

ENVIRONMENT

Title: Quantification of Greenhouse Gas Emissions from a Production Scale Midwestern Breeding/Gestation/Farrowing Facility – **NPB #12-118**

Investigators: Dr. Hongwei Xin, Professor (hxin@iastate.edu); and John P. Stinn, Graduate Research Assistant (elwayjr1@iastate.edu)

Institution: Iowa State University

Date: Submitted: 5/1/2014

Interest in ammonia (NH₃) and greenhouse gas (GHG) emissions from animal feeding operations is increasing. However, information is meager concerning NH₃ and GHG emissions from swine operations, particularly from breeding, gestation, and farrowing facilities. Additionally, current recommendations for swine building ventilation system design to maintain an environment conducive to animal productivity and well-being are based on heat and moisture production rates measured in the 1950s and 1970s. Advancements in animal genetics, nutrition and management practices to increase productivity and pork quality since then likely have led to considerable changes in heat and moisture production rates of modern swine and their housing systems. Therefore, the purposes of this study were to quantify NH₃ and GHG emissions and the total heat production rate (THP) of the animals, along with its partitioning into house-level latent heat or moisture production rate (LHP, MP) and house-level sensible heat production rate (SHP) from a breeding/gestation and farrowing facility located in central Iowa. The monitored portion of the facility consisted of a deep-pit breeding and early gestation (B/EG, ~40 days) barn (1660 head, 204 ±3.2 kg hd⁻¹ (mean ±SE)), a deep-pit late gestation (LG, >40 days) barn (1800 head, 219 ±3.0 kg hd⁻¹), and two shallow-pit farrowing rooms (40 sow/litter per room, 223 ±0.4 kg hd⁻¹). A Mobile Air Emission Monitoring Unit (MAEMU) equipped with state-of-the-art gas analyzers and a data acquisition system was dedicated to the extensive monitoring. Monitoring occurred from January 12, 2011 to June 3, 2013 for GHG and NH₃ emissions and from February 8, 2012 to June 3, 2013 for quantification of the heat and moisture production rates. A dynamic flux chamber was deployed on the external manure storage several times over the monitoring period to capture the seasonal variation of emissions.

Results from the study show the following average daily emissions per animal unit (AU = 500 kg body mass): 35.1 g NH₃, 7.46 kg CO₂, 0.17 g N₂O, and 263.4 g CH₄ for sows in the B/EG barn; and 28.2 g NH₃, 6.50 kg CO₂, 0.12 g N₂O, and 201.3 g CH₄ for sows in the LG barn. The average daily emissions per AU (sow and piglets) of the farrowing rooms while piglets are present are: 59.7 g NH₃, 16.4 kg CO₂, 0.73 g N₂O, and 107 g CH₄. For the monitored period, the external manure storage had the following average daily emission per square meter of surface area: 1.26 g NH₃, 137 g CO₂, and 94.8g CH₄, which was equivalent to daily emissions per AU in the farrowing rooms of 12.2 g NH₃, 1055 g CO₂, and 867 g CH₄.

Results from the study show that THP at 20°C averages 1.8 W/kg for sows in the B/EG stage, 1.5 W/kg for sows in the LG stage, and 3.9 W/kg for sows and litters in week 0 of the lactation stage. The corresponding house-level LHP for the three stages averages 0.7 W/kg (B/EG), 0.6 W/kg (LG), and 2.1 W/kg (lactation, week 0). Finally the corresponding house-level SHP for the three stages averages 1.1 W/kg (B/EG), 0.9 W/kg (LG), and 1.8 W/kg (lactation, week 0). Compared with the ASABE standards, values from the current study for gestation sows in their early and late pregnancy stages showed increases of 28% and 8% in THP, 53% and 22% in LHP, and 16% and 2% in SHP, respectively. Values for lactating sows and litters during the first week after parturition showed increases of 23% in THP, 48% in LHP, and 11% in SHP relative to the ASABE standards. The reductions of THP from day to night for the three stages were 32% (B/EG), 27% (LG), and 7% (lactation). These data will help updating the standards for engineering design and operation of modern swine housing.

These research results were submitted in fulfillment of checkoff-funded research projects. This report is published directly as submitted by the project's principal investigator. This report has not been peer-reviewed.

For more information contact:

National Pork Board • PO Box 9114 • Des Moines, IA 50306 USA • 800-456-7675 • Fax: 515-223-2646 • pork.org