SUBJECT: UNDERSTANDING THE ASPECTS THAT AFFECT COOLING TOWER PERFORMANCE **#7-A-273** **6/10/04**

Advantage Model PT-135F shown

A cooling tower primarily uses latent heat of vaporization (evaporation) to cool process water. Minor additional cooling is provided by the air because of its temperature increase. Cooling tower selection and performance is based on water flow rate, water inlet temperature, water outlet temperature and ambient wet bulb temperature.

Ambient wet bulb temperature and its affect on performance is the subject of this article.

Ambient wet bulb temperature is a condition measured by a device called a psychrometer. A psychrometer places a thin film of water on the bulb of thermometer that is twirled in the air. After about a minute, the thermometer will show a reduced temperature. The low point when no additional twirling reduces the temperature is called the wet bulb temperature.

The measured wet bulb temperature is a function of relative humidity and ambient air temperature. Wet bulb temperature essentially measures how much water vapor the atmosphere can hold at current weather conditions. A lower wet bulb temperature means the air is drier and can hold more water vapor than it can at a higher wet bulb temperature.

For example:

Dry Bulb Temperature	% Relative Humidity	Resultant Wet Bulb Temperature
50°F	40%	40°F
60°F	50%	50°F
70°F	35%	55°F
85°F	55%	73°F
90°F	60%	78°F

Since cooling tower cells cool water by evaporation, the wet bulb temperature is the critical design variable.

An evaporative cooling tower can generally provide cooling water 5° - 7° or higher above the current ambient wet bulb condition. That means that if the wet bulb temperature is 78°F, then the cooling tower will most likely provide cooling water between 83° - 85°F ... no lower. The same tower cell, on a day when the wet bulb temperature is 68°F, is likely to provide 72° - 75°F cooling water.

A TC-405F cooling tower cell mounted on a 30' stand. The stand height was required because the pump tank is mounted inside the building on a mezzanine. You'll notice that the stand is a little wider than the tower to provide a broader base for support. A well anchored pad was required to offset the wind loading force on the tower.

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A unique tower stand expands parking capacity while holding this ADVANTAGE tower system in Northern California. The picture shows the cantilevered support holding TC-135F and Marley tower cells.

When selecting a cooling tower cell, the highest or the design wet bulb temperature your geographical area will encounter must be used. Highest wet bulb temperatures occur during the summer, when air temperatures and humidity are highest.

Again by example, in Indianapolis, Indiana the design wet bulb temperature is 78°F. Historically Indianapolis can expect less than 1 hour per year that the conditions exceed a 78°F wet bulb. Typically 6,000 hours a year will have a wet bulb of 60°F or lower meaning that a cooling tower cell designed for a 78°F wet bulb will be able to make 65-67°F water for 6,000 hours per year ... nearly 70% of the year.

Most cooling towers are capacity rated at a "standard" wet bulb temperature of 78°F. That means on the days when the wet bulb temperature is 78°F, the tower will produce its stated capacity. In other words, a tower rated to produce 135 tons of cooling will produce 135 tons of cooling at a 78°F wet bulb temperature. At a higher wet bulb temperature, the tower cell capacity decreases.

Every location has a unique design (worst case) wet bulb temperature that is published by organizations such as ASHRAE and can be obtained easily. (See FYI #040 for more information).

So, what does it mean when your cooling tower water temperature is higher than the normal 5-7°F above the current wet bulb temperature?

Your cooling load may be larger than the rated capacity of your cooling tower.

- Your cooling tower may have lost efficiency
- Due to scale build up on the tower heat exchange surfaces.
- Due to loss of air flow across the heat exchange surfaces.
- Due to improper water flow

What can you do to improve your tower performance?

- Add tower cell capacity
- Check for the efficiency losses described above
- Replace the heat exchange surfaces with new clean fill.
- Check for proper air flow
- Adjust the water flow

Cooling tower performance is tied to ambient wet bulb conditions. Higher wet bulb temperatures occur in the summer when higher ambient and relative humidity occurs. Initial system design and proper system maintenance is critical to be certain your cooling tower cell is providing proper cooling.

Contact ADVANTAGE for application and design assistance for all of your process cooling needs.

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