The ***Alabama Poultry Engineering and Economics***

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Feature article

Paddle and Recirculating Fans – A Progress Report

For the past several months we have been getting requests for information to help reduce winter fuel costs. Previous newsletters this year have covered retrofitting older houses, improving house tightness, value and use of insulation, and pros and cons of solid sidewalling. This newsletter will report on some of the field studies and information that has been gathered on broiler farms over the last two years on the use of paddle or recirculating fans as an aid in reducing fuel usage. Propane costs can account for as much as 40% of a grower's out of pocket expenses for growing birds. If this cost gets out of hand, any chance for profitability will be greatly reduced. This is why even with the best houses growers are still striving to do more to help keep fuel costs down.

Preventing temperature stratification is one key to saving fuel

One very important way to save fuel is to have good mixing of in-house air so as to prevent temperature stratification, with warm air staying near the ceiling and cold air collecting at bird level. Proper ventilation technique and air inlet management are very important in promoting good air mixing in cold weather. If ventilation is not managed properly, it can make the problem worse. Since recirculating or paddle fans work in conjunction with ventilation, let's quickly review what happens during wintertime ventilation.

If a house is tight and well insulated, and ammonia is not a problem due to good quality litter, one key to minimizing fuel use in cold weather is to run our minimum ventilation fans the least amount of time possible while still providing birds with good air quality. We do not want to bring any more cold outside air into the house than is needed. But we must ventilate enough to remove excess moisture from the house. In other words, in this situation, the ventilation rate is basically tied to how much moisture we need to remove from the house, which in turn depends primarily on bird age.

To get good moisture removal with minimum fuel cost it is imperative that we bring cool outside air into the house in such a way that we can mix the cooler incoming air with the warm air in the top of the house. The incoming air then will be warmed and its humidity lowered so that when it falls to the floor it will be able to pick up as much moisture as possible, and will not chill the birds. In this way our ventilation air promotes good air mixing, and we get the greatest amount of moisture out of the litter and into the smallest amount of air passing through the house. To achieve these goals, it is absolutely necessary to properly use static pressure controlled vent boxes and to set fan timers properly, based on bird age. We should not even consider board or curtain crack ventilating if our goal is minimal fuel costs.

Minimum ventilation is essential to remove moisture, and also can promote good air mixing when done properly

But even with the best management of vent boxes to provide good air mixing, we will be running minimum ventilation fans only a fraction of the time. If we had some full-time way of getting the air to mix and recirculate in the house without running an exhaust fan and without affecting the birds, we could do an even better job of breaking up temperature stratification, plus do a better job of getting more water into the air, thus cutting down on our exhaust fan run times.

One analogy that helps us understand the idea of temperature stratification is to think of taking a leisurely warm bath. After a while the water cools off, so you turn on the hot water at the front of the tub to warm things up. The

Energy-Saving Videotape –

Now available from Auburn University: *Wintertime Broiler House Ventilation for Reduced Fuel Costs.* This 42-minute video details energy saving methods and best wintertime ventilation techniques. Contact Jim Donald, Biosystems Engineering Dept., 228 Tom E. Corley Bldg., Auburn University, Alabama 36849 (334-844-4181). More information on the tape is available on the Auburn poultry website www.poultryhouse.com.

rear of the tub still remains cold while the water at your feet can be very warm or even scalding hot. The only way to make the water uniformly warm is to stir it up. Similarly, mixing or stirring up the air in the broiler house produces less of a temperature difference from ceiling to floor and more uniformity from wall to wall. The result: lower fuel usage, drier litter, less cake under waterers, less cake removal between flocks, and in general a better environment to grow our birds.

Many years ago, recirculating of air was tried by hanging 36-inch fans up high in houses and blowing them horizontally in a racetrack pattern. There were problems with this in that 36-inch fans blast a lot of air and on young birds this is detrimental. Actually several 36's blowing air around a house provide much more air velocity than we need just for mixing during cold weather or brooding. In short, stirring can be accomplished with 36-inch fans if you have plenty of them around, but there are precautions that need to be taken.

Since minimum ventilation runs only a fraction of the time, full-time inside fan mixing can provide even better temperature uniformity

Paddle-type ceiling fans, sometimes called Casablanca fans, were also tried, both for cooling and for recirculating air, but with mixed results at best. When paddle fans were used for recirculating air they most often were used in the down-draft mode, and we saw too much air being blown down under fans. Thus young birds would actually scatter and move away from underneath the fans. When tunnel ventilation came along, the interest in paddle or recirculating fans pretty much went away. In the last four years, however, new approaches to air-mixing with inside fans have emerged.

One new approach is the use of 18- to 24-inch vane axial fans. These are run horizontally in the house much in the same way as 36-inch fans were, but provide a better air-mixing pattern. Also they don't move so much air and don't chill or draft the birds. These fans are also available in variable speed models. Being able to vary the fan speed can be useful, especially for 24-inch models, in making sure the fans do not create cold drafts on young birds.

New approaches to inside fan air mixing are proving much more effective

The second approach now becoming more popular is using paddle fans in the updraft mode, as has been practiced for some time in very cold or mountainous areas. A couple of years ago Auburn University and some of the companies we work with began experimenting with paddle type agricultural ceiling fans used in this way. Pulling air up through the fan directs ceiling air out toward the sidewall of the house instead of blowing air directly down on the birds. Air velocity measurements on the floor were very minimal (less than 50 fpm). Application of the results of these field studies has led to significant fuel savings and presented a tool that can really help improve the overall quality of the environment in the house.

18- or 24-inch vane axial fans hung near the ceiling can recirculate air without causing drafts on birds

In summary, both of these new approaches have proven effective. Which way to go, either paddle or vane axial, is pretty much up to the grower. Both methods are working well in the field. The diagrams on page 3 show typical fan layouts and the airflow patterns they produce.

Note: The terminology used for inside air-mixing fans can be confusing. The terms "stirring fan," "ceiling fan," "recirculating fan," and "mixing fan" are sometimes used interchangeably for different fan types. In this article we use "recirculating fan" only to refer to the axial vane type fan, and "paddle fan" to refer to the paddle type.

Here are some commonly asked questions and answers about paddle or recirculating fans based on observations over the last two years.

Paddle-type ceiling fans work well to break up temperature stratification when run in the updraft mode

Q. *How many paddle fans should be used in a typical 40 x 500 house?*

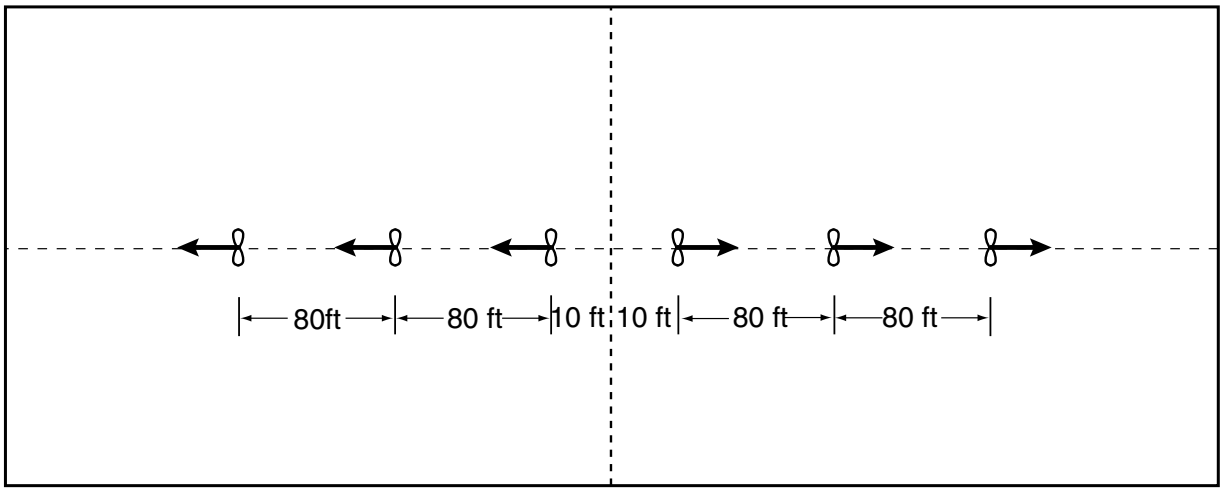
A. In some respects it depends on your equipment spacing. Some companies are using six fans in the brood chamber with three in the back, coming 25 feet off the center curtain and 25 feet off the brood end-wall. Other companies are using five in the brood chamber and three in the back. Either setup will work.

Q. *Is variable speed necessary?*

A. Variable speed is probably a good idea on the 18- to 24-inch vane axial fans but probably not necessary on the paddle fans.

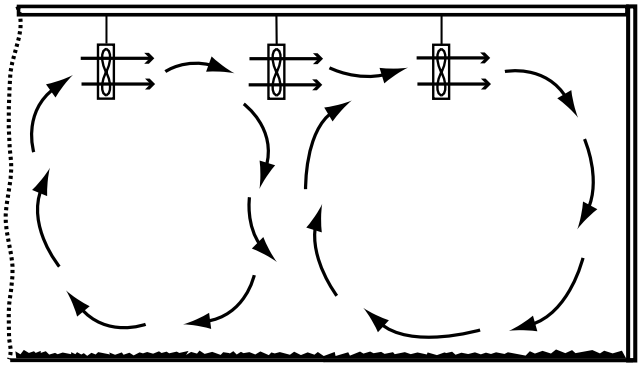
Q. *When do I run these fans?*

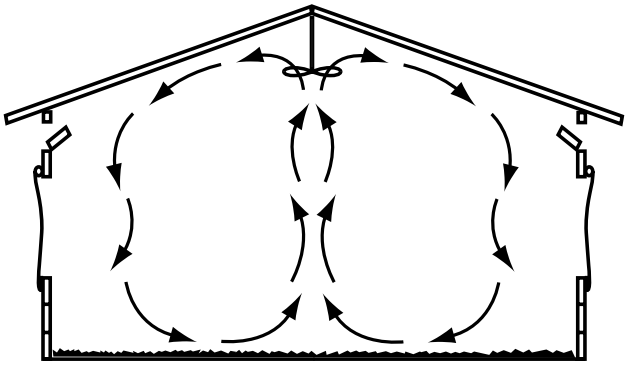
A. In wintertime we want to run them continuously until we get to the point where we are in the cooling mode for birds. In summertime we probably want to run them the first one or two weeks.



Typical recirculating fan layout, using six 18-inch axial vane fans, hung under ceiling along centerline of house. Fan number and spacings may vary according to house conditions and manufacturer recommendations.

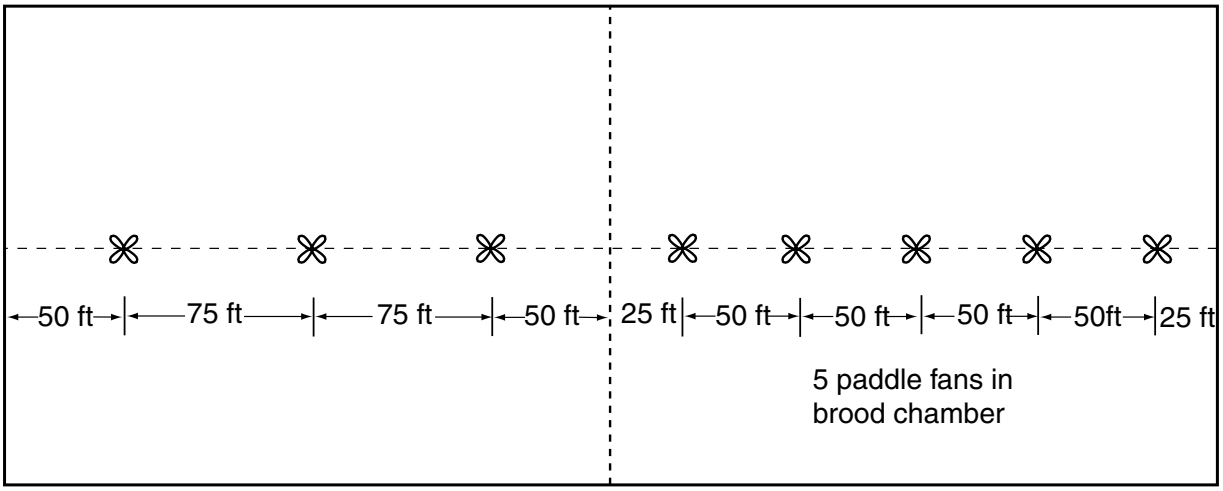
Typical airflow pattern for axial vane recirculating fans





Typical airflow pattern for paddle type air-mixing fans

Typical paddle ceiling fan layout, using five paddle fans in brood chamber and three in the back half. Fan number and spacings may vary according to house conditions and manufacturer recommendations.



Q. *What are the major benefits of paddle and/or recirculating fans?*

A. Along with fuel savings, the benefits include better chick start, warmer floor temperatures, better side to side temperatures, more uniformity, less pre-heat time needed, promotion of drying in the house, less litter treatment needed, less caking, less condensation on curtains and walls and lower minimum ventilation fan run times.

Benefits of good air mixing go beyond fuel savings, providing a better environment for bird growth

Q. *What does it cost to operate stirring fans?*

A. Paddle-type ceiling fans typically cost less to operate than vane axial fans, but costs vary greatly from one brand or model to another for either type. The amperage rating of a fan tells you what the operating cost will be, depending on your electric power rate. Typical paddle fans may draw 0.7 to 1.5 amps (or more) at 120 volts, so operating cost would range from about 20 cents a day to over 40 cents a day, at 10 cents a kilowatt-hour (24-hour operation). A typical 24-inch vane axial fan may draw around 2.0 amps at 240 volts, so operating costs might be around $1.15 a day for each fan. In comparing paddle and vane axial fan operating costs, remember that usually more paddle fans are needed, and the comparison must be on a per-house basis, not just per fan. Even more important, remember that the cost of running either type of fan will almost certainly be much lower than the fuel savings realized, not to mention the improved flock performance that can come from improved in-house conditions.

Q. *Have there been any problems with either type of fan?*

A. In the past, some brands of paddle fans especially have not held up well to the poultry house environment. Both type fans must have high-quality bearings to withstand poultry house use. The Underwriters' Laboratories agricultural rating for fans, which includes a spray-test, can be a guide to fan quality. All fans are not equal and the cheapest fan might not be the best value. Make sure the fan you buy is rated for the environment in the house.

The Bottom Line

The amount of fuel savings achieved with paddle or recirculating fans will depend on your house. A well insulated, well managed house with vent boxes may experience somewhere between 15% and 20% fuel savings. Older houses will probably experience higher fuel savings, although the total fuel cost will probably stay higher than for a well-managed modern house. A furnace brooded house and/or a high-ceiling house (non-dropped ceiling) would experience the greatest fuel savings, sometimes as high as 40%.

The costs of installing paddle or recirculating fans usually can be recouped in less than one year

Costs of paddle and recirculating fans vary, but equipping a house with either type fans should be in the $1000 range per house. This is an investment that usually can be recouped in less than one year. If you are considering making this investment, be aware that there are differences in quality in the different brands on the market today. Look for a fan that has a good warranty and a company that will stand behind it.

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