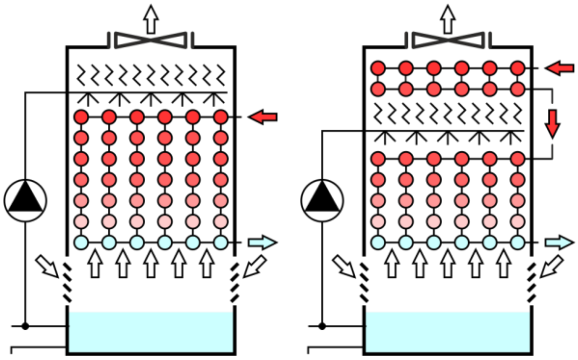
Evaporative re-cooler

The **ESH software** includes 2 versions each for evaporative re-cooling:

Evaporative dry re-cooler for refrigerants
Evaporative dry re-cooler for brines

With the standard system, you have to reckon with visible swaths at times. Visible swaths can be avoided with the special system. Calculations are made with smooth tubes in a line or staggered arrangement. The ESH software not only designs the systems, but also the energy required per year and the cost-effectiveness compared to wet cooling towers.

Standard system **Special system**

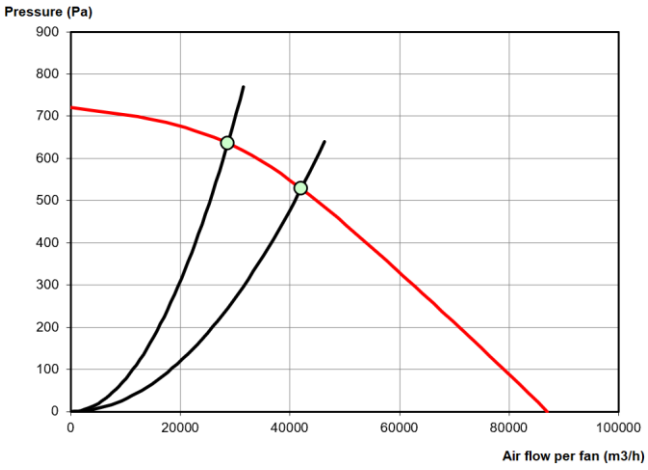


The red characteristic curves for the air volume as a function of the pressure can be stored in the software with 6 points each as the basis for a spline interpolation of more than 60 fans, for example:

1. 60 fans with 1 speed
2. 30 fans with 2 speeds
3. 20 fans with 3 speeds
4. 15 fans with 4 speeds
5. 12 fans with 5 speeds
6. 10 fans with 6 speeds

The black characteristics of the finned heat exchanger result automatically from its calculation. The green intersections are determined within a few seconds using a macro.

Wet- and dry service



Evaporative condenser / Heat exchanger / Wet-Service

Capacity	kW	2307.690	------ sensible:	491.576
Surface reserve	%	0.000	latent:	1816.115
Present surface	m2	424.115		
Required surface	m2	424.113	0.5 % Oil ISO VG32	
k-coeff.	W/m2K	557.505	---------- ffi:	5.000E-05
Average temp. diff. (95.74 %)	K	9.760	ffa:	5.000E-05

Air humid		Inlet	Outlet	Definition
Height over sea level	m			106.000
Pressure	hPa			1000.564
Temp. (32.000)	°C	21.598	34.295	20.000
Rel. humidity (40.000)	%	100.000	100.000	40.000
Abs. humidity (12.014)	g/kg	16.427	35.409	5.858
Density humid	kg/m3	1.171	1.110	1.185
Enthalpy humid	kJ/kg	63.466	125.304	34.992
Volume flow humid	m3/h	116626.828	125266.016	114074.964
Mass flow dry	kg/h	134347.001	134347.001	134347.001
Velocity	m/s	3.600	3.866	3.521
Pressure drop (dry 209 Pa)	Pa		536.491	
Moistening temperature	°C		27.354	
Evaporation total	kg/h		3143.052	

R410A 21.924 bar		Hot gas	Condensate	Subcooling
Temp.	°C	80.000	36.000	33.000
Density	kg/m3	91.393		999.350
Enthalpy difference	kJ/kg	57.574	166.291	5.273
Mass flow	kg/h	36256.349	36256.349	36256.349
Mass flow-Density	kg/sm2	422.158	422.158	422.158
Volume flow	m3/h	396.709		36.280
Velocity	m/s	4.619		0.422
Pressure drop (total 1.850 K)	K	0.455	1.390	0.005

LOGO

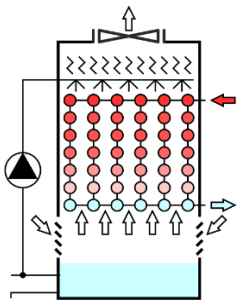
Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

City, 02.05.2022
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

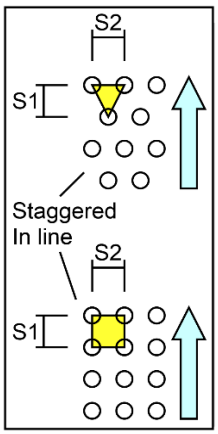
Plant
Object
Position

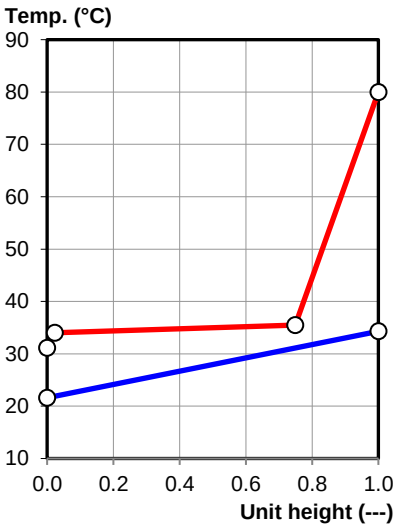


Technical data

Software by www.zcs.ch

Unit height		mm	1500.000
Unit width		mm	3000.000
Unit depth		mm	3000.000
Tubes total		Piece	1800
Tubes blank		Piece	0
Tubes: Height		Piece	30
Tubes: Width		Piece	60
Tube coupling in series		Piece	30
Number of circuits (NC)		Piece	60
Tube diameter		mm	25.000
Tube thickness		mm	1.250
Tube interval on the height	S1	mm	50.000
Tube interval on the width	S2	mm	50.000
Tube arrangement		---	in line
Tubes-Material		---	AISI 316
Collector-Steam		mm	140
Collector-Condensate		mm	114
Collector-Material		---	AISI 316
Connections-Steam		mm	140
Connections-Condensate		mm	114
Connections-Material		---	AISI 316
Circulations:		Piece	2
Circulations:		---	Parallel
Volume		l	2216
Weight		kg	4074
Waste water		m3/h	0.315
Evaporation total		m3/h	3.154
Pump circulation factor (x)		---	74.830
Water-Pump		m3/h	236.000





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

Price net: Heat exchanger **EUR** **81259.00**

Evaporative condenser / Heat exchanger / dry-Service

Capacity	kW	2307.630
Surface reserve	%	0.001
Present surface	m2	424.115
Required surface	m2	424.111
k-coeff.	W/m2K	68.815
Average temp. diff. (99.65 %)	K	79.069

0.5 % Oil ISO VG32
---------- ffi: 5.000E-05
ffa: 5.000E-05

Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

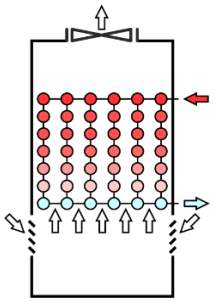
City, 02.05.2022
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position

Air humid		Inlet	Outlet	Definition
Height over sea level	m			106.000
Pressure	hPa			1000.564
Temp.	°C	-60.744	-19.056	20.000
Rel. humidity	%	80.000	0.703	40.000
Abs. humidity	g/kg	0.005	0.005	5.858
Density humid	kg/m3	1.641	1.372	1.185
Enthalpy humid	kJ/kg	-61.112	-19.159	34.992
Volume flow humid	m3/h	120693.847	144380.522	168138.899
Mass flow dry	kg/h	198018.533	198018.533	198018.533
Velocity	m/s	3.725	4.456	5.189
Pressure drop	Pa		311.722	

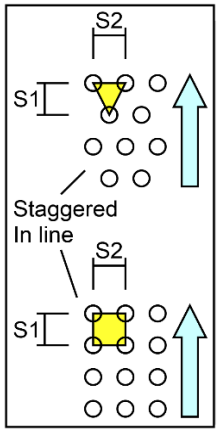
R410A 21.924 bar		Hot gas	Condensate	Subcooling
Temp.	°C	80.000	36.000	33.000
Density	kg/m3	91.393		999.350
Enthalpy difference	kJ/kg	57.780	166.291	5.273
Mass flow	kg/h	36222.811	36222.811	36222.811
Mass flow-Density	kg/sm2	421.768	421.768	421.768
Volume flow	m3/h	396.342		36.246
Velocity	m/s	4.615		0.422
Pressure drop (total 1.916 K)	K	0.670	1.241	0.005

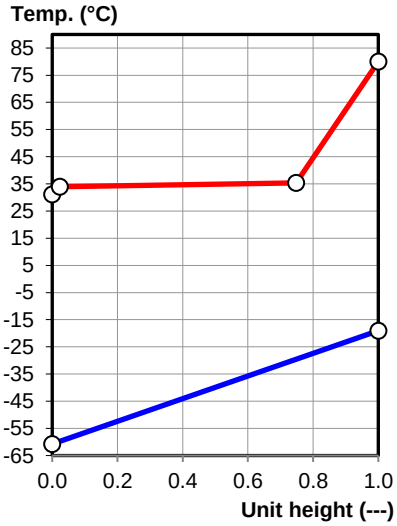


Technical data

Software by www.zcs.ch

Unit height		mm	1500.000
Unit width		mm	3000.000
Unit depth		mm	3000.000
Tubes total		Piece	1800
Tubes blank		Piece	0
Tubes: Height		Piece	30
Tubes: Width		Piece	60
Tube coupling in series		Piece	30
Number of circuits (NC)		Piece	60
Tube diameter		mm	25.000
Tube thickness		mm	1.250
Tube arrangement: Altitude	S1	mm	50.000
Tube arrangement: Width	S2	mm	50.000
Tube arrangement		---	in line
Tubes-Material		---	AISI 316
Collector-Steam		mm	140
Collector-Condensate		mm	114
Collector-Material		---	AISI 316
Connections-Steam		mm	140
Connections-Condensate		mm	114
Connections-Material		---	AISI 316
Circulations:		Piece	2
Circulations:		---	Parallel
Volume		l	2216
Weight		kg	4074

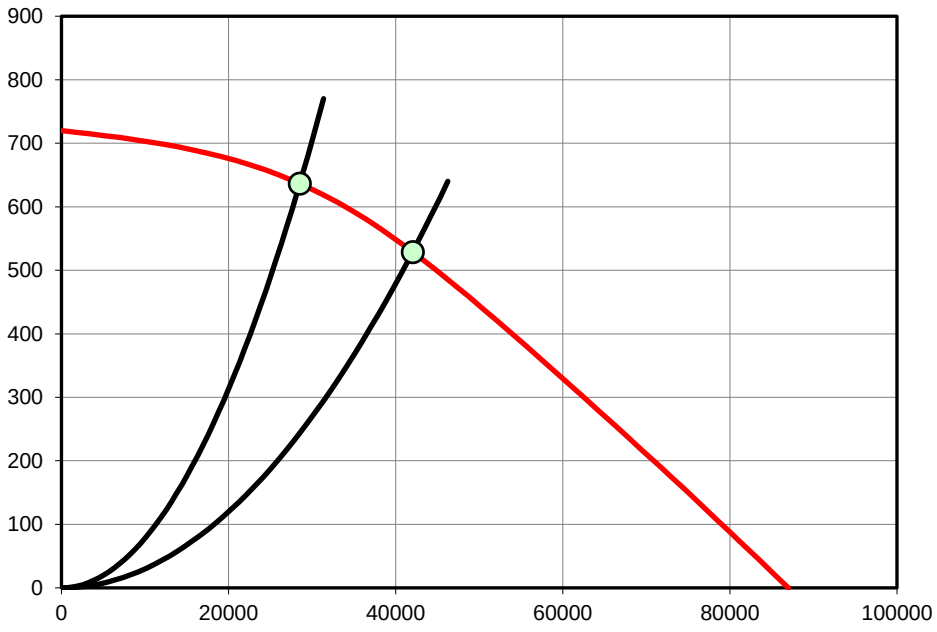




Static pressure, pressure drop

Product	---	Novovent Axial 1400 rpm		
Type	---	4-1250 / 24-3 / 11.0 kW	**Wet**	**dry**
Fan	Piece	4.000		
Air flow per fan	m3/h		28518.741	42034.725
Air flow total	m3/h		114074.964	168138.899
Static pressure	Pa		636.492	528.970
Box	Pa		100.000	217.248
Heat exchanger	Pa		536.492	311.722

Pressure (Pa)



Air flow per fan (m3/h)

LOGO

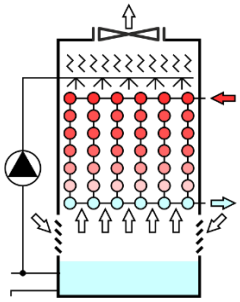
Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

City, 02.05.2022
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position



Software by www.zcs.ch

Economy

Water demand total: 57.45 % less than an open-cooling-tower !

				Year: 8760 Hours				
Station			Water	Day	Night	Temp.	Day	Night
Frankfurt am Main			kg/h	t/a	t/a	°C	h	h
			0.0	0.0	0.0	40.5	0.0	0.0
			0.0	0.0	0.0	39.5	0.0	0.0
Capacity	kW	2307.69	0.0	0.0	0.0	38.5	0.0	0.0
			0.0	0.0	0.0	37.5	0.0	0.0
R410A	h	8760.00	0.0	0.0	0.0	36.5	0.0	0.0
Pressure	bar	21.92	3261.7	3.3	0.0	35.5	1.0	0.0
Hot gas	°C	80.00	3227.8	6.5	0.0	34.5	2.0	0.0
Condensate'	°C	36.00	3193.9	7.2	1.6	33.5	2.3	0.5
Condensate	°C	35.88	3160.0	7.9	3.2	32.5	2.5	1.0
Subcooling	°C	33.00	3126.1	30.5	3.9	31.5	9.8	1.3
Mass flow	kg/h	36256.35	3092.2	52.6	4.6	30.5	17.0	1.5
Mass flow-Density	kg/sm2	422.16	3058.3	73.4	11.5	29.5	24.0	3.8
Volume flow in	m3/h	396.71	3024.4	93.8	18.1	28.5	31.0	6.0
Volume flow out	m3/h	36.28	2990.5	105.4	24.7	27.5	35.3	8.3
Pressure drop	K	1.85	2956.7	116.8	31.0	26.5	39.5	10.5
			2922.8	195.8	49.0	25.5	67.0	16.8
Wet-Service (100.00%)	h	8760.00	2888.9	273.0	66.4	24.5	94.5	23.0
Temp.	°C	32.00	2855.0	294.1	90.6	23.5	103.0	31.8
Rel. humidity	%	40.00	2821.1	314.6	114.3	22.5	111.5	40.5
Abs. humidity	g/kg	12.01	2787.2	339.3	138.0	21.5	121.8	49.5
Air humid (20°/40%)	m3/h	114074.96	2753.3	363.4	161.1	20.5	132.0	58.5
Mass flow dry	kg/h	134347.00	2719.4	429.7	232.5	19.5	158.0	85.5
Pressure drop	Pa	536.49	2685.5	494.1	302.1	18.5	184.0	112.5
Box	Pa	100.00	2651.7	483.9	336.8	17.5	182.5	127.0
Ext. pressure	Pa	0.00	2617.8	473.8	370.4	16.5	181.0	141.5
Pressure drop total	Pa	636.49	2583.9	469.6	417.9	15.5	181.8	161.8
Fan-Efficiency	%	70.00	2550.0	465.4	464.1	14.5	182.5	182.0
Fan power	kW	28.81	2516.1	448.5	474.3	13.5	178.3	188.5
Energy costs	EUR	25239.81	2482.2	431.9	484.0	12.5	174.0	195.0
			2448.3	406.4	501.3	11.5	166.0	204.8
Humidifier (100.00%)	h	8760.00	2414.4	381.5	517.9	10.5	158.0	214.5
Temp.	°C	27.35	2380.5	388.6	501.1	9.5	163.3	210.5
Humidification	kg/h	3143.05	2346.6	395.4	484.6	8.5	168.5	206.5
Humidification (Max.)	kg/h	3261.67	2312.8	386.8	503.6	7.5	167.3	217.8
Pressure drop	kPa	100.00	2278.9	378.3	521.9	6.5	166.0	229.0
Pump-Efficiency	%	80.00	2245.0	368.2	498.9	5.5	164.0	222.3
Pump power (n=75)	kW	8.47	2211.1	358.2	476.5	4.5	162.0	215.5
Energy costs	EUR	7423.82	2177.2	306.4	454.5	3.5	140.8	208.8
Day + 10% Waste water	t/a	11866.21	2143.3	256.1	432.9	2.5	119.5	202.0
Night + 10% Waste water	t/a	11340.36	2109.4	246.8	358.1	1.5	117.0	169.8
Total + 10% Waste water	t/a	23206.57	2075.5	237.6	285.4	0.5	114.5	137.5
Water	EUR	116032.84	2041.6	197.5	255.2	-0.5	96.8	125.0
			2007.7	158.6	225.9	-1.5	79.0	112.5
dry-Service (0.00%)	h	0.00	1973.9	118.9	171.2	-2.5	60.3	86.8
Temp.	°C	-60.74	1940.0	80.5	118.3	-3.5	41.5	61.0
Rel. humidity	%	80.00	1906.1	52.9	79.6	-4.5	27.8	41.8
Abs. humidity	g/kg	0.00	1872.2	26.2	42.1	-5.5	14.0	22.5
Air humid (20°/40%)	m3/h	168138.90	1838.3	21.6	26.7	-6.5	11.8	14.5
Mass flow dry	kg/h	198018.53	1804.4	17.1	11.7	-7.5	9.5	6.5
Pressure drop	Pa	311.72	1770.5	13.7	12.8	-8.5	7.8	7.3
Box	Pa	217.25	1736.6	10.4	13.9	-9.5	6.0	8.0
Ext. pressure	Pa	0.00	1702.7	5.1	8.9	-10.5	3.0	5.3
Pressure drop total	Pa	528.97	1668.9	0.0	4.2	-11.5	0.0	2.5
Fan-Efficiency	%	70.00	1635.0	0.0	2.0	-12.5	0.0	1.3
Fan power	kW	28.81	0.0	0.0	0.0	-13.5	0.0	0.0
Energy costs	EUR	0.00	0.0	0.0	0.0	-14.5	0.0	0.0
			0.0	0.0	0.0	-15.5	0.0	0.0
Service - Energy costs			0.0	0.0	0.0	-16.5	0.0	0.0
Daily hours (100.00%)	h/a	4380.00	0.0	0.0	0.0	-17.5	0.0	0.0
Night hours (100.00%)	h/a	4380.00	0.0	0.0	0.0	-18.5	0.0	0.0
Electric energy (MWh)	EUR	100.00	0.0	0.0	0.0	-19.5	0.0	0.0
Water (t)	EUR	5.00	0.0	0.0	0.0	-20.5	0.0	0.0
Life cycle	Years	15.00	0.0	0.0	0.0	-21.5	0.0	0.0
Support costs	%	5.00	0.0	0.0	0.0	-22.5	0.0	0.0
Capital interest	%	1.00	0.0	0.0	0.0	-23.5	0.0	0.0
Energy increase	%	1.00	0.0	0.0	0.0	-24.5	0.0	0.0
Inflation	%	1.00	0.0	0.0	0.0	-25.5	0.0	0.0
Investment costs	EUR	174000.00	0.0	0.0	0.0	-26.5	0.0	0.0
Water + Energy costs	EUR	148696.47	0.0	0.0	0.0	-27.5	0.0	0.0
Support costs	EUR	8700.00	0.0	0.0	0.0	-28.5	0.0	0.0
Overheads	EUR	157396.47	0.0	0.0	0.0	-29.5	0.0	0.0
			0.0	0.0	0.0	-30.5	0.0	0.0
Capital costs	**EUR**	**223601.58**	3261.7	10787.5	10309.4		4380.0	4380.0

LOGO

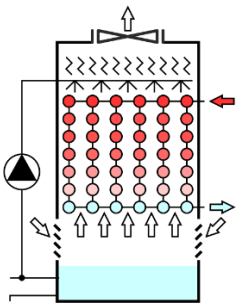
Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

City, 02.05.2022
With the compliments of

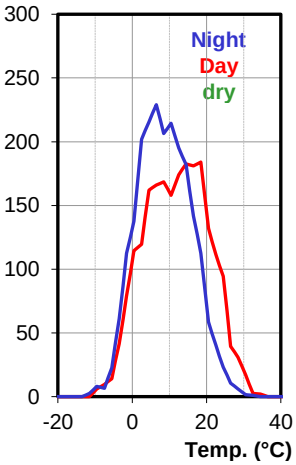
Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position

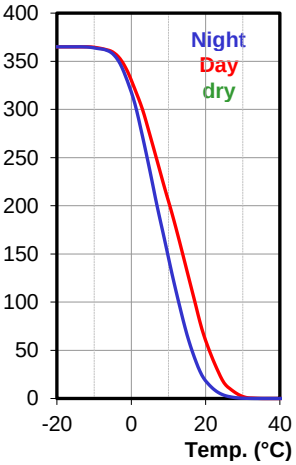


Software by www.zcs.ch

Hours



Days



Economy

Capital interest	%	1.00
Energy increase	%	1.00
Inflation	%	1.00
Support costs	%	5.00

Investment costs

Open cooling tower	EUR	88000.00
Evaporative condenser	EUR	174000.00
Additional costs	EUR	86000.00

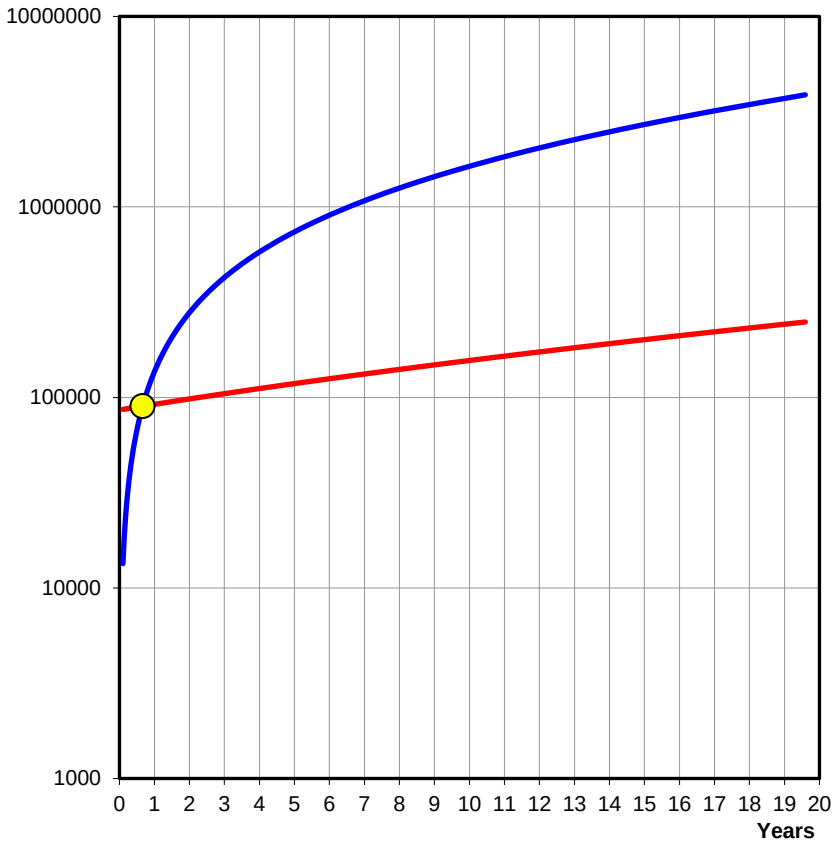
Overheads

Support costs (+)	EUR	4300.00
Energy costs: Open cooling tower (-)	EUR	284000.00
Energy costs: Evaporative condenser (+)	EUR	148696.47
Energy costs: - 47.6 %	EUR	**135303.53**

Amortization

BEP (Break even point)	Years	**0.66**

Incomes (EUR) - Expenses (EUR) - Amortization (Years)



LOGO

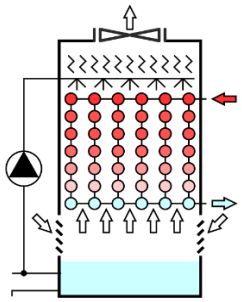
Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

City, 02.05.2022
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position



Software by www.zcs.ch

Evaporative condenser / Heat exchanger / Wet-Service

Capacity	kW	2071.088	------ sensible:	557.511
Surface reserve	%	0.001	latent:	1513.577
Present surface	m2	424.115		
Required surface	m2	424.113	0.5 % Oil ISO VG32	
k-coeff.	W/m2K	542.179	---------- ffi:	5.000E-05
Average temp. diff. (95.15 %)	K	9.007	ffa:	5.000E-05

Air humid		Inlet	Outlet	Definition
Height over sea level	m			106.000
Pressure	hPa			1000.564
Temp. (32.000)	°C	21.600	35.522	20.000
Rel. humidity (40.000)	%	100.000	84.160	40.000
Abs. humidity (12.014)	g/kg	16.428	31.711	5.858
Density humid	kg/m3	1.171	1.108	1.185
Enthalpy humid	kJ/kg	63.472	117.131	34.992
Volume flow humid	m3/h	120622.602	129342.452	117982.363
Mass flow dry	kg/h	138948.777	138948.777	138948.777
Velocity	m/s	3.723	3.992	3.641
Pressure drop (dry 223 Pa)	Pa		530.698	
Moistening temperature	°C		27.661	
Evaporation total	kg/h		2736.887	

R410A 21.924 bar		Hot gas	Condensate	Subcooling
Temp.	°C	80.000	36.000	33.000
Density	kg/m3	91.393		999.350
Enthalpy difference	kJ/kg	57.464	166.291	5.271
Mass flow	kg/h	32554.988	32554.988	32554.988
Mass flow-Density	kg/sm2	379.061	379.061	379.061
Volume flow	m3/h	356.210		32.576
Velocity	m/s	4.148		0.379
Pressure drop (total 1.472 K)	K	0.388	1.081	0.004

LOGO

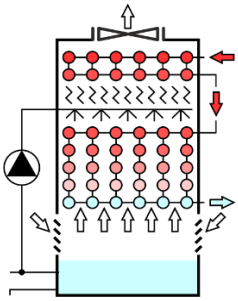
Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

City, 02.05.2022
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

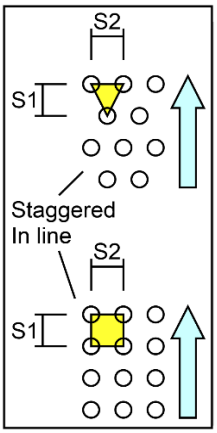
Plant
Object
Position

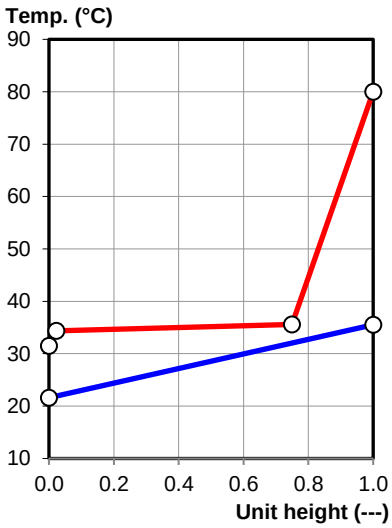


Technical data

Software by www.zcs.ch

Unit height		mm	1500.000
Unit width		mm	3000.000
Unit depth		mm	3000.000
Tubes total		Piece	1800
Tubes blank		Piece	0
Tubes: Height		Piece	30
Tubes: Width		Piece	60
Tube coupling in series		Piece	30
Number of circuits (NC)		Piece	60
Tube diameter		mm	25.000
Tube thickness		mm	1.250
Tube interval on the height	S1	mm	50.000
Tube interval on the width	S2	mm	50.000
Tube arrangement		---	in line
Tubes-Material		---	AISI 316
Collector-Steam		mm	140
Collector-Condensate		mm	114
Collector-Material		---	AISI 316
Connections-Steam		mm	140
Connections-Condensate		mm	114
Connections-Material		---	AISI 316
Circulations:		Piece	2
Circulations:		---	Parallel
Volume		l	2216
Weight		kg	4074
Waste water		m3/h	0.275
Evaporation total		m3/h	2.746
Pump circulation factor (x)		---	75.369
Water-Pump		m3/h	207.000





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

Price net: Heat exchanger **EUR** **81259.00**

Evaporative condenser / Heat exchanger / Wet-Service / dry Part

Capacity	kW	127.925
Surface reserve	%	1.537
Present surface	m2	56.549
Required surface	m2	55.693
k-coeff.	W/m2K	56.823
Average temp. diff. (99.98 %)	K	40.423

0.5 % Oil ISO VG32
---------- ffi: 5.000E-05
ffa: 5.000E-05

Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

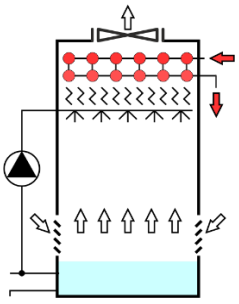
City, 02.05.2022
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position

Air humid		Inlet	Outlet	Definition
Height over sea level	m			106.000
Pressure	hPa			1000.564
Temp.	°C	32.420	35.522	20.000
Rel. humidity	%	100.000	84.160	40.000
Abs. humidity	g/kg	31.708	31.711	5.858
Density humid	kg/m3	1.120	1.108	1.185
Enthalpy humid	kJ/kg	113.817	117.131	34.992
Volume flow humid	m3/h	128042.113	129342.452	117982.363
Mass flow dry	kg/h	138948.777	138948.777	138948.777
Velocity	m/s	3.952	3.992	3.641
Pressure drop	Pa		30.924	

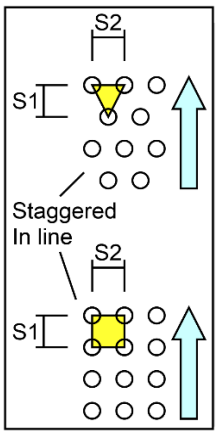
R410A 21.924 bar		Hot gas in	Hot gas out	Average
Temp.	°C	80.000	69.059	74.529
Density	kg/m3			91.393
Enthalpy difference	kJ/kg			14.146
Mass flow	kg/h			32554.988
Mass flow-Density	kg/sm2			379.061
Volume flow	m3/h			356.210
Velocity	m/s			4.148
Pressure drop	K			0.348

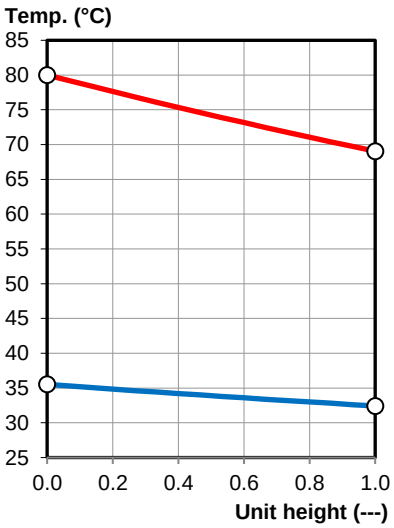


Technical data

Software by www.zcs.ch

Unit height		mm	200.000
Unit width		mm	3000.000
Unit depth		mm	3000.000
Tubes total		Piece	240
Tubes blank		Piece	0
Tubes: Height		Piece	4
Tubes: Width		Piece	60
Tube coupling in series		Piece	4
Number of circuits (NC)		Piece	60
Tube diameter		mm	25.000
Tube thickness		mm	1.250
Tube interval on the height	S1	mm	50.000
Tube interval on the width	S2	mm	50.000
Tube arrangement		---	in line
Tubes-Material		---	AISI 316
Collector-Diameter		---	NW125
Collector-Velocity		m/s	3.785
Collector-Material		---	AISI 316
Connections-Diameter		---	NW125
Connections-Velocity		m/s	3.785
Connections-Material		---	AISI 316
Circulations:		Piece	2
Circulations:		---	Parallel
Volume		l	369
Weight		kg	643





Evaporative condenser / Heat exchanger / dry-Service

Capacity	kW	2071.071		
Surface reserve	%	0.001		
Present surface	m2	424.115		
Required surface	m2	424.111	0.5 % Oil ISO VG32	
k-coeff.	W/m2K	69.404	---------- ffi:	5.000E-05
Average temp. diff. (99.63 %)	K	70.361	ffa:	5.000E-05

LOGO

Company
Branch
Street
Country / ZIP / City

Air humid		Inlet	Outlet	Definition
Height over sea level	m			106.000
Pressure	hPa			1000.564
Temp.	°C	-49.658	-12.266	20.000
Rel. humidity	%	80.000	1.542	40.000
Abs. humidity	g/kg	0.020	0.020	5.858
Density humid	kg/m3	1.559	1.336	1.185
Enthalpy humid	kJ/kg	-49.913	-12.291	34.992
Volume flow humid	m3/h	127097.985	148361.015	168273.879
Mass flow dry	kg/h	198177.500	198177.500	198177.500
Velocity	m/s	3.923	4.579	5.194
Pressure drop	Pa		325.212	

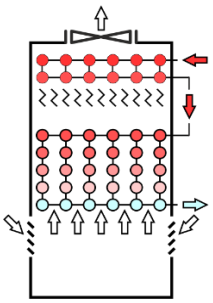
Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

City, 02.05.2022
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position

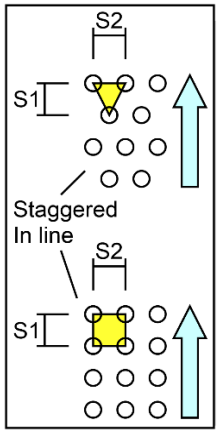
R410A 21.924 bar		Hot gas	Condensate	Subcooling
Temp.	°C	80.000	36.000	33.000
Density	kg/m3	91.393		999.350
Enthalpy difference	kJ/kg	57.601	166.291	5.271
Mass flow	kg/h	32535.210	32535.210	32535.210
Mass flow-Density	kg/sm2	378.831	378.831	378.831
Volume flow	m3/h	355.994		32.556
Velocity	m/s	4.145		0.379
Pressure drop (total 1.518 K)	K	0.533	0.982	0.004

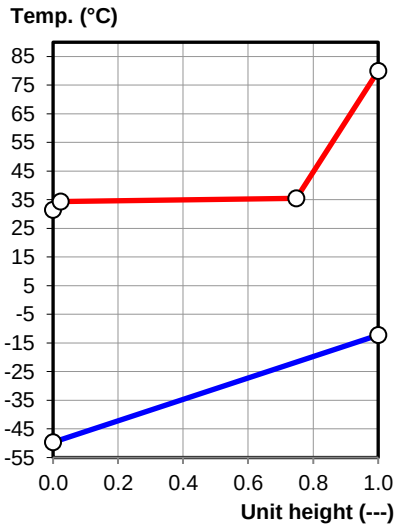


Technical data

Software by www.zcs.ch

Unit height		mm	1500.000
Unit width		mm	3000.000
Unit depth		mm	3000.000
Tubes total		Piece	1800
Tubes blank		Piece	0
Tubes: Height		Piece	30
Tubes: Width		Piece	60
Tube coupling in series		Piece	30
Number of circuits (NC)		Piece	60
Tube diameter		mm	25.000
Tube thickness		mm	1.250
Tube interval on the height	S1	mm	50.000
Tube interval on the width	S2	mm	50.000
Tube arrangement		---	in line
Tubes-Material		---	AISI 316
Collector-Steam		mm	140
Collector-Condensate		mm	114
Collector-Material		---	AISI 316
Connections-Steam		mm	140
Connections-Condensate		mm	114
Connections-Material		---	AISI 316
Circulations:		Piece	2
Circulations:		---	Parallel
Volume		l	2216
Weight		kg	4074

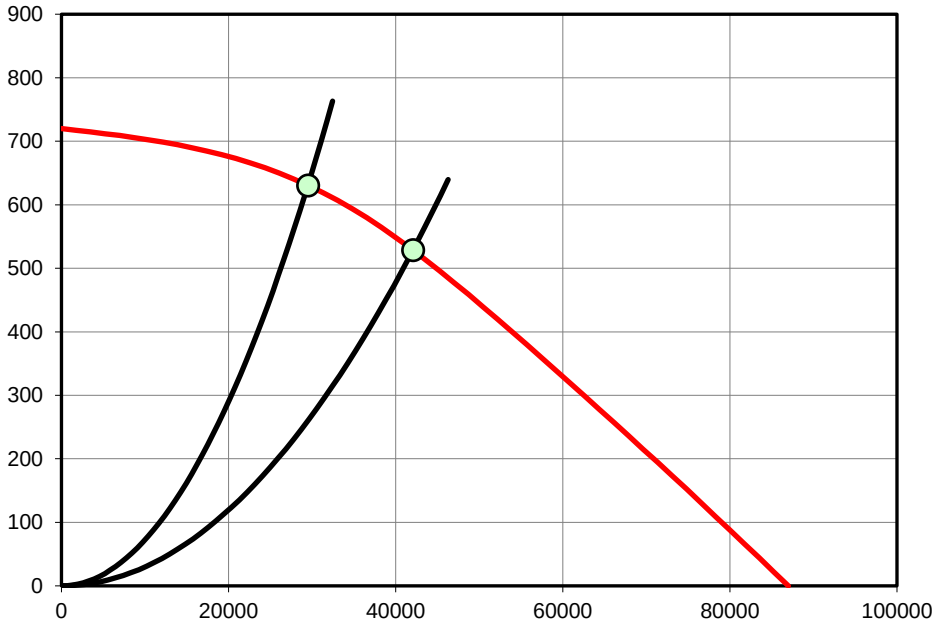




Static pressure, pressure drop

Product	---	Novovent Axial 1400 rpm		
Type	---	4-1250 / 24-3 / 11.0 kW	**Wet**	**dry**
Fan	Piece	4.000		
Air flow per fan	m3/h		29495.591	42068.470
Air flow total	m3/h		117982.363	168273.879
Static pressure	Pa		630.699	528.636
Box	Pa		100.000	203.423
Heat exchanger	Pa		530.699	325.213

Pressure (Pa)



Air flow per fan (m3/h)

LOGO

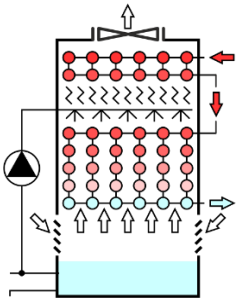
Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

City, 02.05.2022
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position



Software by www.zcs.ch

Economy

Water demand total: 60.43 % less than an open-cooling-tower !

				Year: 8760 Hours				
Station			Water	Day	Night	Temp.	Day	Night
Frankfurt am Main			kg/h	t/a	t/a	°C	h	h
			0.0	0.0	0.0	40.5	0.0	0.0
			0.0	0.0	0.0	39.5	0.0	0.0
Capacity	kW	2071.09	0.0	0.0	0.0	38.5	0.0	0.0
			0.0	0.0	0.0	37.5	0.0	0.0
R410A	h	8760.00	0.0	0.0	0.0	36.5	0.0	0.0
Pressure	bar	21.92	2854.2	2.9	0.0	35.5	1.0	0.0
Hot gas	°C	80.00	2820.7	5.6	0.0	34.5	2.0	0.0
Condensate'	°C	36.00	2787.2	6.3	1.4	33.5	2.3	0.5
Condensate	°C	35.88	2753.6	6.9	2.8	32.5	2.5	1.0
Subcooling	°C	33.00	2720.1	26.5	3.4	31.5	9.8	1.3
Mass flow	kg/h	32554.99	2686.6	45.7	4.0	30.5	17.0	1.5
Mass flow-Density	kg/sm2	379.06	2653.1	63.7	9.9	29.5	24.0	3.8
Volume flow in	m3/h	356.21	2619.6	81.2	15.7	28.5	31.0	6.0
Volume flow out	m3/h	32.58	2586.1	91.2	21.3	27.5	35.3	8.3
Pressure drop	K	1.47	2552.5	100.8	26.8	26.5	39.5	10.5
			2519.0	168.8	42.2	25.5	67.0	16.8
Wet-Service (100.00%)	h	8760.00	2485.5	234.9	57.2	24.5	94.5	23.0
Temp.	°C	32.00	2452.0	252.6	77.9	23.5	103.0	31.8
Rel. humidity	%	40.00	2418.5	269.7	97.9	22.5	111.5	40.5
Abs. humidity	g/kg	12.01	2385.0	290.4	118.1	21.5	121.8	49.5
Air humid (20°/40%)	m3/h	117982.36	2351.4	310.4	137.6	20.5	132.0	58.5
Mass flow dry	kg/h	138948.78	2317.9	366.2	198.2	19.5	158.0	85.5
Pressure drop	Pa	530.70	2284.4	420.3	257.0	18.5	184.0	112.5
Box	Pa	100.00	2250.9	410.8	285.9	17.5	182.5	127.0
Ext. pressure	Pa	0.00	2217.4	401.3	313.8	16.5	181.0	141.5
Pressure drop total	Pa	630.70	2183.9	396.9	353.2	15.5	181.8	161.8
Fan-Efficiency	%	70.00	2150.3	392.4	391.4	14.5	182.5	182.0
Fan power	kW	29.53	2116.8	377.3	399.0	13.5	178.3	188.5
Energy costs	EUR	25866.78	2083.3	362.5	406.2	12.5	174.0	195.0
			2049.8	340.3	419.7	11.5	166.0	204.8
Humidifier (100.00%)	h	8760.00	2016.3	318.6	432.5	10.5	158.0	214.5
Temp.	°C	27.66	1982.8	323.7	417.4	9.5	163.3	210.5
Humidification	kg/h	2736.89	1949.2	328.4	402.5	8.5	168.5	206.5
Humidification (Max.)	kg/h	2854.19	1915.7	320.4	417.2	7.5	167.3	217.8
Pressure drop	kPa	100.00	1882.2	312.4	431.0	6.5	166.0	229.0
Pump-Efficiency	%	80.00	1848.7	303.2	410.9	5.5	164.0	222.3
Pump power (n=75)	kW	7.47	1815.2	294.1	391.2	4.5	162.0	215.5
Energy costs	EUR	6543.16	1781.7	250.8	371.9	3.5	140.8	208.8
Day + 10% Waste water	t/a	9945.38	1748.1	208.9	353.1	2.5	119.5	202.0
Night + 10% Waste water	t/a	9425.31	1714.6	200.6	291.1	1.5	117.0	169.8
Total + 10% Waste water	t/a	19370.69	1681.1	192.5	231.2	0.5	114.5	137.5
Water	EUR	96853.45	1647.6	159.4	205.9	-0.5	96.8	125.0
			1614.1	127.5	181.6	-1.5	79.0	112.5
dry-Service (0.00%)	h	0.00	1580.6	95.2	137.1	-2.5	60.3	86.8
Temp.	°C	-49.66	1547.0	64.2	94.4	-3.5	41.5	61.0
Rel. humidity	%	80.00	1513.5	42.0	63.2	-4.5	27.8	41.8
Abs. humidity	g/kg	0.02	1480.0	20.7	33.3	-5.5	14.0	22.5
Air humid (20°/40%)	m3/h	168273.88	1446.5	17.0	21.0	-6.5	11.8	14.5
Mass flow dry	kg/h	198177.50	1413.0	13.4	9.2	-7.5	9.5	6.5
Pressure drop	Pa	325.21	1379.5	10.7	10.0	-8.5	7.8	7.3
Box	Pa	203.42	1345.9	8.1	10.8	-9.5	6.0	8.0
Ext. pressure	Pa	0.00	1312.4	3.9	6.9	-10.5	3.0	5.3
Pressure drop total	Pa	528.64	1278.9	0.0	3.2	-11.5	0.0	2.5
Fan-Efficiency	%	70.00	1245.4	0.0	1.6	-12.5	0.0	1.3
Fan power	kW	29.53	0.0	0.0	0.0	-13.5	0.0	0.0
Energy costs	EUR	0.00	0.0	0.0	0.0	-14.5	0.0	0.0
			0.0	0.0	0.0	-15.5	0.0	0.0
Service - Energy costs			0.0	0.0	0.0	-16.5	0.0	0.0
Daily hours (100.00%)	h/a	4380.00	0.0	0.0	0.0	-17.5	0.0	0.0
Night hours (100.00%)	h/a	4380.00	0.0	0.0	0.0	-18.5	0.0	0.0
Electric energy (MWh)	EUR	100.00	0.0	0.0	0.0	-19.5	0.0	0.0
Water (t)	EUR	5.00	0.0	0.0	0.0	-20.5	0.0	0.0
Life cycle	Years	15.00	0.0	0.0	0.0	-21.5	0.0	0.0
Support costs	%	5.00	0.0	0.0	0.0	-22.5	0.0	0.0
Capital interest	%	1.00	0.0	0.0	0.0	-23.5	0.0	0.0
Energy increase	%	1.00	0.0	0.0	0.0	-24.5	0.0	0.0
Inflation	%	1.00	0.0	0.0	0.0	-25.5	0.0	0.0
Investment costs	EUR	177000.00	0.0	0.0	0.0	-26.5	0.0	0.0
Water + Energy costs	EUR	129263.39	0.0	0.0	0.0	-27.5	0.0	0.0
Support costs	EUR	8850.00	0.0	0.0	0.0	-28.5	0.0	0.0
Overheads	EUR	138113.39	0.0	0.0	0.0	-29.5	0.0	0.0
			0.0	0.0	0.0	-30.5	0.0	0.0
Capital costs	**EUR**	**198392.60**	2854.2	9041.3	8568.5		4380.0	4380.0

LOGO

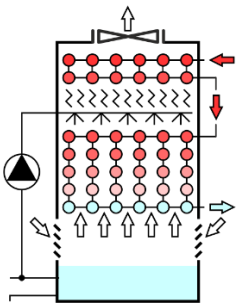
Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

City, 02.05.2022
With the compliments of

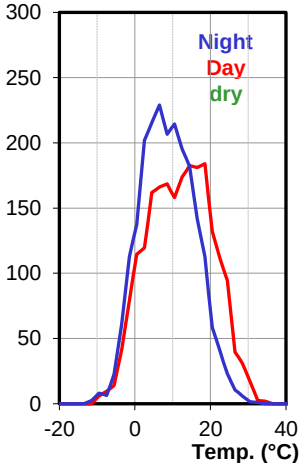
Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position

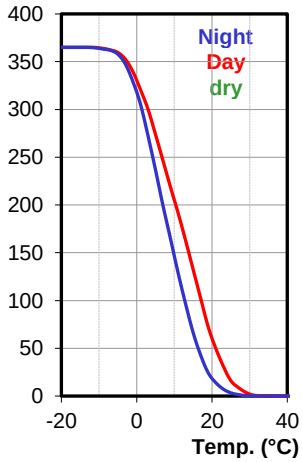


Software by www.zcs.ch

Hours



Days



Economy

Capital interest	%	1.00
Energy increase	%	1.00
Inflation	%	1.00
Support costs	%	5.00

Investment costs

Open cooling tower	EUR	80000.00
Evaporative condenser	EUR	177000.00
Additional costs	EUR	97000.00

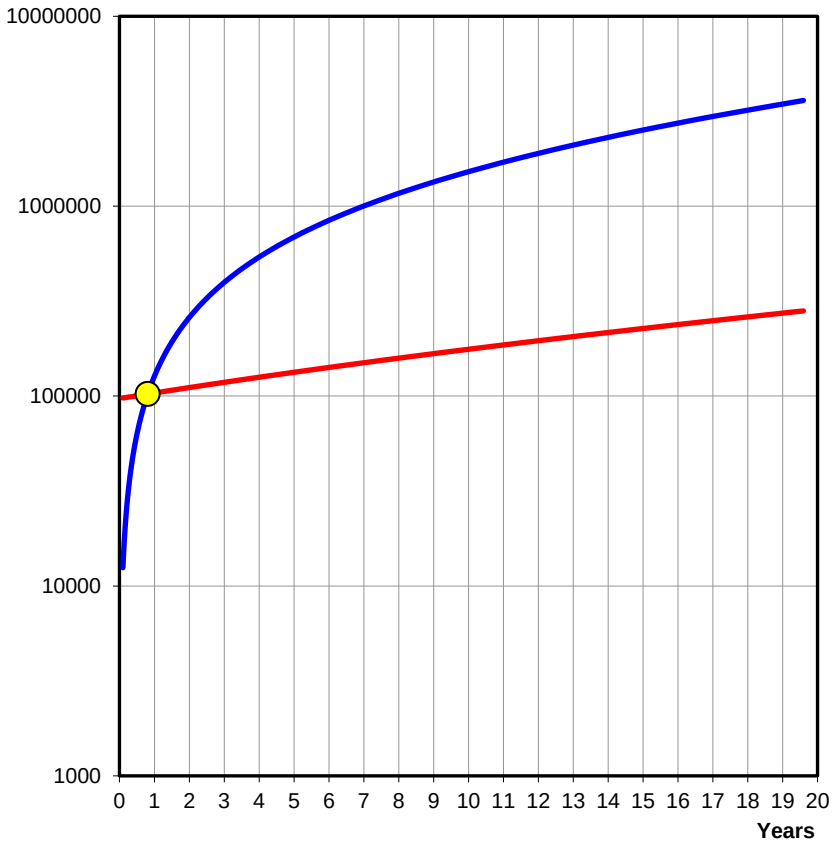
Overheads

Support costs (+)	EUR	4850.00
Energy costs: Open cooling tower (-)	EUR	255000.00
Energy costs: Evaporative condenser (+)	EUR	129263.39
Energy costs: - 49.3 %	EUR	**125736.61**

Amortization

BEP (Break even point)	Years	**0.81**

Incomes (EUR) - Expenses (EUR) - Amortization (Years)



LOGO

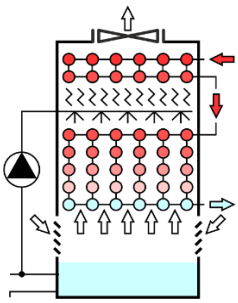
Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

City, 02.05.2022
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position



Software by www.zcs.ch

Evaporative cooler / Heat exchanger / Wet-Service

Capacity	kW	1404.872	------ sensible:	328.633
Surface reserve	%	0.001	latent:	1076.238
Present surface	m2	424.115		
Required surface	m2	424.111		
k-coeff.	W/m2K	512.646	---------- ffi:	5.000E-05
Average temp. diff. (99.99 %)	K	6.462	ffa:	5.000E-05

LOGO

Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

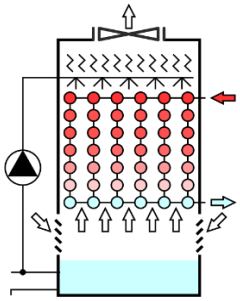
City, 02.05.2022
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position

Air humid		Inlet	Outlet	Definition
Height over sea level	m			106.000
Pressure	hPa			1000.564
Temp. (32.000)	°C	21.593	30.404	20.000
Rel. humidity (40.000)	%	100.000	100.000	40.000
Abs. humidity (12.014)	g/kg	16.421	28.130	5.858
Density humid	kg/m3	1.171	1.129	1.185
Enthalpy humid	kJ/kg	63.448	102.522	34.992
Volume flow humid	m3/h	112359.518	117839.757	109903.807
Mass flow dry	kg/h	129434.596	129434.596	129434.596
Velocity	m/s	3.468	3.637	3.392
Pressure drop (dry 192 Pa)	Pa		478.825	
Moistening temperature	°C		26.381	
Evaporation total	kg/h		2086.033	

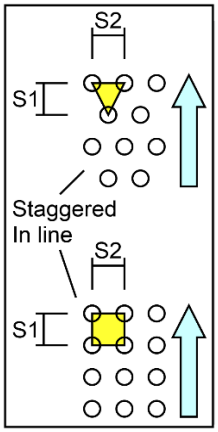
34 V% Et.glycol		Inlet	Outlet	Average
Temp.	°C	44.000	24.000	34.000
Density	kg/m3			1045.273
Spec. heat	kJ/kgK			3.618
Heat cond.	W/mK			0.451
Viscosity	Pas			1.713E-03
Volume flow	m3/h			66.864
Velocity	m/s			0.779
Pressure drop	kPa			58.390

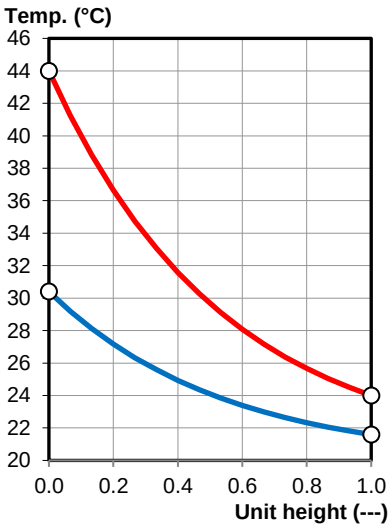


Technical data

Software by www.zcs.ch

Unit height		mm	1500.000
Unit width		mm	3000.000
Unit depth		mm	3000.000
Tubes total		Piece	1800
Tubes blank		Piece	0
Tubes: Height		Piece	30
Tubes: Width		Piece	60
Tube coupling in series		Piece	30
Number of circuits (NC)		Piece	60
Tube diameter		mm	25.000
Tube thickness		mm	1.250
Tube interval on the height	S1	mm	50.000
Tube interval on the width	S2	mm	50.000
Tube arrangement		---	in line
Tubes-Material		---	AISI 316
Collector-Diameter		---	4"
Collector-Velocity		m/s	1.066
Collector-Material		---	AISI 316
Connections-Diameter		---	4"
Connections-Velocity		m/s	1.066
Connections-Material		---	AISI 316
Circulations:		Piece	2
Circulations:		---	Parallel
Volume		l	2202
Weight		kg	4056
Waste water		m3/h	0.209
Evaporation total		m3/h	2.093
Pump circulation factor (x)		---	75.981
Water-Pump		**m3/h**	159.000





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

Price net: Heat exchanger **EUR** **81000.00**

Evaporative cooler / Heat exchanger / dry-Service

Capacity	kW	1404.776		
Surface reserve	%	0.001		
Present surface	m2	424.115		
Required surface	m2	424.112		
k-coeff.	W/m2K	67.098	---------- ffi:	5.000E-05
Average temp. diff. (100.00 %)	K	49.365	ffa:	5.000E-05

Air humid		Inlet	Outlet	Definition
Height over sea level	m			106.000
Pressure	hPa			1000.564
Temp.	°C	-29.937	-1.058	20.000
Rel. humidity	%	80.000	5.374	40.000
Abs. humidity	g/kg	0.187	0.187	5.858
Density humid	kg/m3	1.433	1.281	1.185
Enthalpy humid	kJ/kg	-29.660	-0.598	34.992
Volume flow humid	m3/h	121479.326	135903.043	147754.914
Mass flow dry	kg/h	174012.150	174012.150	174012.150
Velocity	m/s	3.749	4.195	4.560
Pressure drop	Pa		272.009	

34 V% Et.glycol		Inlet	Outlet	Average
Temp.	°C	44.000	24.000	34.000
Density	kg/m3			1045.273
Spec. heat	kJ/kgK			3.618
Heat cond.	W/mK			0.451
Viscosity	Pas			1.713E-03
Volume flow	m3/h			66.860
Velocity	m/s			0.778
Pressure drop	kPa			58.383

LOGO

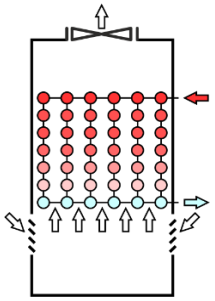
Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

City, 02.05.2022
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

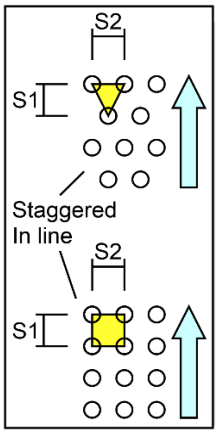
Plant
Object
Position

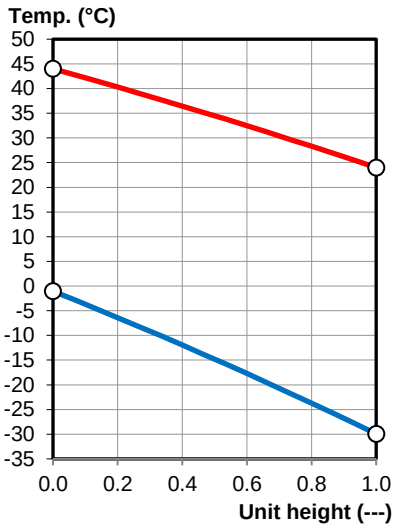


Technical data

Software by www.zcs.ch

Unit height		mm	1500.000
Unit width		mm	3000.000
Unit depth		mm	3000.000
Tubes total		Piece	1800
Tubes blank		Piece	0
Tubes: Height		Piece	30
Tubes: Width		Piece	60
Tube coupling in series		Piece	30
Number of circuits (NC)		Piece	60
Tube diameter		mm	25.000
Tube thickness		mm	1.250
Tube interval on the height	S1	mm	50.000
Tube interval on the width	S2	mm	50.000
Tube arrangement		---	in line
Tubes-Material		---	AISI 316
Collector-Diameter		---	4"
Collector-Velocity		m/s	1.066
Collector-Material		---	AISI 316
Connections-Diameter		---	4"
Connections-Velocity		m/s	1.066
Connections-Material		---	AISI 316
Circulations:		Piece	2.000
Circulations:		---	Parallel
Volume		l	2202
Weight		kg	4056

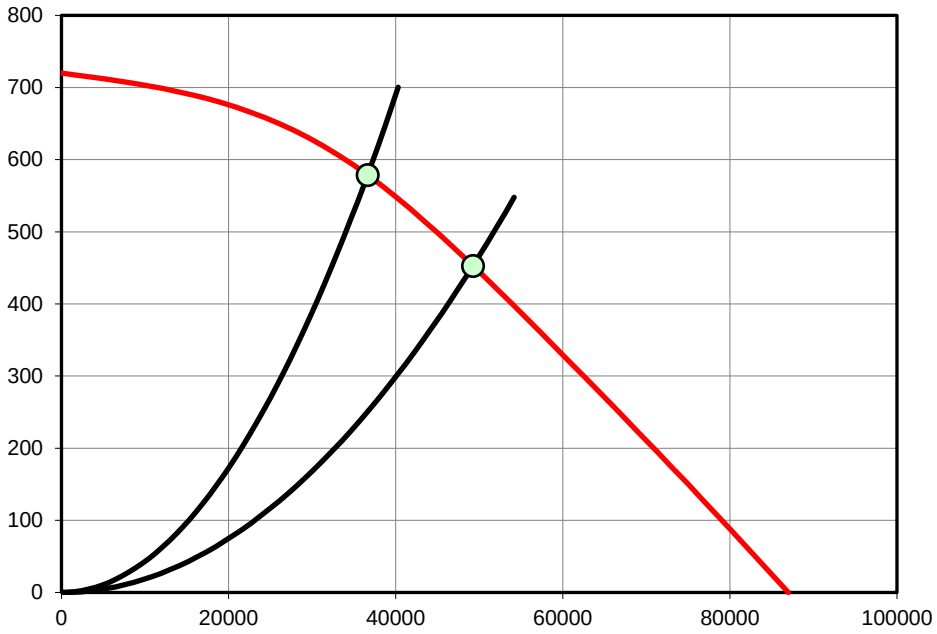




Static pressure, pressure drop

Product	---	Novovent Axial 1400 rpm		
Type	---	4-1250 / 24-3 / 11.0 kW	**Wet**	**dry**
Fan	Piece	3.000		
Air flow per fan	m3/h		36634.602	49251.638
Air flow total	m3/h		109903.807	147754.914
Static pressure	Pa		578.824	452.751
Box	Pa		100.000	180.742
Heat exchanger	Pa		478.824	272.009

Pressure (Pa)



Air flow per fan (m3/h)

LOGO

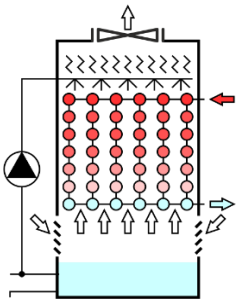
Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

City, 02.05.2022
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position



Software by www.zcs.ch

Economy

Water demand total: 58.52 % less than an open-cooling-tower !

			Water	Year: 8760 Hours Day	Night	Temp.	Day	Night
Station			kg/h	t/a	t/a	°C	h	h
Frankfurt am Main			0.0	0.0	0.0	40.5	0.0	0.0
			0.0	0.0	0.0	39.5	0.0	0.0
Capacity	kW	1404.87	0.0	0.0	0.0	38.5	0.0	0.0
			0.0	0.0	0.0	37.5	0.0	0.0
34 V% Et.glycol	h	8760.00	0.0	0.0	0.0	36.5	0.0	0.0
Temp. in	°C	44.00	2203.9	2.2	0.0	35.5	1.0	0.0
Temp. out	°C	24.00	2170.2	4.3	0.0	34.5	2.0	0.0
Volume flow	m3/h	66.86	2136.6	4.8	1.1	33.5	2.3	0.5
Mass flow	kg/h	69891.43	2102.9	5.3	2.1	32.5	2.5	1.0
Pressure drop	kPa	58.39	2069.2	20.2	2.6	31.5	9.8	1.3
Ext. pressure	kPa	100.00	2035.5	34.6	3.1	30.5	17.0	1.5
Pressure drop total	kPa	158.39	2001.8	48.0	7.5	29.5	24.0	3.8
Pump-Efficiency	%	80.00	1968.2	61.0	11.8	28.5	31.0	6.0
Pump power	kW	3.68	1934.5	68.2	16.0	27.5	35.3	8.3
Energy costs	EUR	3221.32	1900.8	75.1	20.0	26.5	39.5	10.5
			1867.1	125.1	31.3	25.5	67.0	16.8
Wet-Service (100.00%)	h	8760.00	1833.4	173.3	42.2	24.5	94.5	23.0
Temp.	°C	32.00	1799.8	185.4	57.1	23.5	103.0	31.8
Rel. humidity	%	40.00	1766.1	196.9	71.5	22.5	111.5	40.5
Abs. humidity	g/kg	12.01	1732.4	210.9	85.8	21.5	121.8	49.5
Air humid (20°/40%)	m3/h	109903.81	1698.7	224.2	99.4	20.5	132.0	58.5
Mass flow dry	kg/h	129434.60	1665.0	263.1	142.4	19.5	158.0	85.5
Pressure drop	Pa	478.82	1631.4	300.2	183.5	18.5	184.0	112.5
Box	Pa	100.00	1597.7	291.6	202.9	17.5	182.5	127.0
Ext. pressure	Pa	0.00	1564.0	283.1	221.3	16.5	181.0	141.5
Pressure drop total	Pa	578.82	1530.3	278.1	247.5	15.5	181.8	161.8
Fan-Efficiency	%	70.00	1496.6	273.1	272.4	14.5	182.5	182.0
Fan power	kW	25.24	1463.0	260.8	275.8	13.5	178.3	188.5
Energy costs	EUR	22113.80	1429.3	248.7	278.7	12.5	174.0	195.0
			1395.6	231.7	285.7	11.5	166.0	204.8
Humidifier (100.00%)	h	8760.00	1361.9	215.2	292.1	10.5	158.0	214.5
Temp.	°C	26.38	1328.2	216.8	279.6	9.5	163.3	210.5
Humidification	kg/h	2086.03	1294.6	218.1	267.3	8.5	168.5	206.5
Humidification (Max.)	kg/h	2203.91	1260.9	210.9	274.6	7.5	167.3	217.8
Pressure drop	kPa	100.00	1227.2	203.7	281.0	6.5	166.0	229.0
Pump-Efficiency	%	80.00	1193.5	195.7	265.3	5.5	164.0	222.3
Pump power (n=76)	kW	5.81	1159.8	187.9	249.9	4.5	162.0	215.5
Energy costs	EUR	5093.45	1126.2	158.5	235.1	3.5	140.8	208.8
Day + 10% Waste water	t/a	6793.79	1092.5	130.6	220.7	2.5	119.5	202.0
Night + 10% Waste water	t/a	6271.19	1058.8	123.9	179.7	1.5	117.0	169.8
Total + 10% Waste water	t/a	13064.98	1025.1	117.4	141.0	0.5	114.5	137.5
Water	EUR	65324.91	991.4	95.9	123.9	-0.5	96.8	125.0
			957.8	75.7	107.7	-1.5	79.0	112.5
dry-Service (0.00%)	h	0.00	924.1	55.7	80.2	-2.5	60.3	86.8
Temp.	°C	-29.94	890.4	37.0	54.3	-3.5	41.5	61.0
Rel. humidity	%	80.00	856.7	23.8	35.8	-4.5	27.8	41.8
Abs. humidity	g/kg	0.19	823.0	11.5	18.5	-5.5	14.0	22.5
Air humid (20°/40%)	m3/h	147754.91	789.4	9.3	11.4	-6.5	11.8	14.5
Mass flow dry	kg/h	174012.15	755.7	7.2	4.9	-7.5	9.5	6.5
Pressure drop	Pa	272.01	722.0	5.6	5.2	-8.5	7.8	7.3
Box	Pa	180.74	688.3	4.1	5.5	-9.5	6.0	8.0
Ext. pressure	Pa	0.00	654.6	2.0	3.4	-10.5	3.0	5.3
Pressure drop total	Pa	452.75	621.0	0.0	1.6	-11.5	0.0	2.5
Fan-Efficiency	%	70.00	587.3	0.0	0.7	-12.5	0.0	1.3
Fan power	kW	25.24	0.0	0.0	0.0	-13.5	0.0	0.0
Energy costs	EUR	0.00	0.0	0.0	0.0	-14.5	0.0	0.0
			0.0	0.0	0.0	-15.5	0.0	0.0
Service - Energy costs			0.0	0.0	0.0	-16.5	0.0	0.0
Daily hours (100.00%)	h/a	4380.00	0.0	0.0	0.0	-17.5	0.0	0.0
Night hours (100.00%)	h/a	4380.00	0.0	0.0	0.0	-18.5	0.0	0.0
Electric energy (MWh)	EUR	100.00	0.0	0.0	0.0	-19.5	0.0	0.0
Water (t)	EUR	5.00	0.0	0.0	0.0	-20.5	0.0	0.0
Life cycle	Years	15.00	0.0	0.0	0.0	-21.5	0.0	0.0
Support costs	%	5.00	0.0	0.0	0.0	-22.5	0.0	0.0
Capital interest	%	1.00	0.0	0.0	0.0	-23.5	0.0	0.0
Energy increase	%	1.00	0.0	0.0	0.0	-24.5	0.0	0.0
Inflation	%	1.00	0.0	0.0	0.0	-25.5	0.0	0.0
Investment costs	EUR	171000.00	0.0	0.0	0.0	-26.5	0.0	0.0
Water + Energy costs	EUR	95753.48	0.0	0.0	0.0	-27.5	0.0	0.0
Support costs	EUR	8550.00	0.0	0.0	0.0	-28.5	0.0	0.0
Overheads	EUR	104303.48	0.0	0.0	0.0	-29.5	0.0	0.0
			0.0	0.0	0.0	-30.5	0.0	0.0
Capital costs	**EUR**	**153180.72**	2203.9	6176.2	5701.1		4380.0	4380.0

LOGO

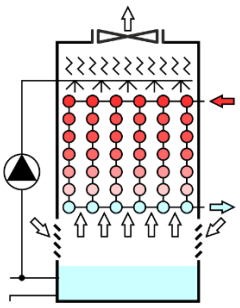
Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

City, 02.05.2022
With the compliments of

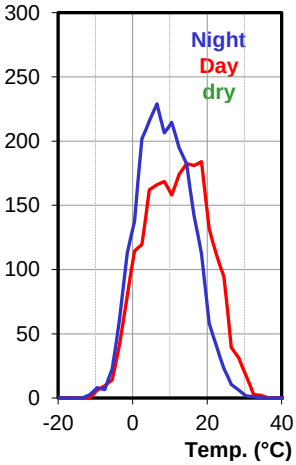
Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position

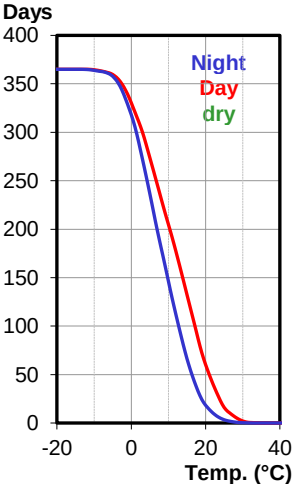


Software by www.zcs.ch

Hours



Days



Economy

Capital interest	%	1.00
Energy increase	%	1.00
Inflation	%	1.00
Support costs	%	5.00

Investment costs

Open cooling tower	EUR	33000.00
Evaporative cooler	EUR	171000.00
Additional costs	EUR	138000.00

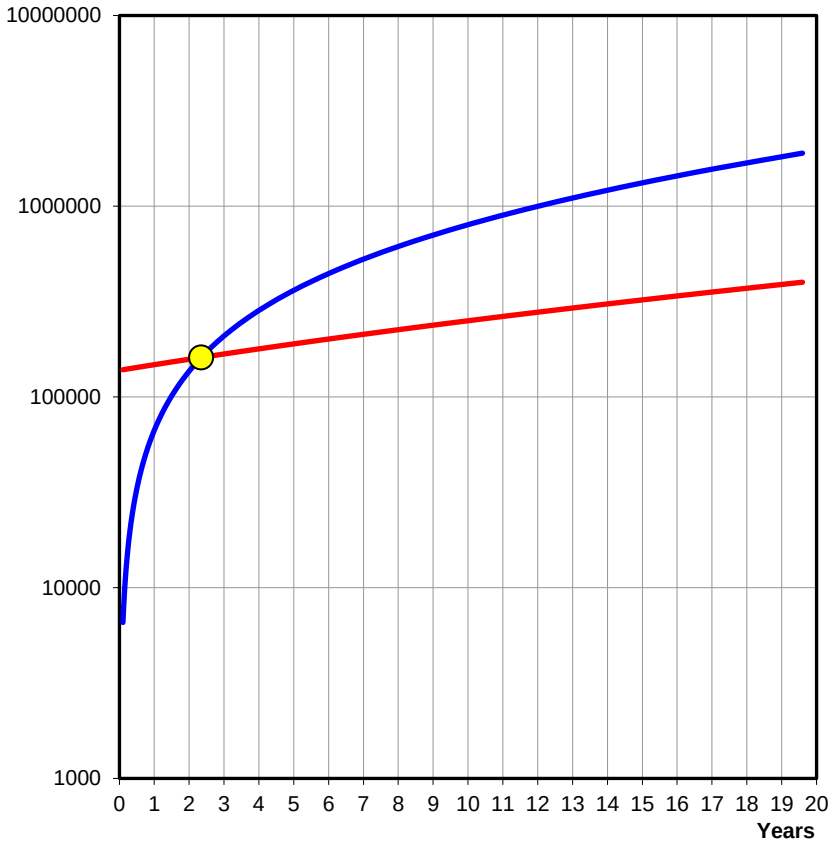
Overheads

Support costs (+)	EUR	6900.00
Energy costs: Open cooling tower (-)	EUR	162000.00
Energy costs: Evaporative cooler (+)	EUR	95753.48
Energy costs: - 40.9 %	EUR	**66246.52**

Amortization

BEP (Break even point)	Years	**2.35**

Incomes (EUR) - Expenses (EUR) - Amortization (Years)



LOGO

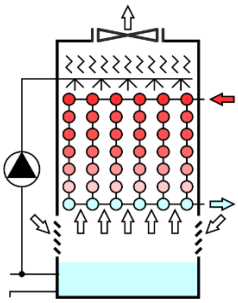
Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

City, 02.05.2022
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position



Software by www.zcs.ch

Evaporative cooler / Heat exchanger / Wet-Service

Capacity	kW	1361.374	------ sensible:	346.069
Surface reserve	%	0.001	latent:	1015.306
Present surface	m2	424.115		
Required surface	m2	424.111		
k-coeff.	W/m2K	505.708	---------- ffi:	5.000E-05
Average temp. diff. (99.99 %)	K	6.347	ffa:	5.000E-05

LOGO

Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

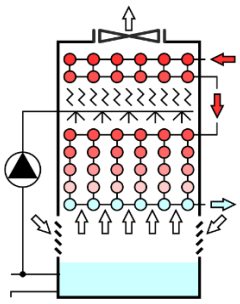
City, 02.05.2022
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position

Air humid		Inlet	Outlet	Definition
Height over sea level	m			106.000
Pressure	hPa			1000.564
Temp. (32.000)	°C	21.594	30.778	20.000
Rel. humidity (40.000)	%	100.000	95.300	40.000
Abs. humidity (12.014)	g/kg	16.422	27.353	5.858
Density humid	kg/m3	1.171	1.128	1.185
Enthalpy humid	kJ/kg	63.449	100.930	34.992
Volume flow humid	m3/h	113511.141	119051.355	111029.990
Mass flow dry	kg/h	130760.912	130760.912	130760.912
Velocity	m/s	3.503	3.674	3.427
Pressure drop (dry 196 Pa)	Pa		475.623	
Moistening temperature	°C		26.475	
Evaporation total	kg/h		2005.756	

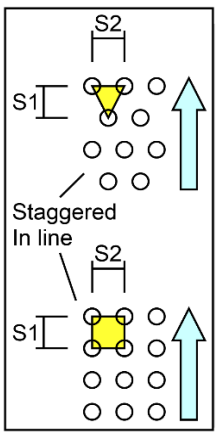
34 V% Et.glycol		Inlet	Outlet	Average
Temp.	°C	44.000	24.000	34.000
Density	kg/m3			1045.273
Spec. heat	kJ/kgK			3.618
Heat cond.	W/mK			0.451
Viscosity	Pas			1.713E-03
Volume flow	m3/h			64.794
Velocity	m/s			0.754
Pressure drop	kPa			55.058

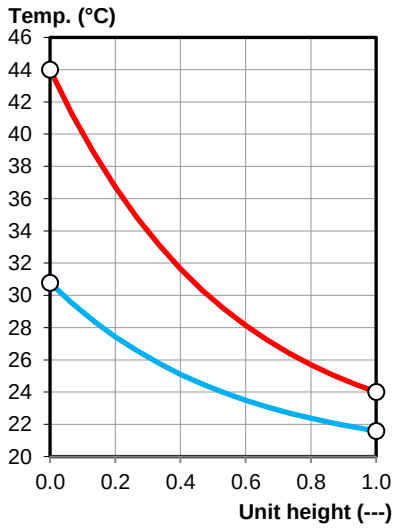


Technical data

Software by www.zcs.ch

Unit height		mm	1500.000
Unit width		mm	3000.000
Unit depth		mm	3000.000
Tubes total		Piece	1800
Tubes blank		Piece	0
Tubes: Height		Piece	30
Tubes: Width		Piece	60
Tube coupling in series		Piece	30
Number of circuits (NC)		Piece	60
Tube diameter		mm	25.000
Tube thickness		mm	1.250
Tube interval on the height	S1	mm	50.000
Tube interval on the width	S2	mm	50.000
Tube arrangement		---	in line
Tubes-Material		---	AISI 316
Collector-Diameter		---	4"
Collector-Velocity		m/s	1.033
Collector-Material		---	AISI 316
Connections-Diameter		---	4"
Connections-Velocity		m/s	1.033
Connections-Material		---	AISI 316
Circulations:		Piece	2
Circulations:		---	Parallel
Volume		l	2202
Weight		kg	4056
Waste water		m3/h	0.201
Evaporation total		m3/h	2.012
Pump circulation factor (x)		---	76.038
Water-Pump		**m3/h**	153.000





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

Price net: Heat exchanger **EUR** **81000.00**

Evaporative cooler / Heat exchanger / Wet-Service / dry Part

Capacity	kW	32.401		
Surface reserve	%	34.702		
Present surface	m2	56.549		
Required surface	m2	41.981		
k-coeff.	W/m2K	57.571	---------- ffi:	5.000E-05
Average temp. diff. (100.00 %)	K	13.406	ffa:	5.000E-05

Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

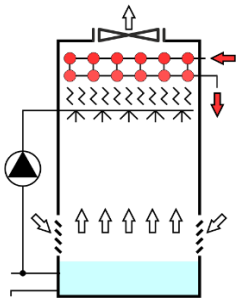
City, 02.05.2022
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position

Air humid		Inlet	Outlet	Definition
Height over sea level	m			106.000
Pressure	hPa			1000.564
Temp.	°C	29.935	30.778	20.000
Rel. humidity	%	100.000	95.300	40.000
Abs. humidity	g/kg	27.353	27.353	5.858
Density humid	kg/m3	1.132	1.128	1.185
Enthalpy humid	kJ/kg	100.037	100.930	34.992
Volume flow humid	m3/h	118721.177	119051.355	111029.990
Mass flow dry	kg/h	130760.912	130760.912	130760.912
Velocity	m/s	3.664	3.674	3.427
Pressure drop	Pa		26.922	

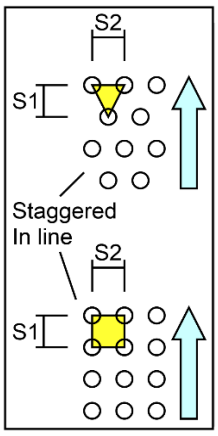
34 V% Et.glycol		Inlet	Outlet	Average
Temp.	°C	44.000	43.528	43.764
Density	kg/m3			1040.595
Spec. heat	kJ/kgK			3.648
Heat cond.	W/mK			0.459
Viscosity	Pas			1.373E-03
Volume flow	m3/h			65.085
Velocity	m/s			0.758
Pressure drop	kPa			10.428

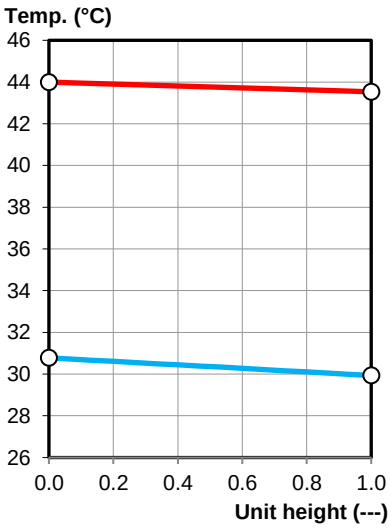


Technical data

Software by www.zcs.ch

Unit height		mm	200.000
Unit width		mm	3000.000
Unit depth		mm	3000.000
Tubes total		Piece	240
Tubes blank		Piece	0
Tubes: Height		Piece	4
Tubes: Width		Piece	60
Tube coupling in series		Piece	4
Number of circuits (NC)		Piece	60
Tube diameter		mm	25.000
Tube thickness		mm	1.250
Tube interval on the height	S1	mm	50.000
Tube interval on the width	S2	mm	50.000
Tube arrangement		---	in line
Tubes-Material		---	AISI 316
Collector-Diameter		---	4"
Collector-Velocity		m/s	1.038
Collector-Material		---	AISI 316
Connections-Diameter		---	4"
Connections-Velocity		m/s	1.038
Connections-Material		---	AISI 316
Circulations:		Piece	2
Circulations:		---	Parallel
Volume		l	342
Weight		kg	608





Evaporative cooler / Heat exchanger / dry-Service

Capacity	kW	1361.281		
Surface reserve	%	0.001		
Present surface	m2	424.115		
Required surface	m2	424.111		
k-coeff.	W/m2K	67.215	---------- ffi:	5.000E-05
Average temp. diff. (100.00 %)	K	47.753	ffa:	5.000E-05

Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

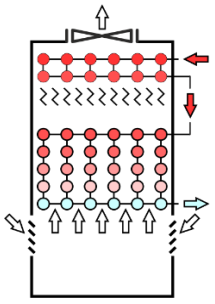
City, 02.05.2022
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position

Air humid		Inlet	Outlet	Definition
Height over sea level	m			106.000
Pressure	hPa			1000.564
Temp.	°C	-27.837	0.111	20.000
Rel. humidity	%	80.000	6.052	40.000
Abs. humidity	g/kg	0.232	0.232	5.858
Density humid	kg/m3	1.420	1.275	1.185
Enthalpy humid	kJ/kg	-27.435	0.693	34.992
Volume flow humid	m3/h	122688.006	136664.944	147936.860
Mass flow dry	kg/h	174226.429	174226.429	174226.429
Velocity	m/s	3.787	4.218	4.566
Pressure drop	Pa		274.550	

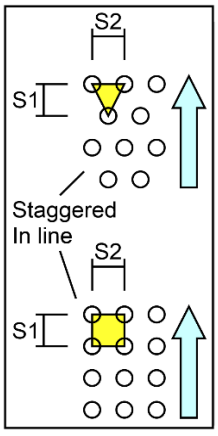
34 V% Et.glycol		Inlet	Outlet	Average
Temp.	°C	44.000	24.000	34.000
Density	kg/m3			1045.273
Spec. heat	kJ/kgK			3.618
Heat cond.	W/mK			0.451
Viscosity	Pas			1.713E-03
Volume flow	m3/h			64.790
Velocity	m/s			0.754
Pressure drop	kPa			55.051

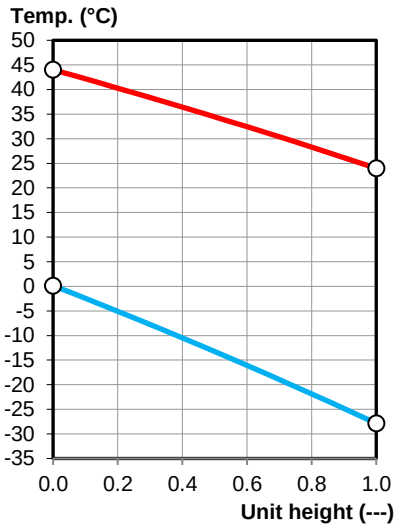


Technical data

Software by www.zcs.ch

Unit height		mm	1500.000
Unit width		mm	3000.000
Unit depth		mm	3000.000
Tubes total		Piece	1800
Tubes blank		Piece	0
Tubes: Height		Piece	30
Tubes: Width		Piece	60
Tube coupling in series		Piece	30
Number of circuits (NC)		Piece	60
Tube diameter		mm	25.000
Tube thickness		mm	1.250
Tube interval on the height	S1	mm	50.000
Tube interval on the width	S2	mm	50.000
Tube arrangement		---	in line
Tubes-Material		---	AISI 316
Collector-Diameter		---	4"
Collector-Velocity		m/s	1.033
Collector-Material		---	AISI 316
Connections-Diameter		---	4"
Connections-Velocity		m/s	1.033
Connections-Material		---	AISI 316
Circulations:		Piece	2.000
Circulations:		---	Parallel
Volume		l	2202
Weight		kg	4056

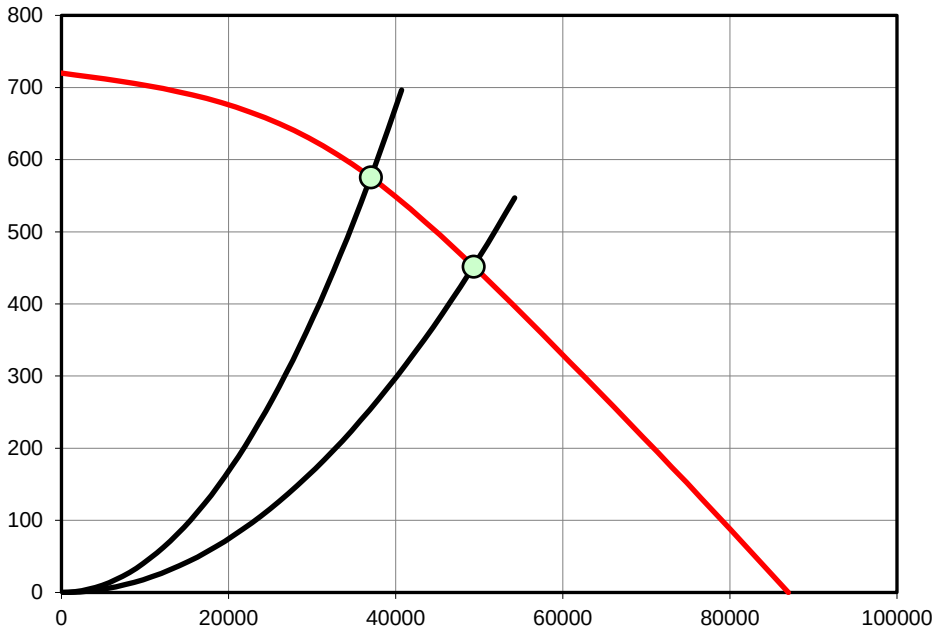




Static pressure, pressure drop

Product	---	Novovent Axial 1400 rpm		
Type	---	4-1250 / 24-3 / 11.0 kW	**Wet**	**dry**
Fan	Piece	3.000		
Air flow per fan	m3/h		37009.997	49312.287
Air flow total	m3/h		111029.990	147936.860
Static pressure	Pa		575.623	452.079
Drop eliminator & Box	Pa		100.000	177.530
Heat exchanger	Pa		475.623	274.549

Pressure (Pa)



Air flow per fan (m3/h)

LOGO

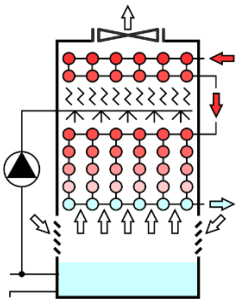
Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

City, 02.05.2022
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position



Software by www.zcs.ch

Economy

Water demand total: 59.62 % less than an open-cooling-tower !

				Year: 8760 Hours				
Station			Water	Day	Night	Temp.	Day	Night
Frankfurt am Main			kg/h	t/a	t/a	°C	h	h
			0.0	0.0	0.0	40.5	0.0	0.0
			0.0	0.0	0.0	39.5	0.0	0.0
Capacity	kW	1361.37	0.0	0.0	0.0	38.5	0.0	0.0
			0.0	0.0	0.0	37.5	0.0	0.0
34 V% Et.glycol	h	8760.00	0.0	0.0	0.0	36.5	0.0	0.0
Temp. in	°C	44.00	2123.1	2.1	0.0	35.5	1.0	0.0
Temp. out	°C	24.00	2089.6	4.2	0.0	34.5	2.0	0.0
Volume flow	m3/h	64.79	2056.0	4.6	1.0	33.5	2.3	0.5
Mass flow	kg/h	67727.46	2022.5	5.1	2.0	32.5	2.5	1.0
Pressure drop	kPa	55.06	1989.0	19.4	2.5	31.5	9.8	1.3
Ext. pressure	kPa	100.00	1955.5	33.2	2.9	30.5	17.0	1.5
Pressure drop total	kPa	155.06	1922.0	46.1	7.2	29.5	24.0	3.8
Pump-Efficiency	%	80.00	1888.4	58.5	11.3	28.5	31.0	6.0
Pump power	kW	3.49	1854.9	65.4	15.3	27.5	35.3	8.3
Energy costs	EUR	3055.92	1821.4	71.9	19.1	26.5	39.5	10.5
			1787.9	119.8	29.9	25.5	67.0	16.8
Wet-Service (100.00%)	h	8760.00	1754.4	165.8	40.4	24.5	94.5	23.0
Temp.	°C	32.00	1720.8	177.2	54.6	23.5	103.0	31.8
Rel. humidity	%	40.00	1687.3	188.1	68.3	22.5	111.5	40.5
Abs. humidity	g/kg	12.01	1653.8	201.3	81.9	21.5	121.8	49.5
Air humid (20°/40%)	m3/h	111029.99	1620.3	213.9	94.8	20.5	132.0	58.5
Mass flow dry	kg/h	130760.91	1586.8	250.7	135.7	19.5	158.0	85.5
Pressure drop	Pa	475.62	1553.2	285.8	174.7	18.5	184.0	112.5
Box	Pa	100.00	1519.7	277.3	193.0	17.5	182.5	127.0
Ext. pressure	Pa	0.00	1486.2	269.0	210.3	16.5	181.0	141.5
Pressure drop total	Pa	575.62	1452.7	264.0	235.0	15.5	181.8	161.8
Fan-Efficiency	%	70.00	1419.2	259.0	258.3	14.5	182.5	182.0
Fan power	kW	25.36	1385.6	247.0	261.2	13.5	178.3	188.5
Energy costs	EUR	22216.81	1352.1	235.3	263.7	12.5	174.0	195.0
			1318.6	218.9	270.0	11.5	166.0	204.8
Humidifier (100.00%)	h	8760.00	1285.1	203.0	275.6	10.5	158.0	214.5
Temp.	°C	26.47	1251.6	204.3	263.5	9.5	163.3	210.5
Humidification	kg/h	2005.76	1218.0	205.2	251.5	8.5	168.5	206.5
Humidification (Max.)	kg/h	2123.08	1184.5	198.1	257.9	7.5	167.3	217.8
Pressure drop	kPa	100.00	1151.0	191.1	263.6	6.5	166.0	229.0
Pump-Efficiency	%	80.00	1117.5	183.3	248.4	5.5	164.0	222.3
Pump power (n=76)	kW	5.61	1084.0	175.6	233.6	4.5	162.0	215.5
Energy costs	EUR	4910.32	1050.4	147.8	219.3	3.5	140.8	208.8
Day + 10% Waste water	t/a	6422.45	1016.9	121.5	205.4	2.5	119.5	202.0
Night + 10% Waste water	t/a	5902.33	983.4	115.1	166.9	1.5	117.0	169.8
Total + 10% Waste water	t/a	12324.77	949.9	108.8	130.6	0.5	114.5	137.5
Water	EUR	61623.87	916.4	88.7	114.5	-0.5	96.8	125.0
			882.8	69.7	99.3	-1.5	79.0	112.5
dry-Service (0.00%)	h	0.00	849.3	51.2	73.7	-2.5	60.3	86.8
Temp.	°C	-27.84	815.8	33.9	49.8	-3.5	41.5	61.0
Rel. humidity	%	80.00	782.3	21.7	32.7	-4.5	27.8	41.8
Abs. humidity	g/kg	0.23	748.7	10.5	16.8	-5.5	14.0	22.5
Air humid (20°/40%)	m3/h	147936.86	715.2	8.4	10.4	-6.5	11.8	14.5
Mass flow dry	kg/h	174226.43	681.7	6.5	4.4	-7.5	9.5	6.5
Pressure drop	Pa	274.55	648.2	5.0	4.7	-8.5	7.8	7.3
Box	Pa	177.53	614.7	3.7	4.9	-9.5	6.0	8.0
Ext. pressure	Pa	0.00	581.1	1.7	3.1	-10.5	3.0	5.3
Pressure drop total	Pa	452.08	547.6	0.0	1.4	-11.5	0.0	2.5
Fan-Efficiency	%	70.00	514.1	0.0	0.6	-12.5	0.0	1.3
Fan power	kW	25.36	0.0	0.0	0.0	-13.5	0.0	0.0
Energy costs	EUR	0.00	0.0	0.0	0.0	-14.5	0.0	0.0
			0.0	0.0	0.0	-15.5	0.0	0.0
Service - Energy costs			0.0	0.0	0.0	-16.5	0.0	0.0
Daily hours (100.00%)	h/a	4380.00	0.0	0.0	0.0	-17.5	0.0	0.0
Night hours (100.00%)	h/a	4380.00	0.0	0.0	0.0	-18.5	0.0	0.0
Electric energy (MWh)	EUR	100.00	0.0	0.0	0.0	-19.5	0.0	0.0
Water (t)	EUR	5.00	0.0	0.0	0.0	-20.5	0.0	0.0
Life cycle	Years	15.00	0.0	0.0	0.0	-21.5	0.0	0.0
Support costs	%	5.00	0.0	0.0	0.0	-22.5	0.0	0.0
Capital interest	%	1.00	0.0	0.0	0.0	-23.5	0.0	0.0
Energy increase	%	1.00	0.0	0.0	0.0	-24.5	0.0	0.0
Inflation	%	1.00	0.0	0.0	0.0	-25.5	0.0	0.0
Investment costs	EUR	172000.00	0.0	0.0	0.0	-26.5	0.0	0.0
Water + Energy costs	EUR	91806.92	0.0	0.0	0.0	-27.5	0.0	0.0
Support costs	EUR	8600.00	0.0	0.0	0.0	-28.5	0.0	0.0
Overheads	EUR	100406.92	0.0	0.0	0.0	-29.5	0.0	0.0
			0.0	0.0	0.0	-30.5	0.0	0.0
Capital costs	**EUR**	**148122.10**	2123.1	5838.6	5365.8		4380.0	4380.0

LOGO

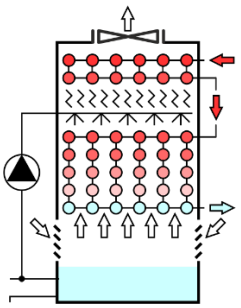
Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

City, 02.05.2022
With the compliments of

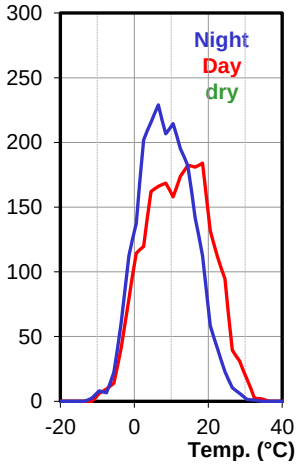
Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position

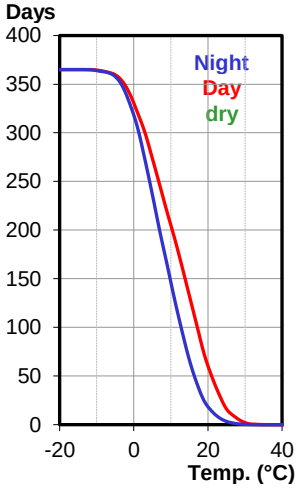


Software by www.zcs.ch

Hours



Days



Economy

Capital interest	%	1.00
Energy increase	%	1.00
Inflation	%	1.00
Support costs	%	5.00

Investment costs

Open cooling tower	EUR	32000.00
Evaporative cooler	EUR	172000.00
Additional costs	EUR	140000.00

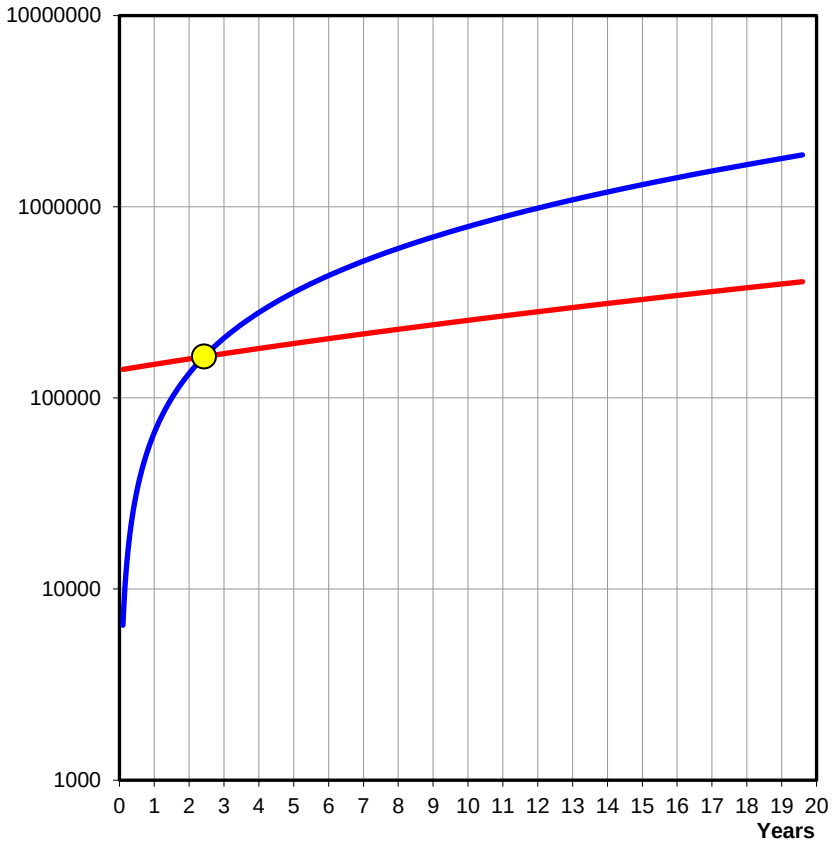
Overheads

Support costs (+)	EUR	7000.00
Energy costs: Open cooling tower (-)	EUR	157000.00
Energy costs: Evaporative cooler (+)	EUR	91806.92
Energy costs: - 41.5 %	EUR	**65193.08**

Amortization

BEP (Break even point)	Years	**2.43**

Incomes (EUR) - Expenses (EUR) - Amortization (Years)



LOGO

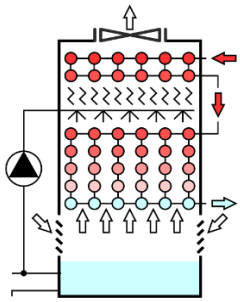
Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

City, 02.05.2022
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position



Software by www.zcs.ch