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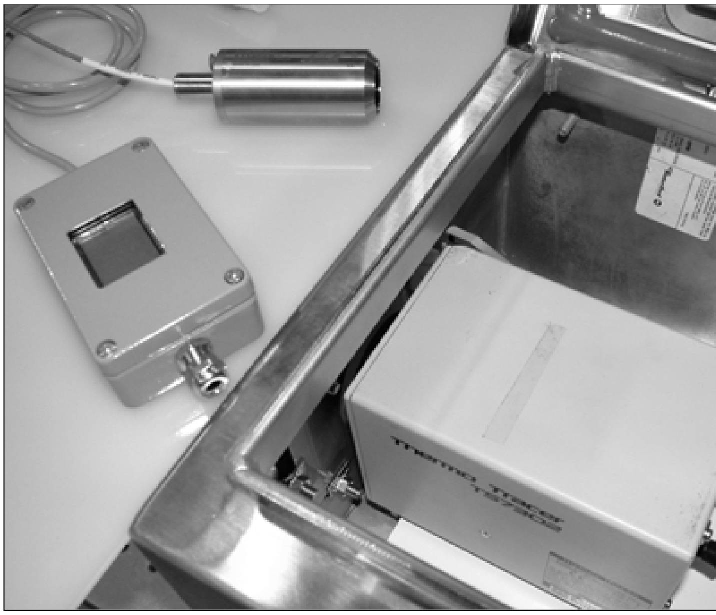
Non-Contact Temperature Monitoring in Poultry Processing

By John Stewart

Non-contact temperature measurement has many applications in poultry processing. For example, such devices can be employed to measure the surface temperature of birds leaving the scalder for a quick determination of overscalding. Similar applications exist for birds in a chilling process. Another important application is to monitor product entering and leaving a cooking process to determine that it was cooked properly.



Infrared cameras and point sensors, like these from Exergen and Mikron, commonly used in non-contact temperature monitoring.

Point sensors and cameras that can measure temperature are relatively inexpensive and available from many different vendors. Properly applied, the sensors can provide accurate temperature measurements to 1 or 2 ¾C and identify trends in temperature variation down ¾C. While the operation of these devices is simple, deploying them in a production environ can be tricky. This article addresses some of the issues with deployment.

All surfaces emit radiation when they are heated above absolute zero (-273 ¾C). As the sur heats, it emits more radiation and emits at shorter wavelengths. For processing temperature between 0 and 100 ¾C, objects emit infrared radiation, and devices that measure temperatu this range typically are sensitive to infrared radiation between 6 and 12 mm. Devices that li responsive band to wavelengths between 8 and 12 mm are less affected by water vapor.

Not all surfaces emit radiation as well as others. Emissivity, e, is a measure of radiation emi efficiency. An object with an e of 1 is a perfect emitter called a black body. Most objects hav of less than 1. For example, typical food objects have an e between 0.6 and 0.95 for wavele between 8 and 12 mm. One challenge of measuring temperature with non-contact devices is knowing the emissivity of the sample, which can change with temperature and other process variables.

Another pitfall to avoid with non-contact sensors is reflections from other hot surfaces. The radiation leaving a surface is a combination of self-emitted radiation and reflected radiation other surfaces. The reflectance of a surface is related to emissivity through the following equ r = 1 – e, so objects with high emissivity are not very reflective. Even though food objects a very reflective, placing an inspection station near bright infrared sources like the mouth of a can corrupt measurements.

Measuring the temperature of individual products on a moving production line can be difficu because sensors often have a slow temporal response and typically have a large measureme area. Typical point sensors need one-tenth of a second to measure temperature. For shackle moving at 180 birds per second with 6-inch centers on the shackles, one-tenth of a second e to 1.6 inches. In addition to the size needed to accommodate product movement, the point s typically have a large measurement area. Many devices ship with a 1:1 spot size. In a 1:1 configuration, the diameter of the measurement area will be the same as the distance to the being measured. In many processing applications, it is necessary to place the device several or more from the product to ensure it remains a non-contact device.

Optics can be added to the devices to change them to a 10:1 configuration or even higher ra However, even with optics, the minimum spot size is typically about an inch. When purchasi devices with optics, choose plastic lenses that are safe and capable of handling the sanitary environment on the processing line. Another important option to consider is an air purge sys for a point sensor. An air purge jacket can help protect the sensor from water encroachment can help keep the lens clean. In a production environment, a dirty lens can cause large erro measurement. The air purge system can also help to keep a stream of clean air between the and the target object. Some non-contact sensors are quite sensitive to water vapor and a cle stream between the sensor and the product can help reduce errors due to transmission thro clouds of steam rising from the product.

For applications that require temperature measurement of small features or many samples o product spanning the width of a belt, an infrared camera may be a better choice. Micro-bolor cameras typically use arrays of Vanadium oxide sensors, which are built with a micro-machi process. Current commercial offerings include 320x240 or smaller arrays and can measure a temperature in about a hundredth of a second. Ethernet or IEEE 1394 interfaces and softwa development kits make it relatively easy to interface the cameras into a real-time productio environment. Unlike more expensive cooled cameras, micro-bolometer cameras use little po and do not require expensive maintenance. All cameras, however, require an external enclo protect them from processing environmental conditions.

As true with any measurement device, an important part of adding non-contact temperature measurement sensors is adding a calibration procedure for the device. Calibration sources a commercially available, and sensors should be checked against calibration sources often to e they are operating properly as part of a routine calibration schedule.

Vendors in this field are an excellent source of application information. Mikron, Exergen, Om IRCon, Raytek, and Flir Systems all sell non-contact temperature measurement devices desi for industrial inspection.

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