

Commercial supermarket

SEIBU GIKEN DST

Moisture control in supermarkets

Commercial Supermarkets

Supermarkets are a complex environment and standard Air Conditioning systems are often not effective for the various store configurations. Humidity can effect refrigeration operation and customer purchasing decisions if the store is too cold or frozen products are not visible or iced up. Humidity is a hidden energy issue. Often over half the store energy is refrigeration and air conditioning, and designs based on first cost can leave a substantial energy legacy for the owner. Desiccant dehumidification offers an array of benefits to store operation energy and comfort, which can outweigh the initial investment.

Reduced Air Conditioning Coil Work

The design practice of (DOAS) Dedicated outdoor air systems with desiccants is now prominent with technology advancement and over 100,000 systems in commercial buildings.[ref AHRAE May 2008]

DOAS avoid humidity problems and save energy by removing the latent load of outside air, and over drying the outdoor air sufficiently (i.e. 5°Cdp or 30%RH @ 23°C) to absorb the store (moisture) latent load. This avoids the cost of dehumidification of the entire recirculated air stream..

Refrigeration energy

Up to 80% refrigeration case energy is consumed by the condition of the air around the evaporator, and ambient moisture is a significant component. Generally it can be said a reduction in store humidity of 10%RH would save 10% of case energy. (ref ASHRAE handbook 2003 2.3 (fig 1)).

Benefits to cases are:

- Reduced energy input
- Reduced latent load (ice) on evaporators
- Reduced defrost cycles.
- Reduce strip or anti fog heaters,
- Less ice and condensation on product
- Reduced product loss due to defrost,

Reheat Avoidance

Reheating of overcooled air is a traditional low cost practice to allow air-conditioning plant to dehumidify to dewpoint (ie 12°C) and re-heat the air back towards room temperature. Part load conditions often see ventilation loads creating a need for dehumidification but little or no sensible cooling, so overcooling is becomes more wasteful. This practice was restricted in 1999 and later banned in USA by building energy standard ASHRAE90.1 and countries like Australia have banned the use of electric elements for reheat.

Stores are often too cool due to the refrigeration case spill loads, the heaters are inclined to be on continuously to maintain comfort temperature neutralise the spill and over cooling.

A Supermarkets with electric reheat capacities of around 150kW and a continuously running heater element can cost $150 \times \$0.10/\text{kWh} \times 365 \times 24 = \$\text{US}134,000$.

Desiccant dehumidification offers an array of benefits to store operation energy and comfort.

Benefits of Dehumidification

- Reduce Supermarket Energy
- Reduce air-conditioning coil work
- Reduce refrigeration energy
- Avoid reheat efficient HVAC
- Better temperature & RH control



Better Temperature & RH Control

The effect of a desiccant dries the air to below 0Cdp (or 20%rh at 23°C) and 11-14°C temperature increase when regenerated with 50-60°C, and rise 25°C when reactivated with 120°C. This warm air can be distributed directly to the cold zone via under case or overhead supply, and as it is dry the case efficiency can be substantially improved. In central Air-conditioning systems, the sensible heat ratio (SHR) mismatch a supermarket has in summer is neutralised by having separate devices for sensible and latent duties, providing independent control capacity. Comfort and product visibility is improved in cold isles where premium product margins are available, and can also improve sales.

Reduced Plant Size

Due to the SHR being substantially different to that of what commercial air conditioning is designed for, the cooling plant is oversized to deal with the latent component. With standard operating temperature differences across cooling plant the recirculation airflow can be double what is needed. ie an operating scenario may have external latent load of 50kWR and internal latent of 50kWR, (ie 199kWR lat) and with total sensible of 100kWR a SHR of 0.5 results, where coils are only comfortably designed for 0.7. When a sensible credit of 100kW is considered a SHR would be 0. (ie often little or no need for cooling). ASHRAE makes comment on this plant size opportunity in ASHRAE HVAC Applications 2.4 where air changes for AC usually 5 l/s per m², and Desiccant systems are 2.5 l/s per m² of sales area. This saves construction cost of: steel work, ducting, air handling plant size, and circulation fan size and energy.

Technology

Desiccant dehumidification has had substantial application into supermarkets in humid climates due to operating and compliance requirements of the case manufacturers, and the inability of conventional HVAC to dehumidify effectively. With energy consideration now prevalent, the low first cost electric reheat systems are being responsibly designed out.

Seibu Giken DSTs range of FLEXISORB products fit the market needs with:

- High efficiency dehumidification, incl. plug fans and advanced D-Max Japanese desiccant rotor.
- Condensation free construction
- Robust base frame designed for better logistics
- External lock, improving internal maintenance
- One side service access for smaller footprint.
- Customized to suite differing needs of supermarket designs (handing, waste heat, gas, split DX, CHW)

Seibu Giken D-Max adsorption rotor technology has been a leader for many years with the invention of the Silica gel wheel, now offers the following advantages:

- Efficient drying process
- Washable
- Bacteriostatic
- Long service life
- High dehumidification capacity
- Mechanically strong
- Japanese quality and performance compliance

Relative humidity

Relative humidity is a measure of how much water there is in the air. A relative humidity of 50 % means that the air is half saturated with moisture. Relative humidity is also affected by temperature. With an outdoor air temperature of +20 °C and an ambient humidity of 60 % RH, ambient humidity rises to 100 % RH if the air is cooled to 12 °C.

Dewpoint

The relative humidity in the air increases when the temperature falls. When the relative humidity is 100 %, moisture starts to condense and forms dew. The dewpoint indicates the temperature at which the ambient

humidity has risen to 100 %. If the outdoor temperature is 20 °C and the relative humidity is 40 %, the dewpoint is 6 °C. At a temperature of 20 °C and an ambient humidity of 60 %, the dewpoint is 12 °C.

The dewpoint in outdoor air is lowest in winter, then rises during the summer and through until the autumn.

Some of our references:

Australia: Coles Supermarkets, Pendle Hill Independent

Czech Republic: Globus

Japan: Rotors used in various Supermarkets

United Kingdom: Asda Supermarkets, Washington,

Tyne & Wear, Tesco Supermarkets, Livingston



CONDENSATION

Condensation occurs on cold surfaces if the dewpoint of the air is higher than the temperature of the surface affected. Moisture after cleaning creates a climate whereby water vapour in the air condenses to form water, which may then drip down from the ceiling onto unpackaged products.



DECREASED ENERGY COSTS

With the Econosorb system there are much energy to be saved and hence also decreased energy costs. The Econosorb system uses only ca 1/4 of the energy consumption compared to a regular sorption dehumidifier.

Seibu Giken DST AB has representatives in more than 40 countries all over the world



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