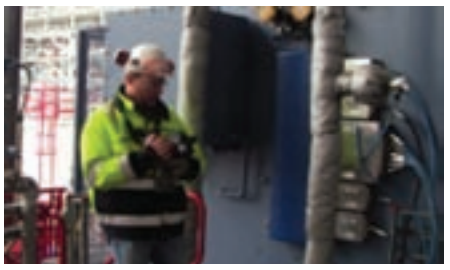
Optical Gas Imaging Camera Helps Improve Environment and Safety at Borealis Stenungsund

Steve Beynon, Business Development Manager EMEA for GF Cameras & Optical Gas Imaging at FLIR Systems
Tel: +44 1604 641180 • Email: steve.beynon@flir.com

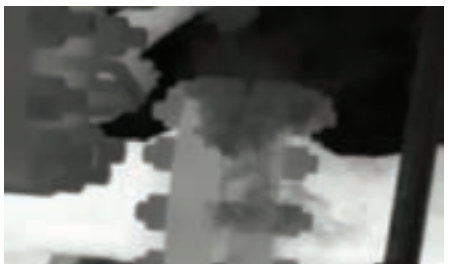
Many petrochemical plants handle invisible gaseous hydrocarbons. Most of these gases pose some sort of safety aspects. They may be toxic, or can cause health issues in case of long term exposure. Others are highly flammable, explosive even, and most of them will have a negative impact on the environment if they enter the atmosphere in large quantities. That is why leak detection is of vital importance in these petrochemical plants.

One of such plants is the Borealis high-pressure, low-density polyethylene (LDPE) plant in Stenungsund, Sweden, which produces LDPE products for the cable and wire sector and has an annual production capacity of 350,000 tonnes. The Borealis cracker facility delivers the main ingredient: ethylene, which is converted into polyethylene in a high-pressure polymerisation process.

Ethylene is a highly flammable hydrocarbon. To further increase the safety within the plant and reduce the environmental impact, Borealis has purchased an optical gas imaging camera from FLIR Systems. With this gas leak detection tool Borealis ensures that no gas leak escapes the attention of the process operators.



Shift supervisor LDPE Jan Åke Schiller was skeptical at first, but is now convinced of the potential of optical gas imaging cameras.



Leaks show up in the optical gas imaging footage as a smoke like vapour

An optical gas imaging camera is a quick, non-contact measuring instrument that can visualise gas leaks in real time. Where many other measuring instruments only present the inspector with a number, optical gas imaging cameras present visual information, making the leak detection process more intuitive. Optical gas imaging cameras can also be used in hard-to-access locations, since they can detect small leaks from a distance. "When we started testing this relatively new technology I was at first very skeptical", says shift supervisor LDPE Jan Åke Schiller. "But seeing these optical gas imaging cameras in action I quickly realised that they had an immense potential for leak detection here at the polyethylene plant and in petrochemical plants in general."

Advantages of optical gas imaging

Before the purchase of a FLIR GF306 optical gas imaging camera Schiller and his colleagues used so-called 'sniffers', devices which measure the concentration of a certain gas in one single location and generate a concentration reading in parts per million (ppm). "The main advantage of the optical gas imaging camera is that it provides you with the possibility to detect gases visually", says Schiller. "Where sniffers just give you a number, an optical gas imaging camera allows you to detect gas leakage anywhere within the field of view of the camera. This speeds up the inspections considerably. Now that we have the optical gas imaging camera we do a quick scan at every startup. With a quick scan we cover approximately 80% of the entire plant in about thirty minutes. You would need a team of ten people with sniffers to work for two full days to reach the same result."

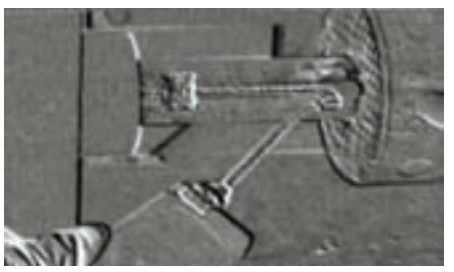
Polyethylene is used to produce a wide variety of plastics, from wiring insulation to car dashboards.

In the control room all gas flows throughout the plant are closely monitored.

This doesn't mean that they stopped using sniffers altogether, stresses Schiller. "We use the sniffers alongside the optical gas imaging camera. We use the optical gas imaging camera to detect the leak and then use the sniffer to quantify the leak." Schiller was surprised to see how sensitive the FLIR GF306 optical gas imaging camera turned out to be. "I detected leaks where the sniffer gave a reading of below 100 ppm, especially when operating in the High Sensitivity Mode this camera is surprisingly sensitive, it can be used to detect even smaller gas leaks from about seventy meters. This enables the operator to perform these inspections from a safe distance."

High Sensitivity Mode

The High Sensitivity Mode (HSM) is a special feature included in all GF-Series optical gas imaging cameras. It is an image subtraction video processing technique that effectively enhances the thermal sensitivity of the camera. The HSM feature subtracts a percentage of individual pixel signals from frames in the video stream from the subsequent frames, thus enhancing the differences between frames, which helps leaks stand out more clearly in the resulting images.



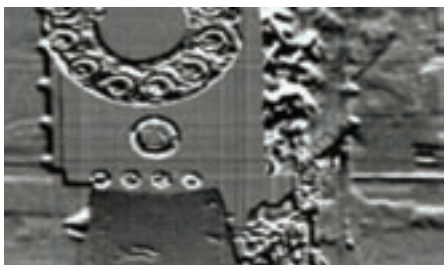
The small gas leak detected with optical gas imaging camera is quantified with a sniffer. As the concentration is below the threshold this leak does not get a high priority.

A sniffer must be held in exactly the right spot to detect a gas leak. Optical gas imaging cameras can detect gas leaks anywhere within their field of view.

All leaks to be repaired are reported to the maintenance crews. In this part of the process the use of optical gas imaging cameras also has an advantage over sniffers, according to Schiller. "When you are using sniffers you have to describe the exact location of the leak using words which can be difficult sometimes. With the optical gas imaging camera we can simply attach a video file to the work order and the maintenance crew will see for themselves where the leak is located. This allows me to spend less time on generating leak reports and more time out in the plant, detecting leaks, or performing other duties."

Higher inspection frequency

Due to the fact that these inspections are much less time consuming now that he uses the FLIR GF306 optical gas imaging camera the leak detection frequency has increased significantly, according to Schiller. "When we only had sniffers we did other yearly inspections. To cover all of the pipework that this plant contains, which is all in all over 100 kilometres in length, it takes a



Light temp deviation along ceiling probably due to deposits inside the piping

The GF306 optical gas imaging camera is compact, relatively lightweight and ergonomically designer, to prevent back and arm strain.

team of people with sniffers a whole week to inspect the whole plant. With the optical gas imaging camera this takes one person one day. Now that we have the optical gas imaging camera we inspect the entire plant twice a year and we also perform a quick inspection at every startup. So the inspection frequency has gone up considerably."

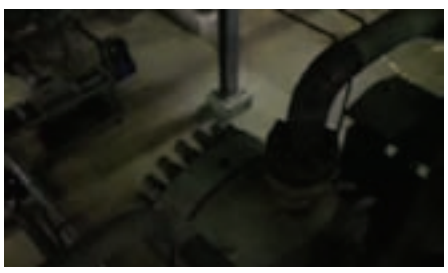
A tool that is used as often as the FLIR GF306 optical gas imaging camera is being used at Borealis in Stenungsund needs to be lightweight, compact and ergonomically designed to prevent back and arm strain. All FLIR GF-Series optical gas imaging cameras are ergonomically designed. With its rotating handle, direct access buttons and tiltable viewfinder and LCD screen the FLIR GF306 optical gas imaging camera is designed from the end-user's perspective, offering advanced ergonomics to improve worker safety. With a weight of 2.4 kg the FLIR GF306 optical gas imaging camera is also relatively light and compact.

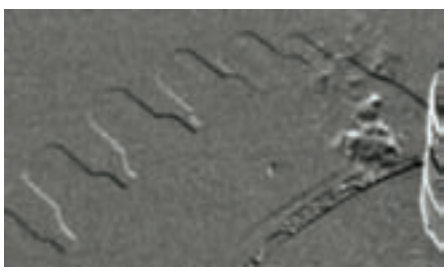
Infrared absorption

The FLIR GF306 optical gas imaging camera contains a cooled Quantum Well Infrared Photodetector (QWIP) that produces thermal images with a resolution of 320 x 240 pixels at a thermal sensitivity 25 mK (0,025 °C). The gas visualisation functionality of the FLIR GF-Series optical gas imaging cameras is based on infrared absorption. Gases absorb electromagnetic radiation in certain parts of the spectrum. FLIR GF-Series optical gas imaging cameras contain a spectral filter, a focal plane array and optics that are specifically tuned to such a part of the spectral range. Since the gas absorbs infrared radiation it blocks radiation from objects behind the gas, causing gas leaks to show up as either a black or a white plume in the thermal image, depending on whether the user opted for the 'white hot' or the 'black hot' settings.

Recording video footage

Apart from real time visualisation the FLIR GF306 optical gas imaging camera is also capable of recording both visual light video and thermal video footage. "This is very important, because the moving smoke like plume shows up much more clearly in a video than in a still picture", explains Schiller. "For leak reports we usually start our video recording in the visual video mode, to show the location to the maintenance crew, then we switch to the gas detection mode to show the leak and then we switch back to visual video mode to verify the leak location. This method has worked really well for us."





The FLIR GF306 optical gas imaging camera can detect even smaller leaks from a distance, such as this leak spotted using the HSM.

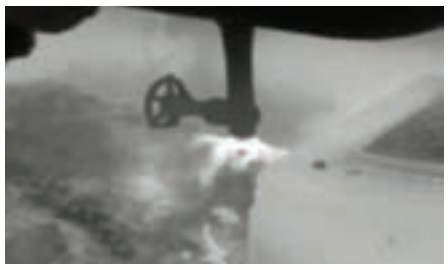
"This plant is relatively new, it was opened a few years ago to replace, the old polyethylene plant" adds Schiller. "The new polyethylene plant had a few teething problems, but with the help of the optical gas imaging camera we have been able to make it into one of the leak-tightest polyethylene plants in the world. To give an idea this new plant produces twice as much polyethylene as the old plant did, but the amount of VOC's escaping due to leakage is ten times less. In my opinion the FLIR GF306 optical gas imaging camera has helped to make this very low leakage rate possible."

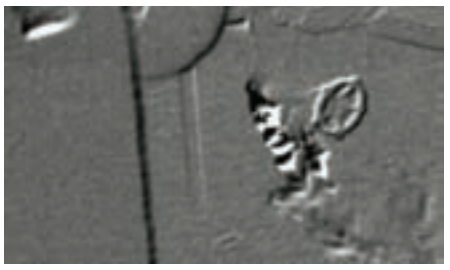
Detecting leaks in unexpected locations

According to Schiller one of the advantages of using optical gas imaging is that you will be more likely to detect the leaks in unexpected locations. "Leaks can really turn up in the strangest of places. There was one case where a support pipe was welded onto a bend in the pipework, but the welder had been overenthusiastic and his welding had caused a leak from the pipework into the support. With the optical gas imaging camera it was very easy to locate the gas escaping from the pipe support, since it stood out very clearly in the thermal image, but with a sniffer it would have taken ages to detect the leak, if we would have ever detected it at all, for who would look for leaks in a pipe support?"

"Another example of an unexpected leak location was when I found gas escaping from insulation material. Due to a leak in a connection at the other end gas leaked in behind the insulation and at the other end it leaked out again. And this is just one of a list of leaks detected with the optical gas imaging camera that would have been nigh impossible to detect with a sniffer. A sniffer has to be held exactly in the right spot to detect a leak, so the inspector will only hold in locations where leaks may be expected. With an optical gas imaging camera you see all leaks within the camera's field of view. You can use it to spot leaks easily, quickly and it makes your inspections more thorough."

This valve is leaking ethylene, showing up as white smoke in the black hot thermal image.



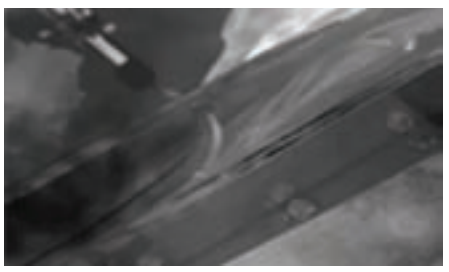


This HSM footage clearly shows a gas leak.

Worth the investment

"Some companies might be reluctant to buy an optical gas imaging camera due to the price tag, which is understandable as a sniffer is much cheaper", continues Schiller. "But the difference in purchase cost is deceptive. For one thing, inspecting with sniffers is much more labour-intensive and man hours do not come cheap, well not here in Europe at least. Secondly leaks in unexpected locations are difficult to find and easy to miss with sniffers, so using optical gas imaging cameras will help ensure the safety of personnel and of the inhabitants of the surrounding area and in my opinion safety is definitely worth investing in. Using optical gas imaging also increases the sense of safety for the plant's workers. They feel safe in the knowledge that no gas leak escapes my attention with the FLIR GF306 optical gas imaging camera."

Leaks can pop up in unexpected locations, such as in this pipe support.



Another unexpected leak location. Due to a leak in a connection the gas escapes from the insulation material.

"Last but not least the use of optical gas imaging will help reduce amount of gas lost to the atmosphere", continues Schiller. "Given the fact that these gases are our base material it is a waste to lose it due to leakage. I would much rather turn it into plastic. So gas leakage is in fact throwing away money. By reducing the leakage the optical gas imaging camera will earn back its purchase cost. So all in all I would definitely say that an optical gas imaging camera is worth the investment."