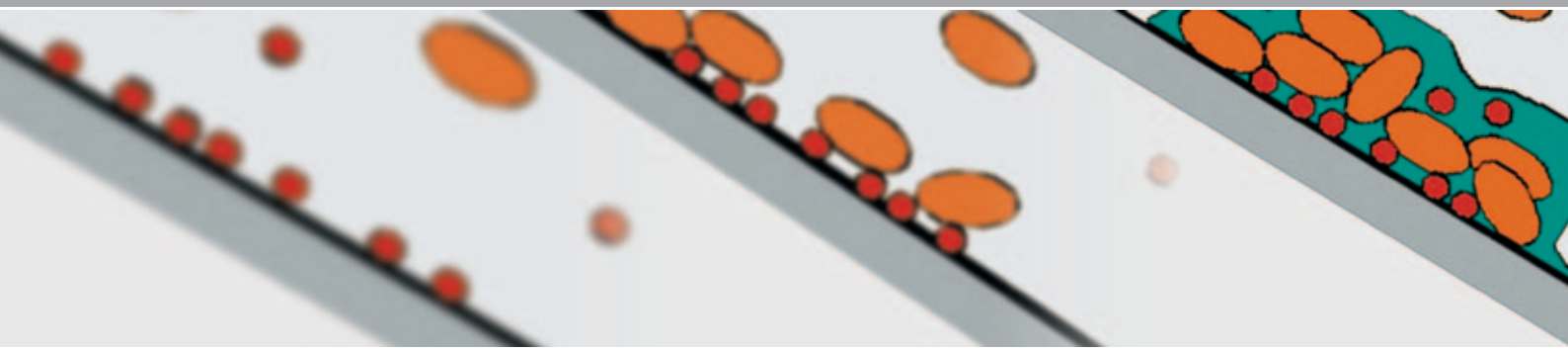
Biofilm prevention instead of reaction



Biofilm

Biofilms consist of a thin layer of slime in which microorganisms, e. g. bacteria and fungi, are embedded. There, they can withstand negative outside influences utilizing synergetic interactions. As a result, their tolerance towards biocides and other influences, such as radiation and lack of food, increases.

Biofilm formation

The development and formation of a biofilm can be subdivided into three phases: induction phase, accumulation phase and stabilization phase.

In the induction phase, a thin layer of organic substances adsorbently attaches to a surface which is moist with water. In the accumulation phase, this layer is adhesively colonized by microorganisms which utilize these organic substances as nutrients. Since the water treatment plants used in dialysis – and in the pharmaceutical industry – are non-closed, non-sterile systems, this adhesion cannot be prevented. The colonisation on the surface takes place in the form of a multilayer film. The stabilisation phase is reached as soon as there is a balance in the increase and degradation of the biofilm.

Life in biofilm

Microorganisms residing in the slime-like matrix find favourable living conditions and feed on dead bacteria as well as nutrients supplied through the water. Biofilm also protects the organisms living in it from external influences and enables them to adjust to changing environmental conditions. As a result, their tolerance towards extreme variations in pH and temperature as well as towards biocides (e. g. chemical disinfectants) increases. The increased tolerance of microorganisms living in the biofilm can be attributed to:

- aggravated penetration (biocides can either not penetrate biofilms at all or to a limited degree only)
- conditions in the biofilm which are unfavourable for the biocide agent (e. g. degradation by catalases)
- a great diversity of organisms having different properties against outside influences
- reduced metabolism or resting states resulting in a passive protection of the microorganism through diminished uptake of biocides

Even if bacteria die off on a large scale, there will always be isolated bacteria which find almost ideal conditions for a renewed and rapid reproduction, owing to the nutrients obtained from the remaining biomass.

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Prevention instead of reaction

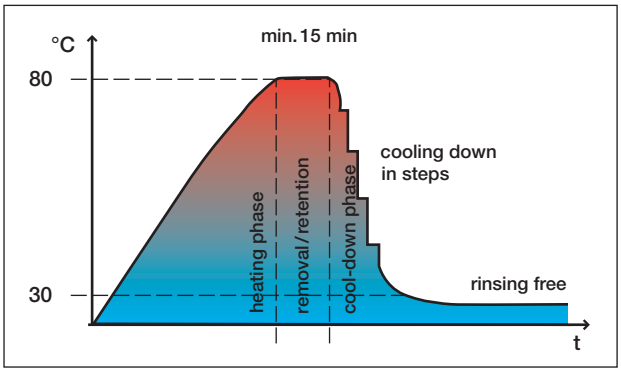
In order to prevent uncontrolled microbial growth in a water treatment system, it is necessary to stop the formation of a solid biofilm by taking regular preventive sanitation measures (ISO 23500:2011[1]) rather than reacting only after limit values have been exceeded.

The sanitation methods usually applied in dialysis are regular chemical disinfection and thermal disinfection by means of hot water. As a matter of principle, all reverse osmosis units offered by Fresenius Medical Care can be chemically disinfected. Two systems are available for disinfection with hot water: AquaA with AquaHT or AquaHF as option. Both systems allow heat disinfection including the haemodialysis systems. AquaA with AquaHT additionally allows heat disisnfection of the membrane modules.

1 ISO 23500:2011, "Guidance for the preparation and quality management of fluids for haemodialysis and related therapies".

Chemical disinfection may only be carried out by instructed personnel and is very expensive because it requires a great deal of time. Initially, hot water systems require higher investment expenditures which are, however, compensated by the low consequential costs compared to regular chemical sanitation.

As we know from experience, a hot water disinfectable system, combined with regular and consistent monitoring, is the best choice to meet the ever increasing quality requirements in a cost-efficient manner.



Heat disinfection curve

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