GOING DIGITAL CAN IMPROVE ENVIRONMENTAL, HEALTH AND SAFETY PERFORMANCE

What does 'digitalisation' mean to environmental management technology? Computers have been used for process control since Fortran 77 was developed in the late 1950s. Commercial transactions have been executed in ERP computer systems for decades. So, what's new about 'digitalisation' for the environmental monitoring sector? And, how can companies active in this industry benefit from getting ahead of the curve? Artificial intelligence (AI), the internet of things (IoT), big data and 3D virtual reality are all examples of sub-sets within the broad digitalisation agenda. Each of them is being applied daily to have a positive impact on environmental management.

Big data is being used to capture and analyse thousands of environmental monitoring data points which are then analysed to make conclusions about the impact of emissions sources on the ambient environment. Cylinder gases distributors, such as Coregas who operate in Australia and New Zealand, are using barcode scanning to track storage assets and maintain a database of cylinder locations that can be made visible to themselves and their customers. The environment can be protected, revenues can be maximised, costs can be reduced, safety is improved, and start-up times are minimised. Everything adds up to a powerful business case for a digital transformation in environmental technology.

UEC WirelessHART Gas Detector side view

Process safety: WirelessHART fixed location gas detection systems to augment existing hard-wired systems on refineries and oil storage terminals

Many refineries operate with a process safety target of zero incidents. But, to achieve the holy-grail of zero requires an absolute and unrelenting commitment to continuous improvement in safety practices and related equipment. This is a driver for the augmentation of existing gas detection systems with additional devices to increase the coverage density of gas detection and further reduce the risks of potentially hazardous leaks going undetected.

On an established refinery the idea of digging new cable trenches for hard-wired fixed gas detection systems would require permitting, engineering management of change reviews, HAZOP studies and costly ground-work. The expense, complexity and lengthy timeline of the installation would demand strong benefits to justify the project.

But in the modern digital world of Industry 4.0, there is an alternative that may result in a much simpler project at lower cost and faster execution: to use wireless fixed gas detection units. And, if they are battery powered and can communicate with a wireless non-proprietary (ie open) protocol, such as WirelessHART technology, their installation and configuration can be achieved in a matter of hours, not weeks.

According to Julian Yeo, Strategic Marketing Manager at United Electric Controls, "ten years ago, the thought of using a battery powered wireless gas detector would have either been a technical fantasy or the costs for a pilot unit would have been prohibitive. Today, the combination of sophisticated power management systems that increase the battery life to an acceptable multi-year period and increased production volumes has made commercialisation possible. Unit for unit, they are still more expensive than a wired device of a similar specification, but from a total cost of installation (materials and labour cost) perspective, deploying gas detectors like the Vanguard WirelessHART can reduce the installed cost by more than 50%.

Furthermore, in some cases the installation cost is not the deciding factor. If a gas detection system is required immediately, then wireless may be the only option that is quick enough to be installed in an acceptable time window. Deployment speed is also enabled by the WirelessHART technology used by the Vanguard, which can be an 'instant drop-in' solution to augment many existing fire and gas systems for data gathering. Consider that the environmental regulator or a safety audit has mandated that operations be terminated until corrective action is taken. The daily costs of non-operation can be many times the cost of the gas detection installation, so speed will be the governing factor.

Throughout this case study, we have referred to 'augmentation' of existing systems not 'replacement'. Why? Is the state of the art for wireless devices not yet ready to eliminate the fixed systems? Yeo answers the question: "the Vanguard was designed to augment gas detection capability in hard-to-access areas or remote areas. It is meant to complement fixed systems instead of replacing them. While WirelessHART technology is extremely reliable and operates on a self-organising and self-healing mesh network, it is still used primarily in monitoring applications and even some open loop control applications. For closed loop control, wired devices are still the preferred choice".

Yeo is positive about the future; he says that "for many industries, the jumpstart begins with a paradigm shift in how WirelessHART

Toxic and hazardous products

Hand-held portable gas leak detection

technology is perceived and used. For good reasons, refinery operators are cautious and will generally want to observe new systems in parallel to existing techniques before trusting them 100%. But in the future, it is likely that critical alarms and process trips will also be triggered by these wireless devices in the same way that their hard-wired cousins are doing today".

Beyond process safety: long term health and environmental benefits

Gas detection systems also sniff for toxic VOC gases such as Benzene, Toluene, Ethylbenzene and Xylene (BTEX) to minimise health risks to the plant operators. Increasingly, gas detection systems are being used for environmental monitoring of VOC emissions from valves, flanges, pumps, compressors and pressure relief devices.

Fixed detectors can continuously monitor for leaks 24 hours a day and are replacing hand-held portable systems that require operators to walk the site sniffing for leaks. This results in labour cost-savings and demonstrates to the environmental regulators that improvements in monitoring are being made. Furthermore, through maintenance for leak reduction, the monitored results can also demonstrate a long-term reduction in VOC emissions. The result is better for the environment and better for the process economics: leaks represent waste. This is a compelling reason to augment existing fixed gas detection systems with wireless devices.

To ensure that these emissions are measured in a harmonised way, the US EPA has published Method 21 – 'determination of volatile organic compound leaks'. It prescribes suitable distances between the potential leak point and the gas detector and makes proposals for suitable gas detection technologies such as photoionisation, infrared absorption or catalytic oxidation.

Method 21 also specifies the frequency of calibration of gas detection systems and the nature of the zero and calibration gas mixture cylinders that should be used. It confirms that the Zero Gas should be: 'Air, less than 10 parts per million by volume (ppmv) VOC'. For calibration gas mixtures it is equally clear. 'If cylinder calibration gas mixtures are used, they must be analysed and certified by the manufacturer to be within 2 percent accuracy, and a shelf life must be specified'.

So, where can gas-detection system users source a product with this specification in the Asia Pacific Region? Alan Watkins, Executive General Manager at Coregas in Australia has the answer: "at our Specialty Gases laboratory in Yennora, close to Sydney we can prepare highly sophisticated calibration gas mixtures for gas detection. BTEX mixtures with concentrations as low as 1ppm can be supplied with a Coregas QC certificate with an accuracy within 2 percent which complies with the Method 21 requirement.

"When it comes to the Zero Gas, clearly it should contain minimal amounts of the target chemical species to be detected. The Coregas 'Zero Air' product specification is less than 1 ppm of total hydrocarbons, which is one order of magnitude less than the Method 21 requirement, so our product comfortably exceeds that specification".

What next for digitalisation?

Up to now, it is estimated that the penetration of wireless gas detectors within the chemical sensor type fixed systems is approximately 5%. In the next five years, it is possible that the penetration of wireless solutions within this segment will double. This will be driven by new adopters and increased usage by the early adopters because the wireless system is so naturally scalable.

As digitalisation gains hold in industrial automation, virtually every analogue device will be digitalised as the preventative maintenance is replaced by proactive maintenance driven by inexpensive data aggregation and intelligent analysis. The first step has already begun as electromechanical switches are increasingly replaced by electronic counterparts. In this regard, United Electric Controls also offers the 'One Series' HART enabled electronic switch. Its unique feature is the combination of a local solid-state relay which allows the device to execute a process control intervention (eg closing a valve) while transmitting data via the HART protocol.

UEC One Series gauge kg-cm

The HART enabled One Series is packed with intelligent self-diagnostics which report minor faults before they escalate to major safety issues and will work seamlessly with control systems in refineries deploying the up-and-coming Field Device Integration (FDI) technology. At present, the electronics are quite power intensive, and a battery-operated WirelessHART model does not yet exist. However, with a bit of creative electrical engineering this technology may soon follow in the footsteps of WirelessHART gas detection.

Hamburg refinery

Toxic gas storage area

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