Sorption technology in energy recovery in AHU´s
Enventus Company Profile

• Manufacturer of
  Rotating heat exchangers, heat wheels

• Turnover 11 Mio Euro (2009)
• 60 employees

• Annual production over 20’000 rotors
• Delivered approx 250’000 rotors over the years

• 3000 m² production area in Sweden
• 1000 m² assembly plant in Kunshan, Shanghai, China

• Market position: Leading Scandinavian supplier
  Number 2 in Europe
Advantages of sorption technology

- 20-40% lower cooling capacity need for AHU´s
- Energy saving in the summer time
- Energy and capacity saving when humidification is needed
- Better air quality (higher humidity) in winter time
Definitions according Eurovent certification program

1. Condensation rotors, non hydroscopic no designed humidity transfer properties
2. Enthalpy / Hydroscopic rotors, low to medium humidity transfer efficiency
3. Sorption rotors, high humidity transfer efficiency

EUROVENT RATING STANDARD for the CERTIFICATION of ROTARY HEAT EXCHANGERS

The class “sorption rotor” has to fulfil specific additional requirements on the latent efficiency: Under all tested conditions with nominal airflow rate, the latent efficiency has to be at least 60% of the sensible efficiency. Rotors which have lower latent efficiency only can be certified in the class “enthalpy rotor / hygroscopic rotor”.
Humidity efficiency of different types

ST1 = Condensation
STE1 = Hydroscopic
HX1 = Sorption
Performance of HX1 Sorption Rotor
with 1.7 mm well height (24C/50%, 30C/50%)
Sorption Rotors (HX1 and HM1)

- Active coating on the sorption foil for sensible and high humidity recovery

- The humidity transfer of the sorption rotors is a physisorption process on a very high active surface.

- There is no chemical process, the catch of molecules is based on Molecule size and weak atomic forces.
Sorption material, Silicagel HX1

- Commonly used material in packing and drying applications, $\text{SiO}_2$
- 1g adsorbent equal to approx. 700 m$^2$. We use silica gel 15 g/m$^2$ aluminum $1\text{m}^2$ surface = 1.5 football fields
- Extreme high humidity efficiency, especially at high RH level
- Wide distribution of pore sizes
- Is not selective on what it adsorbs
Sorption material, Molecular sieve HM1

- Functional group of materials
- Widely used adsorbent in chemical industry.
- Engineered structures to specific function, pore size defined
- In HVAC applications use 3-10Å pore sizes for water (2.7Å)
- We use (AlO$_4$) and (SiO$_4$), 3Å
- High humidity efficiency
- Very selective to adsorb only water molecules
Cool recovery capacity kW/m³/s vs outdoor temp

HM1 2.9 m/s, 1.7 mm, Both indoor and outdoor HR 50%

Outdoor air temperature °C, RH 50%
Case 25°C/50%, 33°C/50%
air flow 36000 m$^3$/h, Rotor 2950 mm, 1.7 mm , 3.0 m/s

<table>
<thead>
<tr>
<th>Explanantion</th>
<th>Condensing rotor</th>
<th>Sorption rotor</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp efficiency</td>
<td>75.0%</td>
<td>75.0%</td>
<td>0 %</td>
</tr>
<tr>
<td>Humidity efficiency</td>
<td>0%</td>
<td>72.7%</td>
<td>72.7%</td>
</tr>
<tr>
<td>Pressure drop</td>
<td>156 Pa</td>
<td>204 Pa</td>
<td>48 Pa</td>
</tr>
<tr>
<td>$\Delta$ Entalphy</td>
<td>6.2 kJ/kg</td>
<td>17.3 kJ/kg</td>
<td>11.1 kJ/kg</td>
</tr>
<tr>
<td>Capacity / m3/s air</td>
<td>7.4 kW/ m$^3$/s</td>
<td>20.8 kW/ m$^3$/s air</td>
<td>13.4 kW/ m$^3$/s air</td>
</tr>
<tr>
<td>Humidity transfer</td>
<td>0</td>
<td>3.6 g/s / m$^3$/s air</td>
<td>4.4 g/s / m$^3$ air</td>
</tr>
</tbody>
</table>

**Cooling capacity saving 13.4kW / m$^3$/s air.** (20.8 if condensing rotor not used in Summer)

Increase of power consumption due to pressure drop increase 0.2 kW/m$^3$/s air
Pay back time

The investment cost of additional cooling capacity is about 100-200 Euro/kW

>>> The capacity savings due Sorption's rotor was 13 kW/ m³/s giving investment savings of 1300-2600 Euro/m³/s

Additional investment for Sorption treatment is 400-800 Euro/ m³/s

With 400-800 Euro investment 1300-2600 Euro savings = 0 days pay back time

There is no additional investment from the system perspective.
To compensate the energy cost of the pressure drop increase we need 3-5% cooling full capacity utilization or total utilization time of AHU or 5- 10 years of AHU without any use of cooling capacity.
Where to use sorption technology

✓ Installations where cooling is required
✓ Regions where peak load management is a topic (capacity shortage of installed power from utilities)
✓ Chilled beam, chilled ceiling, dry cooling fan coils applications
✓ Whenever humidification of supply air is required
✓ Existing installation where chillers capacity is limited and causing problems in summer time
…more info and downloads:

www.enventus.com
Thank you for your interest!

Questions?