Ammonia (NH$_3$) and Hydrogen Sulfide (H$_2$S) Emission Rates for Poultry Operations

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Ammonia emission rates and number of birds taken to produce a maximum daily emission of 100 lb NH$_3$ for broilers, laying hens and turkeys

Poultry Type	Housing Type, Average or Max	Emission Rate		# birds to emit 100 lb NH$_3$/d
		(g NH$_3$/bird-d)	(lb NH$_3$/bird-d)	
Broilers[1]	63-d broilers on built-up litter (average)	0.93	0.00205	
	40-d broilers on built-up litter (max)	1.45	0.00319	31,310
	49-d broilers on built-up litter (max)	1.73	0.00381	26,240
	63-d old broilers on built-up litter (max)	2.16	0.00476	21,020
Broilers[2]	52-d broilers on built-up litter (average)	0.59	0.00130	
	52-d broilers on built-up litter (max)	1.52	0.00335	29,870
	52-d broilers on new bedding (average)	0.51	0.00112	
	52-d broilers on new bedding (max)	0.91	0.00201	49,850
Laying hens	High-rise houses (average)	0.90	0.00198	
	High-rise houses (max)	1.61	0.00355	28,200
	Manure-belt houses with daily manure removal (average)	0.054	0.00012	
	Manure-belt houses with daily manure removal (max)	0.132	0.00029	343,940
	Manure-belt houses with every 3-4 d manure removal (average)	0.094	0.00021	
	Manure-belt houses with every 3-4 d manure removal (max)	0.28	0.00062	162,140
	Manure storage for manure-belt houses	0.10	0.00022	
Turkeys	21-d brooding period (average)	0.14	0.00032	
	21-d brooding period (max)	0.42	0.00093	108,000
	28-d brooding period (average)	0.18	0.00039	
	28-d brooding period (max)	0.81	0.00179	56,000
	35-d brooding period (average)	0.28	0.00063	
	35-d brooding period (max)	1.08	0.00238	42,000
	36 to 140-d toms on litter (average)	1.37	0.00302	
	36 to 140 toms on litter (max)	3.50	0.00771	12,970

Hydrogen sulfide emission rate and number of birds taken to reach a maximum daily emission of 100 lb H_2S for broilers and laying hens

Poultry Type	Housing Type, Mean or Hi	Emission Rate		# birds to emit 100 lb H_2S/d
		(mg H_2S/bird-d)	(lb H_2S /bird-d)	
Broilers	52-d broilers on litter (average)	2.83	6.24×10^{-6}	
	52-d broilers on litter (max)	11.80	26.00×10^{-6}	3,846,150
Laying hens	High-rise houses (average)	2.16	4.76×10^{-6}	
	High-rise houses (max)	5.55	12.23×10^{-6}	8,176,615

Sources of ER data:

Broiler[1] NH_3 ER values are based on one-year intermittent field monitoring in Kentucky and Pennsylvania (Wheeler et al., 2006; Gates et al., 2008).

Broiler[2] NH_3 ER values are based on one-year continuous field monitoring in Kentucky (Burns et al, 2007).

Laying-hen NH_3 ER values are based one-year intermittent field monitoring in Iowa and Pennsylvania (Liang et al., 2005).

Laying-hen manure storage NH_3 ER value is based on laboratory measurements of emission from multiple additions (2" thick each) of hen manure (77% moisture) to the manure stack, every two days, at a constant air temperature of 77°F (25°C) (Li, 2006).

Turkey NH_3 ER values for the various brooding periods are based on ER data of broilers on new bedding that were continuously monitored in Kentucky (Burns et al., 2007). Tom turkey NH_3 ER data are based on one-year continuous field monitoring in Iowa (Xin et al., 2008, to be published).

Broiler H_2S ER values are based on one-year continuous field monitoring in Kentucky (Li et al, 2008)

Layer H_2S ER values are based on one-year continuous field monitoring with standard commercial layer diets in Iowa (Xin et al., 2008, to be published).

Instructions for using the above ER data for EPCRA continuous release reporting

The EPCRA continuous release report requires the estimation of lower bound and upper bound emissions during normal operations over a 24-hr period, as well as an estimate of the total annual emissions. We recommend that the lower bound emissions for both NH_3 and H_2S be reported as zero because no such emissions occur during some portions of the production cycle. Upper bound daily emissions should be estimated using the appropriate max ER values provided in the above tables. Total annual emissions should be estimated using the average ER values in the above tables times the number of days when birds are present in the house. The calculations for estimating EPCRA total annual and upper bound emissions are as follows.

Total annual emission = # of birds $\times$ (average daily ER) $\times$ (days per year barn is occupied)

Upper bound emission = # of birds $\times$ (max daily ER)

Refer to the following EPA web sites for reporting form and preparation instructions:

http://www.epa.gov/emergencies/docs/chem/cont_rel/Continuous%20Release%20Form.pdf

http://www.epa.gov/superfund/policy/release/pdfs/part2-fa.pdf

Examples of emission calculations:

1. A high-rise laying-hen house with 100,000 birds and with an annual average house occupation of 360 days would have the following estimated NH_3 emissions:

    a. Total annual NH_3 emission:

    100,000 birds $\times$ 0.00198 lb NH_3/bird-d $\times$ 360 d/yr = 71,280 lbs NH_3/yr

    b. Upper bound daily (24-hr) NH_3 emission:

    100,000 birds $\times$ 0.00355 lb NH_3/bird-d = 355 lbs NH_3/d

2. A manure-belt laying-hen house with 100,000 birds and daily manure removal into manure storage, and with an annual average house occupation of 360 days would have the following estimated emissions:

    a. Total annual NH_3 emission:

    100,000 birds $\times$ (0.00012+0.00022) lb NH_3/bird-d $\times$ 360 d/yr = 12,240 lbs NH_3/yr

    b. Upper bound daily (24-hr) NH_3 emission:

    100,000 birds $\times$ (0.00029+0.00022) lb NH_3/bird-d = 51 lbs NH_3/d

3. A turkey brooder barn with 10,000 poults on new bedding that is occupied 305 days per year (35 d brooding + 7 day downtime = 8.7 flocks per year) would have the following estimated emissions:

    a. Total annual NH_3 emission:

    10,000 birds $\times$ 35 d/flock $\times$ 8.7 flocks/yr $\times$ 0.00063 lb NH_3/bird-d = 1,922 lbs NH_3/yr

    b. Upper bound daily (24-hr) NH_3 emission:

    10,000 birds $\times$ 0.00238 lb NH_3/bird-d = 24 lbs NH_3/d

4. A turkey barn with 10,000 toms on litter that is occupied 345 days per year (three flocks per year) would have the following estimated emissions:

    a. Total annual NH_3 emission:

    10,000 birds $\times$ 115 d/flock $\times$ 3 flocks/yr $\times$ 0.00302 lb NH_3/bird-d = 10,419 lbs NH_3/yr

    b. Upper bound daily (24-hr) NH_3 emission:

    10,000 toms $\times$ 0.00771 lb NH_3/bird-d = 77 lbs NH_3/d