ADVANTAGES OF USING

OPG550 for Real-Time Leak Detection

Air leaks on the tool are detected much faster, increasing throughput and quality while saving costs and energy.

INTRODUCTION

A critical step in the production of vacuum gauges is the calibration on the tool VEGA with a base pressure of 8.0×10^{-7} mbar.

Before, leaks were detected based on the total pressure profile during pump-down. Depending on the leak size, this took about 10 minutes to 2 hours. Smaller leaks (rough estimated smaller than a hair leak) were often detected very late and the calibration process had to be repeated. Especially for the time-consuming calibration processes (> 4 h) that run overnight, an undetected leak means an enormous loss of time and throughput.

Now, with the OPG550, leaks are reliably detected in less than a minute as the sensor provides the additional information on the gas composition during pump-down in real time. In addition, leak detection is automatable and the user can be alerted remotely. This saves work time and reduces errors.

EXPERIMENTAL

OPG550 was mounted on VEGA calibration tool to simultaneously measure total pressure and gas composition during pump-down in real time. If the gas composition corresponding to an air leak exceeds a predefined limit, the analog output sends an alarm to the tool control.

RESULTS

The aim is the reliable detection of an air leak during pump-down as fast as possible. For this purpose, the OPG550 monitors in real time and besides the total pressure the concentrations of the air components: nitrogen, oxygen and moisture. The functional principle of the sensor is based on optical emission spectroscopy (OES) of a DC plasma, which is generated in the sensor from the residual gas. In this plasma, moisture is split into hydrogen (H) and hydroxide (OH) and these components are then detected.

The moisture signal is used to distinguish leak detection during pump-down from nitrogen purges during calibration. However, if the leak is too large, the moisture signal becomes too weak and the oxygen signal is then taken into account. During the pump-down, a leak is detected based on the nitrogen partial pressure. Since different gases are taken into account and several conditions must be met to trigger an alarm, the leak detection is less error-prone.

ADVANTAGES AT A GLANCE

- Fast air leak detection during pump down in < 1 minute
- Higher throughput of about 160 units per week
- Parallel monitoring of total pressure and gas composition in real-time
- Intelligent algorithms: easy operation and simple output of complex raw data
- Easy tool integration, automatic leak detection
- Long sensor lifetime

OPG550 - VEGA calibration tool, INFICON Balzers

In Figure 1 both, the total pressure and gas partial pressures for nitrogen, hydrogen and hydroxide (OH) are plotted as function of time. Data were taken during pump-down on VEGA with different calibrated leaks attached.

While for total pressure based leak detection only the hair leak is detected in the short pump-down time of a few minutes, OPG550 can clearly detect even the smallest leak used ($2x10^{-4}$ mbar l/s). The measured gas partial pressures of nitrogen, hydrogen and OH for the different leak sizes are compared in Table 1. In particular, it shows that the nitrogen partial pressure increases with increasing leak size.

In Figure 2 the OPG550 signals for the $1x10^{-3}$ mbar l/s leak and no-leak cases are compared based on the measured time-dependent gas partial pressures and the gas composition pie charts after 50s. There are clear differences between the two cases. When there is a leak, the concentrations of nitrogen and oxygen are increased while the amount of moisture (hydrogen and OH) is lower compared to the no-leak case. This shows that already after less than 50s OPG550 detects a leak reliably.

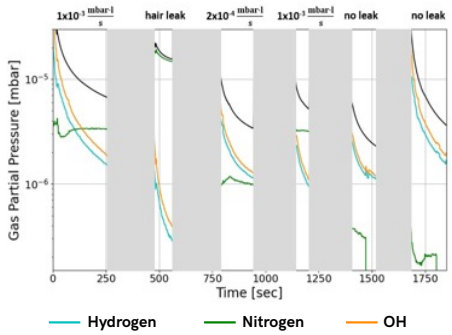


Figure 1:

Total pressure (black) and gas partial pressure for hydrogen (blue), nitrogen (green) and OH (orange) are plotted as function of time for different leak sizes. Data were taken with OPG550 during pump-down on VEGA with the respective calibrated leak attached.

LEAK SIZE in mbar l/s	PARTIAL PRESSURE HYDROGEN in mbar	PARTIAL PRESSURE NITROGEN in mbar	PARTIAL PRESSURE OH in mbar
No leak	2×10^{-6}	$<1 \times 10^{-6}$	2×10^{-6}
2×10^{-4}	1.2×10^{-6}	1×10^{-6}	1.5×10^{-6}
1×10^{-3}	$<2 \times 10^{-6}$	3×10^{-6}	$<2 \times 10^{-6}$
Hair leak	$<1 \times 10^{-6}$	1.5×10^{-5}	$<1 \times 10^{-6}$

Table 1: *Gas partial pressures measured with OPG550 during pump-down on VEGA calibration tool are compared for different leak sizes.*

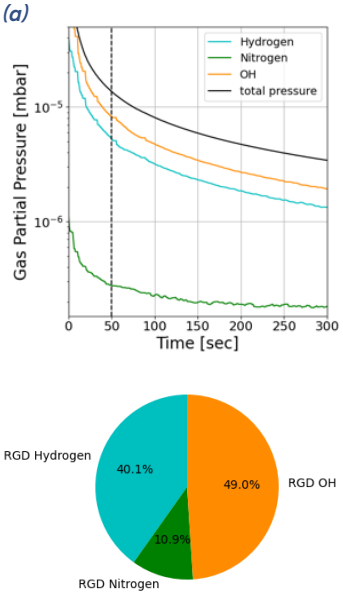
CONCLUSION

OPG550 detects air leaks on VEGA calibration tool during pump-down in less than a minute reliably. Before, smaller leaks were often detected very late or even after the calibration process, resulting in the loss of up to more than 4 hours. In these cases OPG550 provides an enormous benefit and allows a time saving of about 4 hours or a higher throughput of 16 sensors per leak case. With about 10 time-consuming runs per week with unrecognized leakage, this corresponds to a higher throughput of 160 units per week.

Moreover, it offers the possibility to automate the leak detection. The large flexibility in available flanges and electronic connections together with the intelligent algorithms on the sensor make tool integration very simple. In comparison to total pressure based leak detection or to oxygen sensors for example, several different gas types are monitored in parallel and in real time. This enables that leaks are detected faster and more reliable. For this application, other gas analyzers or leak detectors have drawback of either size, prize or required time.

Do you know of similar applications? Then contact us!

(a)



(b)

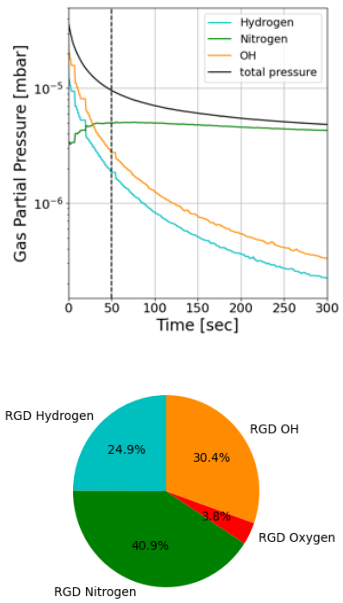


Figure 2:

Total pressure (black) and gas partial pressure for hydrogen (blue), nitrogen (green) and OH (orange) measured with OPG550 during pump-down on VEGA are plotted as function of time. In addition, the gas composition after 50s is shown as pie chart.

(a) *Without leak*

(b) *With 1 x 10^{-3} mbar l/s leak*

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