

Thermodynamics and Catalysis in Cooling Water Circuits

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Abstract:

Almost every chemical process involves at least one cooling step. The engineers have developed a wide range of cooling technologies for rising the efficiency of the production process.

In cooling water circuits, the energy transfer is a result of the partial evaporation of water. This is accompanied by changes of concentrations in water, which influences the chemical potential of the entire system combined with precipitation reactions and scaling effects.

Living bacteria in the free aqueous phase do not usually constitute a problem for technical systems, as long as there are no irreversible thermodynamic changes in the water. If such changes occur, for instance through partial evaporation of water, these can also have an impact on microbiology. In technical applications, the agglomeration and deposition of microbiology, i.e. the biofilm formation, is highly undesirable, both from a technical and a hygienic point of view.

The extent to which the partial evaporation of water leads to an influence on microbiology depends on the amount of time needed for compensating the changes in the water structure. This can be considerably speeded up by a suitable catalyst.

On the surface of special mineral-metal catalysts containing nickel, chromium and iron, it is possible to restore the balance between the water structures much more quickly. Occasional interaction of low-energy visible light can additionally facilitate this process. This results in a markedly reduced usage of biocides and hardness stabilizers. Often, the use of biocides can be even completely avoided. Whereas, the usage of hardness stabilizers is reduced by approx. 20% of the manufacturer's instructions.

This lecture will be focus on principle of the cooling process with showing possibilities for making these processes more efficient and economical. After a short theoretical introduction on cooling processes, the possibilities of increasing performance on industrial cooling systems, will be shown with industrial reference objects.