

Energy Recovery Wheels for Energy Efficient Indoor Air Quality (IAQ)



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What is Indoor Air Quality ?

- **Indoor Air Quality (IAQ)** refers to the **nature of the conditioned (heat / cool) air** that circulates throughout space/area where we work and live i.e. the air we breathe during most of our lives.
- **A Common MYTH** – Air pollution occurs **only outdoors or in industrial environment**.
- **TRUTH!!** – Air inside conditioned space can be substantially **more polluted than outdoor air**.

On an average, spend approximately 90% of our time indoor

Ventilation

The Solution to Pollution is Dilution

i.e.

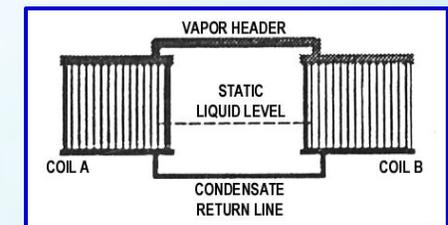
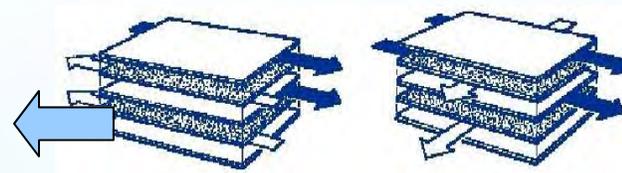
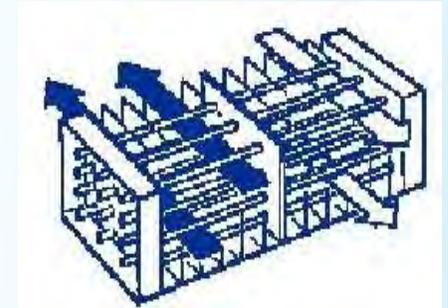
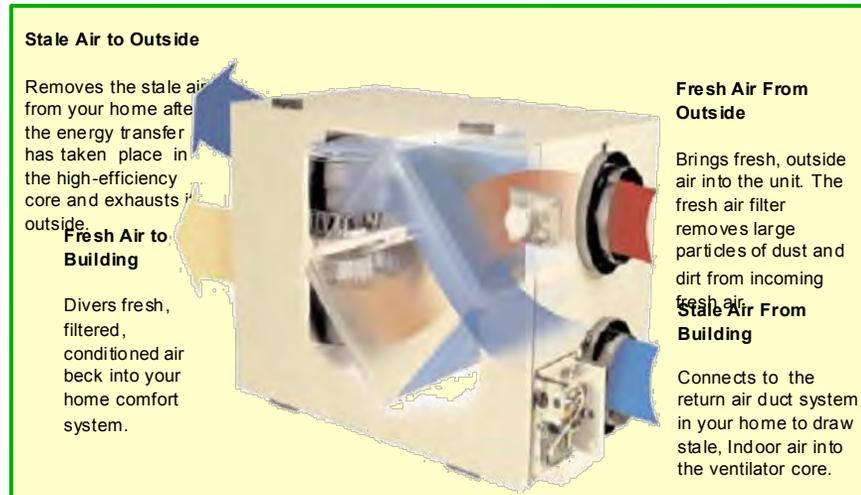
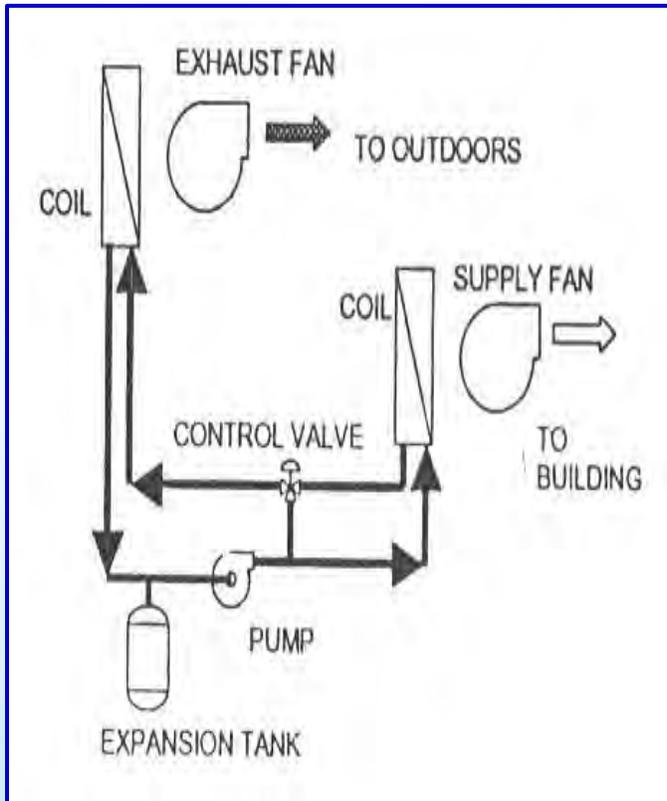
**Bring in Fresh Outdoor Air
to flush out Stale Indoor Air**

The Challenge

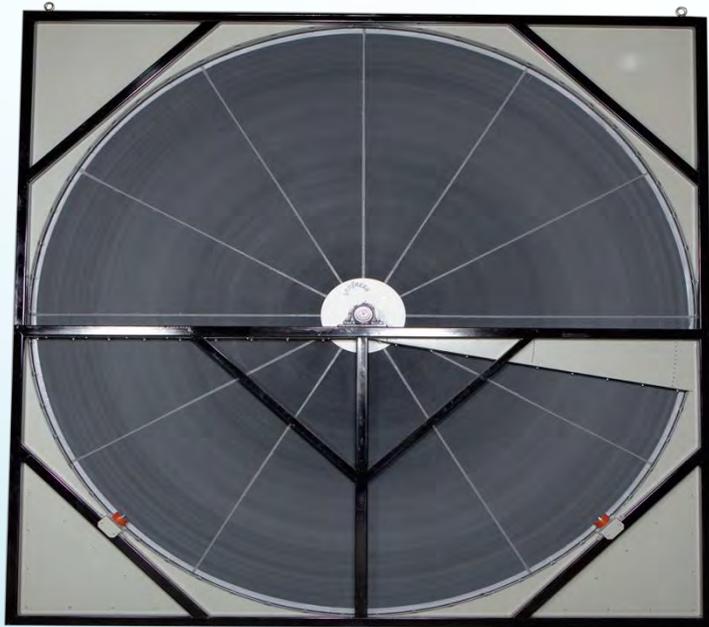
- Improved Indoor Environment
- Higher utility bills
- RH Control

**Energy Recovery
Devices**

Heat Exchangers



Total Energy Recovery Wheels



3Å
Molecular
Sieve Coated



What is Energy Recovery?

- Energy Recovery in Buildings is the **process of recovering the cooling / heating energy from the waste exhaust of the building**. The exhaust air could be mechanically exhausted or getting leaked from the building
- The above is achieved by using **Heat Exchangers** which **exchanges heat** between **Incoming Outdoor Air & Waste Exhaust Air**

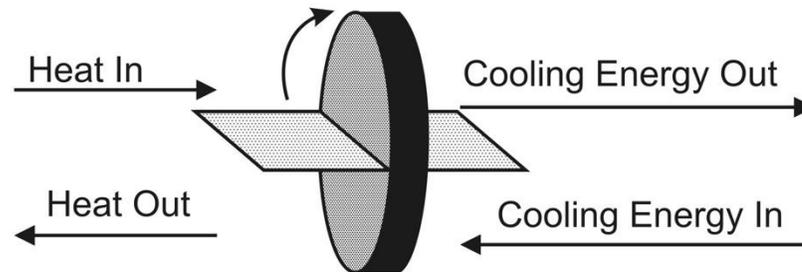
What is Total Energy Recovery?

$$\text{Total Energy} = \text{Sensible Heat (Temperature)} + \text{Latent Heat (Moisture)}$$

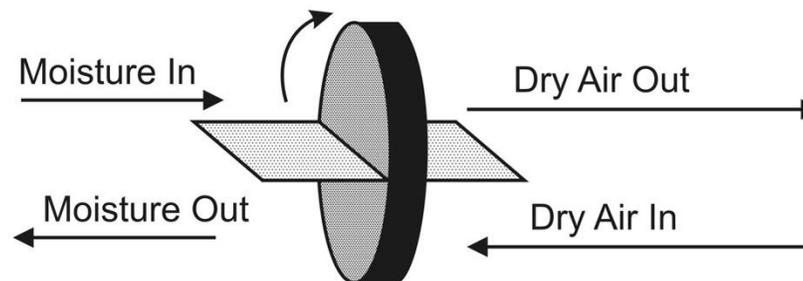
- Can significantly **reduce Energy impact of ventilation**
- As potential first **cost savings** due to reduction in required cooling and heating capacity
- **Improved latent performance** for packaged equipment

Universal Rules of Total Energy Wheels

1. Heating/Cooling Energy (e.g. 80%) Is Always Returned To Where It Came From

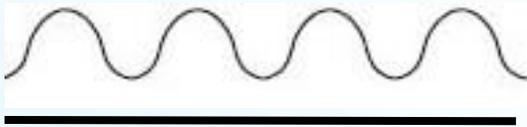


2. Moisture and Dry Air (e.g. 80%) Is Always Returned To Where It Came From



Basic Wheel Construction: Materials

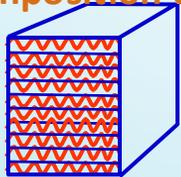
Alternate Layers of Corrugated and Flat Sheets are Bonded and Rolled together to Form A Wheel



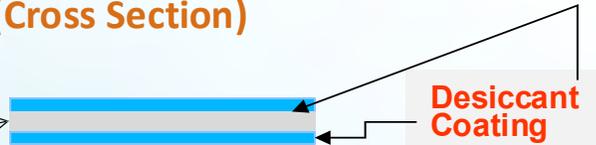
Energy Recovery Wheel = Substrate + Desiccant Coating

(core material or media) (Adsorbent)

Composition of Each Layer (Cross Section)

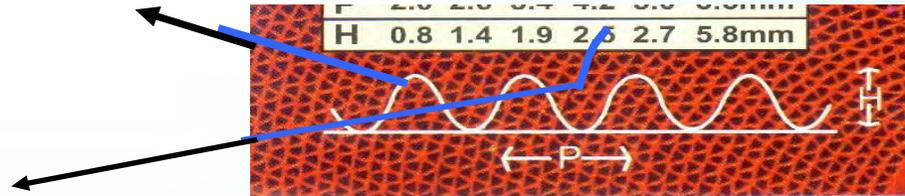


Substrate



Substrate

1. Thickness (gsm)
2. Specific Heat
3. Specific Gravity



Flute Geometry

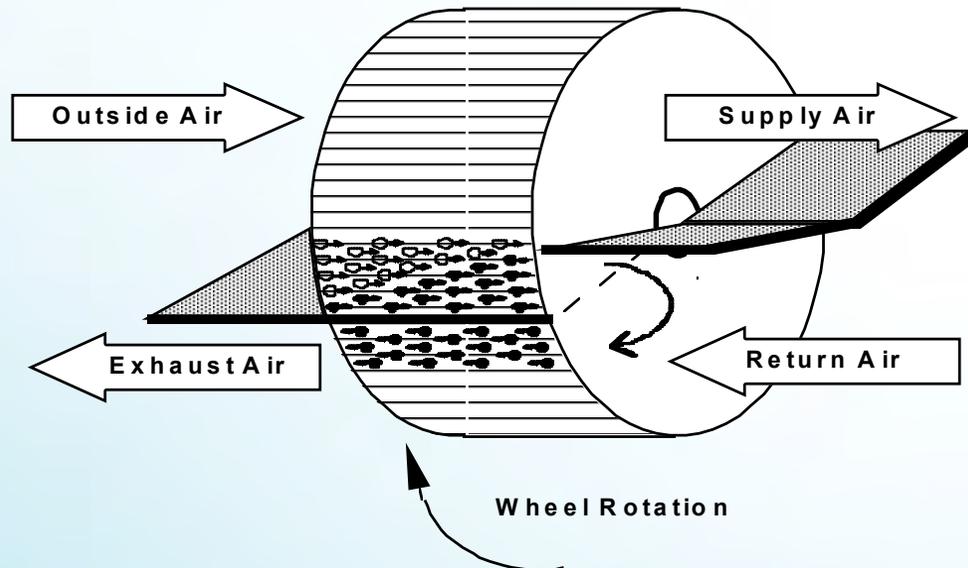
- p-pitch
- h-height
- d-depth

Coating

1. Thickness (gsm)
2. Isotherm
3. Heat of adsorption
4. Heat Capacity

Illustration of Wheel Purge Section

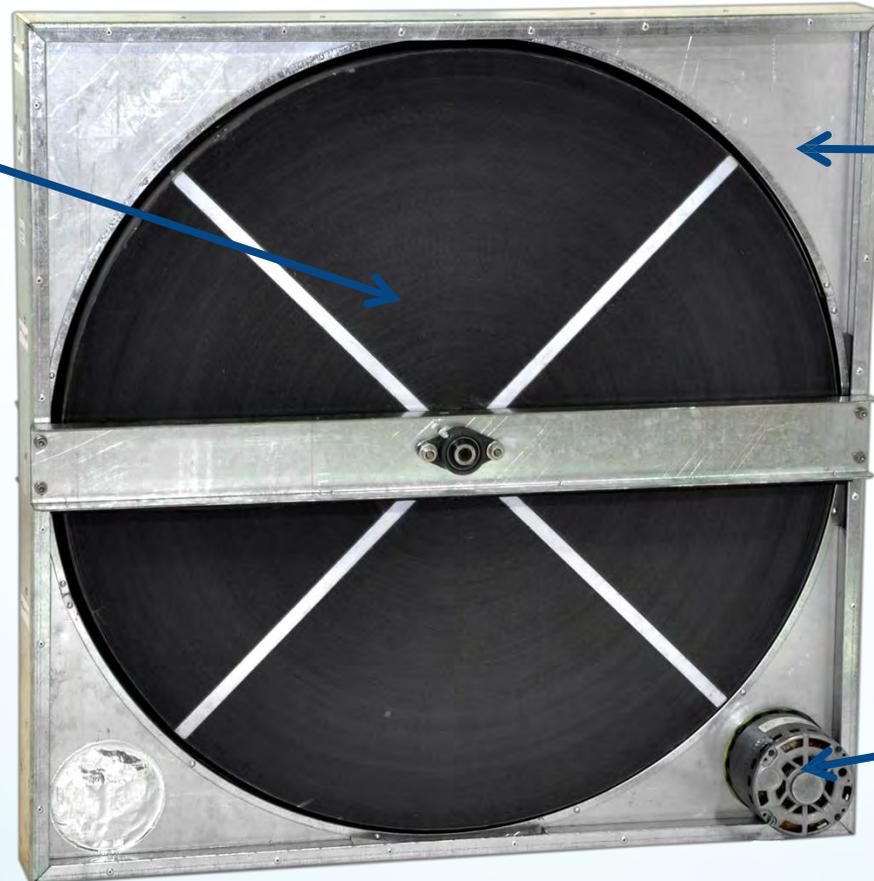
Theory of Operation – A specific volume of air is allowed to bypass into exhaust air stream, minimizing carryover of contaminants from return air.



Purge angle is a function of air velocity, and purge volume is a function of wheel volume and rotation speed.

Energy Recovery Wheel

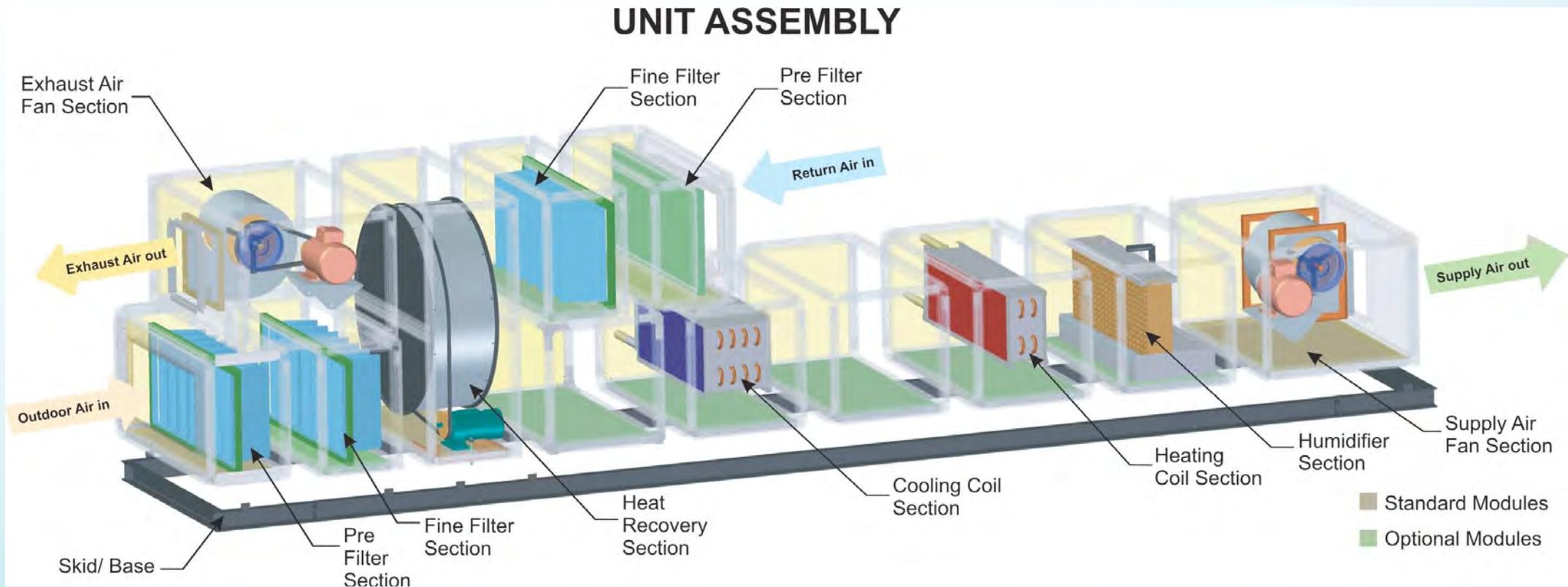
Rotor Matrix



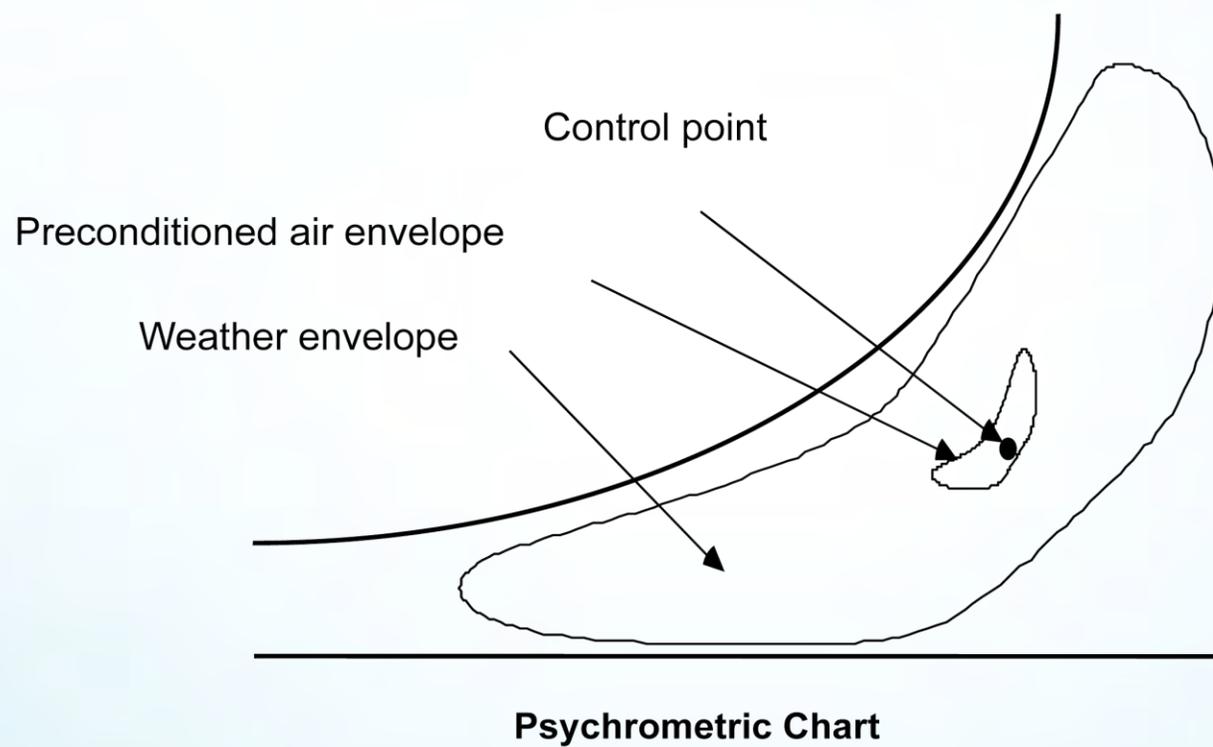
Frame

Drive Motor

Treated Fresh Air Unit Assembly



What Total Energy Recovery does



Certified Performance Items

The following performance items shall be certified

Under standard conditions

(20°C, 50% rel. Humidity and 1.013 105 Pa – or 1.20 kg/m³)

Airflow

Outdoor Air Correction Factor

Pressure drop

Exhaust Air Transfer ratio

Under “regular” winter conditions for all RHEs

Temperature efficiency

Humidity efficiency

Under “regular” summer conditions for Enthlapy and Sorption RHEs

Temperature efficiency

Humidity efficiency

Certified Performance Items

MODEL : HRW-1600 **TYPE :** EZ-200(1.85) Sorption Wheel **DEPTH:** 200 mm

	^o Cdb	^o Cwb	%RH	g/Kg	KJ/Kg		^o Cdb	^o Cwb	%RH	g/Kg	KJ/Kg
S	33.9	23.3	41.1	13.7	69.2		27.9	20.3	50	11.8	58.1
W	17.8	7.9	20.6	2.6	24.5		22.7	15.7	48.2	8.3	43.9

Outdoor Air(O/A)	Std. Air Volume 11640 cmh	TOTAL RECOVERY (η_s)	S 67.7	W 58	%
Exhaust Air(E/A)	9640 cmh	Std. Air Volume 10000 cmh	Supply Air(S/A)	8000 cmh	Return Air(R/A)
		TOTAL RECOVERY (η_w)	S 77.2	W 85	%

	^o Cdb	^o Cwb	%RH	g/Kg	KJ/Kg		^o Cdb	^o Cwb	%RH	g/Kg	KJ/Kg
S	32.5	22.7	43.2	13.3	66.7		25	18.7	54.8	10.9	52.9
W	18.9	9.8	28.1	3.8	28.6		25	18.7	54.8	10.9	52.9

	Flow & Recovery Efficiency			Efficiency-Summer (η_s)			Efficiency-Winter (η_w)			Pressure-drop		
	Massflow	Airflow	Velocity	Temperature	Humidity	Total	Temperature	Humidity	Total	Std. density	Actual	
	Kg/h	cmh	m/s	%	%	%	%	%	%	Pa	S	W
Supply(S/A)	12000	10000	2.8	67.7	67.7	67.7	67.7	68.6	68	148	155	151
Exhaust(E/A)	9600	8000								113	119	119

TEMP. EFFECTIVENESS : 84.6 %
 HUMIDITY EFFECTIVENESS : 85.7 %
 TOTAL EFFECTIVENESS : 85 %

Note: 1. Calculated according to ashrae standard 84 and AHRI standard 1060.
 2. Humidity Efficiency will be in case of Condensation only.

Mechanical Details

Rotor :	Cassette :	
WHEEL DIA : 1600 mm	DIMENSION : (mm) (W) 1730 (H) 1730 (D) 325	
WHEEL DEPTH : 200 mm	DRIVER MOTOR : 0.18(1/4) KW(HP)	
WHEEL SPEED : 20 rpm	WEIGHT : 237 KG (NET UNPACKED)	

	Without Wheel			With Heat Recovery Wheel					
	FRESH AIR LOAD (KW)			RECOVERY EFFICIENCY %			RECOVERY (KW)		
	Sensible	Latent	Total	Sensible	Latent	Total	Sensible	Latent	Total
S	30	23	53	67.7	67.7	67.7	20	15	35
W	-24	-67	-91	67.7	68.6	68	-16	-46	-62

Pressure Difference Between Two Airflows

PRESSURE DIFFERENTIAL: 20 Pa	Atm.Pressure (Kpa): 101.325
EATR : 2.09 %	Altitude : 0
OACF : 1.164	

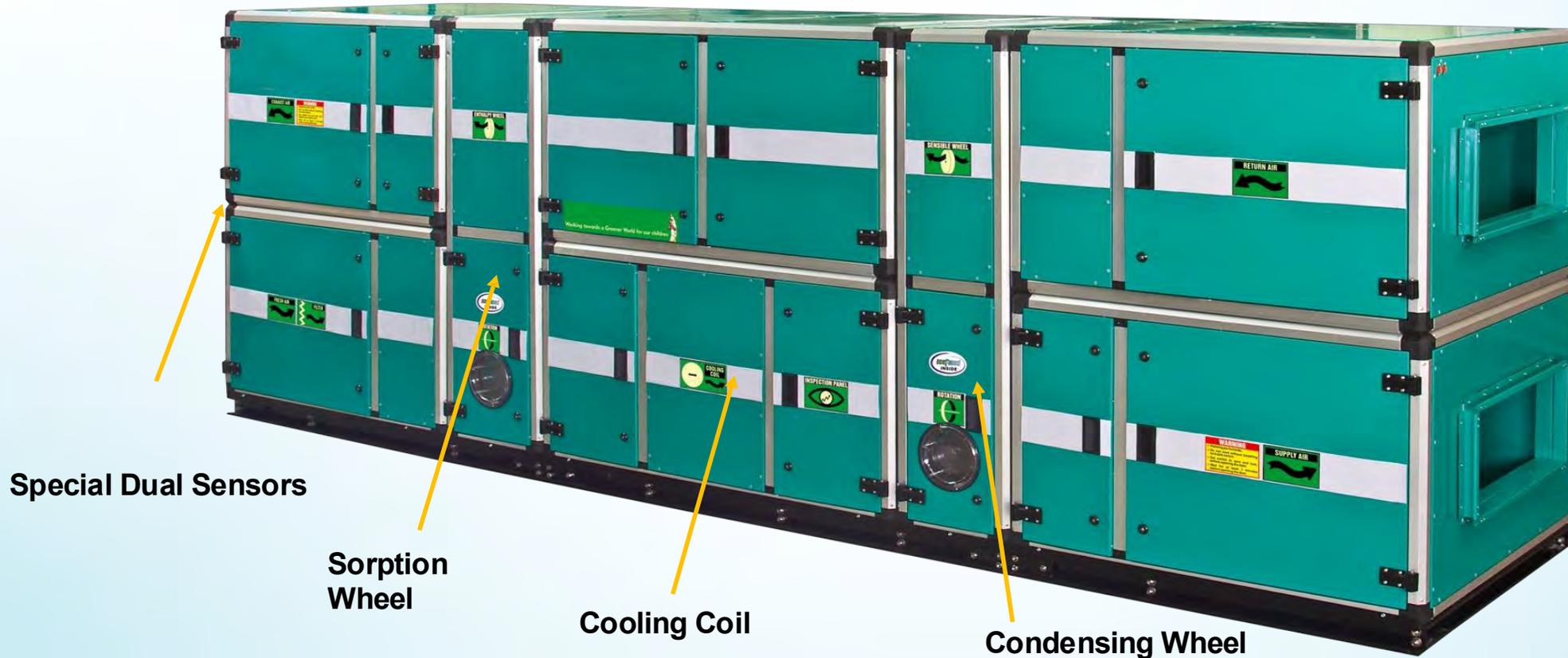
Certifications



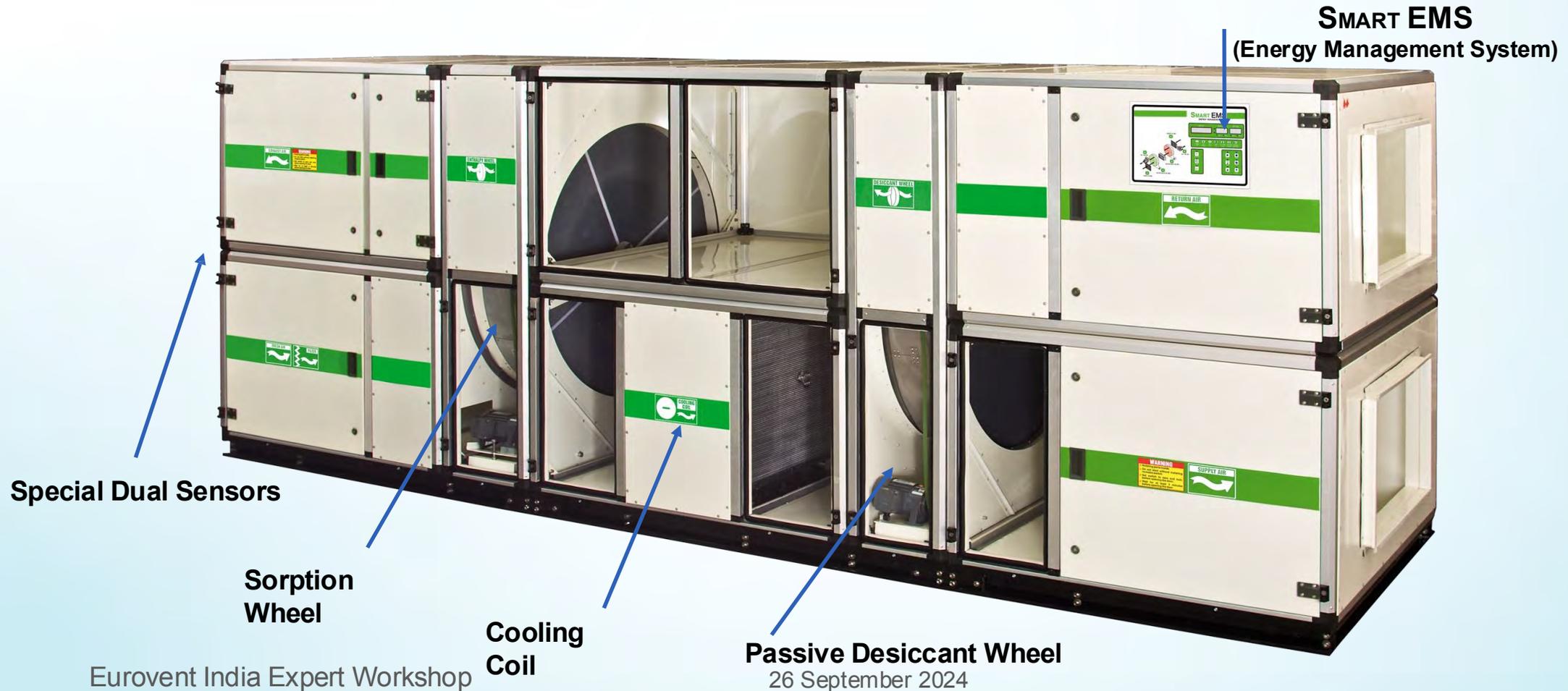
RoHS
compliant



DOAS Dual Wheel Concept



DOAS Dual Wheel Concept



Thank You!

Mr Rahul Aeron
Vice-president
DRI