

PRODUCT APPLICATION GUIDE

A technical bulletin for engineers, contractors and students in the air movement and control industry.

Gaseous Carryover and Cross Leakage in Energy Recovery Wheels

There seems to be a certain degree of confusion in the industry as to what measures are appropriate to limit gaseous carryover and cross leakage of energy recovery wheel products. Of course, gaseous carryover and cross leakage is something that we would like to limit. The question is “what amount of leakage is acceptable?” Is 5% acceptable or do we need to approach 0% leakage. The answer will be based primarily on what space the exhaust air is coming from. For simplicity, let’s break the exhaust air space into two categories.

- 1. Industrial type:** Includes industrial process ventilation where exhaust air contains a wide variety of contaminants. Lab fume hood exhaust also falls into this category.
- 2. Commercial/Institutional type:** Includes comfort ventilation applications in buildings such as schools, offices, nursing homes, theaters, etc.

Industrial Process Applications

For many industrial process applications that use energy recovery, carryover and leakage should be limited to less than 1%. The exhaust air contaminants may be toxic and/or in concentrations high enough to create undesirable air quality if transferred into the supply air stream. To reduce the carryover and leakage of wheels for industrial process applications, two primary technologies have been developed for energy recovery wheels.

One technology that helps reduce the carryover and cross leakage associated with energy wheels is a purge sector. Purge sectors minimize cross leakage by shunting a portion of the supply air back into the exhaust air stream. With properly designed and maintained seals, a wheel with a purge sector is capable of limiting cross leakage to less than 1%.

The trade off is that the purge sector adds cost to the product, increases maintenance and “wastes” the power required by the system to purge the 10% to 20% of supply air volume.

The other technology that has the potential to limit gaseous carryover is the molecular sieve desiccant. The molecular sieve is designed to selectively adsorb species based on kinetic diameter. For example, a 10 A molecular sieve is designed so that it will not adsorb species with molecule sizes larger than 10 A. This feature may be important for some industrial applications.

Commercial and Institutional Applications

For comfort ventilation applications in commercial and institutional buildings, blindly using the features of a product designed for industrial applications does not make sense. To evaluate whether or not the features are appropriate, let’s take a look at the issues facing comfort ventilation.

The fundamental reason why we ventilate commercial and institutional buildings is to prevent the unacceptable build up of gases such as carbon dioxide, bioeffluents, furnishing/office equipment off-gas, etc. This method of providing acceptable indoor air quality simply involves delivering enough outdoor air to the occupied space to sufficiently dilute the undesirable gases. This is an important point. Our goal is to **dilute** these gases, not completely **eliminate** them.

Even manufacturers that promote the use of purge sectors and molecular sieve desiccants recognize this concept. For example, Semco’s FV series commercial energy recovery ventilator product is sold **without** a purge sector. Semco also downplayed the significance of their 3 angstrom

molecular sieve for comfort ventilation applications in their article titled “SEMCO Reinvents the Wheel for Better IAQ”. Semco states:

Few molecules are smaller than the 3 angstrom holes in the sieve, but of those that were able to pass through—like carbon dioxide, increased amounts of which are said to contribute to lethargy—their concentrations were significantly reduced by the increased flow of fresh air.

In other words, for commercial and institutional comfort ventilation applications, controlling carryover and leakage is not nearly the critical issue it may be for industrial applications. In fact, as long as the leakage rate is not extremely high (say above 10%), the impact of carryover and leakage becomes insignificant compared to the dilution of the space by fresh outdoor air.

Now let’s consider the basic requirements for commercial energy recovery ventilators. In a survey of over 200 engineers in the U.S., the top three requirements were:

1. High energy transfer efficiency (particularly with respect to moisture transfer in the eastern half of the U.S.)
2. Economical first cost
3. Low maintenance

With this in mind, an energy recovery ventilator designed specifically for comfort ventilation would not include a purge sector because any value it may add is heavily outweighed by the increase in first cost, operating cost and maintenance. No purge sector and cross leakage of 5% is preferable. Also, to maximize latent energy transfer the desiccant of choice is **silica gel**.

Summary

When selecting an energy recovery ventilator, it is important to understand the intended use of the product. There are applications that are sensitive to the amount of carryover and cross leakage between air streams. In these cases, the consulting engineer may choose to specify product features that are designed to maintain an uncontaminated supply air stream. However, for most commercial and institutional buildings, purge sectors are really a misapplication. And while a molecular sieve desiccant will work fine for comfort ventilation applications, it is not as good at transferring moisture from humid summer air as a silica gel desiccant.

Keep in mind that some energy wheel manufacturers started out solely focused on the industrial market. Today they are still preaching the benefits of their original product, even though the benefits don’t apply to the commercial market. This activity is understandable; the market is competitive and they are trying to differentiate themselves. The point that cannot be stressed enough is:

The commercial market has specific requirements of energy recovery ventilators. For the good of the industry, let’s place the emphasis on the right features.