Type	Shell and tube heat exchangers - Operator instructions
Technical support	Niko Ojapalo
Heat pump types	S series

DESCRIPTION

Shell and tube heat exchangers general guidance

the water filters used on our evaporators, have to be in accordance with applicable technical regulations. The maximum spacing between the wires of the mesh has to be 0.87 mm.

Cleaning water side circuit

- Totally drain the heat exchanger before doing any maintenance operation.
- Do not clean any part of the unit with not-suitable mechanical systems, e.g. drills or too high-pressure jets.
- Do not use any aggressive chemical detergents and verify their compatibility with the materials of construction before handling, especially with the copper.
- We cannot recommend a specific chemical product since we cannot be responsible for cleaning operation. Customer or the responsible of cleaning and maintenance have to ask the supplier of the cleaning products for the compatibility with the copper and other materials before using them.
- If the water circulates inside the copper pipes, we suggest using plastic pipe cleaners with water to remove fouling inside the tubes.

E.g. 

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Water side circuit – Information as to protection and routine checks

Acceptable water quality limits:

pH (25°C)	6.8 – 8.4
Electrical conductivity (25°C)	< 800 µS/cm
Chloride ion	< 150 mg Cl^-/l
Chlorine molecular	< 5 mg Cl2/l
Sulphate ion	< 100 mg SO_4^{--}/l
Sulphide ion	none S^{--}/l
Sodium nitrate	< 100 mg NaNo3/l
Alkalinity	< 100 mg $CaCO_3$/l
Total Hardness	< 200 mg $CaCO_3$/l
Iron	< 1.0 mg Fe/l
Copper	< 1.0 mg Cu/l
Ammonium ion	< 1.0 mg NH_4^+/l
Silica	50 mg SiO_2/l
Dissolved Oxygen	< 8 mg/l
Maximum particle size to pass through heat exchanger (filtration limit)	0.87 mm
Total dissolved solids	< 1500 mg/l
Maximum glycol concentration	50%

Good practice when emptying the water side circuit

Every time the Heat exchanger is emptied of water or glycol solution (inspection, storage, commissioning, and maintenance) it should be dried, all the connections capped and purged with nitrogen.

When using glycol in water circuit

• Water-glycol mixture with the passing of time decays and it gives rise to acid products that can start corrosion processes. Also, the degradation of products in the water-glycol mixture may allow biological proliferation and thus bacteria formation can give rise to corrosion. For these reasons, glycol has to be used with suitable corrosion inhibitors.
• The corrosion inhibitors have a lifespan (1 or 2 years), so it is important to periodically verify the percentage of the water-glycol mixture.
• Inhibitors may become insufficient due to “top ups” of water in the circuit; if water is added to the mixture due to low level, the percentage of glycol must remain as per requirements therefore the correct quantity of glycol should also be integrated.
• The parameters to be checked regularly are the antifreeze concentration and the pH of water-glycol mixture. In the following table we summarize the parameters to be monitored periodically:

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Quality control of water-glycol mixture		
Parameters	Periodicity	Value
Concentration of glycol	3 months	Always equal to requirement depending on working conditions but never less than 20%
pH	3 months	Never less ~7 and never less than one unit of starting value of wa-ter-glycol mixture
Water quality limit	6 months	Not to exceed values in table on point n.1

We recommend asking to the glycol producer for different ways of quality checking.

General information with other fluids

- Ethyl alcohol: C2H5OH or C2H6O or EtOH does not create any problem to copper.
- De-ionized water: If it is in a closed circuit there are not problems with copper or CuNi90/10. At first there will be a slight surface corrosion; as soon as oxygen is consumed corrosive attack stops.
- Calcium chloride: CaCl2 does not create any problem with copper if it is in a closed circuit.
- Soft water: Copper can be used with low ion concentration water (like process water and not potable water) even with 0 °fH = 1 ppm = 1 mg CaCO3/l. Soft water increases copper solubility due to a surface corrosion process, therefore is not likely any kind of local corrosion and pitting. Care has to be taken on open circuit where electrochemical corrosion can affect other metals less noble than copper.
- Glycerol: Water + glycerol mixture does not create any problem to copper.
- Potassium formate: CHKO2 does not create any problem with copper if 8<pH<pH; if there are uncertainties on pH value therefore CuNi or stainless-steel bundle is preferred.
- Calcium nitrate: Ca (NO3)2 does not create any problem with copper even at high temperatures; however, has to be guaranteed 7< pH < 8.4 and no presence of ammonium compounds in the solution.

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Technical Information		
Subject	Recommendation for the sustainability of Copper and CuNi Tubes within water content substances	2017-10-27

The following table gives some recommendations for the use of Copper and CuNi tubes with water and its different contents. These values are recommendations but corrosion is a complex chemical process, which is influenced be different parameters besides the given parameters.

	Concentration [-] bzw. [mg/l]	Copper Cu-DHP, K21, C12200	CuNi CuNi10Fe1Mn, L10, C70600
pH-Value	< 6	0	+
	6 – 8	+	+
	> 8	+	+
Chloride (Cl^-)	< 10	+	+
	10 – 100	+	+
	100 – 1000	+	+
	> 1000	0	+
Sulphate	< 50	+	+
	50 – 200	0	+
	> 200	-	+
Nitrates	< 100	+	+
Free & aggressive Carbonic Acid	< 5	+	+
	5 – 20	0	+
	> 20	-	0
Oxygen	< 1	+	+
	1 – 8	+	+
	> 8	0	+
Ammonium	< 2	+	+
	2 – 20	0	0
	> 20	-	-
Ferric und Manganese	> 1	0	+
Sulfides		-	-
Free Chlorine	< 5	+	+
deposable Substances		0	0

Legend:
+ Typically good resistance against corrosion
0 Corrosions might occur, especially if more than once "0" was chosen
- The use is not recommended Comments:
pH= 7,0 – 7,4 und TOC > 1,5 mg/l is critical

THE INFORMATION ABOVE IS ONLY ADVISE (BASED ON MANUFACTURERS EXPERIENCE) TO OUR CUSTOMERS TO PRESERVE THE INTEGRITY OF THE TUBE BUNDLE FROM CORROSION / EROSION ACTION AND MANUFACTURER DOES NOT ASSUME ANY RESPONSIBILITY FOR ANY DAMAGE THAT MAY HAPPEN TO THE HEAT EXCHANGER DUE TO ENVIRONMENTAL FACTORS AND / OR MATERIALS CONTAINED IN WATER SIDE CIRCUIT.

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