System description / Specifications

Cooling tower series KRH hybrid recooler for closed circuit with radial fans

comprising:

**Housing and steel internals**
The housing and the water collecting tank form a completely assembled unit. It is made of 2 mm-thick stainless steel sheet. The chamfered metal sheets are sealed twice with permanently elastic material and connected with the help of stainless steel screw connections with washers on both sides. In order to increase the surface pressure of the sealing system uniformly KTK stainless steel profile sections are fitted to the flanged housing connections.
The bottom of the water collecting tank is designed with a 2% slope to provide residual drainage or a cooling water outlet nozzle at the lowest point of the basin. This prevents puddles remaining when the basin is drained and harmful bacteria collecting during idle times.
The cooling tower can also be erected on a concrete basin designed as a water collecting tank (not included in the KTK scope of delivery). In this case the cooling tower is open at the bottom across its entire cross section.
An adequately dimensioned inspection opening is located at the rear side of the cooling tower. A conical adapter is fitted between the fan and the cooling tower housing ensuring a sufficiently large distance between the wet area and the fan impeller.

Material: stainless steel, 2 mm thick

**Optional: Fused design**
The metal sheets are fused together in a specially developed welding procedure. Fusing the individual metal sheets in the area in contact with water creates a permanent seal for the cooling tower casing which is laid over with a seal of plastic sealing material and from which dirt can be easily cleaned as required.

**Heat exchangers**
The heat exchangers arranged in the casing consist of copper pipes with smooth aluminium fins arranged in the stainless-steel frame.
The fins have a 2.1mm spacing and are provided with a hydrophillic coating.
The distributors and collectors of the heat exchangers are given non-rusting PN 10 flange connections in accordance with DIN EN 1092-1.
The heat exchangers are produced in accordance with Directive 97/23/EC (Pressure Equipment Directive and tested with a minimum testing pressure of 16 bar gauge.

**Cold wayer connections**
The distributors and collectors of the heat exchangers are given non-rusting PN 10 flange connections in accordance with DIN EN 1092-1, and are fed from the cooling tower wall as a cold water connection.

**Low-pressure high-performance spraying system**
The system comprises horizontally installed stainless steel tubes to which axial hollow-cone nozzles are fitted with the help of mounting clamps. These nozzles provide for fine and uniform humidification of the heat exchangers even with a low inlet pressure between approximately 2 and 5 bars. The nozzle sets are fixed with spigot nuts in the mounting clamps and therefore easy to replace.
The control of the water volume applied to the fin surface is regulated by motorised fittings that are fitted in the supply tubes and release individual areas of the heat exchanger core for water application depending on the current performance requirements. The entire tube system is slightly sloped to ensure that all water runs off through the drain valve to prevent frost damage in wintertime. The supply line to the re-cooling unit should also be laid with inclination and fitted with a drain facility (not included in the scope of delivery). A pre-filter protects the spraying system against the penetration of dirt.

In order to prevent deposits caused by the complete evaporation of the spraying water osmotic water or water of a corresponding quality (conductivity below 100 µScm) should be used for spraying. Including monitoring of the spray pressure, control valves and manually operated drainage valve.

*The spraying system is designed without recirculation for hygienic reasons*

**Fans**

We use double-active low-pressure high-performance fans with forward curved blades of sedzimir-galvanised blades. The fans are distinguished by a high efficiency and low-noise operation. The fans are designed as standard with galvanised casings. Connection frames and bearing struts of galvanised steel with a C4 coating. The cylindrical impellers are statically and dynamically balanced. The fan shaft is made of steel with an additional corrosion protection and runs in grooved ball bearings which are protected against dust and humidity by means of labyrinth seals.

Subsequent greasing is no problem thanks to corrosion-resistant lubricating lines. Bearings are maintenance free up to series 12-18.

**Optional: Stainless-steel fan casings**

**Drive**

The radial fans are driven via small-section V-belts by self-cooling IEC squirrel cage motors, protection IP 55 minimum, type of construction B3. All motors are fitted with PTC sensors to protect the motors against overheating. Motors with direct cooling are not permitted. We use single-speed motors suitable for FC triggering or (on request) Dahlander motors for two-speed operation. The motor is mounted in a horizontal position on an easily adjustable motor slide base of stainless steel fitted on top of the fan socket. Therefore, the motor is well accessible for maintenance operations. The tension of the V-belt can easily be adjusted via a central adjusting screw.

The rotary parts of the freely accessible fans are covered with protective grilles of galvanized steel in compliance with accident prevention regulations.

The supports fitted to the motor ensure stability when the fixing screws are loosened.

All pulleys are made of wear-resistant cast steel and fixed with easily removable taper lock bushes to facilitate repair.

Each fan is driven by a separate motor. In the event of a motor failure in multi-cell cooling towers, the remaining fans keep on running thanks to their dedicated drive. This concept ensures a higher operational safety of the re-cooling system. And if repair is required, the individual single motors are easier to remove and handle due to their lower size. There are no special space requirements for maintenance, e.g. the removal of a shaft.

**Fan-casing**

The stainless steel casing is matched to the cooling tower structure and fitted with inspection openings sufficiently large for maintenance operations.
Supply and exhaust air sound absorbers
The stainless steel casing is matched to the cooling tower structure. The noise damping screens are designed according to the principle of absorption. They are made of seawater-resistant perforated aluminium sheets combined with laminated mineral wool wrapped in abrasion-resistant, moisture-proof and rot-resistant film.

Top-aspirating cooling towers
With cooling towers aspirating at the top, an air feed is integrated between the splitters in the exhaust muffler to prevent an air short circuit in the exhaust area.

Exhaust air maintenance duct
The exhaust air maintenance duct of stainless steel is matched to the cooling tower structure and fitted with an inspection opening which is sufficiently dimensioned to allow inspection and maintenance operations on the spraying system.

Protective grilles including bird protection grilles
Cooling towers with encased fans or supply and exhaust air sound absorbers are not fitted with protective grilles but bird protection grilles only. The latters are made of stainless steel with a mesh width of 25 mm and mounted to the inlet and outlet openings of the tower. The outer dimensions of the cooling tower remain unchanged. The protective grilles cannot be accessed.

Material of protective grilles: galvanized steel
Material of bird protection grilles: stainless steel

Switch cubicle design:
Hersteller Rittal
Material Edelstahl
Design Two-door or
or single-door opening to the top.
Gas springs keep the door in a horizontal position.
It serves as a shelter when open.
Schutzart IP56
Kabeleinführung von unten / Kabelverschraubung

Electrical equipment
Ventilation control cabinet Rittal
Heating control cabinet Rittal
Lighting control cabinet Rittal
Clamps Wago
Switching devices Siemens
Protective devices Siemens
Frequency converter SEW or comparable quality
Frequency 16kHz

PLC (CPU) Siemens S7
Digital inputs/outputs Siemens S7
Analog inputs/outputs Siemens S7
Operating panel Siemens
Sensor technology IFM
Protection of electrical equipment:
All electrical equipment is protected by suitable protective devices. All fuses are fitted with auxiliary contacts, monitored and represented on the display. They are linked to the centralized alarm of the corresponding fan or the general centralized alarm.

Communication with the control & management system:
Connection to control technology by means of profinet or modbus TCP/IP (included).
Input signals to the cooling tower
- External release signal
- Digital switching between zero-potential
- 2 temperature - target values
  (e.g. KM running/free cooling)

Output signals
- Plant-ready-for-operation signal
- Plant-in-operation signal
- Plant-failure signal
- Wet-mode signal
- Dry-mode signal
- External temperature reporting low -
- Frost risk, spraying off
- Lack of spray water report
- External drainage valve activation
  zero-potential

Programming and documentation software
Language: German
Electrical distribution and installation diagram
PLC, control panel programming: Software Siemens TIA in FUP, KOP, AWL, SCL

KTP600 control panel:
The control panel has the following setting options.

Input:
- Cooling water outlet temperature target value, 2 x
- Offset cooling water outlet temperature
- PID setting parameters
- Times for setting the control process and adjusting to local conditions
- Night-time reduction speed limit input
- Input of frost warning parameters
- Input of parameters for spraying drainage monitoring
- Input of spray pressure monitoring parameters
- Setting of date and time

Status display:
- Cooling tower cooling water outlet temperature
- Spray pipe water pressure
- Switching status of the spray valve
- Frequency converter status
- PID regulation status
Manual operation:
- Operating mode selection, manual – off – automatic
- Switching the spray valves on and off
- Connecting the frequency converter
- Target frequency specification

Malfunctions:
- All malfunctions are displayed in clear text with date and time

Message log:
- Ring memory for accrued messages and malfunctions for analysing systems

Password protection of the operating panel:
The operating panel provides for multi-user operation. Password protection allows each user to prevent unauthorized manipulation.

Functional Description:
Start-up and shut-down of the system:
The system's main switch is fitted to the distribution frame door at the switch cubicle. It is used to switch the power supply of the entire cubicle on and off. The system is set by the display's stored start command to active mode. Once external release is activated, the system is in control mode.

Automatic control system:
If the actual temperature exceeds the set target temperature, the SPS regulates the speed of the drives independently of the outlet temperature. Frequency converters that receive the setting signal from the PLC are used for regulating the speed. Where the maximum speed for the fans is insufficient for maintaining the target temperature, the system is set to spray mode. Provided that the spraying pressure is available on the system, the first spraying stage is opened and regulation is optimised by an internal control algorithm to minimise output temperature fluctuations. The lack of spray water is shown by the spray pressure monitoring device on the display and via external signal transfer. Further spraying stages are switched on where the target temperature is not reached.

To ensure spraying is protected against frost, the external temperature is continually monitored, and where the parameters are fallen short of, the frost warning is shown on the system display and via the external signal transfer. Where the pressure drops in the external supply, the spray valves are opened and the system's spray supply drained. In the event of pressure in frost protection mode, a fault message is issued after the set monitoring period that acts as a signal that the external spray supply has not been drained properly by the building automation.

 Interruption of the operation:
If the external release signal is interrupted for any reason, the cooling tower system switches to stand-by mode.
Stopping the plant via the operating panel shuts down the system and the external release signal no takes longer effect.

System protective functions
Before activating the fans after a power failure, power sag, phase error or the external release being switched on or off, the system is checked for kinetic energy. The check runs at an optimised fan speed so as there is no system failure.
The system control power is monitored by diagnosis modules, and corresponding electrical circuits are restricted and, where applicable, switched off to provide protection. Operation is maintained once monitoring has been activated with non-relevant system parts.
Options (for an additional cost)
Monitoring of:
In order to protect the cooling tower from deposits, the water quality is constantly controlled by measuring conductivity. A message is created if the limit is exceeded.

Connection to control technology
Possible bus systems/protocols
- Siemens MPI
- Profibus-DP
- Profibus FMS
- Profibus Profil GA2.0
- MODBUS RTU
- BACnet
- M-Bus
- LONTalk Echelon
- EIB/KNX USB
- EIB/KNX Seriell
- Kieback&Peter P90
- Kieback&Peter P90 GLT
- Allen-Bradley DF1
- SAIA S-Bus
- IEC 60870-5-104

System with stricter hygienic requirements (optional - for an additional cost)
Where increased hygienic requirements are placed on the device, for example due to where installed, KTK recommends the use of water treatment that is low in dead zones and fitted with a multi-barrier system. KTK supplies an additional barrier, a police filter mounted directly on the recooler. This holds back bacteria contained in the spray water. In addition, the spraying system is operated in such a way that during periods of low spraying it is repeatedly flushed through. Repeated spraying minimises the risk of the spray water becoming contaminated, and the device is continually kept free of fine contaminants. This increases the efficiency of the device.

Description of the spraying system:
The device is fitted with a highly efficient and particularly hygienic spraying system. This consists of
a) a straight-way ball valve (for shutting off),
b) a Y-type valve (for regulating the amount of water),
c) a police filter with a pore width of 0.2 μm,
d) an option for manually draining the spraying system into tank,
e) pressure monitoring that identifies whether the spray pressure is sufficient,
f) two or more motorised ball valves for gradually switching spraying on and off, and
g) two spray lances with spray nozzles.
All spraying system pipes are sloped so that, as required, they can be completely drained via the police filter (d) drainage system. The installation has particularly few dead spaces. The spraying system is of particular significance for the hygienic operation of the recooler.

Alterations and/or changes to the spraying system are not permitted.

Pressure monitoring:
The spraying system pressure is monitored during spraying. Pressure monitoring is triggered if the spraying pressure is 0.5 bar lower than the target value. The causes for this may be, that
a) there is no spraying pressure available at the site,
b) the straight-way valve is closed,
c) the Y-type valve is closed,
d) spray nozzle inserts are missing,
e) the spraying system has a leak,
f) drainage on the police filter is not closed
or
g) the police filter is full.

Pressure monitoring is triggered if the spraying pressure is 0.5 higher than the target value. The causes for this may be, that
a) the spraying pressure available at the site is too high,
b) the y-type valve is not properly calibrated,
c) spray nozzles are blocked,
d) pipes past the pressure monitoring device are blocked,
or
e) the police filter is damaged.
In this way, the pressure monitoring device also monitors the functionality of the police filter. **Spraying may not be used without a functional police filter, or with one that is not hygienically perfect.**

**Restraining system (optional - for an additional cost)**

**Functional description:**
The tank for a 'dual system' type recooler can also be fitted with a restraining system. In the event of damage to the heat exchanger, the restraining system prevents leaking liquid from entering the drains.

As an option, the content of connected pipes can also be accepted. The maximum that can be taken is to be agreed accordingly.

The restraining system contains a device for monitoring the pressure of the cooling circuit and a motorised ball valve at the output of the collection tank and the corresponding control unit. In normal operation, excess spray water and rainwater is collected by the collection tank and fed into the drains via the open ball valve.

Where a leak in the cooling water circuit is detected by the pressure sensor, the ball valve is closed and locked by the control unit. An alarm signal is issued by the control unit. The operator must dispose of the liquid professionally. Release on the control unit can only occur after this.

Fill level monitoring is also in the scope of delivery for monitoring the collection tank. An alarm signal is also issued by the control unit if a higher tank fill level is signalled (e.g. by a blocked outlet). The operator must check the type of liquid in the tank and, where applicable, dispose of the liquid professionally. Release on the control unit can also only occur after this.

The pressure sensor required for detecting leaks is to be installed **by the site** in the outlet pipe after the recooler.

**Communication with control technology**

**Output signals:**
- Heat exchanger leak alarm: zero-potential
- Check run off/retraining system alarm: zero-potential
- Or motorised ball valve malfunction: zero-potential

**Options:**
- Additional cost for UPS for motor ball valve activation and internal 24V supply
Performance data for __ KAHV type cooling tower _______

<table>
<thead>
<tr>
<th></th>
<th>Operating mode</th>
<th>Wet mode</th>
<th>Dry mode</th>
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<tr>
<td>Volumetric flow with ____ % water/ethylene glycol</td>
<td>____</td>
<td>____</td>
<td>m³/h</td>
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<tr>
<td>discharged heat</td>
<td>____ kW</td>
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Performance data for each cooling tower

<table>
<thead>
<tr>
<th></th>
<th>Operating mode</th>
<th>Wet mode</th>
<th>Dry mode</th>
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<tr>
<td>Volumetric flow with ____ % water/ethylene glycol</td>
<td>____</td>
<td>____</td>
<td>m³/h</td>
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<tr>
<td>Inlet temperature</td>
<td>____ °C</td>
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<td>Outlet temperature</td>
<td>____ °C</td>
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<tr>
<td>discharged heat</td>
<td>____ kW</td>
<td></td>
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Ambient air temperature          | ____ °C        |          |          |
Wet bulb temperature             | ____ °C        |          |          |
Max. spray water requirement at design point | ____ m³/h |          |          |
Max. required nozzle pressure     | ____ bar       |          |          |
Pressure loss in heat exchanger  | ____ bar       |          |          |

Technical data for each cooling tower

<table>
<thead>
<tr>
<th></th>
<th>units</th>
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<tbody>
<tr>
<td>Fin heat exchangers - number</td>
<td>____</td>
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<tr>
<td>Content per fin heat exchanger</td>
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<tr>
<td>Number of fans</td>
<td>____ units</td>
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<td></td>
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<tr>
<td>Shaft output per fan</td>
<td>____ kW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shaft output per cooling tower</td>
<td>____ kW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of drive motors</td>
<td>____ units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated output for each motor</td>
<td>____ kW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated output for each cooling tower</td>
<td>____ kW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection class</td>
<td>IP 55</td>
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<tr>
<td>Operating voltage</td>
<td>400 V, 50 Hz</td>
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<tr>
<td>Tolerance</td>
<td>± 5 %</td>
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Noise details for each cooling tower

Noise pressure level at a distance of 15 m in the open | ____ | ____ | dB(A) |
Noise measurement in accordance with DIN 45635 - 01 - KL2, cuboid enveloping surface

Acoustic power level: | ____ | ____ | dB(A) |
Determination in accordance with DIN EN ISO 3744

Dimensions + weights for each cooling tower

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<thead>
<tr>
<th></th>
<th>mm</th>
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<tbody>
<tr>
<td>Length</td>
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<td></td>
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<tr>
<td>Width</td>
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<tr>
<td>Approx height.</td>
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The exact rated values for the water connections are determined in the event of an order.

Net weight | ____ kg |
Operating weight | ____ kg |

each cooling tower is fitted with:
1 Laterally aspirating fan casing
1 Inlet sound absorber, incl. stainless steel bird protection grille, screen type
1 Outlet sound absorber, incl. stainless steel bird protection grille, screen type
1 Outlet duct with inspection hatch

Fixtures for each cooling tower
Requirements on quality of the spray water with dual recooling plant operating in wet/dry mode

Limits for quality of recooling spray water
The requirements of quality placed on the spray water correspond to those for water after reverse osmosis treatment. As the water on the heat exchanger surface almost completely evaporates, the spray water must be particularly pure to prevent deposits of the heat exchanger surface.

We recommend permeate as additive. We recommend monitoring the hardness value after the osmosis system.

Spray water:
- Conductivity: < 30 µS/cm
- pH value with aluminium fins: 6.5 - 8.2
- pH value with copper fins: 7.0 - 9.0
- Iron: < 0.1 mg/l
- TVC: < 10,000 /ml
- Legionella: < 100 TVC /100 ml

Required input pressure for the spray system: 3.5 bar

General instructions for operating the reverse osmosis facility:
(The requirements of the manufacturer of the reverse osmosis facility take precedence over this instructions and must be complied with)

During extended periods of the reverse osmosis facility not being used, suitable measures are to be employed to ensure that increased levels of bacteria do not occur in the osmosis facility. The permeate can remain in the permeate tank if the permeate is ‘run’ through the reverse osmosis on a regular basis (e.g. once a week for 2 hours). Alternatively, the reverse osmosis needs to be conserved and the permeate either drained or regularly treated with biocide.
The addition of biocidal products should be tested in each individual case and is in line with the biological load.