Air dehumidification

In many industrial processes, such as in the pharmaceutical industry, relatively dry air is required, otherwise the products to be manufactured can absorb moisture and become unusable. If a lot of moisture has to be removed from the air, part of the output can be achieved via cold recovery, provided that the exhaust air is pre-cooled adiabatically or even hybrid. The rest has to be cooled with cold water at 6/12°C, for example, which results in high operating costs. **Unfortunately, far too many planners still specify such systems without adiabatic or even hybrid pre-cooling of the return air, which causes higher operating costs.**

Return air adiabatically or hybrid pre-cooled	Yes (Page 2)	No (Page 3)
Cold recovery from the return air	106,991 kW	41,190 KW
Additional cold water demand	254,392 kW	320,193 kW

Both coolers must have smooth fins that allow the condensate to drain off easily. The thickness of the fins should be at least 0.2 mm in order to generate large condensate droplets. These are combined into even larger droplets in the upstream demister and separated in the downstream droplet separator. Droplet separators must have a pressure drop of at least 100 Pa in order to ensure a high degree of fractional separation. If this advice is not followed, one should not be surprised if the air heater in the cold recovery does not reach the required air outlet temperature and the air outlet humidity is far too high. The cause is mainly the totally insufficient degree of condensate separation. Part of the condensate ends up in the air heater, which is really not the point. **Sisyphus says hello!**

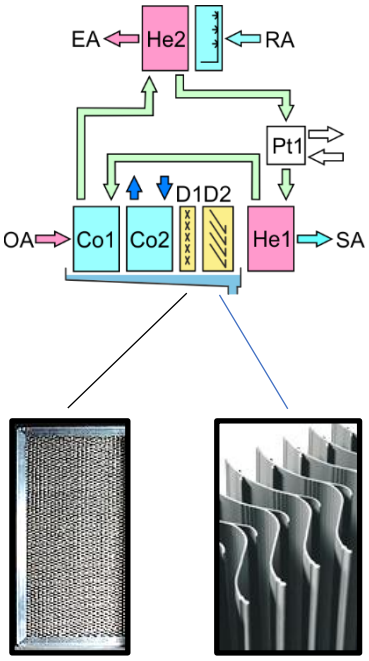
Counterflow in finned heat exchangers only exists in the imagination of some producers who don't care if the temperature efficiency of heat recovery systems is only 50% instead of the promised 70%! One hopes that it will not be remeasured. The correct procedure is described below and has been confirmed by measurements in the laboratory. When it comes to cooling humid air, opinions on latent performance vary widely. Only those who calculate the cooling process with finite elements can determine exactly, how the cooling process works. For the moist air and the coolant, the Reynolds number goes down and the Prandtl number goes up during the cooling process. Therefore the k-value decreases. However, as soon as condensate forms, the k-value increases. **This can only be determined and taken into account by finite elements.** The beautiful exponential temperature gradients in the diagram below must be forgotten, since only sensible power can be dissipated at the beginning and latent power only towards the end. The temperature gradients deform. Since the temperature difference Δtm has to be understood as the area between the two temperature gradients, this reduces the Δtm extremely, also in counterflow! In thermodynamic process technology, the smallest temperature difference between the two media is defined as the pinch point. Conclusion: **Latent power reduces the average temperature difference!**

Dehumidification: System CCSF

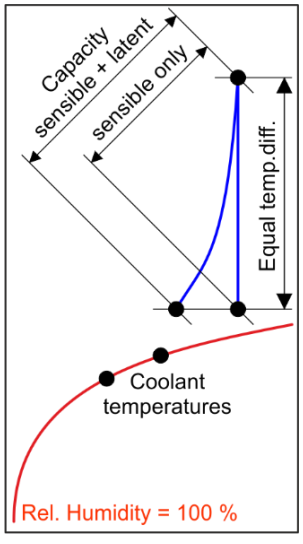
RA: Return air
EA: Exhaust air
OA: Outside air with 16 g/kg
SA: Supply air with 8 g/kg

He1: Air heater
He2: Air heater
Co1: Air cooler
Co2: Air cooler

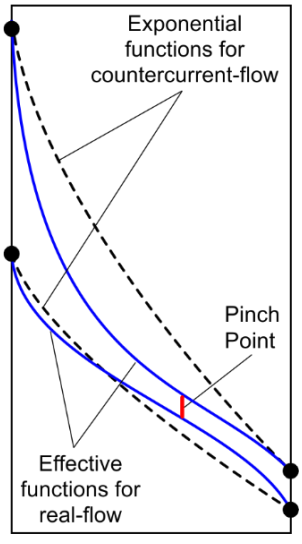
D1: Demister
D2: Droplet eliminator



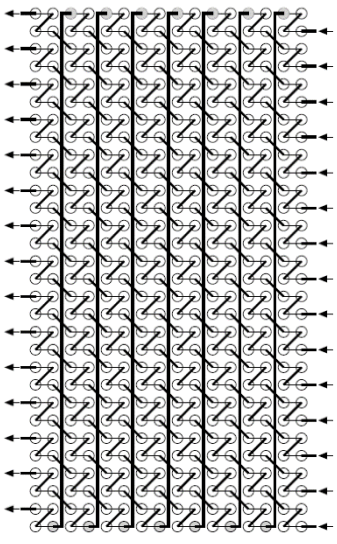
Cooling process



Average log. temp. diff.

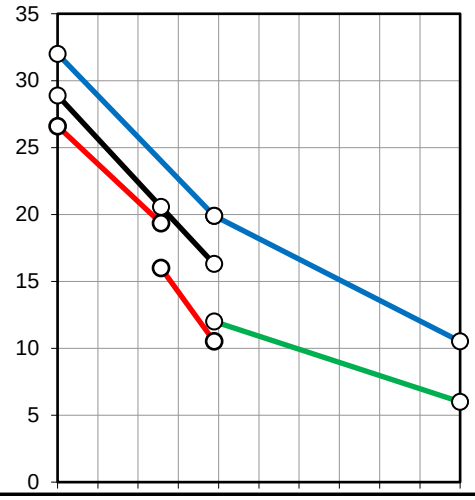


Internal hydraulic coupling



Heat exchanger

CC-System in summer		SA-Co1	SA-Co2	SA-He	RA-Hy
Capacity	kW	161.997	254.392	55.005	106.991
Surface reserve	%	1.083	1.871	1.862	1.595
Present surface	m2	2818.047	863.500	407.637	2368.277
Temp. in (26.000)	°C	32.000	19.900	10.512	19.356
Rel. humidity in (54.175)	%	52.940	97.857	100.000	100.000
Abs. humidity in (11.500)	g/kg	16.000	14.438	8.000	14.261
Temp. out	°C	19.900	10.512	16.000	26.601
Rel. humidity out	%	97.857	100.000	69.967	70.487
Abs. humidity out	g/kg	14.438	8.000	8.000	15.601
Velocity	m/s	1.930	1.890	1.827	1.910
Pressure drop	Pa	153.605	104.630	18.324	124.779
Moistening temperature	°C				15.000
Definition					
Height over sea level	m	106.000			
Pressure	hPa	1000.564			
Temp.	°C	20.000			
Rel. humidity	%	40.000			
Supply air	m3/h	30000.000			
Return air	m3/h	30000.000			
25 V% Et.glycol					
Temp. in	°C	16.300			
Temp. out	°C	28.900			
Volume flow	m3/h	11.948			
Pressure drop total	kPa	377.147			
Water		SA-Co2			
Temp. in	°C	6.000			
Temp. out	°C	12.000			
Volume flow	m3/h	36.395			
Pressure drop	kPa	29.612			



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Plant
Object
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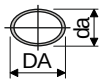
Technical data		SA-Co1	SA-Co2	SA-He	RA-Hy
Tubes blank	Piece	0	0	0	0
Int. vent./drains	Piece	11	0	1	11
Tube rows on the depth	Piece	24	8	4	24
Tube rows on the height	Piece	56	49	56	56
Number of circuits (NC)	Piece	32	49	28	32
Volume	l	357	213	74	357
Weight	kg	1319	491	248	1199
Connections	G	2 ½"	4"	2 ½"	2 ½"
Frame height	RH	2040	2040	2040	2040
Frame width	BT	2500	2500	2500	2500
Frame depth	RT	950	380	250	950
Finned height	LH	1960	1960	1960	1960
Finned width	LB	2281	2232	2281	2281
Frame on top	RO	40	40	40	40
Frame on bottom	RU	40	40	40	40
Frame in front	RV	30	30	30	30
Frame on back (~53/69/53/53)	RN	53	69	53	53
Collector covering	AD	166	199	166	166
Fin spacing	LT	2.500	2.500	2.900	3.000
Fin thickness	LD	0.200	0.200	0.200	0.200
Tube diameter	DA	12.400	16.400	12.400	12.400
Tube diameter	da	12.400	16.400	12.400	12.400
Tube thickness	S	0.400	0.400	0.400	0.400
Tube interval on the height	S1	35.000	40.000	35.000	35.000
Tube interval on the depth	S2	35.000	34.641	35.000	35.000
Tubes	---	Cu	Cu	Cu	Cu
Tubes	---	smooth	smooth	smooth	smooth
Tubes	---	in line	staggered	in line	in line
Tubes	Type	circular	circular	circular	circular
Collector	---	Cu	Cu	Cu	Cu
Connections	---	Rg7	Rg7	Rg7	Rg7
Fins	---	Al	Al	Al	AlMg3
Fins	---	smooth	smooth	smooth	smooth
Frame	---	AISI 304	AISI 304	AISI 304	AISI 304
Protection	---	without	without	without	without
Protection	---	---	---	---	---
Price	**EUR**	**18298.00**	**7091.00**	**3616.00**	**18030.00**



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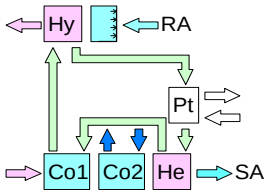
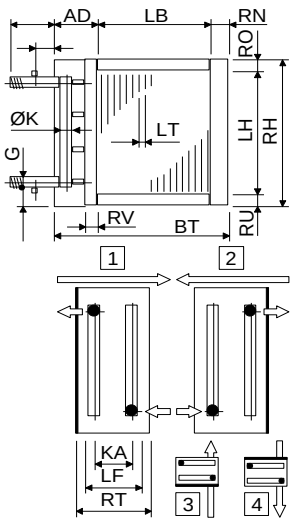
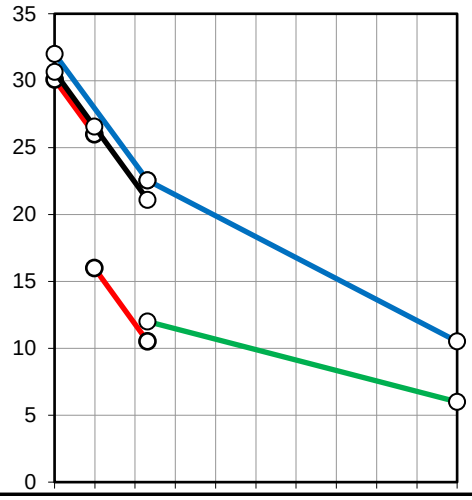




Delivery:	5-6 weeks
Validity:	12 weeks
Condit.:	net, prepaid address
Payment:	30 days net

CC-System in summer		SA-Co1	SA-Co2	SA-He	RA-Hy
Capacity	kW	96.196	320.193	55.005	41.190
Surface reserve	%	0.431	0.262	0.805	0.333
Present surface	m2	2846.463	851.120	207.482	2846.463
Temp. in (26.000)	°C	32.000	22.545	10.512	26.000
Rel. humidity in (54.175)	%	52.940	92.016	100.000	54.175
Abs. humidity in (11.500)	g/kg	16.000	16.000	8.000	11.500
Temp. out	°C	22.545	10.512	16.000	30.081
Rel. humidity out	%	92.016	100.000	69.967	42.736
Abs. humidity out	g/kg	16.000	8.000	8.000	11.500
Velocity	m/s	1.922	1.929	1.795	1.913
Pressure drop	Pa	133.649	110.180	9.186	132.900
Moistening temperature	°C				15.000
Definition					
Height over sea level	m	106.000			
Pressure	hPa	1000.564			
Temp.	°C	20.000			
Rel. humidity	%	40.000			
Supply air	m3/h	30000.000			
Return air	m3/h	30000.000			
25 V% Et.glycol					
Temp. in	°C	21.105			
Temp. out	°C	30.650			
Volume flow	m3/h	9.353			
Pressure drop total	kPa	366.093			
Water		SA-Co2			
Temp. in	°C	6.000			
Temp. out	°C	12.000			
Volume flow	m3/h	45.805			
Pressure drop	kPa	39.989			



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Plant
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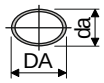
Position

Technical data		SA-Co1	SA-Co2	SA-He	RA-Hy
Tubes blank	Piece	0	0	4	0
Int. vent./drains	Piece	11	0	0	11
Tube rows on the depth	Piece	24	8	2	24
Tube rows on the height	Piece	56	49	56	56
Number of circuits (NC)	Piece	28	49	18	28
Volume	l	351	231	38	351
Weight	kg	1314	546	139	1314
Connections	G	2"	NW125	2"	2"
Frame height	RH	2040	2040	2040	2040
Frame width	BT	2500	2500	2500	2500
Frame depth	RT	900	410	160	900
Finned height	LH	1960	1960	1960	1960
Finned width	LB	2304	2200	2322	2304
Frame on top	RO	40	40	40	40
Frame on bottom	RU	40	40	40	40
Frame in front	RV	30	30	30	30
Frame on back (~53/69/53/53)	RN	53	69	53	53
Collector covering	AD	143	231	125	143
Fin spacing	LT	2.500	2.500	2.900	2.500
Fin thickness	LD	0.200	0.200	0.200	0.200
Tube diameter	DA	12.400	16.400	12.400	12.400
Tube diameter	da	12.400	16.400	12.400	12.400
Tube thickness	S	0.400	0.400	0.400	0.400
Tube interval on the height	S1	35.000	40.000	35.000	35.000
Tube interval on the depth	S2	35.000	34.641	35.000	35.000
Tubes	---	Cu	Cu	Cu	Cu
Tubes	---	smooth	smooth	smooth	smooth
Tubes	---	in line	staggered	in line	in line
Tubes	Type	circular	circular	circular	circular
Collector	---	Cu	Cu	Cu	Cu
Connections	---	Rg7	Rg7	Rg7	Rg7
Fins	---	Al	Al	Al	Al
Fins	---	smooth	smooth	smooth	smooth
Frame	---	AISI 304	AISI 304	AISI 304	AISI 304
Protection	---	without	without	without	without
Protection	---	---	---	---	---
Price	**EUR**	**18173.00**	**8236.00**	**1994.00**	**18173.00**



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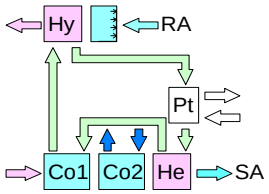

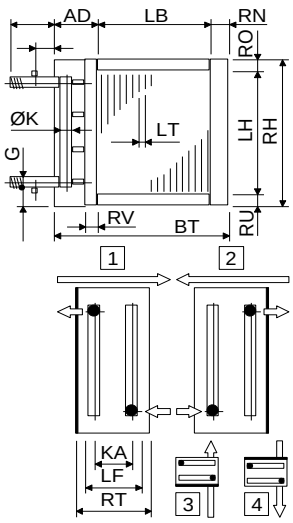

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