



TEMPERATURE TECHNOLOGIES PROVIDE NEW INSIGHTS TO IMPROVE SAFETY, PRODUCTIVITY AT AMERICAN CRYSTAL SUGAR

Customer

American Crystal Sugar (ACS), East Grand Forks, MN

Application

Monitor bearing temperature and motor current in Weibull Bins (sugar silos) and conveyor system to prevent ignition point; remote monitoring of settling ponds.

Challenge

Sugar dust in safety equipment caused a small explosion at a sugar refinery near Savannah, GA. Just eleven days earlier, a similar but bigger blast killed nine workers at a Port Wentworth, GA plant according to a federal investigator. Alerted to the potential danger of sugar dust, American Crystal Sugar (ACS) proactively searched for ways to prevent a similar accident in its plants. The company looked to measure abnormal situations where field equipment could become potential ignition points in hazardous areas, including hazardous dust in the Class II Div 1 & 2 Group G.

“We first identified equipment and devices that were potential ignition points,” said Gary Phelps, Electronic Control Technician for ACS. “We were looking for devices that were not ignition sources under normal conditions, but had the potential to become ignition sources under abnormal situations.” Bearings and motors in the sugar silos where sugar dust was in the greatest concentration were the first to be identified, as were misaligned conveyors that delivered the sugar from the silos to the sugar handling area. “We identified the bearings on the sugar conveyor system as well as them is aligned conveyors, as both could heat up and potentially introduce an ignition point,” said Jay Sorum, also an Electronic Control Technician for ACS. “Even sealed bearings can fail, and create an ignition point. Conveyor belts, too, have the potential if they become even slightly misaligned.” The challenge was installing an instrument network that had high reliability and performance with a low installed cost. In the sugar silos,

Results

- Improved plant safety
- Greater visibility in hazardous areas
- 2.5% reduction in operations time for higher operator productivity
- Improved pond management
- Ready for new upcoming EPA reporting requirements



Image 1. Rub blocks provide an indication when the conveyor is even slightly out of alignment. A conveyor out of alignment can be a potential ignition source.

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an additional challenge was introduced. “The sugar silos are about 75 feet high and 100 feet across,” said Phelps. “A rotating bridge spans the top, and a tube down the center holds the motor where some of the bearing temperature and motor amp measurements needed to be made. There are also two screws on the floor of the silo with motors that require temperature measurements. Conventional instrumentation proposed a huge challenge in this area.” It was also a challenge for wireless, as the silos are made of a heavy gauge stainless steel with an additional metal skin for insulation.

Solution

“We evaluated three technologies to determine the best course to improve safety at our plant,” said Sorum. “The first was a conventional (4-20 mA) wired system, but it was too expensive to wire each instrument point to point.” It also was not an option for the Weibull Bins because of the rotating bridge. The second solution was a wired bus. A bus solution would minimize home run wiring and lower the installed cost of the instruments while providing high performance and reliability. The third technology was a wireless network. This was considered mainly for the silos because of the rotating bridge.

Conclusion

Conveyor System

“We determined that FOUNDATION™ fieldbus provided the highest performance and reliability at the lowest installed cost,” said Phelps. “Since one Rosemount™ 848T FOUNDATION fieldbus Temperature Transmitter could handle all eight measurement points on a conveyor, we were able to handle 72 temperature points with only 9 transmitters.” One Rosemount 848T was installed for each of the nine conveyor belts, with each transmitter reading four bearing temperatures and four “rub block” temperatures. These points were integrated via fieldbus into the DeltaV™ control system to provide automatic detection, trending, and alarming of temperature, rate of change, and temperature delta for the operators. Integrating logic for the rub block temperature alarms was easy with the DeltaV tools. A function block template was used to design the complex logic and copied for all ignition points. Troubleshooting the logic was simple, as making a change to the template changed the function blocks for all ignition points.

Sugar Silos

Since the three Weibull Bins (sugar silos) had rotating equipment, a mixed solution of both *WirelessHART*® and wired instrumentation was installed. Each of the three silos had one Wireless Gateway with four Rosemount 648 (single point) Wireless Temperature Transmitters installed; two measuring bearing temperatures on motors and two measuring motor amps. Since the output of the motors is milliampere and the Rosemount 648 transmitters read millivolts, it was a simple solution to put a 5ohm resistor in the loop to get a millivolt output from each of the motors that the transmitters could



Image 2. Sugar silos at ACS in EGF have a rotating bridge that made wired instrumentation impossible to implement.



Image 3. Each of the nine conveyor belts had four bearing temperature measurements and four rub block temperature measurements that were handled by one Rosemount 848T FOUNDATION Fieldbus High Density Temperature Transmitter.



Image 4. One Rosemount 848T Wireless Temperature Transmitter can handle up to 4 inputs including 4-20mA, mV, Thermocouple, RTD, or ohm. The field hardened enclosures and intrinsically safe Power Module makes it ideal for this hazardous environment.

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read. Within each silo the four instruments formed a “communication mesh” that communicated with the Gateway. Since the outside of each silo was made of a heavy gauge stainless steel (with a thin metal skin and insulation), a remote antenna was placed inside the silo on the central rotating tube. This antenna was wired through the tube to the Gateway located on the outside of each silo. Each of the three gateways was hard wired back with ethernet to the DeltaV control system, where it was seamlessly integrated as “native I/O,” and information was made available for trending and alarming. Installation time was minimized and commissioning was easy with the AMS Device Manager. “The AMS Device Manager was invaluable during installation and commissioning of the wireless and fieldbus instruments. Having one location to manage the devices saved a lot of time, as the instruments are spread all over the plant.”

Pond Management

ACS extended the use of Emerson’s Wireless technology to integrate non-critical points into the control room as well. Remote pond measurements were collected regularly to manually record pond levels, pH, ORP, dissolved oxygen, temperature and discharge flow rate. These conventionally wired devices were too expensive to bring back to the control room since the ponds were three quarters of a mile away or more. ACS realized the Rosemount 848T had a wireless option as well as fieldbus, and could accept four inputs from any combination of RTD, thermocouple, ohm, millivolt and 4-20 mA signals. The analytical devices, ultrasonic flow devices, magmeters, and all other measurements from each of the 9 ponds were locally wired to the Rosemount 848T Wireless Temperature Transmitter and sent back to a Gateway and integrated into the control room environment where they could be automatically recorded, trended and reported. Two Rosemount 702 discrete transmitters, acting as range extenders, were installed on 15 foot poles 0.54 miles from the furthest pond. The intent was to place the second device in series closer to the instrument mesh, but the network was able to communicate reliably at that distance. The second instrument therefore acts as a backup range extender to further improve communication reliability.

Now wireless data is automatically collected at one minute intervals instead of twice weekly by operators. This rich information has helped ACS manage their ponds more closely, to make final treatment more efficient. It has also set the stage for new upcoming EPA reporting requirements, like proving the plant is meeting the new dissolved oxygen standard. Overall, the combination of *WirelessHART* and FOUNDATION fieldbus provided the most cost-effective solution for both critical and non-critical applications. The additional instruments widened the operator view into both hazardous and remote areas of the plant, and enabled engineering to improve plant safety. Operators spend their time more productively with fewer trips out to remote areas, and the plant is set up for new EPA reporting requirements. The Emerson solution has proven to be so valuable that ACS has installed it in all five sugar plants in the region.



Image 5. Four Rosemount 648 (single point) Wireless Temperature Transmitters were placed inside the silos to measure bearing temperatures and motor currents.



Image 6. A remote antenna on the center rotating shaft inside the sugar silo allows the wireless instruments to communicate with the Wireless Gateway located outside each silo.

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00830-0400-4848, Rev AC