Automated Zero/Span Calibrations Using Sealed Cells

By: Bengt Löfstedt

OPSIS gas analysers are renowned for their long-term stability and thereby long calibration intervals. Test reports from German TÜV indicate that it is sufficient to do calibration checks only once per year. However, many users choose to do these checks more frequently, if nothing else so to be on the safe side. It then becomes increasingly important to do them in a simple and cost efficient way.

The most common type of calibration check made in CEM contexts is probably a zero/span check, optionally followed by an adjustment of the offset and/or span parameters. By example, under the European Union Industrial Emissions Directive (IED), this is a part of the "QAL3" procedures covering ongoing quality control of the CEM system.

OPEN CELLS

The traditional approach to a zero/span check of a gas concentration measured by OPSIS CEM analysers is to use a calibration bench. The zero level is achieved simply by an empty bench, while the span level is created by inserting a calibration cell in the bench. The cell is fed by a low flow of a gas mixture with a known concentration of the molecule of interest, resulting in a fixed gas concentration inside the cell. This concentration is compared to the response of the analyser, and any difference can be adjusted by tweaking its span and offset parameters.

SEALED CELLS

For some time, OPSIS has also offered an alternative to the cells utilizing flowing gas: sealed cells with a known and stable concentration of the gas type for which the analyser is to be calibrated. These cells are made of quartz glass, protected from mechanical stress by a cylindrical plastic sleeve. Within certain limits, a sealed cell can hold more than one type of gas with known concentration.

A closed calibration cell in its protective sleeve. The object on the top is the sealed remains of the filling tube.

A sealed cell comes with a time limit within which the gas concentration is certified to a specified level and uncertainty, corresponding to the specification of the gas in the gas cylinder used when the cell was manufactured. However, it is possible to recertify a cell with a new time limit by rechecking its concentration against a reference gas analyser at a calibration laboratory. A specific sealed cell can thereby be utilized for several years.

BENEFITS

The primary benefit of using sealed cells is the cost reduction. Traditional calibration checks using flowing gas are expensive in the long run since the gas cylinders have to be renewed for certification reasons, also if all gas has not been used up. Sealed cells can also be beneficial in environments where pressurised gas cylinders are inconvenient or even prohibited to use. It is also more simple and safer to ship a sealed sell than a gas cylinder.

MANUAL AND AUTOMATIC HANDLING

In the basic approach, a sealed cell is used just as a standard calibration cell, that is by manually inserting it in a calibration bench and checking the response of the analyser. However, and although the procedure is not complicated or labour intensive, there can be situations where it is of interest to execute the calibration checks automatically. For this purpose, OPSIS has recently developed the AQ003 automatic calibration unit for use with OPSIS extractive, EX060-based CEM systems.

The AQ003 consists of a motorized revolver (a revolving holder for sealed cells), and a control unit. The holder is situated in series with the measurement cell of the EX060 and has three positions, where two of them can be used for sealed cells. The third position is left empty, allowing both normal measurements and zero calibrations.

OPERATING PRINCIPLES

During normal measurement operation, the empty position of the revolver sits in line with the EX060 measurement cell. At a programmable interval and time, the AQ003 control unit can initiate a calibration sequence. First, a control signal is sent to the gas analyser requesting it to abort normal measurements. Then, zero air is injected in the sampling head of the extractive system and the measurement cell in the EX060 is purged from all stack gases. With the empty position of the revolver still in line with the measurement cell, a signal can be sent to the gas analyser to initiate a preprogramed zero level calibration sequence. The sequence can be set up to adjust the zero level of the analyser automatically, and/or to report the result of the zero calibration through IO256.

After completing this sequence, the AQ003 control unit can then rotate a sealed cell into the light path, and send a signal to the analyser to initiate a span calibration sequence for the gas or gases in the cell. In similarity with the zero level sequence, the span factor of the analyser can then be adjusted and/or the analyser response can be reported via IO256. This can then be repeated for a second sealed cell in the revolver.

Following the last calibration, the revolver is rotated for the empty position to become in line with the EX060 measurement cell, and a control signal stops the injection of zero air in the sampling head, again allowing normal stack gases to flow through the sampling line and fill the EX060 measurement cell. Finally, when the measurement cell has been filled with process gas, the gas analyser is allowed to go back to normal measurement mode and the regular measurements continue.

VERSATILITY

The system works for a single gas analyser (typically an AR600) and a single-path EX060 extractive system, but also with AR600/AR650 analyser combinations and/or dual-path EX060s such as those normally used for measurement of total mercury (THg).

The AQ003 revolver (prototype) inside an EX060H cabinet, with a calibration cell in the light path.