The Ag forum
by JONES-HAMILTON CO.
FALL 2012

Significant Profit Losses Seen From Ammonia-Caused Performance Decline

Ammonia is the most common cause of performance loss in terms of body weight gain and feed conversion. Extensive research has shown that even ammonia levels as low as 25 PPM can cost growers 19 points of weight per bird (Miles et al 2002) per house in a 7-week grow-out, which equates to a $209 financial loss per house. When you consider that very seldom are ammonia levels below even 50 PPM in a house, which equates to a ½ pound loss per bird, the financial costs of ammonia quickly add up. Proper litter management is the only way to keep ammonia from robbing profits.

The Source of Ammonia Troubles

Whether a house is cleaned out after every flock or built up litter is used, all birds defecate—causing the release of ammonia. Ammonia (NH_3) is a colorless, water-soluble gas formed by the bacterial breakdown of uric acid in the litter. Since ammonia does not have an ionic charge, it is readily released into the atmosphere in gaseous form at a rate determined by the surface area and temperature of the litter. Aggressive litter handling during down-time creates increased surface area which releases more ammonia. Higher temperatures, which increase water evaporation, accelerate this process even more. This is why houses with fine, dusty litter can have such high ammonia concentrations at bird level. It is important to keep litter moisture and other litter characteristics in the middle of the bell curve (not too dry and not too wet) in order to reduce the speed at which ammonia is released from the litter surface.

Measuring ammonia levels an inch or two beneath the litter surface is an indicator of what the litter bed will release over the next few days. Very fine, dusty litter often has deep litter ammonia concentrations over 600 PPM, whereas properly handled litter with a larger particle size will rarely exceed 150 PPM of ammonia deep in the litter.

Ammonia and Bird Health

A bird's ability to respond to respiratory disease challenges is directly related to air quality in the house. Ammonia causes the first breach of respiratory defenses that will then allow viral and bacterial invaders entrance into the bird's respiratory system.

The first line of defense that birds have against respiratory challenges is the mucociliary elevator of the trachea. As a bird inhales, bacteria, viruses and other particles become trapped in the mucus that covers the cilia on the inner surface of the bird's trachea. The cilia are small fibers that beat upward, in effect forming an elevator that lifts the trapped particles in the mucus out of the trachea where they can be removed or swallowed by the bird. Proper functioning of this defense mechanism depends on the integrity of this tracheal lining. Any insult to the mucociliary elevator will impair the bird's ability to clear particles and disease organisms from the respiratory tract.

The most common cause of damage to the mucociliary elevator is ammonia. Ciliostasis, or paralysis of the cilia, can be seen with ammonia levels as low as 25 PPM (barely detectable by the human nose) and can result in bacteria and viruses being trapped by the mucus with the paralyzed cilia unable to remove them. This allows the trapped particles to fall deeper into the bird's respiratory tract. Higher levels of ammonia can cause deciliation, or a loss of cilia, which allows immediate access of viruses (including vaccine viruses) and bacteria into the bird's lower respiratory system. Small particles (dust, bacteria, and viruses) cannot be cleared adequately from the respiratory system and end up in the air sacs where airsacculitis may develop.

NH_3 Level	Detrimental Effects
20 PPM (continuous for 6 weeks)	• pulmonary edema, congestion, and hemorrhage • increased susceptibility to respiratory disease due to ciliostasis
40 PPM	• deciliation and decreased clearance of E. coli from lungs and airsacs
25-50 PPM	• reduced body weights (0.38 lbs. Less at 49 days), feed efficiency and increased airsacculitis in birds exposed to Infectious Bronchitis Virus
50-100 PPM	• keratoconjunctivitis, corneal ulceration, and blindness

Excessive moisture within a house or improper de-caking and litter handling will encourage ammonia production and release. Proper litter management, litter amendment use and ventilation to maintain ammonia levels below 25 PPM should be followed at all times. This ensures that birds are able to maintain their innate defense mechanisms in order to fight off respiratory disease challenges and more importantly to prevent performance losses.

Ammonia's Impact on Bird Performance

While high levels of ammonia can be detrimental to bird performance at any stage, poultry are most susceptible to ammonia insults during the first four weeks of life. A collaborative study between Mississippi State University and the USDA-ARS unit in Starkville, MS, showed the impact of ammonia exposure on broiler performance.

In one study (see Table 1), birds exposed to 50 PPM of ammonia for the first four weeks of the grow-out and no ammonia thereafter were 6.4% lighter and birds exposed to 75 PPM were 9% lighter than birds exposed to only 25 PPM for the first four weeks. Ammonia levels of 75 PPM or greater during the first four weeks of life are quite common (even in the summertime) in houses not using a litter amendment in the whole house at the beginning of each flock.

Male broiler response to low levels of atmospheric ammonia							
		Weight depression				Yield[2] (%)	
							Breast meat
NH_3 (ppm)	BW[1] (g)	(g)	(%)	Feed/gain[1]	Mortality[1] (%)	Overall	(pectoralis major + minor)
4 Weeks							
0 (near)	1,421[x]	–	–	1.53[x]			
25	1,395[x]	26	2	1.52[x]			
50	1,178[y]	243	17	1.62[x]			
75	1,128[y]	293	21	1.62[x]			
7 Weeks							
0 (near)	3,211[x]	–	–	1.93[x]	5.8[xy]	73.2[x]	19.8[x]
25	3,202[x]	9	0.3	1.91[x]	2.8[xy]	73.0[x]	19.7[x]
50	3,004[y]	207	6.4	1.98[x]	10.6[yz]	72.7[x]	19.0[x]
75	2,920[y]	291	9.0	1.97[x]	13.9[z]	72.4[x]	19.0[x]
SEM	(61.6)			(0.11)		(0.31)	(0.34)

[x-z] Means within a column lacking a common superscript differ (P≤ 0.05).

[1] There were 4 observations per mean for the near 0 treatment and 3 observations per mean for the 25, 50, and 75 ppm treatments. In the first trial, mechanical problems with ammonia control required 3 chambers (one each of the 25, 50, and 75 ppm treatments) to be discontinued.

[2] Yield observations per mean for the near 0, 25, 50, and 75 ppm treatments were 160, 107, 151, and 144, respectively.

Table 1. Performance Losses due to Ammonia Exposure the First Four Weeks of Grow-Out, (Miles et al. 2004)

A 1.5 million a week complex on an 8-lb bird program that does not do a good job of maintaining ammonia below 25 PPM could be losing more than a million pounds a week due to ammonia exposure—a substantial loss in an environment of tight margins and very high feed costs. In a second study done by Miles et al, the weight loss from ammonia exposure was an even greater percentage of body weight (Figures 2).

In addition to the loss of weight, the uniformity of the flock also suffers due to ammonia exposure. This is of particular importance in a complex raising a fast-food bird that has to hit a very tight weight specification. As you can see in Figure 3, as ammonia exposure increases from 0 PPM to 25 PPM to 50 PPM, not only does body weight decrease, but the size variability of birds increases dramatically.

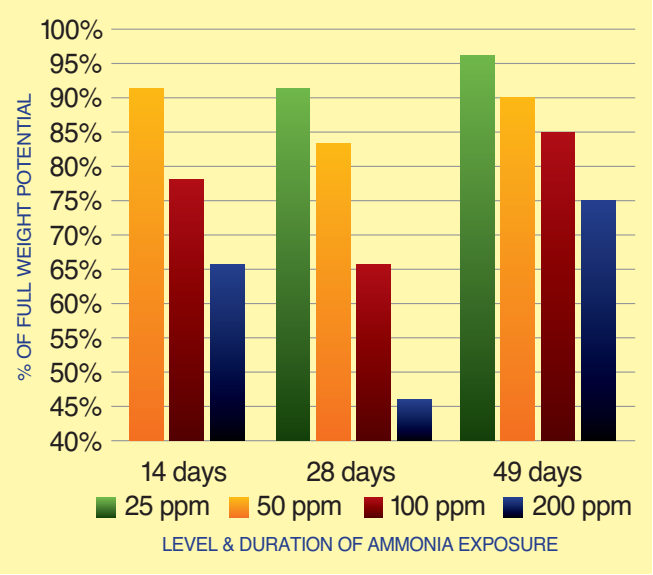

Figure 2. Body Weight Changes with Ammonia Exposure (Miles et al 2002)

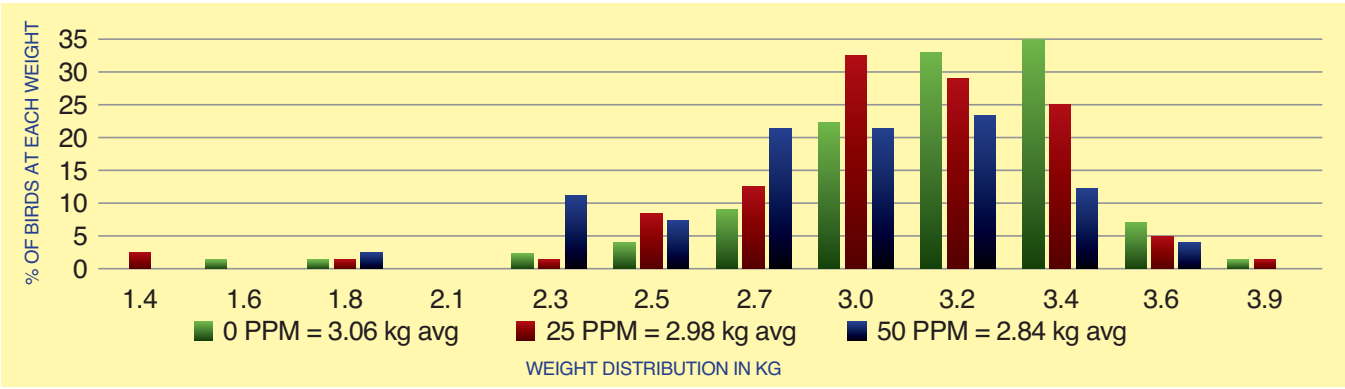

Figure 3. Affect of NH_3 on Average Weight & Weight Distribution, (Miles et al 2002).

The ammonia levels that cause a loss of weight and feed conversion are much lower than the ammonia levels necessary to cause visual changes in a bird. Performance is greatly reduced by exposure to 50 PPM, but birds do no show signs of blindness until ammonia exceeds 100 PPM. Unfortunately, many growers and live production personnel use the presence of blind birds as their metric for ensuring success in controlling ammonia. However, by the time blind birds are present, the damage has already been done in terms of performance and the size of a grower's settlement check.

Controlling Ammonia with Litter Management

Prevention of ammonia release is the key to maximizing bird performance. This is done through proper litter management during the down time and proper usage of a litter amendment such as PLT® litter acidifier..

Ammonia production increases as litter pH approaches 7.0, and is at its highest at a pH of 8.0 or above (Ritz, et al, 2004). It is estimated that 50% to 80% of the nitrogen in manure is converted to ammonia unless it is first converted to stable ammonium sulfate. Converting ammonia into stable, nonvolatile ammonium sulfate (NH_4^+) requires an acidic environment, which is why the most effective litter amendments are acidic in nature.

A commercial broiler complex in the Southeast raising both a large (7.0 lb.) and small (4.5 lb.) bird evaluated the economic and performance benefits of using litter amendments. Contract growers were given a choice of either using PLT® or Al+Clear (General Chemical Corp., Parsippany, NJ) in the brood chamber at the proper rate for their litter age. Eighty-seven percent of the big bird growers and eighty-two percent of small bird growers chose PLT®. The remaining thirteen percent of the big-bird and eighteen percent of the small-bird growers chose to use Al+Clear in an identical manner to the PLT®. A total of 43.9 million birds were evaluated in this demonstration. The variety of housing and management types were similar between the treatment groups.

Bird Size	Performance Parameter	PLT®	Al+Clear
Large (7.0 lb/3.2 kg)	Total Number of Birds	19, 086, 816	2,846,212
	Feed Conversion	2.27	2.29
	Weight (lbs)	6.92	6.81
	Condemnation (%)	1.77	2.11
Small (4.5 lb/2.05 kg)	Total Number of Birds	18,091,297	3,869,792
	Feed Conversion	2.05	2.09
	Weight (lbs)	4.52	4.5
	Condemnation (%)	1.07	1.99

Figure 4. Production Data from Southeast Commercial Broiler Complex for all flocks raised on PLT® or Al+Clear

Both the small and large bird groups raised on PLT® substantially outperformed the birds raised on Al+Clear (Figure 4). In a complex of this size, the general rule of thumb used in the U.S. poultry industry is that an improvement in feed conversion of 0.01 lbs. of weight gain/lb. of feed consumption is worth $1 Million per year (Agrimetrics Associates, Inc., Midlothian, VA). The large birds raised on PLT® had a feed conversion improved by 0.02 and the feed conversion of the small birds was improved by 0.04 over the birds raised on Al+Clear. This reduced performance shown by the birds raised on Al+Clear is consistent with production losses due to ammonia exposure reported in the literature (Miles, et al., 2004). This resulted in a net return of $2.7 million /yr over the cost of PLT ($305,000) on improved feed conversion alone in that complex. Additional economic benefit would have also been realized by the grower and the poultry integrator from the increases in weight and livability observed in this trial.

Taking Action Against Ammonia: The Bottom Line and Smart Steps

20 years of research has shown the effects of ammonia on bird weight (Figure 5). At 50 PPM, figures show a ½ pound lost per bird. Therefore, based on today's production cost, producers and poultry integrators can loose substantially based on weight alone.

20,000 birds @ 6.5 lbs = $0.055/lbs grower pay – ½ lbs. lost weight = $550 lost per house

From a company's perspective the losses are even greater. When updated to today's cost parameters based on the criteria above and research from 2002 (Miles), the losses are substantial and real. Birds challenged with ammonia lose 8 points feed conversion. With feed at $325/ton, the loss on 20,000 birds is $1,690 in lost feed conversion per house. The loss can reach as high as $84,500 per week for a million bird per week complex.

Over ten years of field studies, nearly half of all farms surveyed were above 50 PPM without a litter amendment—a number that equates to a significant loss of more than $35,000 a week just in feed cost. When condemnations and downgrades due to ammonia and bacterial challenges are factored in, integrators face an additional loss of $8,000 in disease and $7,500 due to whole bird condemnation or downgrades on a million bird operation. Paw quality also suffers greatly due to ammonia exposure in the brood chamber resulting in a major loss of grade A paws.

Manage Ammonia to Avoid Profit Loss

In addition to applying PLT® litter acidifier according to manufacturer's directions, simple steps have been defined to avoid these ammonia-induced losses:

- Take air samples at bird level – no more than one inch above litter for chicks.
- Remove cake between flocks, but do not till.
- Pre-heat properly before bird placement to complete the ammonia purge from the litter.
- Apply a litter amendment in the entire house to prevent ammonia losses at move down. Maintain adequate ventilation to achieve ideal relative humidity.
- Avoid wet litter with an efficient waterline management program that avoids leaks and spills.

References

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