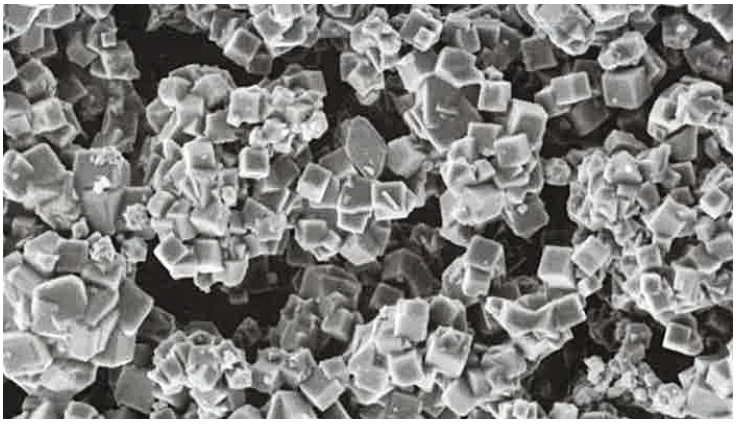
Consider the total picture

Canadian ERV wheel retrofit and specification must consider RER, frosting and maintenance.

BY LEN KOBYLUS



Close-up of absorbant molecular sieve desiccant material.

Canadian HVAC contractors will replace tens of thousands of enthalpy wheels within the next five years. The replacement candidates are rotary air-to-air heat exchangers that have surpassed their useful lifecycles. They are found in packaged rooftop and supplemental dedicated energy recovery ventilators, which were introduced to the Canadian market in the last 30 years.

If the HVAC service contractor selects a wheel replacement based on price rather than total performance, commercial building clients may not get the best overall value. Enthalpy wheels are decidedly different from each other in static pressure efficiency, maintenance and condensation frosting prevention. The latter is an extremely critical challenge in Canada's cold climate.

Proper selection is even more important due to the recent development of drop-in replacement unitary wheel cassettes. Replacement wheels no longer need to be the same OEM (original equipment manufacturer) model that came with the HVAC system. The cassettes are made in several matching replacement wheel diameters and come pre-packaged with an inverter duty motor and industrial-type drive belt that simplifies and speeds up installation.

A vast majority of existing unitary equipment wheels specified for the Canadian new construction market in the last 20 to 30 years have an OEM plastic or polymer film-type of wheel. Polymer-based wheels were preferred decades ago because of their lower cost. Recently, wheels with aluminum and other substrate materials have become more competitively priced, according to Ed Carney, partner, at Mississauga, ON-based, Kilmer Environmental.

Carney believes service contractors and consulting engineers should consider higher performance metal wheels as an alternative to a plastic wheel replacement. Furthermore, on new construction specification, metal wheels should be considered and compared for total performance when ERV manufacturers offer different OEM wheel options.

Technological advancements in enthalpy wheels in the last decade offer energy-efficiency (via reduced fan power), improved frosting prevention and maintenance savings that can equate to tens of thousands of dollars over its lifecycle.

RER EQUALS ROI

The larger flute openings seen in aluminum wheels with molecular sieve desiccant create a non-turbulent laminar flow that allows particles to pass through without accumulation within the wheel media. The aluminum media can also have an anti-stick surface coating applied to both sides of the wheel to further prevent particles from accumulating and plugging the wheel in highly polluted air streams.

Other options may collect more dust and debris, resulting in reduced air flow and higher maintenance costs to clear static pressure-robbing air flow blockages.

A wheel replacement selection should be calculated for recovery efficiency ratio (RER), according to the Air Conditioning, Heating and Refrigeration Institute's (AHRI) Guideline V *Calculating the Efficiency of Energy Recovery Ventilators and Its Effect on Efficiency and Sizing of Building HVAC Systems.* The RER takes into consideration the efficiency and the static pressure of a desiccant wheel replacement.

Intended for service contractors, engineers and building owners, Guideline V provides a means for calculating the impact of applied energy recovery equipment on the energy efficiency of the HVAC system at a single selected operating condition.

More simply, the calculations comprehensively take a host of factors into consideration, such as geographic climate, fan/motor efficiency, exhaust air transfer ratio (EATR), pressure drop, energy recovery methodology, and many other parameters. Guideline V also allows service contractors or their manufacturer representatives to calculate ERV wheel comparisons and arrive at a comprehensive savings for heating and cooling.

Contractors who calculate BTUs transferred divided by the number of watts used will be surprised at the RER difference between wheels. For example, energy recovery wheels of

equal diameter at an air flow of 5000-cfm may offer the same total effectiveness but one wheel may have a lower static pressure of 0.28-inches w.g. This lower static pressure drop results in a higher RER for both the cooling and heating seasons. Although both wheels have identical filters, some wheels require higher efficiency filters to prevent the wheels from plugging due to airstream particulates. This will result in a higher static pressure loss and an even greater RER difference between wheel types.

Generally, the annual savings when choosing a wheel that delivers less static pressure could be up to $100 per 1000-cfm. That sum can rise significantly to the $20 000 range, for example, when considering a 200 000-cfm building ventilation system, depending on the geographic location, climate and other variables.

It is not just efficiency, but both efficiency and static pressure combined that will provide the greatest return on investment (ROI).

FROSTING IS A MAJOR CHALLENGE

Since total enthalpy wheels adsorb moisture from the airstream, frost accumulation on a wheel may damage it. In addition, airflow may be blocked resulting in an increase in static pressure and reduced efficiency. Furthermore, many wheel models (both new and retrofit) have a higher sensible than latent efficiency, which presents a higher dew point saturation temperature on the psychrometric chart and greater frosting potential.

Aluminum wheels are designed to handle temperatures as low as -26C (-15F) without frosting because exhausted water vapours will be transferred back into the supply airstream. This has two benefits: firstly, the exhaust air becomes drier with a lower dew point saturation temperature; and secondly, wintertime humidity for the space is reintroduced. This minimizes the need for humidification from an additional HVAC component, which can be expensive to operate.

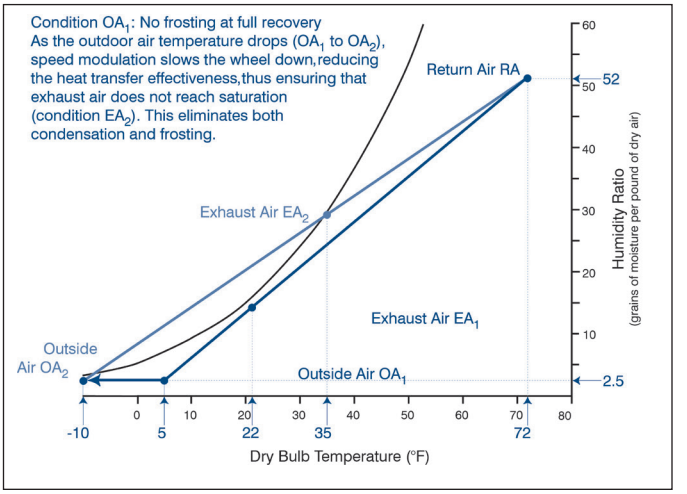
Solutions to frosting are wheel-speed modification, electric pre-heat, or a total bypassing of the energy recovery process by exhausting and using electric heat during extreme low temperatures. The latter defeats the whole concept of wintertime energy recovery.

Preheating can be an energy-efficient approach to avoid wintertime frost formation when moisture conditions are above 30 per cent relative humidity (RH) and temperature is frequently below -26C (-15F). The total energy wheel can operate at full recovery on very cold days, thereby providing for maximum humidification recovery. Reducing the wheel speed to cut temperature recovery also reduces the latent recovery.

The required preheat temperature is determined by:

1. Locating the return air condition on a psychrometric chart;
2. Drawing a line tangent to the saturation curve;

Figure 1 Determining frosting potential



3. Connecting to the heating design outdoor air humidity content;
4. Reading the dry bulb intercept value, as shown in *Figure 1*, line RA-OA_1 (return air-outdoor air); and
5. Preheating the outdoor air to the dry bulb intercept value, as shown by *Figure 1* line OA_2-OA_1.

Controlling wheel speed to avoid frost formation is a better choice when: heating season humidification is not provided, conditions are below 30 per cent RH during cold days and the total number of hours below -26C (-15F) are infrequent.

The dew point control set point is determined by:

1. Locating the RA condition that exists when the winter outdoor air design condition is reached;
2. Plotting the RA point on the psychrometric chart and draw a line between it and the winter design point;
3. Determining the higher dry bulb temperature at which this line intercepts the saturation curve (exhaust air (EA), on *Figure 1*);
4. Adding 1.1C (2F) to this temperature and this becomes the control (winter) set point;

Besides frosting, condensation formation is also detrimental to IAQ because exhausted water-soluble contaminants will be transferred onto the wheel's media and re-introduced to the space.

Today's technological advancements in rotary wheel air-to-air heat exchange offer vastly different options than 10 years ago. Contractors and consulting engineers faced with wheel replacement or a wheel OEM option in new unitary equipment can provide a better service to their building owner clients by considering RER, better frost prevention and reduced maintenance when selecting a total enthalpy wheel. <>

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