Reduce data center PUE using Munters innovative cooling solutions
In the last few years, several trends have emerged that have impacted the way that digital data are manipulated, stored and transmitted. There are three distinct trends:

• Tremendous increase in data transmitted, led by social networking, video, music, and voice transmission and cloud computing

• Ability of electronics to operate at higher temperatures

• Increase in IT equipment utilization by use of virtual computing which leads to greater power density per unit area of a data center

These trends place a greater demand on data center cooling systems. However, the cooling process now occurs at higher inlet and outlet temperatures, resulting in the emergence of a new breed of cooling systems. Engineers have identified several new energy-efficient solutions to manage the thermal loads in data centers. Each strategy has pros and cons, but the biggest dilemma faced by engineers and clients is deciding which one to use.

Munters simplifies this process by presenting the indirect air-side economizer, which has the potential to outperform current cooling strategies while offering some key system advantages.

With over 35 years of experience with air-to-air heat exchangers and evaporative cooling, Munters advanced cooling systems will provide the desired cooling results using significantly less energy than standard air conditioning.

Munters offers custom system designs integrating DX, chilled water, indirect and direct evaporative and economizer cycles to meet the specific requirements of any facility.

The indirect air-side economizer

The indirect air-side economizer (IASE) is a relatively new approach to data center heat rejection. It uses outdoor air to reject heat, with the outdoor air never entering the process or white space. The Oasis™ IASE uses an air-to-air heat exchanger (HX) to transfer data center heat to a separate outdoor airstream ("scavenger air").

Figure 1 (page 3) shows details of one type of Munters Oasis™ IASE system that uses horizontal polymer-tube heat exchangers.

Given this design, outdoor scavenger air is drawn across the exterior of elliptical tubes, which are wetted by a recirculation water pump.

Reduce data center energy costs by up to 75%

Traditional refrigeration cooling systems are an inefficient means of rejecting heat from modern data centers. With Munters Oasis™ Indirect Air-Side Economizer (IASE) and Wet-Bulb Economizer (WBE) products, the energy required to remove heat is significantly reduced. Munters systems use cooling/heat rejection strategies that achieve a balance of reliability and energy efficiency for data centers, some using as little as 20% of the cooling energy required by conventional cooling systems.

Current energy-efficient data center cooling options

Air-side economizers (ASEs), where outdoor air is used for “free cooling" during favorable ambient conditions.

ASE’s complemented with direct evaporative cooling (DEC) for humidity control and operation over an extended envelope of ambient conditions, referred to as Wet-Bulb Economizers (WBEs)

Water-side economizers (WSEs), where cooling towers or fluid coolers are used in a variety of design configurations to reject some, or all of the heat from the data center in combination with, or without, chilled water or DX cooling

Combination air and water-side economizers (CAWEs)

CAWEs complemented with DEC, referred to here as CAWE+D

Liquid-cooled enclosures (LCEs), sometimes referred to as In-Row or In-Rack Cooling, where cool water produced from a combination of chillers and cooling towers, or refrigerant, is pumped to heat exchangers installed directly within the server racks

The elliptical shape of the heat exchanger tubes maximizes the allowable surface area for heat rejection and is sufficiently elastic such that its subtle expansion and contractions, resulting from normal operation, aid in the shedding of residual solids that are a by-product of evaporation. With scavenger air flowing over the wet exterior tube surfaces, evaporative heat transfer efficiently cools the data center hot aisle air flowing through the inside of the tubes.

Although only 45% to 51% effective when operating dry, when the outside of the polymer-tube HX is wetted it operates with 70% to 80% wet-bulb depression effectiveness (WBDE) as an indirect evaporative cooler. WBDE is a measure of the approach of the hot-aisle dry-bulb temperature to the outdoor air wet-bulb temperature.

Using a 75% WBDE HX design, 100% of data center heat may be rejected solely using indirect evaporative cooling (IEC) if the following parameters exist:

• Ambient wet-bulb temperature is 66.2°F (19°C) or lower

• Hot aisle temperature (including recirculation fan heat) is 101.5°F (38.6°C)

• The target cold aisle temperature is 75°F (23.9°C)
Supply air temperature control

Supply temperature is controlled on Oasis™ IASE systems by varying the scavenger airflow in combination with staging or modulating supplemental refrigeration as required. Scavenger fan motors are equipped with variable speed drives. When the ambient wet bulb is high, the scavenger fans run at 100% of design, to achieve maximum heat rejection. At cooler ambient conditions, the scavenger fans throttle back significantly, rejecting heat using a fraction of the power required at peak ambient wet bulb conditions.

Supply fan speed control

Supply fans on Oasis™ IASE units are equipped with Variable Speed Control such that the supply airflow from the units can closely match the airflow of the IT equipment fans. Too much air delivered into a contained rack system is wasteful, and too little air starves the IT fans, which can lead to hot spots.

There are a variety of control algorithms currently being employed. Munters engineers work closely with the consulting engineers and customers to achieve the desired result.

Side stream filtration

A SSF system with MERV 13 filtration provides the necessary particulate removal in a more energy-efficient way compared to conventional air-handling designs. Figure 2 (page 6) For many data centers, the outdoor air (introduced by a separate makeup air system) is independently filtered with MERV 8 + MERV 13 filters.

The removal of air filters within the Oasis™ IASE units relieves a burden of what is typically estimated at 1-inch wc (248.8 pa) of pressure drop from these heat rejection work horses. This results in a significant reduction in power consumption amounting to at least 1.65 kW/10,000 CFM (assumes fan static efficiency of 75% and motor efficiency of 95%).

Since conventional air-side economizer units must utilize filtration (ASHRAE recommends MERV 8 + MERV 11 or 13 filters), the recirculating air Oasis™ IASE heat rejection units consume less supply fan power than air-side economizer units because the air pressure drop through the polymer-tube HXs is typically less than 1-inch wc (248.8 pa).
<table>
<thead>
<tr>
<th>City</th>
<th>Percentage of Total Tonnage picked up by IEC during ASHRAE 0.4% WB Design Condition</th>
</tr>
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<tbody>
<tr>
<td>Salt Lake City</td>
<td>98.8%</td>
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<td>Fort Worth</td>
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<td>73.8%</td>
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<tr>
<td>Guangzhou</td>
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*Note: TMY2: 100°F hot aisle, 75°F cold aisle*
Humidity control within data centers is one of many concerns for design professionals. A dedicated outdoor air system (DOAS), that provides humidification and dehumidification as required, should be used in conjunction with Oasis™ IASE units, as indicated in Figure 2.

Currently 0.25 air-changes-per-hour of ventilation air is recommended for data centers to prevent excessive build-up of VOCs and other pollutants that may be generated within the space. During cold, winter conditions, hot-aisle air from the data center may be mixed with outdoor air, allowing for energy efficient adiabatic humidification.

Using this method, no supplemental heat is required, since the heat for vaporization comes directly from the data center air. The preferred method of adiabatic humidification uses glass fiber wetted media and requires no special water treatment. Wetted media type humidifiers may be controlled by split-media staging or modulating face and bypass dampers around the evaporative media, as required to maintain room dew point at the lowest recommended level – currently about 40°F (4.4°C).

In humid climates, where ambient dewpoint frequently exceeds 65°F (18.3°C), it is recommended that the DOAS system include dehumidification capability. Dehumidification may be accomplished by inclusion of a DX or chilled water coil, or to achieve higher moisture removal efficiency, a waste heat reactivated desiccant or pre-cool air reheat system may be used.

Dehumidification systems should be designed to deliver air at 45°F (7.2°C) dewpoint, or lower as required, such that room dewpoint may be controlled to 60°F (15.5°C) maximum using the minimum outdoor air delivered as the sole means for dehumidifying.
Benefits of Oasis™ indirect air-side economizer

• Filters may be eliminated from some or all of the heat rejection air-handling units (AHUs) because the data hall air is recirculated and cooled with the Oasis™ IASE systems without introducing outdoor air into the data center. Particulate removal may be accomplished by using a side-stream filtration unit, or filters may be included in a portion of the Oasis™ IASE units, such that the room air is filtered at a rate of perhaps 6 to 10 ACH, leading to reduced filter, maintenance, and fan power costs compared to installing filters on all of the heat rejection units, which often have air turnover rates in excess of 100 ACH.

• Reduced risk of outdoor air pollutants adversely affecting the IT equipment because no outdoor air is introduced into the space by the heat rejection units. Space humidity and pressure are not impacted, resulting in the potential to lower humidification costs and maintain more stable moisture levels in the data hall.

• Makeup air units, with MERV 8 and MERV 13 filters, equipped with dehumidification and humidification capability as required by the local climate, provide the recommended ventilation (0.25 ach has been recommended as the minimum) and humidity control. Humidification may be accomplished using direct evaporative media with heat from recirculated hot-aisle air. Decoupling the MUA function allows the Oasis™ IASE units to be optimized for one task: heat rejection.

• Unlike water-side and wet-bulb economizer systems, Oasis™ IASE systems may operate dry during cooler ambient conditions, resulting in lower annual water consumption and eliminating freeze concerns. During dry operation, Oasis™ IASE systems are able to achieve 100% heat rejection when outdoor air temperature is below 48.5°F (9.2°C) using HXs that are 50% effective, or 66.2°F (19°C), using HXs that are 75% effective (based on a hot aisle temperature of 101.5°F (38.6°C), cooling to 75°F (23.9°C).

• Modulating mixed air dampers and relief fans/dampers are not required as part of the heat rejection cycle.

• Oasis™ IASE’s require about one-third of the water flow rate of conventional water-side economizer systems, and operate with less pump head, resulting in significant annual pump power savings.

• When integrated with indirect evaporative cooling, refrigeration capacity may be significantly reduced on Oasis™ IASE systems in virtually all climates.

• Oasis™ IASE units have a rapid restart after power outage with little delay reaching full heat rejection potential.

The Oasis™ IASE strategy is applicable to data centers across the globe and is not limited for use in areas perceived to be cold or dry climates. The Oasis™ IASE strategy may be used even when cooler cold-aisle conditions are desired. The 100°F (37.8°C) hot-aisle and 75°F (23.9°C) cold-aisle conditions are solely a point of reference, since modern data centers are designed to similar or more aggressive conditions. Clearly, the maximum benefit of the Oasis™ IASE strategy is derived when implemented with hot- or cold-aisle containment, with warmer hot-aisle and warmer cold-aisle temperatures.

Munters is a global leader in energy efficient air treatment solutions

Using innovative technologies, our expert engineers create the perfect climate for customers in a wide range of industries, with the largest being food, pharmaceutical and data center sectors.

Munters has been defining the future of air treatment since 1955. Today, manufacturing and sales are carried out in 30 countries by around 3,000 employees. Munters reports annual net sales in the region of SEK 4 billion and is owned by Nordic Capital Fund VII.

For more information see www.munters.com