Meeting the challenge of Standard compliance and energy cost reduction

Outdoor air ventilation seen as a means to curb incidents of hospital acquired infection (HAI).

BY STEVE ULM

The healthcare industry is at a crossroads with the increased incidence of hospital acquired infections (HAI) and the HVAC industry has the solution. HAI statistics spell a sense of emergency. One in every nine patients acquires HAI once entering a Canadian hospital, according to the Canadian Union of Public Employees (CUPE). This has resulted in 220 000 incidents and 8500 to 12 000 patient deaths annually in Canada.

To offset the trend, hospitals worldwide are looking to reduce the HAI trend via 100 per cent outdoor air HVAC systems in an air replacement strategy. A minimum of two times per hour, the entire air volume in a hospital can be replaced by introducing 100 per cent outdoor air, and in turn, exhausting interior air along with any of its potential airborne contaminants. Specialty areas, such as surgical suites, may require additional air changes.

Air replacement is a viable strategy, but it is cost-prohibitive to dehumidify, heat or cool a huge volume of air that can surpass one million CFMs in large facilities. Facility engineers walk a tightrope of reducing operational HVAC energy costs while also complying with ANSI/ASHRAE/ASHE Standard 170, Ventilation of Health Care Facilities.

Furthermore, the challenge for hospital management is to maintain code compliance even though relative humidity (RH) levels between rooms such as a corridor, patient room and surgery suite, for example, can vary. Regardless of safe design precautions such as controlling air changes and a room's negative or positive pressurization, and so on, moisture will migrate from room-to-room, because of its infinity toward a drier space. Controlling the RH in each space makes it easier to control the various vapour pressures and moisture migration into other spaces.

CUTTING EXPENSES

Energy recovery ventilation (ERV) units have many advantages for cutting the expense of dehumidifying, cooling and heating outdoor air.

ERVs that dehumidify outdoor air, for example, can significantly reduce a building's air conditioning load. Dehumidification can be accomplished through mechanical, desiccant or a combination of both methodologies. Mechanical refrigeration coils condense moisture from the air whereas a desiccant-based strategy adsorbs moisture with desiccant wheels.

Heat recovery is also an ERV advantage, because of the significant energy cost reduction potential. ERVs can use exhaust air to preheat or pre-cool the outdoor air before it is conditioned for a set point such as 22C (72F). For example, heating -23C (-10F) outdoor air in January to 22C (72F) is a significant expense. However, using 18C (65F) exhaust air to preheat the outdoor air will deliver significant savings.

Enthalpy wheels are ideal for heat recovery, but in hospitals, the wheel's desiccant media choice–typically silica gel or molecular sieve material–is critical for preventing the incoming outdoor air from residual contamination from the outgoing indoor air.

Silica gel has a propensity for cross contamination because its pores can adsorb and harbour contaminants from the exhaust air. This can also decrease latent heat transfer. Molecular

This conventional cooling, active desiccant dehumidification system delivers and controls low dew point air while minimizing regeneration energy input. Designed for hospitals, archival storage and hotels, the AHR Innovation Award winning unit delivers supply air humidity levels as low as 15 grains. Since exhaust heat recovery is not needed, the unit is suited to applications requiring 100 per cent outdoor air.

sieve materials, on the other hand, are not susceptible to contaminant adsorption, because the smaller pore size only allows the transfer of the water vapour from the exhaust to supply air streams.

In winter, when outdoor air is uncomfortably below 30 per cent RH, humidity collected from the exhaust air can be added to the supply air to raise indoor RH levels. Obviously, it is critical to not contaminate outdoor air with indoor contaminants during the humidification process, because of HAI concerns.

To further minimize cross-contamination, desiccant surfaces can be specified with anti-microbial coatings to help prevent airborne biological contaminants from harbouring in the media.

SPECIALTY CONCENTRATION

Other hospitals are using energy recovery and humidity reduction in critical areas, such as surgical suites, which typically demand very low dew point temperatures C (42F) and drier air, as per ASHRAE 170 requirements. The trend is to design operating rooms (OR) with their own self-contained system to avoid contact with air from other parts of the hospital.

Conventional enthalpy equipment typically cannot handle such low dew points; however the HVAC industry has recently developed alternative dehumidification strategies that utilize an active desiccant wheel to dry out the air to very low levels. These systems bring in outdoor air and use a cooling coil that reduces the temperature to approximately 12C (55F), and then an active desiccant wheel takes the saturated cooling coil's moisture and dehumidifies it by adding heat.

The dried air leaves the wheel in the 26C (80F) range, but at a -1C (30F) to 4C (40F) dew point temperature. The air can then be fed to conventional air handlers for the space's sensible cooling. These systems deliver dry air on the ventilation portion only and decouple (remove) the humidity from the space with just the outside air portion. Another attribute is no cross-contamination between the indoor and outdoor ventilation during heat recovery. The ventilation is only 20 to 30 per cent of the total air volume, so moisture removal is handled energy efficiently.

Many hospitals are currently retrofitting operating room HVAC systems to comply with ANSI/ASHRAE/ASHE Standard 170 requirements for humidity control. This may require either adding a dedicated outdoor air dehumidifier (DOAS) to the operating room's air handler, or replacing the air handler with a DOAS that performs dehumidification and controls space heating/cooling.

The next decade will see hospitals adding improved moisture control combined with energy recovery to control operation expenses and to provide healthier patient IAQ environments.

CANADIAN CASE IN POINT

A hospital poised to serve as a role model for future 100 per cent outdoor air applications is Montreal-based Centre Hospitalier de l'Université de Montréal (CHUM). It will be one of the largest hospital additions in North America with more than 2.5 million square feet when it is completed later in this decade. Instead of using a code minimum amount of outdoor air that is typically well below 50 per cent, as is the case with most hospitals, the mega-project will use mechanical HVAC system enthalpy wheels to reduce moisture in its 100 per cent outdoor air, 2.8 million-CFM design.

Offsetting the significant energy costs of this IAQ strategy will be 47 molecular sieve enthalpy wheels that recover heat from the exhaust air, but without cross-contaminating the outdoor air with both biological and volatile organic compounds (VOC) indoor contaminants. The same enthalpy wheel types will also reduce the cooling load and energy costs by dehumidifying high RH outdoor air before conditioning it. Keeping indoor humidity below 60 per cent RH (specifications require 20 to 60 per cent) will minimize airborne microbial procreation.

Because of Montreal's seasonably dry winter air, indoor moisture recovered by the enthalpy wheels will also pre-treat outdoor air to raise RH, instead of exhausting it outside. This safeguards against low indoor RH levels that can dry out human olfactory systems and increase illness susceptibility.

Aside from the estimated millions of dollars in energy savings over the operational life of CHUM, the system will also help the project attain a Leadership in Energy and Environmental Design (LEED) silver certification. The downsizing of mechanical equipment due to the energy recovery strategy and other sustainable efforts expects to displace approximately 40 000-tons of carbon emissions annually. Furthermore, an estimated 55-million litres of cooling tower water will be saved annually due to cooling system reductions.

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