

# Environmental Analysis

Process and calibration gases for the measurement of air pollutants



The protection of our environment and climate conditions is a matter, which concerns all of us! Emission of air polluting substances causes damage to our greatest treasures, to an intact living environment and to our health. There is no doubt that anthropogenic emission of harmful substances impacts our health and contributes to the climate change. 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. Reliable information on emission and immission values is

mandatory in order to assess the implementation of measures concerning the protection of our environment from long-term air pollution and to compare its results. The measurements of pollutants are carried out by means of analytical devices operating with appropriate process and carrier gases. In order to guarantee a high measurement accuracy even in the smallest concentrations, the measuring instruments have to be calibrated with special calibration gas mixtures in prescribed, regular intervals.



*Industrial activity contributes to our well-being: unfortunately, emissions are inevitable*

## Major sources of air pollutants

Energy production from fossil energy sources such as coal, natural gas power plants and industrial manufacturing processes significantly contributes to the anthropogenic air pollution. In accordance with the relevant EU directives, operators of industrial and commercial installations are obliged to control and monitor the emitted air pollutants. Depending on the applied process, the emission of CO<sub>2</sub>, CO, NO<sub>x</sub>, SO<sub>2</sub> and other organic compounds is measured.

In addition, the world's rapidly rising traffic volume provides a further major contribution to the human-induced air pollution. In order to reduce traffic emissions, strict exhaust emission standards have been established. For each vehicle type, the automobile manufacturers must obtain a type approval in accordance with the statutory regulations.

The compliance with emission limits of registered vehicles is verified by periodic inspection according to statutory regulations. The instruments for such exhaust emission tests have to be calibrated within regular intervals. In the European Union, the composition of the calibration gases is defined within certain limits, in which each EU member state defines the exact composition. Messer offers calibration gases for the car exhaust control under the name „Lambdamix“.

## Air monitoring networks

Wherever emission takes place, immission is also observed: immission describes the effects of emitted pollutants on the environment after they have been released into the atmosphere.

In Europe, most countries operate an air monitoring network with several stations located in rural areas, far away from potential sources of pollutants, in order to monitor and analyze the long-range and transboundary pollution.

In addition, there are measuring stations in cities, in conurbations, in areas with high traffic density, in order to monitor and determine local and regional air quality.



*Exhaust emission test of motor vehicles*



## Analytical procedures

EU directives do not only set limit values for monitoring ambient air, but they also stipulate measurement procedures to detect the relevant pollutants. For example, the content of SO<sub>2</sub> is mostly determined by UV fluorescence and NO<sub>x</sub> by chemoluminescence. CO and CO<sub>2</sub> are detected either by infrared methods or by gas chromatography. The determination of these compounds is usually accompanied by the analysis of various other air pollutants such as methane, sulfur hexafluoride, ozone or other volatile organic compounds (VOC's).

## Calibration gases

All analytical methods currently used in practice are comparative methods. More specifically speaking, the measured value of the respective component is always compared with the signal of well-known samples. Therefore, the careful calibration of used measuring instruments is a mandatory prerequisite for every measurement and determines its accuracy.

It is common practice to use individual gas mixtures for calibration of analytical devices. These calibration gas mixtures are customized solutions to meet the specific requirements of the individual analytical task. This proceeding is, in general, independent to changes 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 usually contain components in the ppm-range. Messer offers these calibration gases under the name "Labline".

For immission measurements in rural areas, the measured values are generally lower by a factor of 1000. A proper calibration needs to be implemented with gas mixtures containing components in the ppb-range. Messer offers these gas mixtures under the name "Traceline".

Such low concentrations pose not only high demands on the measurement devices, but also on the calibration gas used. In this context, the traceability of calibration gas mixtures to a primary reference standard as well as the knowledge of the uncertainties of the measurement are essential for the international comparability of environmental control.

The most common procedure for manufacturing high precision calibration gas mixtures is the gravimetric method according to ISO 6142 (Gas analysis – Preparation of calibration gas mixtures – Gravimetric method).

This method is based on weighing the masses of the particular components. Gravimetrically produced gas mixtures can be traced back to the unit of mass, namely the SI unit „kg“.

## Calibration gases from an accredited laboratory

The ISO 17025 specifies the general requirements for the competence of testing and calibration laboratories. Due to our four laboratories accredited according to ISO 17025, Messer is proficient to manufacture calibration gases with a certificate from one of our accredited laboratories. In several 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

For reliable calibration of analytical equipment, especially in the low concentration range, it is essential to eliminate any influence changing the composition of the gas mixture. Such influences can be, for instance, undesired reaction with the materials of the used equipment and/or moisture. 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 SO<sub>2</sub> or NO<sub>x</sub> and remove them from the gas flow. Therefore, the pipes and valves have to be chemically

inert such as for stainless steel. Moreover, thorough purging with carrier gas is necessary in order to remove residual moisture from the system. Purging techniques by means of a separate purge block referred by Messer as SBE 3 is particularly suitable for this purpose. Other materials such as plastics should be tested for material compatibility. Many plastics show high permeation rates for moisture or other substances. In terms of reliable calibration, it is recommended to use suitable alternative materials.



*Calibration of measuring instruments in laboratory*

## Service and support

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