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Poultry Housing Tips

Ammonia Scrubbers

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You are frying eggs for breakfast. You get distracted and the next thing you know your eggs are burning and your kitchen is filling with smoke. What do you do first? Open the window to get rid of the smoke or remove the skillet from the stove to stop the generation of the smoke? You of course, remove the skillet from the stove, then open windows because opening the windows in itself doesn't solve the problem, because your eggs are still burning and filling the kitchen with smoke.

Controlling ammonia in poultry houses presents a very similar situation. How do you keep your house from filling with ammonia? Sure, you can turn on exhaust fans to remove the ammonia, but to actually solve the problem you need to stop or at least slow the generation of ammonia. At the beginning of a flock, producers with built-up litter typically control the generation of ammonia through the use of a litter treatment. But, for long-term ammonia generation control, producers need to limit the amount of moisture in the litter because moisture is one of the key building blocks of ammonia. The fact is even at the beginning of a flock, ammonia control is tied to litter moisture control. This is because one of the most important factors determining litter treatment life is litter moisture. If the litter is not properly dried between flocks the resulting high ammonia generation rate will quickly overwhelm the litter treatment's limited ammonia neutralizing ability.

Another method of removing ammonia from a poultry house is through the use of a scrubber. An ammonia scrubber works by pulling air from a poultry house through a filter/media, typically containing some type of acid, which chemically scrubs/removes the ammonia from the air. Though this may sound like a great idea, there are a couple of significant issues with this method of ammonia removal. First, though a scrubber can potentially remove ammonia from the air in a poultry house, it will not affect the generation of ammonia because a scrubber does not remove moisture from the air or litter. If minimum ventilation rates are lowered in response to lower house ammonia concentrations, litter moisture levels will tend to increase, resulting in increased ammonia generation rates, which could easily overwhelm the ammonia-removing capacity of the scrubber.

Another important consideration is that since a scrubber's ability to remove ammonia from the air requires a chemical reaction, there is a limited amount of time before the chemicals will need to be replenished. This challenge is not that different from controlling ammonia early on during a flock through the use of a litter treatment. The litter generates ammonia. We apply a litter treatment to the litter, and the acid in the litter treatment neutralizes the ammonia, and ammonia levels are reduced until all the chemical is used up. The greater the amount of ammonia being generated, the greater the amount of chemicals/litter treatment required and the shorter the life of the litter treatment. In either case, there is a limit to how long ammonia can be chemically removed from the air in a poultry house.

During the winter of 2023, a commercially available scrubber was installed in a broiler house and operated continuously for the last three weeks of a flock (Figure 1). The scrubber's air exchange rate was measured and determined to be 300 cfm. Ammonia meters were installed on the intake and exhaust sides of the unit, along with temperature and RH sensors and measurements were recorded every minute.

The scrubber was found to be effective at lowering the concentration of ammonia of the air flowing through the unit. Ammonia concentrations were reduced by between 5 and 30 ppm with the greatest reductions corresponding with the highest incoming ammonia concentrations (Figure 2). One minor weakness of the scrubber was that it did not remove all the ammonia from the air. Ammonia concentrations

leaving the scrubber were typically between 5 and 10 ppm with the higher concentrations typically being associated with higher house ammonia levels. A much more significant weakness was that only 300 cubic feet of air each minute (or 18,000 cubic feet of air each hour) was "scrubbed" of ammonia. 18,000 cubic feet of air may seen like a lot but it is important to realize that there were at least four 36" fans operating a minimum of two minutes out of five, providing 864,000 cubic feet of ammonia-free air each hour. To provide that same ammonia removal rate would have required approximately 48 scrubbers of the design tested. Another way to look at it is that the scrubber was essentially only capable of removing the same amount of ammonia as two 36" fans operating five seconds out of five minutes.

Figure 1. Ammonia scrubber

Another significant weakness is that, as noted previously, scrubbers have a limited amount of ammonia they can react with. For instance, it takes around 1 lb. of most acid-based litter treatments to react with 0.14 lbs of ammonia. The scrubber tested contained approximately 50 lbs. of an acid-impregnated carbon...essentially 50 lbs. of litter treatment, which meant that it theoretically could only neutralize roughly 7 lbs. of ammonia.

Figure 2. shows the ammonia concentration entering and leaving the scrubber over the last seven days of the study flock. As expected, the highest ammonia concentration occurred at night when the only the minimum-ventilation fans were operating off a timer, and the lowest during the day when outside temperatures rose and minimum-ventilation fans were operating continuously along with other fans to maintain the proper house temperatures. During the last week of the flock, house ammonia levels varied between 10 and 35 ppm. Air flowing out of the scrubber varied between 3 and 12 ppm.

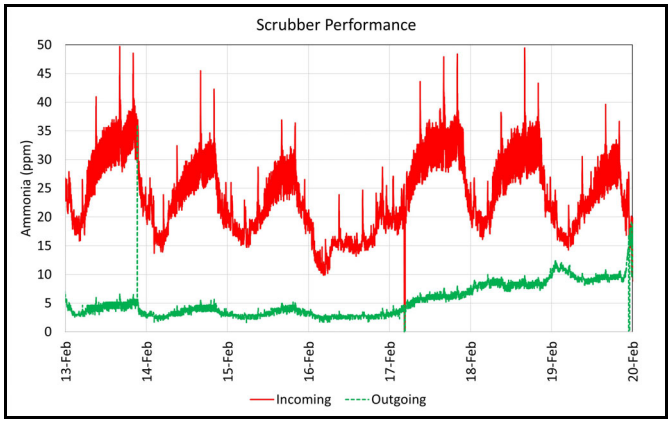

Figure 2. Incoming and outgoing ammonia concentration from scrubber.

It was observed that the concentration of ammonia flowing out of the scrubber during the last three days of the flock were slightly higher than they were earlier in the week when ammonia concentrations were similar, indicating a slight reduction in the scrubber's ability to remove ammonia from the air. The scrubber was removed from the house prior to catching. After the birds were caught, the litter was decaked, and five days later the scrubber was returned to the house and turned on. A 54" fan, operating continuously in conjunction with the side wall inlets, was used to remove ammonia and moisture from the house. The initial ammonia concentration was over 100 ppm and after three days decreased to 40 ppm. Though the scrubber was initially able to decrease the incoming 100 ppm air to 40 ppm, after two days of operation the scrubber was unable to eliminate any ammonia from the air.

During the following, flock the carbon-based scrubber media was replaced with Zeolite. Though the initial performance of the Zeolite material was very similar to that of the acid-impregnated carbon, its life was significantly less, approximately a week.

These studies demonstrate the difficulty of trying to control ammonia using scrubbers. Though it is theoretically possible, they don't address the core problem, ammonia generation. As with the case of a smoke-filled kitchen, if you don't focus your efforts on the generation of the thing causing your problem, you will never solve the problem.

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