

THE AMMONIA WORKING GROUP

Toward Scientific Consensus on the Measurement of Ammonia Flux from Open-Lot Livestock Facilities

THE HOLY GRAIL

A range of emission factors that expresses the most probable, scientifically justifiable, seasonalized, daily NH_3 emission flux from feedyards and dairies as a function of herd size, stocking density or other appropriate measure of capacity or throughput

WHERE WE ARE TODAY

- There are nearly a dozen different ways of estimating the NH_3 flux from an open-lot AFO
- Today, we present results from several of them
- Getting at the *true flux* requires a convergence of results from multiple, independent methods, but even that's not enough by itself
- The true flux is different from the flux to be used in dispersion modeling in the permitting or compliance-monitoring contexts

AVAILABLE METHODS

- Envelope approaches
 - Mass balance
 - Nutrient ratio (N:P)
- Direct approaches
 - Surface isolation flux chambers
 - Wind tunnels
 - Eddy covariance
- Dispersion/box models
 - Gaussian (ISCST, AERMOD)
 - Lagrangian stochastic – backward, forward
 - Integrated horizontal flux (IHF)
 - Flux-gradient
 - Box

FINDINGS

Method	Beef	Dairy	Comments
	Lb N/1,000 hd-d		
N Balance	195	<650	Uncertainty analysis nearly complete; 30% during winter, 70% during summer. Includes NH ₃ and other gaseous N losses
N:P Ratio	213		Includes NH ₃ and other gaseous N losses
Flux Chamber	82	26 (OL) 38 (FS)	Dairy #1 (FS): 54 ± 27 (S); 21 ± 22 (W) Dairy #2 (OL): 34 ± 3 (S05); 17 ± 2 (S04) Beef in summer
Flux-Gradient	191		Uncertainty analysis underway
bLS/OPL	182		Uses open-path lasers to measure N
Box Model	191		

FINDINGS

Method	Beef	Dairy	Comments
	% of Fed N		
N Balance	44	<80	Uncertainty analysis nearly complete (beef)
N:P Ratio	48		Varies from 20-51% depending on source material (fresh manure, pen surface, compost)
Flux Chamber	18	3 (OL) – 5 (FS)	Herds are ~15% dry cows, ~85% lactating; excreted N is 79% of fed N
Flux-Gradient	43		Uncertainty analysis underway
bLS/OPL	41		Uses open-path lasers to measure N
Box Model	31-55		

- NH₃ presents steep challenges because of its:
 - High reactivity with anions and surfaces
 - High aqueous solubility
 - Deposition
 - Condensation
 - Kinetically limited redox pathways w/NO_x species
 - Numerous pools and pathways in real systems
 - Sensitivity to pH
- Accounting for all of those factors in a single measurement scheme is complicated
- Uncertainty analysis assumes all sources of bias (systematic error) have been eliminated