Multi-element combined methods (MECM) increase the reliability of emission factor measurement

P. Robin, M. Hassouna, J.-M. Paillat
UMR INRA/ENSAR Sol Agronomie Spatialisation, 65 rue de St Brieuc, cs84215, 35042 RENNES cedex 01

Introduction
Inventories or Life Cycle Assessment use emission factors for livestock buildings but their results are sensible to the variation range of the emission factors. At the farm scale, technique improvement needs to quantify their effect on the emission factors. Present variability depends either on system characterisation (i.e. intra-class variability) or on measuring method (gradient measurement, air flow rate measurement, time extrapolation). Therefore, there is a need to develop robust methods that will lead to quantify the accuracy of emission factor estimates. In the case of livestock buildings, the measurement period should take several months, it should be adapted to both short-term and mid-term variability of the climate and the farmer practices, and it should allow simplifications for emission certification.

Materials and Methods
The measuring equipment (Fig. 1) associates devices allowing the use of methods considered as reference ones (tracing gas), completed by devices allowing the use of simplified methods (indirect ventilation estimates) or the cheapest method: default of mass balance. Each method has its own pros and cons: technical advantages, assumption validity, price.

Results
Fig. 2: Kinetics of SF6-tracer concentrations: several successive measurements on the same channel and at least two channels outside and inside are necessary to evaluate the measurement.

Fig. 4: heat production, (total, sensible or latent) also used in indirect ventilation estimates, reveals unrealistic air flow rate estimates.

Discussion and conclusion
• Multi-element approach (H2O, C, N, P, K) allows the verification of the estimates and the simplification of the reference method, because the various elements have contrasted behaviours.
• Combined methods (“constant dose” and “decreasing” tracer methods; indirect ventilation measurement; mass balance of the effluent) make it easier to check the observations against realistic values of heat production within the building (instantaneous observations) or realistic values of gaseous losses (mass losses after some weeks or months).
• Gas concentration measurements can lead to both simplified instantaneous estimates, when combined with T-HR measurements, and simplified integrated estimates, when combined with effluent mass balance (see Paillat et al, same session).
• Increasing the redundancy of the data set increases the possibilities to reduce the uncertainty in the emission factor estimates.

This work was supported financially by the GIS “Porcherie Verte”