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Broiler House Lighting Developments

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Recent developments in light bulb technology now make it a good business decision to replace incandescent bulbs with energy-efficient Cold Cathode (CC) and Compact Fluorescent (CFL) bulbs, which are much more cost-effective. When implemented correctly, a broiler grower's lighting cost may be reduced by 70 to 85% while maintaining the same level of flock performance and using existing wiring circuits. Widespread replacement of incandescent bulbs with CC and CFL bulbs is being seen across the Broiler Belt. Detailed background information is in Newsletter #59, May, 2009. In time, everybody will need to retrofit all their bulbs, as there will be no more incandescent bulbs sold within about three years, and growers who do lighting retrofits first will get the most economic benefit. This is no longer experimental; we are all doing it at our homes and now we need to do it on our farms.

Experts recommend that broilers receive approximately 3 to 4 foot-candles (fc) of light (one foot candle equals 10.76 lux) during the brood phase. Brood lasts for 8 to 14 days, depending on the integrator company, and helps the chicks become acclimated to their new environment by finding feed and water, while strengthening their skeletal structure and properly developing their circulatory, digestive, nervous, and immune systems. After the initial brood phase, birds are turned out, migration fences are installed, and light intensity is lowered (dimmed), generally to around one-fourth foot-candle or less, and alternated with short periods of complete darkness for the remainder of the growout. At this low light intensity, birds will be less active, but still eat and drink sufficiently to achieve desired weight gains. Low light intensities during growout also reduce aggression in the flock and tend to lower the incidence of heart attacks, ascites, and other flock problems.

The goal is to provide intense, uniform light in the brood chamber, especially over the feed and water lines. After turnout to whole house we need to fully satisfy dimming requirements for the remainder of the growout.

Properly designed and managed poultry lighting systems using modern compact fluorescent (CFL) and cold cathode (CC) lighting can reduce broiler house lighting costs by 70 to 85% over conventional incandescent lighting. Photo shows a house using CFL bulbs in dual adaptors over feed lines. This lighting layout does not require supplemental brood lights (see Lighting Layout Example 1, page 5).

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All Energy Efficient Bulbs Are Not Created Equal

Lumen output per watt of power consumption is the biggest difference between CC and CFL bulbs. CFL bulbs provide 65-75 lumens per watt, nearly twice the light output per watt of CC bulbs, which give about 35-40 lumens per watt. For comparison, incandescent bulbs provide only 12-17 lumens per watt.

Thus we can replace incandescent bulbs with lower wattage CC and/or CFL bulbs to achieve equivalent light levels at much lower electric power costs. However, because of the relatively low lumen output of CC bulbs, higher wattage CFL brood lights usually must be used as a supplement.

The table at top of page 3 opposite compares wattage, light output, lumens per watt and approximate life for incandescent, cold cathode and compact fluorescent bulbs.

Cold Cathode bulbs (at left) last about twice as long as Compact Fluorescents (at right), but have only about half the light output per watt.

Cold Cathode (CC)

Cold cathode bulbs are dimmable and typically last twice as long as compact fluorescents but are more expensive and have much lower light output. Many poultry growers are using 8 watt CC dimmable bulbs, which dim very well, but only emit 325 lumens of light. Even the new 15 watt CC bulbs generate only 525 lumens, compared to a 15W dimmable CFL that generates 1,100 lumens or a 23W dimmable CFL that emits 1,600 lumens. Consequently, supplemental bright (high lumen) brood lights are required when using CC bulbs.

Many 8W CC bulbs have been installed in broiler houses in the dimming circuits to replace 60W or 100W incandescent bulbs. However, since the equivalent lumen output is still very low, it requires that either dual light adapters be used to allow the installation of two bulbs in one fixture (see Dual Bulb Pull-Chain Adapters, below), or that supplemental brood lights be used to achieve minimum brood lighting levels. CC bulb life is considerably higher than incandescent bulbs at 18,000-25,000 hours.

Compact Fluorescent (CFL) – Dimmable and Non-Dimmable

There are two very different types of CFL bulbs, dimmable and non-dimmable. CFL bulbs are being widely adopted in broiler houses in the US and are the new bulb of choice for several reasons. These bulbs have an estimated lifespan of 8,000-12,000 hours, which is less than the CC but approximately 10 times longer than their incandescent equivalent, and their lumen output is 2 to 3 times that of CC bulbs. A variety of CFL bulbs are on the market in the US and pricing is very competitive. Bulb prices are much lower than the CC equivalent and CFL dimming technology has progressed rapidly. The first generation dimmable CFL bulbs did not perform as well as expected in broiler houses and had problems in early field trials. However, newer generation dimmable CFL bulbs have been field tested with several broiler companies and they show much longer life and improved dimming capabilities.

Reliable dimming CFL bulbs are now available in two common sizes, a 15W (70W incandescent equivalent) and a 23W (100W incandescent equivalent). Both use less than 25% of the power of their incandescent equivalents. Bulb cost is approximately $5.50 per bulb with a lumen output of 1,100 and 1,600 lumens, respectively.

“Jelly jar” fixtures for the “twirly” compact fluorescent bulbs do not collect as much dust and are much easier to clean than the bare CFLs. The result is that proper light levels are much more likely to be maintained, and with less labor involved.

Lumens per Watt and Approximate Bulb Life by Bulb Type

Bulb Type	Wattage	Lumens	Lumens/Watt	Approx. Life (Hr)
Incandescent	25	190	7.6	800-1200
Incandescent	40	470	11.8	“
Incandescent	60	870	14.5	“
Incandescent	75	1,190	15.9	“
Incandescent	100	1,710	17.1	“
Cold Cathode	8	325	40.6	18,000-25,000
Cold Cathode	15	525	35.0	“
Compact Fluorescent	15	1,100	73.3	8,000-12,000
Compact Fluorescent	18	1,250	69.4	“
Compact Fluorescent	23	1,600	69.6	“
Compact Fluorescent	26	1,750	67.3	“
Compact Fluorescent	42	2,700	67.5	“
Compact Fluorescent	55	3,600	65.5	“

Non-dimmable CFL bulbs range in size from 8 or 9W (40W incandescent equivalent) up to 65W (300W incandescent equivalent). Sizes of non-dimmable CFL bulbs commonly found in broiler house applications are 15W (950 lumens), 18W (1250 lumens), 23W (1600 lumens), 26W (1750 lumens), 40-42W (2700 lumens), 55W (3500 lumens), and 65W (3900 lumens). Minor variation among manufacturers is common. Since mass production of “household size” bulbs has resulted in much lower prices, non-dimmable CFL bulbs in the 15W to 26W range are by far the least expensive and most cost effective bulbs, typically ranging in cost from less than $1.50 to about $3.00. The 40-42W bulbs typically retail for about $8.00-$11.00, and the 55-65W bulbs typically range from $12 to $17.

Light Emitting Diode (LED)

LED bulbs are quickly becoming available for many applications and LED technology offers excellent potential for development over the next several years. However, currently LED technology has several attributes that make it poorly suited for use in poultry houses. LED bulbs emit a cone-shaped light pattern similar to a floodlight which makes achieving lighting uniformity very difficult. LED bulbs all have finned heat sinks surrounding their bases to dissipate heat, and the space between these fins collects dirt, debris, and moisture quickly. This will require constant attention by growers and may cause premature failure of these expensive bulbs. Currently the cost of LED bulbs is extremely high, and any economic analyses which compare the true costs of LED lighting against the other new technologies (CC and CFL) will yield economic paybacks of several years compared to economic paybacks of several flocks for the CC and CFL options.

While we believe the future holds promise for LED technologies in poultry housing, we feel that this technology has not currently been sufficiently developed for use in the harsh environment of the typical production house.

Dimming Considerations

While we typically brood birds at 3 or more fc, it is imperative that we have the capability of dimming the lights in the broiler house to 0.10 fc to 0.25 fc measured at bird level along the feed lines. Exact target dimming levels depend on the integrator and should be determined by using a good light meter, not just by “eyeballing.” Thus, each house must be equipped with a compatible light dimmer wired into the dimming lighting circuits in the house.

High wattage dimmers designed to work with incandescent light bulbs typically do not operate in the same manner with CC and dimmable CFL bulbs. Some growers with older dimmers have had good dimming success by simply installing a single 75W or 100W incandescent bulb at the front-most socket of the dimming

circuit when using CC and dimmable CFL bulbs. However, most of the manufacturers making dimmers have developed new dimming hardware and software that is available to field upgrade their existing incandescent dimmers, or they now sell dimmers specifically designed to operate with the lower wattage CC or dimmable CFL bulbs.

Dual Bulb Pull-Chain Adapters

A new 2-bulb adapter has been specifically designed for broiler houses by Retrolite Corporation that elevates socket splitters to another level by adding a pull-chain selectable switch and a ratcheting base. The grower simply unscrews the incandescent bulb and screws in the pull-chain adapter.

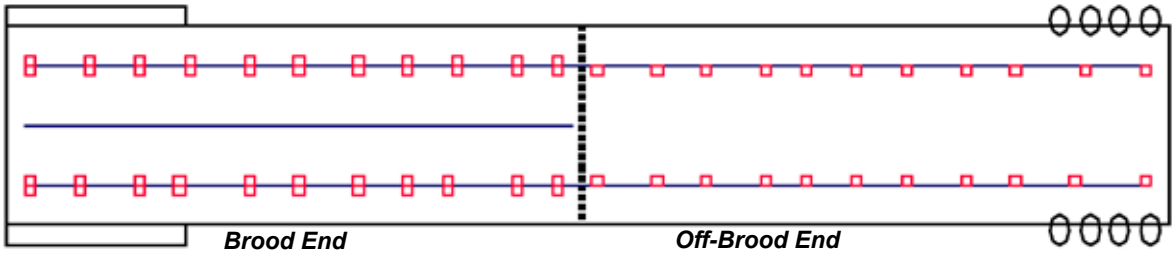
The ratchet allows flexibility in orienting the adapter and the pull-chain permits one bulb to be switched off when dimming is desired. One dimmable bulb and one non-dimmable bulb can be placed in the adapter and no additional wiring is required. The cost of the adapter (about $6.50) is much less than running additional electrical circuits. Both bulbs are used in the brood chamber when high light intensity is necessary during the brood phase and then the fixtures can be switched to turn off the non-dimmable bulb and operate only the dimmable bulb.

New dual bulb pull-chain adapters allow switching one bulb on or off at a time, as well as installing one dimmable and one non-dimmable bulb, as shown in photo above, without requiring additional wiring. Both bulbs are typically used during brooding; after turnout, when much lower light levels are required, the receptacle is switched to the dimmable bulb only.

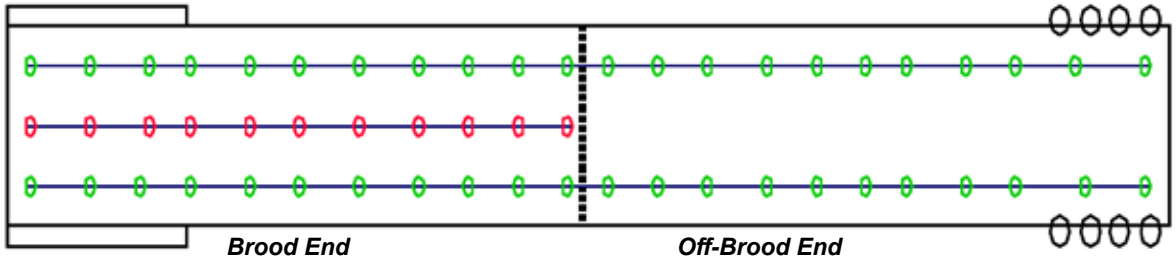
Houses that do not use these adapters typically must operate an additional electrical circuit in the brood chamber to achieve the required foot candle levels, so the adapter adds a great deal of flexibility toward achieving your lighting goals. Additionally, with the use of these adapters, a large number of bulbs can easily be turned off to provide the very low light requested by flock catch crews. These adapters can also be equipped with glass or plastic globe enclosures commonly called “jelly jars.”

Old keyless sockets, as shown at left above and in close-up at right, are highly susceptible to corrosion in the broiler house, leading to higher bulb failures and dimming problems. For this reason, bulb manufacturers highly recommend using only nickel-plated brass sockets for both CC and CFL bulbs.

Example Lighting Layouts - 40 Foot Wide House

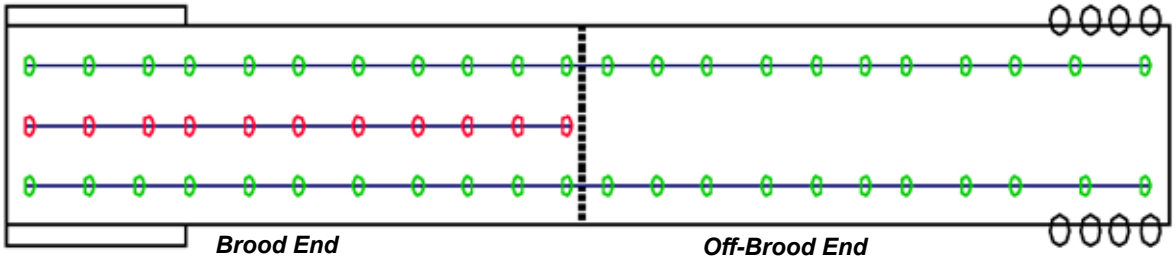


<u>Example #1</u> – Dual socket splitters in brood end using one 15W dimmable CFL bulb and one 18W non-dimmable CFL bulb. No supplemental center brood lights. Off end using single 15w dimmable CFL bulbs only. Delivers 4.5-5.5 foot candles at each feed line.



0 = Dimmable Circuit (15 or 23 watt dim CFL, in outboard circuits)
0 = Non-Dim Circuit (40 or 55 watt non-dim CFL, in centerline circuit)

<u>Example #2</u> - Single dimmable CFLs & high wattage CFL center brood lights. 23W dimmable CFL and 40W non-dimmable CFL delivers 3.0-4.0 foot candles at each feed line.



0 = Dimmable Circuit (8 watt CC, in outboard circuits)
0 = Non-Dim Circuit (40 or 55 watt non-dim CFL, in centerline circuit)

<u>Example #3</u> - Single dimmable CCs & high wattage CFL center brood lights. 8W dimmable CC and 55W non-dimmable CFL delivers 3.0-4.0 foot candles at each feed line.

Keyless Socket Fixtures

Conversations with distributors and integrators, as well as countless field observations, have shown us that many keyless sockets have never been replaced. Usually, we find that there is major corrosion on these sockets, which is a contributing factor to higher bulb failures and erratic dimming performance. Additionally, the majority of keyless sockets in the field are found to be aluminum screw-shell models. We have seen many electrical contact issues using aluminum screw-shell keyless sockets over the past two years. Most bulb manufacturers are now recommending that when first installing a house of CCs or dimmable CFLs, the producer <u>use only nickel plated brass screw-shell keyless socket fixtures</u>, which retail for about a dollar apiece. Aluminum screw-shell fixtures should be avoided with CC and CFL bulbs. The aluminum screw-shell is subject to quickly becoming corroded, which causes high electrical resistance that affects bulb life and dimming performance. The aluminum screw-shell is a very thin and weak material and when used in an already corrosive environment is a key reason why some houses have much higher failure rates than others, since the inexpensive aluminum screw-shells were designed for use in non-corrosive environments. New bulb warranties will likely require using these nickel plated brass screw-shell keyless socket fixtures with CC and dimmable CFL bulbs.

Implementation

Installing CC and CFL bulbs in dropped ceiling houses with 2 feed lines is usually fairly simple, as ceiling height is the same for all sockets, and ceiling material helps reflect light without any shadowing effect. White ceilings deliver higher intensities of light to the floor than black ceilings, typically 0.50 to 0.90 fc more. High ceiling, open truss houses are more of a challenge. These houses usually have lighting installed at a higher distance from the floor and generally require additional wiring work to deliver adequate brood lighting levels. New wider houses with three or more feed lines and different ceiling heights require a mix of different wattage bulbs to achieve lighting uniformity. Many newer houses have installed dimmable and non-dimmable circuits over each feed line with alternating (dim, non-dim) sockets on 10-foot centers.

Cleaning Tips

Cleaning spiral bulbs without a globe is a hard job. However, between flocks, much of the dirt and debris can be removed from bulbs with a leaf blower and/or feather duster. It is also a good idea to wipe down the bulb surfaces with a damp cloth. Cleaner bulbs allow more light to reach bird level. “Jelly jars” may also be helpful in delivering adequate light levels.

Bottom Line

The best way to accomplish a lighting retrofit across a broiler complex is for an integrator company to refine it in a few standard houses and then convey the final layout and the design to the growers. A grower should ask his company for help before trying to implement it on his own. Unfortunately, there are new broiler houses being built with incandescent bulbs specified, which is very short-sighted. In any case, be sure to use the nickel-plated brass sockets when building; otherwise you will be switching them out soon.

Many problems encountered when installing an energy efficient lighting system can be avoided by following these three guidelines:

1) install nickel plated brass keyless sockets;

2) use an appropriate dimmer; and

3) use a light meter to accurately set dimming levels.

The net result is that lighting costs can be reduced between 70% and 85%. The typical break-even payback is within 2 to 3 flocks, and the higher the rate a grower pays for electricity, the quicker his return on investment.

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