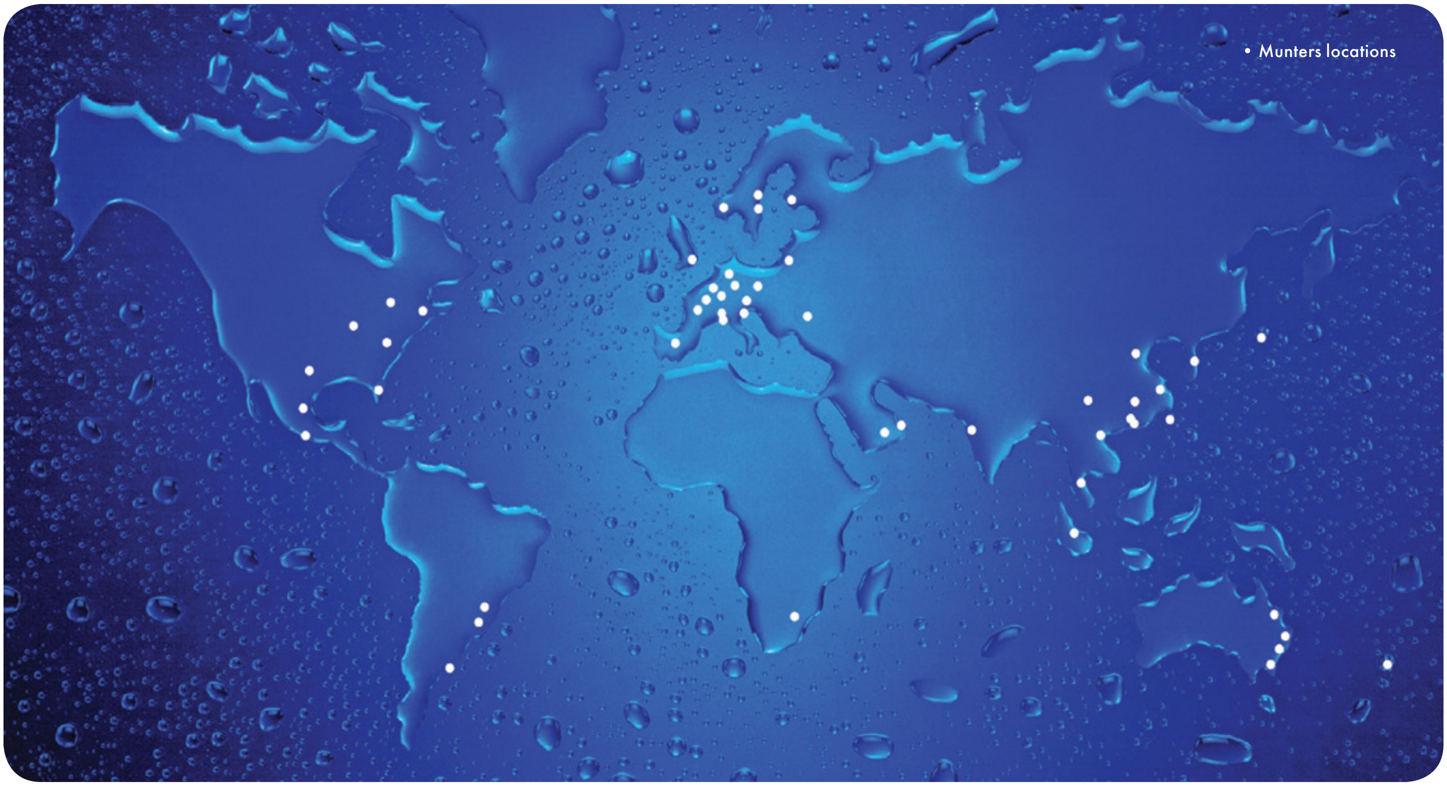
Cost-effective climate control for hospitals

Munters



Munters is the world leader in dehumidification

Munters is the largest manufacturer of dehumidifiers in the world. Since developing the first desiccant dehumidifier in the late 1930's, Munters has continued to innovate in the fields of dehumidification and energy recovery. Our long history and extensive expertise in dehumidification makes us the premier choice for your dehumidification needs.

Controlling humidity in hospitals is obviously important, but the fear of mold and bacteria is not what is truly driving the requirement for dehumidification equipment. Surgeons are demanding cooler, drier operating room conditions. Hospital administration has prioritized indoor environmental conditions not just for the safety of the patient, but also to improve the efficiency and quality of work life for the surgeon.

Many times surgeon discomfort is obvious. The multiple layers of clothing, face masks, hair covers, and protective gloves are uncomfortable as they trap in body heat and exacerbate perspiration. The key is to select the most efficient climate control technologies to eliminate wasted expense impacting operating costs. Given the current climate of product and/or service liability in the health care industry, and the close tolerance for indoor conditions specified by surgical equipment manufacturers, hospitals have to invest periodically in upgrades to existing HVAC systems or acquiring new systems altogether.

Our extensive knowledge and experience makes us the premier choice for your dehumidification needs.

Efficient ventilation solutions for hospitals

Hospital engineers are challenged with the daunting task of employing HVAC systems that provide the proper amount of fresh outside air, filtration, air changes, and temperature and humidity control. The proper selection and sizing of dehumidification equipment is critical for the HVAC system efficiency and basic hospital operation.

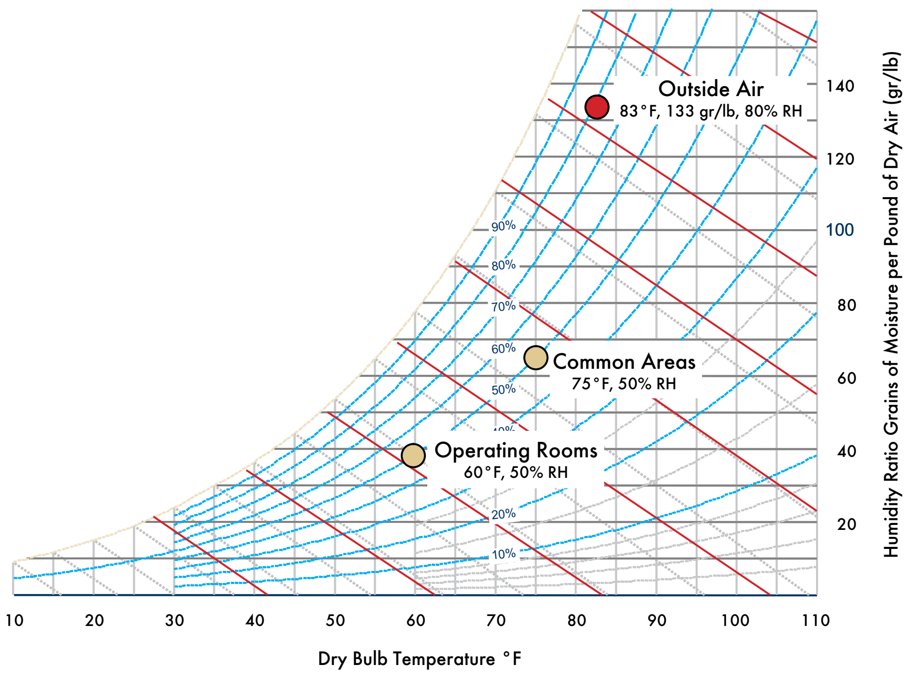


Figure 1: Hospital design conditions

Surgical operations that require cooler space conditions need substantially drier supplied air in order to maintain 50% space relative humidity. Common areas are generally maintained at 75°F and 50% RH, which equates to a 55°F dewpoint. Operating rooms are often maintained at 60°F and also must be kept at 50% RH, but this equates to a 41°F dewpoint. This exact relationship represents the difficulty in designing HVAC equipment to maintain cooler operating room conditions. Both set points equate to 50% relative humidity, but the cooler set point requires substantially drier air.

1. General comfort is significantly higher with RH maintained below 60%.
2. Perspiration issues are minimized with RH maintained below 60%.
3. Mold, mildew and fungi all feed on moisture.
4. Higher relative humidity increases the likelihood that condensation and fogging will occur on magnifying lenses and polished metal working apparatus.

Condensation prevention

In hospital environments, it is critical that condensation be prevented.

Computers, electrical machines and lighting all create high cooling loads. In order to offset these loads, cold air is conveyed throughout the building to maintain space temperature set-points. Ductwork, distribution grills and any adjacent surfaces will be cooler than air temperature set-point and will be areas of condensation formation if the temperature of the surface is below the space dew point.

Ventilation air represents the largest potential for introducing unwanted moisture into a space. For example, in Greensboro, North Carolina, each 1000 CFM of fresh air represents 7.1 gallons per hour of water relative to space set-point of 60°F / 50% RH. Conventional equipment that heats and cools air can remove some of this moisture if the cooling load is high enough. TMY weather bin data indicates 3623 total hours in Greensboro, NC where the ambient dewpoint is above 55°F. The ambient temperature is below 75°F 2,418 of these hours. 66.7% of the dehumidification season is cool and wet simultaneously. During these times, conventional equipment will be off, or cycling on and off. This is the reason why the use of thermostat controlled conventional equipment commonly results in a building with high relative humidity, condensation and mold issues. A simple solution for maintaining accurate humidity levels in the building is to control dewpoint in addition to controlling temperature. By utilizing dewpoint control the indoor environmental conditions will be more manageable.

OA pre-conditioning design guidelines:

1. Positively dehumidify all makeup air to required dew point.
2. Account for internal latent load. People load, open water and infiltration all represent internal sources of moisture. Dehumidification equipment must supply air with a lower dewpoint than the desired space dewpoint to support these internal loads- similar to cooling equipment that must support loads from solar gain, lighting motors, by delivering air cooler than the space temperature.
3. Reheat is required to prevent over-cooling the space. This is especially critical for operating room applications (considering the conventional method for achieving 40°F dewpoint is to over cool the air to 40°F). Reheat location can differ based on the hospitals needs and/or to prevent duct condensation, but applying reheat at the site of the AHU restricts the individual control of conditions in surgical suites.

Low-temp chiller approach

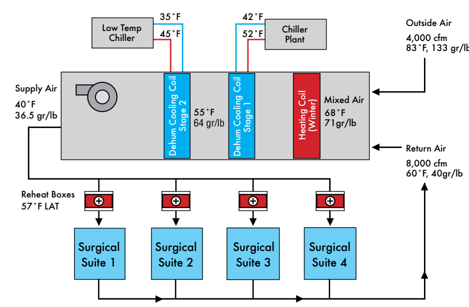
The low-temp chiller approach for dehumidifying operating rooms is to mix ventilation air with return air and then cool the entire air stream to 40°F.

Since 40° F supply air can not be achieved utilizing typical chilled water, this is generally a two step process. The first stage uses normal chilled water; for example, 42°F that cools partially toward the 40°F air temperature goal. The final stage utilizes a lower temperature chilled water/brine mixture to achieve the necessary 40°F air. Because this air is too cold, reheat is applied as needed at each zone to maintain temperature set-point. To simplify this approach, designs often use a one stage approach where the entire dehumidification process is accomplished with one large coil served with 35°F water/brine mixture.

Challenges with this approach are:

1. A low temperature chiller has a 20% first cost premium compared to an equivalent tonnage standard chiller.
2. The KW/Ton is approximately 22% higher for a low temperature chiller vs. an equivalent tonnage standard chiller.
3. 40°F is the lowest dew point that can reasonably be achieved without the risk of freezing the chilled water coil. All of the air must be cooled to this dew point to achieve the desired space humidity and substantial sensible cooling must be consumed before any moisture is condensed.
4. Substantial reheat energy is required to prevent over-cooling of served areas.
5. Either a separate chiller is required or the whole chilled water system needs to be low temperature type.
6. Conveying cold saturated air from the main air handler to reheat boxes will challenge insulation to prevent condensation on duct exteriors.
7. Any apparatus, such as filters, will create condensate down stream of the chilled water coil. Saturated air moving across any pressure loss device will condense.
8. 35°F water/brine mixture requires better piping insulation package in order to prevent condensation.
9. 35°F water/brine mixture has a higher probability of leaking at connection areas.
10. The air handler system for the low-temp chilled water approach should include construction that limits through metal from the inside to outside. If mounted inside or outside, the air handler surrounding dewpoint will often be higher than 40°F, and any through metal area will sweat profusely. Air handler door frames, wall panels and through connections should include a thermal break. This construction is not conventional and will be more expensive compared to a typical air handler.

Figure 2: Low-temp chiller approach



Microbiological growth

Many bacteria flourish in humid air. According to a study done by Pennsylvania State University, the bacteria responsible for Legionnaire's disease (Legionella pneumophila) survive best at a Relative Humidity of 65%. At 35% RH, the bacterium dies quite rapidly. Many viruses also thrive in high humidity. The Polio virus not only survives, but multiplies when air is above 80% RH. Fungi and dust mites also thrive in humid building materials, which can lead to musty odors and respiratory problems associated with sick building syndrome. The high humidity in ductwork downstream for cooling coils is, unfortunately, an ideal environment for these organisms.

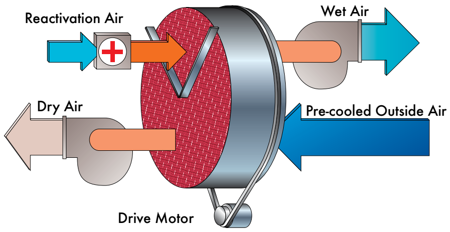


Figure 4: Desiccant dehumidification approach

Desiccant dehumidifiers

Desiccant dehumidifiers utilize a desiccant wheel to provide dehumidification of the supply air. The operation of a desiccant wheel is based on the principal of sorption. Sorption is the adsorption or the absorption process by which desiccant removes water vapor directly from air. Most commonly, desiccant is embedded within a rotary bed (rotor or wheel). The wheel is split into two sectors; the supply air stream and reactivation air stream are continuously rotated in order to provide the dehumidification process. Once the wheel absorbs moisture, the moisture must be driven off of the wheel during a "reactivation process." The desiccant wheel rotates into a secondary air stream (reactivation air) where water vapor is transferred to heated air, and exhausted.

Reactivation temperature can range from 110°F to over 300°F depending on application. Generally, the drier the air requirements, the warmer the reactivation air must be. As supply air is dried through the desiccant, it is simultaneously heated.

For example, 55°F saturated air (64 gr/lb) entering will leave at 97°F and 29 gr/lb. Rotor speed is generally eight revolutions per hour. Most of the heat associated with the drying process is converted latent energy.

Desiccant approach

Desiccant technology is widely viewed as the most viable method to generate air lower than a 45°F dewpoint. In fact, for applications requiring dewpoints below 35°F, desiccant dehumidification is the most reliable and modern approach utilized.

Since hospital applications require cooler temperatures and lower dewpoints, desiccant technology is an optimal method to achieve operating room conditions and helps reduce the cost of equipment investment.

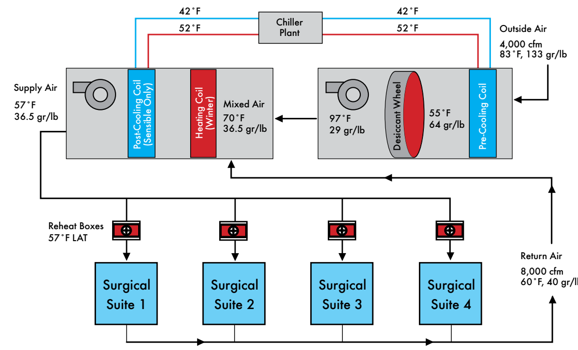


Figure 3: Desiccant dehumidification approach

Note the following:

1. The cost to operate a desiccant approach will be approximately 40% less then the low temp chiller approach.
2. Desiccant pre-cooling and final post cooling requirements are achieved using standard temperature chilled water. The added cost for a special low temperature chiller is removed. The inefficiency associated with a low temperature chiller is also removed.
3. Since desiccant dehumidification can easily achieve dewpoints lower than 40°F, only a portion of the total supply air only needs to be dehumidified. This allows for greater system design flexibility. In this example, only the outside air requirements are dehumidified. All the work associated with sensibly cooling the supply air to dewpoint is removed from the equation.
4. Cooling fluid is warmer reducing the chance for pipe condensation.
5. Cooling fluid does not require brine mixture, removing the added propensity for leaks, and removing the cost of maintaining correct fluid chemistry.
6. Supply air is not over-cooled dramatically reducing the reheat energy required at each zone.
7. Conveyed air is not cold and saturated, which reduces chance for duct condensation, and condensation across pressure loss apparatus within the supply duct.

Conclusion

The medical industry is advancing at a quick pace, and so are the dehumidification technologies. It is critical that design engineers identify the required space temperature and dewpoint conditions to determine what dehumidification equipment will meet the needs of the hospital. When choosing the equipment, in addition to precise space condition control, engineers should also consider methods to improve the total operation of the hospital. With increased utility costs, design engineers are opting for more reliable and energy efficient dehumidification options. Dehumidification of surgical suites is achievable with many technologies, but with the growing demand for colder and drier operating rooms, selecting the proper equipment is more important than ever. Choose equipment wisely, it is not only important for the hospitals bottom line- your life may depend on it.

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.

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AG0002-05 01/14