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Water Savings and Eliminating Unsightly Plume for Large Office Building

A large office building in Chicago, IL utilizes Güntner's Adiabatic Cooling System for waters savings and elimination of unsightly plume traditionally associated with evaporative cooled equipment. By designing the system with the Adiabatic Cooling System, the facility expects to experience an 87% savings in annual water consumption relative to evaporative cooled equipment.

Designed to conserve natural resources

Skidmore, Owings & Merrill LLP (SOM) was hired as the consultant for this project, 1515 West Webster Avenue located near Chicago's Lincoln Park neighborhood, providing architecture, MEP, structural and civil engineering services. Targeting LEED® Gold certification and incorporating low-cost high-efficiency materials, SOM designed the HVAC system with Güntner's Adiabatic Cooling System (ACS) to reduce water consumption while maintaining an efficient cooling system. At peak ambient temperature, the air entering the finned heat exchanger is pre-cooled by wetted cooling pads to a temperature approaching the wet bulb temperature, without aerosol formation and without applying water to the finned surface. The pre-cooling process maintains the required leaving fluid temperature at peak ambient conditions. Additionally, the Adiabatic Cooling System incorporates intelligent controls that regulate water flow based on ambient and process conditions further minimizing water consumption.

Overview

Business line:	HVAC
Application:	Comfort Cooling
Location:	Chicago, Illinois, USA
Refrigerant:	Propylene glycol solution
Product:	GFD V-Shape Vario

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3601 Algonquin Road, Suite #925
Rolling Meadows, IL 60008
USA

SOM, through their due diligence, reviewed several possible solutions for heat rejection component of the HVAC system. An analysis of water and energy use comparing the Adiabatic Cooling System to an evaporative cooled unit indicated a significant water savings and lower annual operating costs for the adiabatic solution. The adiabatic cooler provides a 47% savings annually in the cost of electricity and water; and, perhaps more importantly, an 87% water use savings. Chart 1 depicts the cumulative resource (water and electricity) consumption of the adiabatic cooler based on weather bin data. Note the wet hours are limited to only the warmest hours. The evaporative unit consumes about 2.7 million gallons of water annually. The ACS in contrast consumes a fraction of that at about 341,000 gallons annually.

Chart 1. Annual Resource Consumption of Adiabatic Cooling System

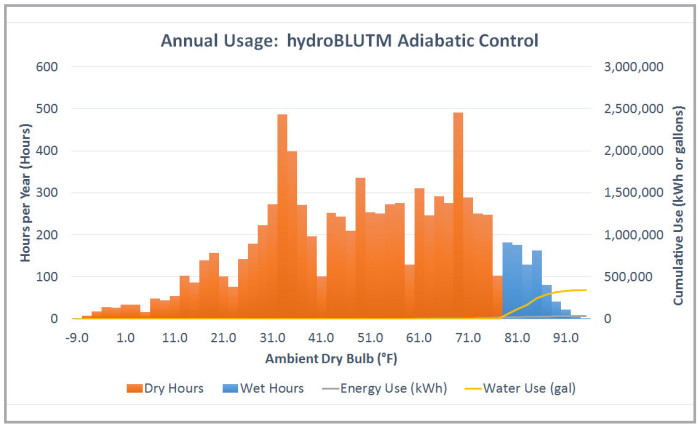
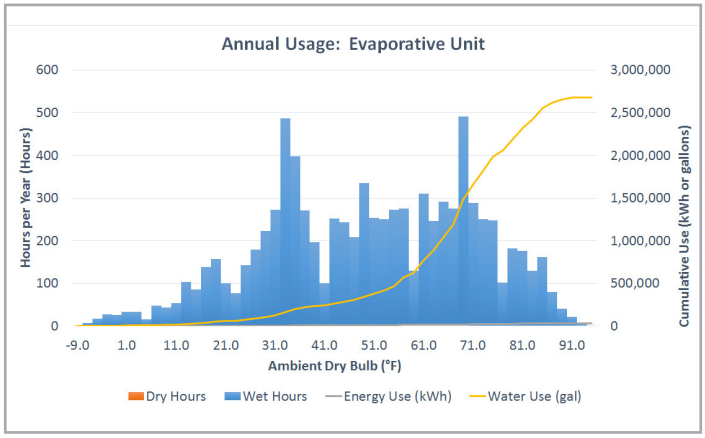


Chart 2. Annual Resource Consumption of Evaporative Unit



The water and energy use analysis takes into account a load profile of the building as well as cost of water, water treatment and power. The design with the Adiabatic Cooling System offers a $12,503 annual savings.

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Chart 3. Load Profile

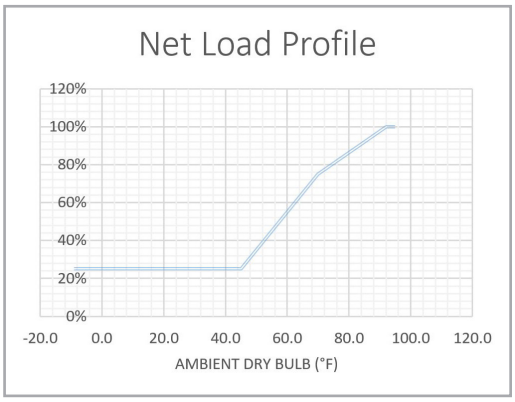

Table 1. Water and Energy Rates

Electricity rate	$0.09	$ / kWh
Demand charge	$8.90	$ / kW / mo.
Water supply	$2.90	$ / kgal
Sewage	$2.70	$ / kgal
Water treatment	$4.00	$ / kgal

Table 2. Energy and Water Use Analysis

Unit Data		Adiabatic	Evaporative
Parameter	**Notes**	**hydroBLU**	**Evaporative**
System		Metered Flow	Integral Pump
Water Control		Configurable	Energy Priority
Fan Motor Control		EC Motor VSD	NEMA VFD, belt
Product Application		Cooler	Cooler
Design heat rejection	Btu/hr	6,000,000	6,000,000
Entering fluid temperature	°F	100.4	100.4
Leaving fluid temperature (LFT)	°F	90.0	90.0
Inlet dry bulb temperature	°F	92.0	92.0
Inlet wet bulb temperature	°F	74.0	74.0
Precooled air (switch point), if appl.	°F	78.0	NA
Total number of fans		24	2
Total fan power, input	kW	88.8	16.9
Total air flow rate	cfm	416,650	58,000
Minimum fan speed setting	(if appl)	10%	25%
Spray water pump power, input	kW	0.0	2.4
Water intake at design	gpm	17.2	15.8
Minimum leaving fluid temperature setpoint	°F	90.0	90.0
Fan power, maximum	kW	88.8	16.9
Spray water pump power	kW	0.0	2.4
TOTAL maximum power	**kW**	**89**	**19**
Fan power, annual average	kW	3.8	1.5
Spray pump pwr., annual avg.	kW	0.0	2.4
TOTAL power, annual avg.	**kW**	**4**	**4**
Fan energy	kWh/yr	33,572	12,866
Spray water pump energy	kWh/yr	0	21,310
TOTAL energy	**kWh/yr**	**33,572**	**34,175**
Cost of fan electricity	USD/yr	12,867	3,242
Cost of spray pump electricity	USD/yr	0	2,199
TOTAL cost of electricity	**USD/yr**	**12,867**	**5,441**

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Unit Data		Adiabatic	Evaporative
Parameter	**Notes**	**hydroBLU**	**Evaporative**
Water use hours per year	hours/yr	797	8,760
Water use hours as % of year		9%	100%
Water use	**kgal/yr**	**341**	**2,682**
Water evaporation	kgal/yr	227	1,788
Chemically treated blowdown	kgal/yr	0	894
Non-treated water blowdown (to other use)	kgal/yr	114	0
Water intake, maximum	gpm	15.8	15.8
Average water intake per year	gpm	0.6	5.1
Water use, (equiv.) cycles of concentration		3	3
Water use savings vs evaporative base		87%	0%
Cost of water	**USD/yr**	**989**	**20,919**
ANNUAL water & energy cost	**USD/yr**	**13,856**	**26,359**

Designed for pleasing aesthetics

In addition to the water and operating cost saving the Adiabatic Cooling System provides an aesthetically pleasing solution that does not generate water vapor plume. When the saturated discharge air from evaporative cooled equipment mixes with cold ambient air the moisture in the air can condensate forming a visible cloud or fog. This visible plume seen emanating from the evaporative cooled equipment can be confused for smoke and is otherwise deemed unsightly. The Adiabatic Cooling System by contrast does not utilize water during the cold ambient times and hence no plume is generated.

The SOM design of the HVAC system for this project incorporating Güntner's Adiabatic Cooling System with hydroBLU provides the building owner with a solution that conserve natural resources while minimizing winterization concerns such as unsightly plume.

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