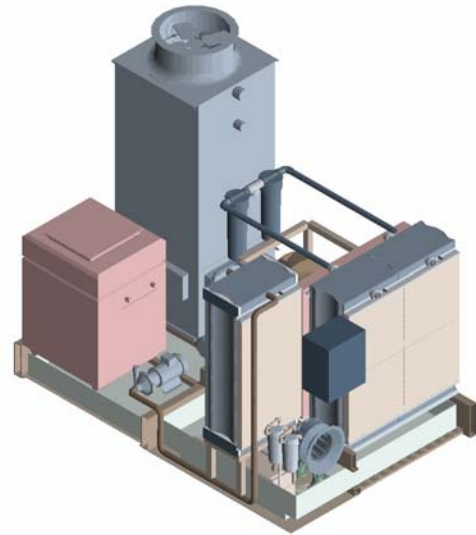


AIL Research

OA6000

A Liquid-Desiccant Dedicated Outdoor Air System



NEEDED: FRESH AIR WITHOUT THE HUMIDITY

In many ways, humidity is making people sweat today. When you are physically active, high indoor humidity can certainly cause beads of perspiration to form on your brow. But the problem is more serious. Indoor relative humidity above 70% is an ideal environment for the growth of mold, mildew and other undesirable organisms. Unlike perspiration, the health problems and property damage that these can cause cannot be solved by a simple shower.

Now, consider more general problems of indoor air quality. For many buildings, the latest ASHRAE standards for ventilation will require three times the fresh air that would have been adequate 15 years ago. These high ventilation rates purge noxious pollutants from the building. But, in humid climates, they can push indoor humidities to uncomfortable--and more importantly--unhealthy levels.

THE SOLUTION: AN AIR CONDITIONER DESIGNED TO DRY AIR

Conventional cooling systems--whether they use a DX or chilled water coil--are notoriously poor at meeting high latent (i.e., humidity) loads. These systems remove water vapor by first cooling air below the dewpoint. They have very limited control. If you need to dry air more deeply with a

DX or chilled water coil, you can in some cases reset the coil temperature lower or you can reduce the air velocity. In either case, your supply air will still leave the coil close to saturated. The net result is that unless some form of reheating is used, conventional systems cannot handle large humidity loads without overcooling the indoor space.

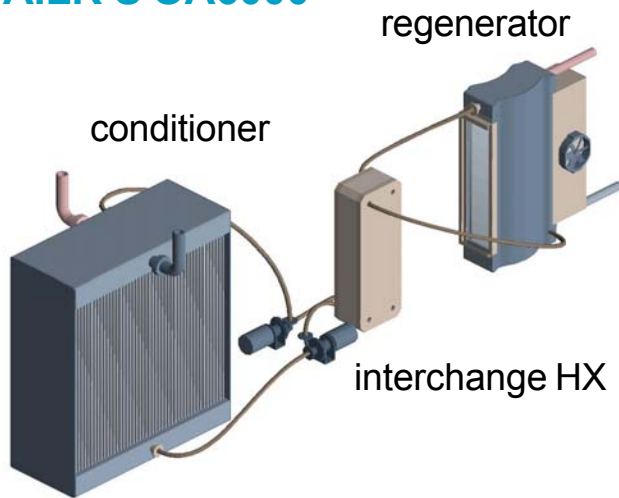
Desiccants, on the other hand, have a natural affinity for water vapor. They do not have to cool air in order to dry. Saturated conditions are avoided and indoor temperature and humidity can be controlled independently.

THE BENEFITS: HEALTHIER, MORE COMFORTABLE IN- DOORS PLUS...

When air can be more thoroughly dried without overcooling, indoor humidity can be kept at comfortable and healthy levels without the need for expensive reheat. In many applications, this benefit is reason enough to install AILR's OA6000.

But the gas-fired OA6000 will increase cooling capacity without appreciably increasing your building's kW demand. When electricity service is limited, the OA6000 may be the only solution. And, with on-site generators becoming more common, using their recoverable heat to run the OA6000 will keep even gas use to a minimum.

THE HARDWARE: AILR'S OA6000



The OA6000 is a packaged rooftop system that can dry 6,000 cfm of outdoor air from over 130 grains to under 55 grains. The OA6000 is a liquid-desiccant system, but one that is a dramatic improvement over all liquid-desiccant systems that have preceded it. Two differences stand out:

- the flow rates of desiccant in both the regenerator and the conditioner are 10 to 50 times lower than in systems now being sold, and
- these components are heat exchanges that allow the desiccant to be either continually heated or cooled.

These changes make the OA6000 the first non-engine thermally activated air conditioner that can compete with electric cooling systems in the rooftop market. Benefits include:

- Low desiccant flow rates eliminate the carryover of droplets without the need for high maintenance mist eliminators.
- Simultaneous cooling and drying of the air in the conditioner produce a much smaller system with very low pressure drops.
- Simultaneous cooling and drying also produce greater grain depressions. In many applications the entire latent load on the building can be met by over-drying the ventilation air. Cooling coils can be designed to run dry.
- Continuous heating of the desiccant as it is regenerated leads to high thermal efficiencies, even with regeneration temperatures as low as 160 F.

DG APPLICATIONS: ADD COOLING TO CHP

Searching for a way to use heat from an on-site engine/generator or fuel cell during the spring, summer and fall? The OA6000 can convert heat as low as 160 F to useful cooling and dehumidification for your building.

THE STATUS: OA6000 DEVELOPMENT

The OA6000 is the product of five years of development and approximately \$2.5 million of support from the U.S. Department of Energy, mostly through the National Renewable Energy Laboratory and Oak Ridge National Laboratory. An "alpha" prototype of the OA6000 was completed and run in the fall of 2003 under the government program.

AILR is now searching for sites where "beta" prototypes of the OA6000 could start operating in the summer of 2004 or 2005. In addition to the OA6000, beta tests will include:

- instrumentation for monitoring performance
- daily download of performance data for immediate reports on system status
- routine maintenance, and
- "quick response" correction of problems should they occur.

Beta testing is not for everyone. However, for some, the OA6000 could play an important role in their energy future. If you have an interest in:

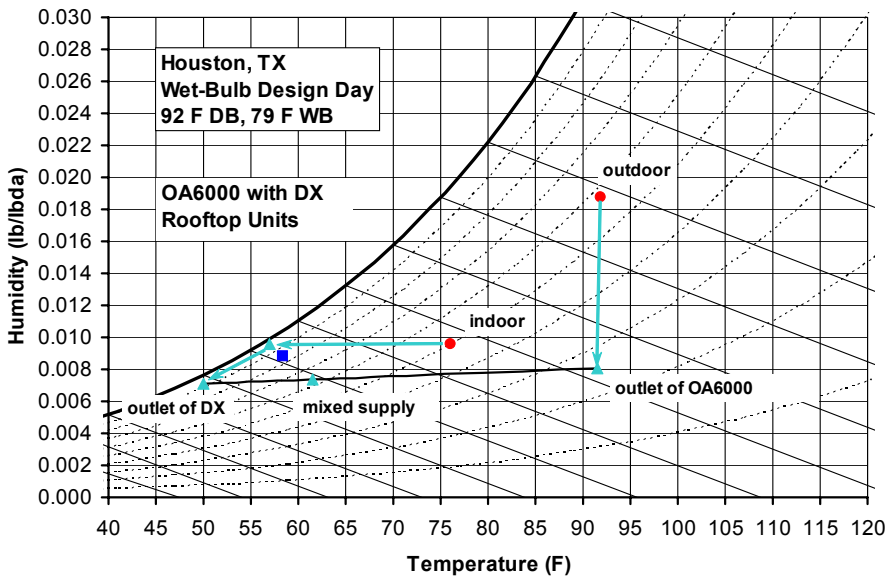
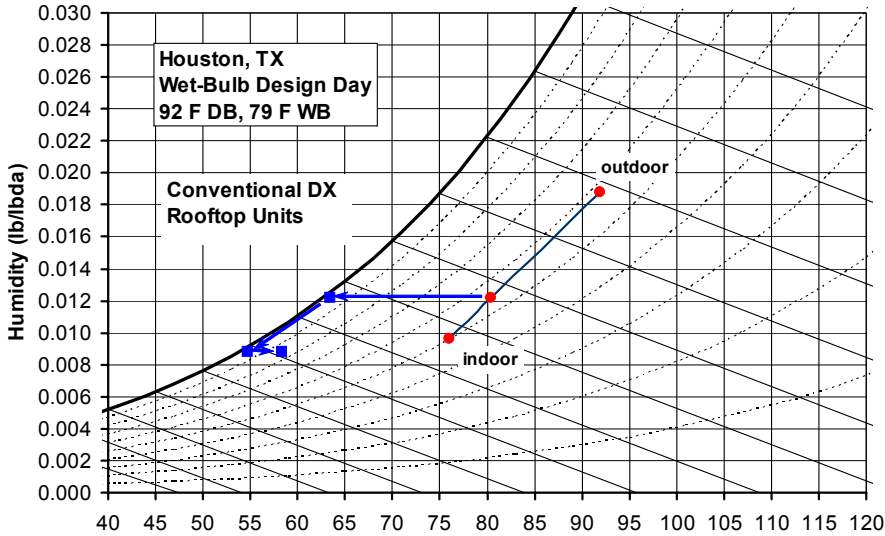
- marketing natural gas during the summer
- improving the competitiveness of Distributed Generation systems
- demonstrating a competitive solar cooling system
- reducing energy costs while at the same time solving problems caused by high indoor humidity for your portfolio of buildings

then we encourage you to explore your options by calling or e-mailing Andrew Lowenstein, 609-452-2950 x40, ail@ailr.com.



CASE STUDY - SCHOOL IN HOUSTON, TX

HOURLY SIMULATION OF DX AND OA6000



The alternative system uses the OA6000 to first process 100% of the ventilation air (see the second psychrometric chart). The return air from the building is conditioned by the DX rooftop units (although less tonnage is needed since they process only 72% of the recirculated air). The air streams from the OA6000 and the DX units are mixed and supplied to the school.

Results of the Case Study

- Without the OA6000, 8.88% of the latent load is missed, leading to periods of excessive humidity within the school. The missed latent load is less than 2% when the OA6000 is used.
- With the OA6000, the required DX capacity is reduced by 28%.
- Annual operating savings are \$3,838 (14%) when the liquid desiccant is regenerated using technology that is now available. In the next two years, an advanced regenerator will be available that will reduce gas use and, in this study, increase savings to \$8,254 (30%).
- Savings increase to about \$10,000 when the OA6000 uses heat recovered from an on-site generator.

	DX Tons	Missed Latent kBtu	Missed Latent %	Reheat & Regen therms	Comp Power kWh	Recirc Fan kWh	Fan Pump kWh	electric annual	gas annual	total annual
DX Base Case	116.1	76,980	8.88%	6,752	133,527	48,863	12,768	\$23,419	\$4,051	\$27,470
LD Precondition	81.9	15,344	1.77%	16,949	66,390	17,493	28,311	\$13,463	\$10,169	\$23,632
Advanced LD	81.9	15,344	1.77%	9,588	66,390	17,493	28,311	\$13,463	\$5,753	\$19,216

Assumptions for the Case Study:

- Study period is April 1 through October 31
- 36,000 cfm recirculated through the school
- 28% ventilation during occupied hours
- 1,989 ventilation hours during study period
- DX system sized for maximum dehumidification
- Utility rates are \$0.12 per kWh and \$0.60 per therm.

The conventional system uses multiple DX rooftop units to process a mix of return air and outdoor (see first psychrometric chart above). When necessary, an 80%-efficient gas-fired furnace or boiler reheats the supply air.

OA6000 SYSTEM SPECIFICATIONS

Conditioner

minimum air flow	4,000 cfm
nominal air flow	6,000 cfm
maximum air flow	8,000 cfm
cooling water flow	75 gpm
desiccant	lithium chloride
desiccant additives	none
desiccant flow	5 gpm
desiccant concentration range	40% to 44%

Performance at Nominal Air Flow

T Inlet F	Inlet grains	Inlet wet bulb	T Outlet F	Outlet grains	Water lb/h	Net Cool tons
95	118	78	91.6	55	245	24.4
95	99	75	88.9	47	200	21.8
86	146	80	91.2	63	320	26.5
68	102	68	76.6	42	232	16.5



Regenerator and Water Heater

nominal air flow	800 cfm
hot water flow	40 gpm
hot water temperature range	180 F to 200 F
gas service	500,000 Btuh
regeneration COP (includes 20% flue loss)	0.50

Cooling Tower

nominal water flow	75 gpm
air flow	6,200 cfm

Pumps and Fans

main blower	2,000 W
(sized for 1.5" w.c. external pressure drop)	
regeneration blower	200 W
cooling tower fan	1,500 W
desiccant pumps (2)	200 W (each)
cooling water pump	1,000 W
hot-water pump	750 W

Dimensions

height (with cooling tower)	98 inches
height (without cooling tower)	77 inches
width	80 inches
length	122 inches

Weights

shipping weight	4,100 lbs
operating weight	5,600 lbs

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