Chill-On Develops Prototype RFID-Enabled Time-Temperature Indicator

The European consortium's goal is to enable companies to remotely monitor the shelf life of refrigerated goods based on temperature exposure during shipment.

By Rhea Wessel

Nov. 15, 2007—A group of partners in an E.U.-backed project known as Chill-On has designed an electronic component that makes it possible to connect time-temperature indicators (TTI) to RFID transponders. The prototype component is the first step in long-term efforts to design a TTI that can be attached directly to an RFID transponder. Once refined, the prototype component should enable cold-chain participants to remotely monitor the shelf lifes of goods based on temperature exposure during shipment.

TTIs work with color-forming, proton-transfer crystals activated by ultraviolet radiation. Depending on the temperatures of its surroundings and the amount of time it has been exposed to those temperatures, a TTI changes colors, enabling a worker to determine if a product has been subjected to improper temperatures. The Chill-On consortium has also developed a TTI utilizing both color changes and an electrical signal to express temperature history. The prototype component can transfer that electrical signal and the temperature information from the TTI to an active RFID tag. Eventually, researchers hope to use the component on passive tags as well.

Upon interrogation of the tag, the temperature information is sent, together with the tag's unique ID, to the reader. This allows cold-chain participants to calculate the remaining shelf life of specific goods, based on the temperature information.

The Chill-On project is currently working to develop a way to monitor food constantly as it is shipped, whether chilled or frozen. Work is divided into seven work packages (WP): WP 1—Risk Assessment and Socio Economic Studies; WP 2—Biosensors for Low-Temperature Microorganisms; WP 3—Chilled Transport and Storage—Supporting Technologies; WP 4—Chain Information Management System; WP 5—Integration and Validation—Field Trials; WP 6—Training, Education and Dissemination; and WP 7—Management and Coordination. The RFID-related research falls under the Chain Information Management System package. The partners have declined to provide further details regarding how the prototype component works, but indicate it is presently too large to be integrated with an RFID transponder, such as a smart label for use on food.

"The main limitation within the food industry is the pricing," says Mark Lohmann, project manager for the Technology Transfer Center (TTZ) in Bremerhaven, Germany, the institute managing the Chill-On project. "Currently used RFID smart labels cost 5 euro cents [$0.07], and the forecast is that these costs will be reduced to 1 cent for bulk packaging by 2010."

If project members succeed in reducing the size of the component and adapting it to passive RFID technology, Lohmann says, the device could be used widely within the food supply chain and, thus, dramatically lower the

cost of using temperature sensors in combination with RFID. Standard TTI labels are currently available for only a few cents apiece.

According to Lohmann, project members are working to determine which types of TTIs and RFID tags work best together. Since the component will be used in sub-zero temperatures, the battery for active RFID tags is being optimized.

The RFID-focused research and integration work of Chill-on is being led by two of the consortium's 27 partners: ActValue Consulting, an Italian technology and solutions provider, and Freshpoint, a Swiss TTI developer. The total budget for the four-year project, which began in 2006, is €15.6 million ($22.8 million), including €10.1 million ($14.8 million) from the European Commission.

Partners are still in the beginning stages of designing the system, though Lohmann says the final version will most likely include RFID interrogators mounted inside the backs of trucks or ships. The tag on a pallet of fish, for example, would report temperature information at regular intervals. The readers would transmit all information collected—that is, the temperature data and the pallet tag's unique ID—via GSM and the Internet, to a database run by the logistics partner. The database will include additional information, such as a method for performing microbiological analysis of the transported food. Based on the time and temperature information collected via RFID, for instance, the system could calculate the fish's remaining shelf life.

Lohmann says the TTI-RFID tags the group is trying to develop will most likely employ passive tags operating at 13.56 MHz, though initial tests might utilize a few RFID tags that operate at 2.45 GHz. "RFID helps to speed up this entire process," Lohmann says. "You have the opportunity to monitor food, not just check it periodically. Monitoring can be done at any time."

RELATED_ARTICLES The partners are not required to develop a commercial product as a result of the project. Still, since the project members are in business to make money, they are eager to produce something that can be sold, Lohmann says, adding, "The first goal is to show what is possible, and to help develop standards."

The mission of the Chill-On project was specified by the European Union as part of the Framework 6 Research Program, and TTZ offered the winning proposal. The world's second largest market for frozen and chilled products (behind the United States), the European Union initiated the research due to concerns regarding food safety and the lack of an integrated solution for the cold chain, particularly for cross-border shipments. Some 70 percent of food produced in the European Union is traded across its internal borders.