SABIC Turns to Yokogawa TDLS Analyzers to Enhance Safety Functions and Production

By Yokogawa

SABIC is a global manufacturer of polymer resins, film and sheet products, special additives, and chemical intermediates. With operations in more than 50 countries, the company has an enormous variety of processes and plant designs to make its range of products. With so many plants, processes and products, there are frequent opportunities to make improvements with hardware and instrumentation.

A case in point is a reaction process in which oxygen gas is sparged into the reactor, and there is a resulting outlet gas stream. Proper and timely measurement of the oxygen content in this outlet stream is of key importance for reaction control and safety. Reaction progress, control of raw materials input, and reaction sequencing are all affected and dependent on the value of the oxygen concentration reading. The reactor contents and outlet stream can also be in the flammable range depending on conditions, so safety and process considerations call for continuous monitoring of the vent line contents.

A Two-Fold Measuring Function

The safety considerations of monitoring oxygen content in the vent line are very important. As long as the oxygen level remains below a limit, the mixture can be kept below the flammable range and will not undergo combustion. If the process allows the concentration to exceed this limit, it shuts off the oxygen flow to the sparging headers. But this safety consideration is only one of the reasons the measurement is important.

Secondly, the amount of oxygen bubbling through the liquid is an indicator of what is happening in the reaction. Oxygen consumption depends on reaction chemistry and it is a direct indication of the status of the process. Accurate reading of overhead oxygen content is especially important for control of reactant addition and temperature control.

The Challenges of Consistent Measurement

Technologies to measure oxygen in a gas stream are not new, and there are countless applications in chemical manufacturing and other industries where oxygen levels need to be monitored. Combustion processes of any size invariably use some type of oxygen sensor in the flue gas stream to maintain efficiency.

SABIC's situation proved to be more challenging than most typical applications due to a mix of specific conditions. For many years operators struggled while working with paramagnetic and electrochemical cell sensors due to degradation of the cells, moisture and debris from the process. These sensors are both very common and used in a wide variety of oxygen measuring applications, but they have some key limitations that became apparent when reviewing this process.

Paramagnetic analyzers are sensitive to vibrations and cross-contamination from other gases. Although the application for these reactors does not call for measuring trace amounts of oxygen, there are also sensitivity issues at very low concentrations. Electrochemical cells should be replaced routinely and have sensitivity to different pressures, temperatures and cross-contamination.

Our sampling systems experienced high failure rates with electrochemical components including sampling lines being plugged from the process, filter element clogging, and failing pumps. Moreover, since an individual test during production took more than two minutes, a possibility existed that a climbing oxygen level may not be identified soon enough.

Paramagnetic and electrochemical cell oxygen analyzers have a three-month verification frequency, and the manufacturers recommended maintaining this regimen precisely. Although the testing does not take long, production was delayed in some situations while performing the verification. Delays and Emergency work due to the failures of these types of analyzers resulted in a significant amount of lost production. Due to these and other issues, a more robust oxygen analyzer technology was required.

Tuning in to Laser Technologies

One technology used commonly in combustion processes is tunable diode laser (TDL) spectroscopy, capable of detecting and measuring a variety of gasses, including oxygen, within many contexts. Theoretically, it has the capability to measure oxygen when mixed with toluene, but there was some concern about it being practical for this specific application.

A TDL analyzer sends a beam with a controlled wavelength range through the gas being analyzed to determine which products are present based on which specific wavelengths of light are absorbed. The problem in this case related to the duct size, because the transmitter and receiver should be a minimum distance apart to ensure adequate absorption.

The duct diameter here was less than half the normally recommended distance, so there was some concern as to whether it would deliver its full degree of accuracy, or even work at all. SABIC's engineers felt the potential benefits to be gained were more than enough to justify installing one analyzer as a test. The performance would be easy to evaluate since the existing sensors were still fully operational and working in parallel.

After two weeks of operation, it was clear the Yokogawa TDL analyzers were performing very well (Figure 1). It was true that they were not delivering the full degree of precision they were capable of due to the short scanning distance, but the precision was high enough to satisfy the needs of the process.

Once installed, the new analyzers proved very reliable and required far less validation and maintenance than the earlier technologies. One issue proved to be debris carried into the duct from the process blocking the light transmission path between the transmitter and receiver. Adjustments to a nitrogen purging system and better control of the process itself minimized this effect, leading to virtually trouble-free operation.

Facilitating the Safety Function

All of these TDL analyzers have been installed for over two years now, with no failures due to the TDLA's to date. Some units were outfitted with the Yokogawa TDLS200 analyzer, while others were outfitted with the Yokogawa TDLS8000 models. There are other manufacturers of this technology but we chose Yokogawa for this application.

There have been occasional visibility blockage incidents, but these are rare after adjustments to the purge system. Overall, these TDL analyzers have supported higher levels of production, and added another layer of protection to the unit.

Figure 1. While the duct size for this application was smaller than is usually recommended for TDL analyzers, the tunable diode lasers reliably provided readings with a high enough degree of accuracy for the application, while eliminating the maintenance problems associated with the earlier sensing technologies.

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