

BIOFILM, AMOEBA, AND LEGIONELLA

Biofilms are the root cause of serious problems in potable and industrial water systems including; clogged piping, reduced heat transfer efficiency, microbiologically-influenced corrosion, and Legionella transmission. Biofilms are dynamic, complex structures optimized for microbial growth and survival, which make them difficult to remove and control.

1 SURFACE ATTACHMENT

Many species of bacteria growing in water will attach to system surfaces to improve survival. Conditions favoring surface attachment include high planktonic bacteria counts, stagnation, and sediment deposits.

Planktonic Bacteria
(Free Floating)

Sessile Bacteria
(Surface Attached)

Secreted EPS
Encapsulates
Growing Sessile Bacteria

2 BIOFILM FORMATION

Surface attached bacteria secrete a sticky, extra-cellular polymeric substance (EPS), often called slime, to form an adherent biofilm.

Biofilms start forming in minutes, but may take days to become visible (100 microns).

Biofilms are over 90% water, which makes them very insulating.

Dirt, corrosion byproducts, and other debris readily attach to biofilms forming biofouling deposits.

3 ESTABLISHED BIOFILM

Complex communities of problem causing microorganisms can grow protected within biofilms and cause biofouling

Bulk water bacteria levels do not measure bacteria growing within biofilms.

Corrosive anaerobic bacteria can thrive in biofilms causing severe damage to system metals. Biofouling deposits can block critical water passages and increase pumping costs.

Established biofilms are tenacious and difficult to remove. The secreted EPS tightly binds to systems surfaces and protects growing microorganisms from environmental hazards including high level cleaner and biocide additions.

Amoeba

4 LEGIONELLA AMPLIFICATION

Biofilms and amoebas play a key role in the survival of Legionella.

Biofilms provide a protective environment for Legionella entering with the source water to grow and multiply. Biofilms also contribute to Legionella amplification as a food source for amoeba.

Legionella is parasitic with several species of common amoeba. When certain amoeba ingest Legionella, the bacteria can multiply to high levels inside the microorganism. When food is exhausted, the amoeba ruptures releasing Legionella in the bulk water. The amoeba amplified Legionella have increased virulence.

Legionella infected amoeba that transform into cysts in response to hostile conditions are exceptionally difficult to kill.

5 BIOFILM PROPAGATION

When conditions become unfavorable, biofilms propagate by detachment, which releases bacteria and pieces of biofilm into the bulk water to inhabit other surfaces.

Environmental stresses such as biocide addition, shear, overcrowding, and low nutrient availability can trigger detachment.