SOLID AIR RECOMMENDATIONS FOR WATERQUALITY

Our recommendations should prevent two main possible phenomena: corrosion of copper tube (UNS C12200) during years of service and absence of significant limescale ($CaCO_3$ and $MgCO_3$). Recommendations are:

Based on analysis of numerous literature and are valid for the conditions of 1 °C - 90 °C operating temperature with occasional short (1 - 2 days) periods of stagnation.

Details about the parameters can be found at the bottom of this page.

An important note is that most of the values below are not absolute, but if directive must be used, namely small derogations (up to ~ 10 %) are allowed and will not cause the failure of the unit, but the overall results should aim for the values below. The only exceptions are the values defined as mandatory (a).

Parameter		Units	Copper C12200
Name	**Designation**		
pH	**pH**	ppm	7,5 - 8,5
Ammonia	**NH_4^+**	ppm	< 5[a]
Sulfide	**S^{2-}**	ppm	0[a]
Bicarbonate	**HCO_3^-**	ppm	70 - 150
Carbon dioxide	**CO_2**	ppm	< 15
Chlorine	**Cl_2**	ppm	< 0,2
Suspended solids		ppm	< 15
Oxygen	**O_2**	ppm	< 0,1
Chloride	**Cl^-**	ppm	< 100
Sulfate	**SO_4^{2-}**	ppm	< 50
Total iron (dissolved)	**Fe**	ppm	< 0,2
Manganese	**Mn**	ppm	< 100
Total hardness		ppm $CaCO_3$	30 - 120
Total number of bacteria	**TBC**	CFU[b]/ml	< 1,000
Sulfate reducing bacteria	**SRB**	CFU[b]/ml	0[a]

(a) Obligatory.
(b) Colony-forming units (viable cells) - unit of measurement of microorganisms.

EXPLANATION AND CLARIFICATION OF THE ABOVE LISTED VALUES AND PARAMETERS:

PH:
Copper tends to form a stabilized protective layer in a slightly alkaline solution (above 7 PH). Too high PH promotes the formation of flakes and is not recommended.

Ammonia:
Ammonia should be avoided as much as possible because it is corrosive to copper.

Sulfide:
Sulfide is very aggressive to copper and should be completely avoided.

Bicarbonate:
Bicarbonate promotes the formation of a protective layer. Without it, the copper is still protected, but the addition of Bicarbonate improves the protective layer. Above a certain range the Bicarbonate is aggressive to copper.

Free carbon dioxide:
Free carbon dioxide is dangerous for copper because it forms carbon dioxide and the limit concentration is 15 ppm.

Chlorine:
Aggressive to metals and should be limited to the 0.2 value.

Suspended Solids:
Should be limited as this can cause pollution and local attack in both promotes metals.

Oxygen:
At high temperature, oxygen accelerates corrosion in metals and should be kept to a minimum.

Chloride:
Can cause corrosion and should be limited in copper.

Sulfate:
Copper is very sensitive to sulphate, much more than to chlorides, so the permissible level concentration is smaller than with chloride.

Total iron (dissolved):
Corrosive to copper (oxidizing copper) and should be limited in copper.

Manganese:
Can cause pitting corrosion in copper and should be limited.

Total hardness:
To prevent deposits, the total hardness must be 30 - 120 ppm $CaCO_3$.

Total number of bacteria (TB) and sulphate reducing bacteria (SRB):
In any cooling water system there is a danger of microbiologically induced corrosion (MIC). TB shows the general presence of microorganisms, and their amount should be < 1,000. The most dangerous type of microorganisms for metals is SRB, hence their amount should be zero.