Monitoring gases from pig buildings: field evaluation of a multi-channel monitor (Phase 3)

Harper Adams University
Project Report 104

SUMMARY

- The European Union is placing greater emphasis on the reduction of gaseous pollutants, including ammonia, from livestock buildings. There is a need for one cost-effective monitor to accurately measure a range of parameters across several pig buildings.
- This third phase of a 3-phase study aimed to evaluate the multi-channel monitor, combining an ammonia sensor (LGD F200) and CO_2 (COZIR) analyser, (designed and developed during earlier phases of work) through field investigations.
- The multi-channel monitor was suitable for use in the pig buildings monitored in this study phase. Recommendations include regular calibration of CO_2 and installation of water traps outside the unit for operation in cold temperatures.

THE NEED FOR A NEW MONITORING SYSTEM

The European Union is placing greater emphasis on ammonia reduction from livestock buildings. The need for accurate monitoring of gaseous pollutant concentrations from livestock buildings is recognised by livestock farmers and government agencies.

The first phase of this study calibrated and assessed the capacity of an ammonia sensor, the LGD F200, (based on the tunable diode laser principle) to accurately monitor ammonia concentrations in pig buildings.

Currently there is no practical, cost-effective monitor available to accurately measure multiple variables (such as ammonia, CO_2, temperature and humidity) and monitor several pig buildings simultaneously. Phase 2 of this study addressed the design and development of a multi-channel ammonia sensor (LGD F200) and CO_2 (COZIR) analyser.

The third phase of the study (reported here) incorporated the field testing of the designed multi-channel monitor. All phases were undertaken by Harper Adams University, and supported by the AHDB Division-BPEX.

AIM OF THIS PHASE OF THE STUDY

The aim of this third phase of the study was to evaluate the multi-channel monitor, combining an ammonia sensor and CO_2 analyser, through field investigations. In particular, the need was to identify any obvious problems such as instability due to temperature variations and potential condensation.

FIELD TESTING METHOD

The multi-channel monitor was tested on two farms.

- Firstly, the Harper Adams University farm was used to assess any sensor or analyser faults in three types of buildings. These were: a small fan-ventilated weaner building; a new fan-ventilated cross-flow building; and a naturally-ventilated building.
- Secondly, two buildings on a commercial farm were used to test the stability of the multi-channel monitor over a longer time (14 days).

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Zeroing and Cleanliness

Before the field testing, the sensor and analyser were zeroed and the ammonia sensor was checked using a span (standard) gas.

The multi-channel monitor was thoroughly cleaned down and disinfected in between the two farm monitoring surveys.

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FIELD TEST RESULTS

It should be noted that all the results are relevant only to the specific housing systems as each building housed a different number of pigs.

The monitor successfully monitored the ammonia concentrations in all three buildings at **Harper Adams University** without any problems. The CO_2 analyser needed to be regularly zeroed to re-stabilise.

Two buildings on **the commercial pig unit** were monitored during two weeks of stable weather. The outdoor temperature and relative humidity were satisfactorily measured and traces are shown in figure 1, below.

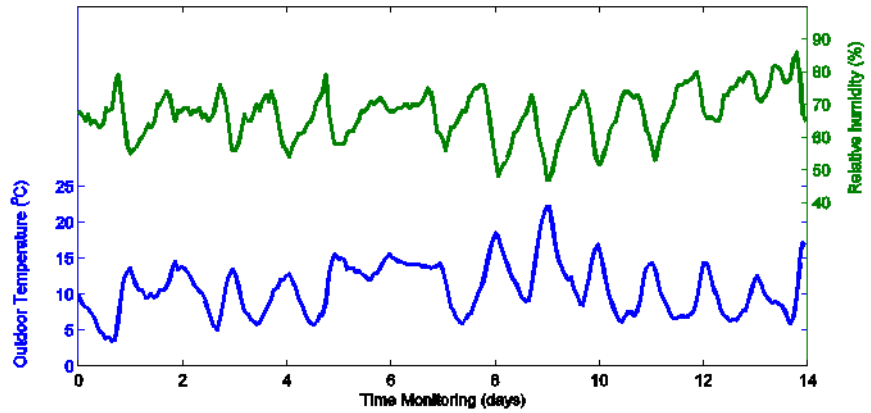


Fig 1. Traces of outdoor temperature and relative humidity over 14 days

The ammonia emission rate of building 1 was lower than that of building 2, averaging about 10 parts per million (ppm). The monitor was able to detect a significant within and between-house variation in ammonia emission rates.

Figure 2, below, shows the emission rates of ammonia from each specific building, after combining ventilation rate with detected ammonia concentrations, at the exhaust of each building (see box).

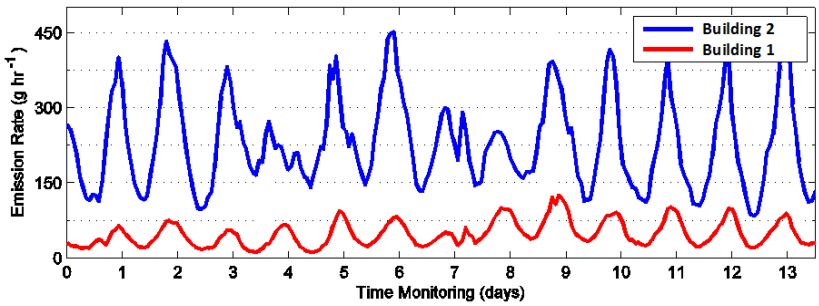
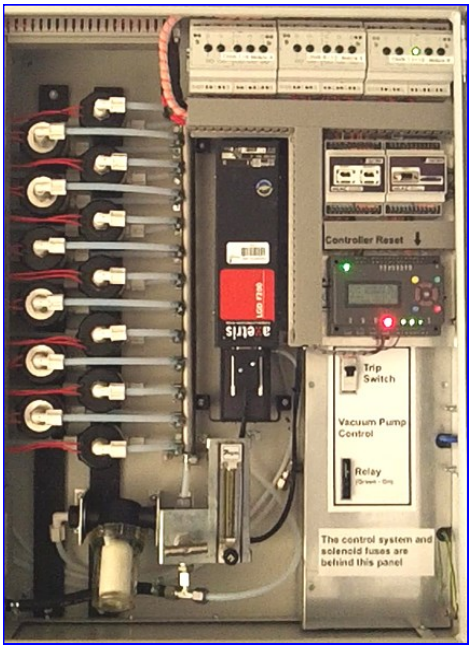


Fig 2. The emission rate of ammonia (g per hour) from both buildings over the monitoring period

CONCLUSION AND RECOMMENDATIONS

The measurement surveys on the University and commercial farming units proved that the multi-channel monitor was suitable in these contexts, without encountering any major faults. Overall, it was cost-effective when compared to the commercially-available photoacoustic system.

Recommendations include: regular CO_2 calibration; and installation of water traps outside the unit for operation in cold temperatures. Future developments could focus on the addition of a sensor for dust detection and, possibly, particle sensors for disease detection.



Ventilation Rate

Measurement of the ventilation rate is crucial to determine the emission factors. The study showed that CO_2 emitted by the animals can be used as a tracer to predict ventilation rates.

Further Information

Norton, T. and Clare, D. 2014. *Monitoring gases from pig buildings: testing and calibration of an ammonia sensor (Phase 1).* HAU Project Report 100. Available from: http://ofi.openfields.org.uk/1.14040633

Norton, T. and Clare, D. 2014. *Monitoring gases from pig buildings: development of a multi-channel monitor (Phase 2).* HAU Project Report 102. Available from: http://ofi.openfields.org.uk/1.14070029

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