Four Strategies for Reducing Energy Costs

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Abstract

Optimizing energy use in modern cotton ginning has gone from a recommended practice to a survival technique. Agriculture as an industry is realizing that profitability is contingent upon the precise use of inputs. From the farm, to the gin, to the various end users, cotton requires embracing technology to provide a quality product at a profitable margin. At the gin, new technology and energy efficient strategies offer savings that have been unavailable in the past. The four focused upon in this paper are fuel savings using SimpleShed Technology, the operating efficiency of the Steamroller System, efficiency gains using the new Moisture Tunnel Technology, and fuel savings features of the Moisture Mirror II.

SimpleShed Technology

Introduction

The Samuel Jackson team has always pursued efficient heater operation through high turn-down ratios and automatic heater temperature control. In December 2005, the engineers at Samuel Jackson created another tool that can further increase fuel savings. The tool is called SimpleShed and is available on all 14-Series Samuel Jackson Heaters when used with a Moisture Mirror II. The premise behind SimpleShed is that many times cotton can be ginned with one or more heaters turned off, which of course saves fuel. In the past, ginning with the heaters turned off could be a risky proposition because of sudden changes in cotton, leading many ginners to avoid this practice. SimpleShed alleviates that risk by allowing the user to define the cotton conditions for your heaters to turn off and on and automatically monitoring the incoming cotton. In dry conditions, SimpleShed can considerably reduce fuel consumption and preserve quality by not exposing fiber to unnecessary and harmful excessive temperatures.

How does it work?

SimpleShed Technology is made possible by the close interaction and communication between the heater and the Moisture Mirror II. The Mirror II is used for automatic heater temperature control, but it also serves as a remote for all 14-Series products. This allows a gin to use one touch screen for all its moisture control needs. There are only two parameters required to customize SimpleShed for your operation. The first parameter is the Incoming Moisture Threshold, which defines the incoming moisture content at which the heater flames will be turned off or on. The second parameter is the SimpleShed Time Delay, which sets how long the actual moisture must be below the Incoming Moisture Threshold before the heater turns off. These two parameters work together to determine when the heater should be turned off, which is known as shedding. Anytime the actual moisture exceeds the Threshold, the heater is immediately sent a signal to relight, which normally occurs within a few seconds. The following table illustrates the relationship between the SimpleShed parameters and the heater's status.

Table 1.

Actual Incoming Moisture	Time Delay	Heater Status
> Threshold	N/A	ON
< Threshold	Time Delay Not Expired	ON
< Threshold	Time Delay Expired	OFF (Standby Mode)

How does it relight so fast?

Experienced Sam Jackson heater operators are accustom to waiting a period of thirty to forty-five seconds for their heater to light. This delay is due to exhaustive safety checks performed by the heater before ignition can occur. These checks ensure the safe and reliable operation of the heater. When using SimpleShed, the heater's initial diagnostic sequence does not change. This would jeopardize the safe operation of the heater. The key to seamlessly lighting and turning off a heater based on incoming moisture is Standby Mode. Standby Mode is the status of the heater when has been lit, then turned off, and is monitoring the system with no established flame. Since the system is being constantly monitored, it can quickly light when prompted by the Moisture Mirror II. As long as adequate airflow is maintained, the heater will quickly and reliably relight in three to five seconds of moisture rising above the Threshold.

Field notes

The 2006 season was the first widespread distribution of the SimpleShed Technology. The 14-Series Heaters have been available since 2004, so there were many gins that already owned the required equipment and only needed to perform a simple software upgrade to take advantage of this powerful feature. Both the heater and Moisture Mirror II need to be updated for SimpleShed to be used. The software is available free of charge on Samuel Jackson's website. The software is in a PLC Updater format that is easy to use and requires no special computer software. Any person with the proper cables (supplied with the equipment) and a laptop computer can easily make the upgrade.

The team at Samuel Jackson learned many things about SimpleShed during the 2006 season. It can be a very useful tool for saving fuel, but is obviously more effective in dry conditions. When conditions are extremely wet, it is recommended that SimpleShed be disabled until conditions are available that facilitate its use. Disabling and enabling SimpleShed can easily be done with the push of a button on the Moisture Mirror II screen. The enable/disable feature was designed for easy access because cotton conditions can change rapidly and the user needs the ability to make rapid changes as well.

A strategy that gins found particularly effective in 2006 was using SimpleShed to stage heaters to light at different incoming moisture thresholds. A great example is the way SimpleShed was used at Monette Coop in Monette, AR. Monette has three stages of drying. They have three Samuel Jackson 14-Series 8-Million Btu Heaters. They usually have the first stage heater set to shed at six-percent incoming moisture. This allows the number one heater to warm the gin unless conditions get extremely dry. Their second stage 8-Million is set to shed at ten-percent, so as cotton moisture increases to ten-percent and above the second heater will light. Their third 8-Million is set to shed at fourteen-percent. Anytime that one of their heaters is below its threshold, it remains in Standby until it is prompted to quickly light.

By the numbers

SimpleShed Technology was first installed at Idalou Coop Gin in Idalou, TX on December 30, 2005. Idalou has a Collider Drying System with two - 8-million Btu Heaters that utilize the Moisture Mirror II to automatically set their temperatures. In January 2006, Idalou Coop used twenty-six percent less cubic feet of natural gas than the previous month when the heaters did not have SimpleShed. The months of December 2005 and January 2006 had very similar climatic conditions. There was no rainfall in either month and the average temperature was six degrees difference between the two months. Idalou ginned a near identical bale count for the two months, so operating time was not a factor. The fuel savings are attributed to the only change that was made in the gin, installing SimpleShed on their heaters.

Operating Efficiency of the Steamroller Lint Conditioner

Introduction

Introduced in 1996, the Steamroller has a well established reputation for effectively restoring moisture to lint in a wide range of conditions. However, many people are surprised to learn that the most powerful lint moisture applicator is also the most fuel efficient. It is important to understand that different moist air applicators using the same model of humid air generator will have very different levels of fuel consumption. This measurable difference comes back to the air volume that each applicator requires to operate effectively.

Air volume

There are currently three proven humid air applicators available on the market today. Each has its own air volume requirements for effective operation. The Steamroller requires 2,400 CFM, the moisture condenser requires 3,500 CFM, and the Lint Slide Grid requires approximately 2,000 CFM (depending on lint slide length). Samuel Jackson does not manufacture a moisture condenser, but has supplied many Humidaire Units over the years for moisture condenser installations. It is this experience coupled with our testing of Humidaire Units at different air volumes that allows us to accurately compare the efficiency of different applicators. The reason that air volume is critical in determining applicator efficiency is that it directly correlates to Btu usage. More air requires more heat units or Btus to heat up that air and therefore uses more fuel. In our experience in testing Humidaire Units, we have found the relationship between air volume and Btu consumption to be very close to linear.

Moisture Restoration Effectiveness

When comparing the efficiency of moist air applicators, the second key variable of comparison cannot be left out. The second variable is how much moisture each applicator can effectively restore to lint. Typical results are twenty pounds per bale for a Steamroller, ten pounds per bale for a moisture condenser, and eight pounds per bale using a Lint Slide Grid. These moisture restoration numbers come from our experience with hundreds of Humidaire Units being set up on a variety of applicator types. These values are also supported by customers that use a Samuel Jackson Humidaire Units, but may use another type of applicator.

Efficiency Comparison

The air volumes for each applicator are easy to compare. The Steamroller requires about twenty percent more air volume than the Lint Slide Grid and the moisture condenser requires about fifty percent more air than the Steamroller. The direct correlation between air volume and Btu consumption tells us that the moisture-type condenser uses the most fuel, the Steamroller places second, and the Lint Slide Grid is last. When looking at the values for moisture restoration, the moisture condenser restores twenty-five percent more than the Lint Slide Grid and the Steamroller restores one-hundred percent more than the moisture condenser. These comparisons easily show that the Steamroller is the most effective and energy efficient moist air applicator.

The comparison of moist air applicators is illustrated by the following table, which is based on a typical 40 BPH gin using natural gas at $1.29 per therm.

Table 2.

Applicator	Typical Moist Air Volume (CFM)	Typical Maximum Moisture Restoration Capability (pounds per bale)	Typical Energy Consumed in a 40 BPH Gin. (Btu per pound of moisture)
Lint Slide Grid	2,000	8	3,125 (4 cents per pound)
Moisture Condenser	3,500	10	5,000 (6.4 cents per pound)
Steamroller	2,400	20	1,625 (2 cents per pound)

Moisture Tunnel Technology

Introduction

Until recently, Samuel Jackson Humidaire Units have used the same thermodynamic design for decades. Improvements have been made to other aspects of the product that include updating controls, gas train, purge system, diagnostics, etc. These changes have created a better product, but the interaction of air, fire, and water has remained the same. The previous Humidaire models have a deflector sheet separating the hot air from the water. This design worked well for many years, but it also limited the maximum output of the unit to two gallons of humid air per minute. This output was adequate when gin capacities were lower, but many gins have reached a point where their needs for moisture restoration are much greater. Faster and drier ginning conditions have led to the invention of Moisture Tunnel Technology found on both the Humidaire Southwest and the Southwest Lite.

Humidaire Southwest Lite and The Southwest

The Southwest Lite was introduced to the Samuel Jackson product line in August 2006. It will replace the HU-60-1455 Classic Humidaire Unit because of its increased output and more efficient operation. The Southwest Lite will evaporate fifty percent more moisture than the 1455 model and do so with ten percent more fuel efficiency. It features Moisture Tunnel Technology and does not need the air deflector sheet used in the previous models of Humidaire Units. Removing the deflector sheet and changing the nozzle arrangement, so that the flame is directly interacting with the water increases the output and the efficiency of the unit. In addition to a higher maximum output, the units with Moisture Tunnel Technology can be operated with a wider temperature differential between air and water. This means its output can be turned down even lower than previous models. This is a particularly important feature for moisture condenser users with installations susceptible to screen hairing problems.

Moisture Tunnel Technology was carried over from the design of the Humidaire Southwest. The Southwest is designed for extreme conditions such as very dry environments and ginning capacities above sixty bales per hour. There are only a small percentage of gins that require the moisture restoration capacity of a Southwest, but for those that do it can be a tremendous asset. It is capable of evaporating four gallons of moisture per minute. Even with one hundred percent better output than the HU-60-1455, the Southwest remains ten percent more fuel efficient. The increase in output and efficiency can be credited to the Moisture Tunnel Technology. See Table 3 below that compares the efficiencies of the three different models of gas-fired Humidaires.

Table 3.

Model	Max Air Volume (CFM)	Max Fuel Consumption (gallons / hour)	Heating Efficiency (Btu / pound of water)	Max Evaporation (gallons / minute)
HU-60-1455	4,000	17.8	1000	2
Southwest Lite	4,000	23.7	900	3
Southwest	5,000	29.7	900	4

Moisture Mirror Technology

Introduction

No discussion about cotton gin efficiency strategies can be complete without taking a moment to talk about the Moisture Mirror product line. The Mirror product line is always evolving and has brought us to field-testing the Mirror III, just five years after the first Moisture Mirror was introduced in 2001. Samuel Jackson engineers can thank the customers who would not settle for just having automatic temperature control and expressed their gins needs to develop the product people see today. Between the three Moisture Mirror models and numerous combinations of sensors and options, an entire paper could be written just about the Mirror product line. This paper will focus on the efficiency features of the Moisture Mirror II that some people may have missed. These will include the Auto-Drying Index, the Auto-Idle feature, and Heater Banks.

Auto-Drying Index

Introduced in 2001, the Moisture Mirror I automatically controls a gin's heater temperatures based upon two factors: the incoming moisture of seed cotton and the Mirror's Drying-Index. The drying-index is a color-coded temperature bar adjusted by the Mirror's user to fine tune the automatic control. The ability to make adjustments is critical because different ginstands are most effective at different levels of fiber moisture. The drying-index allows the Moisture Mirror to adapt to many different ginning environments and styles.

Many gins have a sensor above their extractor-feeder or in the overflow to monitor ginstand moisture. On the Mirror I, the user manually adjusts the drying-index based upon this sensor's reading. In an example of customer ingenuity improving the Samuel Jackson product line, the development of the Auto-Drying Index feature further automates the Mirror's automatic temperature control. Only available on the Moisture Mirror II and III, the Auto-Drying Index allows the user to enter a target for the after-drying moisture. The Mirror II and III automatically adjust the drying index based upon the target set by the user compared to the actual reading at the after-drying sensor. If wet cotton suddenly comes into the gin, the auto-drying index is overridden and the heaters are turned up rapidly. This feature allows a ginner to run optimal heat without concern over cotton moisture rising too high and causing a choke. Running optimal heat means optimal fuel consumption which equals substantial fuel savings.

Auto-Idle Feature

The Auto-Idle feature is available to any gin with a Moisture Mirror II and heaters that will accept a 4-20mA signal. The Mirror II uses a Flow Analyzer to monitor cotton flow through the gin. Cotton flow is derived from the motor load on the module feeder and the inclined cleaners. The flow is visually represented by a bar graph on the Mirror screen. When cotton flow stops, the Flow Analyzer signal back to the Mirror is reduced. The Mirror user can define the reduced signal level and period of time required to idle the heaters. When the flow signal reaches the specified level for a user-specified period of time, the heater will be sent a signal to idle. As soon as cotton flow resumes, the heaters return to their previous status. This feature allows gins to make their downtime as efficient as possible.

Heater Banks

Heater Banks are an often overlooked, but very helpful feature of the Moisture Mirror II. With the Mirror I, the same signal is sent to all connected heaters. Ginners began asking about running different stages of heat at different automatic levels. Heater banks allow the user to set a percentage of the set point for individual heaters. One hundred percent is the base, so if a user wants to set his heat in the second stage a little cooler, he might set it at seventy-five percent. This feature is available without Samuel Jackson heaters, but coupled with SimpleShed allows a user to create a very fine tuned recipe for temperature control. This level of control equals additional fuel savings and more effective drying for the user that takes advantage.

Conclusion

Modern cotton gins are experiencing a new set of challenges related to profitability. Successful gins are meeting those challenges with the use of technology. There are so many tools available that cannot be ignored if gins want to compete in the world market. In the United States, the number of gins is fading while cotton acres are increasing. Many times this is not due to mergers, but rather there are gins that refuse to embrace the technology required to profitably operate. The technology in this paper addresses energy consumption. This topic is especially important because it is one of the largest expenses in a cotton gin and it reoccurs every day that the gin is in operation. While there are initial investments in new equipment, a reduction in energy usage has a return on investment that never stops.