

A range of newly developed mobile generators to dynamically produce SI-traceable reference gas mixtures for reactive compounds at atmospheric concentrations

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Three new mobile facilities have been developed at METAS to dynamically generate SI-traceable reference gas mixtures for a variety of reactive compounds at atmospheric amount of substance fractions and at very low levels of uncertainty ($U_x < 3\%$). We present three new portable “Reactive Gas Standard ReGaS” reference gas generators for the realisation of the following substances:

- ReGaS1: Ammonia and nitrogen dioxide in the nmol/mol (ppb) range
- ReGaS2: Volatile organic compounds (VOCs), e.g. limonene, alpha-pinene, MVK, MEK in the nmol/mol (ppb) range
- ReGaS-3: Fluorinated gases (F-gases, i.e. containing fluorine atoms) in the pmol/mol (ppt) range

These three mobile generators have been designed and manufactured at METAS in the framework of the three EMRP projects MetNH₃, KEY-VOCs and HIGHGAS.

The method is based on permeation and subsequent dynamic dilution: A permeation tube containing the pure substance (e.g. NH₃) is stored in the permeation chamber at constant temperature, pressure and matrix gas flow (N₂, purified air, synthetic air). Under such conditions the pure substance permeates at constant rate into the matrix gas and can be diluted thereafter to the desired amount fractions in one or two subsequent steps.

The permeation rate (mass loss over time) of the permeation tube is precisely calibrated in a fully traceable magnetic suspension balance. The carrier gas is previously purified from the compounds of interest using commercially available purification cartridges. The permeation chambers of ReGaS2 and ReGaS3 have multiple individual cells allowing for the generation of mixtures containing up to 5 different components if required. ReGaS1 allows for the generation of one-component mixtures only.

These primary mixtures are then diluted to the required amount of substance fractions using thermal mass flow controllers for full flexibility and adaptability of the generation process over the entire range of possible concentrations.

In order to considerably reduce adsorption/desorption processes and thus stabilisation time, all electro-polished stainless steel parts of ReGaS1 and ReGaS2 in contact with the reference gas mixtures are passivated with SilcoNert2000[®] surface coating.

These three state-of-the-art mobile reference gas generators are applicable under both, laboratory and field conditions. Moreover the dynamic generation method can be adapted and applied to a large variety of molecules (e.g. BTEX, CFCs, HCFCs, HFCs and other refrigerants) and is particularly suitable for reactive gas species and/or at concentration ranges which are unstable when stored in pressurised cylinders.

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