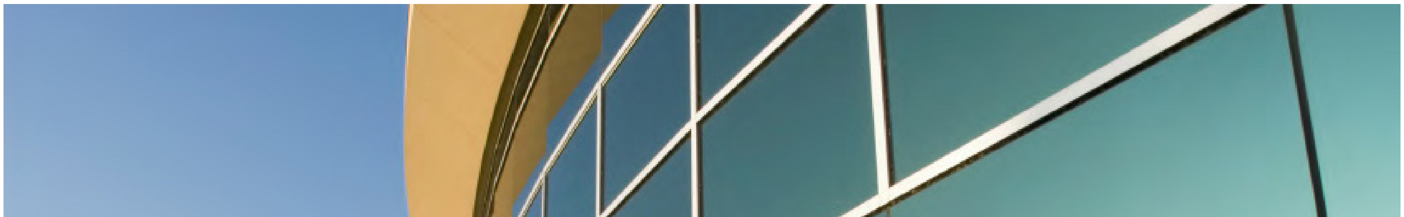
Cooling Technology Options Take the LEED



introduction

SPX Cooling Technologies is a member of the U.S. Green Building Council (USGBC) and an advocate of the Leadership in Energy and Environmental Design (LEED) Program, a voluntary, consensus-based national standard for developing high-performance, sustainable buildings.

This paper provides a brief overview of cooling and heating technology options that offer the potential to gain LEED points as well as achieve greater operating efficiencies. It is for informational purposes only and is not intended to provide instruction or direction in the pursuit of LEED certification.

For information about the USGBC or LEED, go to the USGBC web site at **www.usgbc.org.**

About the Author

Paul Lindahl's 47-plus year career at SPX Cooling Technologies and its predecessor, Marley Cooling Technologies, has included product development, cooling tower heat transfer and optimization, global product application and market development.

He has worked extensively in industry organizations such as the Cooling Technology Institute, of which he is a past president, and has participated extensively in Codes and Standards and other organizational work for the American Society of Mechanical Engineers (ASME), the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), the Air-Conditioning, Heating and Refrigeration Institute (AHRI) and European Committee of Air Handling and Refrigeration Equipment Manufacturers (Eurovent), and its subsidiary Eurovent Certita Certification.

Paul has been the delegate for SPX Cooling Technologies in the USGBC, which administers LEED. He retired in 2015, and his company, Cooling Industry Relations LLC, is now providing consulting services to represent SPX in multiple external organizations. Mark Pfeifer is currently the delegate for SPX Cooling Technologies in the USGBC.

The Push for Greener Choices

When it comes to designing and constructing new buildings and power plants, more and more architects, engineers, facility managers, contractors and building owners are going "green."

It is not just the wave of public opinion that is driving the move to more sustainable building practices. Reduced water consumption, increased energy efficiency, the use of recycled materials and other green strategies often yield long-term cost and operational efficiencies, making them smart business practices as well.

One of the areas in which green building strategies can make a difference is in the selection of cooling and heating technologies.

Leadership in Energy and Environmental Design (LEED) points are awarded by the U.S. Green Building Council (USGBC) to building projects that have applied for LEED Certification for various practices in design and operation that minimize the environmental impact of building operations.

Points can also be obtained by choosing cooling and heating options that operate more efficiently than LEED thresholds.

The Cool Choice: Evaporative Cooling

LEED credits can be achieved for energy savings or water use strategies associated with evaporative cooling towers. Most buildings require some kind of mechanism for cooling air temperatures indoors.

Choosing an evaporative cooling system often offers the potential for significant energy cost savings and water use benefits.

Two seminar presentations at the 2008 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) annual meeting included study results showing that the overall water consumption in some climate zones for air-cooled HVAC may actually be higher than the water consumption from evaporative cooling.[1]

Power plants use a large amount of water to produce energy, both in the plants themselves and in the mining of fossil fuel. The higher power used by air- cooled HVAC systems translates to higher water use.

To learn more about SPX evaporative cooling systems, download the brochure on the SPX Cooling Technologies web site at **spxcooling.com/evaporativecooling**

The Advantages of Evaporative Cooling

Evaporative cooling—the kind of cooling used in open and closed circuit cooling towers, as well as evaporative condensers—uses the evaporation of a small volume of recirculated water within a system to remove heat.

The process is similar to how humans keep cool. When we get overheated, our bodies perspire, causing our skin to become damp. Air moving across our damp skin helps to evaporate the water on our skin, removing some of our body's heat and keeping us cool. The more air that flows across our skin and the more that we perspire; the more heat is removed from our bodies.

This same process allows evaporative cooling equipment to cool below the ambient dry air temperature. The water in a cooling tower is in direct contact with outside air, so evaporation of the hot water takes place easily with an adequate amount of air flow, which is typically produced by a fan in air-conditioning towers.

Evaporative Cooling and Humidity

The lower the relative humidity, the greater the benefits that evaporative cooling offers. This is because the relative humidity is a measurement of the relative difference between the moisture that the air holds and the moisture that it could hold.

It reflects the difference between what is called the wet bulb temperature, which indicates the amount of moisture actually in the air, and the dry bulb temperature, which is the outdoor temperature that a thermometer (with a dry sensor bulb) will indicate and reflects the maximum amount of moisture that the air could hold at 100% relative humidity.

A wet bulb temperature is measured, literally, with a thermometer having a wet sensor bulb. At 100% relative humidity, the wet and dry bulb temperatures are equal.

Evaporative cooling systems transfer heat based on the wet bulb, while dry systems transfer heat based on the dry bulb. It is common for an evaporative system to produce cold-water temperatures approaching the wet bulb temperature and below the outdoor dry bulb. This is not possible with a dry system, which approaches the dry bulb temperature but cannot reach it.

An air-cooled HVAC system is less energy efficient because of its higher fan power need since it does not have the benefit of the large amount of heat transferred with the evaporation of water. It also has to work against the higher dry bulb temperatures through the year.

The higher chiller water temperatures that result cause higher chiller energy requirements. The chiller energy impact is the more significant factor. Hot, humid locations still benefit from evaporative cooling, but the benefits are less than in hot, dry locations.

[1] ASHRAE Technical Program, Tuesday, June 24, 2008. Seminar 48 – Balancing Energy and Water Conservation in HVAC Cooling Systems: A Total Consumption Approach. 1. A comprehensive Comparison of Air-and Water-Cooled Chillers over a range of Climates. Mark Hydeman, P.E. Fellow ASHRAE; Taylor Engineering, Alameda, CA. 2. Minimizing Water Use in Non-Compressor Cooling Applications. Mark Modera, P.E., ASHRAE Member; Western Cooling Efficiency Center, Davis, CA

Efficiency Counts

LEED acknowledges the benefits of evaporative cooling by making evaporatively cooled chiller systems with ASHRAE 90.1 minimum energy efficiency levels the base or threshold requirement upon which a project must improve if it is seeking LEED certification with any type of HVAC system.

Credits are granted based on improvements in overall building energy efficiency, which can be achieved using the minimum ASHRAE standards that, again, include using evaporatively cooled chillers.

Towers that are selected with energy efficiency in gallons per minute per horsepower above the ASHRAE 90.1 minimum can help to acquire LEED credits. Usually, a physically larger tower can reject heat with less fan power, so the gallons per minute per horsepower increase. The capital cost of a larger tower must be balanced against the benefits and costs of other ways of reducing building power consumption.

Exceeding ASHRAE Minimum Energy Efficiency

The ASHRAE minimum energy efficiency standard for axial fan open cooling towers (which comprise the majority of cooling towers) is 40.2 gallons per minute per horsepower (12.24m^3/h/kW). It is 20 gallons per minute per horsepower (6.09 m^3/h/kW) for centrifugal fan open cooling towers (used when the towers have to be indoors and the high pressure handling ability of blowers is needed to push and/or pull the air through ducting from outdoors to the tower and from the tower back outdoors). Both are required at standard conditions of 95°F hot water, 85°F cold water, 75°F wet bulb (35/29.5/23.9°C).

All U.S. states are now required per federal law to have adopted these or stricter efficiency standards for comfort cooling applications.[2]

Standard Marley open and closed circuit cooling tower models are available that range from 20 to 400 gpm/hp. Significantly more energy-efficient cooling towers than the ASHRAE minimums are available.

Larger models (in physical size) typically have more heat transfer volume, which enables them to utilize less air flow and fan power, making them more efficient. For a specific water flow in gallons per minute or gpm, there are many combinations of physical tower size and fan power that will meet a given set of temperature requirements. Saving more power usually means a bigger tower that costs more, that must be balanced against the cost and power consumption of the many options for a system designer.

[2] American Society of Heating, Refrigerating and Air-Conditioning Engineers, ASHRAE Standard 90.1-2016, and the Federal Register, or energy.gov, searching for ASHRAE Standard 90.1.

For more information on tower sizing and selection, consult the SPX tower sizing and selection tools on the SPX Cooling Technologies web site at spxcooling.com/update

An SPX Cooling Technologies representative can also assist with the process of optimizing tower size and power savings.

Speed Matters

The use of variable frequency drives (VFDs) instead of two-speed fans can also enable significant annual energy savings in most climates, which also can help to enable LEED credits. By using a temperature controller to reduce the fan speed whenever the tower can make colder water than the chiller needs to cool the building, the energy drawn by the fan motor is significantly reduced.

According to generally accepted fan laws, the amount of power goes down by the third power of the speed change. At one half speed, the air flow and tower capacity are about one half, but the power is 1/2 times 1/2 times 1.2, or 1/8 of the full speed power—half the air flow with one eighth of the power.

The optimum fan speed for the temperature required is maintained, so a great deal of energy can be saved over a typical single - or two-speed fan on a cooling tower through the year.

Hybrid Systems Offer Best of Both Worlds

Potential LEED credits are available for innovation. One such credit may be possible by the use of hybrid cooling towers such as the Marley NCWD cooling tower to reduce the annual water consumption below what a conventional evaporative tower would use.

The hybrid wet/dry design of the NCWD utilizes a dry section along with a wet section to reduce evaporation due to the heat rejected in the dry section and the visible plume leaving the tower. Both are environmental benefits that have potential to earn innovation credits from LEED.

Our studies have shown that the NCWD design may reduce annual water consumption up to 20%, depending on the particular climate and building heat load profile for a particular facility.

To learn more, download the brochure on plume abatement on the SPX Cooling Technology web site at **spxcooling.com/plumeabatement**

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ISSUED 8/2019 SPX_wp_leed-19