Applications of Stationary Photo Ionisation Detectors

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PID (Photo - Ionisation - Detectors) are used to detect substances which are not detectable with other methods, like in solvents or fuels. These so – called VOCs (Volatile Organic Compounds) are not only present in all chemical industries, but also in areas where one would not expect them. The food industry is using fast ink jet printers to print the best before date on food packages, for example; these printers use relatively little ink. One gallon of ink is enough to print 2 – 3 million characters, but these printers work extremely fast: they can mark 10,000 packages per hour.

Typical ink solvents are; MEK (0,2 ppm), Ethylene cellosolve (10 ppm), N – Methyl pyrrolidone (20 ppm), Tetraethylene cellosolve (toxic) and Pentan dione (toxic). If we assume each package is marked with only 10 characters, this adds up to 1 million characters printed per workday. This means, 1/3 gallon solvent evaporates per shift. In a badly ventilated workplace, during 3 shift operation, or if several printers operate in the same location, the allowable concentration may be exceeded. Gas detection to protect the workers is imperative.

Operation

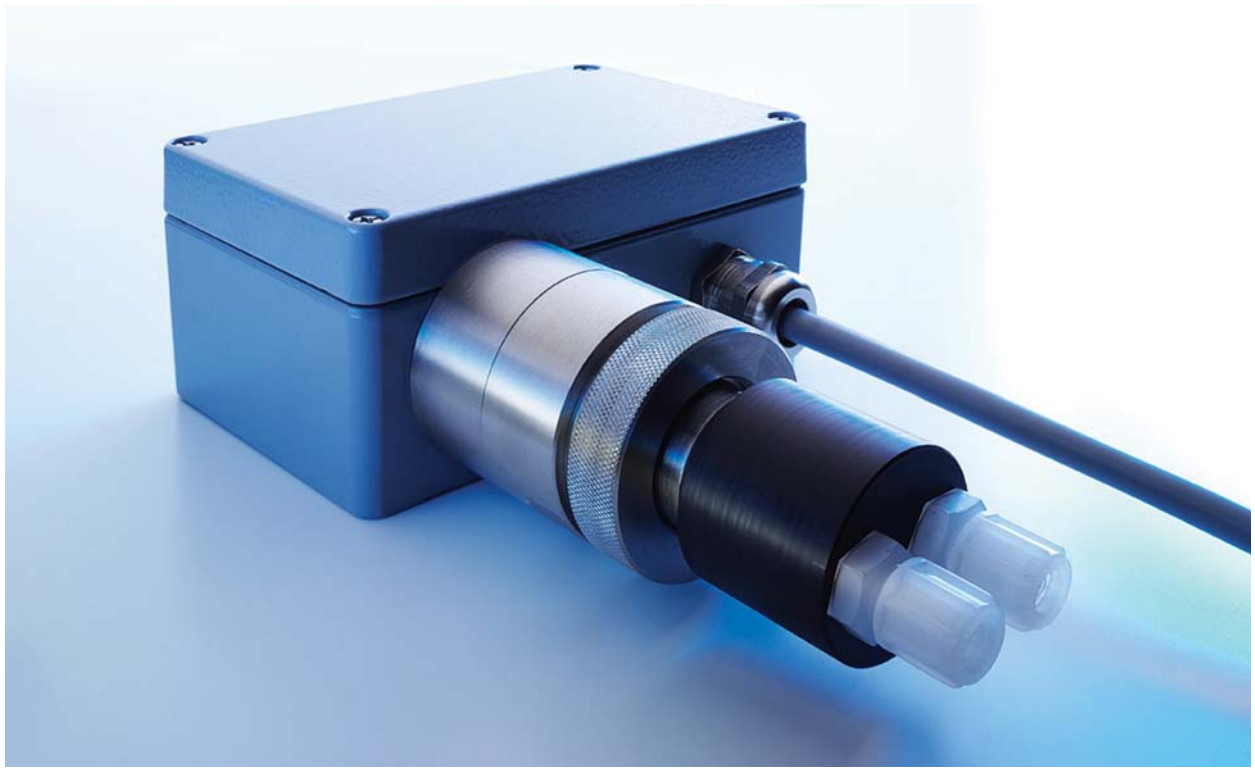
A PID uses a high energy ultra violet light beam to break the gas molecules into radicals. These radicals discharge on the electrodes of a condenser. This discharge current is proportional to the number of molecules, i.e. the gas concentration. The Statox 501 PID operates with a 10,6 eV lamp, consequently detecting all substances which are ionised below 10,6 eV. As the molecules recombine after leaving the measuring cell, the PID can be regarded as a physical measuring method, as there is no material transformation taking place.

Physical methods of gas detection are fast and robust; PIDs are capable detecting gases which cannot be measured with other sensors. Therefore one could expect that this technology is a worldwide standard in gas detection. In reality, this technology has just started to expand. The first PID instruments were brought to the market in the United States of America. In 1970s they were first used to detect Vinyl Chloride monomer. Incrementally, scientists discovered how versatile this technology is and then started measuring reference factors for other gases. PID sensor technology has been used throughout history, primarily in portable instruments for leak detection and industrial hygiene applications.

Positive and Negative Aspects of PID

In comparison to FID which is also capable of detecting VOCs, the PID does not need hydrogen as fuel. FID, Flame Ionisation Detection, uses a hydrogen flame to break the gas molecules into radicals. Applications with hydrogen involved can prove unpopular because they tend to be labour intensive. Apart of the safety risk caused by this highly explosive gas, its transportation and storage is subject to strict regulations.

PID and FID are not specific to a certain substance. While FID will detect anything that has a C-H bond, the PID will detect all substances with an ionisation potential below 10.6 eV. Both



sensor technologies are very sensitive: reliable measurements in the lower ppm or the upper ppb range are attainable.

As a PID is not specific to certain gases, it will monitor all gases that are present; therefore the user must know exactly which gases might be present in the area.

Not all gases will be detected with the same sensitivity, response factors must be observed when calibrating the instrument. For this reason, any sensor interface can be made to specification by Compur Monitors ex works. The user only needs to specify his application to avoid nasty surprises such as false alarms.

For field calibration, Isobutene, is always used; this gas is easy to manage, as it is non-toxic, non-corrosive and therefore stable and, in the concentration used for calibration, non-combustible (LEL = 1,6 %). Isobutene has therefore become a standard for PID calibration. The correct reading of the Statox 501 PID is achieved by correcting the isobutene reading with the relevant response factor.

As the sensor is using light as an energy source, gases which are light – absorbing will have an affect. When gases occur in very high concentrations they might absorb so much energy, that there is not enough energy left for the ionisation of the target gas; as a consequence the reading will be too low.

The user needs not only knowledge of interfering gases, but also about gases that might cause this so - called quench effect.

Marketing Myths

Extreme sensitivity

Some manufacturers praise the nearly unlimited sensitivity of the PID. Indeed is it possible to detect some gases in concentrations as low as 2 ppb. This may be a nice feature as long as the target gas is measured in a binary gas mixture, i.e. air plus one well known substance. As soon as a PID is operatational in an industrial atmosphere, super sensitivity is no benefit. It is common knowledge that in a plant there are always some ppb of gas around; there is no need to spend money to determine this. Frequent false alarms will be a too high price paid for super sensitivity. Compur Monitors recommends not selecting an overly sensitive measuring range for fixed PID systems.

Maintenance free

A physical method of gas detection is maintenance – free. No! To an even greater degree than a normal light bulb, a high energy PID lamp is subject to increased wear and tear. A PID

lamps light intensity will change or decrease from pollution and intensive use. Pollution can be removed with the help of a special lamp cleaning kit. The only response to wear and tear is replacing the lamp or even the entire sensor unit. Depending on, how dirty or corrosive the atmosphere is in which you want to operate your PID, you have to calculate with maintenance intervals between 3 and 9 months.

Handling

The Compur Statox 501 PID gas detector consists of two components: sensor head, consisting of sensor, interface and housing and a Statox 501 control module. The sensor is located in a stainless steel cylinder, which is flanged to the interface, also located in a stainless steel housing.
The interface transforms the sensor signal into a linear, temperature compensated signal, related to the target gas concentration. This signal is transmitted to the Statox 501 control module, which provides the outputs for peripheral instrumentation: 3 relays which can handle up to 2 A and a 4 – 20 mA analogue output.

The sensor head itself, installed in the field, is designed in protection class Ex (ib) em, therefore it can be operated without any additional Zener barrier or repeater. This saves money, installation cost and space in the control room. Operation is very easy: a magnetic pin triggers hall sensors inside the sensor head and thus gives access to a simple menu for calibration and parameter setting.

The sensor can be removed from the interface without tools. As the sensor is intrinsically safe, there is no need to declassify the area before removing it. In addition, the sensor is mechanically coded, so that it can only be installed in the correct position.

Does the industry need fixed PIDs?

Compur Monitors thinks: yes!

PIDs are capable of detecting gases that cannot be detected with 'classic' gas sensors. The PID method has been field – proven in hand held instruments, in the recent years. Now sensor technology has advanced to a level, in that it can be used in fixed systems too. This is a more challenging application of PID, as:

a. They are in operation around the clock

b. They cannot move away from high concentrations together with the user, as portable instruments would do

With the Statox 501 PID, the user has an instrument on hand, including measuring programs for 0 – 10,00 – 100, 0 – 1.000 and 0 – 10.000 ppm. (The true measuring range for the target gas is defined by the PIDs specific response factor to it). PID will give an overall reading of gases with an ionisation potential below 10,6 eV and it requires a degree of maintenance.

Provided the application has been well defined beforehand, this sensor technology will reliably monitor substances such as VOCs with high sensitivity. It is easy to use and affordably priced.

The bottom line: a valuable progress in gas detection!