Brine in the food sector

It is common knowledge, that **ethylene glycol** is not allowed to be used in the food industry. For the sake of simplicity, the highly viscous **propylene glycol** is used, although it is known, that this brine is also **not biodegradable** and, due to its high viscosity, requires much too large finned heat exchangers.

There has long been a wonderful alternative to www.temper.se, which you can get in Germany and Switzerland at www.kaeltefischer.de on every corner.

Temper makes the finned heat exchangers even smaller than ethylene glycol, whereby **Temper is absolutely biodegradable**. And yet **Temper** is used far too little, because you are sluggish like an elephant that avoids the smallest inclines like the plague, as it would consume far too much energy.

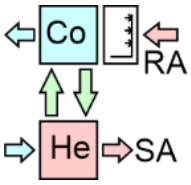
Anyone who thinks, that I will get money from www.temper.se for this free advertising is very wrong.

No, since 1970 I am only an environmentally conscious engineer with a focus on thermodynamics and not a super-sluggish elephant that avoids the smallest inclines like the plague!

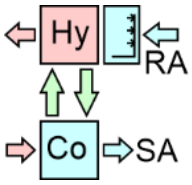
And how do you see that? Are you also one of those who say that temper contains salts, which corrode galvanized air ducts underneath in the event of leaks? Then I would strongly recommend you to stop the nonsense of planning leaks or drive your car around even if the engine loses oil?

The differences are shown using the example of an energy recovery system in a circuit network, consisting of two optimal finned heat exchangers of the latest generation from www.tps-imp.si. However, if you cannot produce such optimal heat exchangers, you will need more rows of tubes anyway and will have to split them into 2 pacts anyway, due to the cleaning option according to VDI 6022.

Winter



Summer



Bern 540 meter over sea level: 949.653 hPa
DIN EN308: Temperature efficiency 70%
SA=RA: 30'000 m3/h on 20°C/40%

OA: Winter -11°C/90%, Summer 32°C/54%
RA: Winter 20°C/40%, Summer 19°C/100%

Temper: Temper-10
Et.glycol: 25% Ethylene glycol
Pr.glycol: 25% Propylene glycol

Description	Unit	Temper	Et.glycol	Pr.glycol
Efficiency: Winter	%	73.15	73.15	73.15
Efficiency: Summer	%	70.03	70.89	73.30
Efficiency: DINEN308	%	69.55	70.14	71.93
Capacity: Winter	kW	212.97	212.97	212.97
Capacity: Summer	kW	88.06	89.14	92.17
Capacity: DINEN308	kW	130.34	131.46	134.80
SA: Pressure drop	Pa	68.98	78.37	93.88
RA: Pressure drop	Pa	81.38	93.89	111.74
Brine: Pressure drop	kPa	366.56	369.63	330.39
SA=RA: Finned spacing	mm	2.90	2.50	2.80
SA=RA: Tube rows	Piece	12	12	16
SA=RA: Finned depth	mm	346	346	462
SA=RA: Frame dept	mm	430	430	540
SA=RA: Investment	EUR	10'087	10'624	13'421

Now there is also the fact, that when using propylene glycol, you have to split the 16 tube rows into 2 x 8 tube rows as a result of VDI 6022, **which increases the price by about 50% to EUR 15,000.00!**

In addition, a minimum distance of 500 mm is required between the two finned heat exchangers in order to be able to clean them, increasing the total installation depth to 2 x 310 + 500 = 1120 mm. **No problem, air handling units are not more expensive than galvanized air ducts, so to speak, are they?**

CC-System in winter		SAHe	RACo	Definition
Height over sea level	m			540.000
Pressure	hPa			949.653
Efficiency	%	73.150	59.019	
Capacity sensible	kW	212.968	172.857	
Capacity latent	kW	0.000	38.965	
Capacity frost	kW	---	1.147	
Capacity total	kW	212.968	212.968	
Surface reserve	%	0.049	0.007	
Present surface	m²	1204.319	1204.319	

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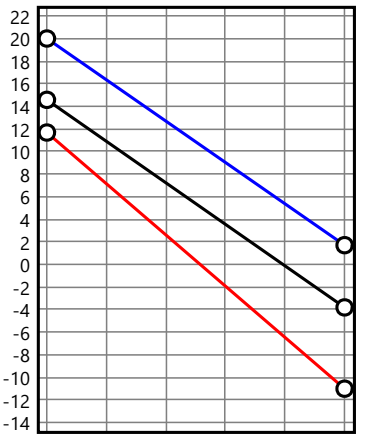
SAHe		Inlet	Outlet	Definition
Temp.	°C	-11.000	11.677	20.000
Rel. humidity	%	90.000	15.473	40.000
Abs. humidity	g/kg	1.394	1.394	6.174
Volume flow humid	m³/h	26623.555	28926.458	30000.000
Velocity	m/s	1.648	1.790	1.857
Pressure drop	Pa		68.982	

Representative

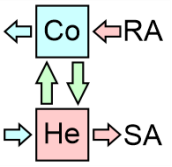
Plant
Object
Position

RACo		Inlet	Outlet	Definition
Temp.	°C	20.000	1.704	20.000
Rel. humidity	%	40.000	99.028	40.000
Abs. humidity	g/kg	6.174	4.524	6.174
Volume flow humid	m³/h	30000.000	28053.861	30000.000
Velocity	m/s	1.857	1.736	1.857
Pressure drop	Pa		81.383	

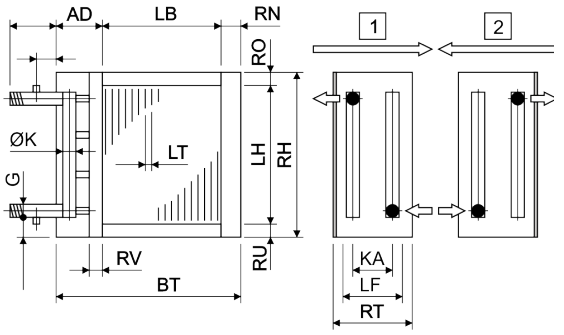
Temperature (°C)



Temper -10			SAHe	RACo
Temp.	in	°C	14.570	-3.805
Temp.	out	°C	-3.805	14.570
Volume flow		m³/h	10.788	10.791
Velocity		m/s	1.161	1.162
Reynolds		---	6364.605	6198.670
Pressure drop		kPa	182.714	183.841



Technical data			SAHe	RACo			
Tubes total		Piece	768	768	Tubes:	Cu	Cu
Tubes blank		Piece	0	0	Tubes:	smooth	smooth
Int. vent./drains		Piece	5	5	Tubes:	staggered	staggered
Tube rows on the depth		Piece	12	12	Tubes:	circular	circular
Tube rows on the height		Piece	64	64	Collectors:	Cu	Cu
Tube coupling in series		Piece	32	32	Collectors:	1.47 m/s	1.47 m/s
Number of circuits (NC)		Piece	24	24	Connections:	Rg7	Rg7
Volume		l	192	192	Connections:	1.47 m/s	1.47 m/s
Weight		kg	593	593	Fins:	Al	Al
Connections	G	---	2"	2"	Fins:	Wave structure	Wave structure
Frame height	RH	mm	2200	2200	Frame:	AISI304	AISI304
Frame width	BT	mm	2300	2300	Frame:	2.00 m/s	2.00 mm
Frame depth	RT	mm	430	430	Protection:	without	without
Finned height	LH	mm	2133	2133	Protection:	---	---
Finned width	LB	mm	2104	2104			
Finned depth	LF	mm	346	346			
Frame on top	RO	mm	33	33			
Frame on bottom	RU	mm	34	34			
Frame in front	RV	mm	30	30			
Frame on back	RN	mm	53	53			
Collector-Diameter	K	mm	54	54			
Collector covering	AD	mm	143	143			
Collector distance	KA	mm	347	347			
Fin spacing	LT	mm	2.900	2.900			
Fin thickness	LD	mm	0.200	0.200			
Tube diameter	DA	mm	12.400	12.400			
Tube diameter	da	mm	12.400	12.400			
Tube thickness	S	mm	0.350	0.350			
Tube interval on the height	S1	mm	33.333	33.333			
Tube interval on the width	S2	mm	28.867	28.867			



SAHe: 33/29/12-12R-64T-2104A-2.9PA-24C-Cu/Al/AISI304 **SAHe:** **EUR** **10087.00**

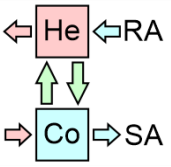
RACo: 33/29/12-12R-64T-2104A-2.9PA-24C-Cu/Al/AISI304 **RACo:** **EUR** **10087.00**

CC-System in summer		RAHe	SACo	Definition
Height over sea level	m			540.000
Pressure	hPa			949.653
Efficiency	%	70.363	70.033	
Capacity sensible	kW	88.063	88.063	
Capacity latent	kW	0.000	0.000	
Capacity frost	kW	---	0.000	
Capacity total	kW	88.063	88.063	
Surface reserve	%	0.481	0.384	
Present surface	m²	1204.319	1204.319	

RAHe		Inlet	Outlet	Definition
Temp.	°C	19.000	28.147	20.000
Rel. humidity	%	100.000	57.700	40.000
Abs. humidity	g/kg	14.703	14.703	6.174
Volume flow humid	m³/h	30303.581	31252.344	30000.000
Velocity	m/s	1.875	1.934	1.857
Pressure drop	Pa		78.321	

SACo		Inlet	Outlet	Definition
Temp.	°C	32.000	22.896	20.000
Rel. humidity	%	54.000	91.888	40.000
Abs. humidity	g/kg	17.224	17.224	6.174
Volume flow humid	m³/h	31777.262	30829.203	30000.000
Velocity	m/s	1.967	1.908	1.857
Pressure drop	Pa		80.089	

Temper -10			RAHe	SACo
Temp.	in	°C	29.239	21.682
Temp.	out	°C	21.682	29.239
Volume flow		m³/h	10.788	10.789
Velocity		m/s	1.161	1.161
Reynolds		---	11593.445	11467.196
Pressure drop		kPa	160.926	161.327



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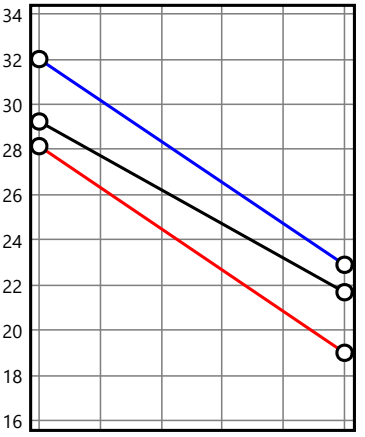
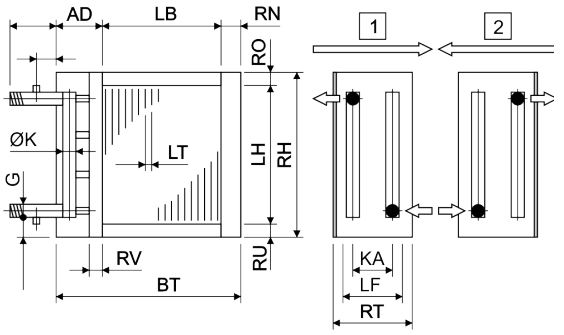
Representative

Plant
Object
Position

Temperature (°C)



Technical data			SAHe	RACo			
Tubes total		Piece	768	768	Tubes:	Cu	Cu
Tubes blank		Piece	0	0	Tubes:	smooth	smooth
Int. vent./drains		Piece	5	5	Tubes:	staggered	staggered
Tube rows on the depth		Piece	12	12	Tubes:	circular	circular
Tube rows on the height		Piece	64	64	Collectors:	Cu	Cu
Tube coupling in series		Piece	32	32	Collectors:	1.47 m/s	1.47 m/s
Number of circuits (NC)		Piece	24	24	Connections:	Rg7	Rg7
Volume		l	192	192	Connections:	1.47 m/s	1.47 m/s
Weight		kg	593	593	Fins:	Al	Al
Connections	G	---	2"	2"	Fins:	Wave structure	Wave structure
Frame height	RH	mm	2200	2200	Frame:	AISI304	AISI304
Frame width	BT	mm	2300	2300	Frame:	2.00 m/s	2.00 mm
Frame depth	RT	mm	430	430	Protection:	without	without
Finned height	LH	mm	2133	2133	Protection:	---	---
Finned width	LB	mm	2104	2104			
Finned depth	LF	mm	346	346			
Frame on top	RO	mm	33	33			
Frame on bottom	RU	mm	34	34			
Frame in front	RV	mm	30	30			
Frame on back	RN	mm	53	53			
Collector-Diameter	K	mm	54	54			
Collector covering	AD	mm	143	143			
Collector distance	KA	mm	347	347			
Fin spacing	LT	mm	2.900	2.900			
Fin thickness	LD	mm	0.200	0.200			
Tube diameter	DA	mm	12.400	12.400			
Tube diameter	da	mm	12.400	12.400			
Tube thickness	S	mm	0.350	0.350			
Tube interval on the height	S1	mm	33.333	33.333			
Tube interval on the width	S2	mm	28.867	28.867			



RAHe: 33/29/12-12R-64T-2104A-2.9PA-24C-Cu/Al/AISI304 **RAHe:** **EUR** **10087.00**

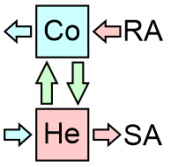
SACo: 33/29/12-12R-64T-2104A-2.9PA-24C-Cu/Al/AISI304 **SACo:** **EUR** **10087.00**

CC-System - (DIN EN 308)		SAHe308	RACo308	Definition
Height over sea level	m			540.000
Pressure	hPa			949.653
Efficiency	%	69.550	69.535	
Capacity sensible	kW	130.343	130.342	
Capacity latent	kW	0.000	0.000	
Capacity frost	kW	---	0.000	
Capacity total	kW	130.343	130.342	
Surface reserve	%	0.205	0.362	
Present surface	m²	1204.319	1204.319	

SAHe		Inlet	Outlet	Definition
Temp.	°C	5.000	18.910	20.000
Rel. humidity	%	0.000	0.000	40.000
Abs. humidity	g/kg	0.000	0.000	6.174
Volume flow humid	m³/h	28185.284	29594.751	30000.000
Velocity	m/s	1.744	1.832	1.857
Pressure drop	Pa		71.997	

RACo		Inlet	Outlet	Definition
Temp.	°C	25.000	11.093	20.000
Rel. humidity	%	0.000	0.000	40.000
Abs. humidity	g/kg	0.000	0.000	6.174
Volume flow humid	m³/h	30211.836	28802.676	30000.000
Velocity	m/s	1.870	1.783	1.857
Pressure drop	Pa		74.008	

Temper -10			SAHe308	RACo308
Temp.	in	°C	20.514	9.322
Temp.	out	°C	9.322	20.514
Volume flow		m³/h	10.808	10.810
Velocity		m/s	1.163	1.164
Reynolds		---	8865.002	8641.998
Pressure drop		kPa	170.926	171.927



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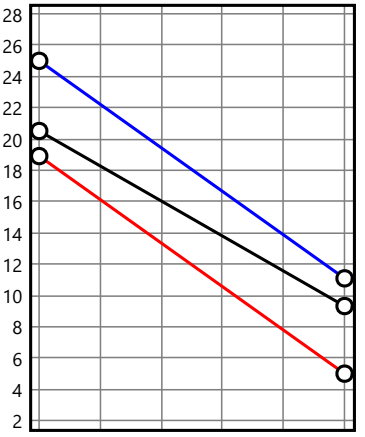
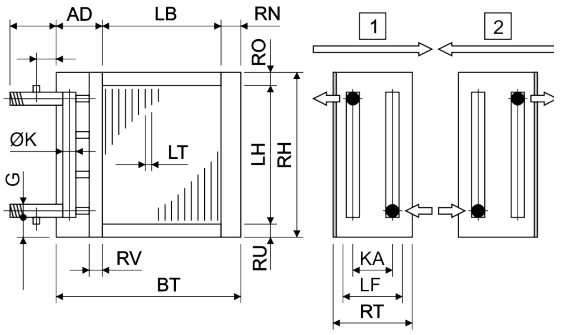
Plant
Object
Position

Temperature (°C)



Technical data			SAHe	RACo			
Tubes total		Piece	768	768	Tubes:	Cu	Cu
Tubes blank		Piece	0	0	Tubes:	smooth	smooth
Int. vent./drains		Piece	5	5	Tubes:	staggered	staggered
Tube rows on the depth		Piece	12	12	Tubes:	circular	circular
Tube rows on the height		Piece	64	64	Collectors:	Cu	Cu
Tube coupling in series		Piece	32	32	Collectors:	1.47 m/s	1.47 m/s
Number of circuits (NC)		Piece	24	24	Connections:	Rg7	Rg7
Volume		l	192	192	Connections:	1.47 m/s	1.47 m/s
Weight		kg	593	593	Fins:	Al	Al
Connections	G	---	2"	2"	Fins:	Wave structure	Wave structure
Frame height	RH	mm	2200	2200	Frame:	AISI304	AISI304
Frame width	BT	mm	2300	2300	Frame:	2.00 m/s	2.00 mm
Frame depth	RT	mm	430	430	Protection:	without	without
Finned height	LH	mm	2133	2133	Protection:	---	---
Finned width	LB	mm	2104	2104			
Finned depth	LF	mm	346	346			
Frame on top	RO	mm	33	33			
Frame on bottom	RU	mm	34	34			
Frame in front	RV	mm	30	30			
Frame on back	RN	mm	53	53			
Collector-Diameter	K	mm	54	54			
Collector covering	AD	mm	143	143			
Collector distance	KA	mm	347	347			
Fin spacing	LT	mm	2.900	2.900			
Fin thickness	LD	mm	0.200	0.200			
Tube diameter	DA	mm	12.400	12.400			
Tube diameter	da	mm	12.400	12.400			
Tube thickness	S	mm	0.350	0.350			
Tube interval on the height	S1	mm	33.333	33.333			
Tube interval on the width	S2	mm	28.867	28.867			



SAHe308: 33/29/12-12R-64T-2104A-2.9PA-24C-Cu/Al/AISI304 **SAHe308: EUR 10087.00**

RACo308: 33/29/12-12R-64T-2104A-2.9PA-24C-Cu/Al/AISI304 **RACo308: EUR 10087.00**

Energy recovery / Year (Service at 100% Air flow = 5667 Hours)

No	Outside air °C	Outside air %	CCSB °C	CCSB %	Return air °C	Return air %	Exhaust air °C	Exhaust air %	Efficiency %	Capacity kW	Energy MWh
1	-8.7	84.0	12.7	16.6	21.1	34.5	2.8	92.6	71.8	200.8	28.4
2	-3.3	78.4	14.0	22.7	21.2	35.0	5.5	87.5	70.6	162.7	23.1
3	-1.4	79.2	14.5	26.0	21.3	35.4	6.5	85.8	70.2	150.3	21.3
4	-0.2	78.5	14.9	27.8	21.4	35.9	7.2	84.6	70.1	142.8	20.2
5	0.8	76.3	15.3	28.6	21.5	36.3	7.8	83.7	69.9	136.3	19.3
6	1.6	79.2	15.6	30.9	21.6	36.7	8.3	83.1	69.8	131.5	18.6
7	2.4	77.1	15.9	31.1	21.7	37.2	8.8	82.5	69.7	127.1	18.0
8	3.0	77.3	16.1	32.1	21.8	37.6	9.2	82.1	69.7	123.6	17.5
9	3.6	76.2	16.4	32.5	21.9	38.1	9.6	81.7	69.6	120.4	17.1
10	4.2	75.3	16.6	32.9	22.0	38.5	10.0	81.4	69.6	117.4	16.6
11	4.7	75.9	16.8	33.9	22.2	39.0	10.4	81.2	69.6	114.5	16.2
12	5.3	73.8	17.1	33.8	22.3	39.4	10.7	80.9	69.5	111.5	15.8
13	5.9	75.2	17.3	35.3	22.4	39.9	11.1	80.3	69.5	108.1	15.3
14	6.5	72.4	17.6	35.0	22.5	40.3	11.6	79.7	69.4	104.6	14.8
15	7.1	73.7	17.8	36.4	22.6	40.7	12.0	79.3	69.4	101.6	14.4
16	7.7	72.1	18.1	36.5	22.7	41.2	12.4	78.7	69.4	98.5	14.0
17	8.3	73.0	18.4	38.0	22.8	41.6	12.8	77.9	69.3	94.9	13.4
18	9.0	73.9	18.6	39.6	22.9	42.1	13.3	76.9	69.3	91.3	12.9
19	9.6	73.3	18.9	40.3	23.0	42.5	13.8	75.7	69.3	87.7	12.4
20	10.3	71.7	19.2	40.4	23.1	43.0	14.2	74.8	69.3	84.5	12.0
21	10.9	72.5	19.4	41.9	23.2	43.4	14.7	73.8	69.3	81.1	11.5
22	11.5	68.9	19.6	40.8	23.3	43.9	15.2	72.7	69.3	76.1	10.8
23	12.3	68.7	19.4	42.0	23.4	44.3	15.7	71.4	69.3	67.7	9.6
24	13.1	69.7	19.3	44.0	23.5	44.7	16.3	70.0	69.3	59.1	8.4
25	13.7	67.7	19.1	43.8	23.6	45.2	16.8	69.0	69.3	51.5	7.3
26	14.3	69.5	19.0	46.0	23.8	45.6	17.2	68.3	69.3	44.7	6.3
27	14.9	71.2	18.9	48.3	23.9	46.1	17.7	67.3	69.3	37.3	5.3
28	15.5	71.6	18.7	49.7	24.0	46.5	18.1	66.6	69.3	30.5	4.3
29	16.1	71.0	18.6	50.4	24.1	47.0	18.6	65.8	69.3	23.3	3.3
30	16.7	67.3	18.4	48.9	24.2	47.4	19.0	64.9	69.3	16.1	2.3
31	17.4	64.6	18.3	48.0	24.3	47.9	19.5	64.1	69.3	8.8	1.2
32	18.0	64.9	18.1	49.3	24.4	48.3	20.0	63.2	69.3	1.4	0.2
33	18.6	63.9	17.6	68.3	17.1	100.0	18.2	93.5	69.4	10.2	1.4
34	19.3	64.2	17.9	70.2	17.3	100.0	18.7	91.5	69.4	13.9	2.0
35	20.1	64.5	18.3	72.5	17.4	100.0	19.3	89.0	69.4	17.9	2.5
36	21.0	60.2	18.6	69.7	17.6	100.0	20.0	86.2	69.4	22.8	3.2
37	22.0	62.1	19.1	74.6	17.7	100.0	20.7	83.3	69.4	28.3	4.0
38	23.2	60.1	19.5	75.2	17.9	100.0	21.6	79.7	69.4	35.2	5.0
39	24.8	56.4	20.1	74.9	18.1	100.0	22.7	75.1	69.4	44.6	6.3
40	28.3	50.1	21.3	75.9	18.2	100.0	25.2	65.3	69.3	67.1	9.5

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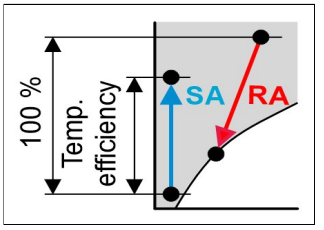
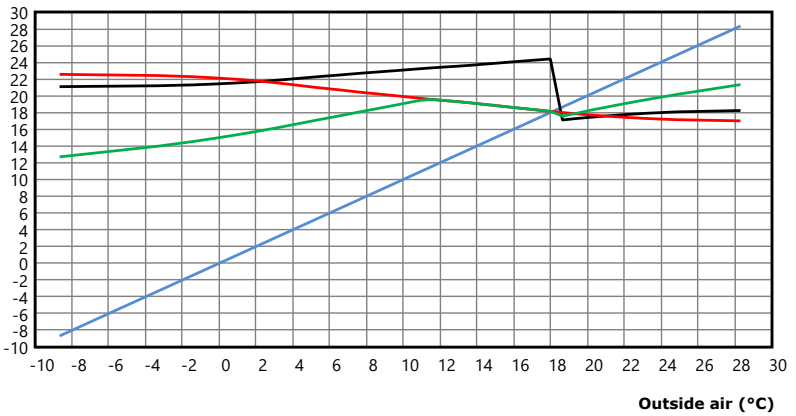
Plant
Object
Position



Air (%)	Service (h/a)
100.00	4000
66.67	2000
33.33	1000
▼	▼
100.00	5667

EU: Energy recovery: Heat energy	MWh	411.99	EUR	24719.00	(60.00 EUR/MWh)
EU: Energy recovery: Cold energy	MWh	34.03	EUR	2722.00	(80.00 EUR/MWh)
EU: 2 Fan: Glycol pump	MWh	-22.17	EUR	-2217.00	(100.00 EUR/MWh)
EU: Energy recovery: Net useful ratio / Year	MWh	423.85	EUR	25224.00	(59.51 EUR/MWh)
EU: Need of energy total / Year	MWh	739.97	EUR	51562.11	(69.68 EUR/MWh)
EU: Net useful ratio / Year	%	57.28	%	48.92	TWG = 73.15%
CH: Guidelines from associations such as SIA and SWKI: TWG>70.00% & JNG>75.00% & ETV>15.00					JNG = 72.80%
					ETV = 23.23

Outside air (°C) **Return air (°C)** **Supply air (°C)** **Energy recovery (°C)**



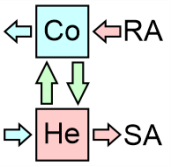
Station		Bern
Height over sea level	m	540.00
Pressure	hPa	949.65
Outside air	m³/h	30000.00
Return air	m³/h	30000.00
Adiabatic return air cooling	h/a	1133.33
Service at 100% Air flow	h/a	5666.67
Capital interest	%	1.00
Energy increase	%	1.00
Inflation	%	1.00
Support costs	%	5.00
Costs without CC-system	EUR	86000.00
Costs with CC-system	EUR	154000.00
Additional costs	EUR	68000.00
BEP (Break even point) after	**Years**	**3.14**

CC-System in winter		SAHe	RACo	Definition
Height over sea level	m			540.000
Pressure	hPa			949.653
Efficiency	%	73.150	59.137	
Capacity sensible	kW	212.968	173.206	
Capacity latent	kW	0.000	38.568	
Capacity frost	kW	---	1.194	
Capacity total	kW	212.968	212.968	
Surface reserve	%	0.237	0.281	
Present surface	m²	1386.938	1386.938	

SAHe		Inlet	Outlet	Definition
Temp.	°C	-11.000	11.677	20.000
Rel. humidity	%	90.000	15.473	40.000
Abs. humidity	g/kg	1.394	1.394	6.174
Volume flow humid	m³/h	26623.555	28926.458	30000.000
Velocity	m/s	1.648	1.790	1.857
Pressure drop	Pa		78.374	

RACo		Inlet	Outlet	Definition
Temp.	°C	20.000	1.668	20.000
Rel. humidity	%	40.000	99.652	40.000
Abs. humidity	g/kg	6.174	4.541	6.174
Volume flow humid	m³/h	30000.000	28050.895	30000.000
Velocity	m/s	1.857	1.736	1.857
Pressure drop	Pa		93.892	

25 V% Et.glykol			SAHe	RACo
Temp.	in	°C	14.570	-3.950
Temp.	out	°C	-3.950	14.570
Volume flow		m³/h	10.754	10.757
Velocity		m/s	1.158	1.158
Reynolds		---	4827.040	4708.594
Pressure drop		kPa	184.185	185.445



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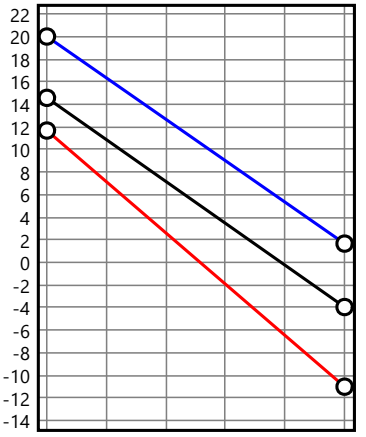
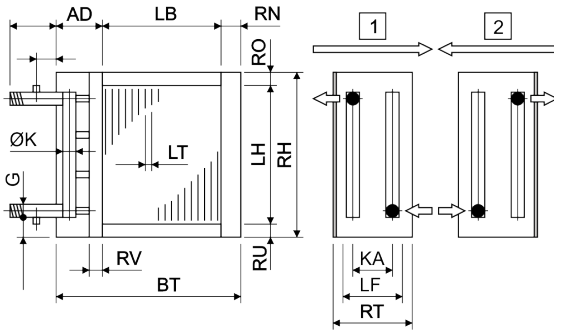
Plant
Object
Position

Temperature (°C)



Technical data			SAHe	RACo			
Tubes total		Piece	768	768	Tubes:	Cu	Cu
Tubes blank		Piece	0	0	Tubes:	smooth	smooth
Int. vent./drains		Piece	5	5	Tubes:	staggered	staggered
Tube rows on the depth		Piece	12	12	Tubes:	circular	circular
Tube rows on the height		Piece	64	64	Collectors:	Cu	Cu
Tube coupling in series		Piece	32	32	Collectors:	1.47 m/s	1.47 m/s
Number of circuits (NC)		Piece	24	24	Connections:	Rg7	Rg7
Volume		l	192	192	Connections:	1.47 m/s	1.47 m/s
Weight		kg	641	641	Fins:	Al	Al
Connections	G	---	2"	2"	Fins:	Wave structure	Wave structure
Frame height	RH	mm	2200	2200	Frame:	AISI304	AISI304
Frame width	BT	mm	2300	2300	Frame:	2.00 m/s	2.00 mm
Frame depth	RT	mm	430	430	Protection:	without	without
Finned height	LH	mm	2133	2133	Protection:	---	---
Finned width	LB	mm	2104	2104			
Finned depth	LF	mm	346	346			
Frame on top	RO	mm	33	33			
Frame on bottom	RU	mm	34	34			
Frame in front	RV	mm	30	30			
Frame on back	RN	mm	53	53			
Collector-Diameter	K	mm	54	54			
Collector covering	AD	mm	143	143			
Collector distance	KA	mm	347	347			
Fin spacing	LT	mm	2.500	2.500			
Fin thickness	LD	mm	0.200	0.200			
Tube diameter	DA	mm	12.400	12.400			
Tube diameter	da	mm	12.400	12.400			
Tube thickness	S	mm	0.350	0.350			
Tube interval on the height	S1	mm	33.333	33.333			
Tube interval on the width	S2	mm	28.867	28.867			



SAHe: 33/29/12-12R-64T-2104A-2.5PA-24C-Cu/Al/AISI304 **SAHe: EUR 10624.00**

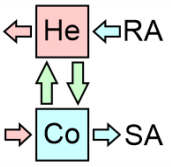
RACo: 33/29/12-12R-64T-2104A-2.5PA-24C-Cu/Al/AISI304 **RACo: EUR 10624.00**

CC-System in summer		RAHe	SACo	Definition
Height over sea level	m			540.000
Pressure	hPa			949.653
Efficiency	%	71.222	70.889	
Capacity sensible	kW	89.139	89.139	
Capacity latent	kW	0.000	0.000	
Capacity frost	kW	---	0.000	
Capacity total	kW	89.139	89.139	
Surface reserve	%	0.019	0.384	
Present surface	m²	1386.938	1386.938	

RAHe		Inlet	Outlet	Definition
Temp.	°C	19.000	28.259	20.000
Rel. humidity	%	100.000	57.328	40.000
Abs. humidity	g/kg	14.703	14.703	6.174
Volume flow humid	m³/h	30303.581	31263.932	30000.000
Velocity	m/s	1.875	1.935	1.857
Pressure drop	Pa		90.022	

SACo		Inlet	Outlet	Definition
Temp.	°C	32.000	22.784	20.000
Rel. humidity	%	54.000	92.508	40.000
Abs. humidity	g/kg	17.224	17.224	6.174
Volume flow humid	m³/h	31777.262	30817.616	30000.000
Velocity	m/s	1.967	1.907	1.857
Pressure drop	Pa		92.051	

25 V% Et.glykol			RAHe	SACo
Temp.	in	°C	29.301	21.607
Temp.	out	°C	21.607	29.301
Volume flow		m³/h	10.754	10.756
Velocity		m/s	1.158	1.158
Reynolds		---	8611.192	8503.399
Pressure drop		kPa	162.192	162.697



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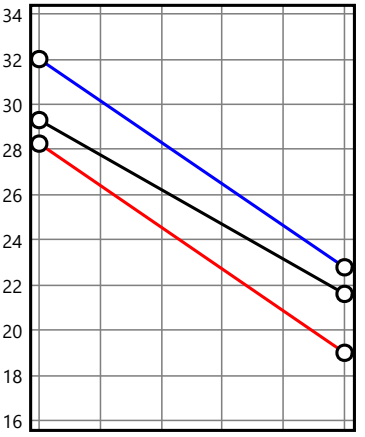
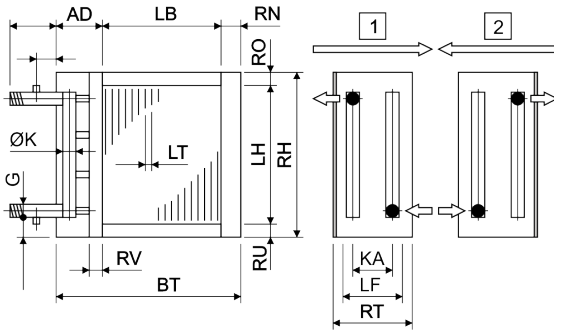
Plant
Object
Position

Temperature (°C)



Technical data			SAHe	RACo			
Tubes total		Piece	768	768	Tubes:	Cu	Cu
Tubes blank		Piece	0	0	Tubes:	smooth	smooth
Int. vent./drains		Piece	5	5	Tubes:	staggered	staggered
Tube rows on the depth		Piece	12	12	Tubes:	circular	circular
Tube rows on the height		Piece	64	64	Collectors:	Cu	Cu
Tube coupling in series		Piece	32	32	Collectors:	1.47 m/s	1.47 m/s
Number of circuits (NC)		Piece	24	24	Connections:	Rg7	Rg7
Volume		l	192	192	Connections:	1.47 m/s	1.47 m/s
Weight		kg	641	641	Fins:	Al	Al
Connections	G	---	2"	2"	Fins:	Wave structure	Wave structure
Frame height	RH	mm	2200	2200	Frame:	AISI304	AISI304
Frame width	BT	mm	2300	2300	Frame:	2.00 m/s	2.00 mm
Frame depth	RT	mm	430	430	Protection:	without	without
Finned height	LH	mm	2133	2133	Protection:	---	---
Finned width	LB	mm	2104	2104			
Finned depth	LF	mm	346	346			
Frame on top	RO	mm	33	33			
Frame on bottom	RU	mm	34	34			
Frame in front	RV	mm	30	30			
Frame on back	RN	mm	53	53			
Collector-Diameter	K	mm	54	54			
Collector covering	AD	mm	143	143			
Collector distance	KA	mm	347	347			
Fin spacing	LT	mm	2.500	2.500			
Fin thickness	LD	mm	0.200	0.200			
Tube diameter	DA	mm	12.400	12.400			
Tube diameter	da	mm	12.400	12.400			
Tube thickness	S	mm	0.350	0.350			
Tube interval on the height	S1	mm	33.333	33.333			
Tube interval on the width	S2	mm	28.867	28.867			



RAHe: 33/29/12-12R-64T-2104A-2.5PA-24C-Cu/Al/AISI304 **RAHe:** **EUR** **10624.00**

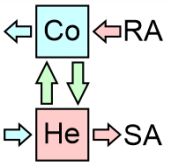
SACo: 33/29/12-12R-64T-2104A-2.5PA-24C-Cu/Al/AISI304 **SACo:** **EUR** **10624.00**

CC-System - (DIN EN 308)		SAHe308	RACo308	Definition
Height over sea level	m			540.000
Pressure	hPa			949.653
Efficiency	%	70.144	70.129	
Capacity sensible	kW	131.456	131.456	
Capacity latent	kW	0.000	0.000	
Capacity frost	kW	---	0.000	
Capacity total	kW	131.456	131.456	
Surface reserve	%	0.318	0.202	
Present surface	m²	1386.938	1386.938	

SAHe		Inlet	Outlet	Definition
Temp.	°C	5.000	19.029	20.000
Rel. humidity	%	0.000	0.000	40.000
Abs. humidity	g/kg	0.000	0.000	6.174
Volume flow humid	m³/h	28185.284	29606.783	30000.000
Velocity	m/s	1.744	1.832	1.857
Pressure drop	Pa		82.676	

RACo		Inlet	Outlet	Definition
Temp.	°C	25.000	10.974	20.000
Rel. humidity	%	0.000	0.000	40.000
Abs. humidity	g/kg	0.000	0.000	6.174
Volume flow humid	m³/h	30211.836	28790.632	30000.000
Velocity	m/s	1.870	1.782	1.857
Pressure drop	Pa		85.021	

25 V% Et.glykol			SAHe308	RACo308
Temp.	in	°C	20.593	9.240
Temp.	out	°C	9.240	20.593
Volume flow		m³/h	10.786	10.790
Velocity		m/s	1.161	1.162
Reynolds		---	6556.757	6399.860
Pressure drop		kPa	173.257	174.292



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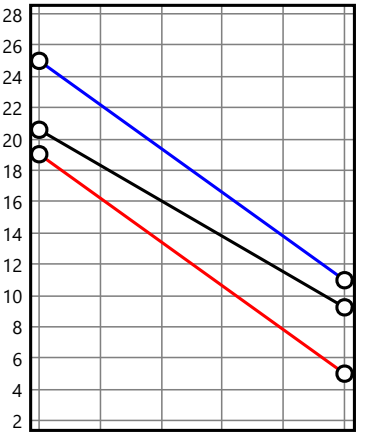
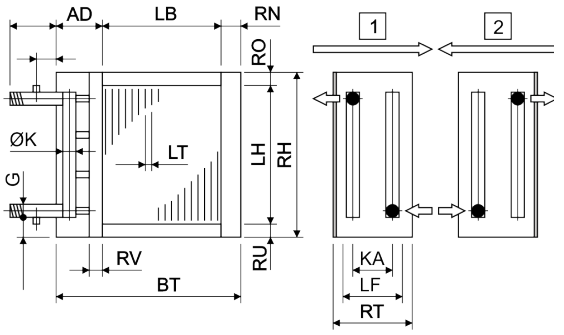
Plant
Object
Position

Temperature (°C)



Technical data			SAHe	RACo			
Tubes total		Piece	768	768	Tubes:	Cu	Cu
Tubes blank		Piece	0	0	Tubes:	smooth	smooth
Int. vent./drains		Piece	5	5	Tubes:	staggered	staggered
Tube rows on the depth		Piece	12	12	Tubes:	circular	circular
Tube rows on the height		Piece	64	64	Collectors:	Cu	Cu
Tube coupling in series		Piece	32	32	Collectors:	1.47 m/s	1.47 m/s
Number of circuits (NC)		Piece	24	24	Connections:	Rg7	Rg7
Volume		l	192	192	Connections:	1.47 m/s	1.47 m/s
Weight		kg	641	641	Fins:	Al	Al
Connections	G	---	2"	2"	Fins:	Wave structure	Wave structure
Frame height	RH	mm	2200	2200	Frame:	AISI304	AISI304
Frame width	BT	mm	2300	2300	Frame:	2.00 m/s	2.00 mm
Frame depth	RT	mm	430	430	Protection:	without	without
Finned height	LH	mm	2133	2133	Protection:	---	---
Finned width	LB	mm	2104	2104			
Finned depth	LF	mm	346	346			
Frame on top	RO	mm	33	33			
Frame on bottom	RU	mm	34	34			
Frame in front	RV	mm	30	30			
Frame on back	RN	mm	53	53			
Collector-Diameter	K	mm	54	54			
Collector covering	AD	mm	143	143			
Collector distance	KA	mm	347	347			
Fin spacing	LT	mm	2.500	2.500			
Fin thickness	LD	mm	0.200	0.200			
Tube diameter	DA	mm	12.400	12.400			
Tube diameter	da	mm	12.400	12.400			
Tube thickness	S	mm	0.350	0.350			
Tube interval on the height	S1	mm	33.333	33.333			
Tube interval on the width	S2	mm	28.867	28.867			



SAHe308: 33/29/12-12R-64T-2104A-2.5PA-24C-Cu/Al/AISI304 **SAHe308: EUR 10624.00**

RACo308: 33/29/12-12R-64T-2104A-2.5PA-24C-Cu/Al/AISI304 **RACo308: EUR 10624.00**

Energy recovery / Year (Service at 100% Air flow = 5667 Hours)

No	Outside air °C	Outside air %	CCSB °C	CCSB %	Return air °C	Return air %	Exhaust air °C	Exhaust air %	Efficiency %	Capacity kW	Energy MWh
1	-8.7	84.0	12.7	16.6	21.1	34.5	2.8	92.6	71.8	200.8	28.4
2	-3.3	78.4	14.0	22.7	21.2	35.0	5.5	87.5	70.6	162.7	23.1
3	-1.4	79.2	14.5	26.0	21.3	35.4	6.5	85.8	70.2	150.3	21.3
4	-0.2	78.5	14.9	27.8	21.4	35.9	7.2	84.6	70.1	142.8	20.2
5	0.8	76.3	15.3	28.6	21.5	36.3	7.8	83.7	69.9	136.3	19.3
6	1.6	79.2	15.6	30.9	21.6	36.7	8.3	83.1	69.8	131.5	18.6
7	2.4	77.1	15.9	31.1	21.7	37.2	8.8	82.5	69.7	127.1	18.0
8	3.0	77.3	16.1	32.1	21.8	37.6	9.2	82.1	69.7	123.6	17.5
9	3.6	76.2	16.4	32.5	21.9	38.1	9.6	81.7	69.6	120.4	17.1
10	4.2	75.3	16.6	32.9	22.0	38.5	10.0	81.4	69.6	117.4	16.6
11	4.7	75.9	16.8	33.9	22.2	39.0	10.4	81.2	69.6	114.5	16.2
12	5.3	73.8	17.1	33.8	22.3	39.4	10.7	80.9	69.5	111.5	15.8
13	5.9	75.2	17.3	35.3	22.4	39.9	11.1	80.3	69.5	108.1	15.3
14	6.5	72.4	17.6	35.0	22.5	40.3	11.6	79.7	69.4	104.6	14.8
15	7.1	73.7	17.8	36.4	22.6	40.7	12.0	79.3	69.4	101.6	14.4
16	7.7	72.1	18.1	36.5	22.7	41.2	12.4	78.7	69.4	98.5	14.0
17	8.3	73.0	18.4	38.0	22.8	41.6	12.8	77.9	69.3	94.9	13.4
18	9.0	73.9	18.6	39.6	22.9	42.1	13.3	76.9	69.3	91.3	12.9
19	9.6	73.3	18.9	40.3	23.0	42.5	13.8	75.7	69.3	87.7	12.4
20	10.3	71.7	19.2	40.4	23.1	43.0	14.2	74.8	69.3	84.5	12.0
21	10.9	72.5	19.4	41.9	23.2	43.4	14.7	73.8	69.3	81.1	11.5
22	11.5	68.9	19.6	40.8	23.3	43.9	15.2	72.7	69.3	76.1	10.8
23	12.3	68.7	19.4	42.0	23.4	44.3	15.7	71.4	69.3	67.7	9.6
24	13.1	69.7	19.3	44.0	23.5	44.7	16.3	70.0	69.3	59.1	8.4
25	13.7	67.7	19.1	43.8	23.6	45.2	16.8	69.0	69.3	51.5	7.3
26	14.3	69.5	19.0	46.0	23.8	45.6	17.2	68.3	69.3	44.7	6.3
27	14.9	71.2	18.9	48.3	23.9	46.1	17.7	67.3	69.3	37.3	5.3
28	15.5	71.6	18.7	49.7	24.0	46.5	18.1	66.6	69.3	30.5	4.3
29	16.1	71.0	18.6	50.4	24.1	47.0	18.6	65.8	69.3	23.3	3.3
30	16.7	67.3	18.4	48.9	24.2	47.4	19.0	64.9	69.3	16.1	2.3
31	17.4	64.6	18.3	48.0	24.3	47.9	19.5	64.1	69.3	8.8	1.2
32	18.0	64.9	18.1	49.3	24.4	48.3	20.0	63.2	69.3	1.4	0.2
33	18.6	63.9	17.6	68.3	17.1	100.0	18.2	93.5	69.4	10.2	1.4
34	19.3	64.2	17.9	70.2	17.3	100.0	18.7	91.5	69.4	13.9	2.0
35	20.1	64.5	18.3	72.5	17.4	100.0	19.3	89.0	69.4	17.9	2.5
36	21.0	60.2	18.6	69.7	17.6	100.0	20.0	86.2	69.4	22.8	3.2
37	22.0	62.1	19.1	74.6	17.7	100.0	20.7	83.3	69.4	28.3	4.0
38	23.2	60.1	19.5	75.2	17.9	100.0	21.6	79.7	69.4	35.2	5.0
39	24.8	56.4	20.1	74.9	18.1	100.0	22.7	75.1	69.4	44.6	6.3
40	28.3	50.1	21.3	75.9	18.2	100.0	25.2	65.3	69.3	67.1	9.5

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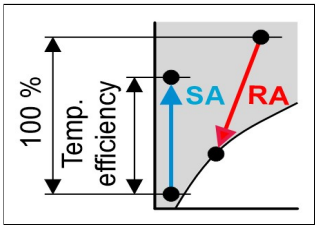
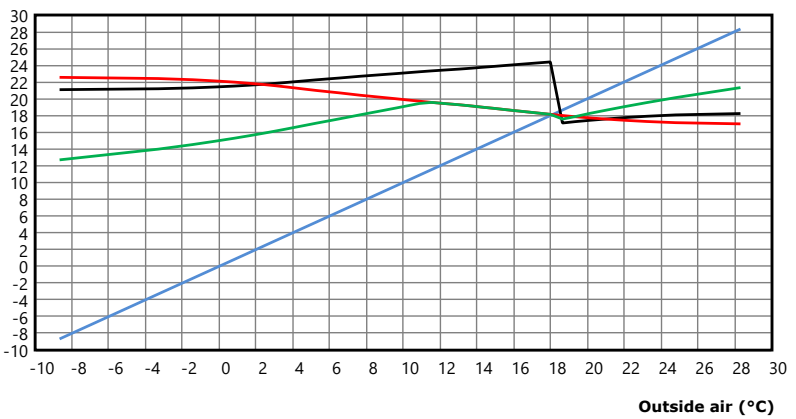


Air (%)	Service (h/a)
100.00	4000
66.67	2000
33.33	1000
▼	▼
100.00	5667

EU: Energy recovery: Heat energy	MWh	411.99	EUR	24719.00	(60.00 EUR/MWh)
EU: Energy recovery: Cold energy	MWh	34.03	EUR	2722.00	(80.00 EUR/MWh)
EU: 2 Fan: Glycol pump	MWh	-23.68	EUR	-2368.00	(100.00 EUR/MWh)
EU: Energy recovery: Net useful ratio / Year	MWh	422.34	EUR	25073.00	(59.37 EUR/MWh)
EU: Need of energy total / Year	MWh	739.99	EUR	51564.86	(69.68 EUR/MWh)
EU: Net useful ratio / Year	%	57.07	%	48.62	TWG = 73.15%
CH: Guidelines from associations such as SIA and SWKI: TWG>70.00% & JNG>75.00% & ETV>15.00					JNG = 72.52%
					ETV = 21.75

Outside air (°C) **Return air (°C)** **Supply air (°C)** **Energy recovery (°C)**



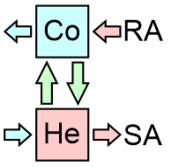
Station		Bern
Height over sea level	m	540.00
Pressure	hPa	949.65
Outside air	m³/h	30000.00
Return air	m³/h	30000.00
Adiabatic return air cooling	h/a	1133.33
Service at 100% Air flow	h/a	5666.67
Capital interest	%	1.00
Energy increase	%	1.00
Inflation	%	1.00
Support costs	%	5.00
Costs without CC-system	EUR	86000.00
Costs with CC-system	EUR	154000.00
Additional costs	EUR	68000.00
BEP (Break even point) after	**Years**	**3.16**

CC-System in winter		SAHe	RACo	Definition
Height over sea level	m			540.000
Pressure	hPa			949.653
Efficiency	%	73.150	59.433	
Capacity sensible	kW	212.968	174.069	
Capacity latent	kW	0.000	38.899	
Capacity frost	kW	---	0.000	
Capacity total	kW	212.968	212.968	
Surface reserve	%	0.483	0.292	
Present surface	m²	1660.110	1660.110	

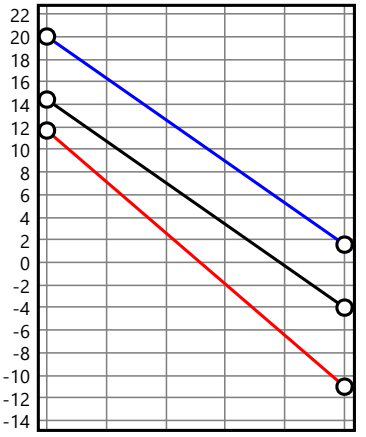
SAHe		Inlet	Outlet	Definition
Temp.	°C	-11.000	11.677	20.000
Rel. humidity	%	90.000	15.473	40.000
Abs. humidity	g/kg	1.394	1.394	6.174
Volume flow humid	m³/h	26623.555	28926.458	30000.000
Velocity	m/s	1.648	1.790	1.857
Pressure drop	Pa		93.878	

RACo		Inlet	Outlet	Definition
Temp.	°C	20.000	1.576	20.000
Rel. humidity	%	40.000	100.000	40.000
Abs. humidity	g/kg	6.174	4.527	6.174
Volume flow humid	m³/h	30000.000	28040.896	30000.000
Velocity	m/s	1.857	1.735	1.857
Pressure drop	Pa		111.736	

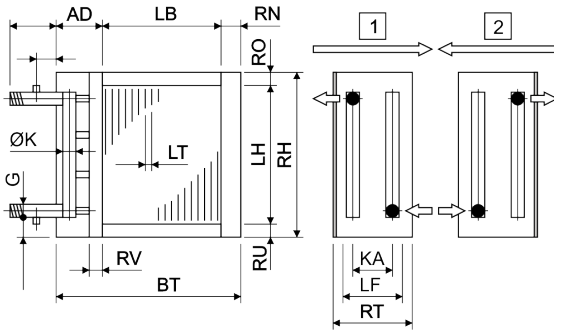
25 V% Pr.glykol			SAHe	RACo
Temp.	in	°C	14.420	-4.000
Temp.	out	°C	-4.000	14.420
Volume flow		m³/h	10.429	10.431
Velocity		m/s	0.962	0.963
Reynolds		---	2748.129	2661.145
Pressure drop		kPa	164.431	165.958



Temperature (°C)



Technical data			SAHe	RACo			
Tubes total		Piece	1024	1024	Tubes:	Cu	Cu
Tubes blank		Piece	16	16	Tubes:	smooth	smooth
Int. vent./drains		Piece	7	7	Tubes:	staggered	staggered
Tube rows on the depth		Piece	16	16	Tubes:	circular	circular
Tube rows on the height		Piece	64	64	Collectors:	Cu	Cu
Tube coupling in series		Piece	36	36	Collectors:	1.42 m/s	1.42 m/s
Number of circuits (NC)		Piece	28	28	Connections:	Rg7	Rg7
Volume		l	253	253	Connections:	1.42 m/s	1.42 m/s
Weight		kg	791	791	Fins:	Al	Al
Connections	G	---	2"	2"	Fins:	Wave structure	Wave structure
Frame height	RH	mm	2200	2200	Frame:	AISI304	AISI304
Frame width	BT	mm	2300	2300	Frame:	2.00 m/s	2.00 mm
Frame depth	RT	mm	540	540	Protection:	without	without
Finned height	LH	mm	2133	2133	Protection:	---	---
Finned width	LB	mm	2104	2104			
Finned depth	LF	mm	462	462			
Frame on top	RO	mm	33	33			
Frame on bottom	RU	mm	34	34			
Frame in front	RV	mm	30	30			
Frame on back	RN	mm	53	53			
Collector-Diameter	K	mm	54	54			
Collector covering	AD	mm	143	143			
Collector distance	KA	mm	462	462			
Fin spacing	LT	mm	2.800	2.800			
Fin thickness	LD	mm	0.200	0.200			
Tube diameter	DA	mm	12.400	12.400			
Tube diameter	da	mm	12.400	12.400			
Tube thickness	S	mm	0.350	0.350			
Tube interval on the height	S1	mm	33.333	33.333			
Tube interval on the width	S2	mm	28.867	28.867			



SAHe: 33/29/12-16R-64T-2104A-2.8PA-28C-Cu/Al/AISI304 **SAHe: EUR 13421.00**

RACo: 33/29/12-16R-64T-2104A-2.8PA-28C-Cu/Al/AISI304 **RACo: EUR 13421.00**

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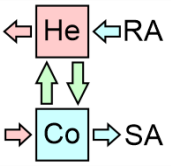
CC-System in summer		RAHe	SACo	Definition
Height over sea level	m			540.000
Pressure	hPa			949.653
Efficiency	%	73.644	73.301	
Capacity sensible	kW	92.171	92.171	
Capacity latent	kW	0.000	0.000	
Capacity frost	kW	---	0.000	
Capacity total	kW	92.171	92.171	
Surface reserve	%	0.488	0.164	
Present surface	m²	1660.110	1660.110	

RAHe		Inlet	Outlet	Definition
Temp.	°C	19.000	28.574	20.000
Rel. humidity	%	100.000	56.291	40.000
Abs. humidity	g/kg	14.703	14.703	6.174
Volume flow humid	m³/h	30303.581	31296.588	30000.000
Velocity	m/s	1.875	1.937	1.857
Pressure drop	Pa		107.572	

SACo		Inlet	Outlet	Definition
Temp.	°C	32.000	22.471	20.000
Rel. humidity	%	54.000	94.281	40.000
Abs. humidity	g/kg	17.224	17.224	6.174
Volume flow humid	m³/h	31777.262	30784.966	30000.000
Velocity	m/s	1.967	1.905	1.857
Pressure drop	Pa		109.808	

25 V% Pr.glykol			RAHe	SACo
Temp.	in	°C	29.441	21.509
Temp.	out	°C	21.509	29.441
Volume flow		m³/h	10.429	10.430
Velocity		m/s	0.962	0.962
Reynolds		---	5607.041	5501.536
Pressure drop		kPa	137.303	137.917



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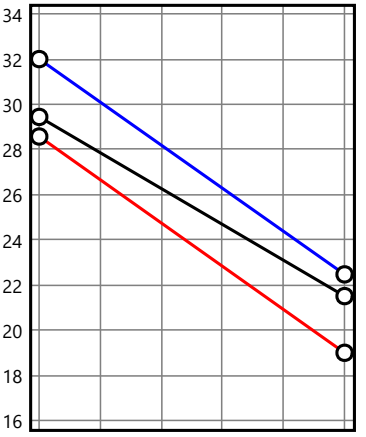
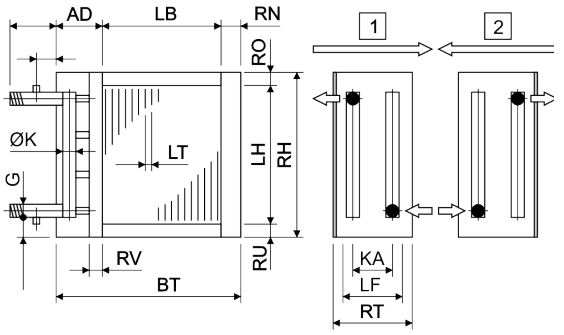
Position

Temperature (°C)



Technical data			SAHe	RACo			
Tubes total		Piece	1024	1024	Tubes:	Cu	Cu
Tubes blank		Piece	16	16	Tubes:	smooth	smooth
Int. vent./drains		Piece	7	7	Tubes:	staggered	staggered
Tube rows on the depth		Piece	16	16	Tubes:	circular	circular
Tube rows on the height		Piece	64	64	Collectors:	Cu	Cu
Tube coupling in series		Piece	36	36	Collectors:	1.42 m/s	1.42 m/s
Number of circuits (NC)		Piece	28	28	Connections:	Rg7	Rg7
Volume		l	253	253	Connections:	1.42 m/s	1.42 m/s
Weight		kg	791	791	Fins:	Al	Al
Connections	G	---	2"	2"	Fins:	Wave structure	Wave structure
Frame height	RH	mm	2200	2200	Frame:	AISI304	AISI304
Frame width	BT	mm	2300	2300	Frame:	2.00 m/s	2.00 mm
Frame depth	RT	mm	540	540	Protection:	without	without
Finned height	LH	mm	2133	2133	Protection:	---	---
Finned width	LB	mm	2104	2104			
Finned depth	LF	mm	462	462			
Frame on top	RO	mm	33	33			
Frame on bottom	RU	mm	34	34			
Frame in front	RV	mm	30	30			
Frame on back	RN	mm	53	53			
Collector-Diameter	K	mm	54	54			
Collector covering	AD	mm	143	143			
Collector distance	KA	mm	462	462			
Fin spacing	LT	mm	2.800	2.800			
Fin thickness	LD	mm	0.200	0.200			
Tube diameter	DA	mm	12.400	12.400			
Tube diameter	da	mm	12.400	12.400			
Tube thickness	S	mm	0.350	0.350			
Tube interval on the height	S1	mm	33.333	33.333			
Tube interval on the width	S2	mm	28.867	28.867			



RAHe: 33/29/12-16R-64T-2104A-2.8PA-28C-Cu/Al/AISI304 **RAHe:** **EUR** **13421.00**

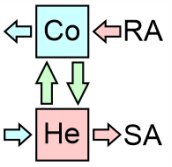
SACo: 33/29/12-16R-64T-2104A-2.8PA-28C-Cu/Al/AISI304 **SACo:** **EUR** **13421.00**

CC-System - (DIN EN 308)		SAHe308	RACo308	Definition
Height over sea level	m			540.000
Pressure	hPa			949.653
Efficiency	%	71.925	71.911	
Capacity sensible	kW	134.795	134.795	
Capacity latent	kW	0.000	0.000	
Capacity frost	kW	---	0.000	
Capacity total	kW	134.795	134.795	
Surface reserve	%	0.387	0.246	
Present surface	m²	1660.110	1660.110	

SAHe		Inlet	Outlet	Definition
Temp.	°C	5.000	19.385	20.000
Rel. humidity	%	0.000	0.000	40.000
Abs. humidity	g/kg	0.000	0.000	6.174
Volume flow humid	m³/h	28185.284	29642.881	30000.000
Velocity	m/s	1.744	1.835	1.857
Pressure drop	Pa		98.877	

RACo		Inlet	Outlet	Definition
Temp.	°C	25.000	10.618	20.000
Rel. humidity	%	0.000	0.000	40.000
Abs. humidity	g/kg	0.000	0.000	6.174
Volume flow humid	m³/h	30211.836	28754.524	30000.000
Velocity	m/s	1.870	1.780	1.857
Pressure drop	Pa		101.444	

25 V% Pr.glykol			SAHe308	RACo308
Temp.	in	°C	20.729	9.145
Temp.	out	°C	9.145	20.729
Volume flow		m³/h	10.467	10.469
Velocity		m/s	0.966	0.966
Reynolds		---	4010.626	3874.514
Pressure drop		kPa	149.887	151.303



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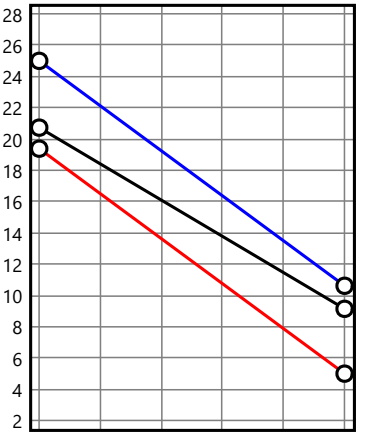
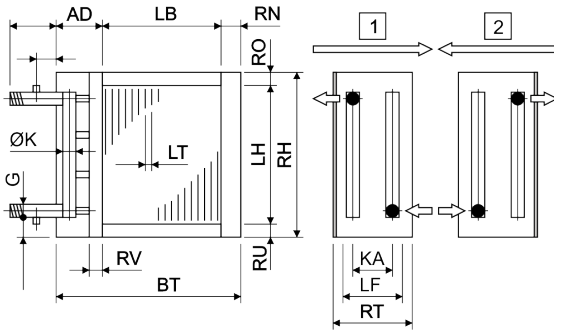
Temperature (°C)



Technical data			SAHe	RACo			
Tubes total		Piece	1024	1024	Tubes:	Cu	Cu
Tubes blank		Piece	16	16	Tubes:	smooth	smooth
Int. vent./drains		Piece	7	7	Tubes:	staggered	staggered
Tube rows on the depth		Piece	16	16	Tubes:	circular	circular
Tube rows on the height		Piece	64	64	Collectors:	Cu	Cu
Tube coupling in series		Piece	36	36	Collectors:	1.42 m/s	1.42 m/s
Number of circuits (NC)		Piece	28	28	Connections:	Rg7	Rg7
Volume		l	253	253	Connections:	1.42 m/s	1.42 m/s
Weight		kg	791	791	Fins:	Al	Al
Connections	G	---	2"	2"	Fins:	Wave structure	Wave structure
Frame height	RH	mm	2200	2200	Frame:	AISI304	AISI304
Frame width	BT	mm	2300	2300	Frame:	2.00 m/s	2.00 mm
Frame depth	RT	mm	540	540	Protection:	without	without
Finned height	LH	mm	2133	2133	Protection:	---	---
Finned width	LB	mm	2104	2104			
Finned depth	LF	mm	462	462			
Frame on top	RO	mm	33	33			
Frame on bottom	RU	mm	34	34			
Frame in front	RV	mm	30	30			
Frame on back	RN	mm	53	53			
Collector-Diameter	K	mm	54	54			
Collector covering	AD	mm	143	143			
Collector distance	KA	mm	462	462			
Fin spacing	LT	mm	2.800	2.800			
Fin thickness	LD	mm	0.200	0.200			
Tube diameter	DA	mm	12.400	12.400			
Tube diameter	da	mm	12.400	12.400			
Tube thickness	S	mm	0.350	0.350			
Tube interval on the height	S1	mm	33.333	33.333			
Tube interval on the width	S2	mm	28.867	28.867			



SAHe308: 33/29/12-16R-64T-2104A-2.8PA-28C-Cu/Al/AISI304 **SAHe308:** **EUR** **13421.00**

RACo308: 33/29/12-16R-64T-2104A-2.8PA-28C-Cu/Al/AISI304 **RACo308:** **EUR** **13421.00**

Energy recovery / Year (Service at 100% Air flow = 5667 Hours)

No	Outside air °C	Outside air %	CCSB °C	CCSB %	Return air °C	Return air %	Exhaust air °C	Exhaust air %	Efficiency %	Capacity kW	Energy MWh
1	-8.7	84.0	12.7	16.6	21.1	34.5	2.8	92.6	71.8	200.8	28.4
2	-3.3	78.4	14.0	22.7	21.2	35.0	5.5	87.5	70.6	162.7	23.1
3	-1.4	79.2	14.5	26.0	21.3	35.4	6.5	85.8	70.2	150.3	21.3
4	-0.2	78.5	14.9	27.8	21.4	35.9	7.2	84.6	70.1	142.8	20.2
5	0.8	76.3	15.3	28.6	21.5	36.3	7.8	83.7	69.9	136.3	19.3
6	1.6	79.2	15.6	30.9	21.6	36.7	8.3	83.1	69.8	131.5	18.6
7	2.4	77.1	15.9	31.1	21.7	37.2	8.8	82.5	69.7	127.1	18.0
8	3.0	77.3	16.1	32.1	21.8	37.6	9.2	82.1	69.7	123.6	17.5
9	3.6	76.2	16.4	32.5	21.9	38.1	9.6	81.7	69.6	120.4	17.1
10	4.2	75.3	16.6	32.9	22.0	38.5	10.0	81.4	69.6	117.4	16.6
11	4.7	75.9	16.8	33.9	22.2	39.0	10.4	81.2	69.6	114.5	16.2
12	5.3	73.8	17.1	33.8	22.3	39.4	10.7	80.9	69.5	111.5	15.8
13	5.9	75.2	17.3	35.3	22.4	39.9	11.1	80.3	69.5	108.1	15.3
14	6.5	72.4	17.6	35.0	22.5	40.3	11.6	79.7	69.4	104.6	14.8
15	7.1	73.7	17.8	36.4	22.6	40.7	12.0	79.3	69.4	101.6	14.4
16	7.7	72.1	18.1	36.5	22.7	41.2	12.4	78.7	69.4	98.5	14.0
17	8.3	73.0	18.4	38.0	22.8	41.6	12.8	77.9	69.3	94.9	13.4
18	9.0	73.9	18.6	39.6	22.9	42.1	13.3	76.9	69.3	91.3	12.9
19	9.6	73.3	18.9	40.3	23.0	42.5	13.8	75.7	69.3	87.7	12.4
20	10.3	71.7	19.2	40.4	23.1	43.0	14.2	74.8	69.3	84.5	12.0
21	10.9	72.5	19.4	41.9	23.2	43.4	14.7	73.8	69.3	81.1	11.5
22	11.5	68.9	19.6	40.8	23.3	43.9	15.2	72.7	69.3	76.1	10.8
23	12.3	68.7	19.4	42.0	23.4	44.3	15.7	71.4	69.3	67.7	9.6
24	13.1	69.7	19.3	44.0	23.5	44.7	16.3	70.0	69.3	59.1	8.4
25	13.7	67.7	19.1	43.8	23.6	45.2	16.8	69.0	69.3	51.5	7.3
26	14.3	69.5	19.0	46.0	23.8	45.6	17.2	68.3	69.3	44.7	6.3
27	14.9	71.2	18.9	48.3	23.9	46.1	17.7	67.3	69.3	37.3	5.3
28	15.5	71.6	18.7	49.7	24.0	46.5	18.1	66.6	69.3	30.5	4.3
29	16.1	71.0	18.6	50.4	24.1	47.0	18.6	65.8	69.3	23.3	3.3
30	16.7	67.3	18.4	48.9	24.2	47.4	19.0	64.9	69.3	16.1	2.3
31	17.4	64.6	18.3	48.0	24.3	47.9	19.5	64.1	69.3	8.8	1.2
32	18.0	64.9	18.1	49.3	24.4	48.3	20.0	63.2	69.3	1.4	0.2
33	18.6	63.9	17.6	68.3	17.1	100.0	18.2	93.5	69.4	10.2	1.4
34	19.3	64.2	17.9	70.2	17.3	100.0	18.7	91.5	69.4	13.9	2.0
35	20.1	64.5	18.3	72.5	17.4	100.0	19.3	89.0	69.4	17.9	2.5
36	21.0	60.2	18.6	69.7	17.6	100.0	20.0	86.2	69.4	22.8	3.2
37	22.0	62.1	19.1	74.6	17.7	100.0	20.7	83.3	69.4	28.3	4.0
38	23.2	60.1	19.5	75.2	17.9	100.0	21.6	79.7	69.4	35.2	5.0
39	24.8	56.4	20.1	74.9	18.1	100.0	22.7	75.1	69.4	44.6	6.3
40	28.3	50.1	21.3	75.9	18.2	100.0	25.2	65.3	69.3	67.1	9.5

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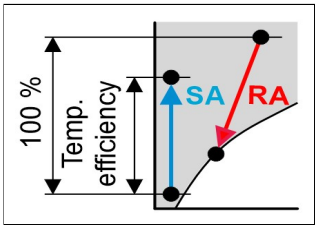
14-05-2026
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

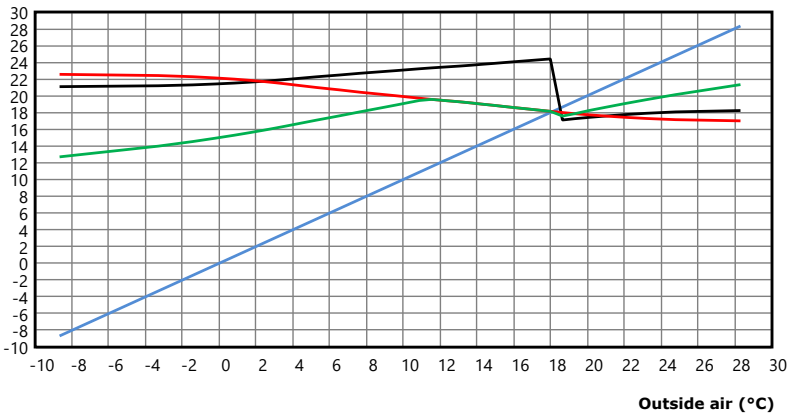
Plant
Object
Position



Air (%)	Service (h/a)
100.00	4000
66.67	2000
33.33	1000
▼	▼
100.00	5667

EU: Energy recovery: Heat energy	MWh	411.99	EUR	24719.00	(60.00 EUR/MWh)
EU: Energy recovery: Cold energy	MWh	34.03	EUR	2722.00	(80.00 EUR/MWh)
EU: 2 Fan: Glycol pump	MWh	-24.76	EUR	-2476.00	(100.00 EUR/MWh)
EU: Energy recovery: Net useful ratio / Year	MWh	421.26	EUR	24965.00	(59.26 EUR/MWh)
EU: Need of energy total / Year	MWh	738.82	EUR	51447.82	(69.63 EUR/MWh)
EU: Net useful ratio / Year	%	57.02	%	48.52	TWG = 73.15%
CH: Guidelines from associations such as SIA and SWKI: TWG>70.00% & JNG>75.00% & ETV>15.00					JNG = 72.32%
					ETV = 20.80

Outside air (°C) **Return air (°C)** **Supply air (°C)** **Energy recovery (°C)**



Station		Bern
Height over sea level	m	540.00
Pressure	hPa	949.65
Outside air	m³/h	30000.00
Return air	m³/h	30000.00
Adiabatic return air cooling	h/a	1133.33
Service at 100% Air flow	h/a	5666.67
Capital interest	%	1.00
Energy increase	%	1.00
Inflation	%	1.00
Support costs	%	5.00
Costs without CC-system	EUR	86000.00
Costs with CC-system	EUR	154000.00
Additional costs	EUR	68000.00
BEP (Break even point) after	**Years**	**3.18**