Special steel is generally regarded as stainless and is regularly used as such. But this disregards usually a number of several items. The great mistake consists in the assumption made very frequently that special steel is good for everything. The opposite is the case, especially in the application of heat exchangers. In the segments of tube bundles and panels in heat exchangers this mistake has some fatal consequences if certain rules are not met.

Lack of wide-spectrum properties

Special steel has not wide-spectrum properties in terms of the variety of corrosion types. However, particularly in heat exchangers you should be aware of various load types in this connection. Let us put the three major ones in a list.

- Stress crack corrosion. This is a type of corrosion attack against which special steel is generally very well applicable.
- Vibration crack corrosion. As special steel tubes are subject to very thin wall thicknesses, in comparison to copper or some special brass types, these are subject to defined points of weakness if tubes or plates of larger sizes are poorly clamped.
- Pitting. This is the most severe shortcoming of special steel in general. The pitting rate of stainless steels ranges, on average, above 100 mi crons per annum, in a very critical segment. The pitting rate of special brass is around 150 microns per annum. The pitting rate for special steel, just like that of Cu-Ni alloys, should be regarded as very critical at water flow rates <1,0 m/s.

Above 1.5 m/s water flow rate, special steel can be used also with industrial water or sea water. This is the value that should be regarded above all in the application of panel-type heat exchangers because this type of construction counteracts a high water flow rate by parallel connected plates. This disadvantage has no effect in serial connection. For tubular heat exchangers, the rate needed can be achieved by proper regulation.

What water quality is required ?

To ensure smooth operation of both tubular and panel-type heat exchangers, the following general rules should be applied:

- The water should be filtered and possibly not contain any solids.
- The chloride content should not exceed 80 – 120 mg/l.
- The water flow rate should not fall below 1.5 m/s.

In cooling circuits, the following problems should be considered. As a certain water volume tends to evaporate through cooling towers, the volume lost should be refilled. Evaporation always loses pure water, while the ingredients are left within the system.

After extended cycles, the ingredients will accumulate again and may cause a dangerous water quality. Various water analyses have shown chloride contents of 1200 … 2800 mg/l. In such cases, it has been observed that tubes and plates made of stainless steels were destroyed by pitting.

The most important items to regard when using special steel

- The water should be filtered and possibly not include any solids,
- The chloride content should not exceed 80 … 120 mg/l.
- The water flow rate should not fall below 1.5 m/s.
- On the water side, do not use a 3-point regulation.
- The regulation should be designed as a 2-point control ON/OFF. Take the “standing water” into account.
- Tubular heat exchangers at low water flow rates should be installed vertically with water connections pointing down.
- Avoid standing water in the heat exchanger.
- For large heat exchangers, the oil side should be controlled so that the water side can be operated at constant volume.
- Avoid stainless steels in sea or mixed water applications, because the build-up of a top layer in the tube cannot be controlled.
- The water flow rate should not be interrupted because any protective layers that may have built up on the inner wall might break down.

To be on the safe side, the use of special steel should be waived completely in industrial water.