Fig 4. UGLD Gas Detectors

REDUCING RISK IN PETROCHEMICAL PLANTS WITH NEXT-GEN SAFETY TECHNOLOGIES

While the dangers and consequences of undetected hazardous gases in the petrochemical industries are well known by process and plant engineers, it doesn't make protecting our talented people, sophisticated equipment and hard-working plants any easier. The consequences of a major accident caused by an unexpected hazard or unforeseen incident can still be devastating–especially when there is the loss of human life.

The technologies responsible for the latest generation of highly intelligent, effective gas monitoring equipment continue to advance in a number of areas. The objective is to make gas safety as effective, reliable, low maintenance and economical as possible. For that reason alone, the safety industry continuously innovates and focuses on developing new technologies, advanced materials and construction techniques (Fig 1).

So, we keep going and that is why it's important for all of us to discuss the latest technological advances available today to everyone responsible for safety. In the safety arena, there are lots of changes and improvements that require process and plant engineers to spend considerable time staying up-to-date. For example, great strides in even the past one to three years are now being made in adopting and implementing the latest digital technologies.

The challenges

Plant teams generally express three concerns about fixed gas detection equipment:

- Frequent sensor replacements
- Installation and maintenance challenges
- Integration with plant control systems

Under the best of circumstances, fixed combustible and toxic gas detection are difficult. Petrochemical processing plants are typically large and often have high-density layouts of tightly placed equipment, piping and tanks. Processing areas that require gas detection are often partially or fully exposed to the outdoors, subjecting gas monitors to heat, humidity, fog, rain and wind.

For these reasons, no single gas sensing technology is appropriate for all applications or situations or geographic location. Depending on the individual plant site, the surrounding environment and the nature of the leak source, a gas sensing technology that is appropriate in one place may not be appropriate in another. The differing chemistry of gases further complicates the detection method. For example, differences in density affect where a gas will pool inside a building or how a large cloud will move in the wind require a comprehensive approach.

Evolving gas sensor technologies

Compared to only 20 to 30 years ago, the most recent advances in fixed gas sensing technologies have led to more reliable and efficient plant safety monitoring systems. This includes all the major sensor technologies from all the safety industry suppliers, including electrochemical cells, catalytic bead, metal oxide semiconductor (MOS), infrared sensors and newer less well-known sensor technologies.

As effective as fixed-point gas sensors are, they still have one limitation: there is always the real possibility that leaking gas may not reach the gas sensors in sufficient concentration and in enough time to prevent a serious incident or accident. In general, the faster a gas sensing technology can detect a leak the quicker the safety system can respond and help to prevent a potential accident for a safer workplace.

This long-understood reality is leading to a new "layered" gas detection strategy for safety. This strategy begins with conventional fixed-point gas detectors and adds additional layers of newer gas sensing technologies such as ultrasonic gas leak detection (UGLD) and enhanced laser diode spectroscopy (ELDS) to provide more comprehensive protection.

Electrochemical cells

The industry's newest generation of fixed point electrochemical cell gas detection sensors has taken a giant step forward in the past 18 months. Electrochemical sensor technology with improved capabilities combined with intelligent features now includes non-intrusive touch button operation, better visual displays, extended calibration cycles, Bluetooth® wireless communication and multiple sensor capability (Fig 2).

These newer improved technologies now available with electrochemical sensors, for example, can expand calibration cycles up to 18 months (local calibration respected). Electrical pulse monitoring multiple times a day diagnostically determines the operational status of sensors in response to the effects of humidity, temperature, or pressure so they can automatically adjust themselves. When manual calibration is required, or sensor replacement is necessary, plant engineers are notified in time to complete the needed maintenance tasks without service interruption.

There are even some sensors that can warn if the sensor opening has become blocked and unable to detect a gas leak. By employing an acoustic mechanical design and algorithms, sound is measured

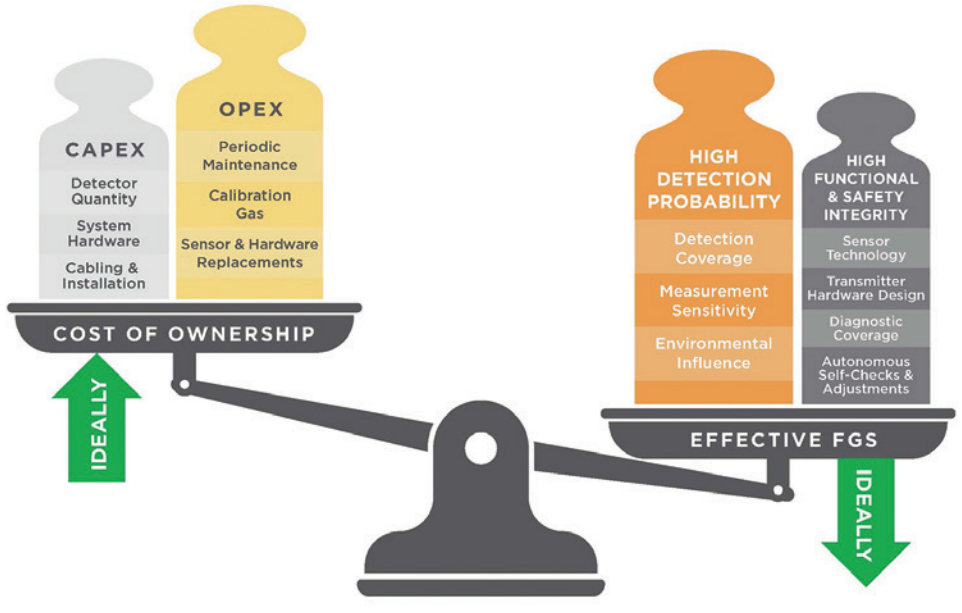

Fig 1. Risk Mitigation Scales Chart

across the sensor's inlet. If the inlet is blocked with a material, such as ice, the difference in the sound is detected and the unit is put into fault. When the obstruction is removed, the sensor detects the clearance and returns to normal operation (Fig 3).

Fig 2. Electrochemical Cell Gas Detectors

Challenged by tight plant equipment layouts, gas detectors are often placed in difficult to reach high locations or crowded equipment areas near piping, valve and other installed equipment where gas leaks can potentially occur. Plant technicians can now securely connect wirelessly to these gas detectors from up to 75 feet (23 meters) away using their Bluetooth enabled smartphone or tablet to access safety apps. The real-time availability of this data helps workers rapidly set-up, operate and maintain gas detectors for better efficiency and use of their time.

Enhanced electrochemical sensor packaging now makes it possible to connect two gas detection sensor inputs into one transmitter, which reduces the cost of wiring, conduit and installation time to make safety even more affordable. All of these innovations are leading to lower routine maintenance requirements and a higher level of safety.

Ultrasonic gas leak detection

In outdoor industrial facilities, conventional gas detectors have to be installed so the leaking gas will most likely reach the detector. If there is just a small amount of wind, the gas can be carried away from the gas detector. A dangerous gas leak can go undetected for a very long time under these conditions. Windblown gas clouds also can be a source of false alarms when they reach detectors that are some distance away from the location of the actual gas leak

Ultrasonic Gas Leak Detectors (UGLDs), in comparison, are a non-physical contact sensing technology that is nearly impervious to windy conditions (Fig 4). UGLD sensors "listen" for a specific acoustic noise signature from a leaking gas source and issue an alarm when leaking gases are detected from pressurized pipes or tanks. UGLDs react instantly when the leak starts so that the plant safety system can adjust operations to reduce the flow of the gas within a fast response time--essential in all effective safety systems.

Laser-based gas detection technology (ELDS)

The gas sensing technology behind ELDS sensing is an open-path non-contacting method to detect specific toxic or flammable gases. In the event of a gas leak, the sensor's laser optical technology recognizes and analyzes a gas's specific harmonic fingerprint.

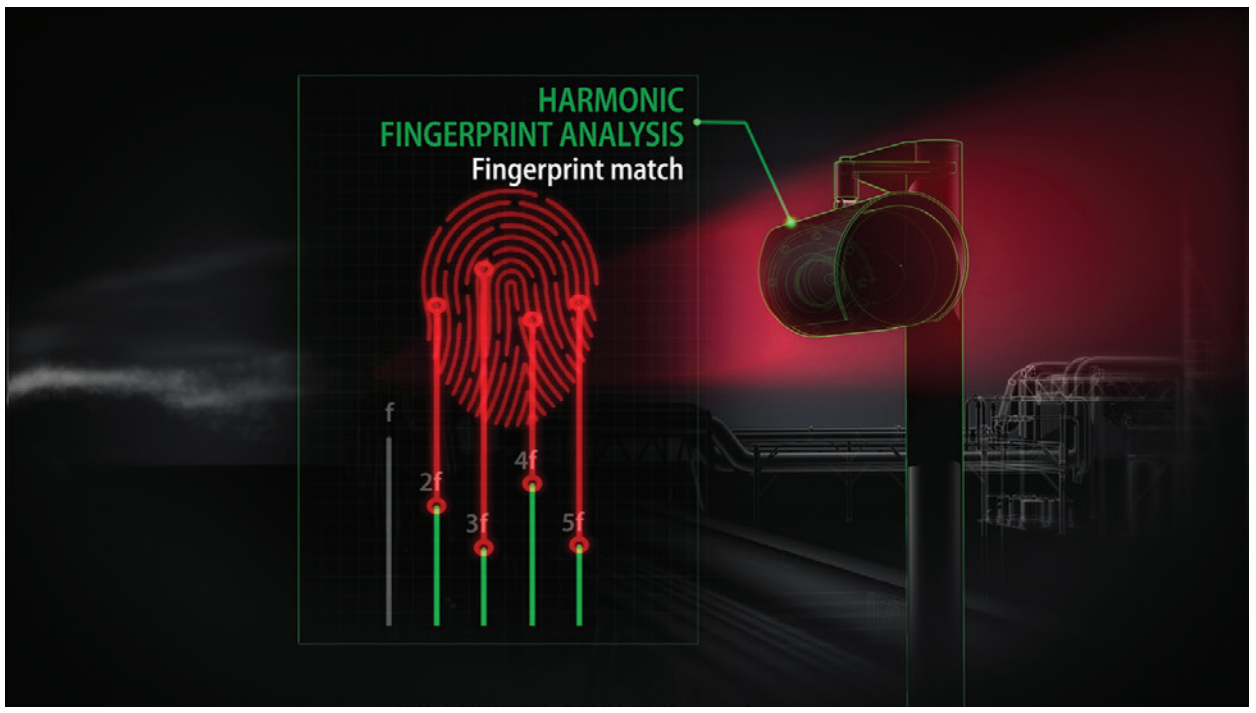

Fig 5. ELDS Gas Detectors

During operation some of the detector's laser light is reflected continuously through a sample of the target gas in a hermetically-sealed reference cell. This design allows the laser to remain locked on the selected target gas's unique wavelength. The detector's harmonic fingerprint technology (Fig 5) helps enable precise gas recognition, eliminating the potential for false alarms, even during adverse environmental conditions.

False alarms caused by interference gases, which are experienced with other detection technologies, are no longer a problem. Unlike electrochemical cells, ELDS sensors are also immune to sensor poisoning and interferent gases, due to their gas specific harmonic fingerprint detection method.

ELDS detectors are designed with Class 1 eye safe lasers that penetrate thick fog, heavy rain and snow. With their automated diagnostic safety integrity self-check, there is no need for the typical sensor gas checks and recalibrations requiring field technician time.

Portable Area Monitoring Technologies

While fixed gas detection is essential for 24/7 monitoring of many critical petrochemical production, processing and storage areas, there are other areas that pose a hazard only when employees are present. In these locations, portable area gas monitors are a more practical solution to help protect employees performing a variety of maintenance and installation tasks. These area monitors can be tied into the personal gas detectors workers wear to provide a larger network of safety so if a leak occurs within the area being monitored, workers in that zone will be alerted via their personal detector of the hazard and take appropriate action.

The next generation of area gas monitors (Fig 6) has been designed to operate with the simplicity of a smart home device. Employees can set up a cloud-based area monitoring network through a highly intelligent, intuitive process and be ready-to-go right out of the box. Plant safety teams can then monitor multiple locations with cloud-based grid mobile apps designed to replace complex instructions, excessive scrolling and confusing menu selections.

Portable local or remote area monitoring with rapid setup and instant feedback gives plant safety teams the confidence they need to know that their workers and job site are safer. They monitor multiple combustible and toxic gases with the flexibility to change to different gases depending on plant or application or maintenance need. Long-life batteries with easy to read indicators and remote diagnostics offer continuous protection for up to sixty days.

The flexible design of area monitors and networks of area monitors simplifies routine maintenance tasks, such as work along a fence line, in confined spaces or any high-risk area where a gas leak might occur. When the area monitor does detect a potential gas hazard, alarms and evacuations will be displayed on-site to workers and to the person overseeing the network.

Fig 6. Portable Area Monitors & Networks

Conclusions

The future of gas safety is a layered sensing strategy that takes advantages of multiple sensor technologies, which are evolving and being optimized with new materials and construction techniques. In addition to better sensor and battery performance, sophisticated communications and cloud-based networks make safety systems more reliable and easier to operate with confidence. The safety industry, individually as companies and together collectively, is dedicated to reducing operational hazards in petrochemical plant environments to protect people, equipment and plants.

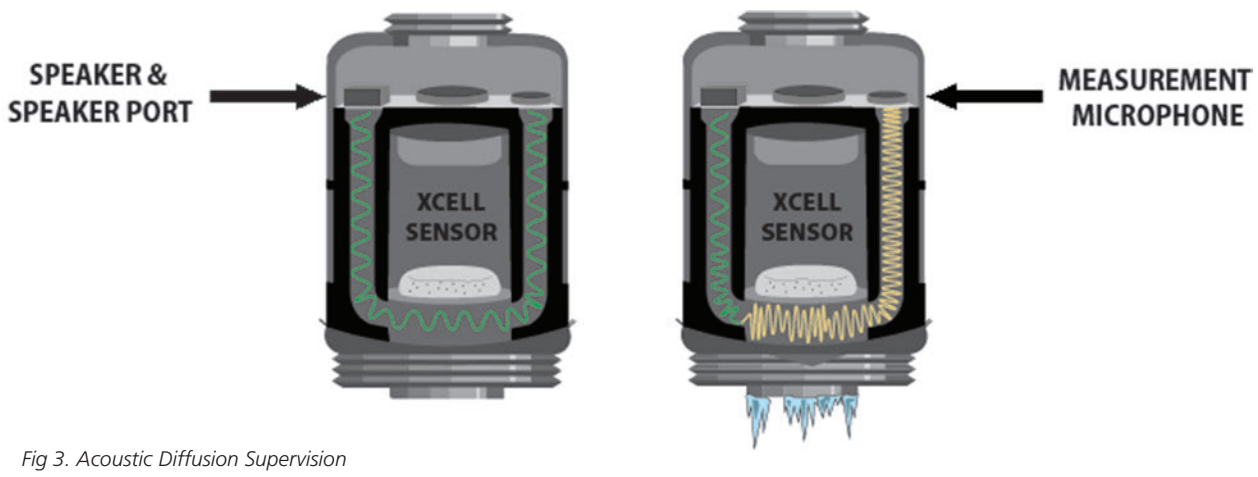

Fig 3. Acoustic Diffusion Supervision

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