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What is... EVAPORATIVE COOLING ???

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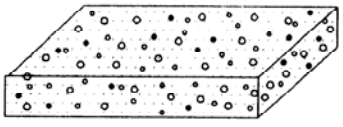
On a warm summer day, if you were to put your hand in a bucket of warm water and pull it out, you would feel a slight chill. The cooling would not be due to the temperature of the water, but rather, the evaporation of water off your arm. Evaporative cooling is a very powerful, yet inexpensive method of cooling. In very dry climates, everything from residential homes to large buildings use evaporative cooling to reduce air temperature. Here in the Southeast, both poultry producers and their birds use evaporative cooling to help reduce summertime heat stress.

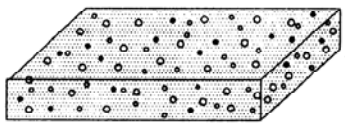
Though widely used, the actual mechanics of how evaporative cooling systems operate are difficult to comprehend. This lack of understanding leads to problems ranging from wet litter and condemnations to increased heat stress and mortality. With a proper understanding of evaporative cooling, problems can be avoided, and the cooling ability of these systems can be increased.

What is evaporative cooling?

When trying to understand evaporative cooling, it may be best to think of air as a type of sponge. Like a sponge, as air comes in contact with water, it absorbs it. The amount of water absorbed depends largely on how much water is already in the air. After all, how easily you can clean up a spill depends on how dry a sponge you are using. The term *humidity* describes the level of water in the air. If the air holds 20% of its capacity, the humidity would be 20%. Whereas, a humidity of 100% indicates that the air is holding all the moisture it can. The lower the humidity, the more water the air can hold, and the greater amount of evaporation that can take place.



20% capacity

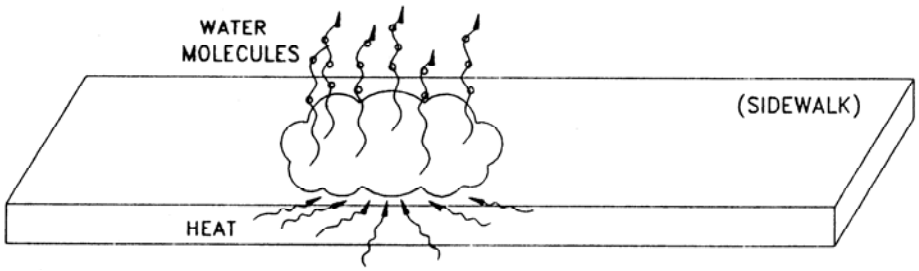


100% capacity

PUTTING KNOWLEDGE TO WORK

When describing the amount of moisture in the air, the term *relative humidity* is used because the "sponginess" of air changes relative to air temperature. The warmer the air, the more spongy it becomes and the more water it can hold. As a result, we must describe the level of humidity relative to the type of sponge we are talking about. Is it a 50°F sponge or an 80°F sponge? An 80°F sponge will hold more water at 50% humidity than a 50°F sponge.

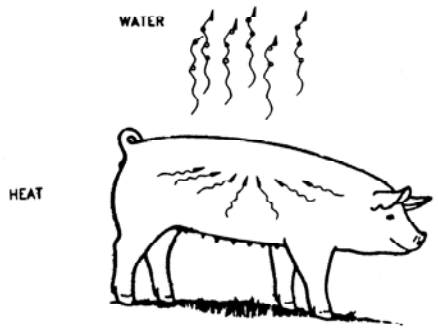
How is the cooling produced? In order to evaporate water, heat (energy) is required. In fact, to evaporate a gallon of water, requires almost 8,700 Btu's of heat. Where does this heat come from? From whatever the water is in contact with as it evaporates. This could be a hot sidewalk, your body, a tree, or from the air itself. As the heat is removed from a object, the temperature of that object is decreased.



It is important to realize that the temperature of the water does not have a great effect upon the cooling produced through the evaporation. If you were to place a gallon of 50°F water on a warm sidewalk (90°F) it would produce 9,000 Btu's of cooling. A gallon of 90°F water would produce 8,700 Btu's of cooling, only a 3 percent difference. After all, if you were sprayed with water at either temperature on a hot day, you would feel much cooler.

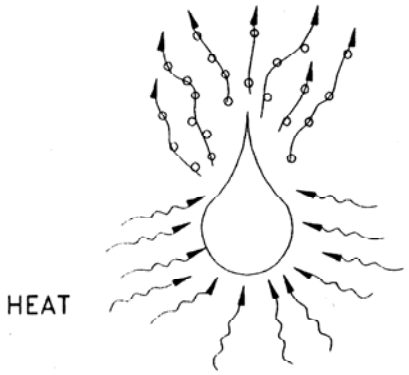
Methods of utilizing evaporative cooling.

For animals without thick fur or feathers a significant amount of cooling can take place by simply getting the animal wet. The water comes in contact with the animal's skin, and as it evaporates, heat is removed directly from the animal. This is not typically done with chickens for a couple of reasons. First, the feathers insulate the bird from much of the cooling effect of the evaporation of water. Secondly, in order to get the birds wet, you also have to get the house wet, including the litter and feed.



WET PIG

The goal in most poultry houses is to evaporate water directly into the air. This removes heat from the air, decreasing air temperature. This is done primarily by two methods: fogging nozzles and evaporative cooling pads. The difference between these two systems lies in the way water and air interact. With a fogging system, the goal is the production of very small water droplets that float around the house removing heat from the air as they evaporate. With an evaporative cooling pad, air is drawn through a wet filter. As air moves over the wet pad, water is evaporated off the pad removing heat from the air. The pad basically acts to support the water within the stream of air entering the house.



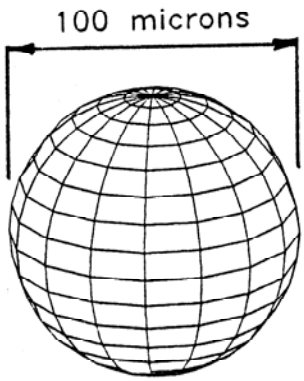
The key to getting the most out of an evaporative cooling system is to maximize the amount of air which comes into contact with the moisture added to the house. This makes sense because the best possible way to clean up a spill with a sponge is to go over it time and time again, flipping the sponge over and over, making sure that the dry sections of the sponge come in contact with the water.

Evaporative cooling pads typically produce the most evaporative cooling because they are designed to provide the maximum interaction possible between the air and the water. An evaporative cooling pad has a tremendous amount of wetted surface area. In fact, a typical 100' X 6' of 4" pad has more than 20,000 square feet of surface area! This allows the air entering the house to become totally saturated with water resulting in the maximum cooling effect.

With fogging systems, the goal is to make sure the water droplets these systems produce evaporate before they hit the ground. One way to assure this is by producing as small a water droplet possible. The smaller the water droplet, the greater the surface area in relationship to the volume of the drop, and the greater the rate of evaporation.

Water Droplets

An ounce of water in droplets this size...



has twice the surface area of an ounce of water in droplets this size.

There are basically two methods of reducing water droplet size: decrease the orifice size of the nozzles and/or increase the water pressure. The most efficient fogging systems have very small orifices and operate at pressures above 1000 psi. The droplets created by these systems are so small that when operating the house looks like it is filled with smoke. A secondary advantage of producing small water droplets is that they are small enough to be easily carried around the house by air movement increasing the time they stay suspended. Nearly 90 percent of the water droplets generated by these systems evaporate into the air compared to 40 percent or less for traditional fogging systems.

Mixing fans are typically used to increase the interaction between water droplets and air in houses with fogging systems. The importance of mixing fans to evaporation can be easily seen by noting how quickly a house will become wet when circulation fans are shut off. Power-ventilated or tunnel-ventilated houses rely on air movement produced by exhaust fans to keep water droplets suspended in the house.

Birds and evaporative cooling

Birds use evaporative cooling throughout the year to remove excess heat from their bodies. The evaporation of water doesn't take place outside their bodies but rather inside. As the bird breathes, air passes over the wet surfaces of its respiratory system. And like an evaporative cooling pad, moisture is evaporated into the air. During most of the year this process remains fairly passive. The bird breathes and excess body heat is lost. But, during hot weather, a bird will start increasing the amount of heat it looses through evaporation by panting. The more air it passes over its respiratory system the greater amount of water that can be evaporated and the greater the amount of heat that is removed directly from its body.

Practical tips on operating evaporative cooling systems.

Listed below are some tips for operating evaporative cooling systems.

1) Be careful when operating evaporative cooling systems at relative humidities higher than 70%.

2) If it is humid, consider operating only a portion of your fogging nozzles.

3) Make sure that fans are on when fogging nozzles are operating.

4) Do not operate evaporative cooling systems at night (never after 10 pm or before 10 am).

5) If water quality permits, use 1 gal/hr nozzles at a pressure of at least 100 psi.

6) Higher pressure booster pumps (200 psi+) are preferred. In general, higher water pressure fogging systems produce more cooling.

7) Cold water does not significantly increase the cooling efficiency of a evaporative cooling system.

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