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K. DEAN, MSA Senscient, Poole, UK

Turn to open-path laser detectors for HF gas safety

Process engineers at a refinery in one of the Rocky Mountain states were concerned about detecting the potential accidental release of hydrogen fluoride (HF) gas at their plant as part of a recent series of upgrades to the facility. HF is a catalyst commonly used in petroleum refining alkylation processes that create octane-boosting additives for gasoline produced at the plant.

The process engineers take great pride in living and working in their community, and the refinery is located near one of the region's major cities, which is recognized as a regional hub for its strong economy, including oil and gas production and refining.

Maintaining a safe working environment at the refinery is the top priority for the company's process engineers. The potential presence of hazardous toxic, flammable and combustible gases requires the plant to employ a highly reliable safety monitoring system with advanced detection sensor technologies.

The refinery (**FIG. 1**) has a crude oil capacity of more than 50 Mbpd. Crude oil is purchased from local producers and imported from Canada via pipeline. The plant's refined products are distributed primarily to the eastern slope of the Rocky Mountain region, including the Denver metro area, eastern Wyoming and western Nebraska.

The problem. Alkylation is a conversion process used in many petroleum refineries, creating additives that boost the octane of gasoline by converting isobutanes into alkylates. This process requires the presence of a strong acid acting as a catalyst, and in many refineries (including this facility), HF is the acid used.

Refinery alkylation processes with HF pose two process safety operating hazards. First, large amounts of hydrocarbons are processed, which are both flammable and explosive. The accidental release of toxic HF gas is also a serious potential threat to plant employees and the surrounding area, should a gas cloud form and be carried away on a windy day.

The US Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA) regulate HF as a highly toxic substance. If HF is released into the atmosphere, it often rapidly forms dense vapor clouds that hover near land and can travel over great distances. Like other powerful acids, HF can cause deep, severe burns and damage the eyes, skin, nose, throat and respiratory system.

The solution. To help the refinery solve its HF gas detection concerns, the process engineers at the plant contacted a manufacturer and told it that they were seeking a highly reliable HF gas monitoring solution that would provide the maximum level of protection with the highest service uptime availability and no maintenance.

The manufacturer's team recommended a gas monitoring system composed of four individual enhanced laser diode spectroscopy (ELDS) open-path HF gas detection sensors, creating a full detection perimeter around the alkylation unit's processing area. The open-path gas detector (OPGD) shown in **FIG. 2** relies on ELDS to detect specific toxic and flammable gases. In the event of a gas leak, the sensor's laser technology recognizes and analyzes a gas' specific harmonic fingerprint—which, in this case, is HF gas—and issues an alarm when gas is present.

During normal operation, some of the laser light is reflected continuously through a sample of the target gas contained by a hermetically sealed reference cell. This design ensures that the laser remains locked on the selected gas wavelength for the specific target gas, such as HF. The detector's harmonic fingerprint technology (**FIG. 3**) helps ensure precise gas recognition, eliminating the potential for false alarms, even during adverse environmental conditions.

False alarms pose a serious problem with many gas and flame detection technologies. They can result in excessive plant downtime, which often requires complex investigations and regulatory reporting. From a safety perspective, frequent false alarms lead to a lack of confidence by employees in the detection technology, and a culture of apathy that can cause employees to fail to act promptly during an actual emergency event.

Class 1 eye-safe lasers are used to penetrate thick fog, heavy rain and snow beyond the capability of traditional open-path

FIG. 1. The potential presence of hazardous toxic, flammable and combustible gases requires refineries to employ a highly reliable safety monitoring system.

FIG. 2. A gas monitoring system composed of four individual enhanced laser diode spectroscopy (ELDS) open-path HF gas detection sensors was recommended to surround the alkylation unit's processing area.

infrared (OPIR) detectors. With its automated safety integrity self-check, the typical OPIR sensor gas checks and recalibrations that usually require field technician time to address are not needed. Unlike electrochemical cells, ELDS sensors are also immune to sensor poisoning and interferent gases, thanks to their gas-specific harmonic fingerprint detection.

The refinery plant team reported that the new HF gas detectors were relatively easy to install, commission and operate. Bluetooth wireless technology with advanced smart diagnostics are an additional feature. No technician or physical intervention is required for local interrogation, event log downloading and troubleshooting.

The process engineers at the refinery considered this gas detector's performance to be excellent for their application, with a fast response time (< 3 sec) compared to other toxic gas detection technologies. The ELDS gas detector features separate transmitter and receiver assemblies, which are certified for use in potentially explosive atmospheres and can

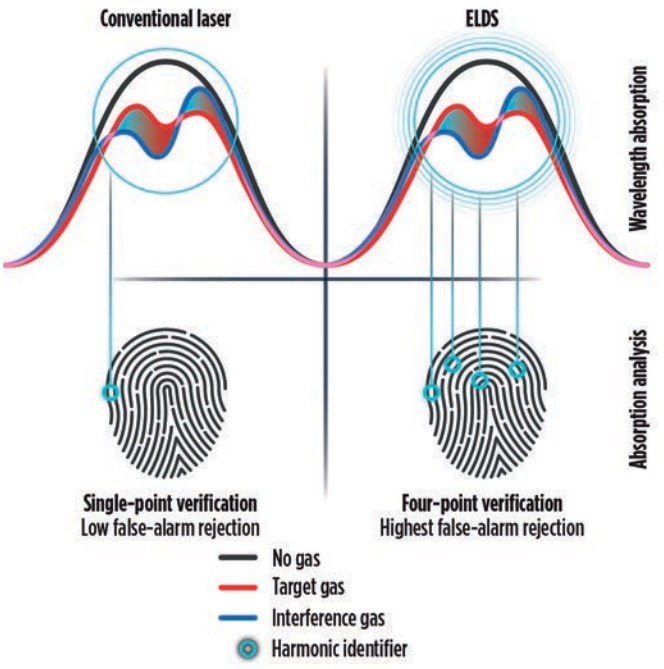

FIG. 3. Multipoint harmonic fingerprint illustration.

detect HF over distances of 5 m–120 m.

The ELDS gas detectors are constructed of high-grade, corrosion-resistant 316 stainless steel. Unlike traditional point detectors and other field instruments, HF corrosion is of less concern as this transmitter/receiver arrangement allows them to be located away from the high HF concentrations found close to a potential leak source.

ELDS detectors are ideally suited for onshore, open and enclosed environments, including the cold winter temperatures in the Rocky Mountain states, or the high temperatures in the Middle East or Africa. Heated optics provide service over a wide temperature range, from –67°F–140°F (–55°C–60°C), and the detector is hazardous area-approved to CSA, UL Class 1, ATEX, IECEx, EAC and INMETRO standards.

Results. The refinery process engineering team continues to be satisfied with the performance of the open-path gas detector for HF monitoring, and no missed events or false alarms have occurred since the detection system was put into service. The engineers also appreciate having virtually zero maintenance detectors, which are expected to provide a significant operational maintenance cost savings over other types of HF gas detection technologies. HP

KEVIN DEAN is a Product Manager with MSA Safety, and has more than 35 yr of experience in industrial gas detection. He has held numerous sales, marketing and product management roles within the industry before joining Senscient, which is now part of MSA Safety. Mr. Dean has an HNC in engineering and a postgraduate diploma in marketing with the UK Chartered Institute of Marketing.