

FOCUS ON EVAPORATIVE COOLING TOWERS



BIOLOGY IN COOLING TOWERS

Microorganisms

Many people associate microorganisms with germs that make you ill. But these organisms are indispensable for the general cycle of matter on our planet. On the one hand, they serve as the basis for many food chains; on the other hand, they break down organic matter into inorganic substances, which in turn are metabolised by larger organisms. Even the human body serves as a habitat for microorganisms. They live on the skin, in the mouth and in the gut, amongst other places, where they prevent pathogenic bacteria and fungi from colonising or spreading. Furthermore, microorganisms perform useful jobs, e.g. in the production of certain foodstuffs, as the producers of medicines or in fighting pests. However, there is also a series of microorganisms that will harm people and cause numerous illnesses.

Legionella bacteria

Legionella are a type of rod-shaped bacteria that can be found in natural waterways (rivers, lakes, etc.), but also in mud and soil. In natural habitats, they reproduce relatively slowly compared to other microorganisms. With a generation time of 22–72 hours, in nature they hardly ever reach concentrations harmful to health. However, under optimum conditions brought about by man their generation time will fall to 3–4 hours and thus allow for much faster growth. An environmental temperature range of 25–50°C, access to oxygen, amino acids and to other substances (e.g. calcium, magnesium, iron, etc.) creates an ideal habitat for legionella where they can reproduce undisturbed and become a risk of infection. Under certain conditions, cooling towers may emit water drops (aerosols) containing legionella into the ambient air, which may cause serious lung infections if inhaled. According to the Robert Koch Institute, around 3000 people a year die from the effects of this so-called legionnaires' disease.



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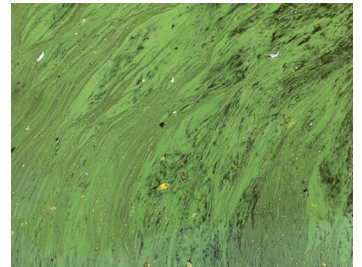
Legionella in evaporative cooling towers

Legionella reproduce in very specific ways both in natural habitats and in technical systems. They reproduce inside protozoans, otherwise known as scavenger cells, which usually utilize bacteria as a source of food. Characteristically, legionella can resist digestion and instead, use the scavenger cells as a habitat. Inside these cells, such as amoeba, legionella find all the nutrients they need, and they can reproduce undisturbed, protected by the cell walls of the protozoans. Eventually, this reproduction process inside the cell makes the amoeba 'burst', and the legionella that are released settle in other scavenger cells and the cycle starts again.

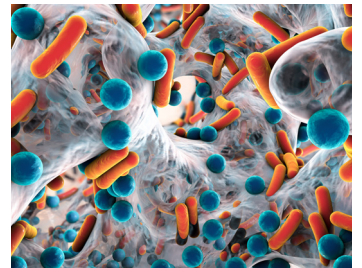
Like the majority of microorganisms, protozoans live in biofilms. For a biofilm to grow only very few requirements need to be met: a surface, sufficient nutrients and dampness. Therefore, it is not surprising that microorganisms reside on virtually all surfaces offering suitable living conditions. The physical and chemical conditions in technical systems carrying water, such as evaporative cooling towers, provide ideal habitats. In fact, hardly anything can prevent biofilms from forming. However, these biofilms will become critical if they damage the system or serve as a reservoir for pathogens like legionella or pseudomonas.

The typical operating temperatures (25–30°C) and the addition of nutrients via makeup water or the washing out of airborne substances aid the formation of biofilms in evaporative cooling towers. Even in the absence of pathogenic microorganisms, biofilms often have a negative impact on the system, causing, e.g., biologically induced corrosion of metals or reduced heat exchanger efficiency due to the insulating effect of the films. Furthermore, biofilms allow legionella, which enter the evaporative cooling towers via makeup water, to take up residence and reproduce in these systems in the first place. Given the optimum living conditions these systems also provide for legionella, they can grow undisturbed and reach concentrations harmful to health.

This explains why an appropriate mode of operation is essential to prevent the formation of pronounced biofilms in evaporative cooling towers. Such a mode of operation must be aimed at making the living conditions as unfavourable as possible for microorganisms and the growth of biofilms (further information is provided on "Focus on Evaporative Cooling Towers – Water Treatment in Cooling Towers").



Algae



Biofilm



Legionella

