



XVIIth World Congress of the International Commission of Agricultural and Biosystems Engineering (CIGR)

Hosted by the Canadian Society for Bioengineering (CSBE/SCGAB)
Québec City, Canada June 13-17, 2010



INTERMITTENT MEASUREMENT TECHNIQUE TO ESTIMATE AMMONIA EMISSION FROM MANURE STORAGE

ALI YOUSSEF¹, SEZIN E ÖZCAN¹, FABRICE GUIZIOU², COLIN BURTON², PAUL ROBIN³, DANIEL BERCKMANS¹

¹ A. Youssef, M3-BIORES: Measure, Model & Manage Bioresponses Katholieke Universiteit Leuven, Belgium, Ali.Youssef@biw.kuleuven.be

¹ S. E. Özcan, Sezin.ErenOzcan@biw.kuleuven.be

² F. Guiziou, Cemagref, Groupement de Rennes, France, fabrice.guiziou@cemagref.fr

² C. Burton, colin.burton@cemagref.fr

³ P. Robin, Unité Mixte de Recherche Sol, Agronomie, Spatialisation de Rennes-Quimper (INRA UMR SAS), France Paul.Robin@rennes.inra.fr

¹ D. Berckmans, Daniel.Berckmans@biw.kuleuven.be

CSBE100773 – Presented at Section II: Farm Buildings, Equipment, Structures and Livestock Environment Conference

ABSTRACT More than 90% of ammonia emission originates from agricultural and about 97% of the emission from agriculture originates from livestock and related activities. About 50% of the livestock emissions originate from the livestock buildings and manure storage. The production of animals has to comply with several environmental requirements. The monitoring of ammonia emission out of agricultural buildings and storage systems is one of them. A condition for effective monitoring is the availability of a cheap measuring technique, which is not available for the moment for the storage systems. Nowadays, for mechanically ventilated barns, intermittent measurement technique is used. It is based on continuous monitoring of easily measurable variables such as ventilation rate, temperature, and animal's weight and number together with intermittent measurement of ammonia emission rate at six well selected days per year. The easily measurable variables allow to model ammonia emission rate continuously. The latter one is used to calibrate the model regularly. Unfortunately, for naturally ventilated agricultural buildings and manure stores, intermittent measurement technique has never been tried due to lack of reliable ventilation rate measurement system which provides accurate estimation of ammonia emission rate. The main objective of this paper is to represent a procedure to determine the ammonia emission from manure storage systems in the field, based on intermittent measurements technique. In this study, two experimental tanks were filled with fattening pig slurry; one of them was covered with a mechanically ventilated cover. Dynamic ammonia measurements from the covered tank were used to calculate ammonia emission. A procedure was developed based on the knowledge that ammonia emission is strongly related to some easily measurable variables such as near manure surface air temperature (u_1) and manure surface temperature (u_2). The paper demonstrates the possibilities of model-based procedures for the determination of ammonia emission with a limited number of measuring days (Figure 1.). Steady-state regression model (equation 1) was good enough to calculate the cumulative ammonia emission over the whole period with accuracy better than 8%.

Keywords: Ammonia, emission, modeling, intermittent measurements method

$$y = 0.240 u_1 - 0.026 u_2 + e$$

[1]

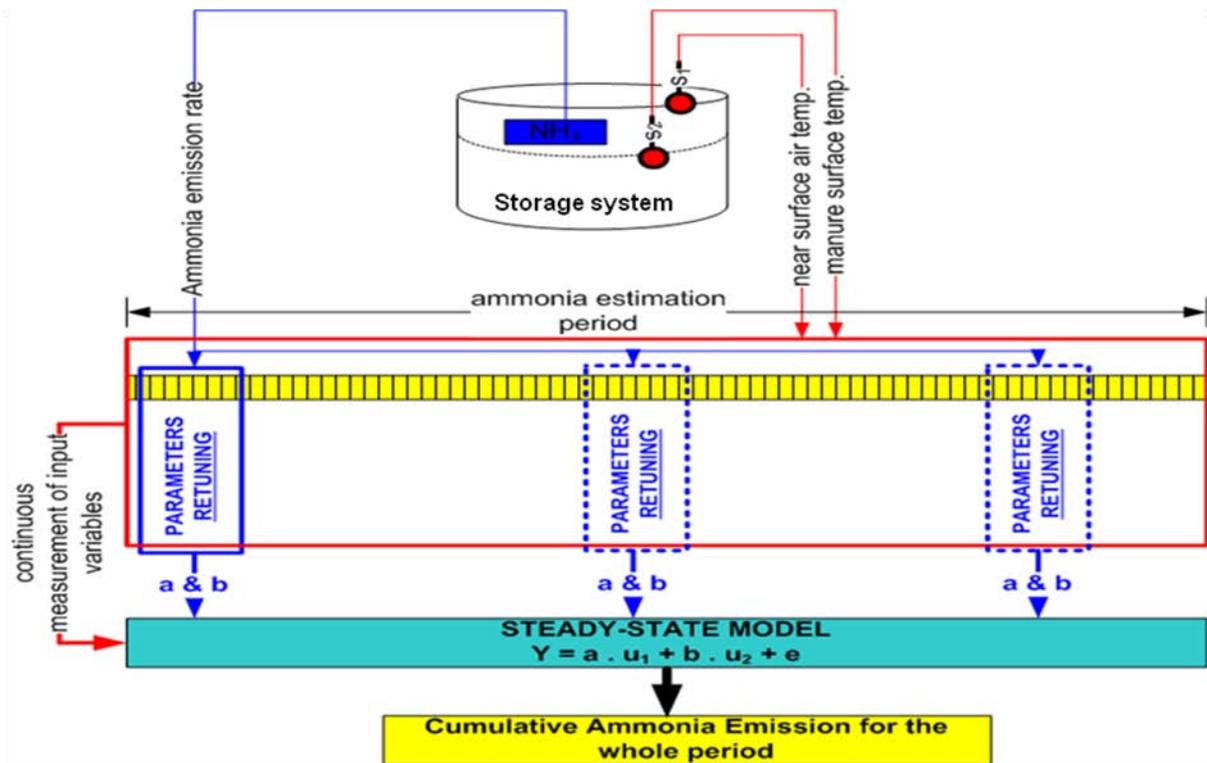


Figure 1. Schematic representation showing the intermittent measurement method to estimate the ammonia emission from manure storage over a certain period. S_1 and S_2 are temperature sensors; NH_3 is the ammonia emission sensor; u_1 and u_2 are near manure surface air and manure surface temperatures, respectively; a and b are the model parameters.

