The Eastman Chemical Company in Columbus, SC uses FOUNDATION fieldbus technology and DeltaV hardware throughout our relatively nonhazardous facility. This system has functioned so well, Eastman decided to install fieldbus technology in a second plant. The challenge was to figure out how to install a FOUNDATION fieldbus system similar to the one in the first plant in the second plant that has a very different environment.

The Challenge
The second plant has many Class I Div. 1 and Class I Div. 2 hazardous areas with processes that are not only explosive but extremely corrosive. Traditional, intrinsically-safe FISCO segments typically have some amount of signal loss and only permit a maximum of four devices with short segments. This second installation needed a FOUNDATION fieldbus system that would function reliably in a harsh and hazardous environment and maximize intrinsically-safe segment capacity. Also, personnel need to be able to work on the instruments in the field. FISCO (Fieldbus Intrinsically Safe Concept) provides a way around the limitations of normal intrinsic-safety. It makes more voltage and current available in hazardous locations—12.8 V and 115 mA. Trunk and spur lengths are 1000 m and 60 m respectively, it verifies safety, system certification is not required, and FISCO avoids having to segregate live-workable and non-live-workable parts of the network in the field junction box.

One of the things that needed to be considered, bringing fieldbus technology with restricted voltage into the plant, was the fact that a system can be clean when it goes in, but with a corrosive environment, connectors get dirty, boxes start to fatigue. Rust and corrosion degrade communication over time and lead to network instabilities. These conditions also create additional resistance, which results in voltage drops. Random and intermittent communication problems are hard to pinpoint and eliminate. Usually you find them only after the plant goes down. Personnel need to be able to find those problems before they cause a shutdown. Also, one cannot be sure if 12.8 V will be enough to compensate for corrosion, given that the fieldbus devices require at least 9 V to operate.

A Possible Solution
Pepperl+Fuchs claims that their Advanced Diagnostic Module (ADM) will not only save time during startup and commissioning, but it would detect degrading conditions or faults occurring on fieldbus segments. Any change in the installation, such as those caused by corrosion or those unnoticed by the operators, will be detected before the change becomes critical to plant performance.

The ADM is part of Pepperl+Fuchs’ FieldConnex product line for fieldbus communications. FieldConnex allows you to design your fieldbus topology specifically for your application. While the fieldbus transmits the data, FieldConnex provides the infrastructure: power supplies, installation equipment, and accessories. The High-Power Trunk concept (HPT) together with FieldBarriers provide a new approach to creating intrinsically safe fieldbus segments. The entire installation is continuously monitored by the ADM integrated in the FieldConnex power hub.
The High-Power Trunk
Rather than limiting the amount of energy on the fieldbus trunk cable to intrinsically safe or nonincendive levels, the HPT limits the energy on the spur connections to the instruments. Using FISCO with the HPT, the energy on the trunk is increased to 500 mA rather than 115 mA. This increases the amount of energy available for field instruments and facilitates a consistent installation design regardless of the area classification. By limiting the energy in the field with a FieldBarrier rather than in the control room, power is more efficiently distributed to the instruments where it is required. As a result, the segment protection devices are similarly installed for hazardous or general-purpose applications. Consistency, cable runs, and cost savings are all increased with HPT.

Another benefit of HPT allows users to standardize on one power conditioning system with optional redundant modules for all areas of the plant. Supplying 30 V/500 mA allows users to achieve maximum cable lengths and maximum loading without using repeaters.

FieldBarriers
FieldBarriers are the core of the HPT. They are mounted near the field devices to provide short-circuit protection as well as energy limitation for explosion protection. They guarantee that the segment remains in operation even during a fault condition on a spur. The HPT expands the FISCO validation methods by considering each spur connection separately. FieldBarriers can be daisy-chained on the trunk and enable the field devices to be serviced without the need for a hot work permit. And they can be used in FISCO, FNICO, hazardous, as well as general-purpose installations.

The Installation
The original plant system was brought online using the standard method: pulling the trunk cables apart, performing resistance and capacitance checks. When there was a problem the technicians went out into the field and determined if it was coming from the trunk system, spur cables, or the instrumentation. It was rather time consuming getting the bugs out of the system at startup. Yet once it was brought online and commissioned, it worked very well. The instrumentation for FOUNDATION fieldbus eliminated the need for technicians to be out in the field doing calibration checks, putting in the scaling factors inside the transmitter, and validating the 4-20 coming back. Startup was extremely fast. In just one day we commissioned and brought over 40 instruments on line.

For the second plant installation, Pepperl+Fuchs claimed that all of that testing, checking, and debugging wasn't necessary. Supposedly, with advanced diagnostics, the networks could be run and scanned before hanging the instrumentation. After hanging the instruments, the network could be scanned again, and the noise levels, power draws, and health of the network could be compared.
That's a significant claim to make. Those who are familiar with fieldbus installations know that installation practices have a significant effect on the quality of communication. So, the second installation was carefully completed to ensure that the system was installed perfectly. The first four segments were installed and checked: the bricks and all the terminations were walked down, the resistance and capacitance checks completed, performed a manual scope sweep, and each instrument was checked with a handheld configurator. Then, the ADM was used to validate all of that information—and it matched perfectly.

The Advanced Diagnostic Monitor
In fact, the ADM caught a problem on one of the bricks that the handheld communicator did not catch. It was over terminated but not to the point that it violated the minimum point where FOUNDATION fieldbus wouldn’t run. The system was still running, there weren’t any communication errors, yet the network was unhealthy. The ADM caught it. The built-in terminating resistor on one of the bricks wasn’t turned off. Confidence in advanced diagnostics was starting to grow.

The next system brought on line had eight segments. They were checked to make sure that the terminators were right and the trunk cables were terminated correctly. After it was determined that the segments were good, the advanced diagnostic monitor was used to commission all eight segments. It took only 20 minutes and actually found two problems that were missed: one where the termination wasn’t turned on at the end of the field, and another where the polarity was reversed. The errors were corrected in 10 minutes, the segments were back up on line and completely healthy.

After that, 40 instruments were hung on the segments and only the diagnostic system was used to validate. Not one had a problem. In fact, even the longest run—1500 feet—came on line with no problem, as quickly and as easily as the run that was 5 feet from the cabinet.

Currently there are six different areas in the facility where FOUNDATION fieldbus using the High-Power Trunk concept is installed. Handhelds are no longer used, and the oscilloscope is no longer hauled out to the field. Once the system is installed, the sweep is done remotely, and everything is ready to go. The ADM is totally reliable.
Even More Features
The diagnostic system also provides a commissioning wizard, alarming and data logging, and a built-in oscilloscope for displaying in-depth detail of fieldbus signals. Once all the instrumentation is on the network, the software allows the user to enter the tag names for each node address manually on a particular segment. During troubleshooting, it’s easy to see which instrument has the problem without ever going out into the field. The commissioning wizard is very easy to use, very intuitive.

The diagnostics feature is equally as reliable. It measures device signal level, proper termination, and cable continuity. It provides a baseline report, comprehensive system documentation. The baseline is continuously compared against actual values and if there’s a problem, it tells the user exactly what that problem is, indicates possible causes, and then offers possible solutions. Best of all, you never had to go out into the field to diagnose a problem.

The physical layer diagnostic module captures snapshots of all values and can store that data for up to two years for long-term trending. Because it has the ability to create a visual representation of the digital fieldbus communications coming from the control room, it truly provides an “extra set of eyes” on communications, making you aware of a problem before it arises.

Another neat feature of the system is the remote software. Segments can be commissioned remotely, from the comfort of an office. There’s no need to be out in the field fumbling with a laptop. And the network can be monitored remotely—even from home.

The amount of time that was saved with advanced diagnostics is dramatic. It actually took longer to walk down the system to set the jumper switches on the boxes than it took to commission the system. The physical walk down and commissioning for the first, four-segment system took a day and a half; on the following eight-segments the physical walk down took about 60 minutes and the commissioning took a mere 20 minutes. The confidence level in the network also increased dramatically. When the ADM certifies that the system was good, it is good.

From Incident-Based Maintenance to Predictive Maintenance
Advanced diagnostics enables incident-based maintenance to go to predictive maintenance. When you have a chemical plant that is running 24-7, and an instrument failure of any kind will bring your operation to a halt, you need a communication system that you can rely on: one with greater power capacity, signal quality, consistency, and efficiency. The ADM delivered on every requirement. It simply outclassed every other product that we used previously.