

Development of a mobile ammonia gas standard generator for environmental measurements

Joint Research Project (JRP) within the Environment Call of the European Metrology Research Programme (EMRP)

Background and need

- Ammonia is a major ambient air pollutant
- Ammonia emission sources and its contribution: Agriculture 93.6 %, waste 2.3 %, road transport 1.8 % and other 2.3 % (EEA*), 2011
- European Directive 2001/81/EC regulates ammonia emissions in the member states
- Understand ambient air quality including particulate matter and atmospheric impacts on ecosystems
- Ensure reliable ammonia measurements in analytical technology, uncertainty, quality assurance and quality control procedures

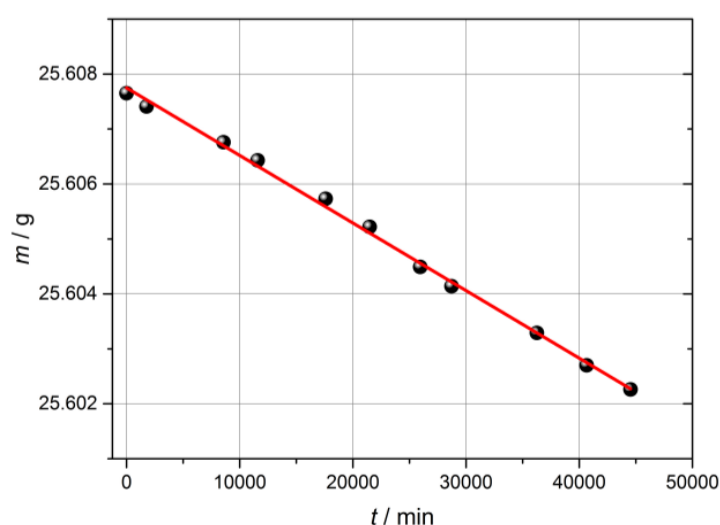
* EEA = European Environment Agency



Ammonia emission source on the example of animal husbandry

Determination of the permeation rate

- Permeation method is an effective tool for dynamically generating precise gas standards [ISO 6415-10:2008]
- Permeation element is a device where the permeability of ammonia through a barrier produces a stable flow of trace gas concentration
- Mass loss is determined on a semi-micro analytical balance ($u(m) = 3,9 \times 10^{-5}$ g) per time at $(30 \pm 0.1)^\circ\text{C}$
- The permeation rate (PR) is the mass loss per time unit as the slope of the functional relation
- $PR = (122 \pm 2)$ ng/min



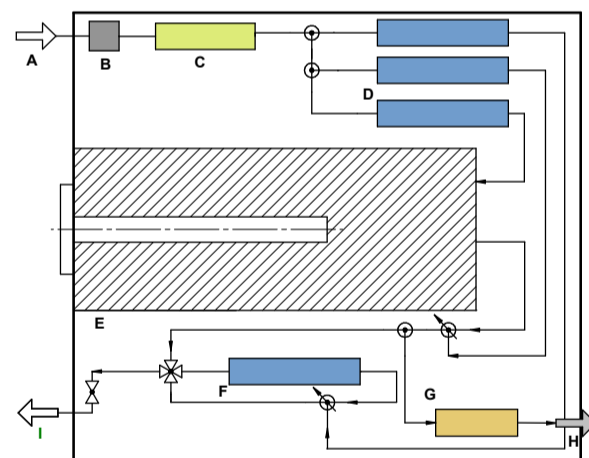
Experimental determination of the permeation rate at 30 °C

MetNH3 project objectives

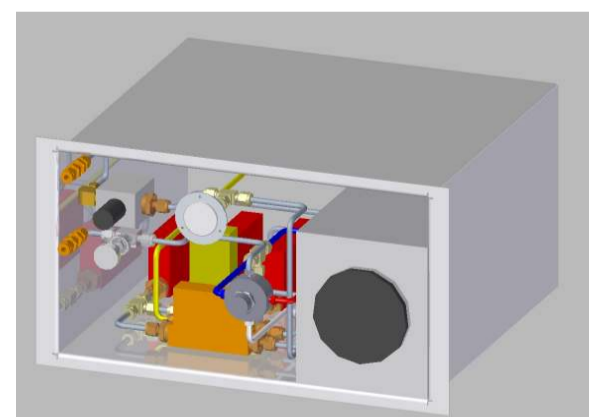
1. Gas calibration standards:
 - Develop improved traceable reference gas mixtures by static and dynamic gravimetric generation methods at molar fraction levels (0.5 to 500 nmol/mol) under real air and laboratory conditions
2. Ammonia detection by laser based optical standards:
 - Develop and evaluate traceable optical transfer standards
3. Metrological transfer to field applicable methods:
 - Giving guidance for the proper use of certified reference materials and sampling in field measurements
 - Evaluate and compare results produced with field measuring methods to develop suitable sampling methods in order to promote long-term efficiency monitoring of ammonia reduction measures

Development of a mobile gas standard generator

- Calibration component permeates through a membrane into a zero gas flow
- Realisation of the molar fraction range by use of a two stage dilution set-up



Flow path design for ammonia gas standards;
 A) carrier gas inlet, B) pressure regulator, C) mass flow meter, D) mass flow controllers, E) Oven with inserted ammonia permeation element, F) mass flow controller for split flow, G) backpressure regulator, H) overflow outlet, I) reference gas outlet



Construction draft of a mobile permeation device with two dilution steps