

Case history

Ultrasonic bin level indicator replaces point-level controls to allow consistent material flow

A producer installs continuous bin-level-monitoring equipment so mixed materials are on spec.

US Mix Products Co., Denver, produces aggregates and cement products such as concrete mix, mortar mix, and sand mix. The producer also contracts specialty blends for the construction market.

The producer purchases sand, rock, and cement and stores the materials in 100-ton silos. Two silos are used for each material. Dump trucks deliver a wet mixture of sand and rocks to pits where belt conveyors transport



At the cement products plant, an ultrasonic bin level indicator sends a signal to this controller, which interfaces with the plant's PLC.

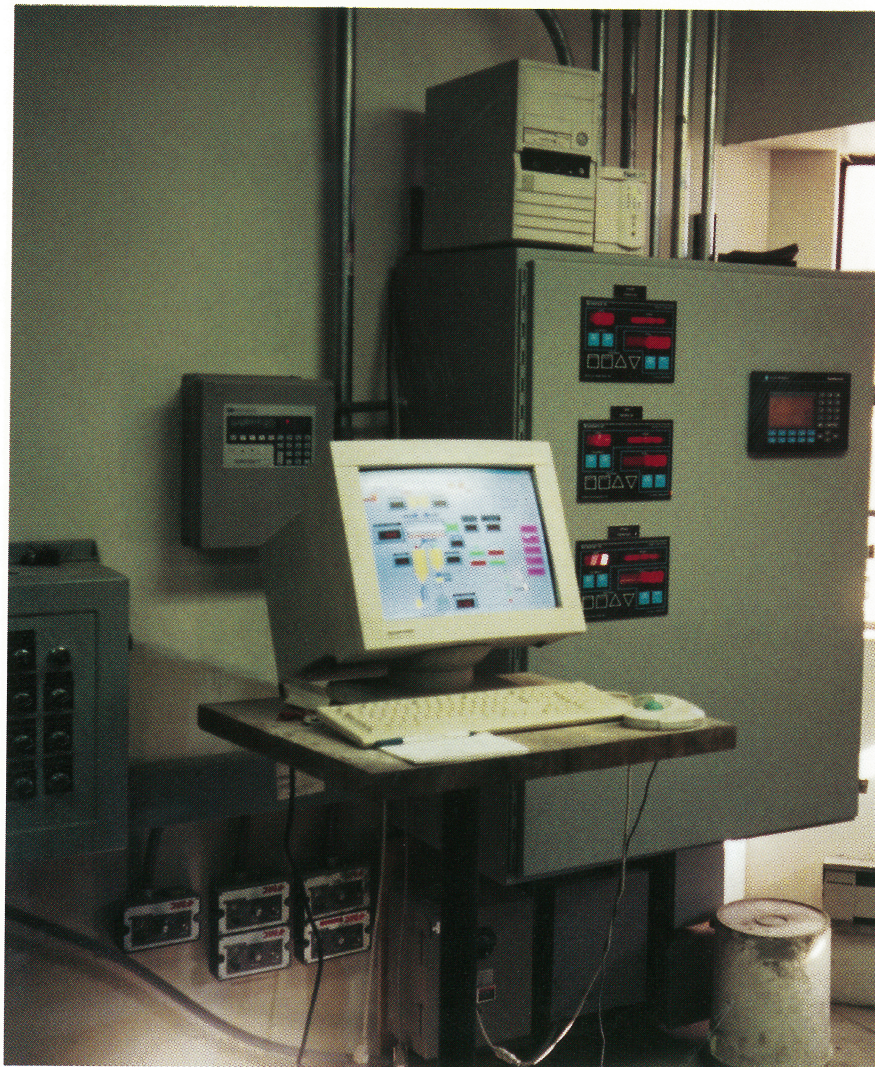
the mixture to rotary dryers. After drying, a bucket elevator carries the mixture to screeners that separate the sand from the rock prior to storage. Three weighbelt feeders carry the separated sand and rock and the cement from storage to a mixer that has an 18-inch agitator with paddles. The mix drops into an 8-foot-tall, 96-cubic-foot surge bin that supplies two packaging machines.

Conveyor stoppages produce inconsistent product

In the past, US Mix used two diaphragm-actuated point-level con-

trols in the surge bin to indicate when the bin was nearly full or empty and thereby trigger the weighbelt feeders to stop or start. "Material in the bin would press against the [point-level control's] rubber pad [diaphragm], which would give a little bit, activating an internal switch," says plant superintendent Lowell Dickmeier. "These rubber pads wore out really fast — a couple of times a month. It was frustrating to shut down to replace them, especially in the summer when the system runs 10 hours straight. When a pad went bad and leaked material inside [the point-level control], we'd have to disassemble it, clean it out, put it back

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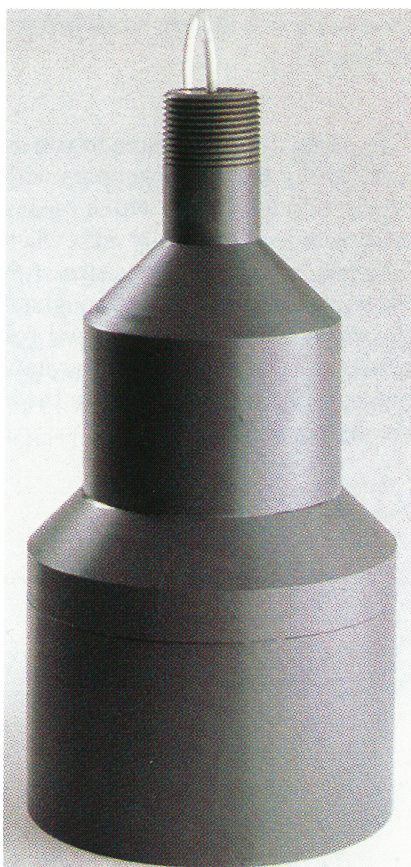
The PLC monitors the surge bin's material level and adjusts weighbelt feeder speeds to ensure even material flow.

together, and get it going. A lot of little parts had to be taken apart and cleaned up." It took a technician about 1½ hours to replace two pads.

The level controls were linked to analog controllers. The controllers would start and stop the cement, sand, and rock weighbelt feeders as the surge bin levels warranted. When the feeders stopped feeding the mixer, the packaging equipment continued to operate, and the surge bin continued discharging material until a "low" signal restarted the feeders. With this method, the weighbelt feeders started and stopped about 50 times daily. Frequent starts and stops didn't affect sand and rock flow from the silos, but it did affect the cement. "The cement tends to lump, causing a bridge or rathole in the silos, resulting in uneven cement flow," says Dickmeier. "We'd get a more even flow of sand and rock." The amount of cement entering the mixer would vary depending on how it flowed from the silo onto the belt. "So we'd get too much or too little cement in the mixture," he says.

This was a problem since cement is the key ingredient in most of US Mix's products. "If you put too much cement in the mix, it affects the quality of concrete or mortar," Dickmeier says. "It's like giving away product. And if you add too little cement, the product won't harden. We'd occasionally hear back from a customer, saying they got a bag without the right amount of cement in it."

Dickmeier says after working with the cement products for many years, some workers can detect if bagged mix is off spec by how the packaging equipment handles the bag or by how the bag looks when it's filled. "The bags will look fluffy or they'll just look different," he says. "It's just a feel for the business. [If the mix isn't right,] the machinery won't handle the bag correctly. The bag won't run through the palletizer quite right, and it won't stack just right. So occasionally we'd have to set pallet loads aside."



An ultrasonic transducer like this is mounted inside the surge bin.

Producer considers new bin-level-monitoring equipment

To remedy the problem, Dickmeier wanted to replace the point-level units with a type that could continuously monitor the surge bin's material level. US Mix was automating their mixing process at the time, so the new bin level indicator's controller would have to digitally interface with a PLC that would run the weighbelt feeders at varying speeds. With variable speed, the feeders could slow rather than stop and keep the cement flowing at a more even rate.

In addition, Dickmeier planned to program the PLC to monitor the cement feeder's actual throughput based on weight and then adjust the sand and rock feeders' speed to match the cement flow. "I wanted a PLC control-

ling the weighbelt feeders with the cement being the key," Dickmeier says. "That way if the cement feed decreased or increased, [the end product] would remain on spec because the sand and rock feed would slow down or speed up accordingly."

When considering what type of level-monitoring device to use, Dickmeier briefly considered installing load cells under the surge bin but ruled them out because it would be difficult to retrofit the bin. He then considered using ultrasonic level indicators in the surge bin but was skeptical. "It's such a dusty, noisy environment, I had my doubts that any [ultrasonic indicator] would work," he says. "I talked to different manufacturers and even they were hesitant about whether or not they could make one work over that short of a distance because there was too much dust in the bin."

Finally Dickmeier talked with a manufacturer of ultrasonic level indicators who was more confident. "We had some of their level indicators in another area of the plant, and they had been in use since the plant was built in 1980," he says. "I asked our PLC supplier about that manufacturer, and he got me in touch with them." The manufacturer was convinced that their ultrasonic system would do the job. "They told me they would *make* it work," Dickmeier says. "So we made the decision to go ahead with their product."

Ultrasonic transducer installed in surge bin

In November 1995, US Mix installed a Sonologic short-range ultrasonic transducer and a Sonologic II transceiver (or controller). The transducer was center-mounted on the surge bin's ceiling.

The transducer pulses ultrasonic sound waves (above 20 kilohertz) against the material and receives the returning signal (or echo). The signal is sent to the controller, which converts the signal's

transit time into a distance measurement, determining the material level.

The controller's microprocessor automatically adjusts the transducer's power, gain, and frequency as conditions in the surge bin vary to ensure the correct echo is measured. Only one controller is needed for up to 16 transducers.

The controller interfaces with the plant automation PLC. The PLC controls the weighbelt feeders' speed based on the surge bin's material level, so the feeders needn't stop and start.

Product quality and productivity increase

Because US Mix's PLC was in place when they installed the ultrasonic indicator, it was easy to link the two and start up without major problems. "It's dusty and noisy in [the bin], so startup took some fine tuning, but nothing out of the ordinary," Dickmeier says. "It was pretty typical of any installation."

US Mix is satisfied with the manufacturer's service according to Dickmeier. "We were having a problem and they sent a repair technician out. He found a defective board. We didn't have to pay for the service call; it was part of our service contract. Since then, whenever they send a technician to our area to see another customer, if he has time he'll stop by and see if everything is okay."

Having the ultrasonic indicator's controller tied to the PLC has produced good results for the cement products producer. "Most of the time, all told, the plant runs a little better and a little faster," Dickmeier says. "We've increased production at least 10 percent, and product quality is better." The three weighbelt feeders no longer stop and start 50 times per day as the surge bin level rises and falls. "The belts stop only three

times a day — during work breaks and lunch.

"We normally don't have to run as hard during the day to keep up with production demands, which means our operators can actually relax when they take a break. It's less stressful. We used to run the system throughout the day and not shut it down for breaks. The operators had to rotate breaks. Now they can take their breaks together."

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With the cement weighbelt feeder acting as a master and the sand and rock weighbelt feeders synchronized to it, product mix accuracy has improved as Dickmeier planned. "We're more accurate than ever before," he says. "We did some testing and measured down to a fraction of a percent accuracy [variance] per feeder.

"We set PLC parameters that won't allow a mix to be 4 percent off spec for over 30 seconds; if so, the system shuts down," Dickmeier says. "That's not long enough to give us a bad product. We haven't received any product complaints that I'm aware of."

Dickmeier says he hasn't had any problems with the ultrasonic equipment, and it requires virtually no maintenance. "There's not really much you can do," he says. "The

transducer is sealed and it's mounted on the surge bin ceiling. Some dust does build up on the detector, and you have to adjust for that after a while. You can go into the Sonologic II controller, check for accuracy, and make a few adjustments that take only a few minutes."

US Mix is satisfied with the bin-level-monitoring equipment. "We recently installed four more ultrasonic units," Dickmeier says. "We installed them in two new silos last week and in two existing silos the week before. All of the transducers are linked to one controller. We've also purchased [the manufacturer's] scaling equipment and load cells, and we'll be installing two more of their transducers next week." **PBE**

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