

IMPORTANT FORMULA

Evaporative Cooling

$$\text{Efficiency} = 100\% \frac{\text{LDBT} - \text{WBT}}{\text{EDBT} - \text{WBT}}$$

$$\text{LDBT} = \text{EDBT} - \frac{\text{E}\% \times (\text{EDBT} - \text{WBT})}{100\%}$$

Water Evaporative and Bleed-off

$$\text{Gallons per Hour Evaporated} = \frac{1.2 \times \text{CFM} \times \text{EDBT} - \text{LDBT}}{10,000}$$

$$\text{Cycles of Concentration} = \frac{\text{Evaporation} + \text{Bleed off}}{\text{Bleed off}}$$

$$\text{Bleed off} = \frac{\text{Evaporation}}{\text{Cycles} - 1}$$

$$\text{Make up} = \text{Evaporation} + \text{Bleed off}$$

Air Flow

$$\text{Velocity} = \text{Feet per minute} \frac{\text{CFM}}{\text{L} \times \text{H}}$$

Abbreviations

E% = Evaporative cooling effectiveness

EDBT = Entering dry bulb temperature (before cooling pad)

LDBT = Leaving dry bulb temperature (after cooling pad)

WBT = Wet bulb temperature (same before and after the pad)

CFM = Cubic feet per minute of air

L = Length of pad wall in feet

H = Height of pad wall in feet

Munters

Evaporative Cooling Division

ENGINEERING BULLETIN

MB-SCP-205

CONTROLLING SCALE AND DIRT IN EVAPORATIVE PADS

WATER DISTRIBUTION

Proper water distribution is the single most important way of prolonging pad life. The water will flush away dirt and contaminants which may be harmful to the pad. Areas "starved" for water will be the first to clog or soften.

- Check the pressure in the distribution pipe. Most distribution systems consist of a perforated plastic pipe with holes directed at a splash plate. If the pressure is low, the water will not break up at the splash plate. Streaking and dry areas will occur.
- Check for adequate water flow. Adjust the flow until there are no dry streaks. When the pads are operating properly, they will be thoroughly wetted with a visible flow of water trickling down the flutes. Most of the water will pass over the pad and return to the sump. If there is little water running out the bottom of the pad, the dirt and minerals are not being flushed.
- The distributor pipe must be level. If more than one pad wall is fed by the same pump they must be carefully balanced with valves. The distributor pipe operates at a relatively low pressure. When the cover is removed to expose the pipe, notice that the water jets only a few inches into the air. If one end of the pipe is lifted, the flow at the high end decreases.
- Check for clogged holes in the distributor pipe. The simplest way to clean the holes is to install a ball valve or threaded end cap at the end of each distributor pipe. While the pump is running, open the valve and allow the water to flush the dirt and debris from the pipe. Usually the first signs of blockage will be at the end of the pipe farthest from the pump.
- Never locate the holes on the bottom of the distributor pipe. If so, they are guaranteed to clog with silt from the bottom of the pipe.
- Clean the water filter often. A dirty filter will substantially restrict the flow of water. Install a ball valve on the clean-out for the filter. This way the filter can be flushed without tools and without shutting off the pump.

- Make sure the pump is large enough. The pump should be sized to supply a certain amount of water at a specified pressure. Besides lifting the water from the sump to the top of the pad, there are other pressure losses in the system. Friction losses in the pipes, elbows and valves can consume between 3 and 5 psi, (6.9 to 11.5 feet of pumping head). A clean, in-line filter will use another 5 to 10 psi the pump's pressure, (11.5 to 23 feet of pumping head).

- Required water flow for various pads:

4" corrugated pads	0.50 GPM per linear foot
6" corrugated pads	0.75 GPM per linear foot

ON-OFF CYCLING OF THE PADS

Many people have reported better control of temperature and humidity from evaporative cooling pads when the water is cycled on and off with a timer. Typically, a ten minute timer is used with the 'on' time set between three and seven minutes. **These timers should not be used.**

With these timers, the pad is forced to wet and dry six times per hour and up to 144 times per day! Like any other piece of equipment, every cycle shortens its life. Why? Because the minerals and chemicals in the water dry on the surface of the pad when the water evaporates. It is the most concentrated when the pad is almost dry. It is important to keep the concentration of these chemicals as low as possible by maintaining an adequate flow of water over the pads.

Each type of pad has a recommended quantity of water for best operation. This water flow will provide a protective coating on the surface of the pad. Only a small portion of this water will actually evaporate. The remainder of the water will continually flush the pad.

The pads should, however, be allowed to dry out every 24 hours while the fans are running to help curb algae growth.

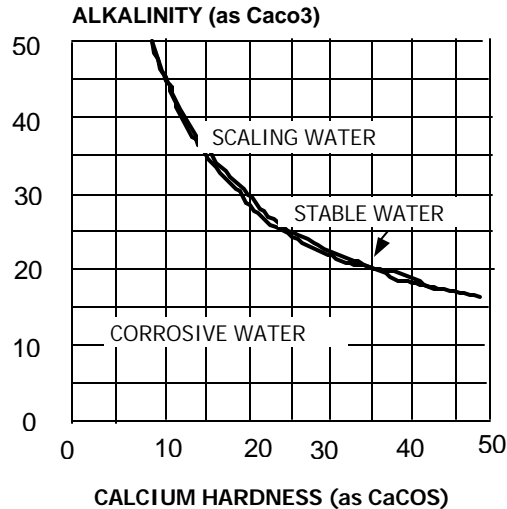
COMMON SCALE FORMING MINERALS

Calcium Carbonate
 Calcium Sulfate
 Calcium Phosphate
 Iron Oxide
 Silica (SiO₂)

In most systems, calcium carbonate and silica are the most troublesome scale formers. The silica is the most straight forward. It must be kept at a concentration less than 150 PPM. Calcium carbonate scaling is more dependent on alkalinity (an indication of pH). Its solubility can be simplified to a curve of calcium carbonate concentration versus alkalinity.

On the chart, notice that stable water is represented by the narrow line. Water quality to the right of the line forms scale. Water to the left of the line is scale dissolving or corrosive. It is difficult to keep water perfectly balanced. Instead, try to keep the water reasonably close to the line so that it fluctuates between scale forming and scale dissolving.

QUICK REFERENCE CHART



CLEANING THE SUMP AND DISTRIBUTION SYSTEM

When water evaporates, only pure water is released. The dirt and harmful chemicals are left behind with the water on the pads and in the sump. Eventually, the water becomes so contaminated that it is harmful to the pads and gutters.

Quarterly cleaning and flushing of the pads will increase their service life.

- Completely empty the sump of water and silt.
- Refill with clean water.
- If possible, turn off fans.
- Manually turn on the pumps to run fresh water over the pads for about 30 minutes. Use as much water as possible.
- Open the ends of the water distribution pipes to flush out debris which could clog the holes.
- Replace the covers when done. When using silt collection, remove plug and drain the system.
- Gently hose stubborn deposits from the face of the pads.
- Completely empty the sump to remove the old algae and dirt which was just rinsed off the pads.
- Disinfect the system by adding the proper amount of approved chemical.
- Check to make sure the bleed off is still functioning properly.
- Refill with clean water.