Cooling Tower Cleaning 101

Presenters

Paul Keller Jr., ASCS

Disclaimer

This presentation is not intended to be a comprehensive program covering all aspects of this topic. All technicians are encouraged to read and follow all applicable standards, codes and regulations related to this topic.

- ✓ It is the responsibility of each individual contractor to follow local building codes and licensing requirements and to work safely in accordance with OSHA guidelines.
- ✓ It is the contractor's responsibility to take proper precautions on each project to prevent cross contamination. Always take the health and safety of the building occupants into consideration before you conduct any cleaning procedures.
- ✓ All of the following tips are only general tips. They do not cover every situation and it is your responsibility to adapt these tips to the individual system you are working on.
- ✓ The Instructor is not responsible in any way for the work you perform after viewing this slide show. You are responsible for your own work.
- ✓ The views and opinions following are the instructors opinions and not necessarily the official position of the National Air Duct Cleaners Association.

What is a Cooling Tower?

- A cooling tower is a device used to reduce the temperature of water also known as heat rejection.
- The type of heat rejection in a cooling tower is termed "evaporative" in that it allows a small portion of the water being cooled to evaporate into a moving air stream to provide significant cooling to the rest of the water stream.

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- The heat from the water stream transferred to the air stream raises the air's temperature and its relative humidity to 100%, and this air is discharged to the atmosphere. Evaporative heat rejection devices such as cooling towers are commonly used to provide significantly lower water temperatures than achievable with "air cooled" or "dry" heat rejection devices, like the radiator in a car, thereby achieving more cost-effective and energy efficient operation of systems in need of cooling.

Common Applications

- Cooling towers provide cooled water for air-conditioning, manufacturing, and electric power generation.

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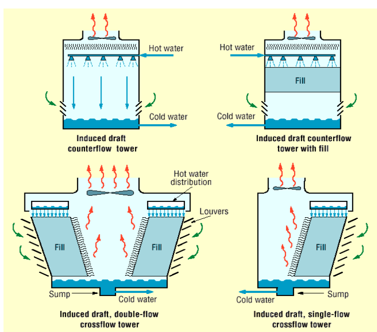
- The smallest cooling towers are designed to handle water streams of only a few gallons of water per minute supplied in small pipes like those one might see in a home, while the largest cool hundreds of thousands of gallons per minute supplied in pipes as much as 15 feet in diameter on a large power plant.

Cooling Tower Types



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- The term "Cooling Tower" is used to describe both direct (open circuit) and indirect (closed circuit) heat rejection equipment. While most think of a "cooling tower" as an open direct contact heat rejection device, the indirect cooling tower , sometimes referred to as a "closed circuit cooling tower" is nonetheless also a cooling tower.

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Open Circuit

A direct or open circuit cooling tower is an enclosed structure with internal means to distribute warm water fed to it over fill that comes into direct contact with moving air.

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The fill provides an expanded air-water interface for heating of the air and evaporation to take place. The water is cooled it descends through the fill by gravity while in direct contact with air that passes over it.

The cooled water is then collected in a cold water basin below the fill from which it is pumped back through the process to absorb more heat. The heated and moisture laden air leaving the fill is discharged to the atmosphere at a point remote enough from air inlets to prevent its being drawn back into the cooling tower.

The fill can consist of multiple, mostly vertical, wet surfaces upon which a thin film of water spreads (film fill), or several levels of horizontal splash elements which create a cascade of many small droplets that have a large combined surface area (splash fill).

Closed Circuit

An indirect, or closed circuit cooling tower involves no direct contact of air and the fluid being cooled.

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- Unlike the open cooling tower, the indirect cooling tower has two separate fluid circuits. One is an external circuit in which water is recirculated on the outside of the second circuit, which is a tube bundle (closed coil) which is connected to the process for hot fluid being cooled and returned in a closed circuit.
- Air is drawn through the recirculating water cascading over the outside of the hot tubes, providing evaporative cooling similar to an open cooling tower. During operation the heat flows from the internal fluid circuit, through the tube walls of the coils, to the external circuit and then by heating of the air and evaporation of some of the water, to the atmosphere.
- Operation of the indirect cooling towers is therefore very similar to the open cooling tower with one exception. The process fluid being cooled is contained in a "closed" circuit and is not directly exposed to the atmosphere or the recirculated external water.

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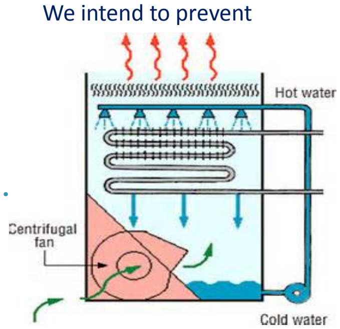
We intend to prevent

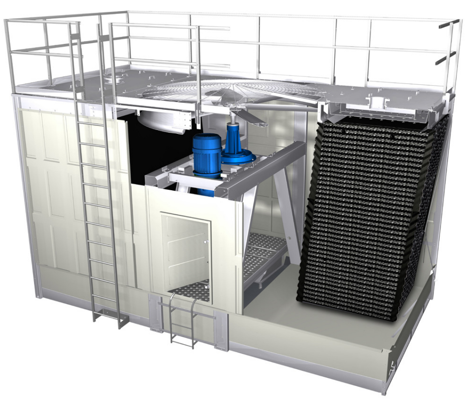


Counter-flow

Air travels upward through the fill or tube bundles, opposite the downward motion of the water.

Cross-flow

Air moves horizontally through the fill as the water moves downward



How Else are Cooling Towers Characterized?

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Cooling towers are characterized by the means by which air is moved

- Mechanical Draft
- Natural Draft

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- Mechanical draft cooling towers rely on power driven fans to draw or force the air through the tower
- Natural draft cooling towers use the buoyancy of the exhaust air rising in a tall chimney to provide the draft.
- A fan assisted natural draft cooling tower employs mechanical draft to augment the buoyancy effect. Many early cooling towers relied only on prevailing wind to generate the draft of air.
- Natural draft towers

Make-Up Water

- If water is returned from the cooling tower to be reused, some water must be added to replace, or make-up, the portion of the flow that evaporates.

Blow-down

Because evaporation consists of pure water, the concentration of dissolved minerals and other solids in circulating water will tend to increase unless some means of dissolved-solids control, such as blow-down, is provided.

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- The make-up water amount must equal the total of evaporation, blow-down, drift, and other water losses such as wind blowout and leakage, to maintain a steady water level.

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Commonly Used Terms in the Cooling Tower Industry

- Drift
- Blow-out
- Plume
- Blow-down
- Leaching
- Noise

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- **Drift:** Water droplets that are carried out of the cooling tower with the exhaust air. Drift droplets have the same concentration of impurities as the water entering the tower. The drift rate is typically reduced by using drift eliminators, through which the air must travel after leaving the fill and spray zones of the tower
- **Blow-out:** Water droplets blown down out of the cooling tower by wind. Water may also be lost, in the absence of wind, through splashing or misting. Devices such as wind screens, louvers, splash deflectors and water diverters are used to limit these losses.

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- **Plume:** The stream of saturated exhaust air leaving the cooling tower. Plume is visible when water vapor it contains condenses in contact with cooler ambient air. Under certain conditions, a cooling tower plume may present fogging or icing hazards to its surroundings.
- **Blow-down:** The portion of the circulating water flow that is removed in order to maintain the amount of dissolved solids and other impurities at an acceptable level.

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- **Leaching:** The loss of wood preservative chemicals by the washing action of the water flowing through a wood structure cooling tower.
- **Noise:** Sound energy emitted by a cooling tower and heard at a given distance and direction. The sound is generated by the impact of falling water, by the movement of air by fans, the fan blades moving in the structure, and the motors, gearboxes or drive belts

Scale

As the system water increases in solids and minerals, the solids become more prone to attaching themselves to the pipe walls and other components.

Concentrated solids can build up in the form of scale, causing blockages and corrosion to the cooling tower system materials.

Scale of Crossflow Tower on Fill

Corrosion & Debris

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- When the water evaporates the minerals are left behind on the tower. Mineral deposits mean that you do not have proper water treatment. Install the proper water treatment to prevent scale deposits.
- This scaling can cause catastrophic failure and damage to the system.

Operational Efficiency

- There are many measures that are needed to assure a cooling tower system is operating in a water efficient manner.

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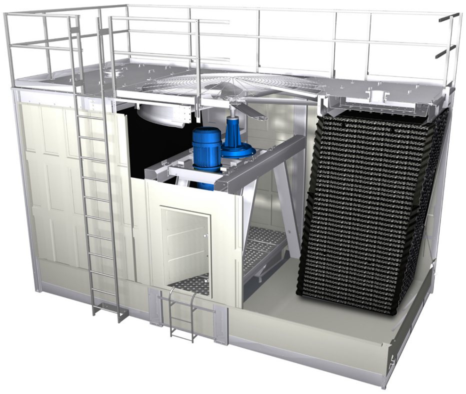
- At a minimum the system should have a dedicated water meter that is read daily by the local maintenance staff and a TDS meter/controller to maintain proper bleed-off rates. In addition, chemical treatment controllers and filtering equipment can greatly reduce water use while properly maintaining the equipment

1. Prevent any sediment or algae from collecting in the water basin.
2. Stop scale buildup on the surface of the cooling tower.
3. Clear debris from the air outlet and inlets.
4. Check the pump so that it is working properly.
5. Check the belt drive system.



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- Inspect the water distribution system at least once every other week to make sure there is an even water level.
- Debris can clog the water spray nozzles. Clogged nozzles result in uneven water distribution and airflow. This will reduce the evaporation which means the unit has to work harder to cool the air. Clean these nozzles regularly. Since cooling towers are highly individualized, you should consult the manufacturer's instructions for details on cleaning nozzles.

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- Check the strainers on the cooling towers on a consistent basis and look for any debris that have built up. Different towers vary on the accessibility of their strainers, but many can be accessed from the outside without having to turn the tower's power off.
- Clean out any debris that have accumulated within the strainers. Again towers will vary, but many come equipped with a spraying system that allows the strainers to be effectively cleaned out without much hassle. This should be done at least once every other week. Doing so will help prevent clogs and should keep the cooling tower functioning at maximum efficiency.

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- Remove accumulated dirt from the cooling tower's basin by flushing it out through the tower drain every two to three weeks. Doing so should improve efficiency and lower operating costs.
- Inadequate airflow will reduce the amount of heat that can be removed from the water to the air. Other possible causes of inadequate airflow include damaged fan blades, loose motor mounting hardware, poor fan alignment, improper fan pitch or loose fan. Check all possible causes until the air flow is back to normal. Clean tower at least once a year for proper maintenance.

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- The pump is responsible for transporting the water over the cooling tubes. Other possible causes of reduced water flow such as loose connections and clogged strainers. Check everything if the pump is working properly but the water flow is low. Reduced flow decreases the efficiency and can cause equipment to fail earlier than normal.
- Check the belt drive system to make sure it is as tight as the manufacturer specifies. You should also make sure that the oil level is where the manufacturer specifies as well. This should be done approximately every three months.

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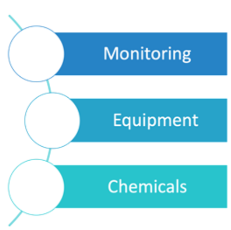
Water Treatment



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- Manual or automated systems are used to monitor water levels, temperature, and quality. Monitoring systems may contain a thermal sensor, an AC coupled conductivity sensor drive and conductivity measurement, PH electrodes, flow status switches, and a bleed solenoid to handle excess water buildup or temperature rises.
- Automated monitoring systems will include LCD displays to identify the location of any system faults and readout system measurements. An alarm system will be used to announce serious problems, and a phone system will provide communication between the monitoring station and relevant personnel.

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- Flow metering valves and copper/PVC piping make up the backbone of the treatment systems. Water is pumped through an electrolytic chamber to precipitate dissolved metals. A filtration apparatus will filter out these salts as well as remove any biological contaminants. A pump system maintains regular water flow.
- To counteract water evaporation, a pressure or density sensitive valve will connect the system to a water reservoir. When the water level drops below a predetermined level, the valve will open and remain open until water levels have been restored.
- Aside from system sensors, a sampling system may be used to siphon off water periodically for sampling, either manual or automatic, and record-keeping purposes.

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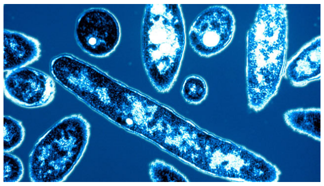
- Water treatment uses a variety of chemicals to deal with biological contaminants and the buildup of calcium carbonate, a substance that accumulates on the tubing and tower walls.
- Chloride is a preferred chemical in treatment systems because it does not form a precipitate. Ammonia or phosphates are then used to regulate pH levels and to prevent the buildup of calcium carbonates and other precipitates that are collectively referred to as scale.
- Depending on the state or country, a variety of biocides may also be introduced to kill off bacteria and microorganisms. Common biocides include ozone, iodine, and chlorine. Organic biocides may also be introduced to deal with specific contaminants.
- Water treatment information should include an MSDS for all chemicals stored onsite. There also should be an authorization to use the chemicals for the type of system on-site.

Legionnaires' Disease

Legionnaires' Disease is a form of pneumonia that can be fatal. It is caused by the common bacteria *Legionella Pneumophila Bacillus*



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- It is possible for anyone to catch the disease, provided the bacteria can get to the deep parts of the lungs where the disease can grow, but certain groups within the community are more prone to the illness than are others.

Groups Most at Risk

- Over 50 years of age
- Are male
- Have a history of smoking
- Have a history of heavy alcohol intake
- Have a medical condition or are undergoing a treatment that impairs the body's natural defense mechanisms

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Where is it Found?

Legionella is found in moist environments such as Lakes, Rivers, Creeks, Mud and other water sources at temperatures ranging from 41 degrees Fahrenheit to 131 degrees Fahrenheit.

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- However no cases of Legionnaires' Disease has been proven to have been caused by Legionella present in the natural environment.
- All of the Legionnaires' Disease outbreaks have been attributed to man made environments

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Optimum Conditions

The optimum conditions for the multiplication of Legionella Bacteria has been shown to be between 95-98.6 degrees Fahrenheit with an acid balance between pH6.5 and pH 6.9

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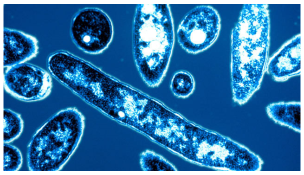
Cooling Towers and Evaporative Condensers Provide this Environment

The primary concern with the cooling tower is its ability to spread the Legionella over a vast area due to Drift (aerosols) carrying the bacteria from the tower.



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Presenter Contact Information

- Paul Keller Jr.
- pkeller2@service-techcorp.com
- (727) 539-7000

Thank you
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