NEW VENTILATION STANDARDS FOR INDOOR AIR QUALITY (IAQ) *vs* ENERGY CONSERVATION: ENTHALPY WHEELS MEET THE CHALLENGE

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- 'FRIGAIR'96', South Africa
- 'APCSEET'96, Singapore

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ABSTRACT

In recent years, the attention of environmental researchers has been focused on indoor air pollution, as a result of reports of symptoms or specific diseases that occur mainly in airconditioned and mechanically ventilated buildings. Studies have proved that level of contaminants in the indoor air can be often several times higher than outdoor air. This combined with the fact that people tend to spend 90% of their time indoors, proves the point that a person's major source of exposure to airborne contaminants can be indoors.

Poor indoor air quality leads to an increased incidence of health related symptoms, which in turn can lead to an increase in absenteeism and a loss of productivity.

"The solution to the problem of pollution is dilution" or increased ventilation, runs contrary to the energy conservation guidelines being followed by airconditioning designers for the buildings. However new standards and guidelines being dictated by ASHRAE standard 62-1989 for IAQ, establishing generally 20 cubic feet per minute (cfm) per person as recommended outdoor air requirement, has set new challenges for equipment manufacturers to meet the needs of the building owners and designers for matching the IAQ requirements with energy conservation needs.

This paper examines the above issues in greater detail and also how 'enthalpy wheels' have effectively provided the solution for improving IAQ by curtailing energy costs.

The advancement in the manufacture of enthalpy wheels and the resultant strides in efficiency and features are discussed alongwith the methods of physical integration of the "wheels" into the HVAC system.

WHAT IS IAQ?

The world focus has shifted from the environment to 'Invironment'. This is a new terminology, being used increasingly to focus on the Indoor Air Quality (IAQ) and its effect on human health. While the outdoor environment continues to be of concern, the indoor environment is receiving increased attention as more information has become available on the presence and effect of indoor contaminants.

Indoor air quality, as defined by ASHRAE, is that which provides acceptable comfort level to 80 percent of the people exposed to it.

The origins of poor IAQ issue are well known. An emphasis on energy conservation after the oil embargo of 1970s resulted in tighter buildings with recirculated air for building ventilation and minimum amounts of fresh air being brought into commercial buildings. This minimized the amount of air to be heated or cooled and hence conserved on energy.

However, the combination of "tight" buildings with little or inadequate fresh air ventilation, produced an indoor environment with relatively high levels of chemical contaminants, bacteria, fungi and dust. It is a well recognised fact now, that indoor air in an airconditioned/mechanically ventilated space can be several times more polluted than outdoor air. The larger concentration of indoor air pollutants, combined with the fact that most people spend 85 to 90% of their time indoors, make them susceptible to illnesses related to these airborne contaminants.

POLLUTANTS CONTRIBUTING TO POOR IAQ

Sulphur, nitrogen dioxide, carbon monoxide produced by combustion and emission, high pollen counts, pesticides, chemical compounds, all contribute to outdoor pollution. Indoor air will contain all of the pollutants of the outdoor air as well as those generated indoors by the occupants and their activities.

The indoor air contaminants which can be hazardous to health include Environmental Tobacco Smoke (ETS), formaldehyde, radon, asbestos, VOCs emanating from solvents, paints, varnishes, carpets causing long term and short term illnesses. Biologicals like bacteria, viruses, fungus due to presence of high humidity, directly affect the health of the occupants. Odours and dust can cause significant discomfort, feelings of unpleasantness.

In a conditioned space, since free passage of air is limited, pollutants tend to accumulate resulting in higher concen-tration of some contaminants than outdoor ambient air. Most of the pollutants that we find indoors can be sourced to commonly found items around us.

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AIR CONTAMINANTS CAN BE CLASSIFIED INTO THREE (3) BROAD GROUPS

Contaminants	Sources
✍ Gases & vapour	Human beings
- CO_2	Cigarette Smoke
- Butyric Acid	Road & highways
- Carbon monoxide	Adjacent parking lots and garages
- Nitrogen dioxide	Industrial area
- VOCs	Paints, wood panelling, office equipment, air fresh-eners, cleaning agents, pes-ticide sprays.
✍ Inert particles	Man made fibres, dust, etc.
✍ Micro organism	Damp corners,
- Fungus	Behind insulation,
- Bacteria - Virus	Under carpets.
- Mold	Evaporative/desert/swamp coolers, cooling towers, air washers, human beings.

The consequences of poor Indoor Air Quality in a work environment can be twofold :

1. the effect on the health of the individual
2. the subsequent or related economic effect by loss of productivity and increased absenteeism.

EFFECTS OF POOR IAQ ON <u>HEALTH</u> AND <u>PRODUCTIVITY</u> :

THE SICK BUILDING SYNDROME (SBS)

In recent years, the attention of environmental research has been focussed on indoor air pollution as a result of reports of symptoms or specific diseases that have been identified among the occupants of airconditioned buildings, by a phenomenon called 'Sick Building Syndrome'.

"Sick Building Syndrome" is a term that describes the presence of acute non-specific symptoms in the majority of the people, caused by working in buildings with an adverse indoor environment. It is a cluster of complex irritative symptoms that include irritation of the eyes, blocked nose and throat, headaches, dizziness, lethargy, fatigue, irritation, wheezing, sinus congestion, dry skin, skin rash, sensory discomfort from odours, and nausea.

Symptoms are usually work related, that is, they begin a short time after a person enters a building and disappear within a few hours after he leaves it.

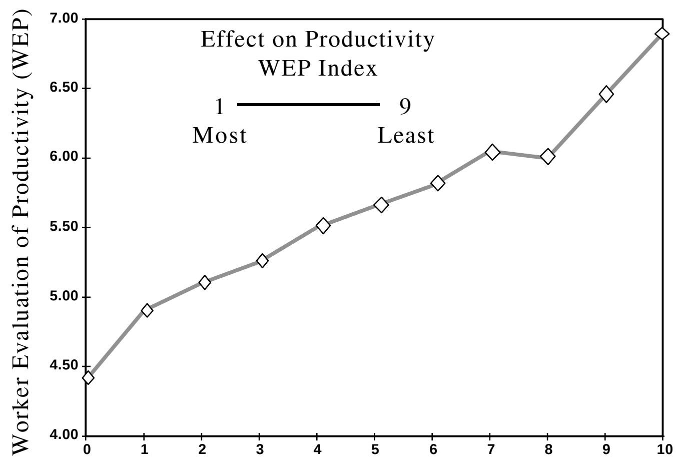
However, a more serious long term, damaging effect on health may arise due to a long exposure to a building related illness, typically the legionnaires' disease.

The economic consequences of the sick building syndrome and building related illnesses relate to decreased productivity, absenteeism and the cost of providing the correct environment.

Although not much conclusive data is available, it has been seen that productivity in the office and absenteeism is sensitive to conditions leading to poor indoor air quality. There is a synergistic effect of a multitude of factors that affect the performance of workers in a workplace. According to a study, IAQ problems cost American business nearly $60 billion annually, most of it due to the result of loss in productivity.

In UK, authorities assessed, that the cost of sick building syndrome, in a large government office with 2500 occupants, assuming one day of sickness absence per year, attributed to sick building syndrome, at 1990 prices, was $ 400,000 for one year.

The effect of building related health symptoms (dry eyes, itching or watering eyes, dry throat, lethargy, headache, blocked or stuffy nose, running nose, flu like illnesses, breathing difficulties, chest tightness) on productivity is shown in the figure below. The results indicate that the individuals who showed more than two symptoms also reported a decline in productivity (i.e > 5).



Number of symptoms
(from Burge et al. [1987]).

While there is no proof that maximum comfort leads to maximum productivity, there is ample evidence that an improved environment decreases worker complaints and absenteeism, thus indirectly enhancing productivity.

SBS in buildings may be due to a variety of causes like:

- Inadequate maintenance of the HVAC system, which becomes a source of contamination.
- Increased load (occupancy and activities) than designed.
- Inadequate fresh air/ventilation.
- Poor circulation or badly placed vents to prevent outside air reaching the occupants.
- Improperly located outdoor vents bringing in contaminanted air from automobile exhausts or restrooms.

However, poor IAQ is generally associated with improperly managed HVAC systems and inadequate ventilation. For each of the two effects of poor health and loss of productivity, adequate amounts of fresh air and appropriate ventilation can address the problem adequately.

MEASUREMENT OF IAQ . . . . . CO_2 AS THE SURROGATE INDEX

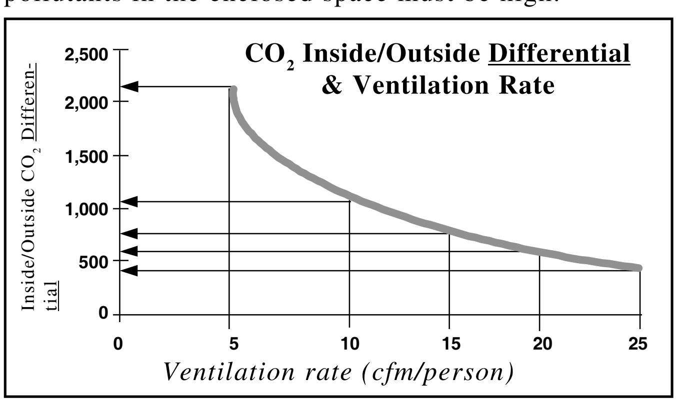
In order to evaluate excessive indoor air pollution and its health effects, it is important to identify which pollutants are present in a room or building and to determine how the levels of each vary with the time. Monitors are available for particulates and a few gases such as radon, formaldehyde, nitrogen dioxide, sulphur dioxide and carbon monoxide; however analysis of each can be complex, costly and time consuming. In some situations the source of contamination may be unknown and testing for a broad spectrum of possible pollutants may be required.

Although it is extremely expensive and difficult to detect or measure the indoor air contaminants, CO_2 (carbon dioxide) has been recognised by ASHRAE (American Soceity for Heating, Refrigeration and Airconditioning Engineers) as the surrogate ventilation index or the only measurable variable.

Carbondioxide levels in an airconditioned room is a good indicator of occupancy and ventilation rate within a space.

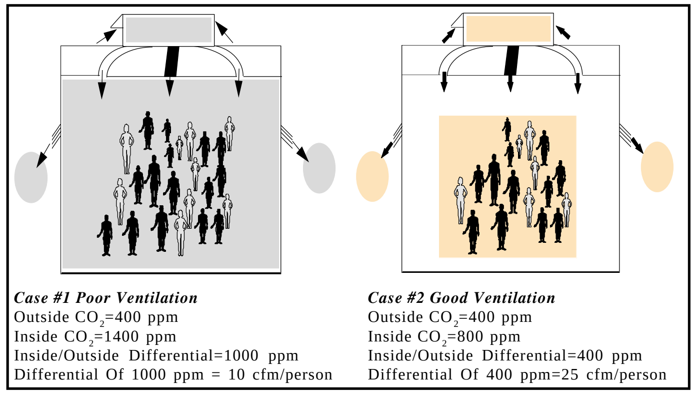
CO_2 by itself is not considered an indoor air contaminant. Humans are the major source of CO_2. As people exhale CO_2, they also exhale and give off a wide range of 'bioeffluents'. These bioeffluents include gases, odours, particulate, bacteria, viruses. When these bioeffluents are allowed to build up in space, due to poor ventilation, occupants complain of fatigue, headache and general discomfort. The assumption is that if there is sufficient ventilation to remove the human generated contaminants, there will be no discomfort.

Outside levels of CO_2 are relatively constant and range between (350 to 600 ppm); inside levels will never be below the outside level. The amount of CO_2 in the space can give us an indication of the number of persons within the space. Therefore, the concentration of CO_2 in a space can provide an indication of the actual ventilation rate per person within the space. If the CO_2 levels are higher than 1000 ppm (parts per million), then it is an indication that not enough outdoor air is coming in to dilute the CO_2 level. Therefore the indoor air is being recirculated and the levels of the other pollutants in the enclosed space must be high.



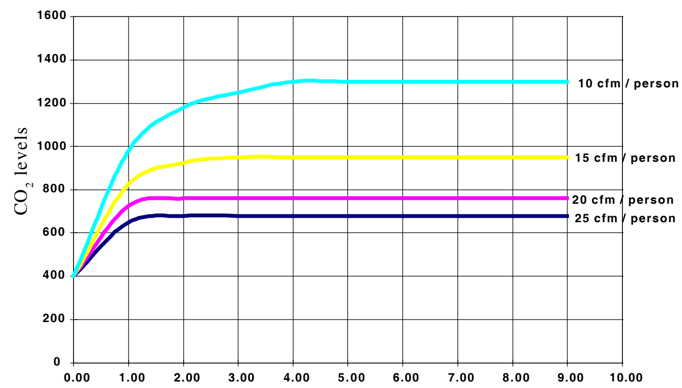
Source : Telair Systems, Inc.

CO2 and Ventilation



CO_2 itself does not create these symptoms but elevated CO_2 concentrations will often occur at the same time other pollutant levels build up.

The real value of CO_2 in Indoor Air Quality control is a very good indicator of ventilation rates within a space.



Equilibrium Levels At Various Ventilation Rates

The time it takes for a room to reach equilibrium is dependent on the number of people in a room or building zone, the volume of the space and the ventilation rate within the space. If the room is poorly ventilated and has very low occupant densities, it may take a number of hours before the equilibrium level is reached. However, once concentrations inside exceeds a certain inside outside differential, (such as 700 ppm differential equal to 15 cfm per person) one can conclude that the ventilation rate is probably below acceptable levels.

"THE SOLUTION TO POLLUTION IS DILUTION"!

There are two basic solutions to mitigate the unacceptable levels of airborne pollutants in the workplace: **addressing the source of pollution** and **addressing the level of contaminants in the air**. These may be referred to as '**source control**' and '**removal**' respectively.

Source control, though the preferred approach, may not be often practical. Source control measures are pollutant specific and may include use of low formaldehyde emitting materials, banning of cigarette smoking, prevention of radon entry through sealing of foundations, eliminating use of asbestos and storing of paints and chemicals outside the occupied space. Controlling relative humidity will prevent microbial contamination.

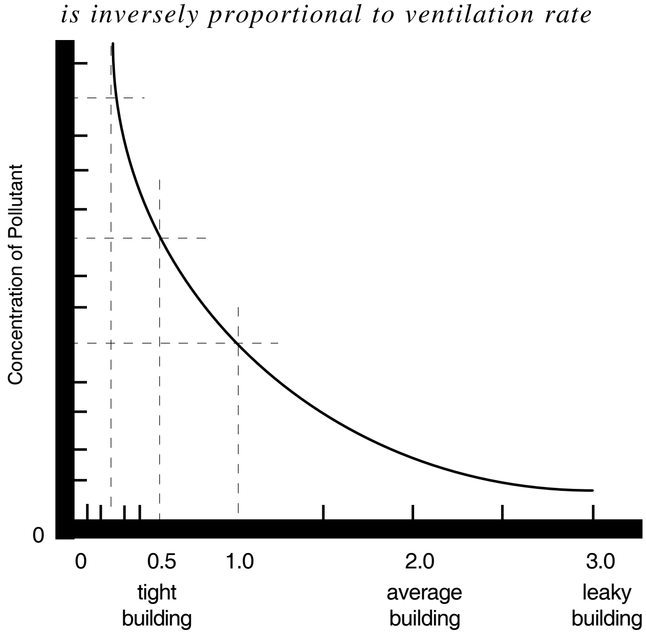
Removal of contaminants from a building or reducing its concentration within a work space can be accomplished by passive or active ventilation.

Passive ventilation refers to air exchanged through doors, windows or other openings by natural forces. In most airconditioned buildings, these openings have been reduced to the minimum to conserve energy.

Active ventilation systems provide continuous ventilation to which passive ventilation may add but not subtract when pollutants are evenly mixed throughout a space and the source rate is constant; the concentration of airborne pollutants will be inversely proportional to the ventilation rate, that is, doubling the ventilation will halve the concentration!

An existing ventilation system which is inadequate because of design flows, poor maintenance or expanded use of a building is often associated with poor indoor air quality. Mitigation can often require redesign or maintenance. In cases where the outdoor air ventilation provision of an HVAC system is not being used, the remedy is obvious - increase ventilation.

The Dilution Principle : concentration of pollution is inversely proportional to ventilation rate



ASHRAE 62-1989 IAQ STANDARD: "VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY"

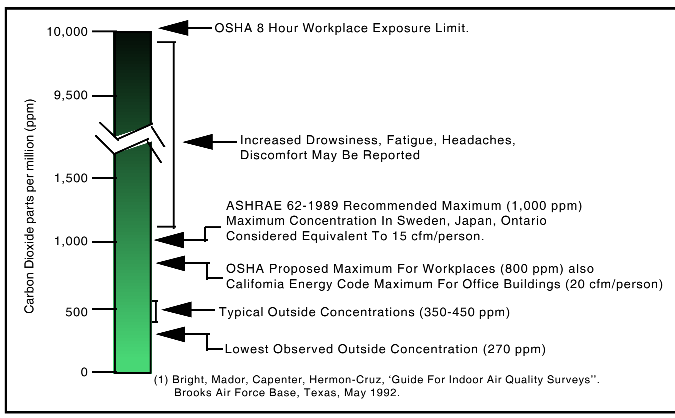
The shift of focus to address total indoor environmental quality needs of offices and workplaces to include higher ventilation and fresh air needs along with other issues like ergonomics, light, noise, decoration, and ambience has forced world bodies such as ASHRAE to relook at the prevailing standards. In 1983, ASHRAE authorised an early review of their standard 62-1981 on ventilation. The required standard 62-1989 recommended fresh air intake of 15 to 20 cfm per person where 5 cfm was considered adequate by the industry. CO_2 levels, which have been recognised by ASHRAE as the surrogate ventilation index (being the only economically and practically measurable variable), should not exceed 1000 ppm.

The following are some of the standards in force, or under implementation, for ventilation rates for buildings.

Regulations and Guidelines pertaining to IAQ

Regulatory Body	Country	Standard	Ventilation	CO_2 (not exceeding)
OSHA	US	29 CFR 1910.1033 (Proposed)		800ppm
ASHRAE	US	62-1989	15 cfm/person 20 cfm/person 7 people/1000ft2 for office	1000 ppm
		Codes for new homes/construction		
NBCC	Canada		0.5 AC/HR	1000 ppm
	Sweden		0.5 AC/HR	1000 ppm
	France		0.5 AC/HR	1000 ppm
	Japan		15 cfm/person	1000 ppm

Various organizations have established recommended levels for CO_2 concentrations in indoor spaces.



Reproduced below are the recommended ventilation rates under the ASHRAE 62-89 standard.

Application	Ventilation Rate/person	Application	Ventilation Rate/person
Office space	20 cfm	Smoking Lounge	60 cfm
Restaurants	20 cfm	Beauty Salon	25 cfm
Bars/Cocktail	30 cfm	Supermarkets	15 cfm
Hotel Rooms	30 cfm/room	Auditorium	15 cfm
Conference Rooms	20 cfm	Classrooms	15 cfm
Hospital Rooms	25 cfm	Laboratory	20 cfm
Operating Rooms	30 cfm	General Retail	15

Source : ASHRAE Standard 62-1989

INCREASED VENTILATION STANDARD <u>vs</u> ENERGY MANAGEMENT : THE CHALLENGE

As the recommended levels of outside air brought into conditioned space has been increased by 4 times (to 20 cfm from 5 cfm per person), much higher latent and sensible loads are imposed on the cooling/heating equipment. This translates in two ways : (1) an improved indoor environment, and, (2) significantly higher utility bills for the owners.

Introduction of even a small quantity of air into an HVAC system raises physical plant requirements dramatically, bringing to fore a new dimension of balancing energy needs with the IAQ standard. In fact the HVAC designers are faced with several parameters which need to be incorporated in response to the regulations and guidlines laid down by market needs.

HVAC System "Wish List" for the '90s

- Efficiently handle increased outdoor air percentage (20 vs. 5 CFM/person) with humidity control.
- Minimise first cost, operating and maintenance costs.
- Decouple the outdoor air load so that conventional packaged HVAC equipment can be used effectively.
- Retrofit into existing system design.
- Maintain space humidity between 30% - 60% RH all year.
- Curtail peak electrical demand charges.
- Reduce or eliminate the use of CFCs.

THE SOLUTION OPTIONS : ENERGY RECOVERY DEVICES

As market needs for control of humidity, energy, IAQ, continue to rise, it is imperative to integrate heat/energy recovery devices to airconditioning design to keep all these requirements in mind.

Ashrae equipment handbook 1988 refers to six types of air to air heat exchange devices. There are some which are sensible only and some are total heat exchangers (sensible and latent heat or enthalpy). The twin tower loop is a total heat exchanger. The rotary exchanger or heat wheel can be either a sensible only or a total heat device. The rest are essentially sensible heat exchangers in which transfer of latent heat, if any, is incidental.

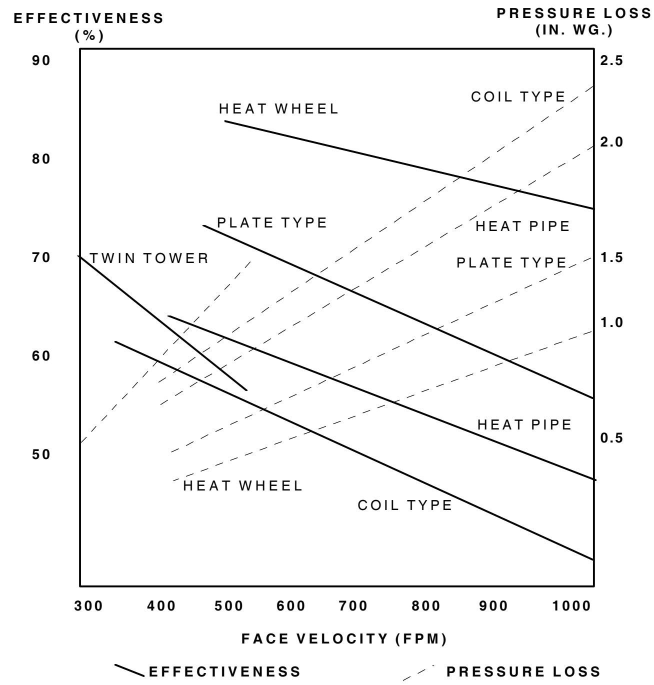
Types of Recovery Devices

1. Rotary Energy Exchangers
2. Coil Energy Recovery Loop
3. Twin-Tower Enthalpy Recovery Loop
4. Heat Pipe Heat Exchangers
5. Fixed Plate Exchangers
6. Thermosyphon Heat Exchangers

The ability to transfer both sensible and latent heat makes the enthalpy wheel far more effective in energy recovery. It is found that the total heat recovery device typically recovers nearly three times as much energy as the sensible heat recovery device.

The chart below compares typical effectiveness and pressure drop data for different recovery devices.

Performance Comparison
Enthalpy Wheels <u>vs</u> Other Recovery Devices



It is seen that the enthalpy wheel has the highest effectiveness and least pressure drop at any face velocity, making it the most appropriate choice for energy recovery in comfort ventilation.

ENTHALPY WHEELS : THE BEST OPTIONS FOR IAQ ENHANCEMENT

The enthalpy wheel is a cylinder, usually 4 to 10 inches deep, packed with a heat transfer medium that has numerous small air passages, or flutes, parallel to the direction of airflow. The flutes are triangular or semicircular in cross-section. The structure, commonly referred to as the honeycomb matrix, is produced by interleaving flat and corrugated layers of a high conductivity material, usually aluminium, surfaced with a desiccant. Stainless steel, ceramic, and synthetic materials may be used, instead of aluminium, in specific applications. The flutes in most wheels measure between 1.5 mm to 2.0 mm in height. The surface area exposed to airflow in a wheel lies between 300 to 3300 m^2/m^3, depending upon the configuration.

In a typical installation, the wheel is positioned in a duct system such that it is divided into two half moon sections. Stale air from the conditioned space is exhausted through one half while outdoor air is drawn through the other half in a counter flow pattern. At the same time, the wheel is rotated slowly (2 to 20 RPM). Sensible heat is transferred as the metallic substrate picks up and stores heat from the hot air stream and gives it up to the cold one. Latent heat is transferred as the medium condenses moisture from the air stream that has the higher humidity ratio through adsorption by the desiccant (with a simultaneous release of heat) and releases the moisture through evaporation (and heat pick up) into the air stream that has the lower humidity ratio.

The psychrometrics of recovery is explained in the figure below. In simple sensible recovery (Figure A), cold air is heated from 1 to 2 while hot air is cooled from 3 to 4. In this case, the cold air temperature is above the dew point of the hot air and no condensation takes place in the media.

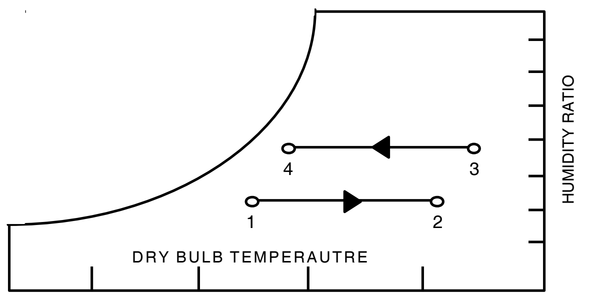


Figure A : Sensible Heat Recovery

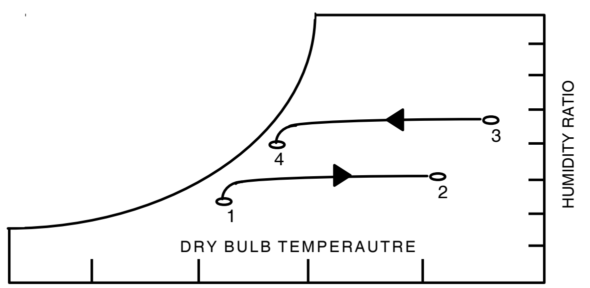


Figure B : Sensible Heat Exchanger Recovering Latent Heat

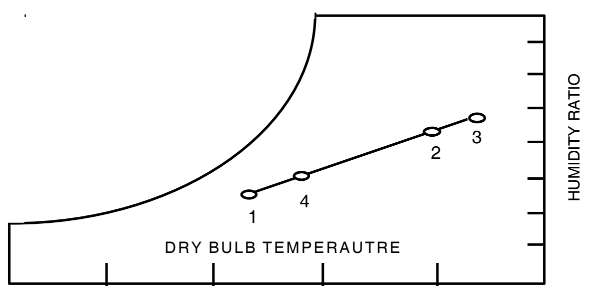


Figure C: Total Heat Recovery

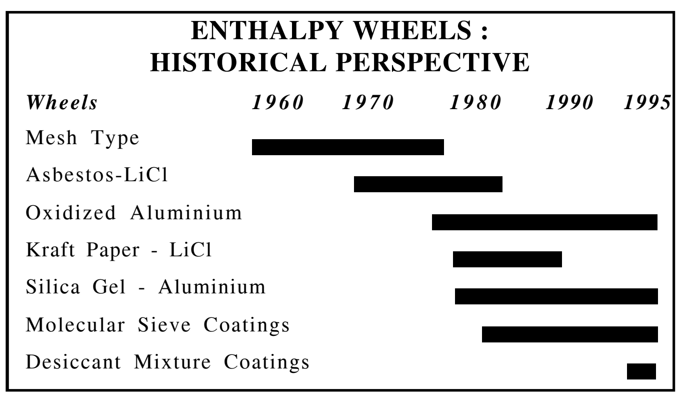
Figure B illustrates a sensible process in which condensation occurs in the hot air stream along with evaporation in the cold one. In this case, latent heat transfer enhances the overall wheel effectiveness. Figure C depicts the total heat recovery process of the enthalpy wheel, assuming mass flow rates in the air streams are the same, and latent and total heat effectiveness are equal.

A HISTORICAL PERSPECTIVE

Use of rotary heat exchangers in comfort air conditioning dates back to mid fifties with folded wire mesh pads. These devices were essentially sensible heat devices. Wheels with the familiar honeycomb matrix were introduced in the mid sixties. The medium was asbestos paper impregnated with lithium chloride. Due to inherent absorption properties of asbestos and lithium chloride these rotors had a short life and in the late seventies asbestos was replaced by kraft paper; however, lithium chloride continued to remain the preferred desiccant due to its ease of impregnation of media.

In the mid seventies, two new enthalpy wheel models hit the market and continue to be offered till date. The oxidised aluminium wheels offered by some manufacturers, has corrugated aluminium foil wound on a mandrel and braced by steel strips on the sides. The assembly is dipped into a bromide solution to cause the aluminium to oxidise and form a layer of alumina - a known desiccant. Such wheels have heat transfer characteristics comparable to the others at a lower cost. However, they have a weaker structural integrity and suffer from a desiccant migration problem. The other type of wheel uses silica gel as desiccant which is bonded to the aluminium substrate through a coating process. The matrix is supported by spokes and rim assembly.

In the 1980s, considerable advances were being made in the fabrication of silica and other compounds for the semiconductor industry. A derivative of these innovations was the development of molecular sieves - synthetic zeolites that could be designed at the molecular level. At the same time, manufacturing processes had been developed to allow the bonding of a breathable layer of desiccant to metal or plastic surfaces. These technologies have influenced the newer generation of enthalpy wheels. The chronology of wheel development is graphically depicted.

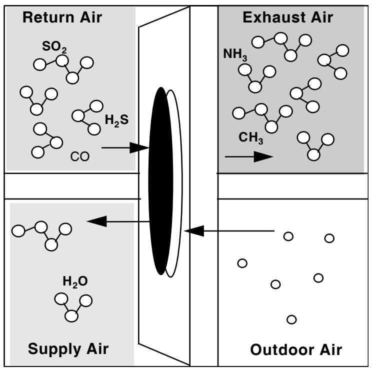


ADVANCEMENTS IN ENTHALPY WHEELS . . . . . . WHAT YOU SEE!

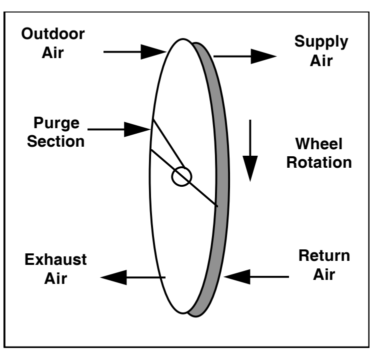
The new generation of enthalpy wheels have several features which have distinct advantages over others, which need to be carefully studied before selecting the correct wheel for the application.

- Selective adsorption which eliminates cross contamination of bacteria and air borne contaminates.

  In certain application areas such as hospitals, hotels, clean rooms and animal houses requiring stringent control of IAQ, where 100% fresh air is normally the requirement, designers are apprehensive of using the heat wheel for fear of cross contamination due to carryover of bacteria, germs or foul odours from the exhaust to the incoming air. The new generation wheels using 3Å/4Å (mole-cular sieve) mixtures as the desiccant; however would allow even the smallest diameter pollutants to blow over, because the pore size of the desiccant will essentially allow molecules smaller than 3Å in diameter, 5000 times smaller than the diameter of the human hair to pass into the fresh air supplies. Water molecules, 2.8Å in diameter, can enter and exit the sieve. As a result, the contaminations remain in the exhaust air stream.

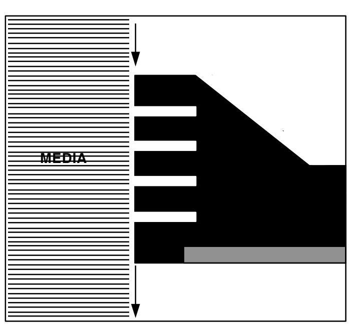


- In-built purge sector eliminates cross contamination. Cross contamination generally refers to a mixing of air between supply and exhaust air streams. In rotary heat exchangers, this occurs through leakage and carryover. Carryover occurs each time a portion of the matrix passes the seals dividing the supply and exhaust air stream, as the exhaust air still inside the flutes is pushed back into the room by the incoming outdoor air. To eliminate carryover, a purge sector is constructed, which flushes out the flutes before they enter the supply air side.



With effective purge arrangements some manufacturers are able to limit cross contamination to .04% of the exhaust air concentration by volume.

- Models of heat wheels using non contact seals have a distinct advantage of larger life and effective sealing due to the use of four pass labyrinth seal.



- The choice of desiccant is the key element in the enthalpy wheel technology. Silica gel, activated alumina and molecular sieves are the desiccants currently being offered on enthalpy wheels. Molecular sieves have a relatively higher sorption capacity at low concentration levels of water vapour, which does not increase significantly with increase in relative humidity. However the decrease in adsorption capacity of molecular sieve with increase of temperature is much smaller compared to the other two desiccants. Both silica gel and activated alumina have adsorption capacity twice as much as molecular sieve at 100% RH. These characteristics influence wheel design and determine moisture transfer effectiveness of the wheel at different temperature and humidity conditions of the two air streams.

While selecting the enthalpy wheels for any application, therefore, the following points should be carefully scrutinized: choice of desiccant, selectivity, flute dimension, purge sector, seal arrangement, efficiencies, pressure drops, structural strength of the rotor. Though manufacturers give detailed data on performance, which should be consulted for a given application, there are a few other characteristics of the manufacturing process which must be known to make a wiser choice.

ADVANCEMENTS IN ENTHALPY WHEEL . . . . . . WHAT YOU DON'T SEE!

1. Desiccant technology, in the recent years has made considerable advancements and wheels are currently available coated with desiccants with the distinguishing features, such as :
   - Desiccants with high diffusion rates
   - Desiccants with selective adsorption characteristics
   - Desiccant mixtures which combine high diffusivity with selectivity.
   - Desiccants which are adhered to substrate using water based/non masking adhesives with pollution control considerations.
2. High quality substrate webs utilising simultaneous double sided coating methods.
3. Structural rigidity of the honeycomb media/matrix by using state-of-the-art surface winding techniques in place of centre winding techniques.
4. Highly polished and finished surfaces enabling distortion free production of large diameter rotors for use with contact less seals.

These very recent 1995 developments, in manufacturing techniques, have enabled the new generation rotors to have all advantages of the previous wheels plus more to provide the best recoveries, rigidity and reliability, with minimum pressure drops.

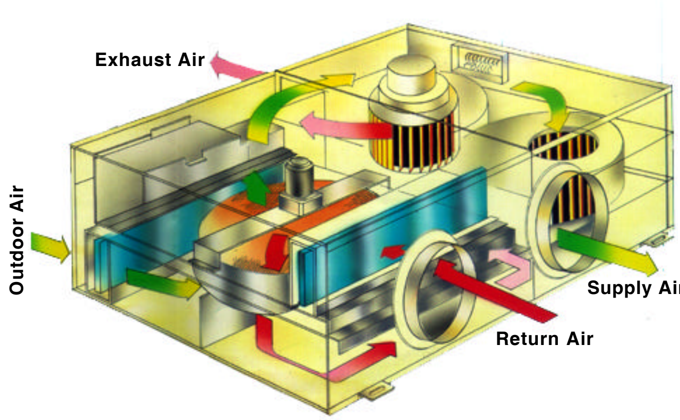
INTEGRATING THE ENTHALPY WHEEL IN HVAC SYSTEMS

The most widespread application of enthalpy (heat) wheels is for *preconditioning* fresh outside air before it is introduced to a building. The system can easily be tapped into an existing ventilation system. A portion of the air that would normally be recirculated through the system is exhausted through the wheel and fresh air is introduced into the building in its place. Operating in virtually any climate zone, a single desiccant wheel operated with just a small motor to rotate the wheel can deliver fresh air on a year round basis that is generally within 3-7 degrees and 10% RH of inside conditions, regardless of what outside conditions are (without any type of mechanical cooling or heating). The cost to provide high levels of fresh air ventilation becomes minimal compared to the normal heating cooling requirements of the building. The potential benefits are numerous.

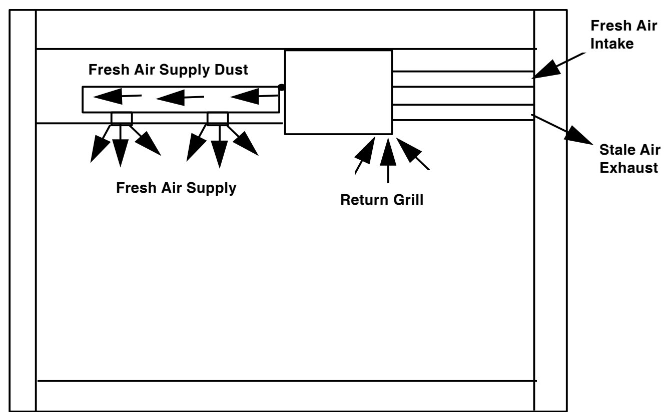
- Current standards for outside air ventilation can be met or exceeded with minimal energy cost impact on the building.
- Incoming outside air is dehumidified by the desiccant wheel, allowing the rest of the ventilation system to run dry. As a result, indoor humidities are maintainable well below the conditions that would favour the growth of mould, mildew and other microbial contamination.
- The need for cooling capacity that normally would be required to dehumidify and cool outside air is eliminated. This is typically 30 to 50% of total system capacity. **In most cases, the cost of the energy wheels is almost less than the cooling capacity it is replacing.** The first cost of a building's cooling system can actually be reduced with a wheel system.
- Many utilities charge extra for the electrical energy used during peak cooling periods. A wheel system can significantly reduce peak demand charges.
- In the winter, wheel systems can preheat and humidify incoming cold dry air.
- Because the system is capable of recovering 80% of the heating or cooling energy that is exhausted from a building, the cost of fresh air ventilation is reduced. Annual savings can range from US$1 to $2 annually for each cfm of fresh air ventilation.
- Given that the cost of the system is similar to the cost of conventional heating and cooling capacity, the system has an immediate payback. In retrofit applications, where cooling capacity is already in place, payback would typically take place in 1 to 3 years.

The enthalpy wheels are available in several sizes and configurations and are being integrated in small, compact standardized units for installation in hotels, restaurants, discotheques, bars, pubs, offices, nursing homes, as unitary systems and are being sold as energy saving fresh air preconditioners to handle smaller loads.

Typical Unitary Energy Recovery Ventilator (ERV)

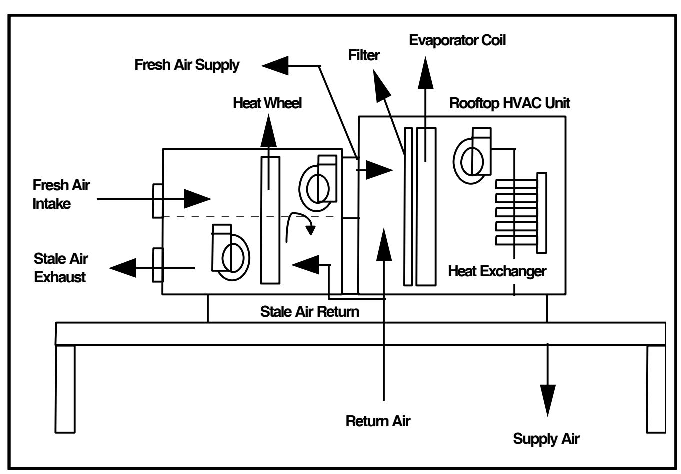


Typical Installation Option : Ceiling Mounted



Larger heat wheels are being integrated in packaged AHUs or designed in modular systems for integrating into HVAC systems to cater to larger fresh air loads for hospitals, animal laboratories and hotels.

Typical Installation : 'Heat Recovery Wheel Integrated with HVAC for New Areas



CONCLUSION

There have been changes in the air! The rules have changed for the way the buildings have to be designed and built. The demands for stringent indoor air quality, additional fresh air ventilation, concerns about humidity and microbial contamination and the need to find non toxic replacements for CFCs have posed a challenge to the technical creativity and design finesse of the engineers, to find solutions to these needs. The **desiccant enthalpy wheel** has remarkably successcully addressed the market needs of the 90's and has integrated the task of providing indoor air quality with efficient use of energy.

REFERENCES

- ASHRAE Standard 62-1989.
- 'Application guide for CO_2' - Telair Systems Inc, USA.
- "Impact of Indoor Environment on productivity"- ASHRAE Technical Bulletin.
- 'Eco-Fresh ' - Technical data, Arctic India Engineering.
- HVAC Systems and Equipment - ASHRAE Handbook.
- Indoor air pollution - An introduction for health professionals-EPA.