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Resin Supplier Uses RFID to Perfect the Curing Process

Reichhold helps a fiberglass pipe manufacturer improve production, saving time and money.

By Michael Belfiore

Tags: Manufacturing, Supply Chain

Feb 28, 2016—The Reichhold Group, based in Durham, N.C., is a global supplier of unsaturated polyester resins for composite materials and a range of industrial coatings. The company operates 19 manufacturing sites worldwide and employs more than 1,300 workers.

Reichhold, the Group's U.S. company, approached a manufacturer of fiberglass pipes with a proposition: If it switched from epoxy to cure the pipes to one of Reichhold's snap-curing Advalite Vinyl Hybrid resins, it could significantly speed up production. "Due to the relatively slow cure nature of epoxy resins, they needed the full length of their oven to cure and, therefore, couldn't run their production any faster," says Douglas Betts, a chemist associate at Reichhold. Betts believed his company's quick-curing resins could speed up the process, thereby reducing costs.

Coating the Micro-T's data logger in silicone grease and then wrapping it in packing tape protected it from the resin.

Betts and his team at Reichhold demonstrated that their resin was able to cure pipes before they reached the end of the manufacturer's oven. But discovering exactly where in the oven the pipes cured proved more difficult. Betts needed to know how much time the pipes had to be in the oven with the new resin, because that would determine whether the manufacturer could optimize production processes.

Reichhold worked with Phase IV Engineering to develop a solution that can pinpoint exactly when the snap cure of the resin occurs—as indicated by a temperature rise in the composites being cured. Phase IV's RFID-enabled Micro-T Data Logger captures the temperature of pipes as they cure in the customer's ovens. With that information, production managers can choose to either shut down portions of the oven farther down the line from where the resin curing takes place, in order to save energy, or speed up the line to use the full length of the oven in less time. Betts and his team are working with the customer to fine-tune the manufacturing process.

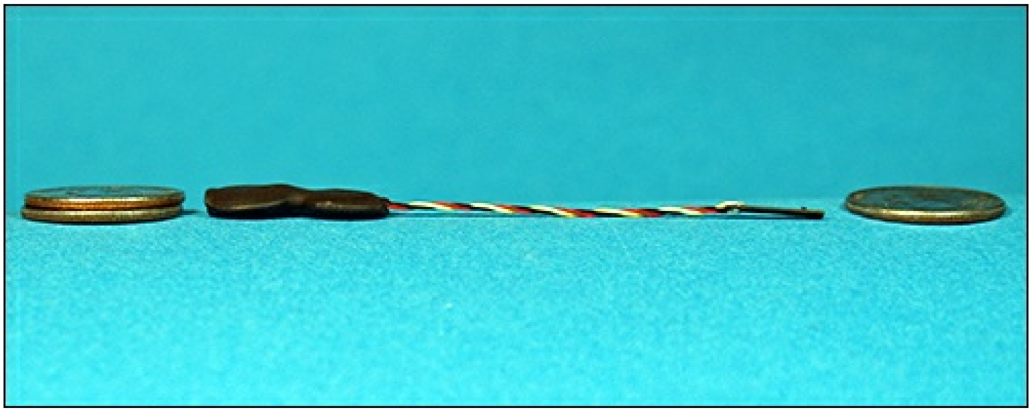
"For the first time ever, the Micro-T has enabled the engineers that are trying to dial in these fiberglass processes to get very, very accurate temperature readings of the fiberglass assembly while it's curing," says Scott Dalgleish, Phase IV Engineering's CEO. That enables the pipe manufacturer to save time and energy during the production process.

Searching for a Cure

To gain insight into the curing process, Betts knew he'd need to get an unobtrusive temperature sensor inside materials as they were curing in the oven. Wired thermocouples were not an option, he explains, because they would be a very cumbersome way to monitor the composite pipe temperature. So in November 2013, Betts shopped online for a wireless solution. "Just searching on the Internet," he says, "I came across Phase IV and their whole lineup of wireless technologies for temperature sensing." Among those offerings was the Micro-T Data Logger.

Betts says he didn't consider other options after he initiated a dialogue with Dalgleish. "Phase IV was great to work with," he recalls. The clincher was a loaner kit that Phase IV sent to Betts to try out. "I was so confident that he'd be thrilled with it that I loaned him a reader and I gave him a few of these thin data loggers," Dalgleish explains.

In June 2014, with data loggers and an RFID reader in hand, and with Phase IV-developed software installed on his laptop, Betts visited his customer for a trial run. It couldn't have gone better, he says. Purchasing the devices, he adds, was a no-brainer for Reichhold, given their utility and affordability. "I had to get a couple of OKs," he recalls of the purchasing process, "but Phase IV makes it really easy, because the Micro-T Data Logger system is very reasonably priced."



A side view of the Micro-T

But when Betts and his team returned to the customer to pilot the solution, they faced a challenge in recovering the sensors from the cured fiberglass. The temperature sensor and the data logger were hardwired to each other with a three- to four-inch wire. Since the temperature sensor was embedded in the cured fiberglass, the team had to cut the wire to retrieve the data logger, and then send it back to Phase IV for repair if they didn't want to sacrifice the device.

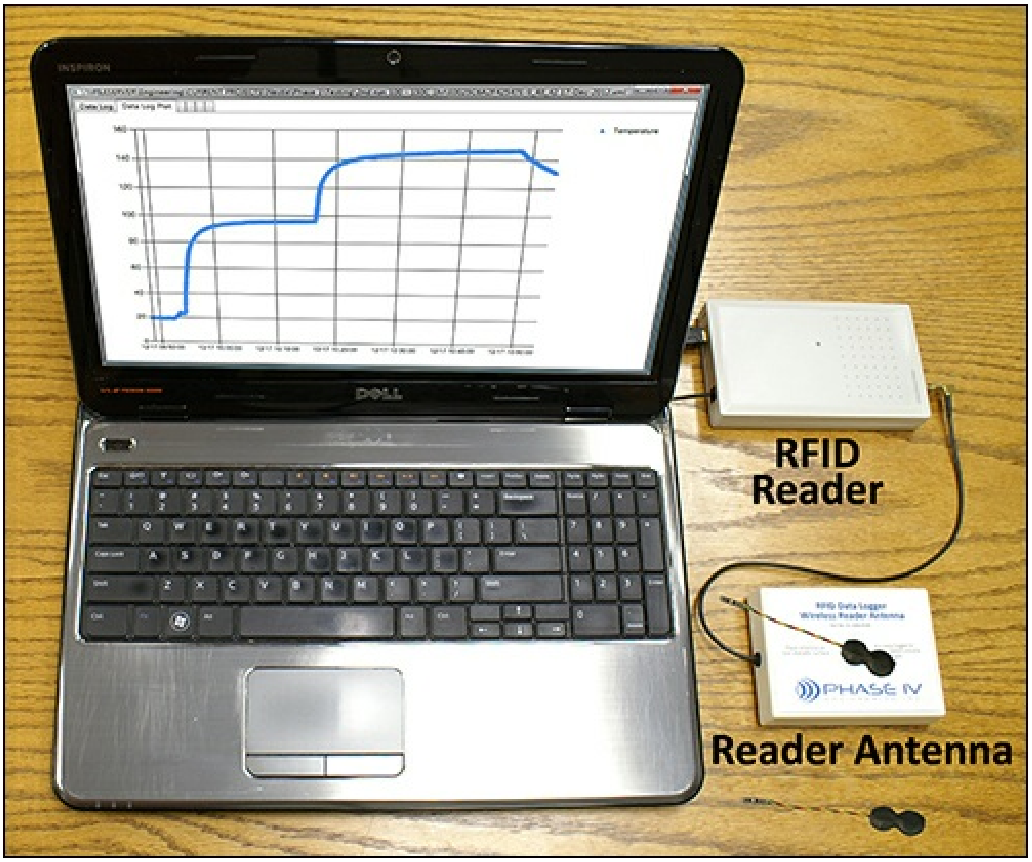
So Betts asked Dalgliesh if Phase IV could make the temperature sensor easily detachable from the data logger. "The data logger electronics component is much more expensive than the temperature sensor," Betts explains. "And so it is not a financial burden if the sensor itself gets lost and buried in the composite part, because that can be easily and cheaply replaced."

The Phase IV engineers reconfigured the system as requested, with good results. "That's working very well now," Betts reports. "That's what we're using."

Training, Betts says, wasn't required because the Micro-T system is easy to use. "It's very self-explanatory," he states. That, Dalgleish notes, is by design. "We put a lot of work into making the software user interface easy to use," he says. In fact, Dalgleish adds, "We just had a couple of customers say that they hadn't even looked at the manual."

Taking the Temperature of a Process

The Micro-T Data Logger has a battery-assisted passive RFID tag operating at 13.56 MHz (the ISO 15693 standard). It measures 0.55 inch wide by 0.18 inch thick. The onboard battery is good for more than two million sensor readings, Dalgleish says, which should be sufficient for at least a year and a half of use.



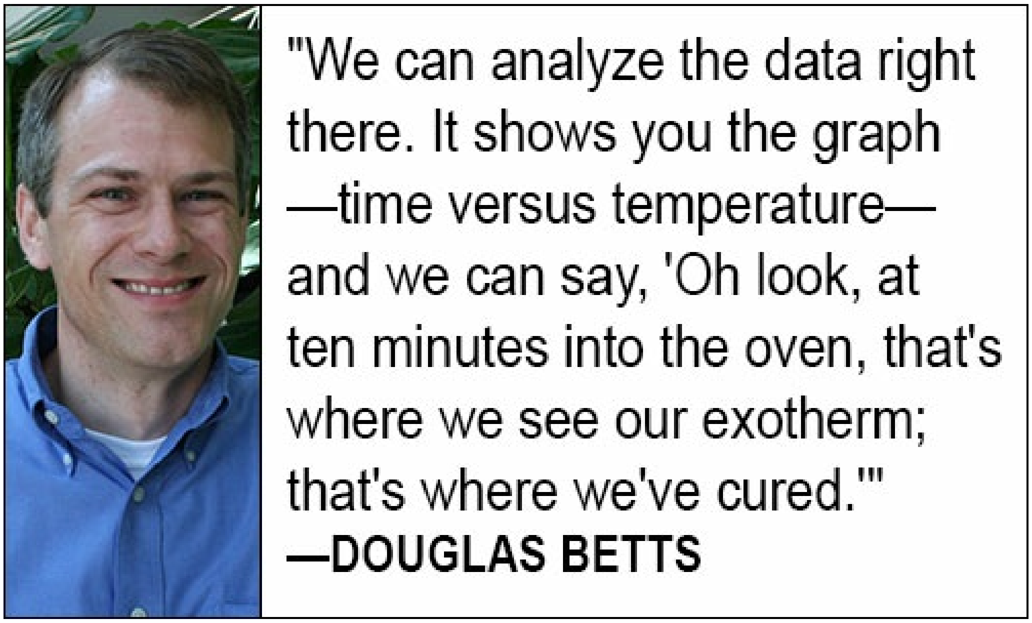
The Micro-T's very small size is made possible by the device's passive RFID technology, Dalgleish says. It doesn't need battery power to send data to the computer, so the battery for the ultra-low-power microprocessor that processes temperature readings can be kept much smaller than would be required for an active RFID tag, he explains. "The RFID interface is the key to the Micro-T's unique high-value miniature features," he adds.

To use the system, a technician first attaches a FEIG Electronic OBID MR102 high-frequency RFID reader to a laptop running Microsoft Windows. "The reader is a real small box," Dalgleish says. "It's about the size of half of a sheet of paper. It connects to the computer with a USB cable. There's a little antenna box about the size of two cigarette packs that connects to the RFID reader, and it just sits next to your computer."

With the Micro-T Data Logger placed on top of the antenna, the user launches Phase IV's logging software on the laptop and clicks the "Find Data Logger" button. "The radio energy coming out of the antenna wakes up the microprocessor, and then it will start talking to the computer so you can configure the data logger," Dalgleish explains. "The main thing you configure is how often you want to take a temperature sample." The software can begin logging data immediately, he says, or it can be set to begin logging after a specified amount of time.

Betts found that coating the Micro-T's data logger in silicone grease and then wrapping it in packing tape protected it from the resin. To monitor a pipe, the Micro-T's temperature sensor is then placed in the resin-soaked fiberglass composite. After the pipe proceeds through the oven and exits the other side, a technician can retrieve the data logger by detaching it from the wire connecting it to the temperature sensor, thereby leaving the sensor embedded in the fiberglass.

The device is again placed on the reader's antenna, and the collected data is transmitted to the Phase IV software. "We look for a temperature spike," Betts says. That rapid rise in temperature indicates exactly when the curing reaction took place. That information, combined with the speed of the production line, allows Betts and his team to calculate exactly where in the oven the reaction occurred.



Saving Time, Saving Energy

Betts and his team used the data logger multiple times at the pipe-making plant to get a fix on the exact curing times for different oven temperatures and for three resins. "We wanted to compare the cure profile for each of the resins," Betts says. Although the company makes pipes in a range of diameters, all testing was conducted on 2-inch pipe—the type produced in the greatest quantity. The company's pipes are all cured at the same temperature, regardless of diameter, but the line speed is adjusted for the difference in mass between the various diameters. Smaller-diameter pipes, with less mass to heat, can be run through the oven more quickly, while larger-diameter, larger-mass pipes must be run more slowly to allow sufficient heating time.

"We can analyze the data right there," Betts says. "It shows you the graph—time versus temperature—and we can say, 'Oh look, at ten minutes into the oven, that's where we see our exotherm; that's where we've cured.'" Since no additional time in the oven is required once the reaction occurs, managers then have the option of shutting down sections of the oven farther down the line in order to save energy. Alternatively, they can choose to leave the ovens unchanged but instead speed up the line. Betts's customer is considering both options to determine the optimal balance between line speed and energy savings.

Meanwhile, now that Betts and his team have added the Micro-T Data Logger to their toolbox, they look forward to trying it out with other Reichhold customers that need greater insight into their manufacturing processes. As for Phase IV, the RFID provider plans to add additional capabilities to the system, such as Near Field Communication technology. "In the future," Dalgleish says, "it's possible that it could communicate directly with an Android smartphone."

