



Ammonia Emissions from U.S. Broiler and Turkey Houses

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An OSU Ammonia Workshop Presentation

May 2, 2011, Columbus, OH



Presentation Outline

- Advancement in monitoring of ammonia (NH_3) emissions from animal production facilities
- European and U.S. data on broiler and turkey NH_3 emissions
- An application of the U.S. emissions data



U.S. Broiler & Turkey Production Characteristics

- Mostly built-up litter, decaking between flocks, litter treatment
- Tunnel ventilation, esp. for broiler houses, some use hybrid system
- Cooling pads or misters
- Pancake brooders & space heaters
- Broilers marketed at 6-9 wk
- Hen & tom turkeys at 12 & 20 wk



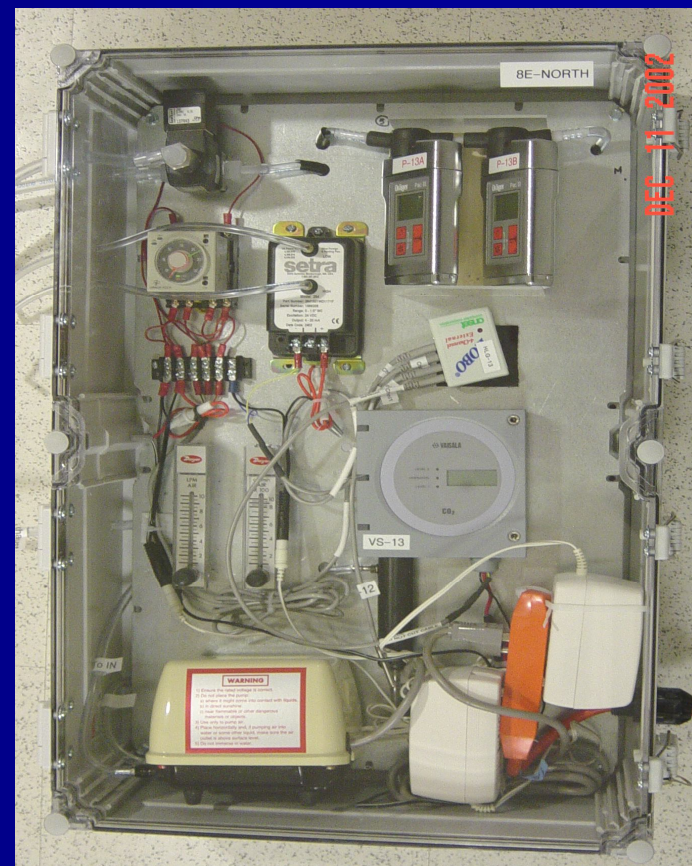
Evolution of Aerial NH_3 Concentration Monitoring Devices/Methods



Colormetric tube with Pump
15% - 20% accuracy \$400



Electrochemical
3% accuracy \$900



Portable Monitoring Unit (PMU)
Purged Electrochemical, \$4000

Evolution of Aerial NH_3 Concentration Monitoring Devices/Methods



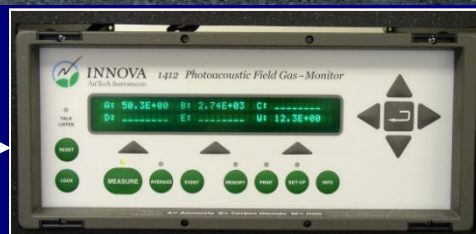
Mobile Lab



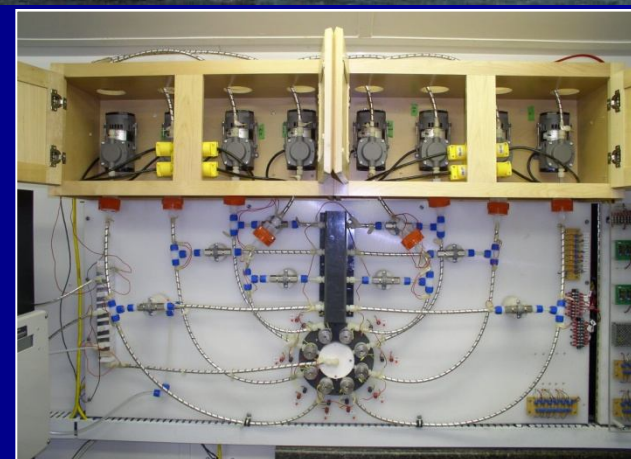
PM monitors



NH_3 , CO_2 , CH_4



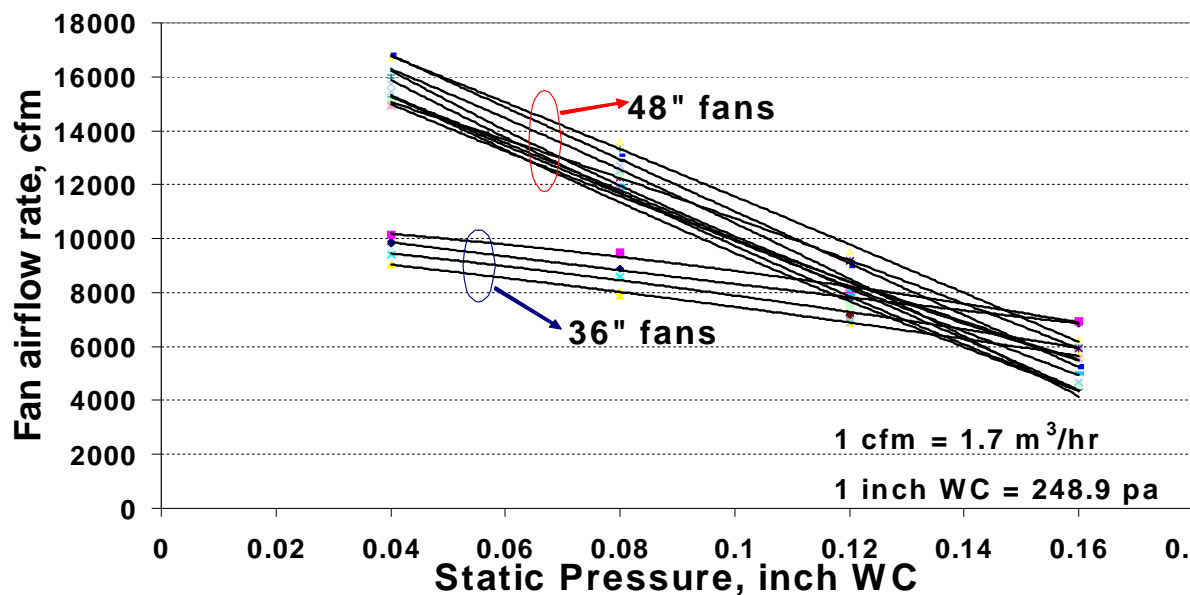
H_2S





Improved Ability to Accurately Determine Building Ventilation Rate

All fans are not made equal!



Performance of 36\" & 48\" fans in the field

In-situ Vent Fan Testing with FANS



Prior to 2000, NH_3 Emission Data Were from European Broiler Houses

Country	ER, g/d-bird	Litter & Market Age
UK (1999)	0.11	Typically new bedding for each flock. Birds are marketed at much younger age than in the U.S., generally <u>32-35 d.</u>
UK (1997)	0.26	
UK (1998)	0.48	
Denmark (1998)	0.21	
NL (1998)	0.27	
Germany (1998)	0.44	
Average	0.30	



NH₃ Emission Rate (ER) of U.S. Broiler Houses

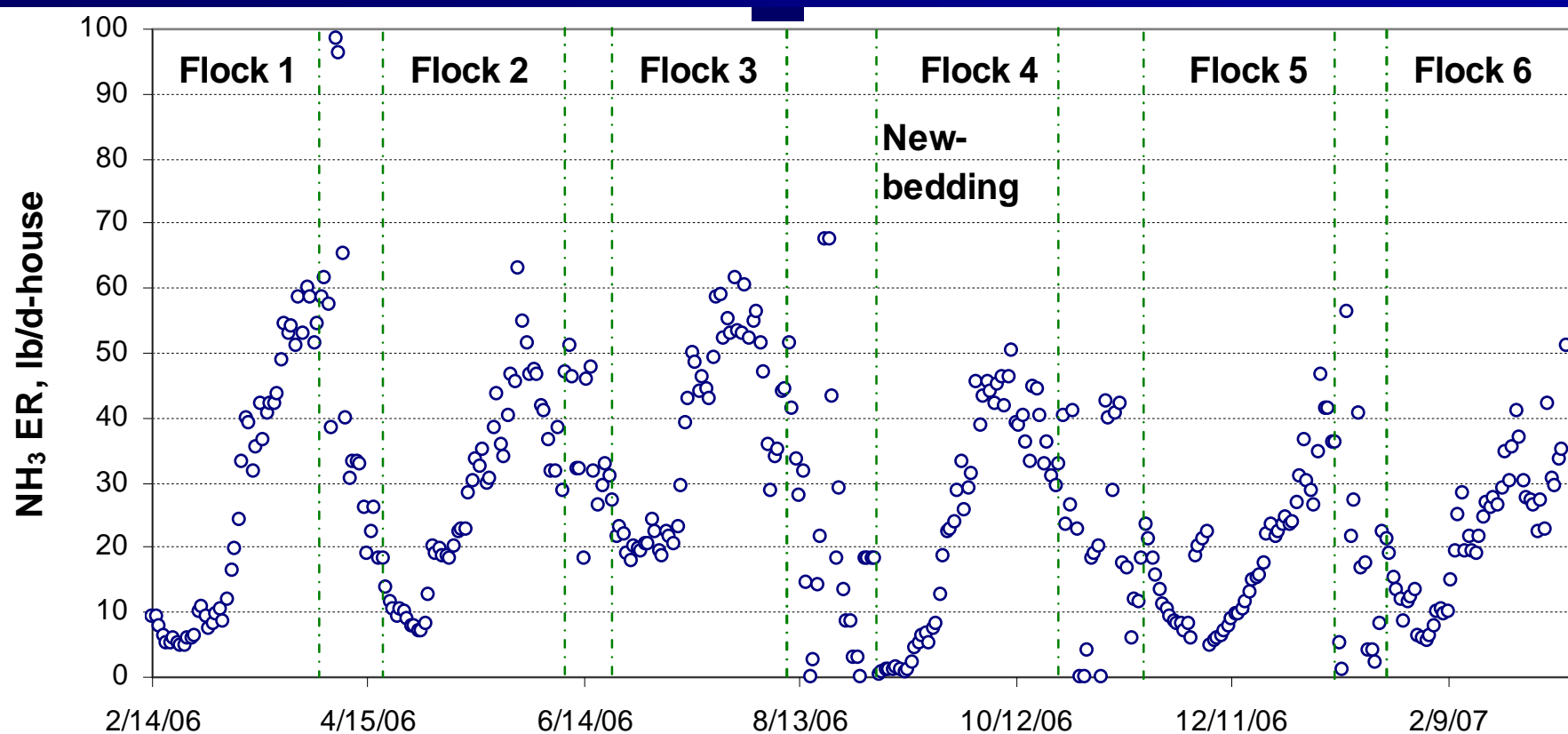
Growth Period, d	Market BW, kg (lb)	ft²/bird	No. Flocks (season)	Litter Status	ER, g/d-bird	Location (yr)
42	2.2 (4.8)	0.73	10 (all)	New	0.47	KY & PA (06) ¹
42	2.2 (4.8)	0.73	12 (all)	Built-up	0.65	KY & PA (06) ¹
49	2.5 (5.5)	0.81	24 (all)	Built-up	0.76	KY & PA (06) ¹
49	2.4 (5.3)	0.80	12 (Su, F)	Built-up	0.63	TX (03) ²
52	2.8 (6.2)	0.85	3 (all)	New	0.49	KY (07) ³
52	2.8 (6.2)	0.88	9 (all)	Built-up	0.62 ^{**}	KY (07) ³
63	3.3 (7.3)	1.00	20 (all)	Built-up	0.98	KY & PA (06) ¹

**** Downtime NH₃ ER: 0.38 g/d-bird (average downtime of 8 d)**

¹Wheeler et al (2006), ²Lacey et al. (2003), ³Burns et al. (2007)



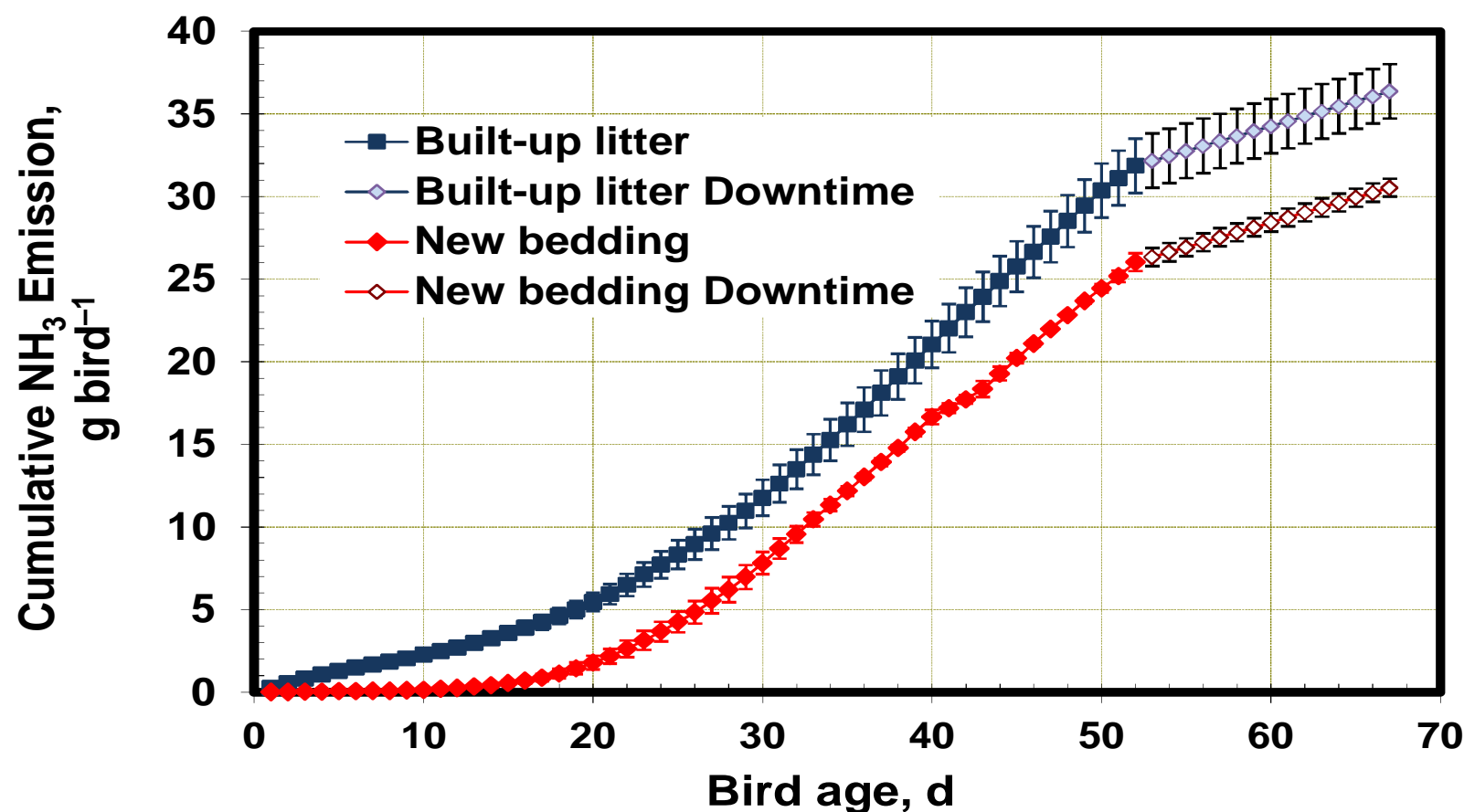
Daily NH_3 Emissions of Broiler House in KY, Including Growout & Downtime



No. of birds/house: ~25,000 (straight run or mixed sex)

Burns et al. (2007)

Cumulative per Bird NH_3 Emission of Broiler Houses in Kentucky

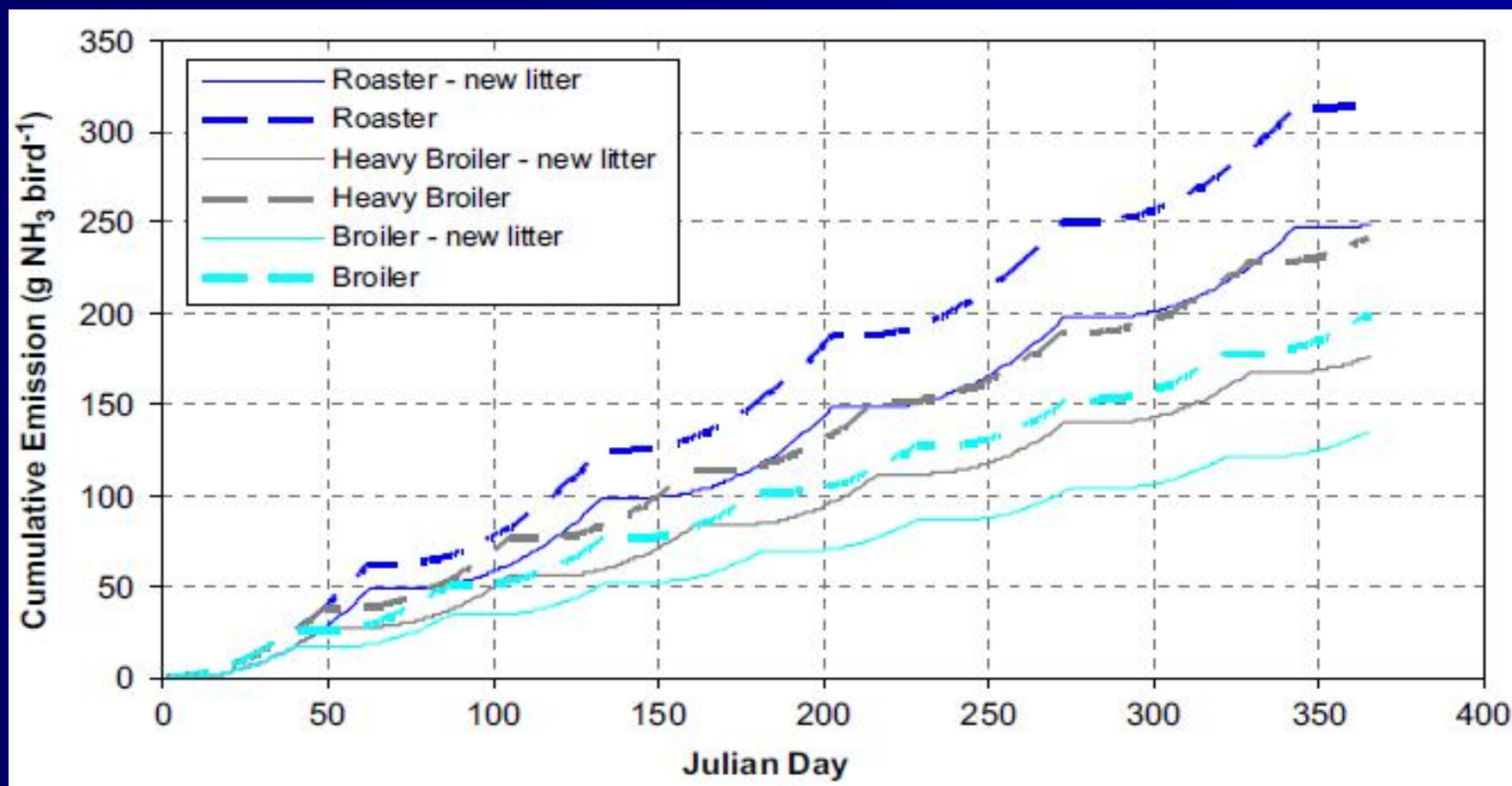


Burns et al. (2007)



Annual Cumulative Per-Bird NH_3 Emission of Broilers at Different Market Ages

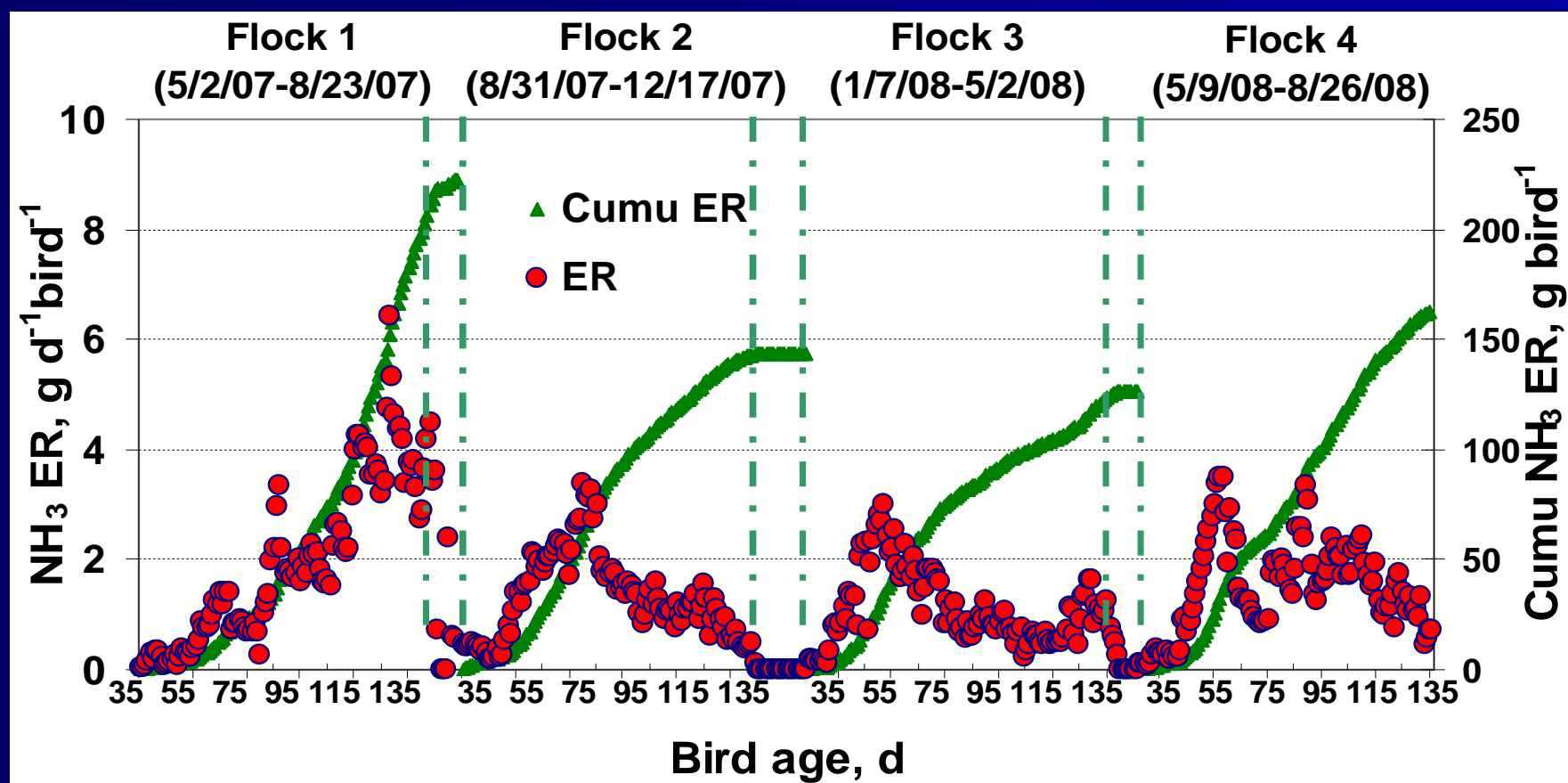
(modeled based on data by Wheeler et al., 2006)



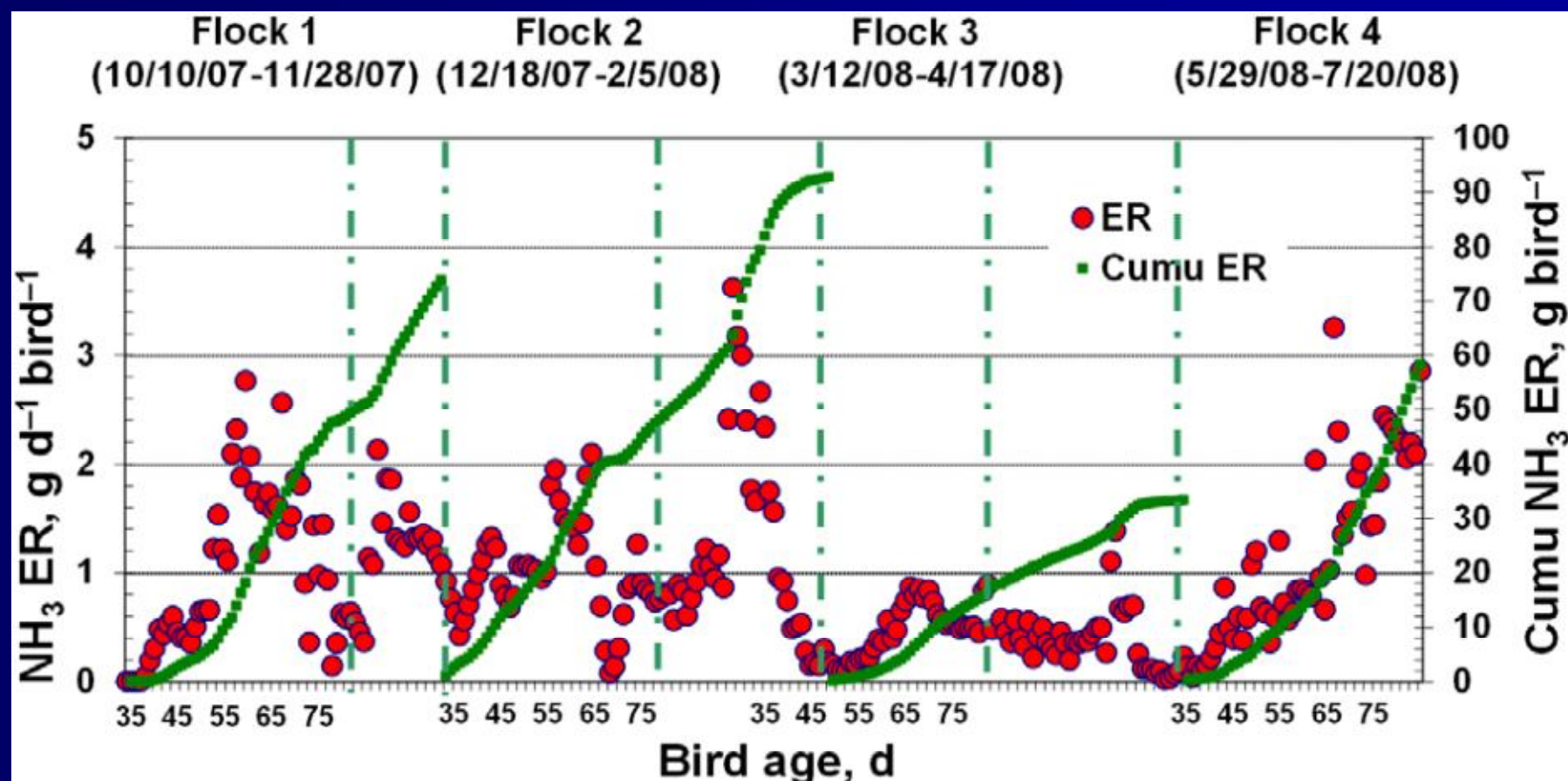
Roaster: 63 d, Heavy broiler: 49 d, Broiler: 42 d

Gates et al. (2008)

Daily NH_3 Emissions of Tom Turkeys in IA, Including Grow-out & Downtime

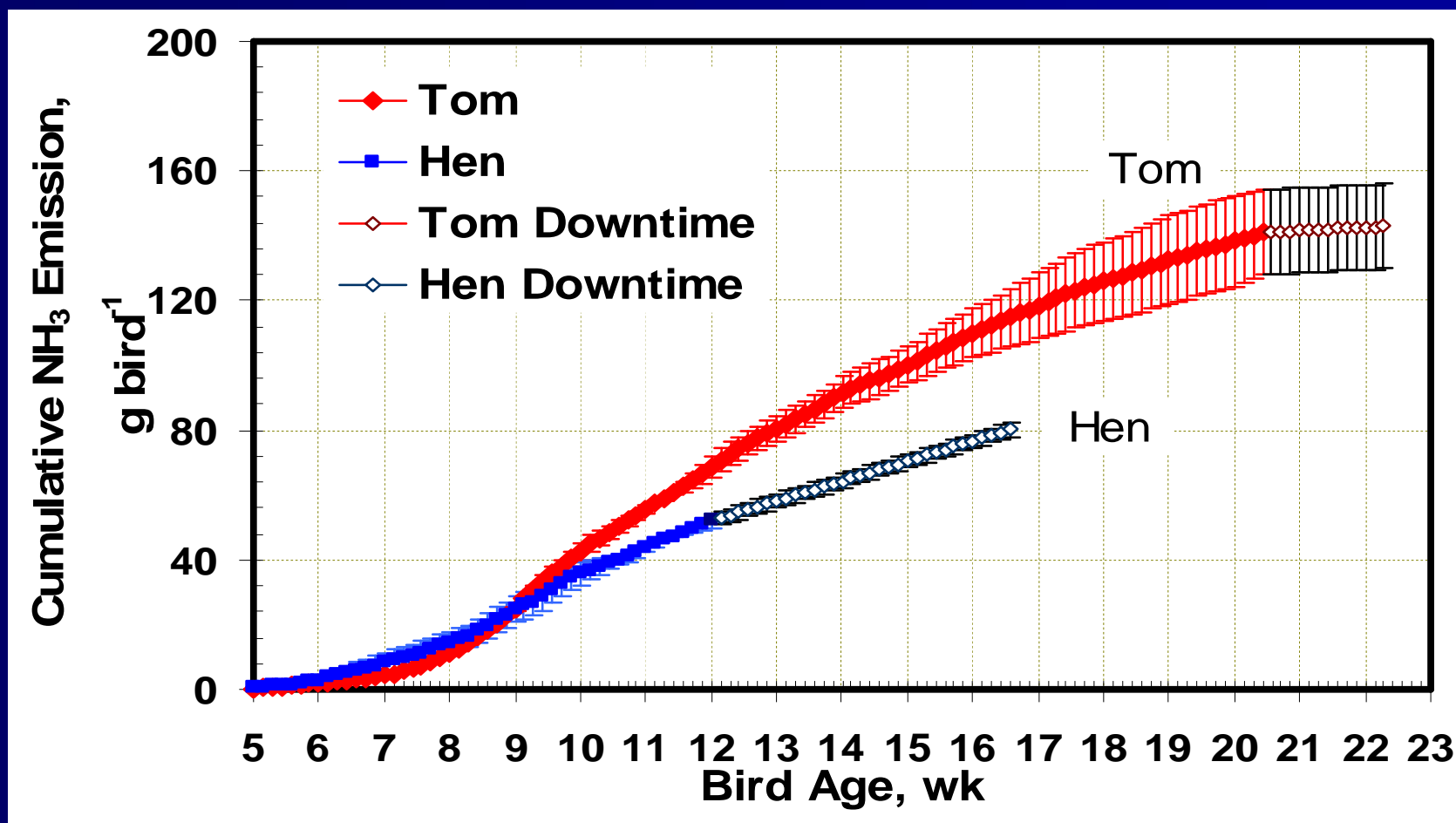


Daily NH_3 Emissions of Hen Turkeys in MN, Including Grow-out & Downtime

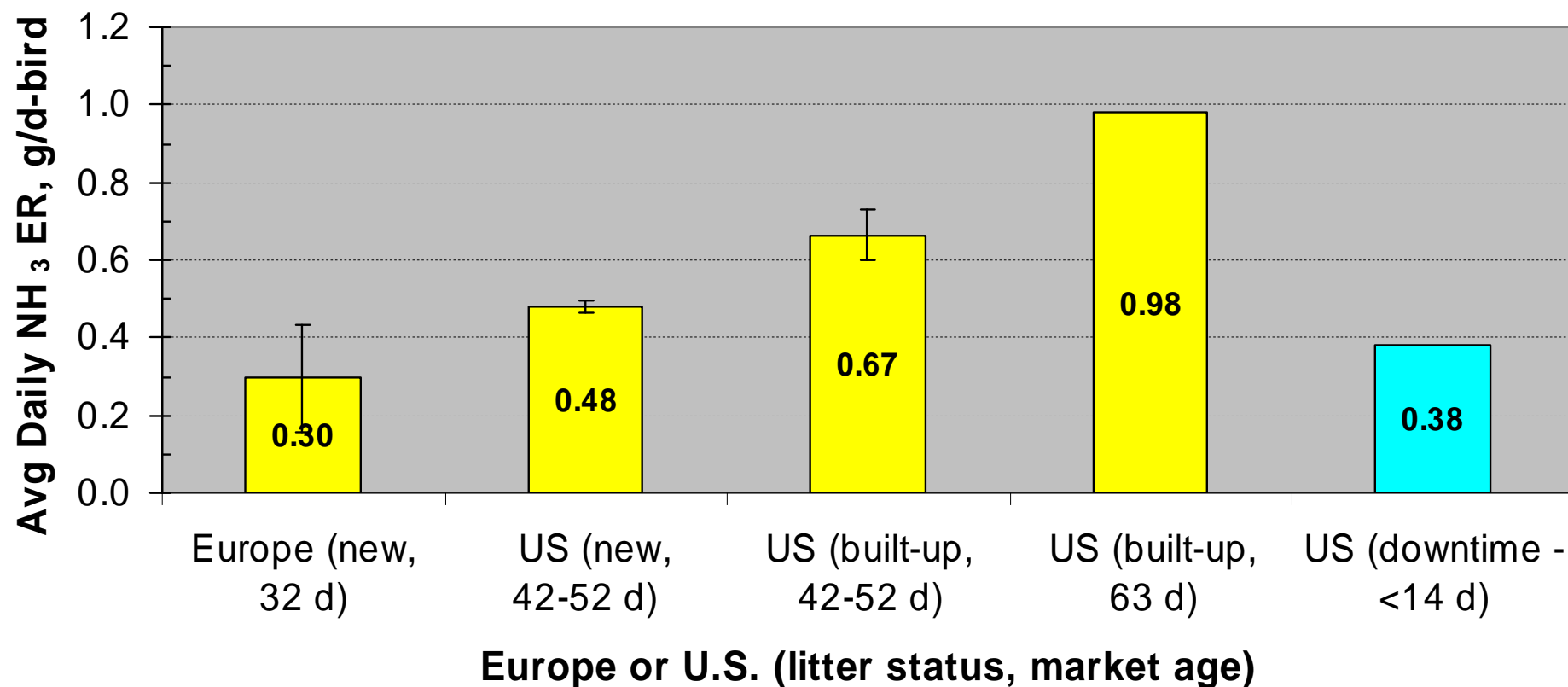


Li et al. (2010)

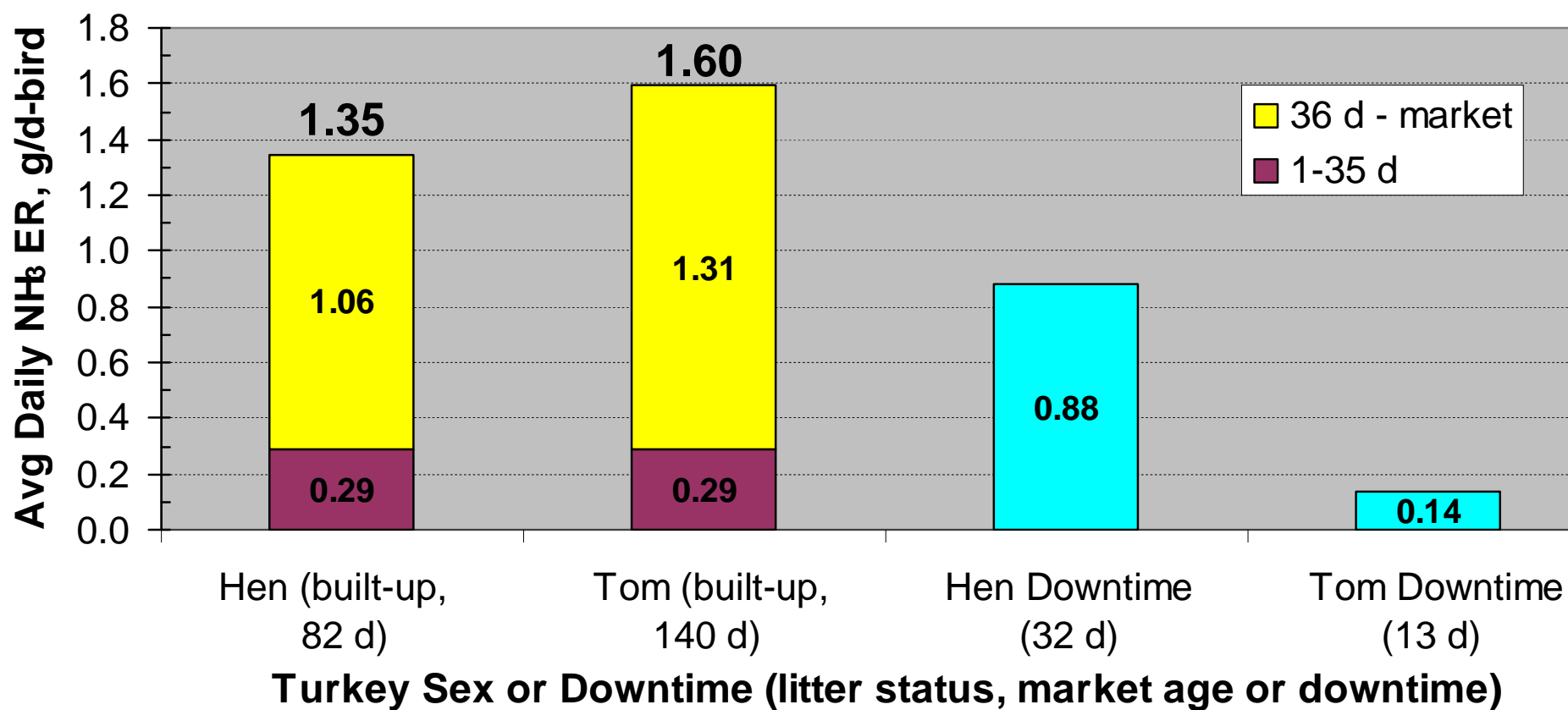
Cumulative per Bird NH_3 Emission of Hybrid Turkeys in IA and MN



Daily NH_3 Emission Rate (ER) of Broiler Houses – Pooled European & US Data



Daily NH_3 Emission Rate (ER) of Turkey Houses in Iowa (tom) & Minnesota (hen)



Consequence of Estimating Turkey NH_3 Emissions with Broiler Data

Bird Type	Growth period, d	Market BW, kg (lb)	NH_3 Emission, g/bird marketed
Tom Turkey	140	17.9 (39)	151 [#]
Hen Turkey	84	6.7 (15)	62 [#]
SR Broiler	52	2.8 (6.2)	35.4
TT/B ratio		6.5	4.3
HT/B ratio		2.4	1.8

[#] Including estimated emissions (10 g/bird) during 5-wk brooding on new bedding

Using T/B BW ratio would yield NH_3 emission of 230 g for TT & 85 g for HT!

An Example of Broiler NH_3 Emission Data Application

Estimate annual NH_3 emission of a broiler barn, 40 x 500 ft, that raises mixed-sex birds till 52 day. The barn grows 6 flocks per year, and the litter is removed once a year.

Assumptions: initial placement = 25,000; livability = 95%

AE = 1 flock emission with new bedding + 5 flocks of emissions with built-up litter + emission during downtime

$$\begin{aligned} \text{AE} &= (0.49 \times 52 + 0.67 \times 52 \times 5 + 0.38 \times 53) \times 25,000 \times 0.95 \\ &= 5,221 \text{ kg/yr} = 11,486 \text{ lbs/yr} = 5.74 \text{ tons/yr} \end{aligned}$$

Summary

- NH_3 emission data for commercial broiler houses have been collected extensively in KY, PA and TX.
- Litter management greatly affects emissions, with new bedding per flock substantially reducing NH_3 emissions (20-30% reduction).
- Turkey NH_3 emission data are much limited, with only one long-term study in the Midwest – IA & MN.
- Extrapolation of broiler NH_3 emission data to turkeys would lead to erroneous results (overestimation).

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