Desiccant Enhanced Air Conditioning

Membrane Energy Exchangers

Raising the Bar of Efficiency

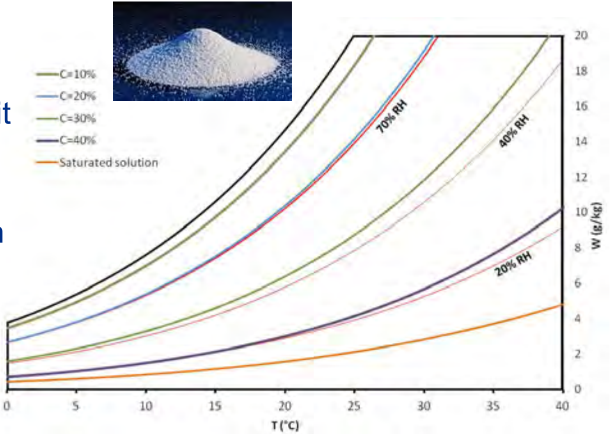
VENMAR CES
A CES Group® Company

Introduction

- The Potential of Liquid Desiccant Technology
- Membrane Energy Exchanger Development
- Active Enthalpy Pump System
- Comparison of System Level Efficiencies
- Conclusions

Liquid Desiccant Technology

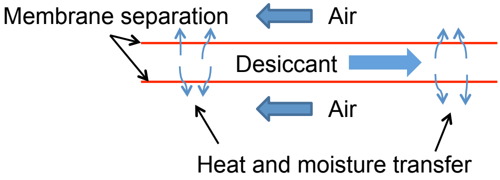
- Advantages:
  - Humidity control
  - Conditioning unit design flexibility
  - Energy efficient dehumidification
- Challenges:
  - Desiccant corrosiveness
  - Exchanger design

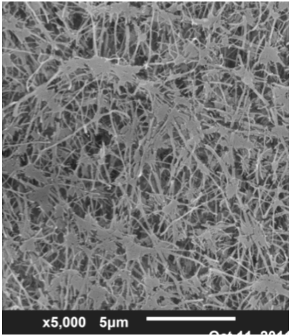


Equilibrium air conditions over Lithium Chloride (LiCl) solution

Membrane Energy Exchanger

- Vapor permeable membrane technology is enabling an exchanger breakthrough
  - Membrane provides complete separation of air from desiccant
  - Low vapor transfer resistance
  - Zero liquid penetration

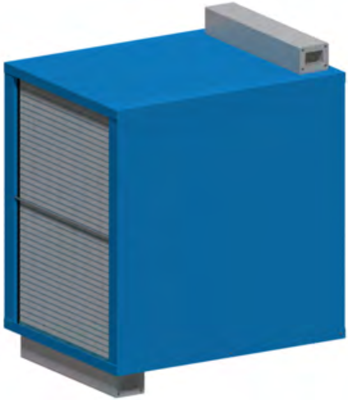




SEM of filtration membrane

Membrane Energy Exchanger

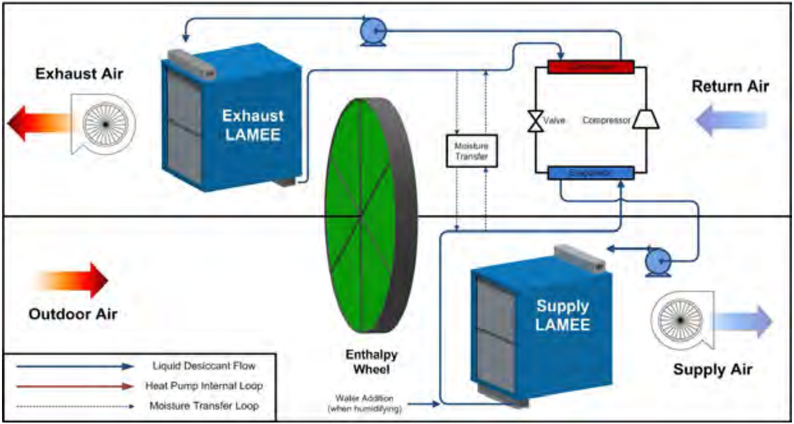
- Viable exchanger design requires:
  - Complete separation of liquid desiccant from the air stream
  - Corrosion resistant (polymer) construction
  - High sensible and latent effectiveness (compact)
  - Cost competitiveness
  - Proven durability
  - Flexibility of application



Counter flow, flat plate Liquid to Air Membrane Energy Exchanger (LAMEE)

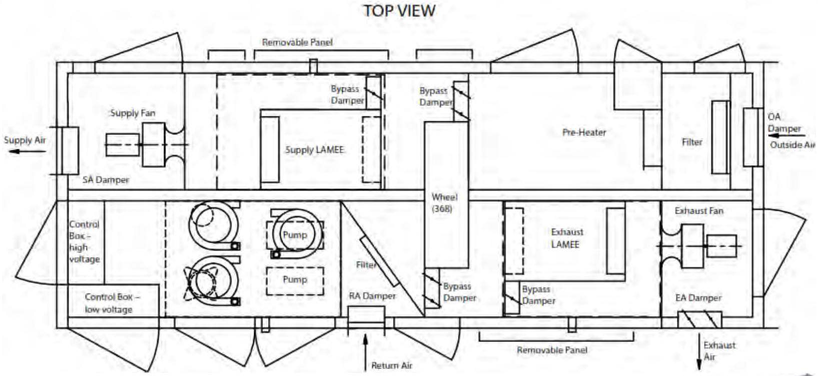
Active Enthalpy Pump

DOAS with liquid desiccant system and heat pump



Active Enthalpy Pump

Packaged unit configuration



- Full packaged unit will help with industry acceptance
- Standard power and ducting connections
- Cost competitive with substantial energy savings!

Efficiency Comparisons

Basic DX Air Conditioning Unit

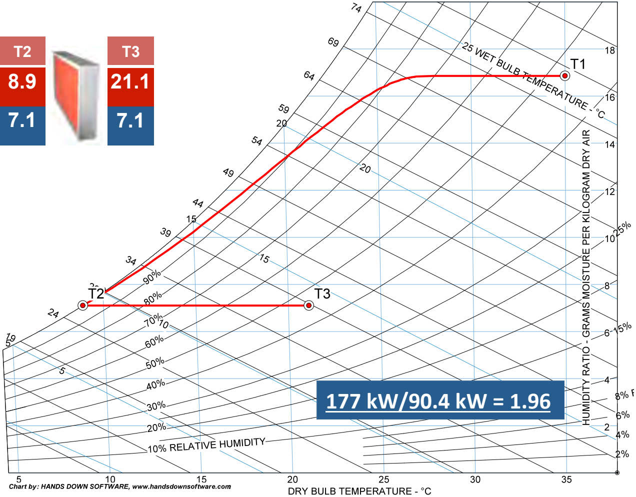
	T1		T2		T3
DB (°C):	35.0		8.9		21.1
W (g/kg):	16.8		7.1		7.1

<u>**177 kW net cooling @ 8000 cfm**</u>

Cooling coil: 233 kW

Power inputs:

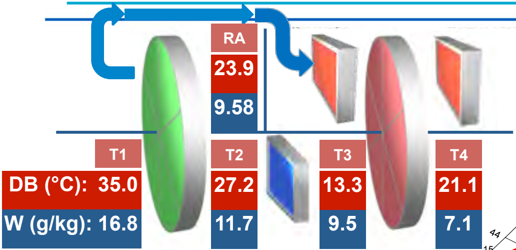
- *Compressor: 79.6 kW*
- *Fans: 4.8 kW*
- *Misc: 6.0 kW*
- *TOTAL: 90.4 kW*



<u>**177 kW/90.4 kW = 1.96**</u>

Efficiency Comparisons

Solid Desiccant System with Active Regeneration (DX)

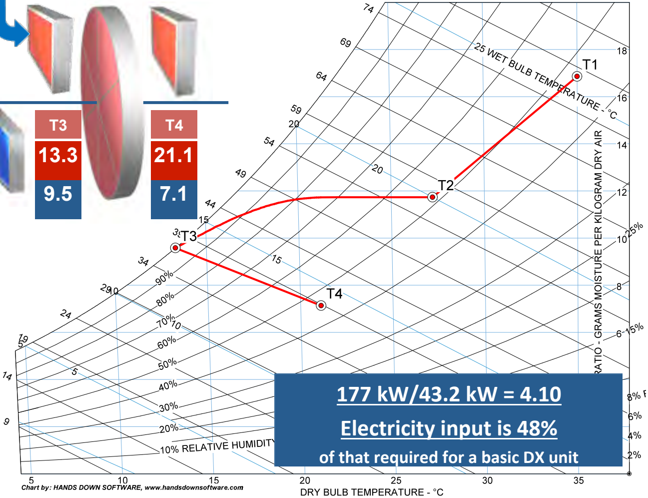


177 kW net cooling @ 8000 cfm

Cooling coil: 89.1 kW

Power inputs:

- *Compressor: 26.0 kW*
- *Fans: 16.0 kW*
- *Misc: 1.2 kW*
- *TOTAL: 43.2 kW*



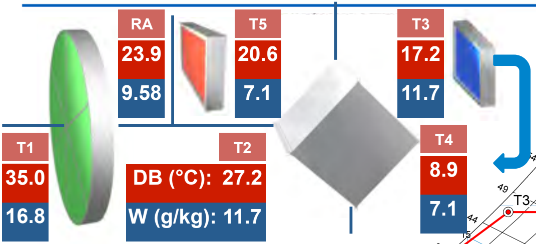
177 kW/43.2 kW = 4.10

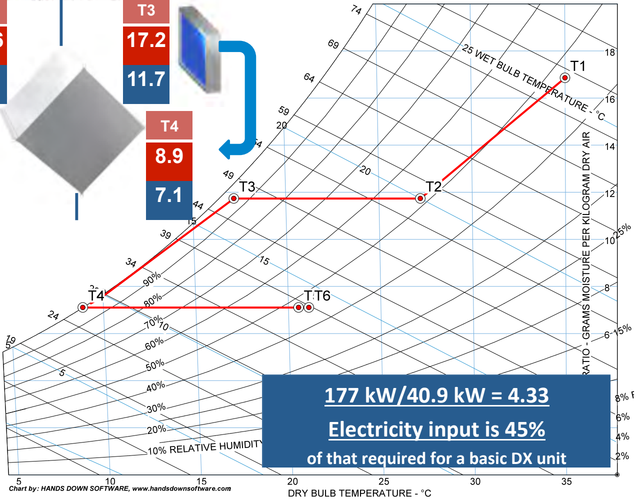
Electricity input is 48%

of that required for a basic DX unit

Efficiency Comparisons

Wheel – Alpha Plate System (DX)





<u>**177 kW net cooling @ 8000 cfm**</u>

Cooling coil: 83.5 kW

Power inputs:

- *Compressor: 24.4 kW*
- *Fans: 13.7 kW*
- *Misc: 2.8 kW*
- *TOTAL: 40.9 kW*

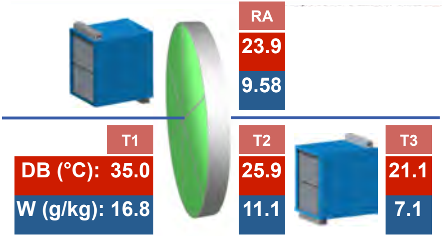
<u>**177 kW/40.9 kW = 4.33**</u>

<u>**Electricity input is 45%**</u>

of that required for a basic DX unit

Efficiency Comparisons

Enthalpy Pump System (DX)

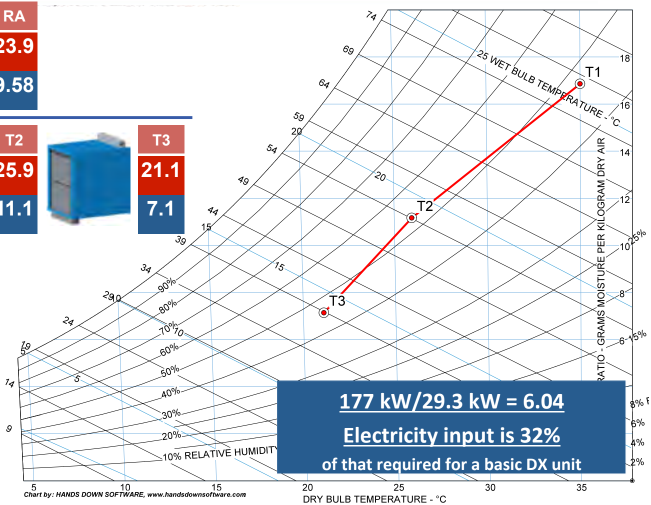


<u>177 kW net cooling @ 8000 cfm</u>

Cooling coil: 76.9 kW

Power inputs:

- ***Compressor: 14.8 kW***
- ***Fans: 13.3 kW***
- ***Misc: 1.2 kW***
- ***TOTAL: 29.3 kW***



<u>177 kW/29.3 kW = 6.04</u>

<u>Electricity input is 32%</u>

of that required for a basic DX unit

Conclusions

- Liquid to air membrane energy exchangers are a revolutionary technology that will change how we condition air in buildings.
- The combination of energy recovery and liquid desiccant conditioning offers significant energy savings even when compared to state-of-the-art HVAC systems.
- Desiccant systems offer expanded capability, especially enhanced humidity control and drying for specialized applications (low dew point).