What's your poison?

For plant engineers keen to avoid disaster caused by flammable or toxic gas leaks, Steed Webzell provides an update on some of the latest sensing equipment and methodologies

According to the HSE, in 2010–11 there were three fatal injuries, 84 non-fatal injuries and 116 over three-day injuries due to poisoning and/or exposure to harmful gasses. Clearly, failing to install an effective gas detection system can be catastrophic.

So, where to start? Well, the application tends to be a good place. According to gas sensing specialist Draeger Safety UK, pertinent questions for a plant engineer should include: What is the main purpose of the monitoring? Where, how often, and in what concentrations and quantities are the hazards likely to be released? How many sensors are needed? Where and how should sensors be positioned and calibrated? What alarm thresholds are appropriate? And how will alarm information be processed?

Draeger, quite rightly, is keen on the ethos that 'position is everything'. Quite simply, sensors should be positioned so that gas accumulations can be detected well before they create a hazard. And the firm reminds plant engineers that any or all of point, area and perimeter monitoring strategies can be implemented to suit different workplace environments.

Gas type has a huge bearing on positioning. For instance, vapours from combustible liquids are heavier than air and so sensors should be positioned close to the ground. However, combustible gases, such as methane, ammonia and hydrogen, are lighter than air and accumulate near ceilings. Equally, as the distribution or dispersion of toxic gases that are heavier than air, but present in low concentrations is mainly dependent on thermal air currents, they should be monitored at head height (the breathing zone).

Once positioning has been tackled, the sensor options themselves come into play. Here, most pundits agree that more options now exist for gas detection than ever before. Interestingly, however, among the most obvious trends has been the evolution of wireless units, which add to the flexibility of conventional portable and fixed detectors. At the same time, improved technology means that modern gas detectors can be as small as mobile phones.

For example, Draeger's X-am 5600, which is believed to be the smallest portable gas detector capable of seeing up to six gases, measures just

47 x 130 x 44 mm. Combining infrared (IR) sensors with miniature electrochemical sensors, it is immune to poisons such as hydrogen sulphide, and can be used to detect explosive hazards, as well as toxic gases and vapours.

Meanwhile, when it comes to fixed gas detection systems, key sensor selection criteria include: fast response; stable signals; good measurement performance; low drift; long lifetime; extended temperature ranges; poison resistance; and wide measuring ranges.

Of course, there are always special applications – and working in confined spaces is among the most common of those. Here, the operators often have to wear protective clothing and may be harnessed, as well as carrying tools and equipment to complete the task in hand (eg: welding). The last thing a worker in this environment needs to worry about is the gas detector. So it should be designed specifically for confined space entry, be unobtrusive and have a clear display that is easy to see at a glance.

With these thoughts in mind, gas firm Crowcon says it went back to the drawing board. Its result was Gas-Pro, which is not only smaller than conventional, front-mount diffusion detectors, but also provides a bright, clear top-mount display and tri-colour status indication, enabling quick monitoring of gas test, calibration, over-range and recent alarm notifications.

Infrared developments

Crowcon also has an interesting spin on IR detectors for flammable gases, such as methane and other potentially explosive hydrocarbons. Unlike conventional detectors, the company's IRmax does not use heaters to prevent condensation on windows and mirrors. Instead, its optical components are treated with a durable hydrophobic coating called Stay-Clir that prevents signal faults due to condensation. And, in a new development, Crowcon has also introduced the HART communication protocol, the global standard for digital information communications between smart devices and control or monitoring systems.

With so many types and makes of gas detectors available, it's useful to know that specialist Scott Safety has produced a reference guide (available free on its website) to help plant engineers and technicians understand and identify the properties and hazards of gases in the workspace – and how best to protect themselves. The guide lists gases and the effects they can cause, ranging from suffocation to cancer, fire and explosions.

It also lists exposure limits (the quantity to which workers can be exposed) for each gas, classified as permissible exposure limit, short-term exposure limit and threshold limit value. Understanding detection limits is a key part of the equipment specification process, as Mike Fikuart, managing director at gas detectors company Industrial Design, confirms.

"It's vital to understand what the detection limits are and what they mean. For instance, the LEL [lower explosive limit] is defined as any concentration of gas [by air volume] that can be ignited and support a flame. Anything below the gas LEL threshold will not burn and so does not present imminent danger."

That said, it is important to remember that the actual concentration of gas in air that matters depends on the type of gas. For instance, methane gas over 4.4% by volume is capable of ignition. "When dealing with flammable gases, even a percentage of less than 50% LEL [for example, 2.5% methane in air] needs to be acted upon, although it does not present an immediate ignition danger," states Fikuart. "50% LEL is an arbitrary threshold, but one that is widely adopted as the highest safety limit before shutting down machinery [or other sources of ignition] in the area exposed to leaked gas."

Incidentally, one interesting new development for those looking to transfer the onus of knowledge from people to technology is the Sentro 1, from Trolex, which has 'intelligent', plug-in gas sensing modules. Each of these pre-calibrated input eModules is capable of storing all necessary data about type identification, sensing range and calibration. The eModules can be substituted at any time by replacement modules, without the need for calibration by a technician.

Alas, there is no one-size-fits-all solution when it comes to gas detection. Each application must be considered carefully with regard to system type and positioning. That said, everyone is surely pleased we have better solutions than caged canaries to protect workers from gas leaks. PE

Above: Trolex's Sentro 1, with its intelligent, plug-in gas sensing module
Left: Remote gas detection in action
Bottom left: Crowcon's infrared Stay-clir sensor

Hot topic

Looking beyond the norm for gas detection, thermal imaging technology provides an interesting alternative for finding (but not identifying) leaks in some cases. Among main advantages here is the speed with which inspections can be conducted and leaks pinpointed.

According to infrared cameras manufacturer Flir, thermal imaging allows thousands of components to be scanned in a single shift, without any requirement to interrupt the process. Gas leaks can be visualised in real time at a safe distance – and, by changing lenses, the operator can capture a complete scene or focus on a small detail.

Thermal imaging can be used to detect a range of greenhouse gases and VOCs (volatile organic compounds), with leaks appearing as plumes of 'smoke' through the camera's viewfinder or LCD. A thermal sensitivity of less than 25mK should be the benchmark for this field of work and some models also have a high sensitivity mode to enhance their capability. No post-processing is required and video footage can simply be played back via a proprietary media player, such as Windows.

By comparison with 'sniffer' technology, thermal imaging is left of centre. However, the obvious benefit is that it can be used to scan large areas – even kilometres of pipeline in real time from a moving vehicle.