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Poultry Housing Tips

High Efficiency 48" Fans Reduce Electricity Cost 20 to 30 Percent

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Ten years ago the average broiler producer spent twice as much on fuel as on electricity. Today, many producers are finding that their yearly electricity bills are equal to or even greater than the cost of heating their houses. One of the biggest reasons for the dramatic increase in electricity usage is the need for increased cooling for the bigger birds many people are growing, more specifically tunnel ventilation. Further contributing to the increased electricity usage on many farms is the trend of using power ventilation year round.

Most producers know approximately how many miles to the gallon their car or truck gets. Usually the level of a person's knowledge of their mileage goes hand in hand with how many miles they drive a year. If someone drives 5,000 miles a year, gas mileage is not that crucial, and they may not know exactly how many miles they get out of a gallon of gas. However, someone driving 40,000 miles a year, would probably have a really good idea of their gas mileage. Gas mileage is more important to people that drive a lot because their yearly fuel bills are high.

With this in mind, do you know what kind of "mileage" your exhaust fans get? Most poultry producers do not. Would you consider buying a car without knowing the gas mileage expected? Considering that a producer could spend $2,500 or more a year for the electricity to operate a 500' tunnel-ventilated house, purchasing high energy efficient fans could save a lot more money than they would get out of purchasing a car that gets a few more miles per gallon.

Fan efficiency is described in terms of cfm per watt (cfm/watt). Or in other words, how many cubic feet of air a fan can move in a minute using one watt of power. The higher the cfm/watt rating, the more energy efficient the fan. The energy efficiency ratings of most 48" fans range between 15 and 21 cfm/watt. In general, for every two cfm/watt increase, power usage is reduced approximately 10 percent. So, if your trying to decide between two fans, <u>which move the same amount of air</u>, and one has an energy efficiency rating of 18 cfm/watt and the other 21 cfm/watt, it would probably be a wise investment to purchase the fan that has the higher energy efficiency rating even if it costs a little more. The 21 cfm/watt fan would take 15% less power to operate than the 18 cfm/watt fan.

What if you had the opportunity to purchase a fan that had an energy efficiency rating of between 25 and 30 cfm/watt? As compared to a good slant wall belt driven fan you could reduce your fan operating cost by 30 percent or more. When compared with a direct drive fan with an exterior shutter, the savings could be more than 40 percent.

What is the catch? As you might expect the high efficiency fan costs more. Nevertheless, preliminary field tests have shown that in most cases the payback is less than two years. After you have paid for the additional cost of the fans, you could put as much as $1,000 per house in your pocket each year

How do you make a high efficiency exhaust fan? First, you put a discharge cone on a high quality slant wall fan. The discharge cone makes it easier for a fan to move air out of the house, which means the fan will move more air. For instance, an ACME BDR 48" slant wall fan will move approximately 20,000 cfm (17.8 cfm/watt). Installing a discharge cone increases the fan output to 22,400 cfm (20.4 cfm/watt). Some producers think that increasing the output of their fans is an opportunity to reduce the number of fans in their house to decrease the initial cost of the house. Though you can do this, you would be missing out on significant power savings over the life of the fan. To get further electricity savings you slow the fan by replacing the existing belt pulley with a smaller diameter pulley so that it only moves approximately the same amount of air as before you added the cone. Why would you do this? Reducing the speed of a fan slightly increases the fan efficiency. Slowing a fan, for instance 14%, reduces air flow by 14%; it reduces power usage by 30%. This is because the air moving capacity of a fan decreases at the same rate as fan speed . . . but, horsepower decreases exponentially with fan speed.

This sounds good, but does it work in the real world? Over the last six months a field test has been conducted on a four-house broiler farm in West Georgia to evaluate the cost effectiveness of using high efficiency exhaust fans. The four 40' X 500' broiler houses have nine tunnel ventilation fans and are power-ventilated year round. Two houses are equipped with nine, Coolair NBF 48" slant wall fans (19,200 cfm @ 0.05", 19.2 cfm/watt) and two 36" fans in the brooding end. The other two houses have nine 54" ACME fans (19,300 cfm @ 0.05", 29 cfm/watt) and the same type of 36" fans in the brooding end. The 54" fans were selected because of the large amount of air they move. A standard 54" slant wall fan moves approximately 24,000 cfm @ 0.05" static pressure (22 cfm/watt). By adding a cone and slowing the fans (300 rpm vs. 400 rpm) so that they only moved 19,300 cfm, the energy efficiency of the fans increased dramatically (from about 22 cfm/watt to 29 cfm/watt). Table 1 illustrates the differences in electricity usage and air speed between the houses with the two different types of fans.

Tunnel Fans (nine)	**Amps**	**Watts**	**Air Speed (measured in the center of the house)**
48" Slant Wall Fans	40.5	9000	530 ft/min
54" Slant-Wall Cone Fans (reduced rpm)	29.7	5900	530 ft/min

Table 1. Exhaust Fan Comparison

Table 2 shows how much electricity each house type used over the three 42 day growouts that have taken place since June. The projected electricity cost is also shown assuming seven growouts a year. Table 3 estimates the electricity each house would have used if they would have been growing a 56 day-old-bird as well as the projected yearly electricity usage for six growouts. More precise numbers will not be known until the data is gathered for an entire year. The projected electricity usage in both the tables below could vary plus or minus 20% according to weather conditions, house operation, downtime between flocks, and price of electricity.

	June, 7-Aug, 6 ($0.09 Kw*Hr)	Sept 3-Oct 12 ($0.08 Kw*hr)	Oct 16-Nov27 ($0.065 Kw*hr)	Projected Electricity Usage Over Seven Growouts	Projected Yearly Savings
48" Slant Wall Fans	$400	$233	$159	$1848	
54" Slant-Wall Cone Fans (reduced rpm)	$272	$162	$143	$1346	$502

Table 2. 42 Day Growout Total House Electricity Usage

	June. (estimated)	Sept. (estimated)	Nov. (estimated)	Projected Electricity Usage Over Six Growouts	Projected Yearly Savings
48" Slant Wall Fans	$672	$324	$312	$2616	
54" Slant-Wall Cone Fans (reduced rpm)	$454	$224	$274	$1904	$712

Table 3. 56 Day Growout Total House Electricity Usage (estimated)

The 54" fans used in this study would cost approximately $2,500 more than the 48" slant wall fans. With an $700 a year savings it would take approximately four years to payback the added cost. ACME as well as other fan manufactures are presently working on less expensive models of this fan to make it a more viable option. It is important to note that the Coolair 48" fans used in this study are one of the more energy efficient fans commonly used in tunnel-ventilated poultry houses. Had the test been conducted using a less energy efficient fan, ie., fan with an exterior shutter or a direct drive fan, the electricity savings would have been significantly higher.

Though the 54" has a fairly long payback there are fans that you can purchase from a number of different manufacturers that would have similar power savings at significantly less initial cost. Instead of using a 54" cone fan, a 48" slant wall fan with a cone can be used. As with the 54" fans the cone increases cfm: You slow the fan back down so that it moves the same amount of air as it did before you added the cone, and the energy usage is greatly decreased. Estimates from preliminary lab tests indicate savings on the reduced rpm 48" cone fans will be in range of 20 to 25 percent.

Let's look at an example. A 40' X 500' broiler house should ideally have approximately 170,000 cfm (@ 0.05" static pressure) of tunnel fan capacity (a 40' X 400' house should have 150,000 cfm @ 0.05" static pressure). Broiler House A has nine 48" ACME BDR slant wall fans (20,000 cfm @0.05" and 17.8 cfm/watt). Broiler House B has nine of the same fans but a cone has been added and the fan speed reduced through the use of a smaller pulley (19,100 cfm @ 0.05" and 25 cfm/watt). Broiler House B would have slightly lower air speed, but significantly lower electricity usage. Table 4 compares the power usage of House A with House B as well as with a house with 54" fans. Considering the fans in House B would cost about $75 dollars a piece more, the electricity savings of about $650 dollars per year would pay for the additional cost of the fans in about a year. Table 5 compares a house with direct drive fans with ones with

48" and 54" reduced rpm cone fans. Since a direct drive fan is less energy efficient, the savings are greater.

Tables 4 through 7 demonstrate the possible savings associated with installation of high efficiency 48" fans in a 40' X 500' broiler house manufactured by the major three fan companies. The same three companies, as well as others, manufacture other fans that could possibly show similar savings. The data in Tables 4 through 7 are based on the assumption that each 48" fan in a house power-ventilated year round will run an average of 2,500 hours (48+ day-old-birds). Energy efficiency and cfm ratings were measured by each fan manufacturer in their own labs. In the future these tests will be repeated by an independent fan test lab. The fan costs are approximations.

One potential problem of reduced rpm fans is that they sometimes do not hold up as well under higher static pressure as higher speed fans. For example, the output of the 54" fan decreased 20 percent when the static pressure increased from 0.05" to 0.10", whereas the conventional ACME slant wall 48" fan only decreased 5 percent. The reduced rpm 48" slant wall cone fan output decreased approximately seven percent as static pressure increases from 0.05" to 0.10". If a house has evaporative cooling pads and fans that do not hold up well to higher static pressures, the air velocity may drop to unacceptable levels when all the fans are operating. To avoid this potential problem make sure when you're considering purchasing a high efficiency fan that fan output decreases less than ten percent as static pressure increases from 0.05" to 0.10". Furthermore, make sure your house will have sufficient pad area. Insufficient pad area will cause excessively high static pressures resulting in reduced air speed and bird cooling. To be on the safe side you may want to install 10% more pad than what is typically recommended. If you have any questions on how much pad your house should have, contact the manufacturer of the pad you are planning to install.

One of the biggest reasons why these fans are not already in poultry houses and poultry producers are not already benefitting from the savings is that too much emphasis has been placed on initial fan cost. Often equipment installers or growers will switch from a high quality fan to a fan that is less energy efficient and not as well made to save $20 to $40 a fan. Yes, this will save a little money in the short run but could cost a grower literally thousands of dollars over the life of the fan. It is important to remember that part of what goes into determining whether a house will cash flow is operating costs, of which electricity usage is a major component. As seen in the tables below the payback of most of the reduced rpm cone fans is less than two years. So, even if you have to spend a $1,000 more for these fans, in the long run you will be much better off financially.

Some points to consider when purchasing high efficiency 48" fans.

1) Look for tunnel ventilation fans that have an energy efficiency rating of 25 cfm/watt or better.
2) Ask if the fan has been tested by an independent test lab (AMCA or BESS Labs)
3) If the fan has been tested, make sure the fan you are purchasing has the same motor and shutter used during testing.
4) Make sure that fan output does not drop excessively at high static pressure (0.10")
5) Base fan numbers on the fact that a 40' X 500' house should have 170,000 cfm of fan capacity at 0.05"of static pressure (40' X 400' house = 150,000 cfm)

Field tests are continuing and information on other high efficiency fans will be covered in future newsletters.

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Tunnel Ventilation Fan	Fan performance @ 0.05" static pressure	Fan performance @ 0.10" static pressure	Air Velocity (nine fans)	Hourly power usage ($0.08 Kw*hr) (nine fans)	Yearly Power Usage (2,500 hrs/yr)
BDR 48, Slant Wall	20,000 cfm 17.8 cfm/watt	18,900 cfm 16.4cfm/watt	500 ft/min	$0.81	***$2,025***
BDR 48, Slant Wall with Cone (reduced rpm)	19,100 cfm 25 cfm/watt	17,825 cfm 22.2 cfm/watt	480 ft/min	$0.55	***$1,375***
DC 54, Slant Wall with Cone (reduced rpm)	19,340 cfm 30 cfm/watt	15,483 cfm 22.2 cfm/watt	490 ft/min	$0.46	***$1,150***

Tunnel Ventilation Fan	Yearly Power Usage (2,500 hrs/yr)	Initial Cost (approximate)	Additional Initial Cost	Yearly Savings	Payback
BDR 48, Slant Wall 1 h.p. motor	$2,025	$5,340	-	-	-
BDR 48, Slant Wall with Cone (reduced rpm)	$1,375	$6,050	$710	**$650**	1.1 years
DC 54, Slant Wall with Cone (reduced rpm)	$1,150	$7,940	$2,600	**$875**	3.0 years

Table 4. ACME Tunnel Ventilation Fan Comparison (40' X 500' Broiler House)

Tunnel Ventilation Fan	Fan performance @ 0.05" static pressure	Fan performance @ 0.10" static pressure	Air Velocity	Hourly power usage ($0.08 Kw*hr)	Yearly Power Usage (2,500 hrs/yr)
48" ACME Direct Drive, Exterior Shutter	17,540 cfm 16.6 cfm/watt	16,000 15.5 cfm/watt	490 ft/min (ten fans)	$0.85 (ten fans)	*$2,125*
BDR 48, Slant Wall with Cone (reduced rpm)	19,100 cfm 25 cfm/watt	17,830 cfm 22.2 cfm/watt	480 ft/min (nine fans)	$0.55 (nine fans)	***$1,375***
DC 54, Slant Wall with Cone (reduced rpm)	19,340 cfm 30 cfm/watt	15,483 cfm 22.2 cfm/watt	485 ft/min (nine fans)	$0.46 (nine fans)	***$1,150***

Tunnel Ventilation Fan	Yearly Power Usage (2,500 hrs/yr)	Initial Cost (approximate)	Additional Initial Cost	Yearly Savings	Payback
48" ACME Direct Drive, Exterior Shutter	$2,125	$4,800	-	-	-
BDR 48, Slant Wall with Cone (reduced rpm)	$1,375	$6,050	$1,250	**$750**	1.7 years
DC 54, Slant Wall with Cone (reduced rpm)	$1,150	$7,940	$3,140	**$975**	3.2 years

Table 5. ACME Tunnel Ventilation Fan Comparison with Direct Drive 48" Fan (40' X 500' Broiler House)

Tunnel Ventilation Fan	Fan performance 0.05"	Fan performance 0.10"	Air Velocity (nine fans)	Hourly power usage ($0.08 Kw*hr) (nine fans)	Yearly Power Usage (2,500 hrs/yr)
Coolair NEF 48" Slant Wall	20,880 cfm 18.5 cfm/watt	19,950 cfm 17.1 cfm/watt	520 ft/min	$0.81	***$2,030***
Coolair NEF 48" Slant Wall with Cone (reduced rpm)	19,100 cfm 25 cfm/watt	17,850 cfm 22.1 cfm/watt	480 ft/min	$0.55	***$1,370***

Tunnel Ventilation Fan	Yearly Power Usage (3,000 hrs/yr)	Initial Cost (approximate)	Additional Initial Cost	Yearly Savings	Payback
Coolair NEF 48" Slant Wall	$2,030	$5,340	-	-	-
Coolair NEF 48" Slant Wall with Cone (reduced rpm)	$1,370	$6,040	$710	**$660**	1.1 years

Table 6. Coolair Tunnel Ventilation Fan Comparison (40' X 500' Broiler House)

Tunnel Ventilation Fan	Fan performance 0.05"	Fan performance 0.10"	Air Velocity (nine fans)	Hourly power usage ($0.08 Kw*hr) (nine fans)	Yearly Power Usage (2,500 hrs/yr)
Aerotech Grower 48" Slant Wall	18,600 cfm 18 cfm/watt	17,500 cfm 16.2 cfm/watt	470 ft/min	$0.74	***$1,860***
Aerotech Grower 48" Slant Wall with Cone (reduced rpm)	19,300 cfm 26 cfm/watt	18,000 cfm 23 cfm/watt	480 ft/min	$0.55	***$1,370***

Tunnel Ventilation Fan	Yearly Power Usage (3,000 hrs/yr)	Initial Cost (approximate)	Additional Initial Cost	Yearly Savings	Payback
Aerotech Grower 48" Slant Wall	$1,860	$5,340			
Aerotech Grower 48" Slant Wall with Cone (reduced rpm)	$1,370	$6,050	$710	**$490**	1.5 years

Table 7. Aerotech Tunnel Ventilation Fan Comparison (40' X 500' Broiler House)