Engineering Options for Reducing Dairy Cow Heat Stress

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Is it hot or what?

Hot and humid weather is here. Minnesota typically experiences 175 hours (approximately seven days) each year when ambient temperatures are at or above 84°F. Some years we get more, some years less. A cow's performance begins to suffer when the average temperature she experiences exceeds 70°F. Cool nights can offset hot daytime temperatures. High humidity levels, low air velocities, and solar radiation on sunny days contribute to heat stress. They affect a cow's ability to get rid of the metabolic heat she produces.

Dairy cows that suffer from heat stress have reduced feed intake, milk production, and reproductive efficiency. Dairy producers may also notice that cows drink more water and breathe faster than normal in hot and humid weather. Higher producing cows are especially susceptible to heat stress.

Preparations for hot and humid weather should minimize the potential for cows to experience heat stress. Consider options that help cows get rid of heat, and consider the costs and benefits associated with each option.

Provide Shade

Shade reduces heat stress by reducing the amount of solar radiation that reaches cows on sunny days. Naturally ventilated curtain-sided barns serve as a shade in the summer. Shades should be built high enough to allow for good airflow under them. Shade height should be 12 ft or higher for maximum effectiveness. A light or white colored roof will help increase shade effectiveness. Cows will often lie down in the shade so some of the shaded area should be maintained for good cow comfort. Shades over feed bunks encourage eating but do not provide an appropriate place for cows to lie down.

Increase the Ventilating (Air Exchange) Rate and Ventilation Effectiveness

Ventilating air picks up heat that the cows produce and carries it away. If the rate of ventilation or the amount of air exchange is increased, the animals have an easier time getting rid of their heat. As air temperatures rise to values closer and closer to body temperature, ventilation loses its effectiveness for removing heat.

Air exchange can be increased in mechanically ventilated barns by cleaning existing fans and inlets. Dirty fans with rusty and dirty louvers can have their airflow reduced by up to 39%. Plugged or dirty inlets reduce the airflow rate further. Installing more fans and

inlets can also increase air exchange. Hot weather ventilating systems should be designed to provide 500 cfm (cubic ft of air per minute) per 1,400-lb cow. Use fans for which performance information is available to better ensure that you will get the necessary flow rate.

Inlet location and adjustment can help improve ventilation effectiveness. Slot and ceiling inlets should be uniformly distributed throughout the barn so that every cow gets fresh outside air. Inlets should be adjusted to provide an inlet air velocity between 600 and 800 per minute. Calculate inlet velocity by dividing airflow (cfm) by the area of the opening (square ft). Uniform distribution and sufficient velocity will help mixing and animal heat loss in hot weather.

In naturally ventilated barns, air exchange is increased by opening up the sidewalls as much as possible, having adequate sidewall height, and minimizing obstructions (i.e., silos, trees, other buildings, equipment, and hills) around the barn. These obstructions reduce wind flowing past and through the barn. Make sure that the ridge is as open as possible and not obstructed.

Use Tunnel Ventilation in Stall Barns

Tunnel ventilation is an option for ventilating stall barns in warm weather. It provides both air exchange and airflow past the animals. In tunnel-ventilated barns, large exhaust fans are located at one end of the barn. Outdoor air enters at the other end and the barn serves as a tunnel. The ventilating rate is based on the cross-sectional area (height times width) of the animal area and the average air velocity (minimum of 220 ft per min). Typical airflow values range from 60,000 to 90,000 cfm. The inlet needs to be sized adequately to handle the airflow. Long barns with 110 cows or more need extra fan capacity to ensure adequate air exchange. Tunnel ventilation is not used in cold weather. Tunnel ventilation generally requires more airflow than a slot-inlet ventilated barn. Some producers report fewer flies in tunnel-ventilated barns.

Use Mixing Fans

Mixing fans create a draft across or past an animal. They can be used in both mechanically and naturally ventilated barns and milking parlor holding areas. The draft created by the fans helps remove animal heat from the cow. These fans provide a draft but no air exchange so they do not really “ventilate” the building. Air exchange is needed to exhaust the air heated by the cows and to bring in fresh outdoor air. Mixing fans can be controlled with thermostats.

In stall barns with low ceilings, mixing fans blow air along the length of the barn across the cows’ backs. Fans are usually located around the barn to create a racetrack effect. The distance between fans depends on how far the draft from a fan can be felt, but 20 to 25 feet is common.

In naturally ventilated barns, mixing fans are normally installed at a height of about 12 ft and angled downward at about 20 degrees. The goal is to create air velocities around 200 to 300 per minute across the cows' backs. The recommended distance between fans is 30 ft for 3-ft diameter fans and 40 ft for 4-ft diameter fans. All of the fans should be blowing air in the same direction.

Use a Sprinkling System

Sprinkling systems can be used along feed bunks and in holding areas to wet cows periodically. Body heat evaporates the water, which helps cool the cow. It is critical that the sprinkling be intermittent to permit evaporation. Adequate air exchange is also critical to remove the heated and humidified air. Water droplet size is important because the system should wet the hair and coat the skin with water. A fine mist should not be used. Irrigation nozzles and solid-cone coarse droplet spray nozzles with flow rates between 0.2 and 0.5 gallons per minute work very well. Sprinklers are typically "on" for 1 to 3 minutes every 10 to 15 minutes. Excess sprinkling wastes water and does not reduce heat stress. Mixing fans should remain on during sprinkling. Sprinklers should be installed to avoid wetting feed in the feed bunk and bedding in the freestalls. Wet bedding can lead to an increase in mastitis. Sprinkler systems can be automatically controlled using a thermostat and 30-minute cycle timer in series. Turn off the sprinkler system when the temperature falls below 70° F so animals don't get chilled.

Don't Overcrowd the Milking Herd

Overstocking freestall barns increases the number of cows in the barn and the amount of heat that must be removed. It also reduces airflow past the cows, which reduces their ability to get rid of heat. Some people have even suggested using less than 100% occupancy to allow more airflow past the remaining cows. Since cows are more crowded in holding areas, limit the time cows spend in holding areas before milking to no more than 45 to 60 minutes and place fans in these areas, too.

Following these practices should increase cow comfort and help maintain productivity during hot, humid weather.

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