ZEB-konferansen 2012

Energiforsyning og tekniske installasjoner – hva er valgmulighetene?

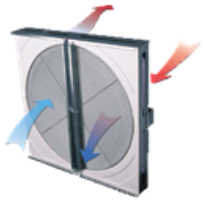
Ventilasjon og energigjenvinning i kaldt klima

Hans Martin Mathisen, NTNU

2012-09-05

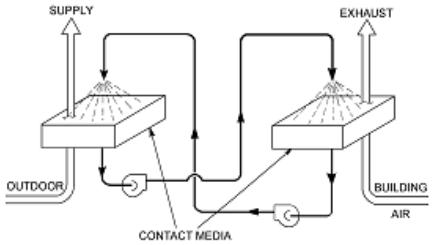
Common heat exchangers

Flat Plate Exchanger (paper or membrane)



Energy (Enthalpy) Wheel

Energy Exchange – Adjacent Duct



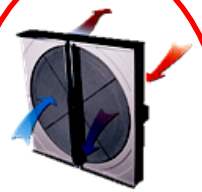
Twin-Tower Enthalpy Recovery Loop

2004 ASHRAE Handbook—HVAC systems and equipment handbook. © American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

Research Stage: Run-around, Membrane Energy Exchanger (RAMEE)

Energy Exchange – Non-adjacent Duct

Heat Exchange – Adjacent Duct



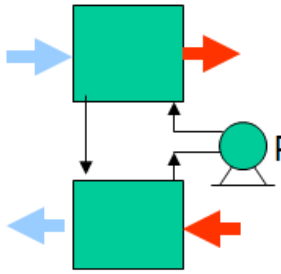
Heat Wheel

Heat Pipe

Flat Plate Exchanger (aluminum or solid plastic)

Heat Exchange – Non-adjacent Duct

Exhaust Exchanger



Glycol Run-Around System

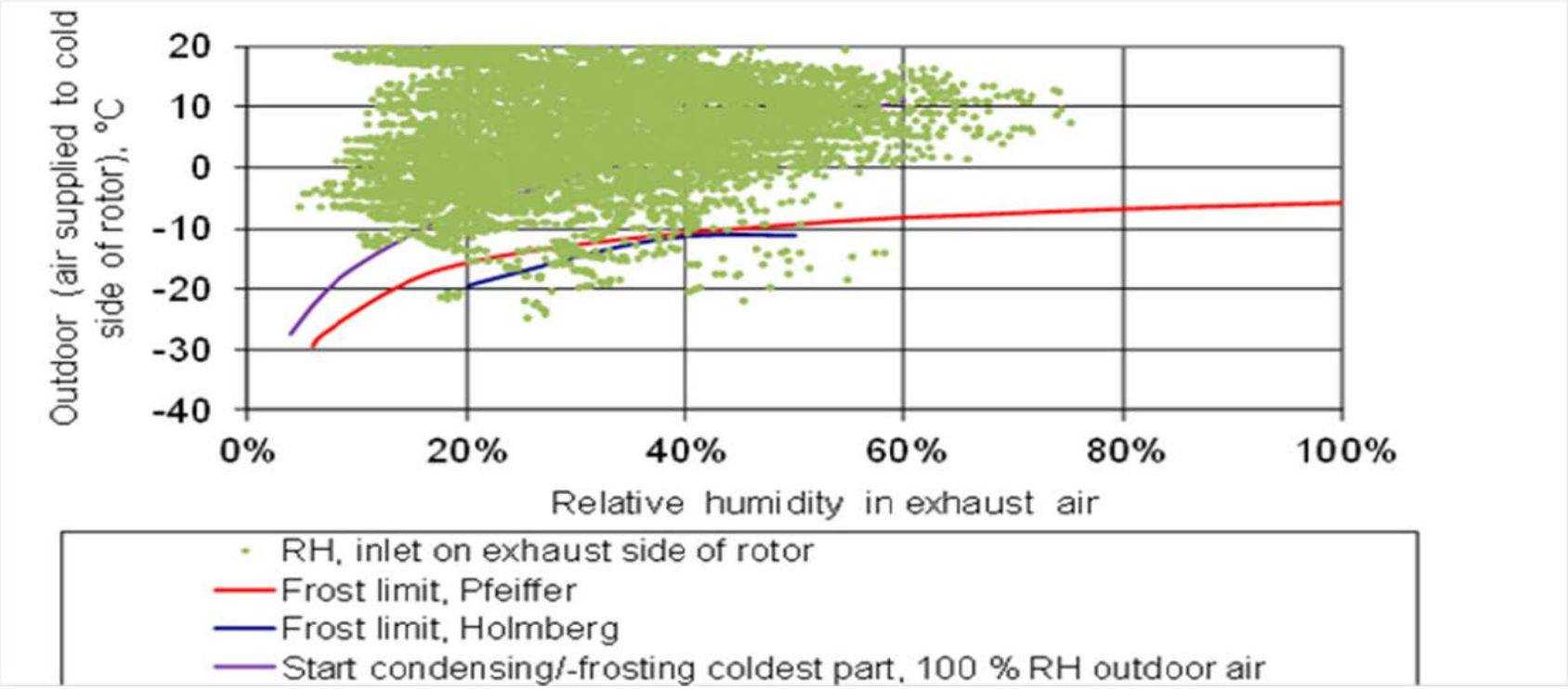
Supply Exchanger

Most common types for residential ventilation

Heat Wheel

- Heat wheels extensively used in Nordic climates.
- Main drawback is the transmission of odours.
- Frosting when excess water condensed in a zone where mean temperature of rotor in one revolution is lower than 0 °C.
- In (Holmberg 1989) practical limits: “Calculations and laboratory tests show that the supply air limiting temperature … can be assumed to be approximately -10 °C (14°F)”.
- Frosting is not a usual problem since frosting is very slow and indoor humidity conditions usually change before this becomes a problem.

Frosting - Heat Wheel



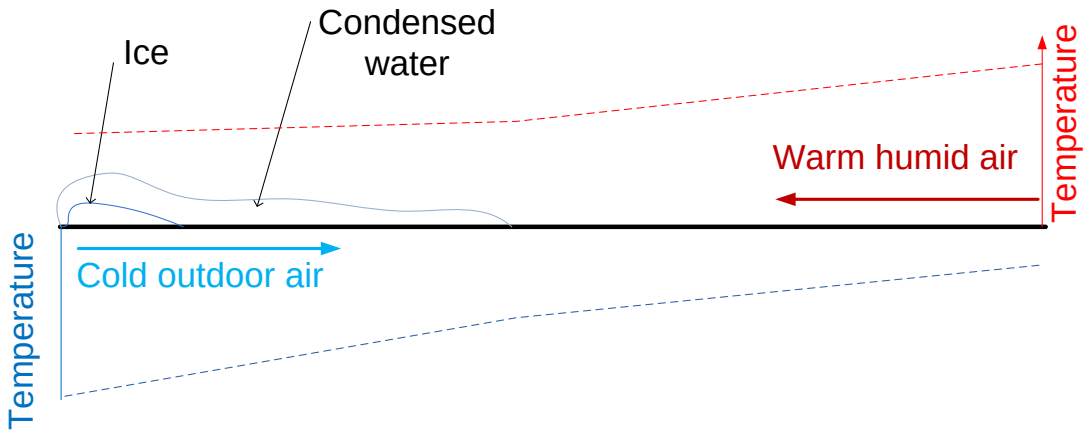
Frost threshold vs (Pfeiffer 1987) and (Holmberg 1989) limits over RH given constant temperature 21° C indoors temperatures and normal year outdoors conditions in Oslo and humidity production from a family with school children and non-home job parents. No humidity absorption in interior materials of the house.

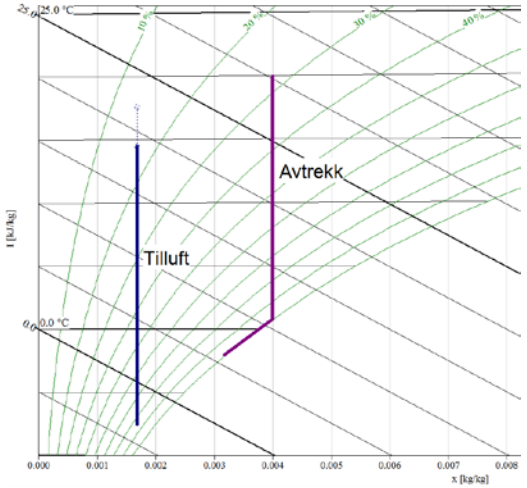
Frosting – Flat plate

- **Flat plate heat exchanger, need of defrosting in cold climates.**
- **Using a membrane reduce the condensation and freezing problems.**
- **In Oslo 70 % moisture efficiency to avoid freezing**
- **Design requires knowledge of the membrane properties**
  - to ensure membrane deflections not increasing pressure drops;
  - and knowledge of moisture and heat transfer properties to ensure adequate transfers

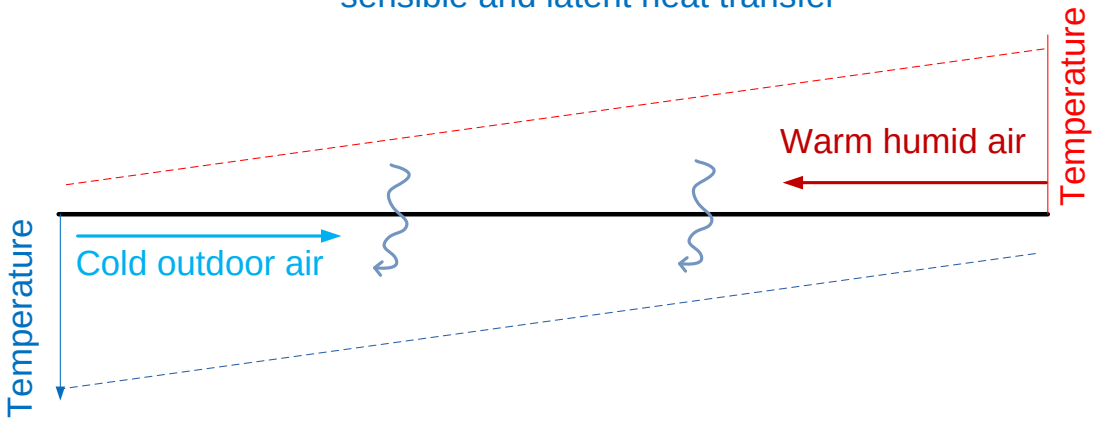
Flat plate exchangers

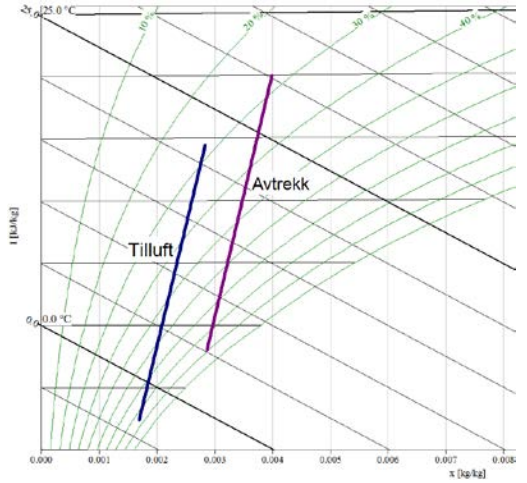
Conventional heat exchanger with heat transfer through aluminium exhanger surface





New energy exchanger with membrane exchanger surface with sensible and latent heat transfer





Membrane transport

- Polar characteristics of water ; a unique penetrant.
- Moisture transfer .
  - water from the "wet" air stream is absorbed on the membrane surface.
  - moisture diffuses through the material from higher to lower humidity concentration
  - Water is desorbed on the dry side .
- Very thin layer of water permeable polymer coatings acts as selective barrier to air and contaminants but allows water vapor passage
- Coatings should be as thin as possible, since they represent another layer to be diffused by the water vapor.

Research issues

- Membrane for flat plate must be hydrophilic and selective to air and contaminants
- It remains to be seen if the structural characteristics will change during longer term testing.
- Also it is important to test if membranes that are saturated in humidity have any effect in fungus or bacteria formation.
- Maximum rate of humidity transfer to avoid freezing has to be thoroughly studied

Takk for oppmerksomheten!!

Hans.M.Mathisen@ntnu.no