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Dairy Cow Cooling

By Ted Gribble

Dairies throughout the U.S. have shown to be susceptible to significant heat stress issues with the Pacific Northwest area being the only exception. The benefits of providing supplemental cooling for dairy cattle have been well documented. Numerous technologies and systems for alleviating heat stress have been used with varied degrees of success. When selecting cooling technologies, it is important to implement the most effective methods that fit the operation's specific needs. The ultimate goal is to obtain the most efficient cooling in terms of effect on cows (or gain in milk) versus cost. This article provides an overview of technology options and some basic applications.

Figure 2 Position of large HVLS overhead fan in a freestall barn.

Cooling Technologies

Cooling technologies are presented in order of complexity and cost. The least costly and simplest cooling techniques are passive. These consist of siting the facilities to take maximum advantage of natural breezes, minimizing radiant heating from sun penetration and insulating to control heat flow. One caveat -frequently technologies can be at odds with each other or specific site conditions may present problems. In an ideal situation, each barn can be positioned to allow maximum air flow from predominant breezes while not allowing excessive sun entry which adds to heat issues.

Figure 1 Naturally ventilated freestall barn

Usually the first item on the "fix" list is to maximize the abilities of structures to collect cooling air flow. Natural ventilation, the cheapest and easiest to use, should be maximized. During siting, it is important to obtain maximum benefit from any natural breezes by exposing the most area of side walls directly to these air flows. Design features primarily consist of high, openable sides, and vented ridge (Figure 1). It is also important to allow 80' to 100' between buildings to enhance air circulation.

Next is sun penetration. This usually consists of minimizing total interior exposure to sun from May through August. Especially important is protection from late afternoon sun penetrations. This can be controlled through proper siting by comparing sun position to orientation, providing larger overhangs, and even curtains in extreme conditions.

The last of the passive means is insulation. This very effective heat gain barrier is one that has been misunderstood for sometime. Traditionally, insulation was associated with warm barns, those with supplemental heating, and thought of as a way to hold heat in or control condensation in winter. While it can perform these functions, it can also stop radiant heat from entering these structures in summer. We recently conducted tests in Florida and found a 10° difference in temperature at cow height caused by radiant heat in freestall barns with and without insulation (other cooling systems were inactive during the test).

Once the need goes beyond passive, active systems for ventilation and cooling are employed. Fans used to supplement natural ventilation are generally the next most effective technology versus cost. Fans are generally of two types:

- Horizontal fans
- Large HVLS overhead fans

HVLS (Figure 2) is an acronym for High Volume Low Speed.

These units are similar to ceiling fans, but much larger. They are quite efficient at moving large volumes of air at low velocity, just as the name says. However, these provide only general air movement within a structure with little impedance to free air flow.

Horizontal fans (Figure 3) are generally most efficient when used to create high speed air flow at cow level. The most common way to mount these fans is on interior posts to move air within the barn, aiding the natural flow. These fans can also be mounted in walls as exhaust units to generate overall airflow.

Next in line in efficiency versus cost is the addition of water for cooling accomplished by either evaporation or contact cooling. A better way to categorize these methods is "**cooling the air" or directly "cooling the cow by contact."** "Cooling the air" employs evaporation and works better in areas with lower humidities. By misting water into the air, evaporation raises the relative humidity and lowers air temperature. Water can also be used to directly soak the cows causing primary "cooling on contact." With soaking there is secondary cooling when this water evaporates off the cows.

The above constitutes the primary technologies used to ventilate and cool dairy cattle structures. Other technologies are available such as air conditioning, heat pump systems, and heat exchangers; however, these technologies are more expensive and seldom used.

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Figure 3 High speed horizontal fans to cool dairy cattle

Cooling Systems

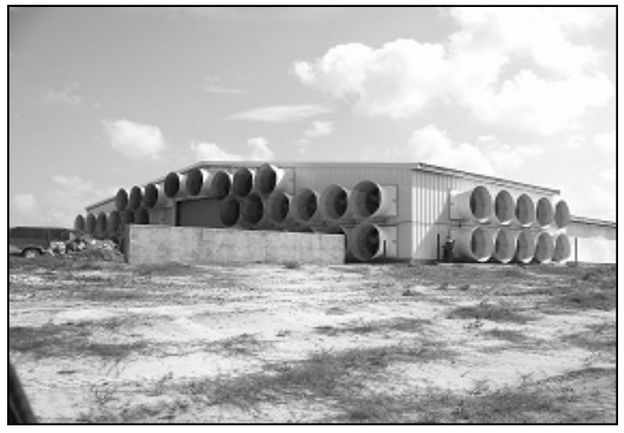
Most cooling systems are a conglomeration of the aforementioned technologies. The simplest system is to combine natural ventilation with horizontal fans to provide aid in severe heat conditions. This consists of an optimally sited and designed open barn with 36" to 48" diameter horizontal fans positioned to enhance air flow. These fans are usually from 24' to 36' apart at the feed bunk first, then over the beds. The next addition would be to add water soakers at the feed line to provide additional contact cooling during feeding. These soakers are generally operated on a three minute on, twelve minute off cycle. This system of fans and soakers also works well when added to holding pens. In dry climates, misters can be used in lieu of soaking; however, the nozzles are more difficult to maintain, making soaking more popular.

The HVLS fans can be helpful with overall airflow when used in the absence of natural ventilation. Recent tests at the University of Georgia affirm that HVLS units are much less effective than horizontal fans at lowering heat stress. The reason here is primarily velocity, while they move a large volume of air; it is at a very low velocity. Cows need a high velocity air flow to carry away the heat. The best use of HVLS fans is for areas that because of design or other issues have poor natural ventilation.

The ultimate in mechanical systems is to completely pass on natural air flows and move to **"tunnel ventilation."** In these systems, structures are completely enclosed on three sides. A large number of exhaust fans are mounted opposite the open end and all air is forced to travel through the barn (the long direction) to create a high speed air flow throughout (Figure 4). The desired design air velocity here is 8 m.p.h. minimum increasing to 12 m.p.h. along the Gulf Coast.

It is helpful to use a flat pitch roof and low side walls to minimize the cross section area which increases air speed. Normally, barns also feature curtain sides, roof insulation, and misting or soaking. An advantage of the tunnel concept is that barns may be located close together without compromising ventilation.

Cross ventilation systems, a type of tunnel barn where air is moved the short direction across instead of the long distance through the structure, are also used. Generally, buildings are then made much wider with more animals. Obtaining high air speeds is more difficult, but total construction costs can be less. These structures ventilate very similar to most swine and poultry buildings.



The ultimate in mechanical systems is to completely pass on natural air flows and move to "tunnel ventilation.

SUMMARY

This narrative touches on the most common technologies and systems in use today for ventilating dairy structures. It is important to understand how the systems work and properly apply each to your facility.

Ted Gribble of Five-G Consulting is a **Registered Agricultural Engineer** and has a **Bachelor of Architecture Structures Degree** from Texas Tech University and a **Masters Degree in Engineering Management** from Portland State University. As an active member of the American Society of Agricultural Engineers he has worked on numerous dairy projects throughout the US and overseas. He continuously attends industry seminars and visiting all types of facilities to keep current with new ideas in the dairy industry. Recently he has worked on designing dairies up to 13,000 cows, University facilities and in all climates from Saudi Arabia to Maine.

The Ultimate Cow Cooling System

By Donald Gribble

The standard 3 minutes of cow soaking then 12 minutes drying time is inefficient and wasteful. When temperatures reach about 74 degrees cow cooling is required, at this temperature a little soaker water is helpful to keep cows comfortable. As temperature increases, then soak times should also increase. Humidity also affects the effectiveness of cow cooling and should be considered when determining soak and dry times.

The Agpro Fan Soaker Cow Cooling System monitors both temperature and humidity. Based upon a preset user defined profile, cow wetting and drying times are calculated providing optimum water usage. The eliminates wasted water and reduces heat stress potential for cows. The bottom line is more milk, less water and power usage.

The Agpro Fan Soaker Cow Cooling System monitors both temperature and humidity.

In addition to providing water usage optimization, the cooling system provides automatic starting of two banks of fans for each cow group. Normally the first bank of fans start at 70 degrees, the second bank at 72 degrees. Fans turn off when temperatures drop below the set points.

The control has one other unique feature. An external push button is available to shut down all fans and cow soakers for a preset time. This allows the milkers to shut the cow cooling system off while cows are being milked or herdsmen can shut off the system when soakers and fans may annoy men performing heard health tasks. After a predetermined time, the system returns to normal operation. This feature can save thousands of dollars per year in reduced electrical consumption, less water usage and less wear on fans.

For More Information about the Agpro Cooling System Controls Please call 1-800-527-1030 or Agpro@neto.com

Cow Cooling System in Florida