 3 displays values from Table 3, and is set up like previous charts. Generally, there was not great degree of data correlation between the two test methods, and the standard deviation tended to be higher on the values determined with the meter.

SAMPLE DATE	SAMPLE MOISTURE AVERAGE CALCULATED PER OVEN BALANCE	BALE MOISTURE AVERAGE WITH METER
12 OCTOBER 2006	6.47 %	7.1 %
13 OCTOBER 2006	6.11 %	7.2 %
15 OCTOBER 2006	5.38 %	6.7 %

TABLE 4

Table 4 is a comparison of average after conditioning moisture levels for each day. The values in the center column come from oven balance data in Tables 1 to 3. The column on the right is made up of average values from the corresponding bales. The meter and the double speared probe were used to measure the bales. On occasion, the ginner used the same meter to measure bale moisture, and adjusted the moisture unit output on a 0 to 100 percent output scale. His goal was to keep the bale moisture in the 6.5 to 7.5 percent range. The operator interface for the moisture unit was on the same touch screen with all of the burners in the plant. The program written for the moisture unit controlled the burner, water pump, and water tank temperature in the moisture unit. A switch in the lint riser was used to turn on the moisture only when cotton was present.

These test results suggest the Cirrus Cotton Conditioner successfully added over 2 percent moisture under these conditions. There were many instances when significantly more moisture was added, but these were not documented.

The few moving parts in the machine are relatively easy to inspect due to the integral service platform. We suggested that the clean out doors on the rear and bottom of the lower half be opened, and air cylinders extended at the end of each 12 hour shift to inspect and clean out the unit. Some accumulation of lint occurred between inspections, but it was not densely packed. Suggested maintenance also included periodic inspection and lubrication of the bearings.

Sandy Ridge experienced more moisture addition capacity with the Cirrus than with the louver system, even though the same moisture unit was used again. The moisture unit capacity far exceeded the demands made by the Cirrus. Overall, the prototype unit performed well, and very few changes were made in the design for the finished production model. An automatic moisture control system utilizing commercially available components is also currently under development.