IR TEMPERATURE SENSORS FOR ROLLER AND SAW GIN STAND CONTROL

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Abstract

Gin stand saws (in a saw stand) and gin stand rollers (in a roller stand) are prone to overheating. Running a high temperature will shorten their operating life and may cause fires. Some ginning conditions, such as wads tangled at the saws, may cause the machine to overload and chock. Temperature measurements of the rotating saws is one method to detecting such condition. IR temperature sensor is uniquely suitable to measuring surface temperature remotely without contact with the saws or the rollers. A battery of IR sensors was designed and built to monitor the temperature of a gin stand roller in a Pima gin. The IR sensors monitor the temperature across the roller and warns the operator when the temperature overshoots a predetermined set point. Furthermore, the system can idle the gin stand when the temperature surpasses a critical point. By doing so, it prevents the destruction of the roller and reduces the possibility of igniting a fire in the gin.

Introduction

Gin stand rollers (in a roller stand) are subject to friction caused by the constant contact of the stand stationary knife. Misalignment of the knife and sticky fibers often causes rise in temperature at one or more location of the rotating roller. Temperatures in the range of 150 to 200 deg F are normal operating conditions of such rollers and would normally not constitute a fire hazard nor would it cause a rapid deterioration/disintegration of the roller. Temperatures of 250 deg F and higher, will char the rollers and accelerate their depreciation. A roller is made of layers of fabric like material and is usable for a limited amount of processed seed cotton under normal operating conditions. These higher temperatures will reduce the usable life of the roller by as much as 50% or more. Higher temperatures may ignite the lint and cause fires in the entire conveying system.

IR temperature sensor is uniquely suitable to measuring surface temperature remotely without contact with the saws or the rollers. The sensors absorb radiated energy in the form of IR rays and calculates the remote average temperature of the object. The deployment of a bank of sensors provides a means of measuring the temperature of the roller and controlling it to a set point.

System Description and Operation

The system consists of multiple IR temperature sensors (Figure1), a Central Processing Unit (CPU), a touch screen display (Figure 4), which also provides for user entry of system parameters. The CPU is also equipped with control output ports, which can stop the operation of the stand (stop the feed and disengage the knife).

Multiple IR sensors mounted along the roller (Figure 2), monitors the temperature of the stand roller, transmitting the readings to the Central Processing Unit. The data is displayed on the display screen. Temperature threshold specify the condition under which the gin stand would stop its operation, thus allowing the roller to cool down. During operation, the CPU compares the actual temperatures detected by the IR sensors to the specified threshold points.

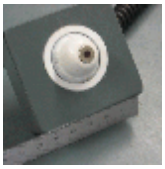

Figure 1. IR Temperature

Figure 2. IR sensor mounting configuration in roller gin.

Temperature Footprint

The IR sensor is a bell shape temperature signature. In a typical structure, a 40 deg view, the sensor will cover an area of a diameter which is about same as its distance from the object. In the roller stand application, a distance of 10" will result in about 10" diameter of coverage. Additionally, about 5% of the detection periphery will include surfaces outside the circle of view. This will result in reduction of the overall temperature as such areas will fall outside the roller, thus will have a lower temperature. A compromise between the number of sensors used for the application and the accuracy of the overall measurement should be considered when designing the layout of the system components. Figure 3 present the coverage area of the roller with four sensors used for temperature monitoring.

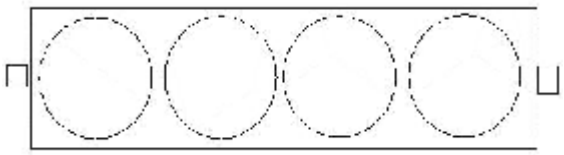

Figure 3. Temperature area coverage of the roller using a 4 sensor assembly; 3db line presented.

Figure 4; System touch screen display.

Operational Results

With the roller temperature fully monitored and the stand operation under control of the system CPU, the temperature of the roller were tightly controlled and did not rise above the set point set by the operator/manger in the installed gins stands. Reduction of roller replacement and the incident of fires were reduced in comparison to prior years. (The fires are random and are caused by numerous events, some of which relate to the high temperature at the gin roller).

Summary

IR temperature sensor and control system was presented as a means of curtailing a rise in roller temperature, thus enhancing the performance (life) of the roller while reducing fire incidents.