Defrosting and Frost Protection Measurements of Heat Recovery in Cold Climate



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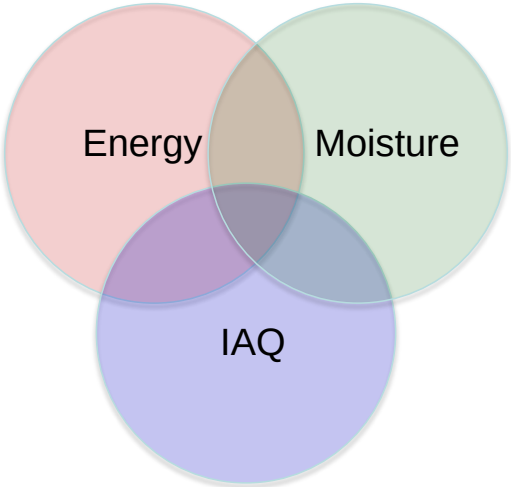

Building Services – LTH
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http://www.hvac.lth.se

http://www.renoveringscentrum.se

Background

- Ventilation losses are an increasing part of all losses
  - Heat recovery is a solution
  - Depends on efficiency of heat recovery
- Simulated efficiencies may often over-estimate benefit
- Frosting or frosting protection may often be a major issue

Frosting protection

- Protection
  - Blocking or turning off the supply air.
  - Bypassing the supply air
  - Pre-heating supply air or heating the extract air.
  - Switching airflow direction or switching between serial heat exchangers.
- Detection
  - Exhaust temperature
  - Exhaust temperature and condensation
  - Pressure drop
  - Visual ice

Aim

- Measurements in 6 air handling units with heat recovery
- Simplified calculations
- Judge the influence from frosting

Method

- Measurements during the winter 2018-2019 in four units, 2012 in two units
- Kiruna, Malmberget, Umeå
- $\eta s = \frac{Tvvx - Tout}{Tet - Tout}$; $\eta e = \frac{Tet - Tex}{Tet - Tout}$
- Simulations
  - Tex<0°C
  - Tex<0°C AND condensation, Tex<Texsat
  - Tsa=20°C; Tet=22°C; vs=1; 2; 4 g/m³

Abr	City	Heat exchanger	Size	Notes
A	Kiruna	Coil	Apartment block	
B	Kiruna	Rotor	Apartment	Not possible to measure Tvvx
C	Kiruna	Plate	Apartment block	
D	Malmberget	Rotor	4 apartments	
E	Umeå	Plate	Apartment block	
F	Umeå	Plate	Apartment block	

Method

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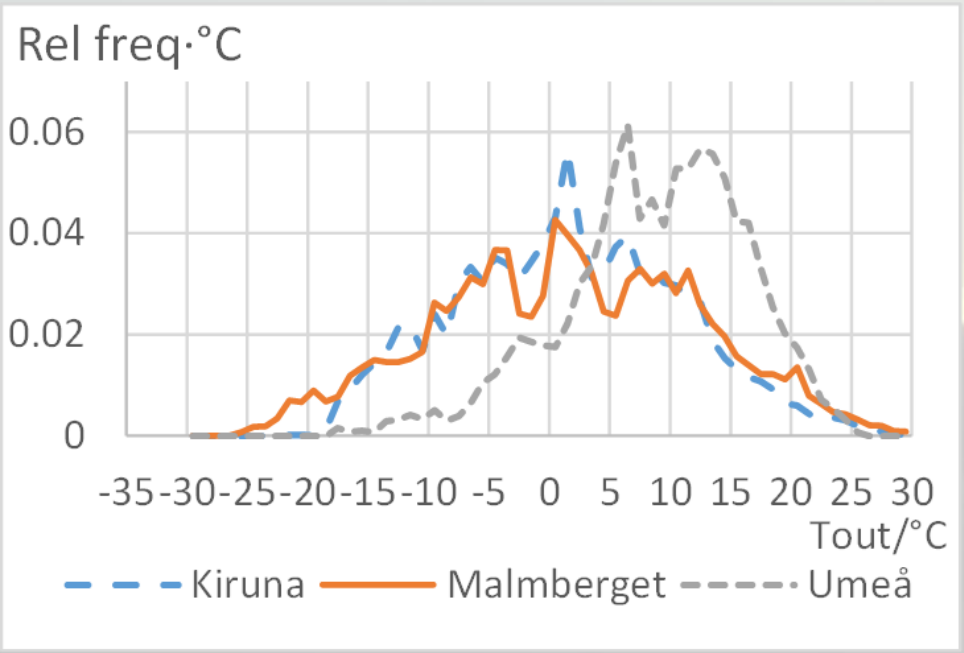
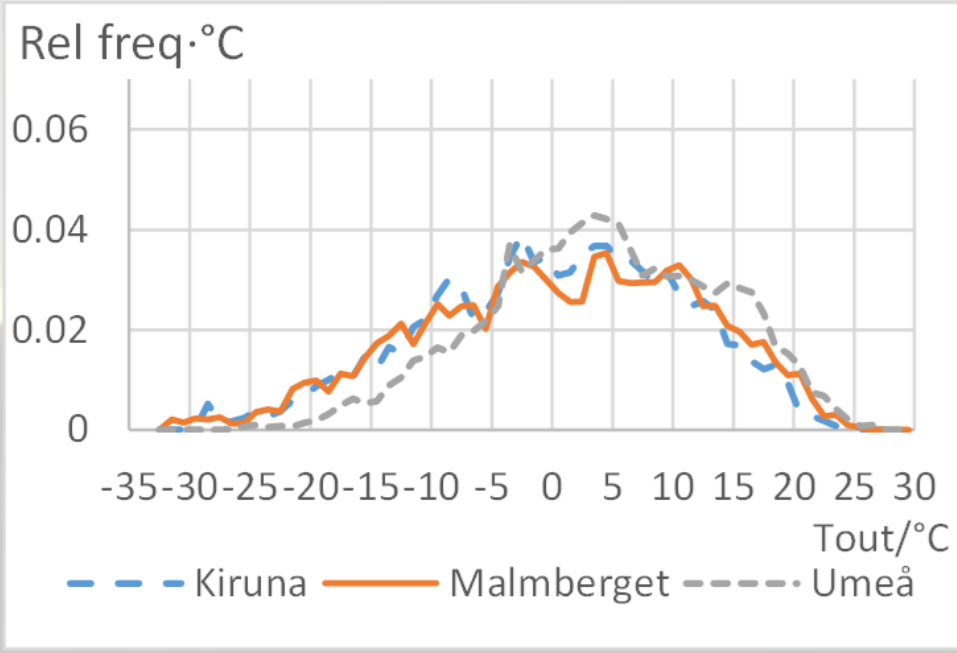
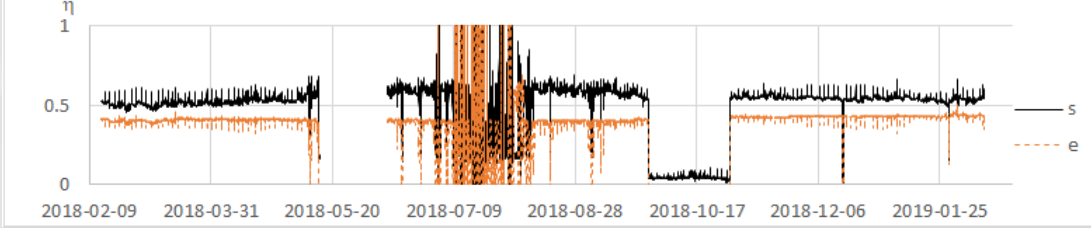
Outdoor climate

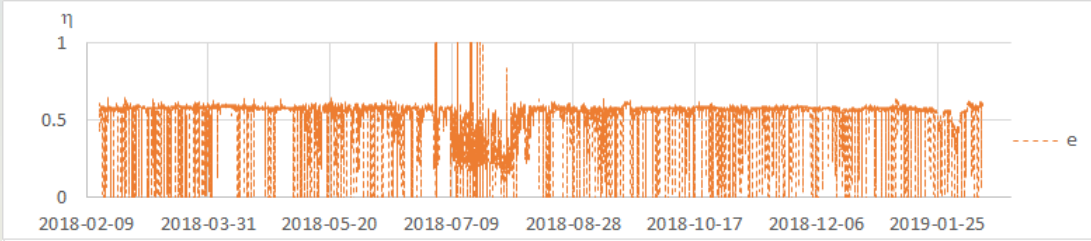


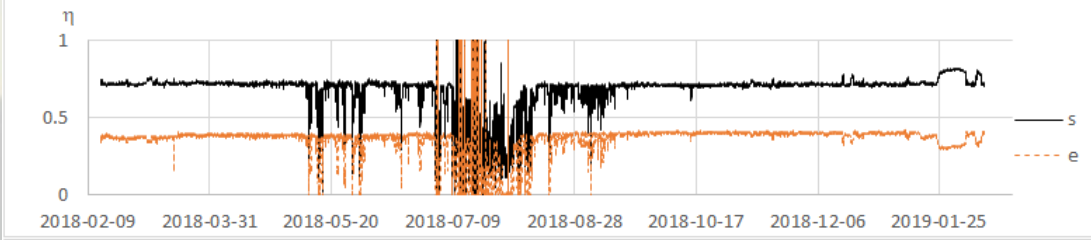


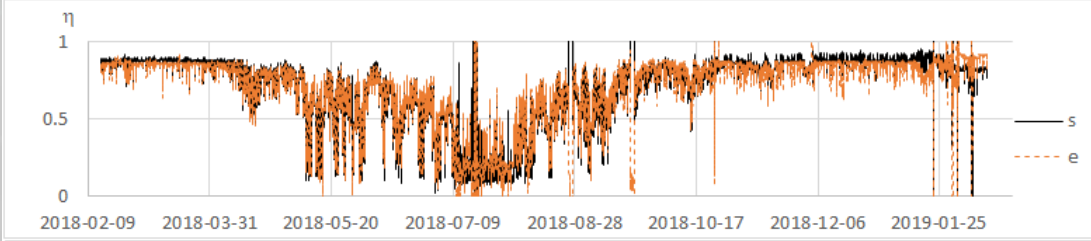
Results

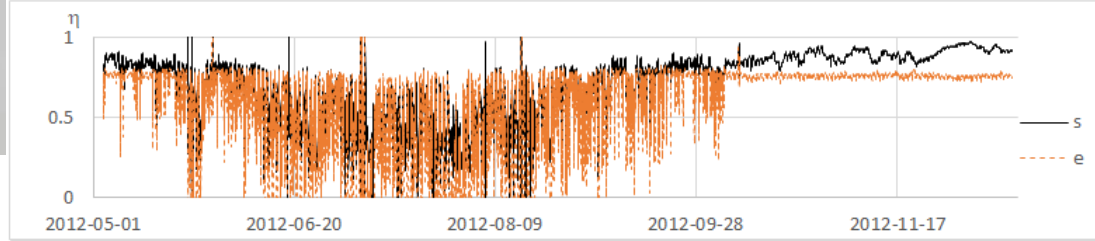
- Temperature efficiencies over time

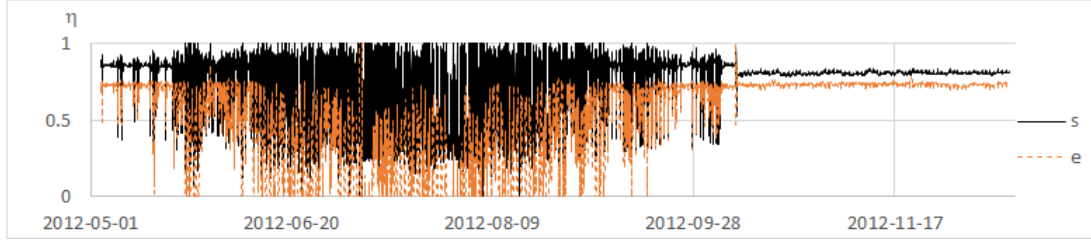




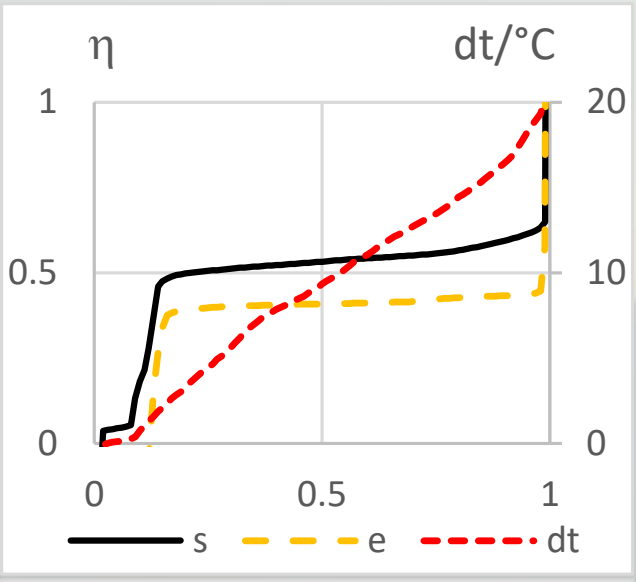


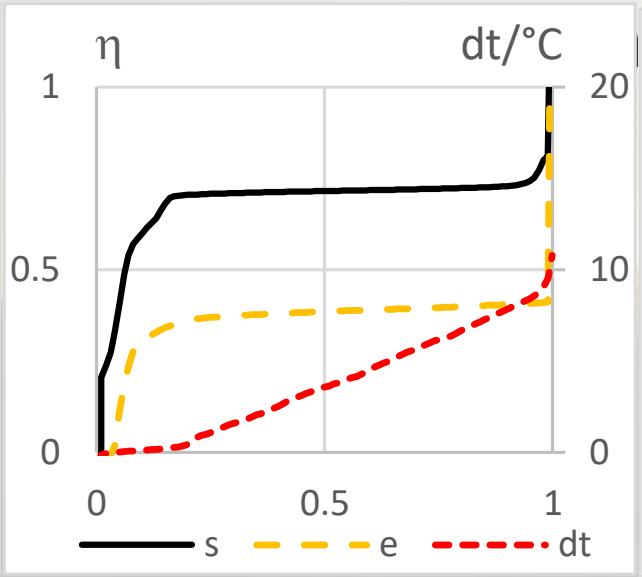


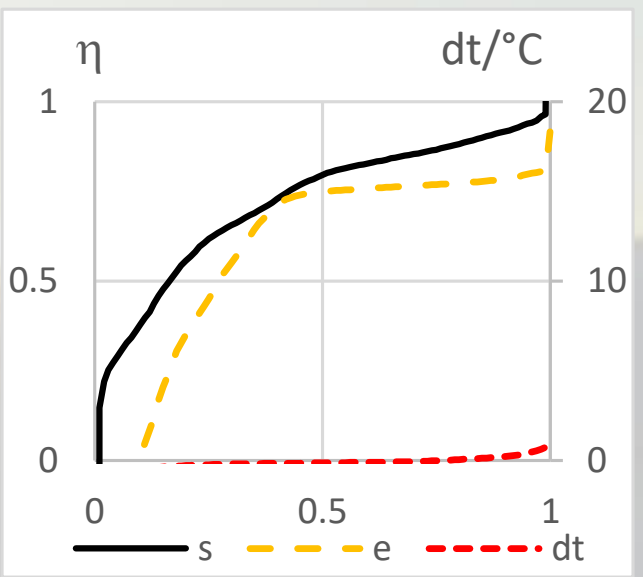


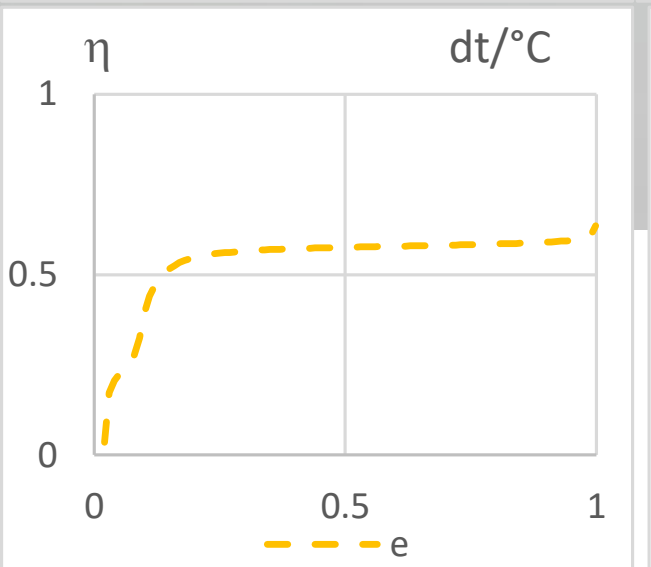


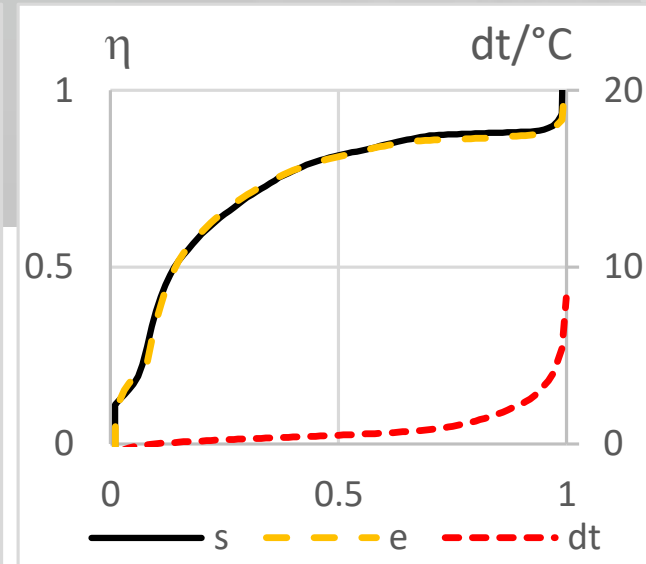
Duration of temperature efficiency and added heating

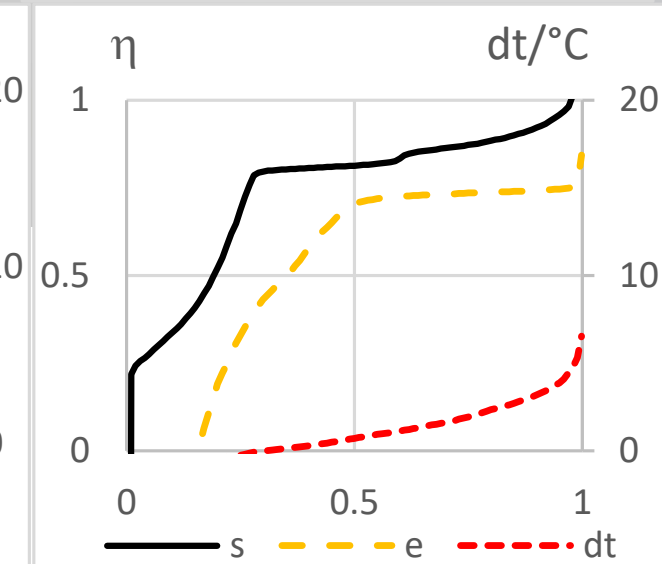






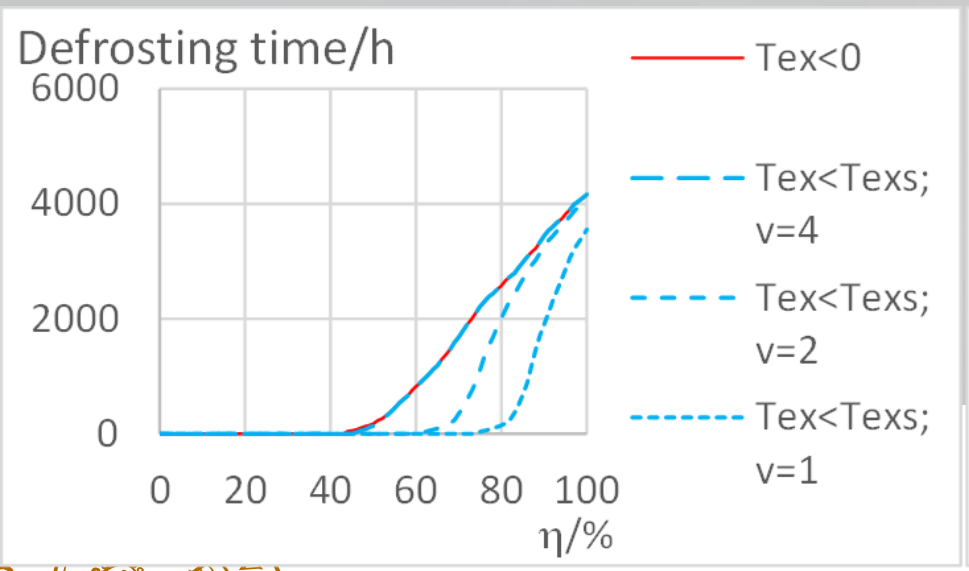


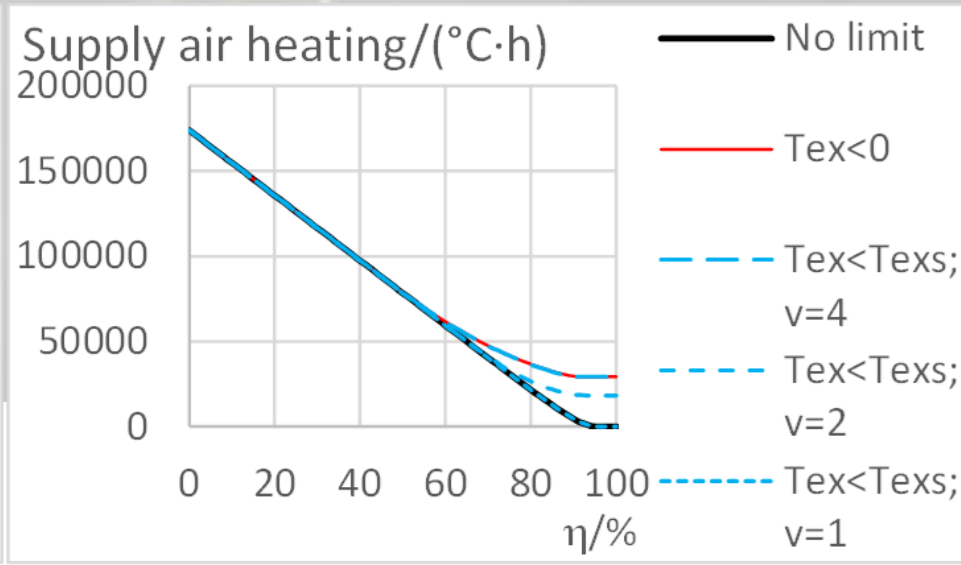




Temperature efficiency and added temperature

- Kiruna Meteonorm outdoor climate
- Tet=22°C; Tsa=18°C
- Constant moisture supply





Conclusions

- Measurements
  - Rather low temperature efficiency in some units
  - Not much frosting conditions occurred in the measurements
  - Imbalance a probable reason for low temperature efficiencies – first priority to check for
- Simulations
  - High moisture supply (indoor vapour content minus outdoor vapour content) is equivalent to just detect subzero temperatures in exhaust air
  - With low moisture supply there is not very many hours of frosting conditions
- Future simulations with varying moisture supply and other parameters
- Measurements in colder and balanced conditions
- Problems exist of frozen rotors

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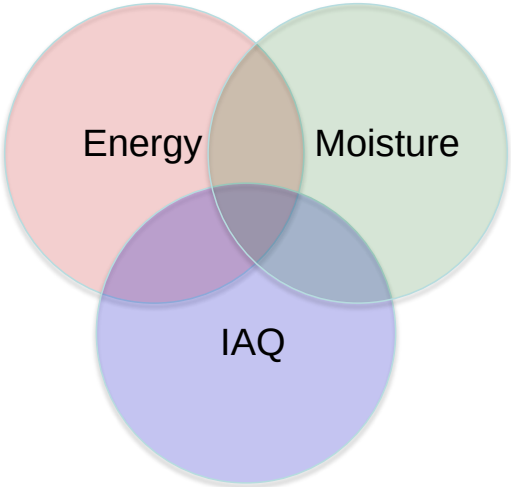

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