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Energy Conservation in Agriculture

Ventilation and Cooling Systems for Animal Housing

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Mechanical ventilation aids in maintaining a productive environment for animals in confined housing by removing moisture and odors and replacing them with fresh air. Ventilation also provides air movement that promotes cooling.

There are two principle types of fans used for animal housing: 1) box type fans; and 2) large, low-speed paddle type fans. Box fans are used in conventional tie stall barns or loose housing such as freestall barns. Large paddle type fans, also called high-volume, low-speed fans (HVLS) can only be used in loose housing applications.

Figure 1. Box fan in freestall barn.

Box fans

If fans are being used, choose the most efficient ones available. Generally, the larger the fan diameter, the higher the efficiency (figure 1). The efficiencies for box fans range widely from 8.7 to 33.0 cfm per watt for 24" to 54" diameters. Table 1 below indicates the efficiency range and target values for what is considered high efficiency.

A standard 48" box fan would have an average efficiency of 17 cfm/watt while a high efficiency 48" box fan would move 20 cfm/watt or more, a 20% increase in efficiency. To compare fans from different manufacturers, the Bioenvironmental and Structural Systems Lab at the University of Illinois at Urbana-Champaign conducts standardized tests on fans with accessories and publishes the test results. It is highly recommended that if you are replacing or installing new fans, purchase or get access to a copy of the University of Illinois publication *Agricultural Ventilation Fans – Performance and Efficiencies* (see refer-

Table 1.

Fan diameter	Efficiency range*	High efficiency*
24"	8.7 to 19.4 cfm/watt	16 cfm/watt and higher
36"	12.7 to 23.7 cfm/watt	20 cfm/watt and higher
48"	13.5 to 27.0 cfm/watt	20 cfm/watt and higher
50 to 54"	16.1 to 33.0 cfm/watt	23 cfm/watt and higher

* @ 0.05" water static pressure, 230V single phase electrical power

ences for sources). You will save the cost of this publication many times over by making an informed purchasing decision with the information it provides, even if you only purchase one fan. Other issues that affect fan efficiency include inlet size, venting exhaust against the prevailing winds and light traps that are used in the poultry industry.

High-volume, low-speed (HVLS) fans

HVLS fans are intended for freestall or loose housing barn applications, and can save a considerable amount of electrical energy over high-speed, box-type fans. A 24-foot HVLS fan uses a one-horsepower motor and moves the same amount of air as six 48" high-speed box fans, each with one-horsepower motors, saving up to 3.3 kWh per hour of operation. Current users of HVLS fans have reported dryer floors, fewer flies and reduced bird traffic in the barns. Research is ongoing as to the effectiveness of HVLS fans compared to box fans for cooling dairy cows. Figure 2 shows a high-volume, low-speed fan in a freestall barn.

Ventilation maintenance

Fan performance can be reduced significantly because of a lack of maintenance. Dirty shutters can decrease fan efficiency by up to 40% and bird nests, weeds, tree branches and brushes obstructing air inlets and fan outlets can further reduce fan efficiency.

To keep fans performing at peak efficiency, disconnect power for safety and clean fan blades, guards, motors, thermostats and shutters. Check belt tension and alignment and trim any weeds or brush away from inlets and outlets monthly. Check shutters for free operation and lubricate shutter hinges with graphite (*not* grease or oil) every three months or sooner if needed unless the manufacturer recommends otherwise. Clean the air inlets annually to maintain free flow of air. Cover unused fans during the winter with plastic or insulated panels and disconnect power while not in use.

Thermostats

Installing thermostats to control fans so they are on only when needed saves energy and increases productivity. Research has indicated that dairy cows begin to show mild heat stress at 74˚F with 70% relative humidity (the average relative humidity for Wisconsin) so it is recommended that the thermostat be set between 70˚F and 75˚F. Purchase a thermostat that is designed for use outdoors in damp, dusty environments. Mount thermostats out of the reach of the animals but in an area that will accurately reflect the air temperatures to which the animals are subject. Thermostats must be protected from direct sunlight and cleaned monthly as dust and direct sunlight affect the accuracy of temperature reading.

Sprinkler systems

Sprinkler systems that wet cows' backs used in conjunction with mechanical ventilation will increase evaporative cooling, cooling the animals more effectively than fans alone. Sprinklers can be installed in the holding area of a milking parlor or in the feed alley of a freestall barn. Sprinklers are generally activated for 1 to 3 minutes and turned off for 6 to 12 minutes, providing time for evaporation to occur. Never use sprinklers without mechanical ventilation because the increased humidity can cause severe heat stress in dairy cows. Refer to publications by Kansas State University *Reducing Heat Stress in Holding Pens* and *Sprinkler Systems for Cooling Dairy Cows at a Feed Line* for more information.

Figure 2. High-volume, low-speed fans in a freestall barn.

Variable speed fans

In confinement installations, variable speed fans can vary the ventilation rate in order to maintain a temperature set point instead of cycling constant speed fans on and off. Properly adjusted, variable speed fans reduce excessive ventilation, heat loss, energy usage, and temperature fluctuations and drafts.

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