SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT
The Power To Do More.®

Energy Efficiency & Customer Research & Development
Technology Brief…The Coolerado Cooler

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Background

In 1998, Applied Behavior Consultants (ABC School) became one of the first commercial customers to install indirect-direct (a.k.a. two–stage) evaporative cooling (IDEC) systems. Unfortunately, these units have proven to be troublesome and a source of many comfort-related complaints (for more information, download the report entitled "Operation IDEC Rescue" available at the Customer Advanced Technologies Program web page www.smud.org/education/cat/hvac.html).

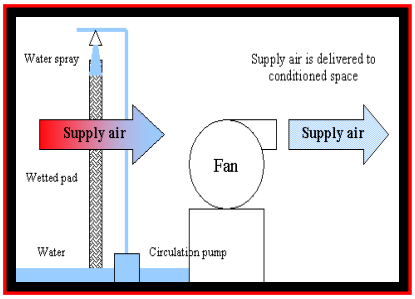
Last month ABC School agreed to test an innovative evaporative cooling system known as the **Coolerado Cooler.** According to the manufacturer, Idalex, this compressor-less cooling system offers the same comfort levels as traditional air-conditioning systems at a fraction of the operating costs.

The Coolerado Cooler

The Coolerado Cooler was installed during the week of August 26, 2004 and SMUD has begun testing the system. The purpose of this demonstration project is to test the thermal performance and reliability of the Coolerado system while providing some much needed relief for ABC's staff.

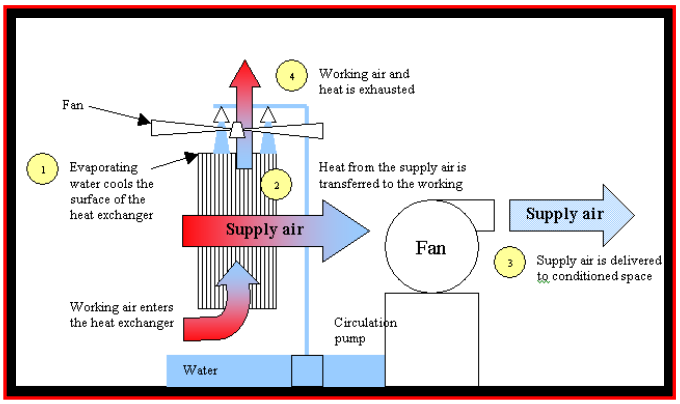
HVAC 101: Evaporative Cooling

Before we discuss the Coolerado Cooler, we should pause a moment to talk about the principles behind evaporative cooling. When water evaporates, it 'absorbs' heat from the surrounding air and lowers its temperature. However, the heat is still there – it has just been captured in the form of water vapor within the air (humidity). Conventional or direct evaporative cooling systems use this principle to provide cooling. The supply air is moved across a wetted pad and then enters the conditioned space. Although the air provided by these systems is relatively cool, it is also very humid and must be exhausted through ducts or open windows.



Direct Evaporative Cooling

Indirect evaporative cooling systems use a different approach. Unlike direct systems, the supply air does not come into direct contact with the water. Instead heat from the supply air is transferred to the outside air via a heat exchanger. This is accomplished in the following manner (please refer to the diagram below):



Indirect Evaporative Cooling

1) The surface of the heat exchanger is cooled by the evaporation of water within the working air stream.

2) The supply air is drawn across the heat exchanger. Heat from the supply air is transferred to the water vapor within the working air.

3) The cool supply air is delivered to the conditioned space.

4) The working air (and the heat contained within it) is exhausted to the outside of the building.

The process reduces the temperature of the supply air indirectly without adding moisture.

Wet Bulb Temperature

The effectiveness of evaporative cooling depends greatly upon the humidity or amount of water vapor in the air. Simply put, the drier the air, the more effective evaporative cooling will be.

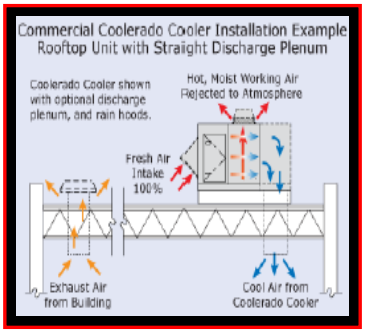
Air conditioning technicians often use a special thermometer known as a sling psychrometer to determine how much water vapor is present in the air. Essentially, this measurement involves placing a wet cloth (wick) on a thermometer and spinning the psychrometer until the water has evaporated and recording the lowest temperature obtained. This measurement is known as the 'wet-bulb' temperature. What is important to understand about wet bulb temperature is that it tells us what the theoretical lowest supply air temperature for evaporative coolers will be. For example, standard design conditions for residential cooling systems in Sacramento, California are:

- ❑ Outside air temperature: 101°F
- ❑ Wet bulb temperature: 70°F
- ❑ Desired indoor temperature: 78°F

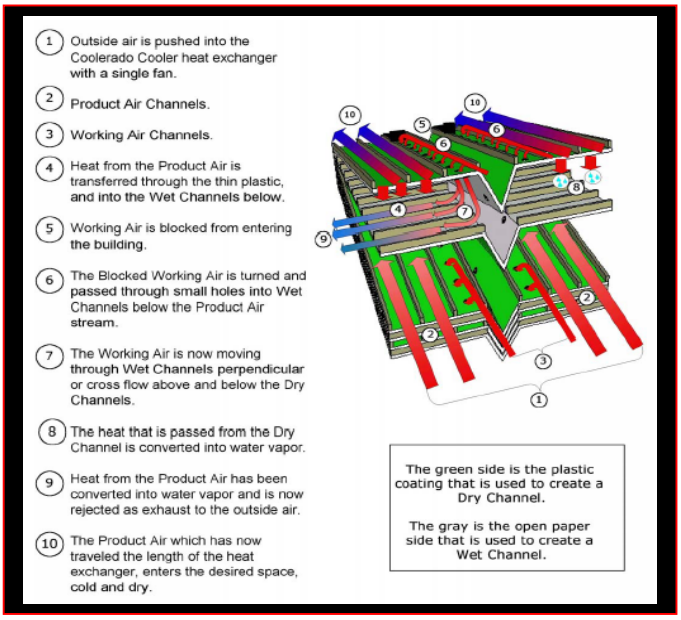
Under the conditions above, the lowest theoretical supply air temperature that a standard evaporative cooler could provide would be 70°F. However, realistically speaking, most evaporative systems would only be able to achieve 75°F. To put this into perspective, conventional refrigerant based air conditioning systems are designed to deliver supply air at about 55 to 65°F. The problem is that it is difficult cool a home or business down to 78°F by using air that is 75°F. To make matters worse, direct evaporative coolers increase the humidity within the house – making conditions even less comfortable.

What Makes the Coolerado Cooler Unique?

Unlike direct evaporative coolers, the Coolerado Cooler uses only *indirect* evaporative cooling. In this type of system, the supply air is cooled indirectly via a heat exchanger. As discussed earlier, this provides cooling without adding moisture to the supply air. However, what makes the Coolerado Cooler truly unique is that it uses a patented heat exchanger that actually cools the air **twenty times** before it enters the conditioned space. In essence this creates a 'cascade' effect that enables the Coolerado Cooler to cool the air ***below*** the ambient air wet bulb temperature.



The Coolerado Cooler's Heat Exchanger



Initial Test Results

So far, the Coolerado Cooler is performing as promised. On September 8, 2004, the following measurements were taken on-site at ABC School:

- ❑ Outside air temperature: 97°F
- ❑ Outside wet bulb temperature: 64°F (RH = 13%)
- ❑ Inside air temperature: 74°F
- ❑ Inside wet bulb temperature: 57°F (RH = 32%)

Although the Coolerado Cooler is indeed off to a great start, the real test will be to determine the performance and reliability of the system. Stay tuned for a full technology report in the fall of 2005! In the meantime, if you want to learn more, visit: www.coolerado.co.m

The Customer Advanced Technologies Program

SMUD's Customer Advanced Technologies (C.A.T.) program works with customers to encourage the use and evaluation of new or underutilized technologies. The program provides funding for customers in exchange for monitoring rights. Completed demonstration projects include lighting technologies, LED lighting systems, residential building shell construction, geothermal heat pumps, indirect / direct evaporative cooling, non-chemical water treatment systems and a wide variety of other technologies.

For more program information, please visit: http://www.smud.org/education/cat/index.html