

# success story



More comfortable  
lecture halls with  
evaporative cooling

## where

### University

- Riyadh - Saudi Arabia.

## what

### ChillBooster installation

- cooling in summer and humidification with 162 evaporative coolers for 162 double skin air handling units.

## why

- energy saving;
- low running and maintenance costs;
- high efficiency ensured by very fine atomisation of water;
- reduced dimensions, capacity and energy consumption of the cooling coils on the air handling units;
- easy to install with modular manifolds easily adaptable based on the required dimensions.

## University for girls new learning opportunities

In 2006 a decision was made by royal decree to build the university for female students only in Saudi Arabia. The first stone was personally laid by King Abdullah.

This is a major development. The university complex will be able to host up to 40,000 students, twice the number of students enrolled at Oxford. The students will be able to choose between 15 faculties on a large campus that, among other facilities, includes a 700-bed hospital, staff accommodation, a school, a kindergarten and a high-tech transport system. The decision by the King to take part in the ceremony to inaugurate the work is seen as a sign of his personal commitment to promoting education in Saudi Arabia, both for women and men.

Zamil Air Conditioners, the company charged with supervising this enormous project, was founded in 1974 and was one of the first companies to deal with air-conditioning in Saudi Arabia. Its headquarters are in Dammam and today it is an international-level manufacturer of air-conditioning systems, as well as the leading company in the sector in the Middle East, thanks to strategic alliances and significant investments in research and development. The Zamil group also includes the Italian company "Geoclima srl", manufacturer of chillers and fan coils, acquired in 2000, and the Austrian company "Clima Tech Airconditioners GmbH", acquired in 1998, which develops and manufactures air handling units.

The ChillBooster evaporative cooler has been chosen for the air handling units. This unit, compared to adiabatic washers typically used in these applications, guarantees a higher absorption ratio and less hygiene problems. The latter in fact occur when recirculating a large amount of water, a resource that moreover has limited availability.

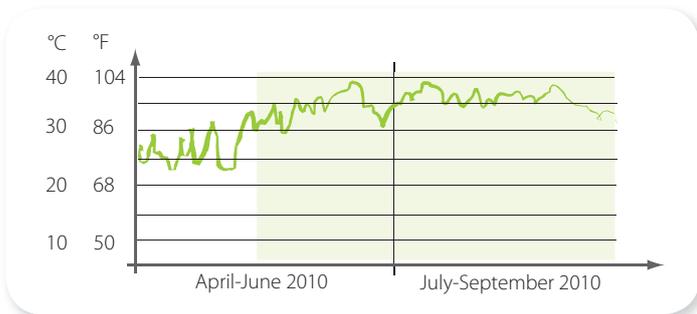
The various university environments are now air-conditioned by double skin air handling units, each fitted with a ChillBooster evaporative cooler. Direct evaporative cooling, especially suitable for hot and dry climates, reduces temperatures in summer by around 10 °C, with very low energy consumption.



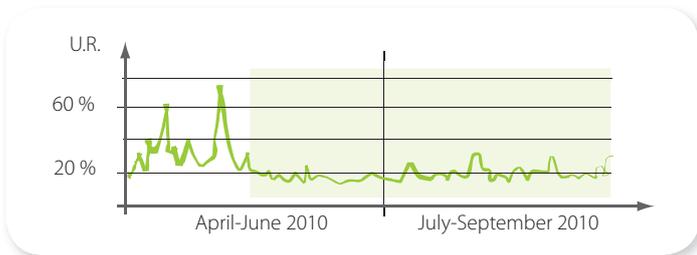
## Mitigating a hot and dry climate

The climate in Riyadh sees hot and dry summers: humidity from May to October is around 20% RH and the temperature exceeds 30 °C, with peaks of 40 °C. Direct evaporative cooling has been identified as the best solution for air-conditioning. Cooling capacity is boosted when temperatures are relatively high and humidity is low, even with a humidifier saturation efficiency humidifier of 90%, as can be seen on the psychrometric chart:

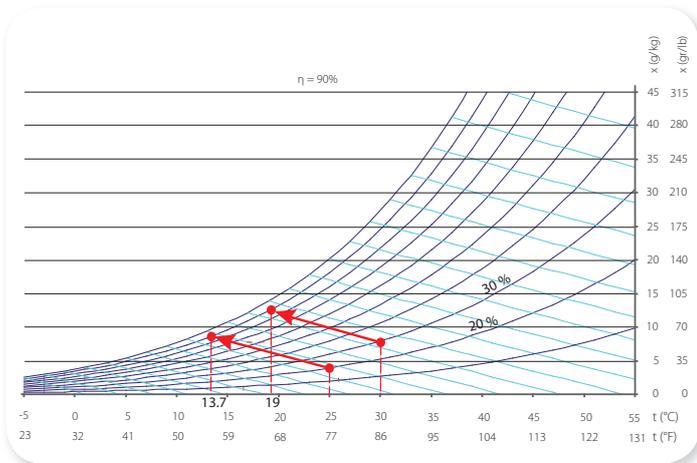
- from a dry bulb temperature of 30 °C with relative humidity 30% a temperature of 19 °C is reached;
- from a dry bulb temperature of 25 °C with relative humidity of 20% a temperature of 13.7 °C is reached.



temperature trend in Riyadh



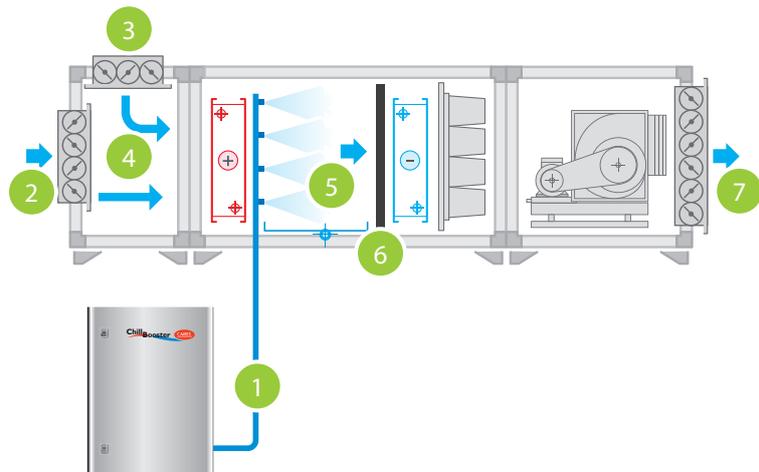
humidity trend in Riyadh



evaporative cooling seen on the psychrometric chart

## Direct evaporative cooling with ChillBooster

The direct evaporative cooling system uses a pumping unit in summer. The greatest effect can be achieved when the temperature is at its highest and the relative humidity is at its lowest. Note that 1 litre of water atomised by ChillBooster has droplets with a total surface area of 170 m<sup>2</sup>: this water evaporates rapidly, absorbing sensible heat from the air, which is cooled. Indeed 100 l/h of atomised water absorbs 68 kW of sensible heat from the air, for a power consumption of just 0.35 kW!



schematic example of direct evaporative cooling

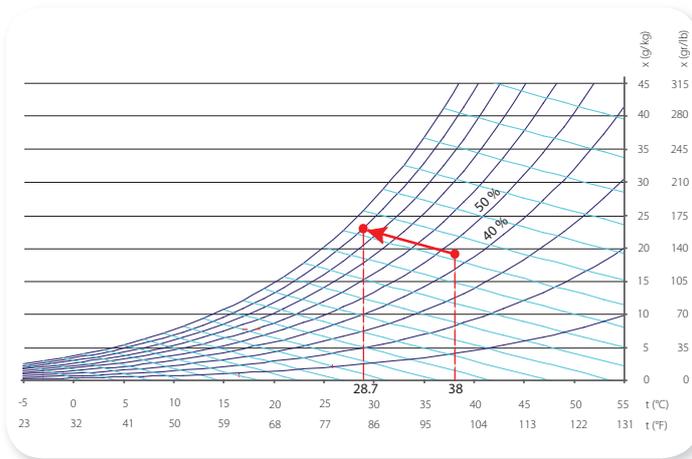
- |   |                        |   |                               |
|---|------------------------|---|-------------------------------|
| 1 | pressurised water line | 5 | evaporative cooling in summer |
| 2 | return air             | 6 | droplet separator             |
| 3 | outside air            | 7 | outlet air                    |
| 4 | recirculated air       |   |                               |

## ChillBooster

In this specific application, the design of the humidification section requires a transformation taking air at 38 °C and 45% RH to a temperature of 28.7 °C.

The ChillBooster system supplied consists of:

- pumping unit that provides pressurised water at 10 bars to the distribution system, with ON/OFF control of flow-rate, high temperature protection valve and drain solenoid valve;
- modular stainless steel manifolds;
- atomising nozzles;
- distribution system drain solenoid valve;
- metal hoses and fittings;
- UV water sanitisation system (optional).



evaporative cooling seen on the psychrometric chart



pumping unit



nozzle



droplet separator



stainless steel hose



solenoid valve at the end of the line



nozzle manifold



UV lamp (optional)



compression fittings

## A powerful and complete solution

CAREL provides all components ready for assembly. The ChillBooster system is easy to install: nozzle pipes available in various lengths, connection hoses and quick fittings mean no special tools are needed and no welding is required. The racks can be assembled and adapted based on the required dimensions. In addition, no water stagnates in the system pipes and hoses due to the drain solenoid valve on the pumping unit and the solenoid valve at the end of the line that empties the water when the unit stops.

### Material supplied for a 51,800 m<sup>3</sup>/h AHU

Description	Quantity
Pumping unit (1000 l/h) with electrical panel, 230 V 60 Hz	1
Manifold dia.= 20 mm, 19 holes 1/8" F L= 2.87	8
10 nozzles, 7.5 kg/h	15
Brass nipple G1/2"	1
Stainless steel corrugated hose	1
Manifold fittings	16
Drain solenoid valve	1
Gaskets	16
Control panel	1
Temperature (-20T70 °C) and humidity probe (10 to 90% RH)	1



ChillBooster in equipment room



evaporative cooling with atomised water



## Conclusions

The 162 air handling units are cooled by 162 ChillBooster units that manage the air-conditioning system in one wing of the university. On the largest air handling unit, up to 1000 kg/h of water is atomised, with a cooling capacity of 680 kW for a power consumption of just 0.7 kW. Summer temperature set points are maintained within the design requirements.

The project was developed thanks to the active partnership between the CAREL HQ Export subsidiary and "Zamil", manufacturer of air handling units based in Dammam, Saudi Arabia.

This ensured a high level of customer satisfaction that, as well as excellent products in terms of quality and reliability, identified an excellent partner for its air-conditioning applications in large buildings.



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