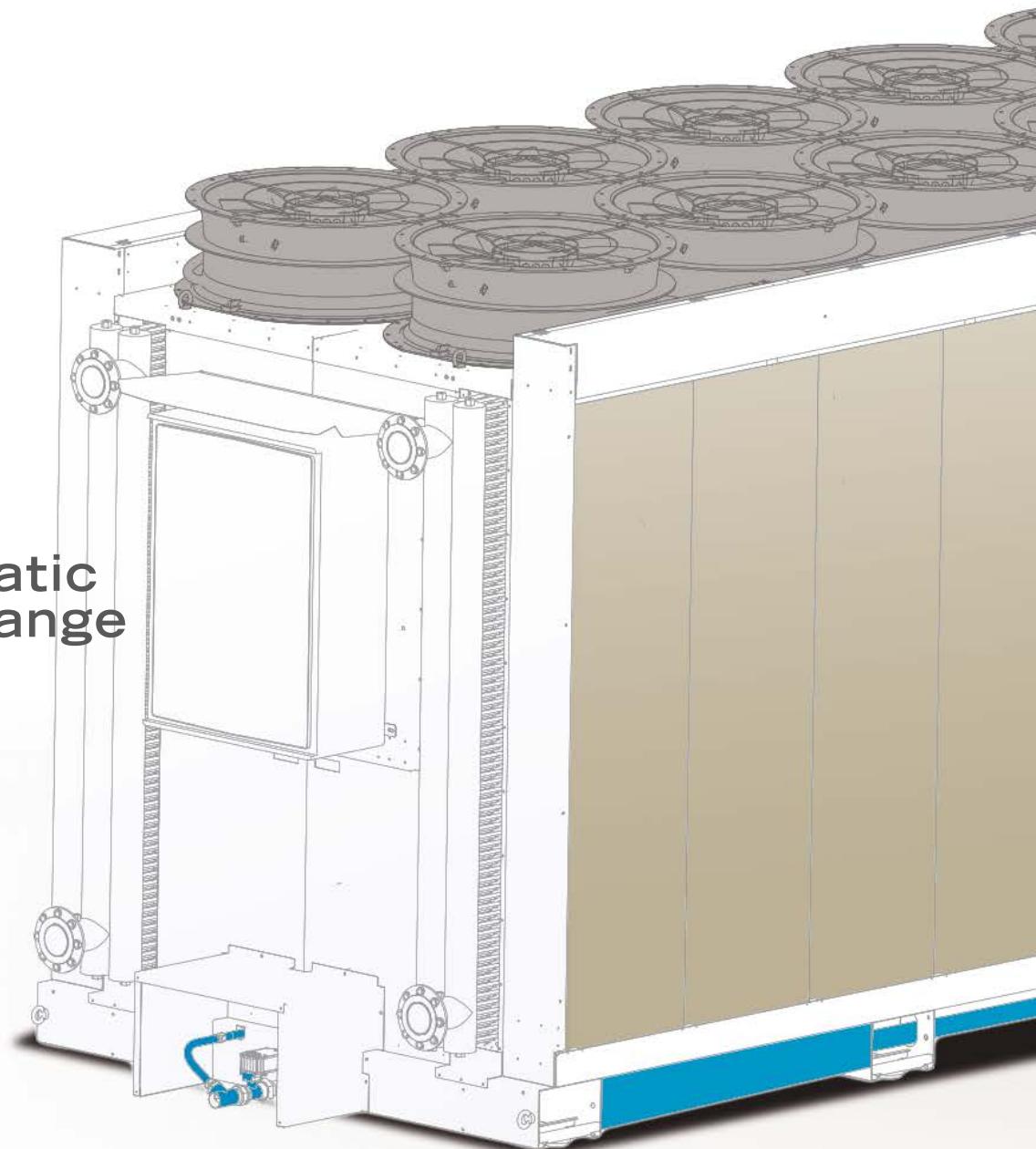




REFRION
a better innovation

The adiabatic systems range



 RELATIVE HUMIDITY INCREASE
ERHÖHTE RELATIVE FEUCHTE
ACTION DE L'HUMIDITÉ RELATIVE
INCREMENTO UMIDITÀ RELATIVA

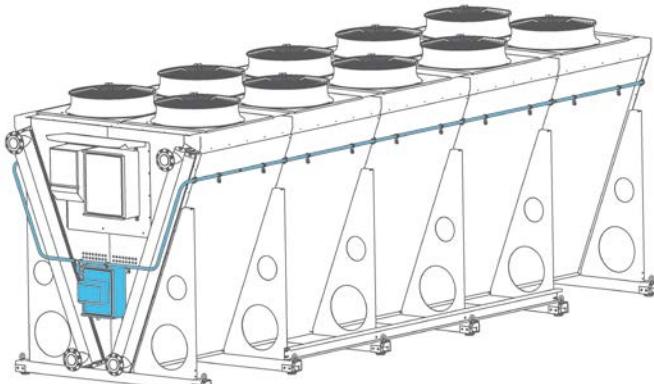
 WATER CONSUMPTION
WASSERVERBRAUCH
CONSUMMATION D'EAU
CONSUMO D'ACQUA

 USAGE LIMITATIONS
LIMIT BETRIEBSDAUER
LIMITES D'UTILISATION
LIMITI DI UTILIZZO

 HYGENIC CERTIFICATION
HYGIENE-ZERTIFIKAT
CERTIFICATION HYGIÉNIQUE
CERTIFICAZIONE IGIENICA

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SPRAY ADIABATIC SYSTEM



Inlet air humidification system through water atomisation.
A very thin water mist generated by specific nozzles fills and humidifies the inlet air, thus making it colder, depending on the different working conditions.

Befeuchtung der Ansaugluft durch Wasserzerstäubung.
In Abhängigkeit der jeweiligen Betriebsbedingung, wird von speziellen Hohlkegeldüsen feiner Wassernebel erzeugt, dieser erhöht die Luftfeuchte der Ansaugluft vom Wärmetauscher und kühl sie dadurch ab.

Système d'humidification de l'air à l'aspiration de l'appareil moyennant la nébulisation d'eau.
L'air aspiré se verra chargé d'un léger nuage de gouttelettes d'eau générée par des buses à contre courant, l'humidifiant et le refroidissant à des valeurs en fonction des conditions extérieures.

-  Compliant with VDI 2047 Part 2
-  +30%
-  LOW
-  150 hours/year

Sistema di umidificazione dell'aria in aspirazione dell'apparecchio ventilato mediante nebulizzazione d'acqua. L'aria in aspirazione viene investita da una sottilissima nebbia di goccioline d'acqua generata da appositi ugelli, umidificandosi e raffreddandosi con valori che cambiano a seconda delle condizioni di esercizio.

AVAILABLE FOR THE FOLLOWING PRODUCT RANGE



Superjumbo



Combo



Tower



Wall

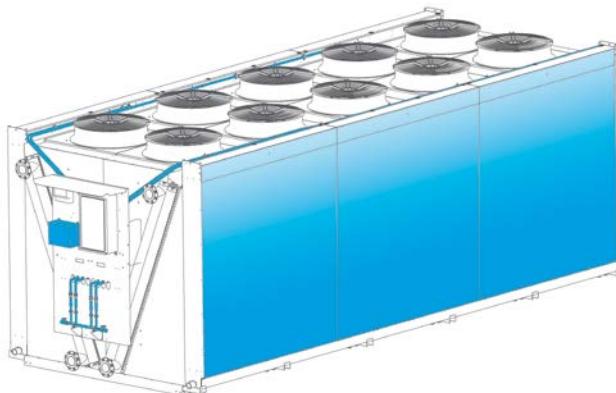
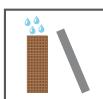


HV

WATER QUALITY

- $6 < \text{pH} < 8$
- Conductivity $< 1500 \mu\text{S}/\text{cm}$
- Chlorides $< 100 \text{ ppm}$
- Hardness $2\text{-}4^\circ\text{f}$
- Water according to EC Directive 98/83
- Total bacterial count $< 1000 \text{ cfu/ml}$

INDUSTRIAL ADIABATIC SYSTEM (PADS) – OPEN CIRCUIT



-  Compliant with VDI 2047 Part 2
-  +42%
-  HIGH
-  No limitation

Sistema di umidificazione dell'aria in aspirazione dell'apparecchio ventilato mediante speciali pannelli adiabatici. I pannelli, posti davanti agli scambiatori di calore a monte del flusso d'aria, sono uniformemente bagnati attraverso un sistema di distribuzione con acqua "a perdere". L'aria, traversando i pannelli, viene umidificata e raffreddata con valori che cambiano a seconda delle condizioni di esercizio.

Inlet air humidification system by means of special adiabatic panels.
The panels, placed in front of the heat exchangers on the air inlet side, are homogeneously soaked through a distribution system with no water recirculation. The air, by passing through the panels, increases its humidity and gets colder depending on the different working conditions.

Befeuchtung der Ansaugluft durch spezielle Befeuchtungsmatten.
Wasser rinnt konstant an den Befeuchtungsmatten, die im Luftausgang des Wärmetauschers platziert sind, herunter und Luft wird so je nach Betriebsbedingung adiabatisch vorgekühlt; das nicht verdunstete Wasser fließt ab.

Le système d'humidification de l'air à l'aspiration de l'appareil ventilé à l'aide de panneaux adiabatiques spéciaux.
Les panneaux, positionnés devant les échangeurs en aval du flux d'air sont uniformément baignés par un système de distribution d'eau (perdue).
L'air, traversant les panneaux est humidifié et refroidi en fonction des conditions extérieures.

AVAILABLE FOR THE FOLLOWING PRODUCT RANGE



Superjumbo



Combo



Tower



Wall

WATER QUALITY

- $6 < \text{pH} < 8$
- Conductivity $< 1500 \mu\text{S}/\text{cm}$
- Chlorides $< 200 \text{ ppm}$
- Hardness $< 25^\circ\text{f}$
- Water according to EC Directive 98/83
- Total bacterial count $< 1000 \text{ cfu/ml}$

 RELATIVE HUMIDITY INCREASE
ERHÖHTE RELATIVE FEUCHTE
ATION DE L' HUMIDITÉ RELATIVE
INCREMENTO UMIDITÀ RELATIVA

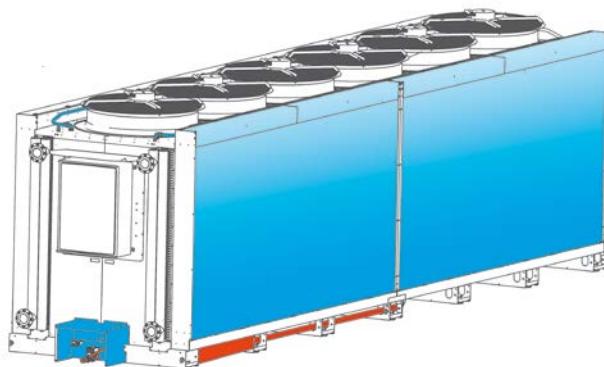
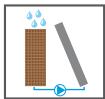
 WATER CONSUMPTION
WASSERVERBRAUCH
CONSUMMATION D'EAU
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REFRION
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INDUSTRIAL ADIABATIC SYSTEM (PADS) - CLOSE CIRCUIT



Inlet air humidification system by means of special adiabatic panels , combined with a water recirculation system. These panels, placed in front of the heat exchangers on the air inlet side, are homogeneously soaked through a water distribution system, designed for water collection and recirculation. The air, by passing through the panels, increases its humidity and gets colder depending on the different working conditions, whereas the water consumption is limited to the water evaporated during the adiabatic process.

Befeuchtung der Ansaugluft durch spezielle Befeuchtungsmatten mit einem Wasserumlaufsystem. Wasser rinnt konstant an den Befeuchtungsmatten, die im Luftansaug des Wärmetauschers platziert sind, herunter und Luft wird so je nach Betriebsbedingung adiabatisch vorgekühlt. Das nicht verdunstete Wasser wird dem Wasserkreislauf wieder zugeführt und der Füllstand ergänzt, der Wasserverbrauch wird so rein auf das verdunstete Wasser beschränkt.

Système d'humidification de l'air à l'aspiration de l'appareil ventilé à l'aide de panneaux adiabatiques spéciaux combinés à un système de recirculation d'eau. Les panneaux, positionnés devant les échangeurs en aval du flux d'air, sont uniformément baignés par un système de distribution avec récupération d'eau. L'air, traversant les panneaux est humidifié et refroidi en fonction des conditions extérieures, et la consommation d'eau se verra limitée seulement à la quantité évaporée.

 Compliant with VDI 2047 Part 2

 +42%

 VERY LOW

 No limitation

Sistema di umidificazione dell'aria in aspirazione dell'apparecchio ventilato mediante speciali pannelli adiabatici abbinato ad un sistema di ricircolo dell'acqua. I pannelli, posti davanti agli scambiatori di calore a monte del flusso d'aria, sono uniformemente bagnati attraverso un sistema di distribuzione con recupero d'acqua. L'aria, attraversando i pannelli, viene umidificata e raffreddata con valori che cambiano a seconda delle condizioni di esercizio, mentre il consumo d'acqua è limitato alla sola acqua evaporata.

AVAILABLE FOR THE FOLLOWING PRODUCT RANGE



Ecooler



Superjumbo



Combo



Tower

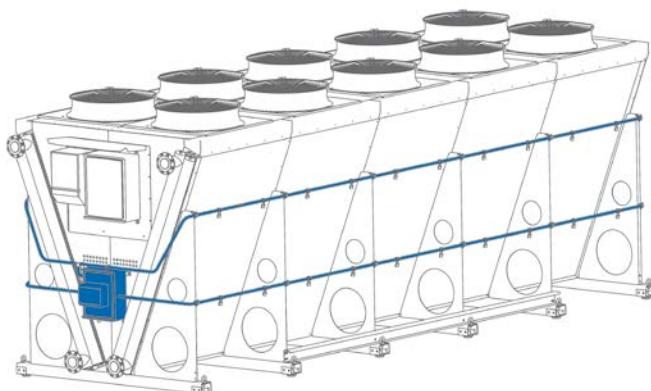


Wall

WATER QUALITY

- $6 < \text{pH} < 8$
- Conductivity $< 1500 \mu\text{S}/\text{cm}$
- Chlorides $< 200 \text{ ppm}$
- Hardness $< 25^\circ \text{f}$
- Water according to EC Directive 98/83
- Total bacterial count $< 1000 \text{ cfu/ml}$

HYBRID SYSTEM



 Under approval

 +50%

 MEDIUM

 1000 hours/year

Sistema di raffreddamento della superficie di scambio dell'apparecchio ventilato mediante nebulizzazione diretta d'acqua. Speciali ugelli diffusori nebulizzano acqua umidificando e raffreddando l'aria in aspirazione; lo scambiatore di calore a pack alettato cede calore sensibile all'acqua nebulizzata incrementando ulteriormente la capacità di scambio termico.

WATER QUALITY

- $6 < \text{pH} < 8$
- Conductivity $< 500 \mu\text{S}/\text{cm}$
- Chlorides $< 50 \text{ ppm}$
- Sulphate $< 50 \text{ ppm}$
- Hardness $< 25^\circ \text{f}$
- Water according to EC Directive 98/83
- Total bacterial count $< 1000 \text{ cfu/ml}$

AVAILABLE FOR THE FOLLOWING PRODUCT RANGE



Superjumbo



Combo



Tower



Wall



HV

COMPARISON CHART

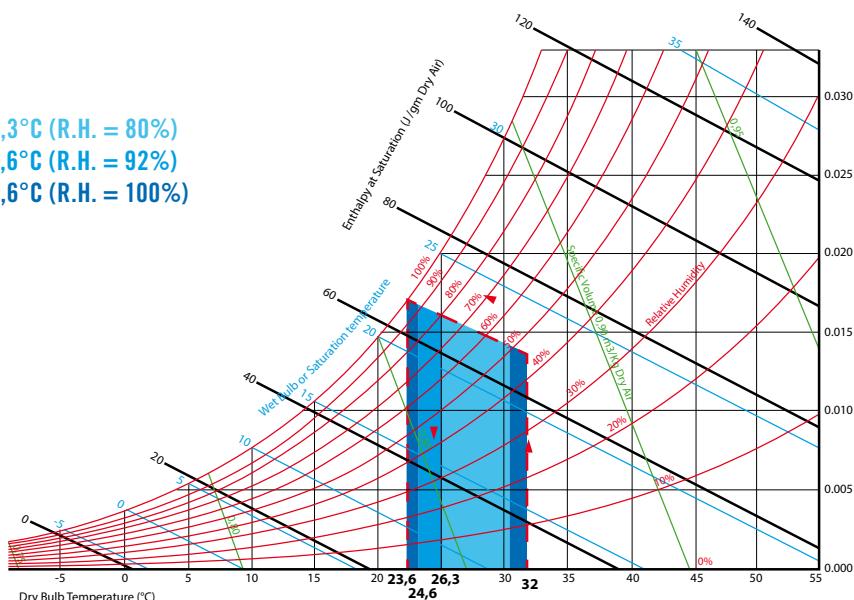
ADIABATIC SYSTEMS

	SPRAY	PADS - OPEN CIRCUIT	PADS - CLOSE CIRCUIT	HYBRID
SATURATION	██████ 80%	██████████ 92%	██████████ 92%	██████████ 100%
INCREASING R.H.	██████ 30%	██████████ 42%	██████████ 42%	██████████ 50%
AIR TEMP. REDUCTION	██████ -5 K	██████ -8 K	██████ -8 K	██████ -10 K
VENTILATION ENERGY SAVING	██████ 2/10	██████ 4/10	██████ 4/10	██████ 5/10
DIRECT ENERGY CONSUMPTION	██████ 1/10	██████ 1/10	██████ 3/10	██████ 1/10
WATER CONSUMPTION	██████ 4/10	██████████ 9/10	██████ 3/10	██████ 5/10
INVESTMENT	██████ 2/10	██████ 5/10	██████ 6/10	██████ 3/10
WATER QUALITY	██████ 6/10	██████ 3/10	██████ 3/10	██████ 8/10
LIMIT OF USE	150 HOURS/YEAR	∞	∞	1000 HOURS/YEAR
HIGIENIC CERTIFICATION	OK	OK	OK	UNDER APPROVAL

THEORY

EXAMPLE:

SPRAY: $T_{AMB} 32,0^{\circ}\text{C}$ (R.H.= 50%) $\rightarrow T_{CALC} = 26,3^{\circ}\text{C}$ (R.H. = 80%)
 PADS: $T_{AMB} 32,0^{\circ}\text{C}$ (R.H.= 50%) $\rightarrow T_{CALC} = 24,6^{\circ}\text{C}$ (R.H. = 92%)
 HYBRID: $T_{AMB} 32,0^{\circ}\text{C}$ (R.H.= 50%) $\rightarrow T_{CALC} = 23,6^{\circ}\text{C}$ (R.H. = 100%)



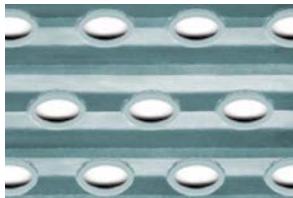
The adiabatic saturation reduces the suction air temperature (respect to the ambient air) and therefore the efficiency of the heat exchanger increases. The adiabatic saturation temperature lowers - since evaporating water removes heat - though it is still higher than the dew temperature, as evaporation itself raises the partial pressure of water vapour. Thanks to Refrion's systems, the adiabatic saturation guarantees an increase of the relative humidity up to the whole saturation of the air (R.H.=100%).

Das Erhöhen der Luftfeuchte - der adiabatischen Sättigung - reduziert die Lufttemperatur und erhöht die Leistung des Wärmeaustauschers. Die adiabatische Sättigungstemperatur fällt, weil verdampfendes Wasser Wärme abführt, bis hin zur Taupunkttemperatur. Die Arten der adiabatischen Kühlsysteme von REFRION erlauben das Erhöhen der Luftfeuchte bis zu einer Gesamtsättigung der Luft (100% r. F.).

Par l'effet de la saturation adiabatique on obtient une baisse de la température d'air avec la conséquente augmentation de l'efficacité de l'échangeur. La température de saturation adiabatique sera inférieure à celle de départ car l'évaporation absorbe la chaleur; celle-ci est cependant supérieure à la température de rosée, et donc la même évaporation augmente la pression partielle de la vapeur d'eau. La saturation adiabatique, obtenue par les systèmes Refrion, permet d'obtenir une augmentation de l'humidité relative jusqu'à la saturation totale de l'air (HR=100%).

Per effetto della saturazione adiabatica si ottiene un abbattimento della temperatura dell'aria con il conseguente aumento dell'efficienza dello scambiatore. La temperatura di saturazione adiabatica risulta inferiore a quella iniziale poiché l'acqua che evapora sottrae calore; essa è tuttavia superiore alla temperatura di rugiada, in quanto la stessa evaporation innalza la pressione parziale del vapore acqueo. La saturazione adiabatica, resa possibile dai sistemi di Refrion, permette di ottenere un incremento dell'umidità relativa fino alla saturazione totale dell'aria (R.H.=100%).

PROTECTION COATING



Pre-painted hydrophilic coating

- High surface tension: it gives the drops of water wetting the fin a flattened shape (contact angle > 15°).
- It favours circulation and the adiabatic saturation of the air.
- Corrosion resistance (ASTM B117): 250 hours.



Pre-painted hydrophobic coating

- It gives the drops of water wetting the fin a spheroid shape (contact angle > 50°). for easier draining.
- Corrosion resistance (ASTM B117): 1000 hours.



Thermoguard®

- Polyurethane based coating.
- High flexible properties.
- Heat conduction and UV resistant properties.
- Prevents chemical and galvanic corrosion.
- Corrosion resistance (ASTM B117): 3000 hours.



Blyhold®

- Heat conductive pigmentation.
- Very high chemical resistance at a low layer thickness.
- Corrosion resistance (ASTM B117): 4000 hours.



ElectroFin®

- Suitable for marine and salt air environments.
- Withstand exposure to an extensive variety of corrosive and chemical fumes.
- Corrosion resistance (ASTM B117): 6000 hours.



Heresite®

- Water-based, flexible cationic epoxy polymer using an electro-coat process.
- It guarantees complete heat exchanger coverage.
- Corrosion resistance (ASTM B117): 6000 hours.
- C5M & C5I High Durability (ISO 12944).

V - UV LAMP FOR ADIABATIC SYSTEM



The UV lamp sterilizes the water in the adiabatic system (UV-C rays = 254 nm) emitting UV rays lethal to pathogens (including Legionella), providing an alternative effective solution to chemical biocides.

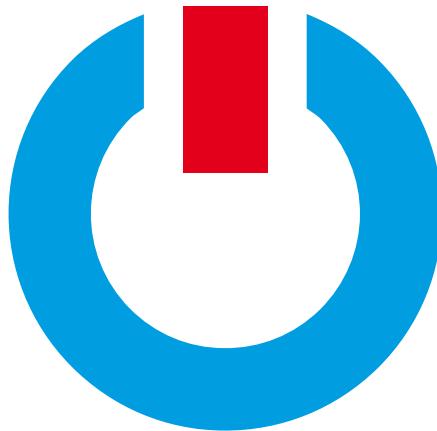
Sterilisierung des Wassers der adiabatischen Vorkühlung durch eine Lampe, die UV-Strahlen aussendet (UV-C Strahlen = 254 nm), um Krankheitserreger (einschließlich Legionellen) abzutöten - eine effiziente Alternative zum Einsatz von chemischen Biociden.

Elle permet de stériliser l'eau du système adiabatique par le biais d'une lampe qui émet des radiations ultraviolettes (rayons UV-C = 254 nm) letales pour les agents pathogènes (y compris la bactérie Legionella), offrant ainsi une solution alternative efficace aux biocides chimiques.

ADDITIONAL RECOMMENDED WATER QUALITY REQUIREMENTS

- Fe < 0.3 ppm
- Hardness <12 °f
- S.A.C. (Spectral Absorption Coefficient) > 20 1/m

Permette la sterilizzazione dell'acqua del sistema adiabatico per mezzo di una lampada che emette radiazioni ultraviolette (raggi UV-C = 254 nm) letali per agenti patogeni (incluso il batterio della Legionella), offrendo un'efficace soluzione alternativa ai biocidi chimici.

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