



The Benefits of IR Gas Detection for Oil and Gas Applications

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Gas detection has been through a number of evolutions since the birth of the industry over 50 years ago. A major milestone in its history has been the introduction of Infrared (IR) gas detection, which uses a Hydrocarbon gas' ability to absorb IR light at a pre-determined wavelength. Thanks to its notable value, which includes a fast speed of response (typically T90 in less than 5 seconds), fail-to-safety operation, immunity to poisons and ability to work in inert atmospheres, IR detection is fast becoming a popular method of detection - particularly within the oil, gas and petrochemical industries.



Since the conception of IR gas detection in the late 1970s, a variety of key principles have been developed but the one most widely used for gas detection is Infrared absorption. In fact, this principle has formed the basis of the majority of IR gas detectors for the last 20 years.

Principle of IR detection

IR gas detectors compare the amount of light at a certain wavelength (colour) where Hydrocarbon molecules absorb light (known as the sample) with light at a wavelength where no absorption occurs (known as the reference). When the light passes through a Hydrocarbon gas, the intensity at the sample wavelength will drop, while the intensity at the reference wavelength will be unaffected. The ratio of the two signals is proportional to the gas concentration.

An IR detector consists of one or more infrared sources, one or more infrared detectors and optical filters to separate the sample and reference wavelengths from the background light. It also requires a light path which is open to the atmosphere so that gas can diffuse into the light beam.

There are two basic types of IR gas detector - a Point detector, where the light path is very small (approximately a few inches in size) and an Open Path detector, where the light path is much longer (up to 200 m). An Open Path detector usually has two components with a beam of infrared light between them, and detects a gas cloud that drifts into the beam, which can improve the chance of detecting a gas leak and reduce the number of point detectors that are required.

In fact, Honeywell Analytics worked in partnership with a large oil company to produce one of the first Open Path flammable gas detectors in the World. The commercially available version, known as the Searchline, was launched in 1988 and was the first hazardous area certified Open Path detector on the market. This collaboration highlights the oil, gas and petrochemical industry as not only an early adopter of gas detection technologies like IR, but joint pioneers in its application for gas detection.

IR and maximising device stability

The configuration of the hardware and firmware used can greatly affect the performance and stability of an IR gas detector. The use of processors, algorithms and optical hardware configurations can make the difference between a highly stable device that minimises cross-interference from other gases like CO₂ and compounds like water or a device that produces spurious alarms and other operational issues.

With a Point IR gas detector, one objective is to produce a device that does not require calibration and is resistant to drift in span and zero. This gives the maximum confidence in the operational performance of the detector and reduces the cost of ownership. Maximised uptime and performance is a key benefit of IR gas detection over catalytic bead based detectors, which require regular calibration due to loss of sensitivity through their operational life.

The IR principle relies on the physical properties of the molecules to be detected and is a highly stable detection solution for Hydrocarbons. However, in practice there are electronic and mechanical drift issues that can compromise the stability offered by some IR gas detectors. This stability is achieved by the configuration of the optical system itself.

The source of light, normally an incandescent lamp, may drift in two ways. Firstly, the absolute intensity of the light may increase, decrease or even fluctuate. This must be distinguished from signal changes due to absorption by gas. Secondly, the emission spectrum of the source may change with time. This is known as a change in the "colour temperature" of the source. A change in colour temperature results in a relative change in intensity of the sample and reference wavelengths.

Optical Configurations and their limitations

Various optical configurations could be considered for point detectors, including:

Single source single detector: Only the sample wavelength is selected and measured at the detector. This scheme cannot distinguish between a gas reading and source or detector drift, or any dirt or moisture in the optical path. Therefore, it is only appropriate for a sealed instrument like a device used in a laboratory or sampling system.

Single source dual detector: This type of system features two detectors that are filtered for sample and reference wavelengths of light. The source is susceptible to colour changes as it ages, which can be mistaken for zero drift or gas but the use of two detectors discriminates between overall changes in source intensity. Any detector drift could be interpreted as a ratio change, therefore care must be taken to locate the detectors as close as possible to each other, so that they experience the same environmental conditions (e.g. temperature).

Dual source dual detector: With this configuration, in addition to measuring the sample and reference wavelengths, this type of system can compensate for source and detector drift. There are two light paths in the device - the "measure" path interacts with the outside atmosphere and hence the gas, whilst the "compensate" path remains inside the device. Thus, the real gas reading can be separated from internal component drift.

IR device design and maximising performance and stability

As one of the World's leading optical gas detection manufacturers, Honeywell has developed a number of solutions that are considered to set the benchmark for IR detection within the industry. Honeywell delivers a winning combination of fast, stable performance, minimal cross-interference and maximised uptime by combining intelligent optical configuration design with algorithms and software that compensate for factors that have traditionally compromised IR



Searchline Excel

detection. These products are capable of delivering enhanced performance with T90 responses of less than 1 second, compared with comparable solutions that may take up to 10 seconds and unparalleled performance in all weather conditions.

Acclaimed products include Searchline Excel - a high performance Open Path IR solution designed to offer maximised uptime, minimised cross-interference and immunity to sunlight, rain, fog, snow and sea spray. The device's weather immunity is achieved by using a Xenon flash lamp that is actually brighter than the sun at infrared detection wavelengths. Its lamp is also modulated to have a unique pulse duration and shape. Searchline Excel's receiver then uses high speed digital signal processing to validate that all the signals received have this unique signature and rejects any extraneous signals. This makes Searchline Excel the leading-edge solution for Open Path IR gas detection technology.

A big factor in this device's success is its filters and optical component configurations. By comparison, many models use software to mask design inadequacy and this can lead to performance issues under various weather conditions and the occurrence of false alarms. Searchline Excel uses a patented double band pass filter that can fully compensate for water molecules (from fog, rain or sea spray) found in the path.

When it comes to Point IR detection, Honeywell Analytics' Searchpoint Optima Plus has an IR detection principle that offers the fastest speed of response and fail-to-safety operation, ensuring maximum uptime and stability. The development of advanced internal fault diagnostics and false alarm rejection algorithms ensures that Searchpoint Optima Plus delivers the highest level of operational integrity. Searchpoint Optima Plus uses a 4-channel (dual compensated) optical design to accommodate changes in the external environment and to compensate for long-term component drift. This enables Searchpoint Optima Plus to be one of the most stable optical designs available. The popularity of these two products and their increasing installed base globally, is a clear testament to the fact that IR detection implementation is gaining momentum. Historically the gas detection market is conservative regarding new technology, and some 30 years since its conception, it is only now that we are seeing a major trend towards IR detection implementation in a wide diversity of applications and environments.

Many sites that have traditionally used catalytic beads are changing their systems to Point IR, whilst sites that have traditionally used Point IR are now integrating Open Path to include a mix of both. There are various factors catalysing these market trends. Despite having a higher purchase price than a catalytic bead gas detector, IR provides tangible value in reducing on-going maintenance costs. Businesses factor in whole product life costs, making ongoing device maintenance requirements an important aspect when it comes to selecting a principle of detection. IR Open Path's ability to monitor a long path length (up to 200m with a device like Searchline Excel), makes it the premier choice for perimeter monitoring of Hydrocarbons cost-effectively. IR detection's ability to offer no unseen modes of failure and enhanced self-checking diagnostics that can assist with planned maintenance regimes by warning of developing issues like dirty optics is highly attractive to today's gas detection purchaser.

Another key driver has been the online availability of devices; for example, an Open Path system is able to "know" if it is online and able to see gas due to the constant communication between transmitter and receiver. Safety Integrity Levels (SILs) have emerged out of this need to minimise the unrevealed failure modes and provide ratings to components and final system configurations based on their Probability of Failure on Demand (PFD). The lower the PFD fractions, the higher the SIL rating of the device (1-4 in Europe with 4 having the lowest PFD value), and to rate a final system, all components must be taken into consideration including how they are installed and applied. SIL rated solutions are being specified more and more by Oil, Gas and Petrochemical applications.



Searchpoint Optima Plus

IR Point detection value:

- Enhances site safety and maximises uptime
- Fail-to-safety operation
- Device is able to warn of developing issues such as beam block/dirty optics
- Excellent performance
- T90 in less than 10 seconds
- Minimised cross-interference
- Reduces the on-going cost of gas detection
- Assists with preventative maintenance regimes through the ability to warn of issues before a fault occurs
- Flexible use for a wide range of environments
- Works in inert atmospheres
- Immunity to poison

In addition to these aspects, Searchpoint Optima Plus also provides the following value:

- Detects over 100 Hydrocarbons including solvents
- Reduced power consumption
- Dynamic heating controls to ensure condensation-free optics
- Integral event logging and enhanced diagnostics help to assist with cost-effective maintenance
- Intelligent microprocessors provide algorithms and signal processing that offers enhanced false alarm rejection
- Immunity to long term component drift maximises uptime and reduces the ongoing maintenance requirement
- Remote or inaccessible locations can be monitored effectively by modifying the device into a gas sampling system with flow housing
- When used with the DVC 100(l) junction box, Intrinsically Safe (IS) connection socket and Honeywell's Hand Held Interrogator (SHC-1), one-man maintenance is permitted without the need for a hot work permit
- Certified for use in use in a wide range of application with ATEX, UL, CSA

IR Open Path value

- Enhances site safety
- Provides a greater chance of seeing gas through the monitoring of a long open path
- Fail-to-safety operation
- Fast speed of response: typically T90 in less than 5 seconds
- Reduces the ongoing cost of gas detection
- Greatly reduces the number of points of detection required
- Permits preventative maintenance regimes with ability to warn of developing issues such as dirty optics/blocked beam
- Flexible use for a wide range of environments
- Works in inert atmospheres
- Immunity to poisons

In addition to these aspects, Searchline Excel also provides the following value:

- Immunity to weather including sunlight, rain, fog, snow and sea spray
- Increased sensitivity that allows for the measurement of between 0-100% LEL (Lower Explosive Limit) or LEL metres
- Excellent speed of response with T90 in less than 1 second
- Operates over a range of up to 200m with a single transmitter and receiver configuration