



16-11-2023 – 12H15 – 19H – VUB BRUSSELS

STUDIEDAG ATIC: INDIRECTE VERDAMPINGSKOELING – IEA – ANNEX 85

JOURNEE D'ETUDE ATIC: REFROIDISSEMENT EVAPORATIF INDIRECT – AIE – ANNEXE 85





REAL PERFORMANCES OF AN IEC AIR COOLER

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Introduction

Investigation for the existing project using IEC

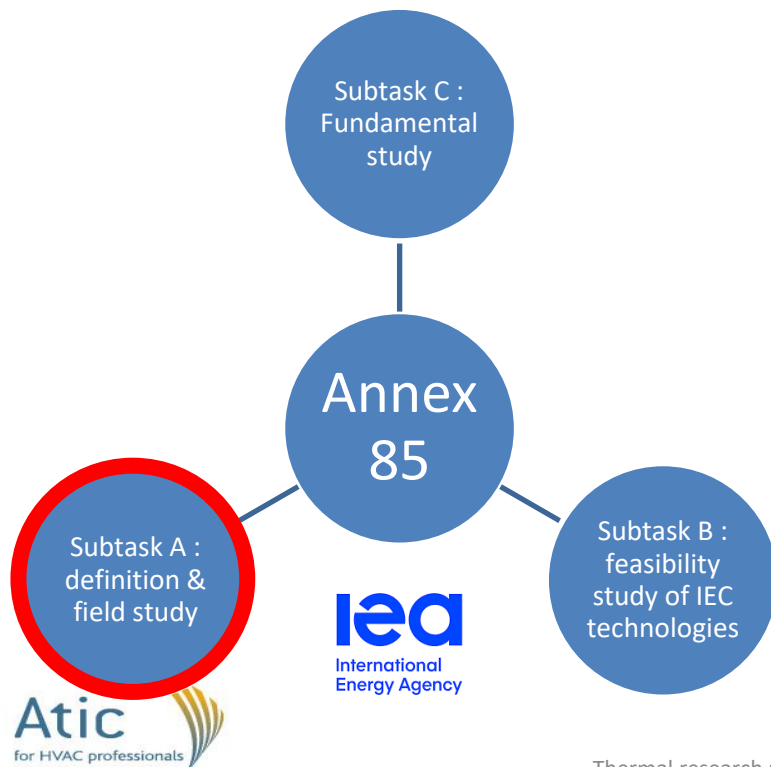
Beter understand how it works

Investigation of the climate data and building feature

What kind of building and weather data

Field testing

Real performances (Summer 2022)



Investigation of the climate data and building feature

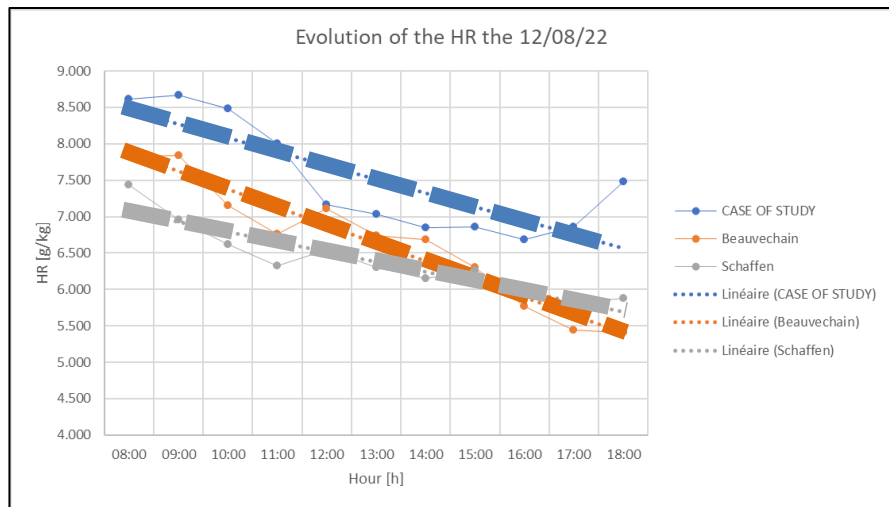


Building overview		
City of Aarschot in an industrial area		
Building area	750	m ²
Building volume to be cooled	1875	m ³
Number of floors (with ground floor)	2	-
Number of employees	7 to 25	-
Heat transmission coefficients (Walls)	0.168	W/m ² *K
Heat transmission coefficients (Roof)	0.186	W/m ² *K
LED for the lights	-	-
Manual external solar screen for the Windows	-	-

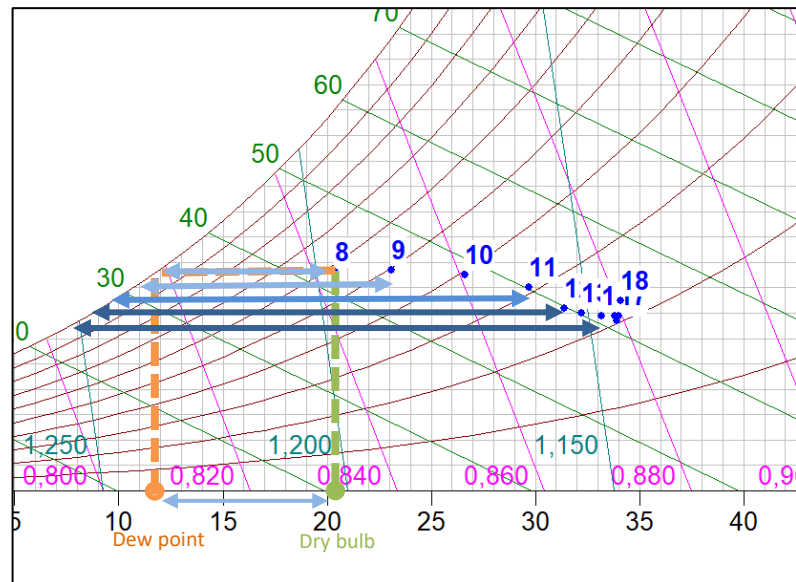
Investigation of the climate data and building feature



The humidity ratio



Dry bulb and dew point ODA



Investigation for the existing project using IEC



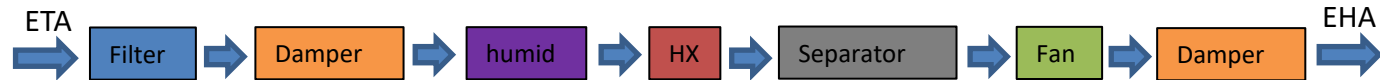
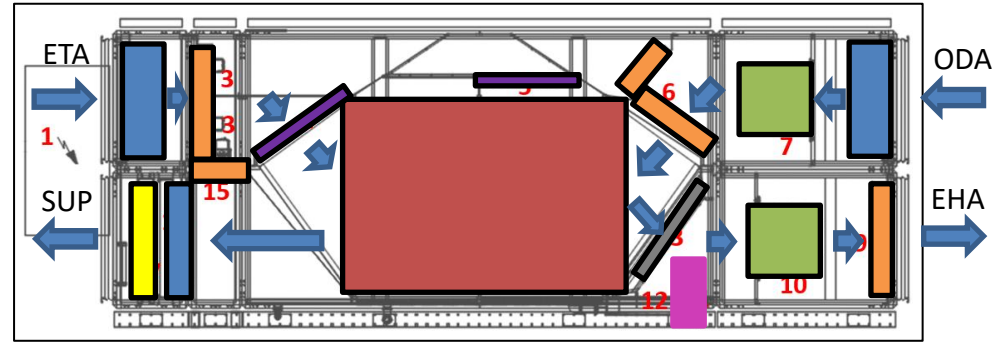
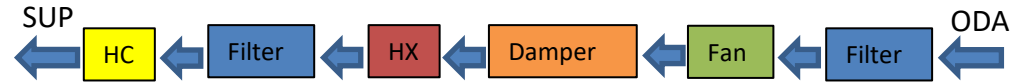
For ventilation and air conditioning



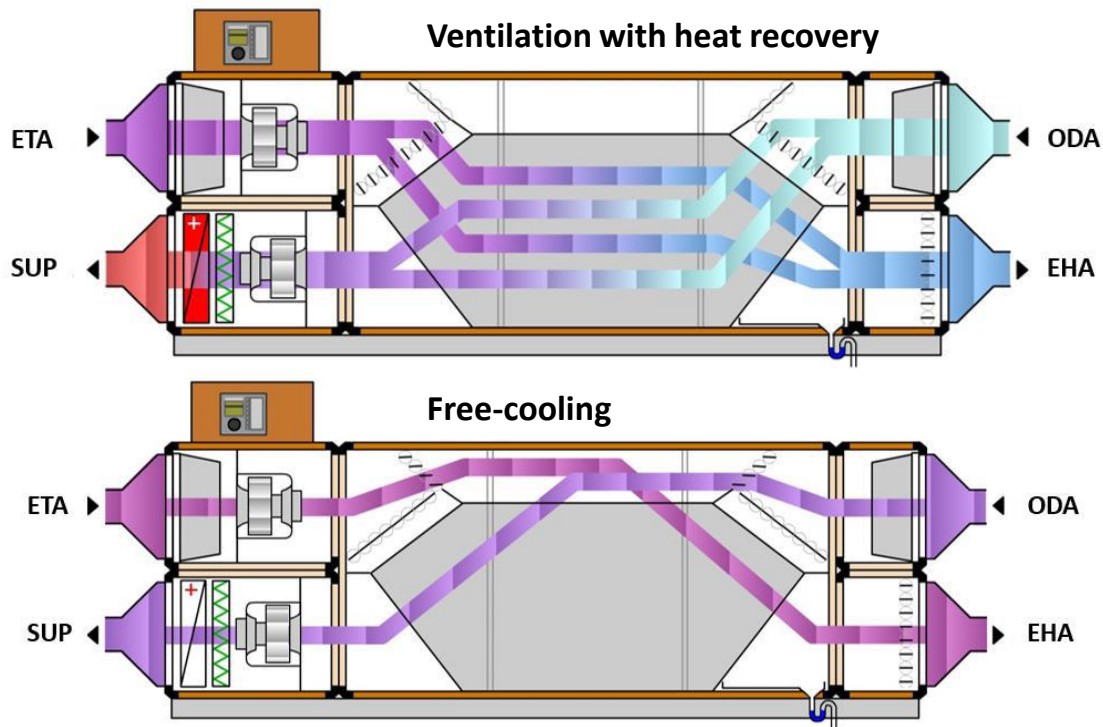
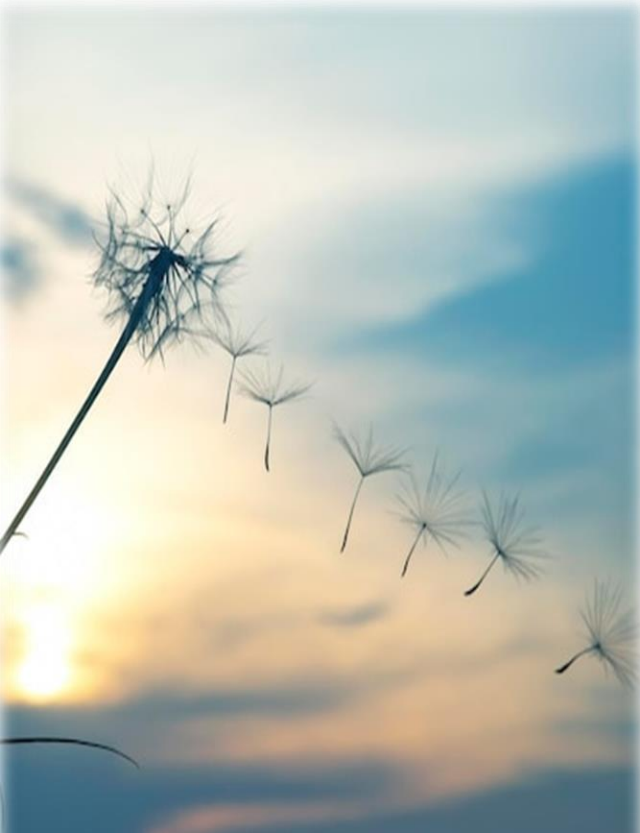
SUP airflow : 2500 [m³/h]



2 different IEC mode

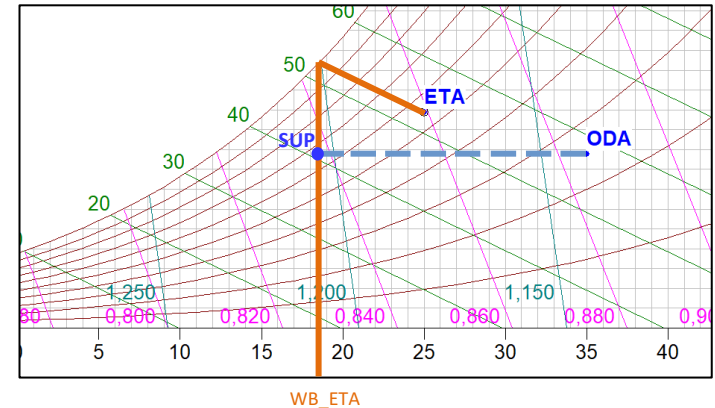
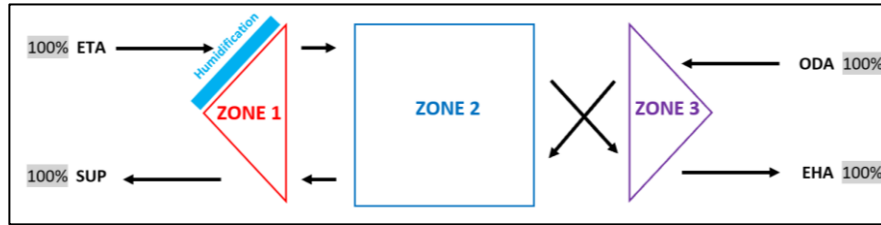
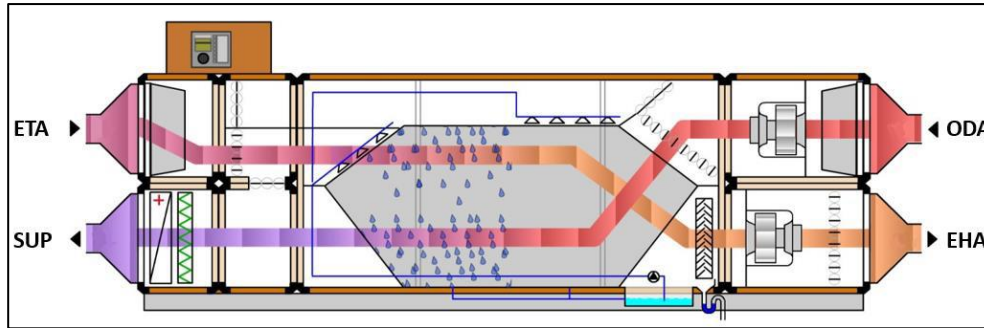


Investigation for the existing project using IEC



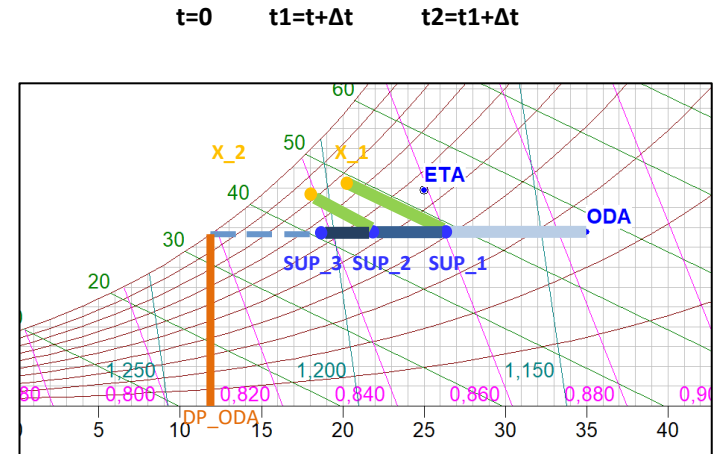
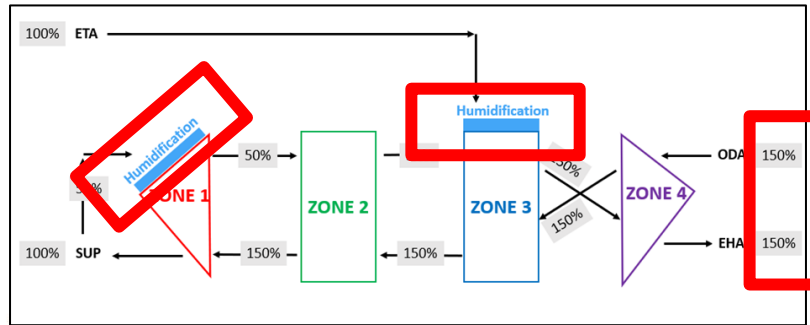
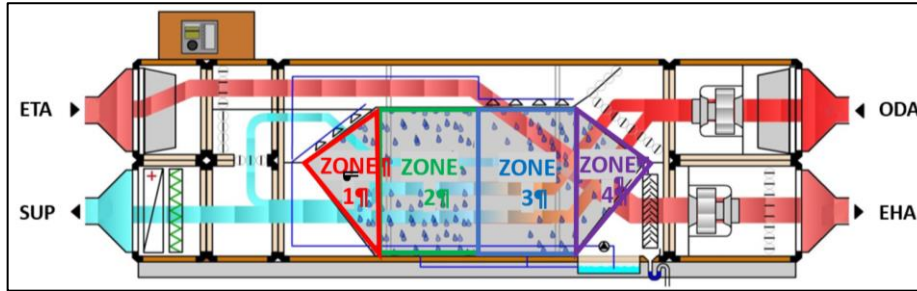
Investigation for the existing project using IEC

IEC 1 – Wet bulb



Investigation for the existing project using IEC

IEC 2 – Dew point



Investigation for the existing project using IEC

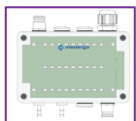
Measurements

$T : \pm 0.4K$;
 $RH : \pm 3\%$



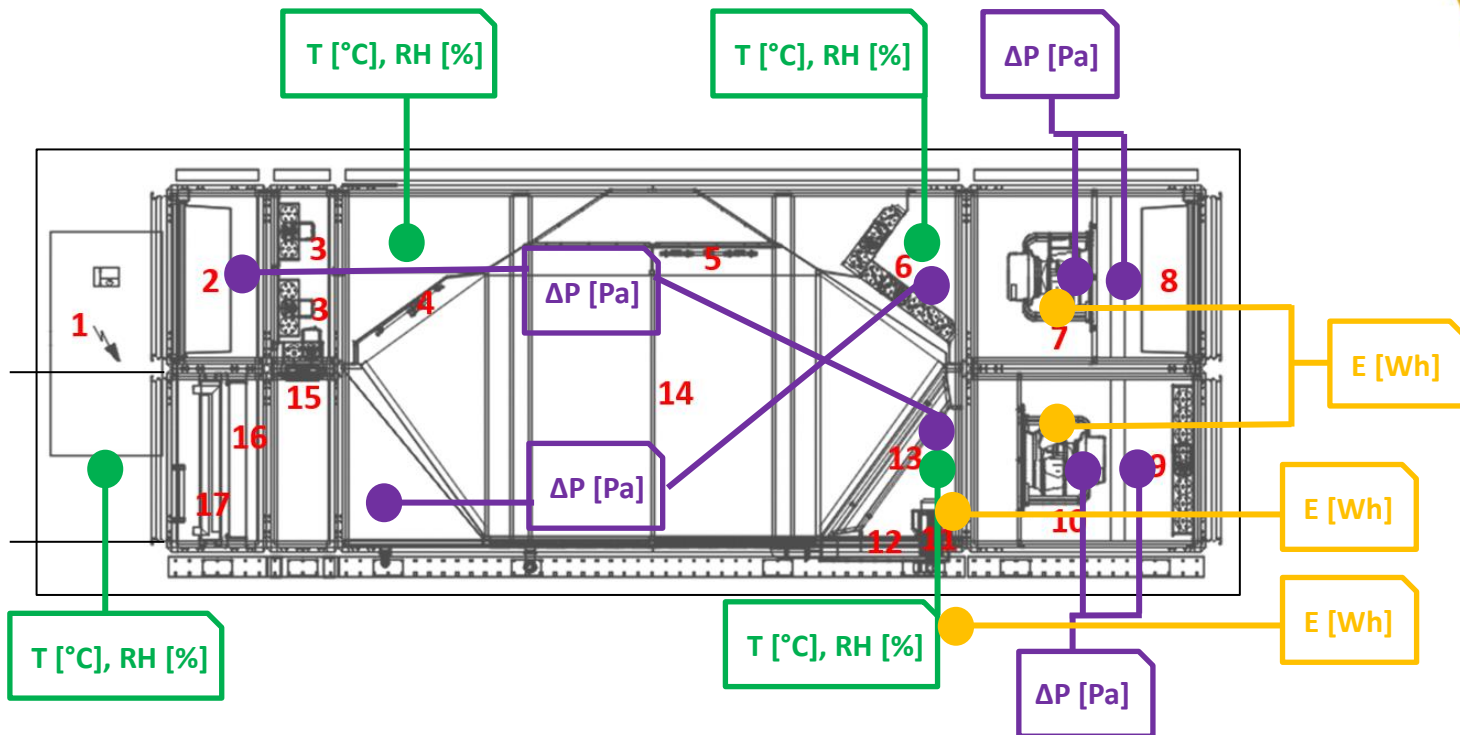
Measurements

$\Delta P : < 2\%$



Measurements

$E :$

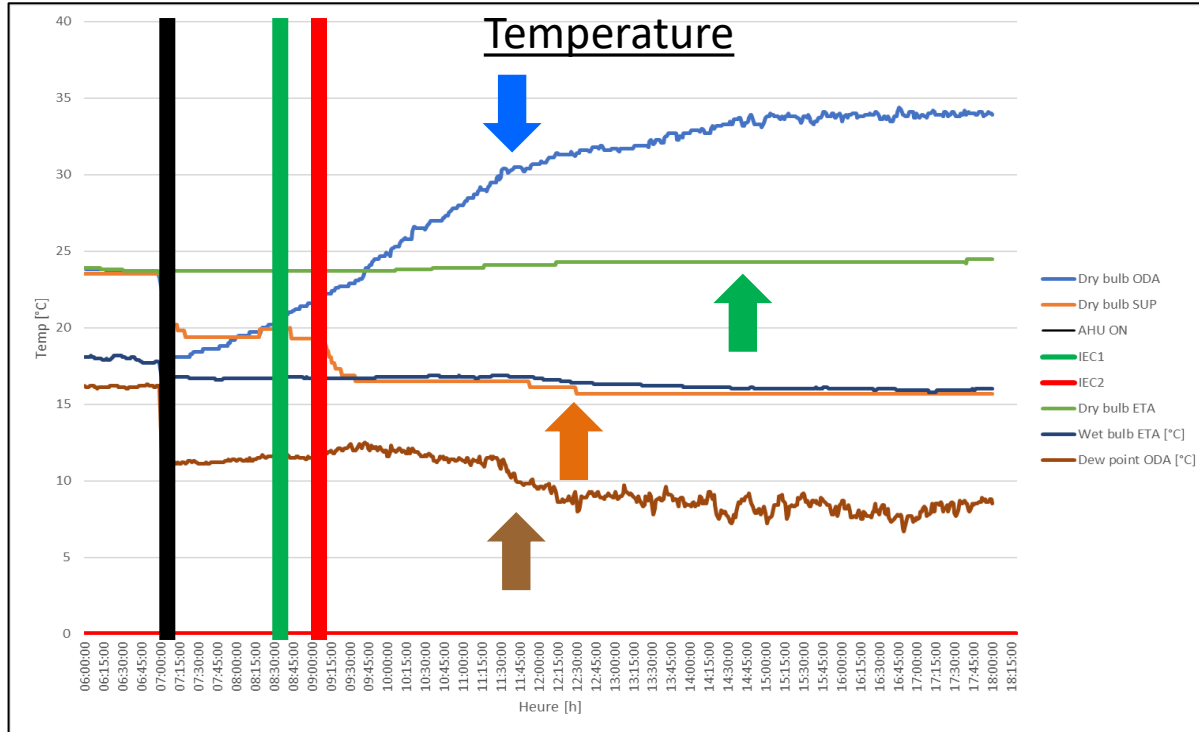


Evaluation of the real performance of and IEC air cooler for the **12/08/22**

- Temperature;
- Friction loss;
- Power consumption;
- Coefficient of performance (COP);

Hour [h] 12-08-2022	AHU mode	± SUP Airflow [m³/h]
06:00:00	OFF	0
07:00:00	ON (ventilation)	2400
08:00:00	ON (ventilation)	2400
08:34:00	IEC1	2400
09:00:00	IEC1	2400
09:06:00	IEC2	2400
10:00:00	IEC2	2400
11:00:00	IEC2	2400
12:00:00	IEC2	2400
13:00:00	IEC2	2400
14:00:00	IEC2	2400
15:00:00	IEC2	2400
16:00:00	IEC2	2400
17:00:00	IEC2	2400
18:00:00	IEC2	2400
19:00:00	OFF	0
20:00:00	OFF	0

Field testing



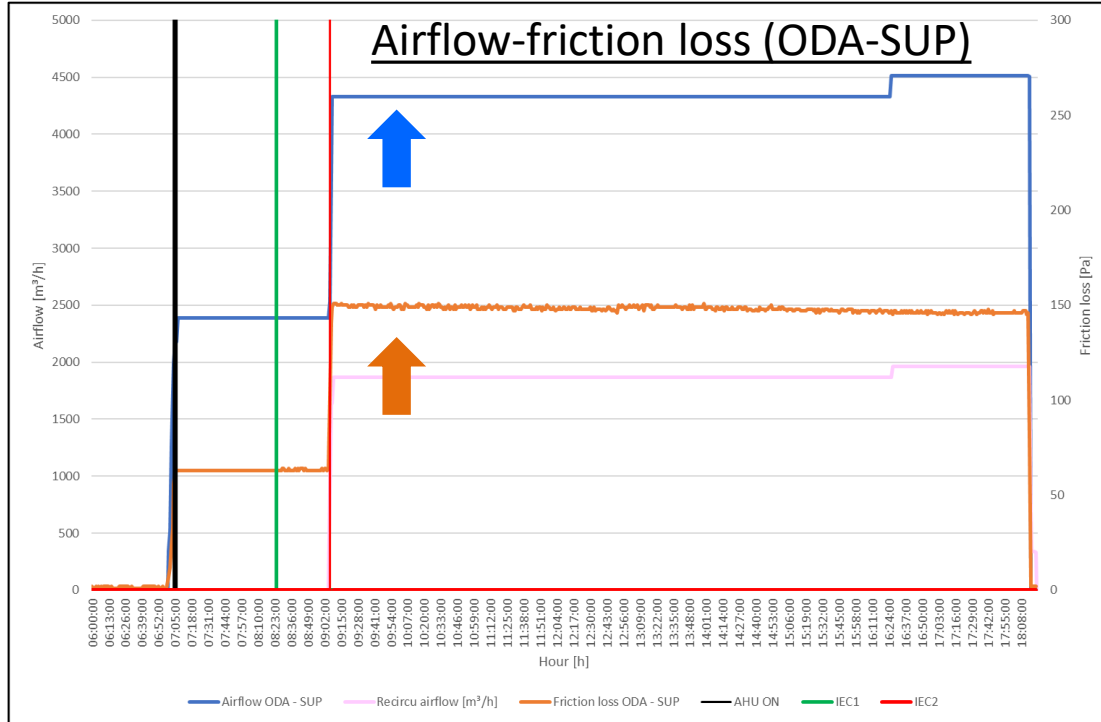
Increasing of dry bulb ODA during the day

Decreasing of dew point ODA during the day

Dry bulb SUP lower than wet bulb ETA

Dry bulb ETA quite constante

Field testing

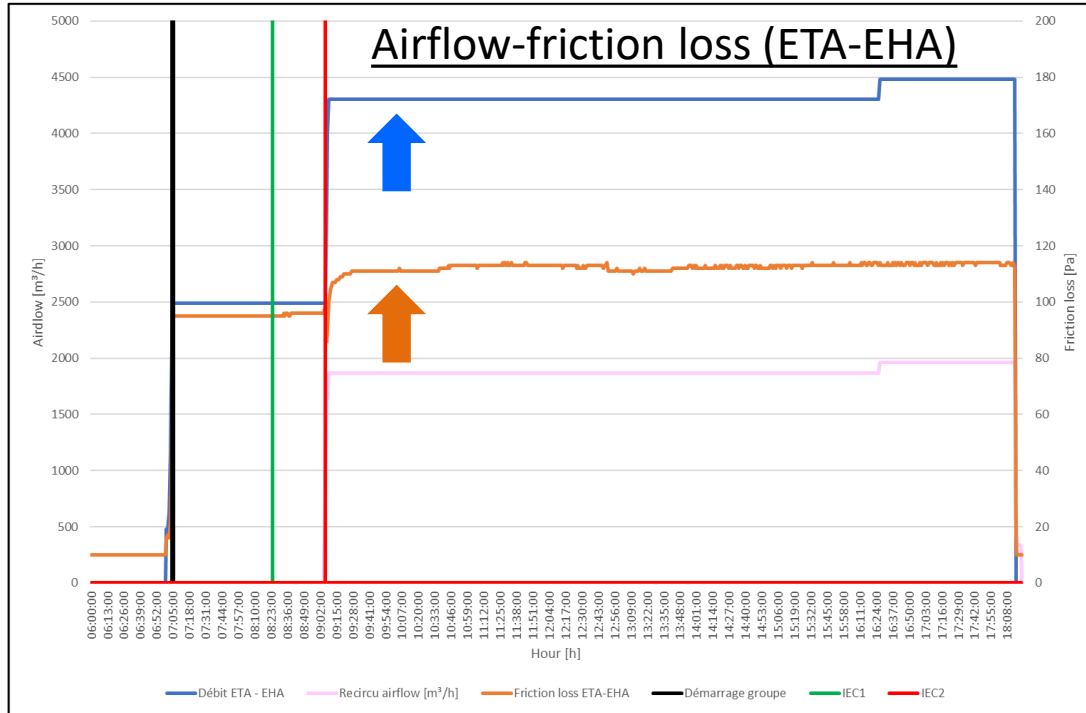


Average value			
	Without IEC	IEC1	IEC2
Airflow ODA-SUP [m³/h]	2390	2390	4370 (4512)
Airflow recirculation [m³/h]	0	0	1890 (1965)
Airflow SUP [m³/h]	2390	2390	2480
Friction loss ODA-SUP [Pa]	63	63	148

Increasing of the airflow for IEC2 mode

Increasing of the friction loss for IEC2 mode

Field testing



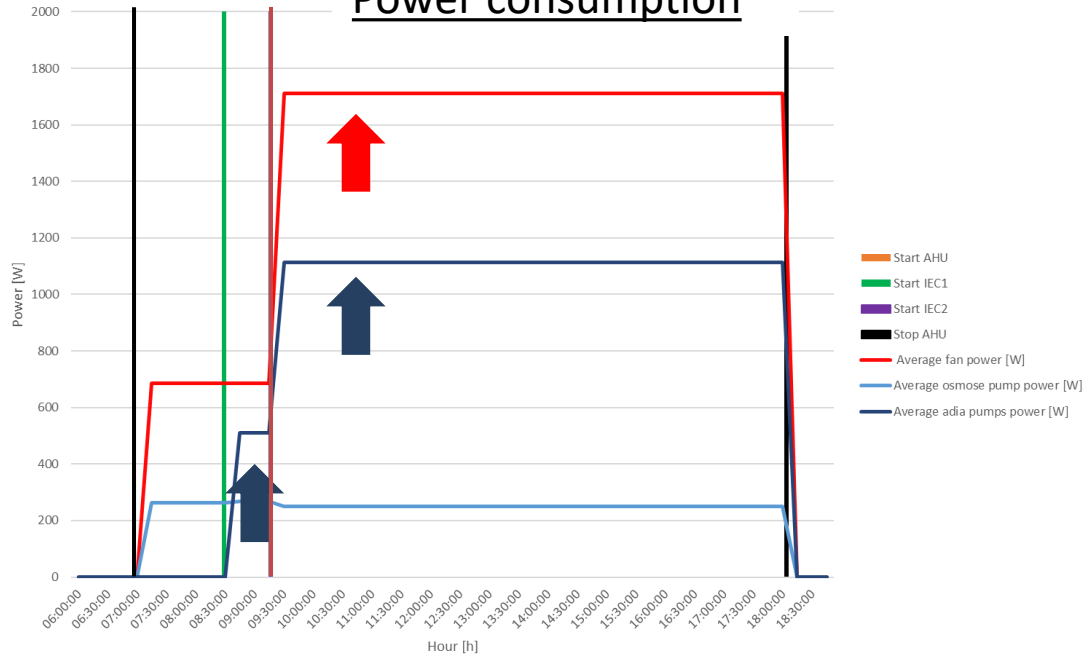
Average value			
	Without IEC	IEC1	IEC2
Airflow ETA-EHA [m³/h]	2490	2490	4330 (4480)
Airflow recirculation [m³/h]	0	0	1890 (1965)
Airflow ETA [m³/h]	2490	2490	2440
Friction loss ETA-EHA [Pa]	95	95	112

Increasing of the airflow for IEC2 mode

Increasing of the friction loss for IEC2 mode but not in the same range compare with ODA-SUP

Field testing

Power consumption



Average value

	Without IEC	IEC1	IEC2
Fan power [W]	686	686	1712
Osmose pump [W]	264	250	250
Adiabatic pumps [W]	0	510	1110

500 [W]
+/-70%

1600 [W]
+/-130%

Adiabatic pump n°1 ON

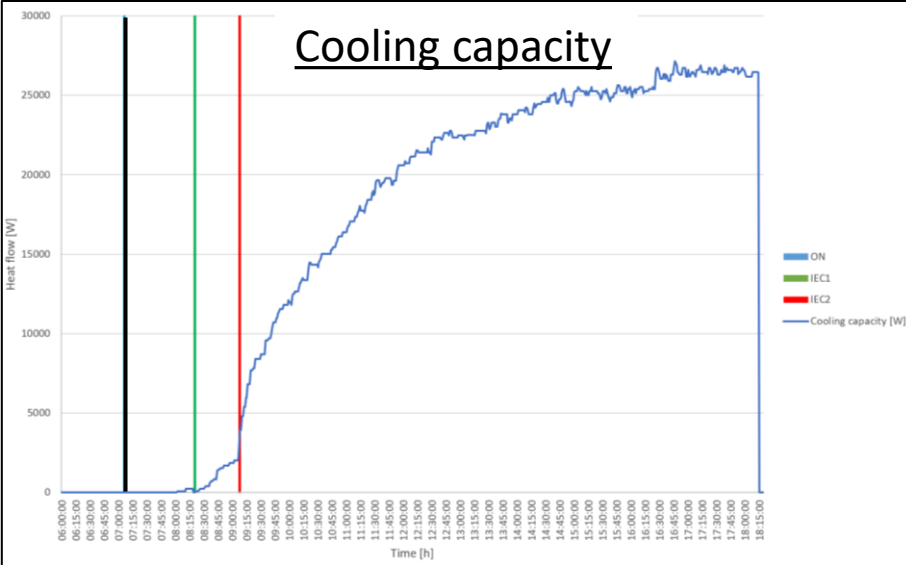
Adiabatic pump n°1 and n°2 ON
and increasing of the airflow and
friction loss

Field testing

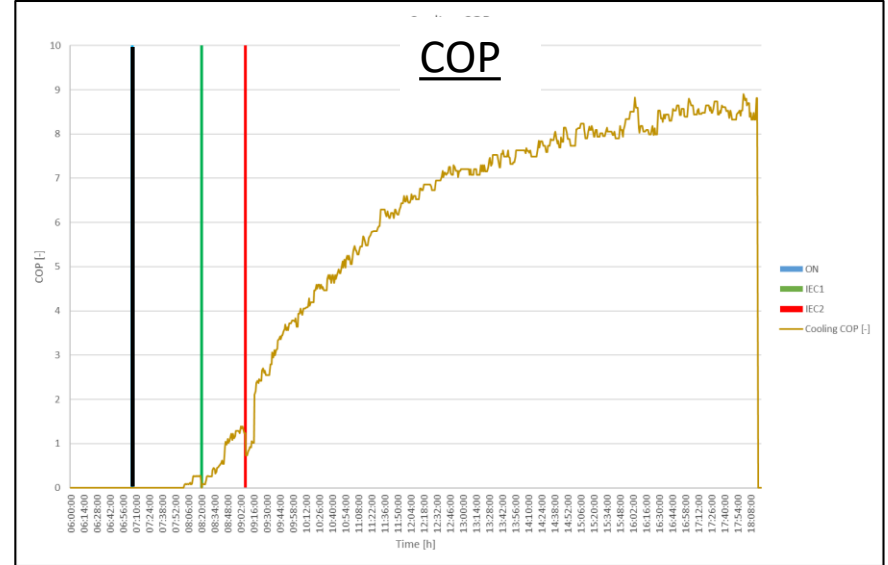
$$\text{Cooling capacity} = \left(\frac{Qv_{ODA-SUP}}{3600} \right) * \rho_{ODA-SUP} * (h_{ODA} - h_{SUP}) [kW]$$

$$\text{Cooling COP} = \frac{\text{Cooling capacity}}{\text{Total power consumption}} [-]$$

Cooling capacity



COP



The conclusion and perspectives

Only a **first approach**/validation of the system

Difficult to understand **the control of the system** (black box);

A good **cooling capacity** (more than 25 [kW]) and a good **cooling COP** (more than 7) in the afternoon;

A **significant increasing** of the **power consumption** ;

What about the **water consumption** ?

Develop a **strong mathematical model** to modify the inputs (weather data and building).

The conclusion and perspectives

“The best time to plant a tree was 20 years ago.
The second best time is now.”

– Chinese Proverb



- [1] Thesis of BRUYERE Pierre-Emmanuel : *Study and instrumentation of an air handling unit with indirect evaporative cooling (IEC)*
- [2] <https://www.carel.com/evaporative-cooling>
- [3] Study report CEREF Annexe85 IEC EN, Pourbaix Adrien, 2022.
- [4] Study_report_II_CEREF__Pourbaix_Annexe85_IEC_EN
- [5] Centrale de traitement d'air adaptée pour le tertiaire, Verplaetsen Johan, le 28/04/21.
- [6] Daikin psychrometric software