

Environmental analysis

Process and calibration gases for the measurement of air pollutants



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Climate change is in fact nothing new: in the geological course of history, cold and warm stages took turns regularly. However, these changes were of natural origin. In today's parlance the expression refers mainly to human-induced changes. These anthropogenic influences can cause lasting damage to our greatest treasure, an intact environment. Based on a better understanding of the processes in our ecosystems a rethink at social and political levels led to a regulation of released substances showing an increased risk potential. In order to assess the implementation of

measures concerning the protection of our environment from air pollution on long term and to compare the results of which, reliable information on emission and immission values is mandatory. The measurements of pollutants will be carried out by means of analytical devices operating with appropriate process and carrier gases. In order to guarantee an extremely high measurement accuracy even in the smallest concentrations the measuring instruments have to be calibrated with special calibration gas mixtures in prescribed, regular intervals.



Chemistry contributes to our well-being; unfortunately emissions are inevitable

Major sources of air pollutants

Emissions of industrial facilities have significant influence on the anthropogenic air pollution. In accordance with the relevant EU directives operators of industrial and commercial installations are obliged to monitor the air pollutants emitted from their site. Depending on the process, this typically requires the monitoring of CO, CO₂, NO_x, SO₂ and possibly other organic compounds.

World's rapidly rising traffic volume provides a further major contribution to the human-induced air pollution. In order to mitigate these emissions in many countries of the world exhaust emission standards and limit values have been established.

For every vehicle type there are emission standards that must be adhered to gain official design approval. Statutory regulations for registered vehicles require periodic proof of compliance with emission limits. The instruments for such exhaust emission tests have to be calibrated. Within certain limits compositions of the calibration gases in EU countries are determined. Consequently, in the individual countries partly different compositions have prevailed. Messer offers the calibration gases under the name "Lambdamix".

Wherever emission takes place, immission will be observed: Immission describes the effects of emitted pollutants on environment after having spread in ambient air. The higher the concentration and its duration at site of impact the greater the extent of contamination. In accordance with EU directive 1996/62/EG in every member state of the EU measurement networks have been installed to monitor ambient air. So original sources of pollutants are located and their spread through atmosphere is demonstrated.



Exhaust emission test of motor vehicles

Analytical procedures

EU directives do not only set limit values for monitoring ambient air quality but also stipulate measurement procedures to detect the amount of pollutants under investigation. Thus the content of SO₂ is mostly determined by UV fluorescence and NO_x by means of chemoluminescence. CO and CO₂ are detected either by infrared methods or by using gas chromatography. The latter process is usually carried out together with the determination of many other air pollutants such as methane, sulphur hexafluoride, benzene, and other hydrocarbons and halogenated hydrocarbons (CFCs, HFCs).

Calibration gases

All analytical methods currently used in practice are, in principle, comparison methods; the measured value of the respective component is always compared with the signal of well-known samples. So the careful calibration of used measuring instruments is mandatory prerequisite for every measurement and determines its accuracy.

In the case of less volatile components with corresponding low vapour pressure, permeation systems can be used for calibration. However, this procedure is pressure and temperature dependent.

A more contemporary and simple method is the use of ready-made calibration gas mixtures which can be supplied directly from the pressurized gas cylinder to the instrument. This procedure is in general independent to fluctuations in pressure and temperature. With linear calibration functions the magnitude of the concentration required should be approximately 80 % of the maximum value of the instrument's measurement range.

Calibration gases for emission measurements are normally used in the ppm-range. Messer offers these calibration gases under the name "Labline".

For immission measurements, the measured values are generally lower by a factor of 1000; here measurements must be carried out in the ppb-range. Messer offers these gas mixtures under the name "Traceline".

The low concentrations pose not only high demands on the measurement devices but also on the calibration material used. The traceability of the calibration gas mixtures to admitted primary reference standards and the knowledge of the uncertainties of the measurement are the basis for international comparability and thus essential for environmental control.

Gravimetrically produced gas mixtures are directly traceable back to the SI unit "mass" by calibrating the scales with certified weight standards. The ISO 17025 describes the corresponding requirements on manufacturers of calibration gases.

Messer has five laboratories accredited according to ISO 17025 and is thereby able to deliver calibration gases containing the most important components in ppm- and ppb-ranges with certificate from accredited laboratory (according to ISO 17025). In some European countries, the use of calibration gases from an accredited laboratory is mandatory according to the relevant EU directives.



Measuring station for immission monitoring

Correct use of calibration gases

Particular care must be taken when using calibration gases especially in low concentration range regarding the materials used. Some components which have to be determined are very reactive. Even the slightest traces of moisture strip the few molecules to be detected such as SO₂ or NO_x and remove them from the gas flow. Therefore the pipes and valves have to be chemically inert such as stainless steel.

Moreover, thorough purging with carrier gas is necessary in order to remove residual moisture from the system. Separate purge block referred by Messer as SBE 3 is particularly suitable for this purpose. Plastic piping should be tested for material compatibility. Many plastics show high permeation rates for moisture or other substances. The use of these materials should be avoided wherever possible.



Calibration of measuring instruments in laboratory

Service and support

We will be happy to help you choosing the required calibration gases and the right composition of the gas supply system.

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