ENV52 HIGHGAS

Dynamic methods for trace concentrations and dissemination to the field

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MESURES & RÉFÉRENCES
Clés de la COMPÉTITIVITÉ et d'un MONDE PLUS SÛR

Context

- Results of international comparisons on greenhouse gases
  - Dynamic generation methods do not have the necessary accuracy to meet the uncertainty requirements for global monitoring
- Need of significant research to lead to a new generation of methods for providing these dynamic standards
- Key challenges for developing a new generation of dynamic devices to provide high accuracy reference standards
  - Lower concentrations and uncertainties
  - Capability to provide stable measurements in long-term to be used in field monitoring
  - Accurate methods for the quantification of target components in the diluent gas
  - Detailed investigation of the materials used for constructing the device in order to minimise adsorption of the reference standard
  - Accessible cost

Objectives and participants

- Objectives
  - Development of ***novel dynamic generation methods and devices***
    - Dissemination of the traceability to field measurements at monitoring stations
    - Validation of the gravimetric reference standards prepared in the framework of this JRP

- Which type of dynamic devices ?
  - Based on dynamic dilution of static gas mixtures at a higher concentration
  - Based on the permeation or diffusion method

- Participants
  - LNE, NPL, VSL, METAS, CMI, FMI, TUBITAK, EMPA

Development of dynamic generation devices

- Development of ***novel dynamic generation methods and devices*** for
  - On-site preparation of reference standards with uncertainties that meet WMO targets
    - CO between 50 and 500 nmol/mol ; target uncertainty of 2 nmol/mol
    - N_2O between 50 and 500 nmol/mol ; target uncertainty of 0.1 nmol/mol
  - A selection of strategically important F-gases (including SF_6)
    - HFCs, perfluorocarbons (PFCs), SF_6 (Kyoto Protocol) and chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs)
    - Concentrations in the range of 100 to 1000 nmol/mol
    - With a target uncertainty of 3%

High accuracy dynamic reference standards for CO and N_2O

- First step : development of new high accuracy dynamic reference standards for atmospheric CO and N_2O
  - Development of different dynamic systems from static reference standards
    - One at LNE for generating dynamic reference standards of CO and N_2O
    - One at TUBITAK for generating reference standards of CO
    - One at FMI for generating reference standards of N_2O
  - Requirements on the development
    - Use different kind of flowmeters

      - Laminar flow meters

      - Complementary Metal Oxide Semiconductor (CMOS) mass flow controllers

      - Sonic nozzles

High accuracy dynamic reference standards for CO and N_2O

- First step : development of new high accuracy dynamic reference standards for atmospheric CO and N_2O
  - Requirements on the development
    - Use of static reference standards

      - At about 5 µmol/mol of the target component
    - Use of dilution gases

      - Synthetic air

      - Whole air
    - Generation of several concentrations

      - Range : 50-500 nmol/mol

      - At least five concentrations

High accuracy dynamic reference standards for CO and N_2O

- Second step : validation of new high accuracy dynamic reference standards for atmospheric CO and N_2O
  - Validation of these new dilution devices with comparison made to in-house static reference standards
  - Organization of an inter-laboratory comparison to validate the dynamic mixtures against the gravimetric reference standards
    - CO : NPL, LNE, TUBITAK
    - N_2O : FMI, VSL
  - Organization of a comparison of the dynamic reference standards of CO (LNE and TUBITAK) and N_2O (LNE and FMI), generated with these facilities to existing NOAA and AGAGE scales (standards supplied by EMPA)

High accuracy dynamic reference standards for F-gases (1)

- First step : Development of new high accuracy dynamic reference standards for F-gases at sub nmol/mol concentrations
  - Purity of the used F-gases
    - Development of a method for the purification of F-gases (including SF_6) in synthetic air and the determination of the level of F-gas contained
    - Ensure a F-gas concentration of less than 0.5 pmol/mol
  - Development of a novel high accuracy dynamic device based on dilution using CMOS technology or sonic nozzles (METAS and CMI) to generate dynamic reference standards of SF_6 at concentrations close to 100 pmol/mol as a step towards the WMO target of 20 pmol/mol
  - For the other F-gases, generation of dynamic reference standard at 1 µmol/mol using either a permeation or a diffusion device (METAS)
  - Use of the dynamic device based on dilution developed before in conjunction with the permeation or diffusion device to generate reference standards of F-gases (including SF_6) at concentrations close to 100 pmol/mol with a target standard uncertainty of 3%

High accuracy dynamic reference standards for F-gases (2)

- Second step : Field dissemination and comparison to global scales for F-gases
  - Aim
    - Evaluate the concordance between international scales and an independent European scale
    - Improve world-wide traceability of F-gases (especially for emerging requirements for new components where current calibration scales do not exist)
  - Comparison of the SF_6 reference standards (dynamic device based on dilution) and the reference standards of other F-gas components (permeation or diffusion device) to existing calibration scales (NOAA and SIO for AGAGE measurements)
    - Form basis of an independent European scale
    - Provide an essential link for SI traceability to the globally accepted NOAA and SIO scales

High accuracy dynamic reference standards for F-gases (3)

- Second step : Field dissemination and comparison to global scales for F-gases
  - Development of a novel portable device for disseminating reference standards of F-gases to field measurements (suitable for monitoring station usage)
    - Set up of this novel portable device via dynamic dilution of high concentration gas at pmol/mol levels (METAS, EMPA)
    - Validation of this device at pmol/mol levels by comparison to at least one reference standard used in the field and generated at EMPA
    - Use of this dilutor device by EMPA as an on-site or travelling calibration unit and test it in the field (at least one monitoring site) by comparison with traditionally filled air standards from global background sites

Thank you for your attention

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Any questions ?

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