XCHANGE ADVANCED TECHNOLOGIES

SISTEMA ADIABATICO
ADIABATIC SYSTEM
ADIABATISCHES SYSTEM
SYSTÈME ADIABATIQUE
SISTEMA ADIBÁTICO

Adiabatic System

Theory :

The adiabatic saturation temperature is a specific temperature value at which water by adiabatic evaporating brings the air itself to a saturation point, this then cools the water turning the temperature towards the wet bulb temperature.

Example :

T amb. (Ambient Air) : 32°C / 50 % RH

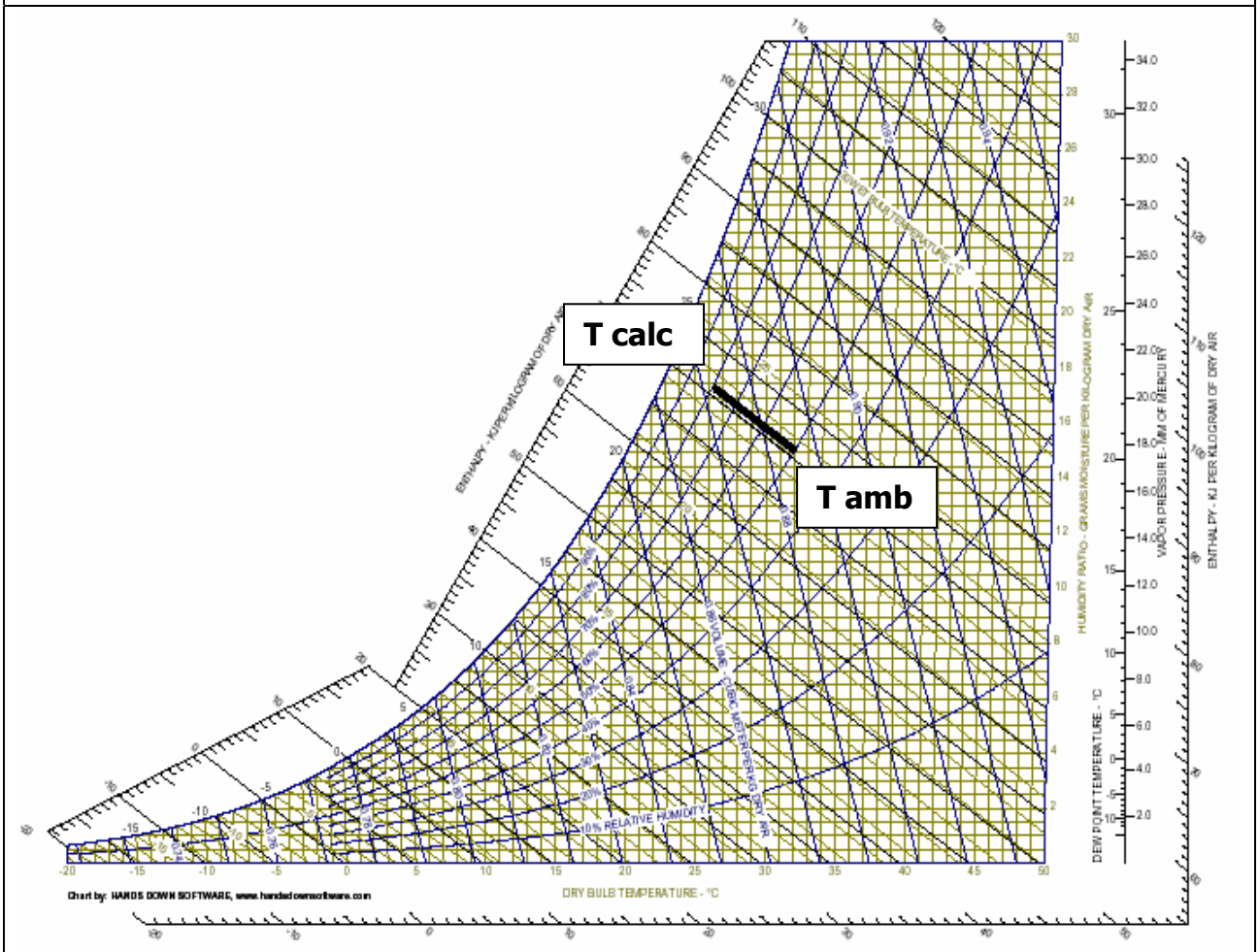
T calc. (Design Air Temp.) : 26,3°C / 80 % RH

Working :

The physical phenomenon of adiabatic saturation is obtained by using an adiabatic vaporizing system. The suction air on the water cooler collides with a very fine water particle mist obtained with custom built spray nozzles fitted in order to create a complete and uniform saturation of the entering air.

Advantages :

- The Dry-Cooler / Condenser can be designed for a much lower entering air temperature (see the example) to obtain a smaller dimension unit with a smaller heat exchanger surface.
- It is possible to use the unit to cool water at temperatures lower than the ambient air temperature.
- The combination of an adiabatic system with a inverter temperature controller lowers the energy consumption of the fans and considerably reduces the sound pressure level, optimizing the water spray consumption.



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Adiabatic System

Calculation temperature :

In the following table you can find the ambient temperature (T amb.) and the value you need for the calculation (T adiab.) at the ambient pressure of 1,013 bar.

Table 1:

$T_{Amb.}$ (°C)	Ur (%)	$T_{Adiab.}$ (°C)	ΔUs (g/Kg)	Dens. (Kg/m^3)	$T_{Amb.}$ (°C)	Ur (%)	$T_{Adiab.}$ (°C)	ΔUs (g/Kg)	Dens. (Kg/m^3)	$T_{Amb.}$ (°C)	Ur (%)	$T_{Adiab.}$ (°C)	ΔUs (g/Kg)	Dens. (Kg/m^3)
5	30	2,0	1,9	1,27	19	30	13,6	3,7	1,20	33	30	24,7	6,3	1,15
5	40	2,2	1,4	1,27	19	40	14,0	2,5	1,20	33	40	25,7	4,1	1,14
5	50	2,6	1,0	1,27	19	50	14,9	1,6	1,20	33	50	27,2	2,4	1,14
5	60	3,5	0,7	1,27	19	60	16,4	1,1	1,20	33	60	29,2	1,5	1,14
6	30	2,8	2,0	1,26	20	30	14,4	3,8	1,20	34	30	25,5	6,5	1,14
6	40	3,0	1,4	1,26	20	40	14,8	2,6	1,20	34	40	26,5	4,1	1,14
6	50	3,5	1,0	1,26	20	50	15,8	1,7	1,20	34	50	28,0	2,4	1,14
6	60	4,4	0,7	1,26	20	60	17,3	1,1	1,20	34	60	30,2	1,6	1,14
7	30	3,7	2,1	1,26	21	30	15,2	4,0	1,20	35	30	26,3	6,7	1,14
7	40	3,9	1,5	1,26	21	40	15,7	2,7	1,20	35	40	27,3	4,2	1,14
7	50	4,4	1,0	1,26	21	50	16,7	1,8	1,19	35	50	28,9	2,4	1,13
7	60	5,3	0,7	1,26	21	60	18,2	1,1	1,19	35	60	31,1	1,6	1,13
8	30	4,5	2,2	1,25	22	30	16,0	4,2	1,19	36	30	27,2	7,1	1,13
8	40	4,7	1,6	1,25	22	40	16,5	2,8	1,19	36	40	28,2	4,4	1,13
8	50	5,3	1,1	1,25	22	50	17,6	1,8	1,19	36	50	29,8	2,5	1,13
8	60	6,2	0,7	1,25	22	60	19,1	1,2	1,19	36	60	32,0	1,6	1,13
9	30	5,4	2,3	1,25	23	30	16,8	4,3	1,19	37	30	28,0	7,4	1,13
9	40	5,6	1,7	1,25	23	40	17,3	2,9	1,19	37	40	29,0	4,5	1,13
9	50	6,2	1,1	1,25	23	50	18,4	1,8	1,19	37	50	30,7	2,6	1,12
9	60	7,2	0,8	1,25	23	60	20,0	1,2	1,18	37	60	33,0	1,7	1,12
10	30	6,2	2,4	1,24	24	30	17,6	4,5	1,18	38	30	28,8	7,6	1,13
10	40	6,4	1,7	1,24	24	40	18,2	3,0	1,18	38	40	29,9	4,7	1,12
10	50	7,1	1,2	1,24	24	50	19,3	1,9	1,18	38	50	31,6	2,7	1,12
10	60	8,1	0,8	1,24	24	60	21,0	1,3	1,18	38	60	33,9	1,7	1,12
11	30	7,0	2,5	1,24	25	30	18,4	4,7	1,18	39	30	29,6	7,9	1,12
11	40	7,3	1,8	1,24	25	40	19,0	3,1	1,18	39	40	30,7	4,8	1,12
11	50	8,0	1,3	1,24	25	50	20,2	2,0	1,18	39	50	32,4	2,6	1,12
11	60	9,0	0,8	1,24	25	60	21,9	1,3	1,18	39	60	34,8	1,7	1,11
12	30	7,9	2,7	1,24	26	30	19,2	4,9	1,18	40	30	30,4	8,2	1,12
12	40	8,1	1,9	1,23	26	40	19,8	3,2	1,17	40	40	31,5	4,9	1,11
12	50	8,8	1,3	1,23	26	50	21,0	2,0	1,17	40	50	33,3	2,7	1,11
12	60	9,9	0,8	1,23	26	60	22,8	1,3	1,17	40	60	35,7	1,7	1,11
13	30	8,7	2,8	1,23	27	30	20,0	5,1	1,17	41	30	31,2	8,5	1,11
13	40	9,0	2,0	1,23	27	40	20,7	3,3	1,17	41	40	32,4	5,1	1,11
13	50	9,7	1,3	1,23	27	50	21,9	2,0	1,17	41	50	34,2	2,8	1,11
13	60	10,8	0,9	1,23	27	60	23,7	1,3	1,17	41	60	36,7	1,8	1,10
14	30	9,5	2,9	1,23	28	30	20,8	5,3	1,17	42	30	32,0	8,8	1,11
14	40	9,8	2,1	1,23	28	40	21,5	3,4	1,17	42	40	33,2	5,2	1,11
14	50	10,6	1,4	1,23	28	50	22,8	2,1	1,16	42	50	35,1	2,8	1,10
14	60	11,8	0,9	1,22	28	60	24,6	1,3	1,16	42	60	37,6	1,8	1,10
15	30	10,3	3,1	1,22	29	30	21,6	5,5	1,16	43	30	32,8	9,1	1,11
15	40	10,7	2,2	1,22	29	40	22,3	3,5	1,16	43	40	34,1	5,5	1,10
15	50	11,5	1,5	1,22	29	50	23,7	2,2	1,16	43	50	36,0	2,9	1,10
15	60	12,7	1,0	1,22	29	60	25,6	1,4	1,16	43	60	38,5	1,8	1,09
16	30	11,1	3,2	1,22	30	30	22,4	5,7	1,16	44	30	33,6	9,4	1,10
16	40	11,5	2,2	1,22	30	40	23,2	3,7	1,16	44	40	34,9	5,6	1,10
16	50	12,3	1,5	1,22	30	50	24,5	2,2	1,15	44	50	36,9	3,0	1,09
16	60	13,6	1,0	1,22	30	60	26,5	1,4	1,15	44	60	39,5	2,0	1,09
17	30	11,9	3,3	1,21	31	30	23,2	5,9	1,15	45	30	34,4	9,8	1,10
17	40	12,3	2,3	1,21	31	40	24,0	3,8	1,15	45	40	35,8	5,8	1,09
17	50	13,2	1,5	1,21	31	50	25,4	2,2	1,15	45	50	37,8	3,1	1,09
17	60	14,5	1,0	1,21	31	60	27,4	1,5	1,15	45	60	40,4	1,9	1,09
18	30	12,7	3,5	1,21	32	30	24,0	6,1	1,15	46	30	35,2	10,1	1,09
18	40	13,2	2,4	1,21	32	40	24,8	3,9	1,15	46	40	36,6	5,9	1,09
18	50	14,1	1,6	1,21	32	50	26,3	2,3	1,15	46	50	38,6	2,9	1,08
18	60	15,4	1,0	1,21	32	60	28,3	1,5	1,14	46	60	41,3	1,9	1,08

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Adiabatic System

Water quality :

The water to employ for the adiabatic system must have characteristic following :

- Maximum water hardness 8-12 °F or in other words to have a max $CaCO_3$ content of 80 – 120 ppm.
- The water PH value must be inferior to 7 in order to avoid corrosion problems on the finned package.

Nozzles working condition :

- The necessary pressure to the corrected operation of the nebulizzazione system is of 2,5 bars.
- The capacity for single nozzle to the pressure of 2,5 bars can vary from 1,15 to 1,9 dm3/min to second of the type of installed nozze

Water flow calculation :

The water flow needed for the adiabatic system can be calculated using the following procedure:

- From the table 1 find the values for **ΔUs** , $\mathbf{D_{air}}$ relative at the temperature $\mathbf{T_{Amb}}$, and the **Ur** value.
- From the selection card find the total air flow value **Qa**.
- The value of water flow for the adiabatic system is given from the following relation:

$$\mathbf{Qw} = \mathbf{Qa} \times \mathbf{D_{air}} \times \mathbf{\Delta Us} \times \mathbf{0{,}001} \ \ (\mathbf{dm^3 / h})$$

- **The real water flow (Qw real) to the adiabatic system will hold account of the Qw capacity multiplied for 1,3. This in order to guarantee a efficient operation of the adiabatic system. The water flow in excess will come dispersed to the ground; the system <u>does not</u> preview the water recovery.**

$$\mathbf{Qw\ real = 1{,}3 \times Qw} \ \ (\mathbf{dm^3 / h})$$

Es) Air Flow **Qa =** 75000 (m^3 / h)

$\mathbf{T_{Amb}}$ = 25 (°C)

Ur = 50 %

From table 1 :

$\mathbf{D_{air}}$ **= 1,18 (Kg / m^3)**

ΔUs = 2,0 (g / Kg)

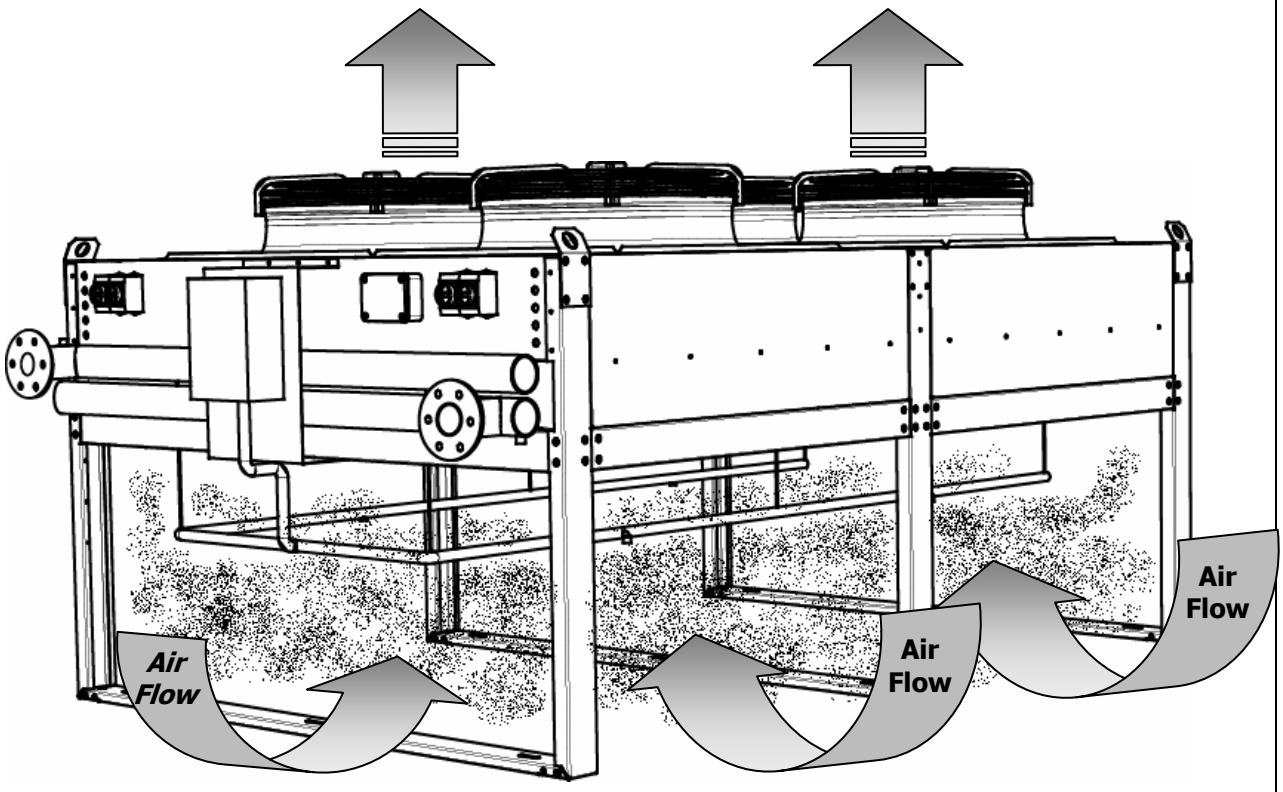
Qw = **75000** x **1.18** x **2.0** x **0,001** **= 177 (dm^3 / h)**

Qw real = 1,3 x 177 = 230 (dm^3 / h)

Adiabatic System

Features :

- Built-in microproccessor controlled system
- Tubes with custom built injectors fitted on the air suction side and set in the air direction
- Electric valves for drain and vent control
- Pressure reducer to adjust the necessary pressure for injection and nebulizing
- SOFTWATER in order to avoid the limestone deposition on the finned package (see next page)
- Pressure switch for controlling the water pressure
- Temperature probes
- Water resistant wiring box (IP65).
- Aluminium fins with treatment BLUEFIN, used in order to improve the distribution of the water on the package and to prevent corrosion phenomena on the fin.



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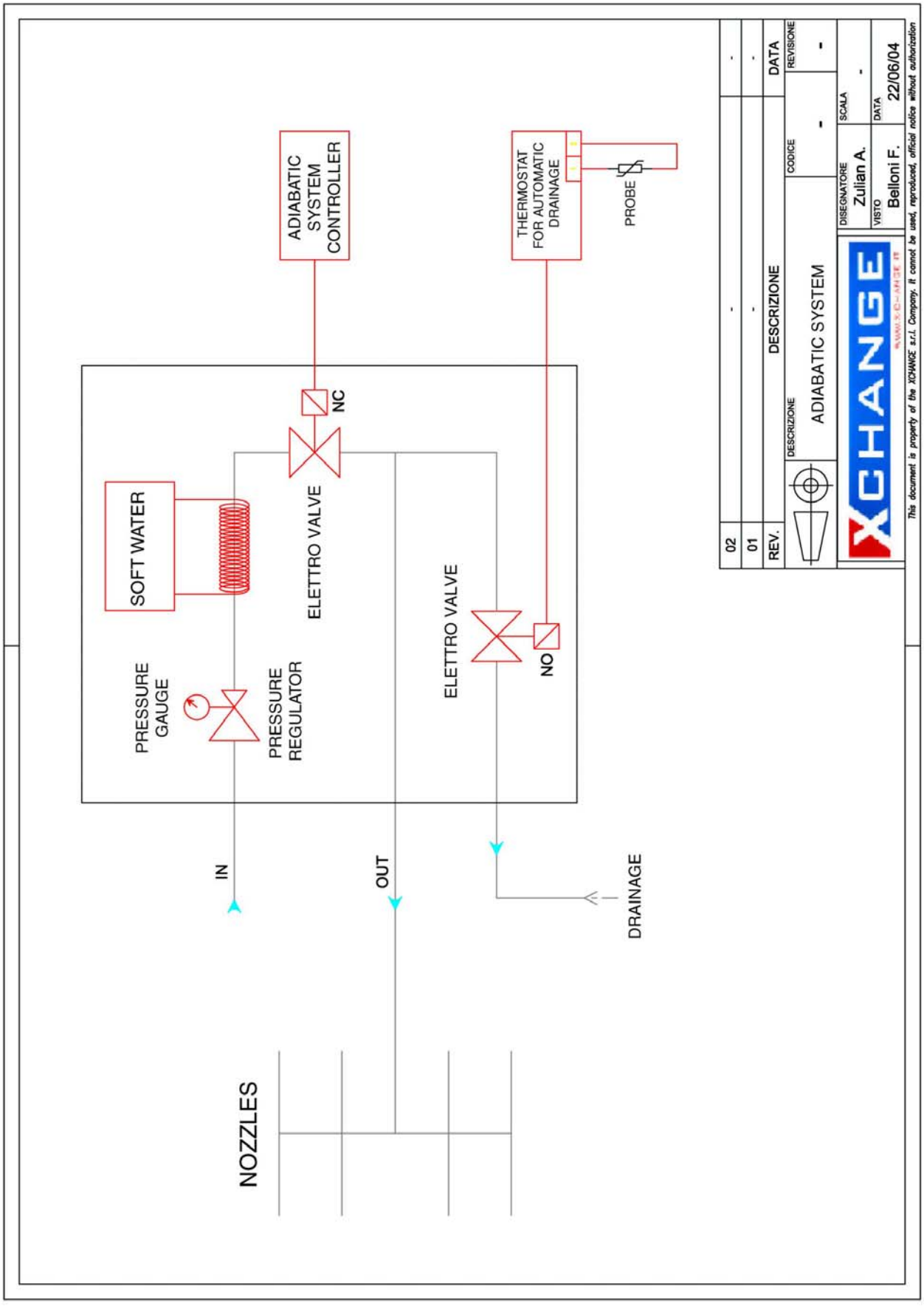
Adiabatic System



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Adiabatic System

SOFT WATER

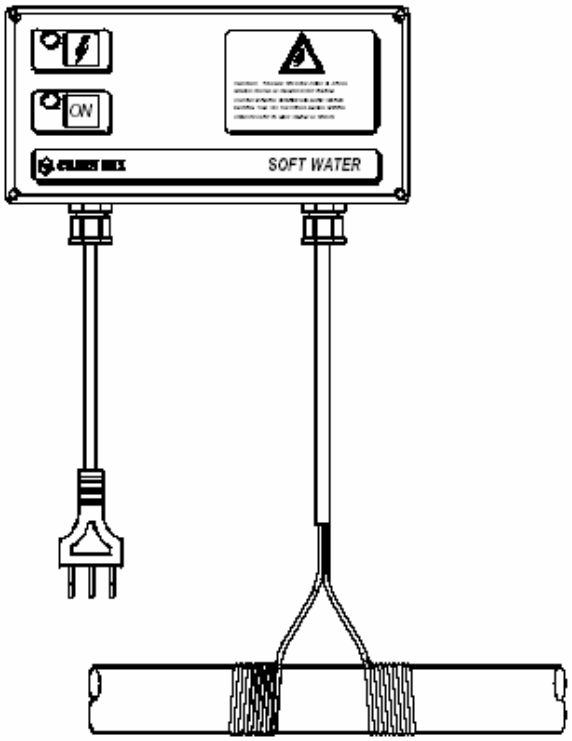
In most industrial processes where a heating/cooling system is involved, water is used as the medium for thermal energy transfer.
The composition of water is a solution consisting of carbon dioxide, mineral salts, microorganisms and other substances. Typically, water is characterised by hardness, a term referring to the concentration of mineral salts (calcium and magnesium) dissolved
therein. The unit of measurement for hardness is the French Degree: 1 French Degree corresponding to 10 mg of calcium carbonate per kg of water i.e. 10 parts per million (ppm).
Facing lime stone problems in pipework, heat exchangers and moulds, when water, without chemical treatment, is used as a process fluid is only to be expected. The presence of limestone is due to the precipitation of calcium carbonate (in calcite form) produced by calcium bicarbonate ions dissolving in water. The thermal fluctuations considerably increase the reactions of the calcium and magnesium salts encouraging the precipitation of the carbonate crystals. Decreased performance and efficiency of the heat exchanger in thermodynamic systems with consequential increased energy consumption, maintenance and running costs are consequences of lime stone deposition.

DECARBONATIZATION AND WATER SOFTENING

In decarbonatisation and softening by precipitation processes, normally chemical products such as lime milk; lime, caustic soda and soda & phosphate are used to initiate carbon dioxide precipitation (the hardness due to the presence of carbonates and non-carbonates normally employed in such water treatments). The ion exchange process is a chemical treatment based on the principle of exchanging ions; the cations and anions of the chemical products used in special filters being exchanged with ions of the calcium and magnesium salts in the water. SOFT WATER is instead an innovative device that efficiently prevents limestone by application of physical phenomena alone, with no chemical treatment involved.

WORKING PRINCIPLE

As a result of thermal stresses, the calcium (and magnesium) salts precipitate as carbonates under the form of calcite crystals. Calcite (trigonal calcium carbonate in the rhombohedral phase) is a stable form of carbonate and due to its crystalline structure is highly aggregating. An electronic device, installed in either the water supply pipeline of a water cooling system or a temperature controller, induces an electro-magnetic field in the process fluid itself. The electro-magnetic field acts on the calcite crystals modifying their structure to that of aragonite (calcium carbonate in the orthorhombic phase). Aragonite is a polymorph of calcite, which means it has the same chemical composition of calcite but a different structure and as such a different crystalline shape and symmetry. The aragonite structure is metastable at ordinary temperatures and the crystals exhibit a non-aggregating property.
The dimorphism of calcium carbonate may be metaphorically compared to the dimorphism of water in its solid, iced state. Calcite, hard and incrusting is like the consistency of ice (typically solid) while aragonite with its thin elongated crystalline clusters is like snow (typically powdery and inconsistent). It should be noted that the electro-magnetic field, appropriately modulated in frequency and intensity, does not at all alter the organoleptic characteristics of water.
A SOFT WATER device when installed in a closed water circuit is also able to transform calcite already present in existing pipelines, depending upon the thickness of limestone incrustation, into aragonite thus carrying out a limestone pipe-cleaning effect.



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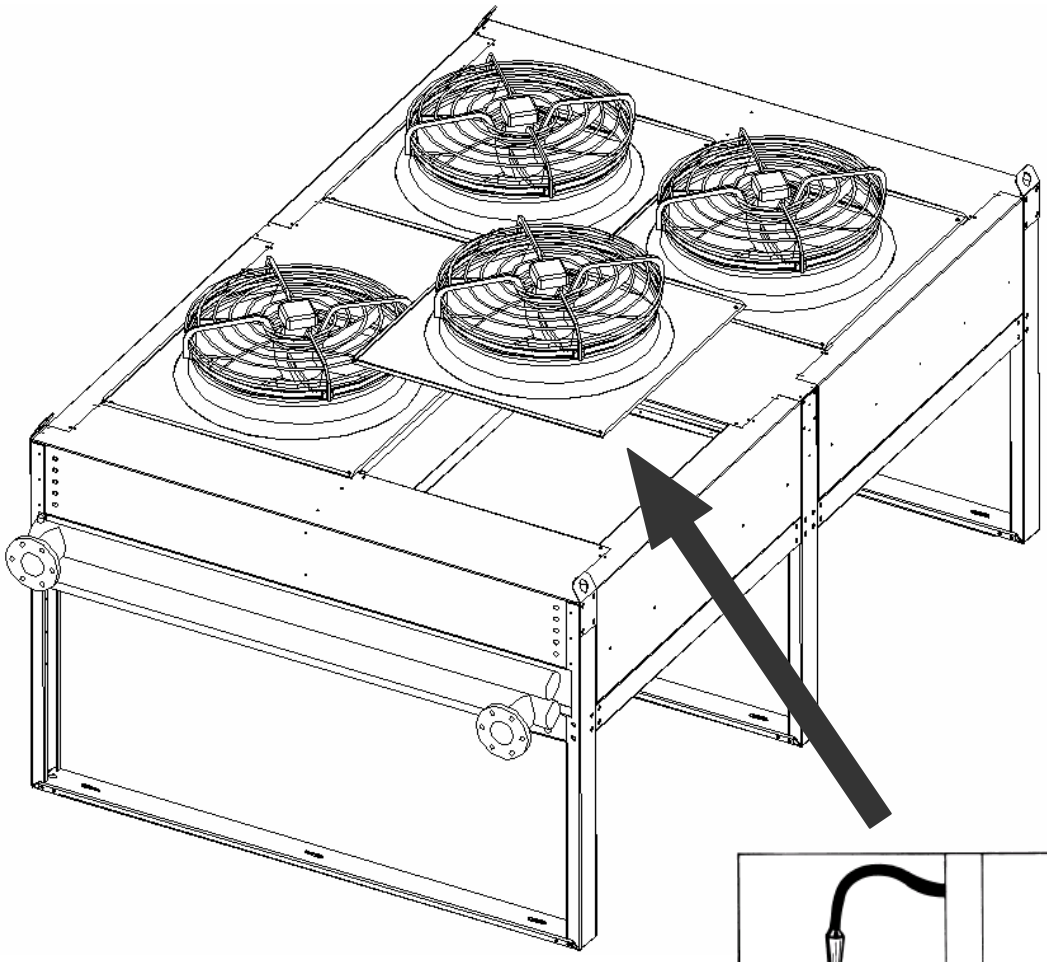
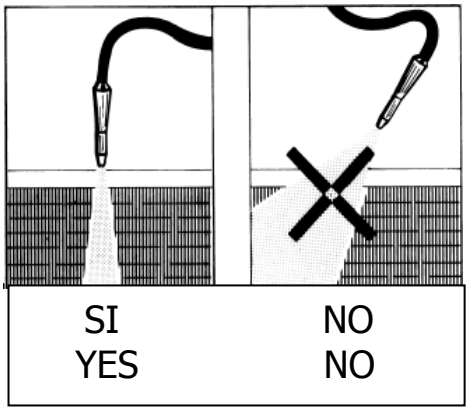
Adiabatic System

Maintenance :

- Drain the water from the adiabatic system when the ambient temperature is next to 0 °C.
- Check the nozzles at least one time for year

The finned package must be cleaned up using a water jet with one inferior pressure to the 2 bars.





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