Department of Animal Science

UNDERSTANDING LED LAMP AND LIGHT DIMMER ISSUES

March 2022
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Photo: Tom Tabler

The US broiler industry is a major source of animal protein for a rapidly increasing world population that is expected to reach near 10 billion by 2050. While proper temperature, humidity and ventilation are all critical to flock performance, the lighting program is also an essential environmental factor for broilers to achieve optimal performance. Even so, the lighting program is only as good as the lamps and the dimmer, and recently there have been numerous issues between various brands of light emitting diode (LED) lamps and light dimmers. Unknowingly, many of the lighting issues that plague the poultry industry today were self-inflected wounds. Fortunately, we now know what is causing most of these problems. However, unless we take corrective action to alleviate these problems, they will not go away. As a result, we will continue to face the same issues flock after flock. We've been down this road before, but let's take another look at what the problems are and what needs to be done to correct them.

We are partly to blame

When LED lamps first arrived on the scene in poultry houses, we unscrewed the old incandescent lamps and screwed the new LED lamps into the old sockets and the new lamps worked (sort of). Maybe they flickered, maybe they strobed, maybe we had to put an incandescent lamp at the end of the line, but we **worked with what we had,** and put the old sockets, the old light dimmer, and the new LED lamps together and made do. In hindsight, this was a serious mistake and today we are paying for that mistake. We now know that many of the old sockets and practically all the old dimmers should have been changed as well. Unfortunately, five to 10 years ago, LED lamps were well ahead of dimmers in terms of technology. That's part of the problem today. Growers today are all too often still using a dimmer that is five to ten years old or more and that dimmer is not a compatible dimmer with LED lamps. That's not all the problem. Many growers are also using brands of LED lamps that have no place in a chicken house.

Education is critical

A multitude of various brands of LED lamps are in use in poultry houses today. Some are very expensive, some are quite inexpensive, and some are somewhere in between. You don't need the most expensive LEDs to get good flock performance. However, you don't want the least expensive ones because these LEDs are not designed for poultry house use and you will not be happy with their performance. Choose an LED lamp that is mid-range in price and manufactured by a company with a proven track record in agricultural lighting. Look for a beam angle that puts most of the light on the floor of the poultry house and very little on the walls and ceiling. The chickens are on the floor so that's where the light needs to be. Inexpensive LED lamps designed for home or office use are omni-directional and give coverage to the ceiling, walls and floor. That's fine in a home or office, but omni-directional lamps have no place in a poultry house. Agricultural LED lamps are somewhat more expensive because they use a better heat sink and heavy-duty components to improve life expectancy, to allow for 100 percent dimming, and particularly, to withstand the harsh poultry house environment. Dust, ammonia, humidity and moisture are all constant challenges to LED lamps in a poultry house. Agricultural LEDs can withstand this challenge. Inexpensive omni-directional LEDs from the big box stores designed for residential settings cannot.

Some light dimmers and LED lamps aren't compatible

Today there are numerous combinations of LED lamps and light dimmers in use in poultry houses across the country. Five to 10 years ago, everyone was unaware this would cause issues down the road. Today, we know better. Again, hindsight is 20:20, but it was a mistake for this to happen. We now know that many combinations of LED lamps and light dimmers we are now using will never work well together. Light dimmers that were great at dimming incandescent lamps (with a piece of tungsten filament wire that produces the light) can't handle LED lamps (with a sophisticated circuit board and driver and LED chips that produce the light). A horse is great for riding across the back 40, but it can't handle getting you across the country and back. You need something a little more high-tech for that. We are asking most light dimmers in the field today to do something they can't do, handle the sophisticated technology of LED lamps. Instead, we need something a little more high-tech for that.

How light dimming is possible

Most light dimmers in the field today are leading edge (forward phase) dimmers that are not capable of operating LED lamps without issues such as flickering, excessive lumen depreciation, premature lamp failure and damage to the individual LED chips over time. There are now also trailing edge (reverse phase) dimmers that are a much better option for dimming LED lamps. Alternating current (AC) has varying voltage polarity in an undulating sine wave that fluctuates from positive to negative voltage. In the US, this alternating cycle happens 60 times per second. This frequency is referred to as hertz. Common electrical supply in the US is 60 hertz (meaning the current direction "alternates" 120 times, or 60 cycles per second). Light dimming is possible because a dimmer chops off a percentage of the AC sine wave. There are two main dimming methods used to chop the sine wave, depending on whether the front edge or back edge of the sine wave is chopped.

Leading edge (forward phase) and trailing-edge (reverse-phase) dimming

Leading edge dimming — Leading edge dimming utilizes a current that is turned off as the AC sine wave begins, just after it crosses zero into positive territory. It cuts the front edge of each wave's half cycle. Leading edge dimming creates a rush of voltage every half cycle, resulting in a rush of current to the light source. Also called forward-phase dimming, these dimmers can produce current spikes that can cause increased stress to electronic drivers. These current spikes are likely the cause of the many issues we are seeing with LED lamps. Most LED chip manufacturers have indicated that exposure to current greater than 300 milliamperes will cause irreversible damage to the chips, which is typically seen in the field as erratic performance, excessive lumen depreciation and premature lamp failure. Leading edge dimmers are simpler, less expensive and much more common today than trailing edge dimmers. They typically use a TRIAC (Triode for Alternating Current) switch to control power. TRIAC dimmers have been used since about 1960 and were originally designed to dim incandescent and halogen lamps and wire-wound magnetic transformers. They are good at what they're designed for, but **they weren't designed for LED lamps**. Many leading-edge dimmer switches have a relatively high minimum load, which often rules out their use with modest-load LED circuits. This explains why it is sometimes necessary to put an incandescent lamp at the end of the line in a chicken house to help the dimmer find enough load to do its job.

Trailing edge dimming — Trailing edge (reverse-phase) dimming utilizes a current that turns off as the AC sine wave ends, just before it crosses zero into negative territory. Trailing edge dimmers are more sophisticated and provide smoother dimming control with less interference. They have been designed specifically for use with low-wattage LED lamps because high-wattage leading edge dimmers can't read or control LED circuitry very well and are much less compatible with modest-wattage LED lamps. Trailing edge dimmers usually use a MOSFET (Metal Oxide Semiconductor Field Effect Transistor) or IGBT (Insulated Gate Bipolar Transistor) switch rather than a TRIAC switch and coil. Trailing edge dimmers have a much lower minimum load than leading edge, making them ideal for powering modest-wattage LED lamps. **These dimmers avoid current spikes** by switching the light phase circuit on just as the current changes direction and allowing the voltage to rise gradually before turning it off later in the half cycle.

Unlike incandescent lamps, LED lamps have a built-in driver at their base. The driver converts AC power to direct current (DC) power and maintains a constant current supply to the LED lamp. **LED chips are current-sensitive devices** and require good quality constant DC current, but not overcurrent spikes. For an LED lamp to work properly with a phase control dimmer, the electronics of its driver must be compatible with the dimmer. Leading edge dimmers work best with resistive loads (incandescent lamps). Trailing edge dimmers work best with capacitive loads (LED drivers). For an increased chance of compatibility, trailing edge dimmers tend to work better with the capacitive load of LED drivers.

Light sockets may need replacing

Many growers have replaced incandescent lamps with LED lamps without changing the light sockets. However, retrofitting an older farm with LED lamps should also include replacing the screw shells and sockets. Over the years, moisture and ammonia may have corroded fixtures and

screw shells. Have a professional electrician check the wiring, connections and screw shells. Realize that **nickel plated brass screw shells and porcelain sockets are best** to deliver optimum LED performance. Poultry house conditions are extremely hard on equipment and if keyless sockets are more than about 3 years old — particularly if they are not nickel plated — they should be inspected, and, if damaged, be replaced. One malfunctioning keyless socket on the line will affect the lighting operation of the entire house. Lighting circuits should have their own dedicated neutral (not a common neutral) for LED lamps to function properly. All connections must be tight to avoid issues and make sure that earth grounds are secure.

To do list

1. **Switch to a trailing-edge dimmer immediately!** LED lamps should only be paired with trailing-edge dimmers. Switching will solve a host of problems such as strobing, flickering, uneven dimming, excessive lumen depreciation and premature lamp failure.
2. **Be sure screw shells are not corroded and fixtures are intact and tight**. Nickel-plated brass screw shells should be used for best LED lighting performance.
3. **Have an electrical professional check your farm and poultry house wiring annually**.
4. **Closely follow your company's lighting program**. Intensity of light vs. days of age in the grow out are constantly changing. The lighting program must adapt to these changes.
5. **Purchase a good light meter and learn how to use it**. Don't trust your eyes to know if the light level is correct.
6. **Use only LED brands rated for agricultural use.** Most big box store LED lamps are designed for homes, not poultry houses. Invest in quality and you will be much happier with the outcome.

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