Campbell's

PHASE IV ENGINEERING INC.

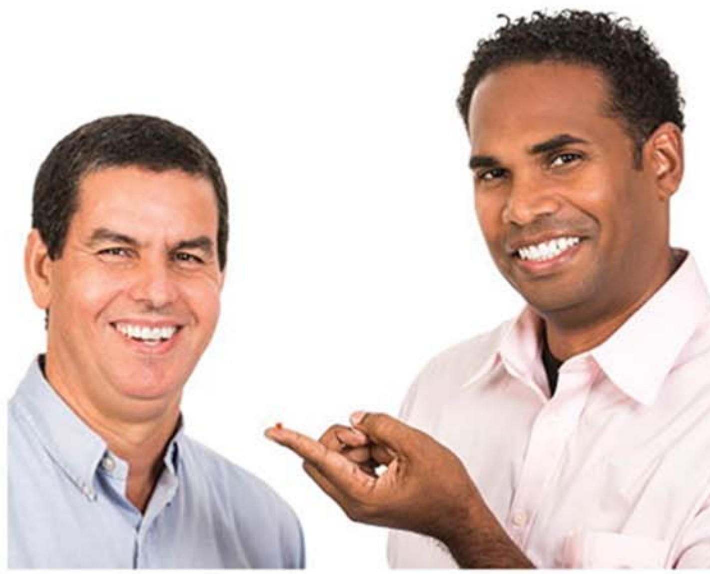
FoodEngineering Magazine

The fantastic voyage of a temperature probe

Best way to measure the internal process temperature of a cooking stage: Send an RFID probe through the process piping!

Measuring the internal temperature or the doneness of any product as it travels through a continuous cooking system is not an easy task. But if you're designing a new and innovative, garnished soup, knowing the temperature of, for example, potato or meat chunks at any given location in the process is an absolute must. While humans can't navigate a 270°F cooking process like the miniaturized submarine navigated a human circulatory system in the film, "Fantastic Voyage," there must be another way. Why not send a surrogate—a robotic-like temperature probe—through the process that could radio its temperature to outside equipment? And why not make the probe with a mass consistent with the chunks to be cooked?

Mohammed Karkache and Rasheed Mohammed, both senior program managers in Campbell's process research & development team and science & technology organization, saw the challenge and rose to the occasion. Together, they realized it should be possible to create a temperature probe small enough to travel through the process piping, yet equipped with an RFID system that could relay temperature readings in the process to an external data collection system. After all, they reasoned, if RFID pressure sensors can detect under-pressure levels in tires and relay the information to drivers or pilots, why couldn't they do the same with internal temperatures?



"You can measure the temperature of a liquid on the processing line by just putting a conventional probe in the product and capturing the information," says Mohammed Karkache. "But during the product development process for an aseptic garnished soup, the FDA also wants to know the temperature at the core cold-spot of the fast-moving particulates, such as the chunks of meat or potatoes or vegetables that are in the liquid. Our newly patented technology gives us a unique tool to do just that. Though the tool was developed for aseptic processing, it can be applied to other manufacturing methods as well. It also has the potential to improve products and processes."

"And we are not limited to temperature measurement," adds Rasheed Mohammed. "For example, we could use it to measure line pressures and to investigate the ways to improve our mixing processes when blending our soups."

Finding a partner that could provide an RFID temperature probe small enough to swim through the process piping was one challenge, but process conditions presented another. "We teamed up with ***Phase IV Engineering in Boulder, CO*** to develop a viable device that would survive the 270°F temperatures of an aseptic environment,"

PARTNERING WITH INDUSTRY INSIDERS -

DELIVERING INNOVATIVE SOLUTIONS.

PHASE IV ENGINEERING, INC. | 2820 WILDERNESS PLACE, UNIT C | BOULDER, CO 80301
1-866-608-6168 OR 303-443-6611 | SALES@PHASEIVENGR.COM | WWW.PHASEIVENGR.COM

says Rasheed Mohammed.

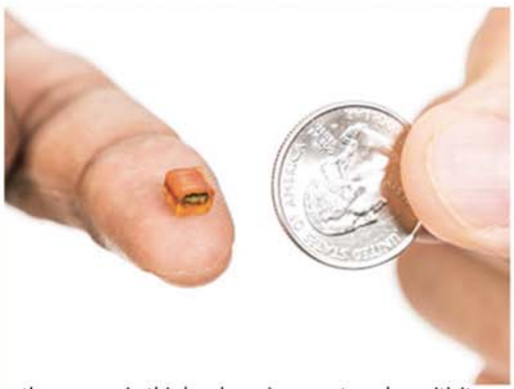
The resulting tool from their efforts: a roughly 5-mm cube that is injected into a particulate before entering the aseptic processing line in the pilot plant. As the food chunk progresses through the system to be heated, units outside the line capture the temperature data. “We would use this in the pilot plant at World Headquarters to develop and validate a process for a new product,” says Rasheed Mohammed. “The data would support documentation for FDA approval to put the product into the market.” The tool is not used in commercial manufacturing, so there is never a risk of the RFID tool entering the market.

FE: What are the central challenges to improving aseptically manufactured liquid products with particulates that microbiological methods have been unable to overcome?

Rasheed Mohammed: Radio frequency identification technology (RFID) gives you a direct measurement in real time on how your heat exchanger is performing during the validation or optimization studies to enable a thermal process to achieve the best product quality. Similar tests using microbiological methods would be complex, expensive and time consuming and would not yield detailed insight into the performance of the equipment.

FE: How does RFID compare to microbiological methods for validating aseptic processes of high-garnish soups?

R. Mohammed: RFID offers real-time data of the particulates as they are moving in an aseptic process. Once installed, the system can record data as fast as you can launch the samples, and therefore, a complete set of tests can be completed in a matter of hours. Microbiological methods can take weeks or more to prepare the samples and another a month or more to complete incubation periods. Proper handling and disposal of the samples is also a consideration. RFID can finally replace bio-validation if accepted by the FDA.



FE: How is RFID data collection more efficient?

R. Mohammed: One can measure and record a statistically significant data set within a short period of time using multiple sensors. The collected process data from RFID will be further applied to validate the computer model as an aseptic process development tool.

FE: What changes to the process equipment are required to implement the RFID method?

R. Mohammed: A launching system to inject the RFID-embedded particulates; several sections of non-metallic, high-pressure/temperature piping where the RFID drive coil and receive antenna are housed; and a PLC or laptop computer running custom software.

FE: What were the main obstacles facing the development of the RFID?

R. Mohammed: The main technical obstacles were the size of the sensors, the overall performance of the sensors in this harsh environment, and sensitivity and repeatability of the drive coil and receive antenna during early development.

FE: Does RFID help manufacturers better understand the rheology of the particulate?

R. Mohammed: The rheology of the product influences the velocity profile of the liquid and the particulates in that liquid as they flow in a pipe. The RFID measurements can be plotted and analyzed for residence time distribution, which yields how fast or slow the particulates are moving. This impacts the thermal process by indicating the actual time spent in the heat, hold and cooling zones.

FE: Will RFID be used in conjunction with a probe that measures the temperature of the liquid?

R. Mohammed: Yes. At each sensor location, a corresponding temperature probe is used to measure, record and compare the temperature difference of the liquid and particulates. This can be used to understand how fast the particulates are conducting heat from the liquid to the center of the particle.

FE: How do the characteristics of the particulate change when the RFID is inserted?

R. Mohammed: A tool is used to bore a hole into the particulate where the RFID sensor is inserted. The hole is then filled with material to maintain similar physical properties of the particulate. The density and heating characteristics of the particles are not significantly changed.

FE: What device measures and collects the RFID data?

R. Mohammed: The drive coil and receive antenna are in a single housing. There are several housings placed at strategic locations along the length of the heat exchanger, hold tube and cooling sections. The receive antenna then relays the signal to a PLC or laptop computer.

Reprinted with permission from Food Engineering Magazine   Flyer number: 61-100052-00 rev1_0