

**EXCELLENCE
IN SOLUTIONS**

FläktGroup®



Erinevad soojusutilisaatorid
erinevates kliimaolukordades.
TwinWheel rootorid &
energiasäästlik kuivatus

Heikki Jürilo EKVÜ 24.04.2025

Al ai ai

Kuidas küsida mis sind huvitab, nii, et mitte sattuda olukorda, kus sulle öeldakse, mis sind huvitab.

Ja kokkuvõttes teha seda nii, et sa ei jääks ilma asjadest, millest ei osanud unistadagi.



Energiaklassid A – H, LEED, PREEM, DGNB, WELL, Passive House

SOOJUSUTILISAATORID VASTAVALT OTSTARBELE

FläktGroup[®]



- ROOTORUTILISAATORID
 - Regoterm
 - RegAsorp, Sorptsioon
- PLAATUTILISATORID
 - ristvoolu
 - Vastuvoolu
- VAHESOOJUSKANDJAD
 - Ecoterm
 - Econet

EXCELLENCE
IN SOLUTIONS

Nõuded ja vajadused

- Milline saaste – niiskus, CO2, temperatuur, lõhnad jne.
- Niisutus/ kuivatus
- Hügieeninõuded
- Füüsiline mahtumine ja paiknemine



Peab efektiivselt tomima nii tavaolukorras kui ka ääretingimusel.



PLAATUTILISAATORID

FläktGroup

TALVISED OLUKORRAD

Võtmeküsimus on vajaduspõhine, kastepunkti järgi rakenduv sektsioonsulatus

AFP (Advanced Frost Protection)

Kuni -25°C ilma eelsoojendusega – säästab eelsoojenduse paigalduselt/eksplotatsioon

Väike järelkütte võimsus – säästab soojussõlmelt/soojuspumbalt jne

Väljatõmme 2 m³/s; +22°C @ 20%RH

Sissepuhe 2 m³/s; +20°C

PLAATUTILISAATORID	Kasutegur	EN308	Järelküte AFP	Temp. peale	AFP rakendub
	@ - /25°C			plaati	alates
	%	%	kW	°C	°C
Välis temperatuur -25 °C					
Vastuvoolu plaat sektsioonsulatus	57	83,5	42	+2	-0,6
Ristvoolu plaat sektsioonsulatus	52	75,6	48	-0,6	-1,7
Välis temperatuur -21 °C					
Vastuvoolu plaat sektsioonsulatus	57	83,5	38	+3,7	-0,6
Ristvoolu plaat sektsioonsulatus	52	75,6	44	+1,3	-1,7
Möödaviiguga plaat, rõhuvahe järgi sulatus	----	83,5	72	-10...-15	-0,6

Intelligentse härmatisest hoidumisega AFP vs bypassiga versioon => u 1,9 x suurem tipukoormus.
Suurem soojussõlm/soojuspump, pumbad, torud, armatuur, isolatsioon jne.



VAHESOOJUSKANDJAD

Eraldatud õhuvoolud

Parim kasutegur ka seal, kus teisi utilisaatoreid kasutada ei saa.

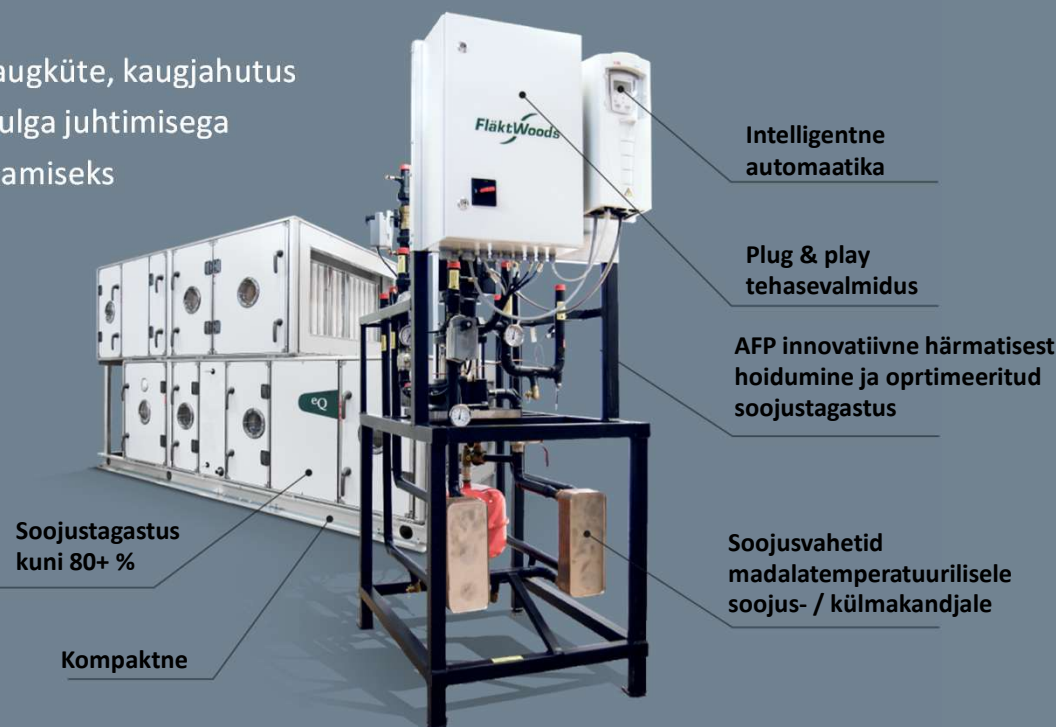
Madalatemperatuuriline lisaküte – soojuspumbad, jääsoojus, kaugküte, kaugjahutus

Intelligentne, vajaduspõhine härmatisest hoidumine AFP, vooluhulga juhtimisega

Vedeliku/õhu massivooluhulga kontroll parima kasuteguri saavutamiseks

Eestis on paigaldatud üle 350 Econet® seadme

VAHESOOJUSKANDJAD		EN308	Lisaküte	Temp. ilma
			AFP	lisasoojuseta
		%	kW	"C
Välitemperatuur -25 "C				
Econet		71,1	54	+2,8
Econet Premium		83,4	57	+2,1
Välitemperatuur -21 "C'				
Econet		71,1	43	+3,3
Econet Premium		83,4	43,5	+2,5



ROOTORID

- Regoterm alumiiniumrootorid
- RegAsorp sorptsioonrootorid

Uue generatsiooni Zeolite „molekulaarsõelaga“ adsorbsioonkate

Niiskusülekanne ja suvine kuivatusvõimsus 30% parem

Jahutuse utiliseerimine koos kuivatusega!

Härmatumise oht väiksem

3Ångström pinnakate– minimaalne saaste ülekanne

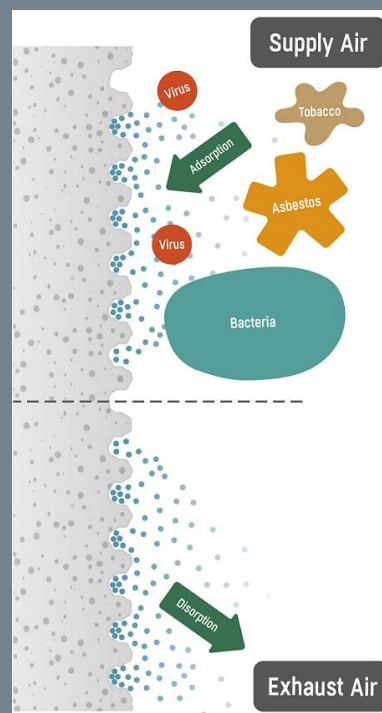
Pikk tööiga

- TwinWheel - RegAsorp + Regoterm

Parima kasuteguri ja kuivatusvõimsusega,
ideaalne kasutada koostöös jahutuspaikidega,
lisaks väga efektiivne soojustagastus.

Lihtne tööpõhimõte:

- I astme Regasorp rootoris kuivatatakse
- Jahutuskalorifeeris järelkuivatus
- II astme Regoterm rootoris soojendatakse sissepuhe ja eeljahutatakse väljatõmme.



ROOTORID TwinWheel numbrites

TwinWheel - RegAsorp + Regoterm

- Võimas jahutustagastus/kuivatus väikese jahutusvõimsusega, väiksem jahutusseade
- Ei vaja järelkütet peale jahutus-/kuivatuskalorifeeri – vähem installatsiooni
- Talvel väga efektiivne soojustagastus;
 - välistemperatuuril -10...-15°C - > sp u +19°C kui vt +22°C => dT 3..4 °C



Õhuhulk 2 m3/s	Jahutuse tagastus	Kastuegur EN308	Niiskuse kasutegur	Järelküte Jahutus	Temp peale utilisaatorit	SFP
Välistemperatuur -21 "C" -> ruumi +20" C	%	%	%	kW	"C	
Rooror Regoterm alumiinium 8		83,1	43,7	11,2	+14,7	1,43
Rooror sorptsioon 8		83,9	82,7	10,5	+15,1	1,49
Roororid TwinWheel 8/6		83,3/79,7	81,6	4,1	+17,6	2
Roororid TwinWheel 6/6		79,8/79,7	78,3	5,2	+17,1	1,8
Välistemperatuur +27 "C @ 60% RH, kuivatuseks jahutus +12" C => ruumi 45 % RH						
Rooror Regoterm alumiinium	81,4		0	65,6	25,4/66	1,43
Rooror sorptsioon 8	83,1		76,6	52,7	25,3/53	1,49
Roororid TwinWheel 8/6	82,4		75,0	33	+ 12...+20	2
Roororid TwinWheel 6/6	79,8		68,0	39	+ 12...+20	1,8

Rooror peab olema optimaalne, et säästa SFP'd.

UTILISAATORID KOKKUVÕTE

TwinWheel võimaldab

- vähendada suvel kuivatusvajadusel jahutusvõimsust 30...50 %
- vähendada talvel järelkütte võimsust kuni 50%

RegAsorp sorptsioonrootor võimaldab

- vähendada jahutusvõimsust 20 + % ja vähendab tipukoormust

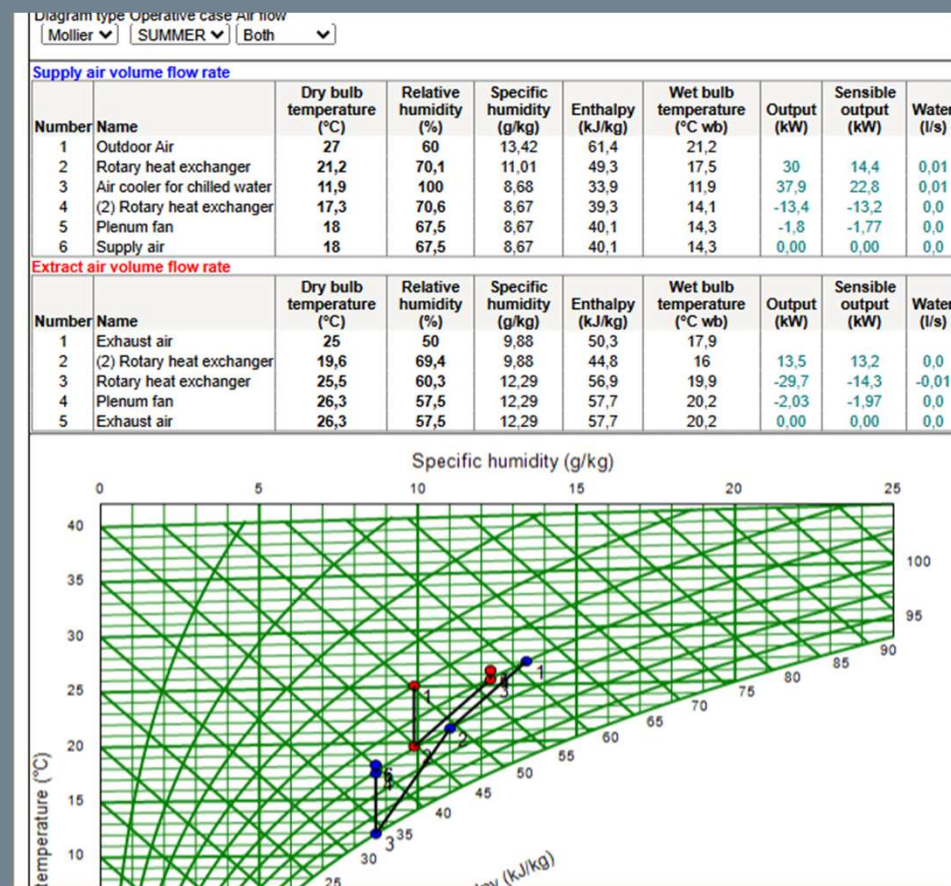
Plaatutilisaatori AFP vajaduspõhine sektsioonsulatus võimaldab:

- vähendada tipukoormust 40...60 + %

Econet seadmed võimaldavad eeskujulikke kasutegurit ja madalat tipukoormust ka seal, kus teised utilisaatori tüübid hästi ei sobi – niisked ruumid, tervishoid, köögid jne.

Vähenevad märkimisväärselt investeeringud ja energiakulutus.

Paraneb hoone energiklass



Design conditions – 1 m³/s

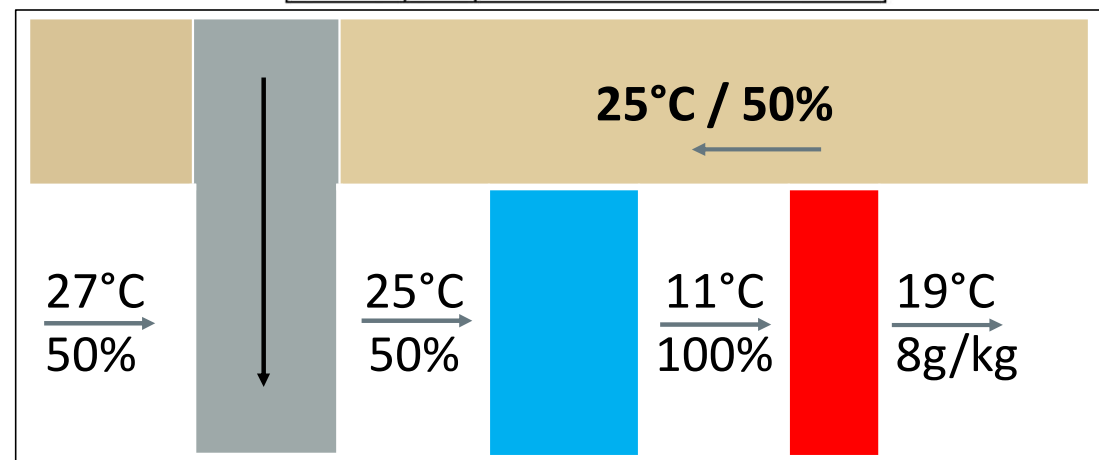
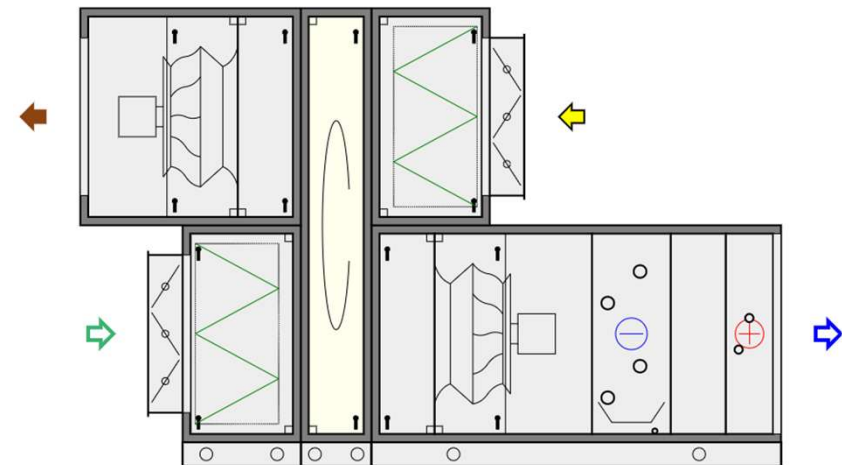
THE STANDARD WAY

An AHU with:

- **Cooling/heat recovery**
- **A Cooling Coil and a Heating Coil**

Features:

- Low/medium investment costs
- Low/medium pressure drops on the air side
- Reduces the cooling peak load and cooling energy consumption but more can be done
- High heating energy consumption
- High heating power (peak) demand



Design conditions – 1 m³/s

FläktGroup

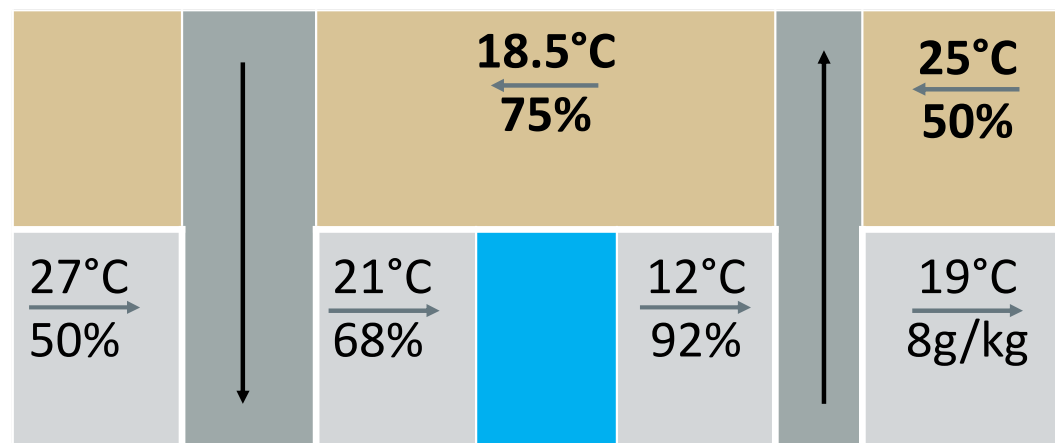
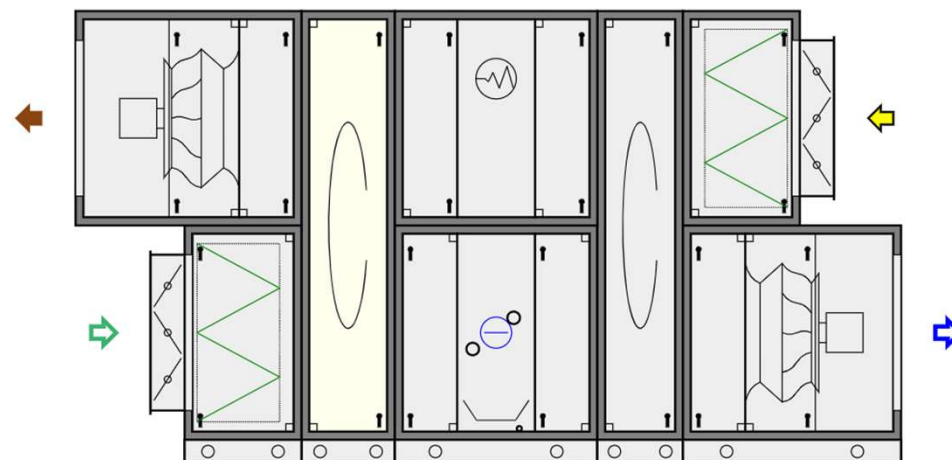
3. THE MOST EFFICIENT WAY

An AHU with:

- Cooling/heat recovery
- A Cooling Coil and heat recovery for reheating

Features:

- Medium investment costs
- Medium pressure drops on the air side
- Low cooling energy consumption
- Low cooling power (peak) demand
- No heating energy consumption
- No heating power (peak) demand

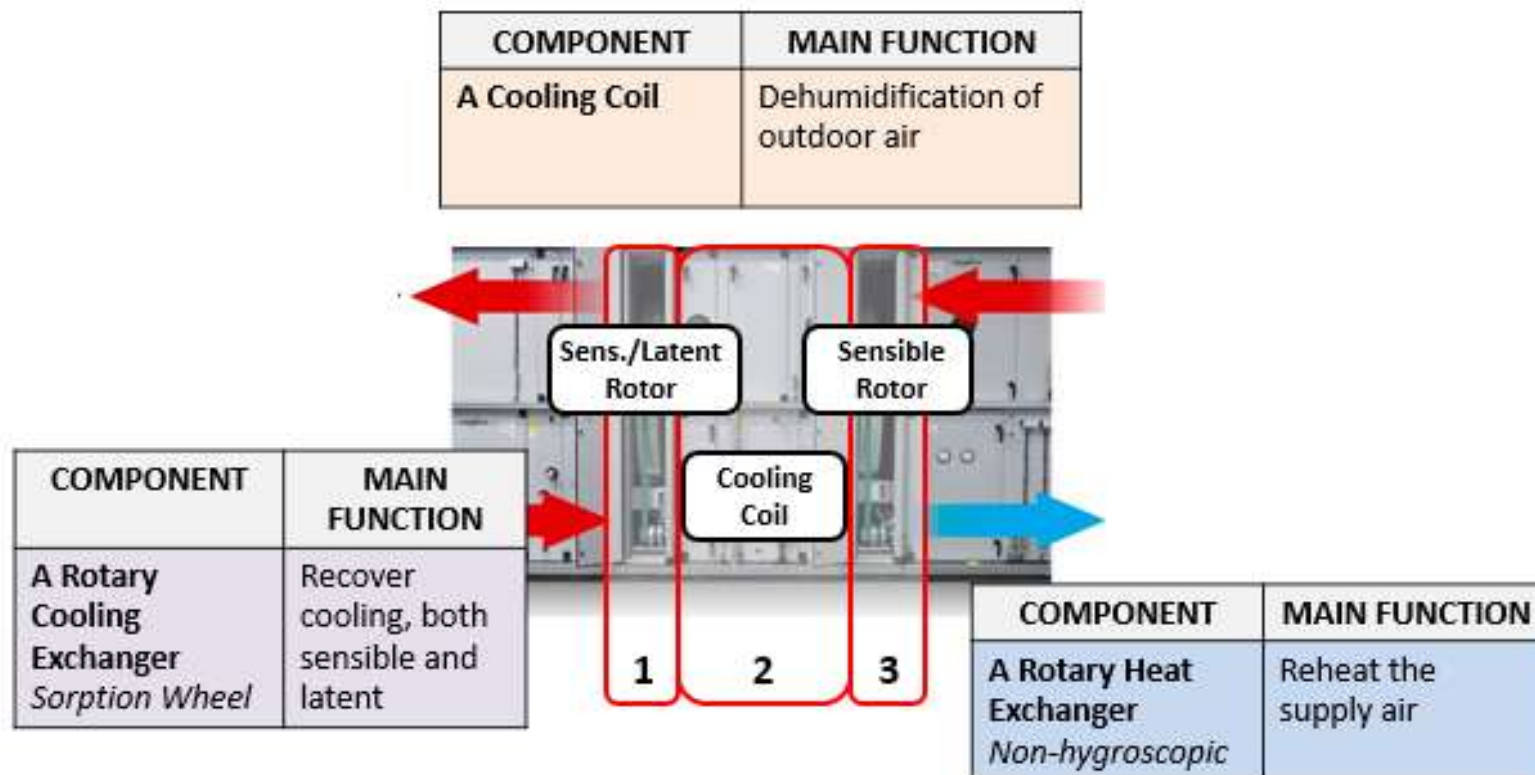


This makes the Twin Wheel such a good idea:

The outer rotor pre-cools supply air. The system thereby lowers the requirements on both cooling coil and chiller.

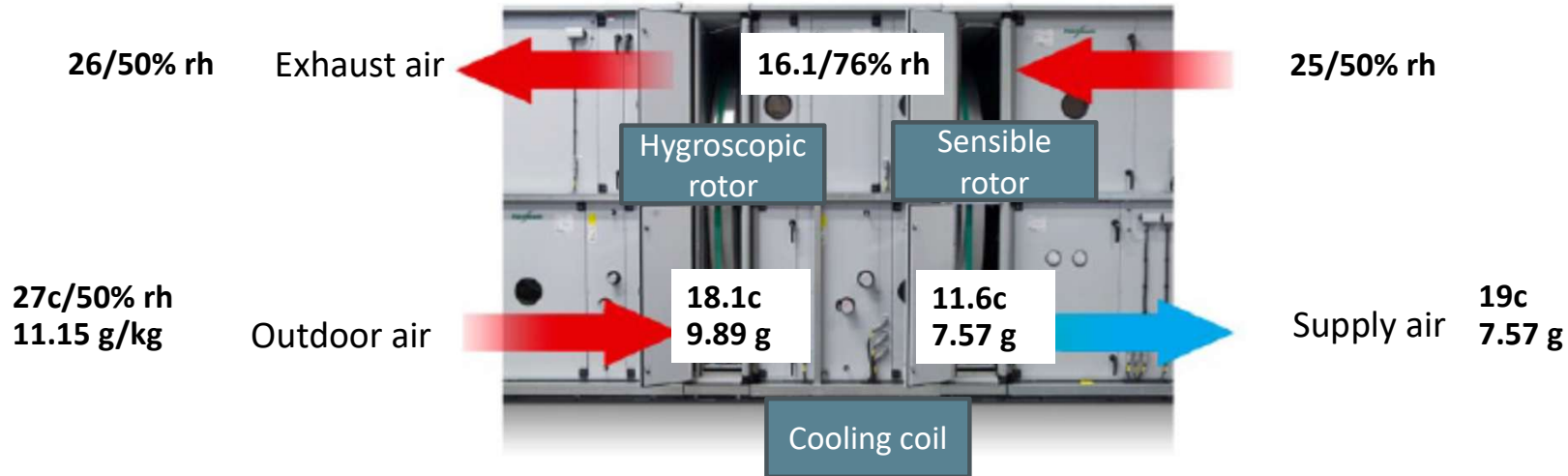
- The outer sorption rotor also transfers humidity from supply to exhaust air flows. This leaves less moisture to remove for the cooling process, which makes it possible to downsize coils and chillers even further.
- Need for heater dramatically reduced. The inner rotor recovers enough heat from the exhaust air flow – heating for free for most of the year!
- The Twin Wheel is the perfect match for chilled beams (and fan coils) as it lowers the risk of condensation on the chilled beam.





Design conditions

Air flow rate 5 m³/s • Outdoor condition: 27°C dry bulb, 50% relative humidity
Required supply air condition: 19°C with 8 g/kg absolute humidity
Exhaust air design condition: 25°C with 9.88 g/kg absolute humidity



The total cooling demand for a single wheel unit is 182 kW and the reheat demand is 70 kW.

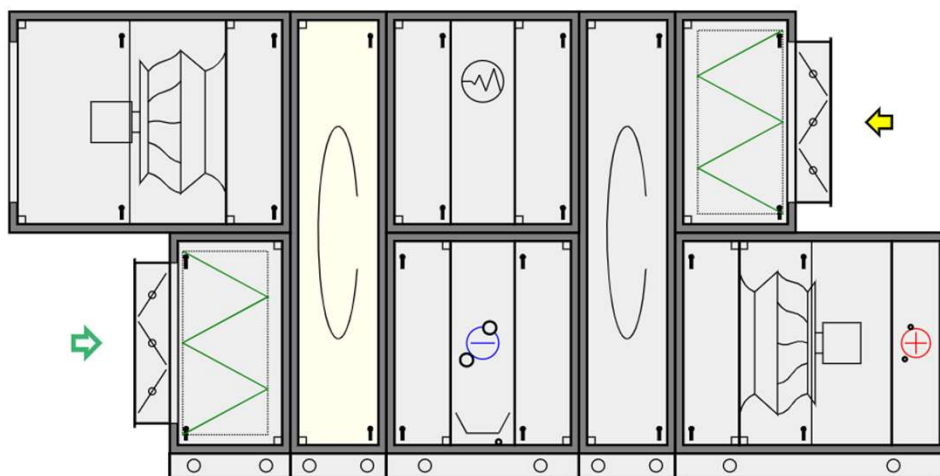
With the twin wheel system the first rotary heat exchanger recovers 79 kW of cooling leaving just 67 kW for the cooling coil.

The reheat demand is furnished by the second rotary heat exchanger (*red*) and the supply fan. A re-heat battery may be provided for the winter condition.

5 m³/s

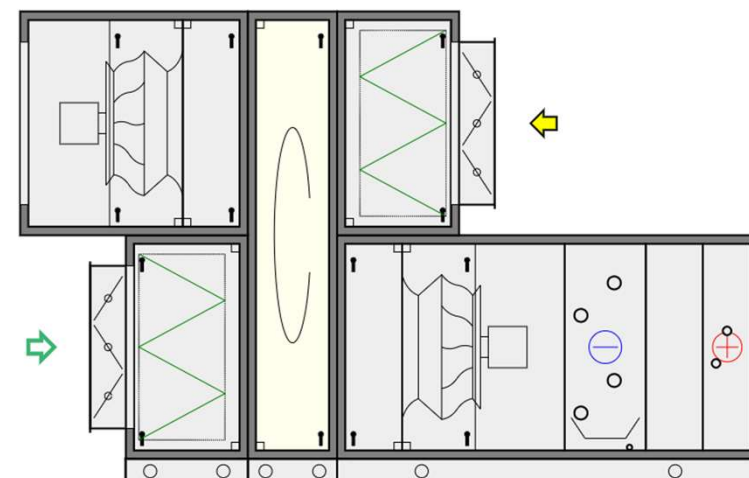
Summer & Winter supply 22c/ 8g/kg

Twin wheel rotor efficiency v single wheel- comparison conditions



83.0%

78.3%



83.3%

Impact on coil size (& Therefore chiller & boiler size) 5 m³/s

	Coil size	Cooling Coil	Heating Coil
	Twin Wheel	67 kW	24 kW
	Single Wheel	179 kW	70 kW
Total cost of supply and installation per kW	Chiller @ 500€ / kW Heat Pump @ 500€/kW	Δ €56,000	Δ €23,000



	Twin wheel	Single wheel	Cost difference
AHU	€ 75,630	€ 60, 250	+ € 15,380
Chiller		+ € 56,000	- € 21,000
Air to water HP		+ € 23,000	- € 17,000
Installation saving Twin Wheel AHU			- € 63,620
Installation saving Twin Wheel AHU per m ³ /s			- € 12,700

LCC calculation criteria

Energy

Calculation model

FläktGroup model

Currency

EUR

Climate data

Specify climate data

Lithuania

VILNIUS

temperature

Moisture

Average year temperature/moisture

7.1

89.6

°C, %

Temperatures

Winter

Summer

temperature

Moisture

temperature

Moisture

Supply air temperature / Moisture

20

50

20

50

°C, %

Extract air temperature / Moisture

22

30

24

50

°C, %

Cooling calculation

To temperature and moisture

Outdoor temp. compensation

Operation

Days/week

Hours/day

Air flow [%]

Return air [%]

Day operation

5

14

100

0

Night operation

Variable flow

Energy calculation

Heating

Cooling

Electricity

Reheating

Energy cost

Energy price

0.075

0.1

0.25

0

EUR/kWh

CO₂ - emission

Investment

Economy

Energy - economy

Cancel

Calculate >>

The calculation is for 5 days a week/14 hours a day to reflect a commercial application

Electricity €0.25 / kWh
Hot water €0.075 / kWh

Twin wheel

RESULT

Annual energy recovery	
Annual energy efficiency	97.0 %
Heat recovery	237513 kWh
Reheating recovery	78065 kWh
Temp. rise in supply air fan	16656 kWh
Cooling recovery	26985 kWh
Total	359219 kWh

Annual additional energy	Energy demand	Energy cost
Heating	6167 kWh	463 EUR
Cooling	101276 kWh	10128 EUR
Supply air fan	19110 kWh	4778 EUR
Exhaust air fan	24737 kWh	6184 EUR
Other Equipment	1942 kWh	486 EUR
Total	153232 kWh	22037 EUR

single wheel

RESULT

Annual energy recovery	
Annual energy efficiency	93.0 %
Heat recovery	248636 kWh
Temp. rise in supply air fan	14436 kWh
Cooling recovery	2507 kWh
Total	265579 kWh

Annual additional energy	Energy demand	Energy cost
Heating	17433 kWh	1307 EUR
Reheating	77829 kWh	5,837 EUR
Cooling	145362 kWh	14536 EUR
Supply air fan	16492 kWh	4123 EUR
Exhaust air fan	15090 kWh	3772 EUR
Other Equipment	1752 kWh	438 EUR
Total	273958 kWh	30,014 EUR

Energy demand impact (Per 5 m³/s)

	Twin Wheel	Single Wheel	@	Single wheel
Annual Energy Recovery	359,219 kWh	265,579 kWh		
Heating	6,167 kWh	95,262 kWh	0.075 € /kWh	+6,7 k€
Cooling	101,276 kWh	145,362 kWh	0.1 € / kWh	+4.4 k€
Supply Fan	19,110 kWh	16,492 kWh	0.25 € / kWh	-0.7 k€
Exhaust Fan	24,737 kWh	15,090 kWh	0.25 € / kWh	-2.4 k€
SUMMARY	153,232 kWh	273,958 kWh		+8 k€
				+ 1.6 k€ per m³s

Summer unit calculation

Supply air volume flow rate

Number	Name	Dry bulb temperature (°C)	Relative humidity (%)	Specific humidity (g/kg)	Enthalpy (kJ/kg)	Wet bulb temperature (°C wb)	Output (kW)	Sensible output (kW)	Water (l/s)
1	Outdoor Air	27	50	11.15	55.6	19.5			
2	Rotary heat exchanger	18.1	76.3	9.89	43.3	15.5	75.7	54.7	0.01
3	Air cooler for chilled water	11.6	99.5	8.43	32.9	11.5	63.9	40.2	0.01
4	(2) Rotary heat exchanger	18.1	58.6	7.57	37.4	13.3	-27.5	-40.1	0.01
5	Plenum fan	19	55.4	7.57	38.3	13.7	-5.61	-5.5	0.0
6	Supply air	19	55.4	7.57	38.3	13.7	0.00	0.00	0.0

Extract air volume flow rate

Number	Name	Dry bulb temperature (°C)	Relative humidity (%)	Specific humidity (g/kg)	Enthalpy (kJ/kg)	Wet bulb temperature (°C wb)	Output (kW)	Sensible output (kW)	Water (l/s)
1	Exhaust air	25	50	9.88	50.3	17.9			
2	(2) Rotary heat exchanger	16.1	82.4	9.41	40.0	14.3	63.2	54.5	0.0
3	Rotary heat exchanger	25	53.8	10.66	52.3	18.5	-75.4	-54.6	-0.01
4	Plenum fan	26	50.7	10.66	53.3	18.8	-6.31	-6.15	0.0
5	Exhaust air	26	50.7	10.66	53.3	18.8	0.00	0.00	0.0

Supply air volume flow rate

Number	Name	Dry bulb temperature (°C)	Relative humidity (%)	Specific humidity (g/kg)	Enthalpy (kJ/kg)	Wet bulb temperature (°C wb)	Output (kW)	Sensible output (kW)	Water (l/s)
1	Outdoor Air	27	50	11.15	55.6	19.5			
2	Rotary heat exchanger	25.3	50.5	10.20	51.5	18.3	25.3	10.2	0.01
3	Plenum fan	26.2	48.2	10.20	52.3	18.5	-5.1	-4.98	0.0
4	Air cooler for chilled water	10.5	99.4	7.85	30.3	10.5	135	96.2	0.01
5	Air heater for hot water	19	57.4	7.85	39.0	13.9	-53.1	-52	0.0
6	Supply air	19	57.4	7.85	39.0	13.9	0.00	0.00	0.0

Extract air volume flow rate

Number	Name	Dry bulb temperature (°C)	Relative humidity (%)	Specific humidity (g/kg)	Enthalpy (kJ/kg)	Wet bulb temperature (°C wb)	Output (kW)	Sensible output (kW)	Water (l/s)
1	Exhaust air	25	50	9.88	50.3	17.9			
2	Rotary heat exchanger	26.7	49.6	10.83	54.4	19.2	-25.3	-10.2	-0.01
3	Plenum fan	27.3	47.6	10.83	55.1	19.4	-4.29	-4.18	0.0
4	Exhaust air	27.3	47.6	10.83	55.1	19.4	0.00	0.00	0.0

This slide shows the unit calculation taken from ACON to demonstrate we meet the overall summer design conditions

Winter calculation

Supply air volume flow rate

Number	Name	Dry bulb temperature (°C)	Relative humidity (%)	Specific humidity (g/kg)	Enthalpy (kJ/kg)	Wet bulb temperature (°C)	Output (kW)	Sensible output (kW)	Water (l/s)
1	Outdoor Air	-23	90.1	0.43	-22.1	-23.1			
2	Rotary heat exchanger	0	100	3.76	9.4	0	-190	-139	-0.02
3	(2) Rotary heat exchanger	17.2	31	3.76	26.8	9	-106	-105	0.0
4	Plenum fan	18	29.5	3.76	27.7	9.4	-4.98	-4.92	0.0
5	Air heater for hot water	22	23	3.76	31.7	11.1	-24.5	-24.2	0.0
6	Supply air	22	23	3.76	31.7	11.1	0.00	0.00	0.0

Extract air volume flow rate

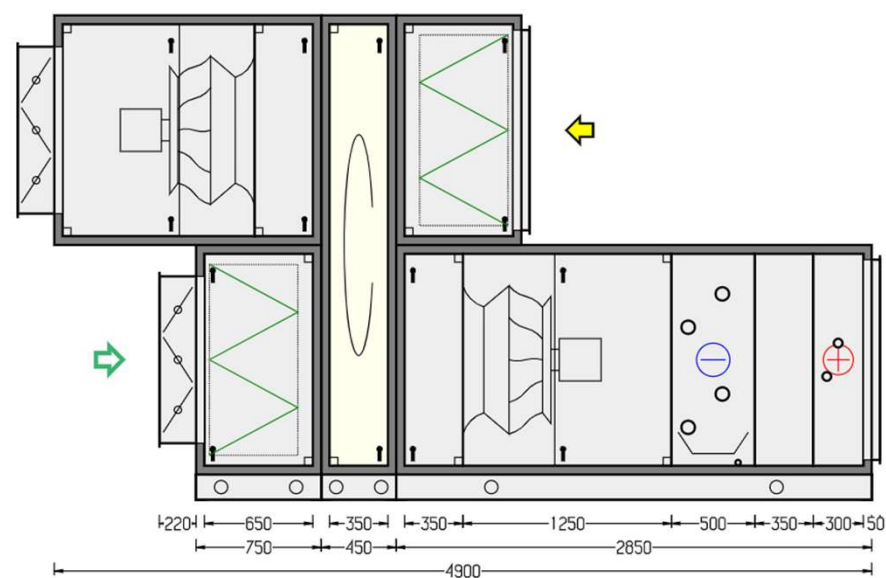
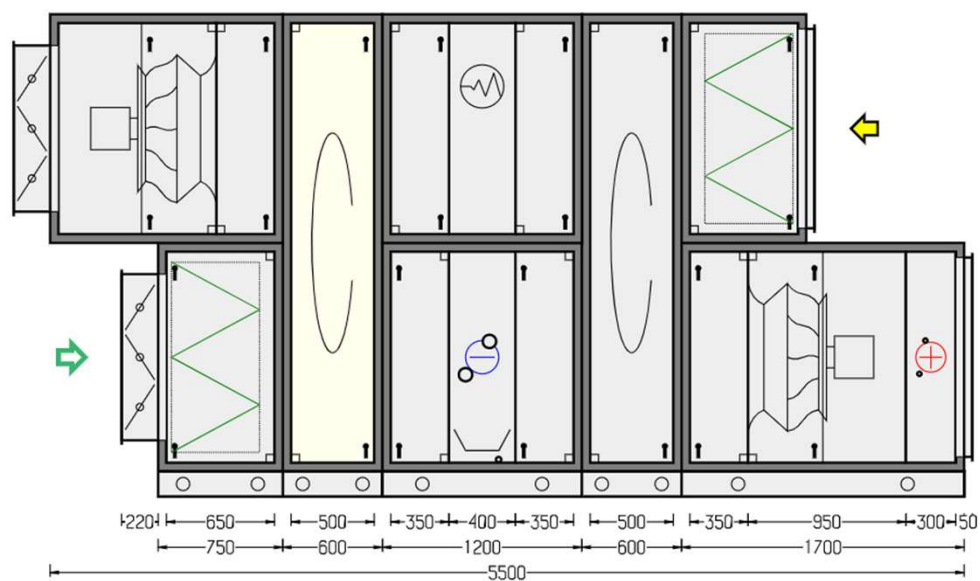
Number	Name	Dry bulb temperature (°C)	Relative humidity (%)	Specific humidity (g/kg)	Enthalpy (kJ/kg)	Wet bulb temperature (°C)	Output (kW)	Sensible output (kW)	Water (l/s)
1	Exhaust air	22	30	4.91	34.6	12.3			
2	(2) Rotary heat exchanger	4.7	92.8	4.91	17.0	4.2	107	105	0.0
3	Rotary heat exchanger	-18.3	100	0.75	-16.5	-18.3	204	140	0.02
4	Plenum fan	-17.4	92.7	0.75	-15.7	-17.6	-5.08	-5.01	0.0
5	Exhaust air	-17.4	92.7	0.75	-15.7	-17.6	0.00	0.00	0.0

This slide shows the unit calculation taken from ACON to demonstrate we meet the overall winter design conditions with a reduced size heating coil



Footprint

Footprint



The difference in footprint is a function of the fan selections and the affect that the required dimensioning conditions have on the coil selections. The above is indicative only but based on the same airflow and off unit condition

Total installation costs for chillers & boilers

Sources for chiller & heat pump total installation costs

Air-cooled chillers < 400 kW

Air-cooled chillers < 400 kW				
Service and residential sector				
	2015	2020	2030	2050
Technical data (stock)				
Cold generation capacity (kW)	80	80	80	80
SEER of stock	3,3	3,5	4,3	4,9
SEER of sales	3,8	4,2	4,6	5,2
Technical lifetime (years)	15	15	15	15
Financial data (of sales)				
Selling price installed (€/kW)	257	270	290	337
Specific investment (€/unit)	20560	21600	23200	26960
- hereof equipment (%)	60%	60%	60%	60%
- hereof installation (%)	40%	40%	40%	40%
Additional specific investment (€/unit)	-	-	-	-
Fixed O&M (€/unit/year)	822	822	822	822

Looking at capital costs divided by kW capacity suggests the following:

- ASHP costs ranged between £900 and £2,900 per kW of installed capacity.
- Costs per kW for very small ASHP are higher than for larger heat pumps. This is primarily due to the fact that neither installation costs nor capital equipment costs are significantly lower for, for example, a 3kW heat pump versus an 8kW heat pump.

Included to show that the total cost of installation of the chiller and the hot water system is at least realistic

European Commission
<https://ec.europa.eu/research/downloadPublic> PDF

Space Cooling Technology in Europe - European Commission

31 Aug 2017 — The "selling price installed" per kW corresponds to the price paid by the final customer (manufacturer selling).



Heat pump retrofit in London

summary

Flakt Group twin wheel benefits summary

Benefit	How?	Scope	Saving
Investment cost, cooling demand	Smaller chiller	Up to 60% reduction	Typically €7.5 k per m ³ /s
Investment cost, heating demand	Smaller boiler	Up to 100% reduction	
Investment cost, other services	Smaller pipework, pumps, insulation	See above	
Operating cost reduction, cooling	Reduced coil load	Up to 60% reduction	Typically €1.6 k per m ³ /s
Operating cost reduction, heating	Reduced coil load	Up to 100% reduction	
Operating cost increase, fans	Extra unit resistance	But a lot less than above	
Improved indoor air quality	Controlled room humidity		Reduced supply enthalpy reduces the period at which the chilled beam flow and return increases – which reduce the cooling power

Back up slides

Controls

- The Twin Wheel is equipped with a pre-programmed integrated control system, specifically developed to meet the requirements for cost effectiveness, user friendliness, reliability and energy efficiency.
- The control system is based on a powerful digital controller with internal Modbus communication and an integrated web server as standard. Connection to other BMS system are a selectable option. The user interface includes an operator panel, with an easy to use and logical menu structure. The control system is automatically selected and configured in ACON. Thereby simplifies the design process, reduces time spent dimensioning and money spent on engineering and documentation.

Humidity control

- The Twin Wheel controller operates the hygroscopic rotor and cooling coil in sequence to a dew set-point value, thereby limiting the supply air humidity level. During the course of the year, the system will limit indoor humidity.

Twin wheel Rotor rotation speed and operating sequence

- **ROTORS**

Twin Wheel is equipped with two rotors. The first one is hygroscopic (moisture and heat transfer) rotor. The second is sensible (heat transfer)

- **Hygroscopic rotor**

For winter mode, the hygroscopic rotor is first in the heating sequence. It is blocked from the heating sequence during summer mode, where only the sensible rotor is used. In the cooling sequence however, the hygroscopic rotor is used whenever possible. For cooling recovery, the hygroscopic rotor is run at 100 %. The condition for cooling recovery to start, is when the outdoor temperature is 2 degrees (default) higher than the extract air.

- **Sensible rotor**

The sensible rotor regulates so that the supply air temperature set point is withheld. Under conditions when the sensible rotor fails to reach the set point, the hygroscopic rotor is used (if allowed to start).

Rotor settings are found under:

- **Temperature control**

The temperature sequence is independent of the humidity sequence. The temperature sequence uses both rotors (under the condition that the current operating mode allows it). When cooling is needed, the cooling coil is used. When the conditions for cooling recovery are met, the hygroscopic rotor is used. If the temperature set point is not reached the controller can call for external heating to start through a digital output.

REGASORP - MINIMAL CARRY OVER

Other types of heat exchanger are often chosen where hygiene and air cleanliness are important considerations. But because plate heat exchangers and liquid-coupled heat exchangers generally have lower efficiency there are considerable gains to make from choosing rotary heat exchangers for these applications too.

The RegAsorp rotor has minimal carry over on the rotor surface. It is treated with a 4 Angstrom (an angstrom is one hundred-millionth of a centimetre) Molecular Sieve desiccant (the coating is Zeolite, an alumina-silica ceramic based crystal containing pores) , that captures water by using adsorption principle, but does not collect bacteria (typically 1000 angstrom) or other contaminants. Practically all substances that are regarded as contaminants in the air handling context are larger than 4 Angstrom, which means that they pass through the heat exchanger and are carried away with the exhaust air assisted by the purge sector.