Test installation of first wireless infrared gas detector for oil and gas industry

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Summary

Infrared hydrocarbon gas detectors are an essential safety barrier at oil and gas installations, but cabled power complicates installation. A detector with low-power optical design based on a MEMS gives several years of reliable battery operation. The detector has been tested successfully at an onshore gass processing plant for a period of four months.

Introduction

Reliable and fast detection of hydrocarbon gas leaks is important for safety in the petroleum industry. Detectors based on infrared absorption measurements are widely used.

The measurement itself is not particularly challenging from a spectroscopist's point of view. However, the real challenge lies in designing a reliable, practical, and not too expensive instrument also satisfying the following requirement: *No recalibration shall be necessary during a lifetime of up to 20 years, in a wide operating temperature range and harsh environments.*

A few commercially available gas detectors have demonstrated that they satisfy the requirements above. However, the energy consumption is in the order of 5W, and as much as 80% of the detection system cost may come from installing cables for power supply and communication. Therefore, there is a demand for battery operated, wireless detectors.

We have developed such a detector [1]. An ultrasonic sensor monitors the air composition, which trigger the optical sensor when the air composition changes. The optical sensor is based on a voltage-controlled holographic MEMS chip [2] that can switch between measurement and reference wavelength bands. A complete measurement takes 0.5s, and is completely self-contained, with no additional filtering. Each measurement represents the actual gas concentration in the cell.

Discussion

A network of wireless infrared detectors “GS01” were installed at Statoil’s test facilities at Kårstø in February 2012. The individual location of each detector was chosen to challenge the radio communication coverage. In addition, locations were chosen where strong and turbulent winds were expected, rapid temperature fluctuations, precipitation and gas leakages. During a time period of 50 days, the detectors were exposed to typical western Norway weather. During the period, there were no false alarms.

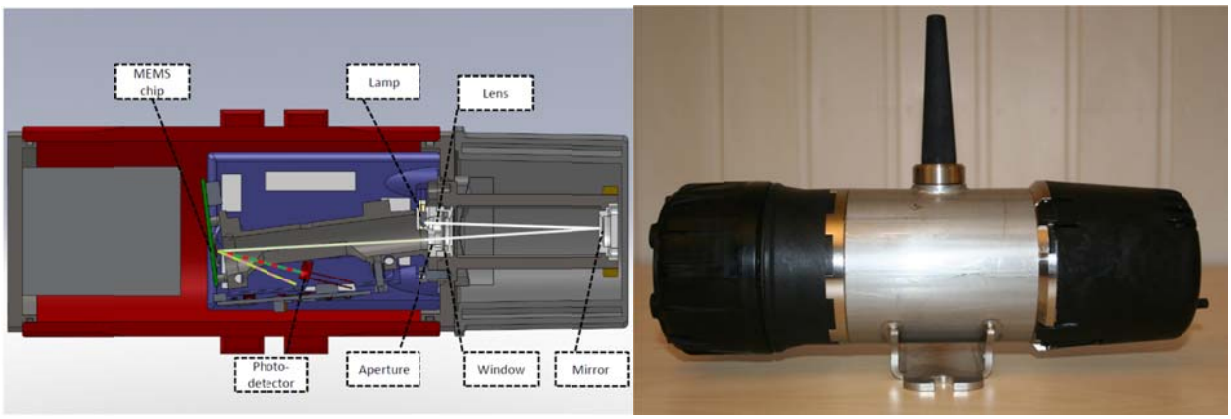

Fig 1. The MEMS-based infrared gas sensor GS01. Left: Optomechanical design showing the main optical components, the beam of broad band light (white line), and the filtered and modulated beam (red and green dashed line). Right: The GS01 detector, with battery compartment to the left, weather protection to the right, electronics and spectrometer in the steel housing and antenna on top.

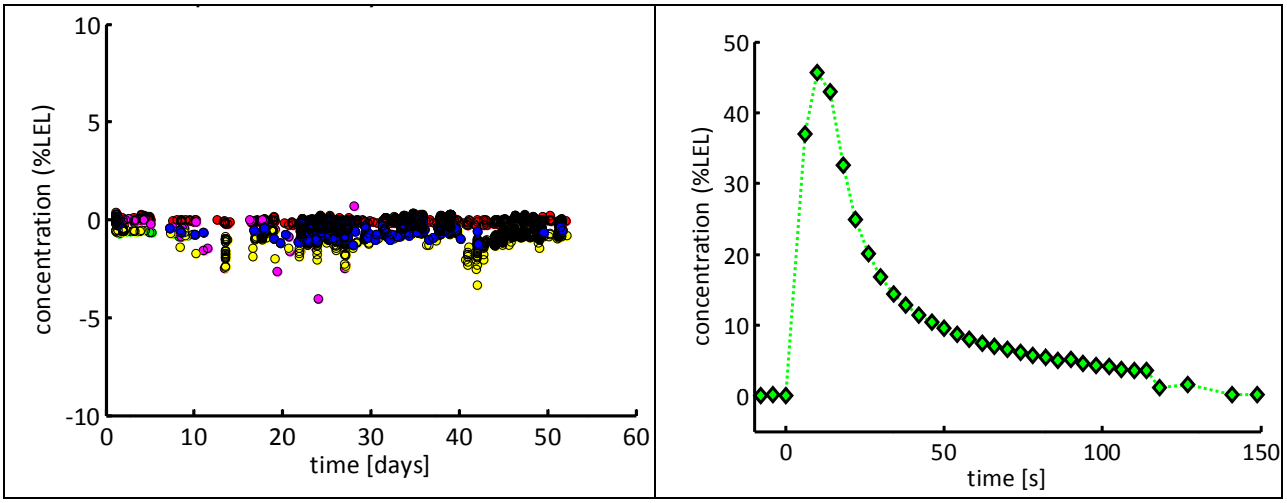

Fig. 2. Left: Zero-point stability of five GS01 detectors installed at Kårstø over a 50 day period. Temperatures were in the range -5 to +20 degrees. Right: Response time measurement done at lab. Each measurement is shown in green diamonds with linear fit in between for clarity. GS01 is exposed to methane gas at t=0, and the response time is 4s.

Conclusions

We have successfully made a test installation of GS01, the first wireless gas sensor for the oil and gas industry. The zero point drift is within +/- 3%LEL methane equivalents over a time period of 50 days, and the response time of the detector is 4s.

References

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