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COOLING PAD CHECKLIST

- Reduce the number of on-off cycles.
- Shade the pads and sump.
- Dry the pads out completely once every 24 hours.
- Maintain a suitable water bleed off.
- Drain and disinfect the entire water distribution system quarterly.
- Avoid harmful contaminants, including dust, fumes harsh cleaners, and water treatment chemicals.
- Run the recommended quantity of water over the pads.
- Avoid dry areas on the pad.
- Stop annoying leaks in the water distribution system.
- Clean the water filters regularly.

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Important Formula

Evaporative Cooling

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

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

Water Evaporation and Bleed-off

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

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

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

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

Air Flow

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

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 af air
L = Length of pad wall in feet
H = Height of pad wall in feet

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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. Often, 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 one hundred and forty four 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 very important to keep the concentration of these chemicals as low as possible by maintaining an adequate flow of water over the pad.

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.

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METHODS OF CONTROLLING SCALE

Scale and mineral deposits form on the face of the cooling pad because the mineral content in the water is too high.

- Increase the flow of water over the face of the pad.
- Make certain the flow of water is even from one end of the distributer pipe to the other.
- Clean and flush the distributor pipe regularly, especially if dry areas appear on the face of the pad.
- Maintain the pH of harder water between 6 and 8.
- Use plenty of bleed-off.

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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 distributer pipe must be level. If more than one pad wall is fed by the same pump they must be carefully balanced with valves. The distributer 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 distributer pipe. The simplest way to clean the holes is to install a ball valve or threaded end cap at the end of each distributer 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 distributer 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

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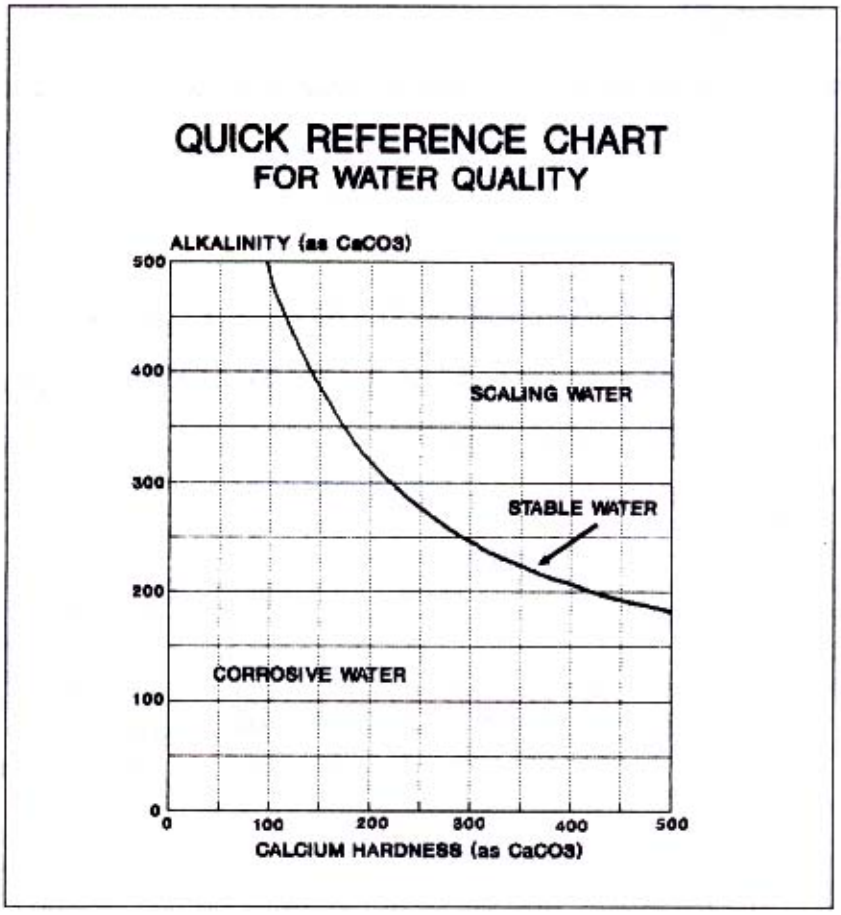
COMMON SCALE FORMING MINERALS

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.

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 pad 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.

PREVENTING ALGAE IN EVAPORATIVE COOLING PADS

Algae needs three essential elements to survive, **light, moisture and nutrients.**

SHADE THE PAD AND SUMP

Algae only needs sunlight for a few hours each day. If sunlight can be minimized, the growth period will also be shortened. Remember to cover the sump. Algae may be growing there, too.

Locate pads inside the pad house away from direct sunlight. If there is no pad house, erecting a barrier of shade cloth or awnings will inhibit algae growth.

Cover the sump to keep out dirt and light.

Do not use clear or translucent hoses, tanks, or water distributors.

If inlet louvers or curtains are used, a dark color will reduce the sunlight.

ALLOW THE PADS TO DRY COMPLETELY ONCE EVERY 24 HOURS

Algae cannot live when it is bone dry. Regular drying of the pads for several hours at a time will stop algae growth. Minimize the number of drying cycles, though. Too many will weather the pad. During the cooling season, they should cycle once each day.

Set automatic controllers so the water to the pads turns off before the fans turn off. Pad pumps should be turned on last and turned off first.

Do not allow the bottom of the pads to set down in the water when the system is not running. Adjust the float valve and overflow after the system shuts down and all of the water returns to the trough.

MINIMIZE NUTRIENT CONTAMINATION

Algae feeds off the nutrients in the water and air, not from a "good" cooling pad. Look for sources of nutrients and try to eliminate them.

Nearby farm fields and roads contribute dust and fertilizer which can be drawn into the pads.

Injectable fertilizers find their way into the pad via sprinkler systems. Do not allow sprinklers to spray into the pad or sump.

Feed hoppers should not be located near the pad wall.

When cleaning pads, remove from the pad wall. Old algae growth should be cleaned and removed from the system. When the pads are cleaned, algae and dirt are usually flushed into the gutter and go back to the sump. If it is not removed, it will serve as a nutrient for the next crop of algae.

Remove spent, rotted media pads as they may decompose to form nutrients.

Do not use phosphate type scale control agents or detergents on the pads. They degrade to form phosphate type nutrients.

Use water from deep wells or municipal supplies. Surface water from lakes and shallow wells may be high in nutrients.

Do not allow exhaust air from other processes to blow into the media. Volatile organic compounds from kitchens, paint shops, and furnaces can be absorbed into the recirculating water.

Since it is impossible to keep all nutrients out of the evaporative cooler, flush the pads, gutter and sump at least once a week during the cooling season.

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COMMON ALGAE TREATMENT CHEMICALS

Continuous use of algae treatment chemicals is not recommended. Besides being potentially harmful, they will not control algae without periodic cleaning and flushing of the system. Housekeeping and preventative tips are outlined in Engineering Bulletin MB-ACP-405, ***PREVENTING ALGAE IN EVAPORATIVE COOLING PADS.***

After cleaning and flushing the evaporative cooling system, according to Engineering Bulletin MB-SCP-405, ***CONTROLLING SCALE AND DIRT IN EVAPORATIVE PADS***, it can be treated with certain algae control chemicals. There are many control chemicals comercially available. Most contain one, or a combination of, certain active ingredients. Read the label to determine the nature of these ingredients. Never use any chemical which is not labeled for use in evaporative coolers or do not list the ingredients. Remember, there are no miracle chemicals.

The three most common chemical groups are quaternary amines, oxidizing biocides and copper compounds.

Examples of the **quaternary amines** are:

- Octyl Decyl diMethyl **Ammonium Chloride**
- Alkyl diMethyl Benzyl **Ammonium Chloride**
- n-Alkyl diMethyl Ethyl Benzyl **Ammonium Chloride**

Combinations of these chemicals are found in many swimming pool chemicals and commercial disinfectants. If used in evaporative coolers, dosage should be maintained between **30** and **50 PPM.**

Examples of the **oxidizing type biocides** are:

- sodium **hypochlorite** (Clorox)
- solid calcium **hypochlorite** (HTH Pool Tablets)
- dimethyl **Hydantoin** (AgraBrom)
- Ethyl Methyl **Hydantoin** (DantaBrom)
- diMethyl **Hydantoin** (SpaBrom)
- Hydrogen **Peroxide** (Baqua Shock, Pool Treatment)
- Potassium **peroxy**monosulfate (Oxy-Bright)

These products when used continuously or in too high of concentrations, can destroy wood, cellulose and metals. The concentration must be maintained between **1 and 2 PPM.** For bleach, HTH and other forms of hypochlorite, the water pH must be maintained less than 7.5 or it will have no effect on the algae.

Copper compounds:

- Copper is effective for killing algae. However, it is not usually sold as a general disinfectant because it is not effective against bacteria. Copper is also extremely **corrosive**, and therefore should not be used in systems containing stainless steel, galvanized steel or aluminum.

CALCULATING DISINFECTANT DOSAGES

Whenever disinfectants or algaecides are used to clean evaporative cooling pads, it is very important to use the correct dosage. Too much of any chemical, (especially oxidizing biocides) may burn the pads as well as corrode the pumps and gutters.

Correct dosage can be estimated as follows:

$$\text{Dose Size(Fluid Ounces)} = \frac{\text{Desired PPM X Sump Capacity (Gallons)}}{\text{Percent Active Ingredient X 78}}$$

For instance, when treating a 250 gallon sump with chlorine bleach (5.25% active)* to a concentration of 2 PPM use the following dose:

$$\text{Dose Size} = \frac{\text{2 PPM X 250 Gallons}}{\text{5.25\% X 78}} = \text{1.22 Fluid Ounces}$$

Conversely, if the entire gallon of chlorine bleach was poured into the sump, the concentration would be:

$$\frac{\text{5.25\% X 78 X 128 Fluid Ounces}}{\text{250 Gallons}} = \text{210 PPM}$$

This is way too much chlorine! So, be careful when disinfecting pads and reservoirs, because overdosing is easy.

*Commercially available chlorine laundry bleaches have an active chlorine concentration of 5.25%.

MAXIMUM RECOMMENDED DOSAGES	
Quaternary Amines	30-50 PPM
Oxidizing Biocides	1-2 PPM
Coppers (not recommended)	

If the chemical manufacturer recommends a different dosage, use the lesser amount.

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UNDERSTANDING CORROSION OF METAL EVAPORATIVE COOLER COMPONENTS

There are four major forms of corrosive attack to evaporative cooling equipment.

Pitting is the removal of metal at the surface in small, localized sites. These sites start out as inconspicuous flecks of rust or oxide, and eventually eat their way through gutters and pans in saucer like depressions.

Pitting is usually caused by the presence of copper, sodium chloride, sulphur and other strong contaminants in the water. The chemicals in a droplet of water are the most concentrated as the droplet dries. Avoid wetting and drying cycles, splashing and dripping where water can become concentrated.

Crevice corrosion occurs in lap joints exposed to air and moisture. For aluminum and galvanized steel, oxygen must be present for corrosion to occur. For stainless steel, oxygen will help form a protective layer on its surface.

To avoid this form of corrosion, joints should be well caulked with a caulking compatible with the metal. Read the label carefully. Notice that some caulks should not be used with certain metals!

Galvanic corrosion occurs when dissimilar metals are used in the same system. Even when they are not touching, the corrosion can occur through the water.

Avoid mixing aluminum, stainless steel and galvanized steel in the same system. Pay special attention to pumps, screws, and valves. When metals must be mixed in a system, the odd metal should have a heavy protective coating, and transition joints should be used.

Poultice corrosion is due to contact with nonmetals. It may cause some serious problems. Materials such as cork, wood, cloth or paper provide moisture and air which contribute to corrosion. If they have been treated with certain fire retardants or biocides (such as copper arsenite) the attack could be very severe. To prevent attack, coat the metal surface, or keep the porous material from becoming wet.

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THE ADVANTAGES OF MI-T-edg

It is very important to protect the air entering face of evaporative cooling media. This face is exposed to the harshest part of the ambient climate. Furthermore, the first one half inch of media gets more abuse than the rest of the media combined. This first half inch is where the air is the hottest, driest, where the greatest amount of evaporation takes place, and where the resulting concentration of minerals and contaminants is the greatest. It is also where the dust and sand loading is the most intense.

The new MI-T-edg media edge coating was developed to address some of the needs of the evaporative cooling industry. These include:

- **Wettability**: MI-T-edg has been formulated with special wetting agents to prevent water beading. Water spreads over the surface of the coating as a thin film.

- **Quick Drying**: The MI-T-edg surface dries out quickly when the water is turned off. This drying inhibits the growth of micro-organisms (especially algae) which require moisture to live.

- **Non-porous**: Does not allow algae or minerals to anchor themselves into the substrate. Algae and minerals sluff off when dried.

- **Tough and Resilient**: The MI-T-edg surface can be repeatedly cleaned.

- **Weather Resistant**: Inlet louvers may be eliminated. The louvers may be necessary, however, to inhibit algae growth in situations where the coolers are poorly maintained.

- **Improved Life Expectancy**: The synthetic MI-T-edg coating extends the life of the media pad over that of non treated pads. Heavy mineral deposition, and frequent abrasive cleaning will shorten the useful life of any media pad.