

Prevention of Biofilm through physical water treatment

Biofilm is a organic plant vegetation in natural and artificial water systems. Biofilm can be found everywhere where water contacts a firm surface. Theoretically there is no surface, which has no Biofilm on it.

In agricultural water systems Biofilm develops throughout the entire water circulation such as:

- water wells
- water reservoirs and water pressure balance systems
- water pipes
- drinking and irrigation water and
- collecting ponds and sewage systems

The development of Biofilm is a natural process, which proceeds steadily and even faster if the settlement and the developing habitats are existing. On farms and agricultural businesses Biofilm can have toxic impacts on the animal digestion, because it is a hatchery for bacteria and germs.

1. Development of Biofilm

Biofilm is composed of settlements of micro-organisms, which are present in all water sources. It consists mostly of bacteria, algae, fungi, and protozoa (germs and viruses). Micro-organisms settle on all water borders and water contact areas and on the wall recipients. Once the Biofilm settles it forms a highly efficient biocoenosis, which connects the single Biofilm cell to a solid block of Biofilm (i.e ecosystem) which inhibits or even prevents water flow.

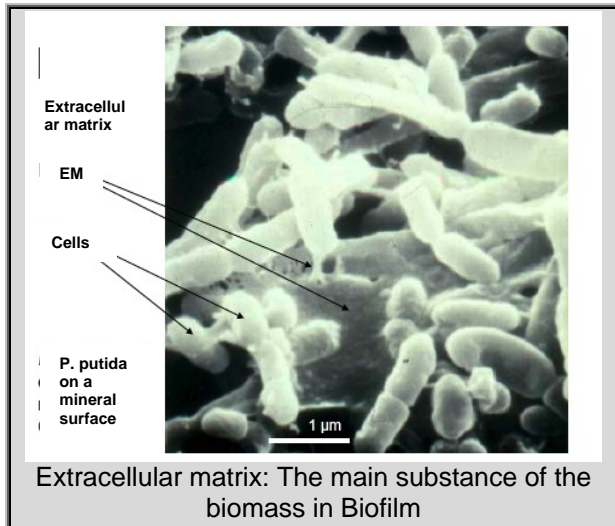
Biofilm cells anchors with water as its nutrition source and develops into a film cover inside pipes.

Biofilm settlement in water pipes

The development of a Biofilm layer happens through an interactive cell-to-cell communication with the intention to construct a stable connection among each cell.

Communication between Biofilm cells and ecosystem development

This is how the basic substance of Biofilm-connections **“Extracellular Matrix”** (i.e. Biopolymers microbial origin) develops. This is the environment of the Biofilm, which creates a stable connection to the surface and ensures as an autarchic ecosystem that continues settlement in the water systems.



2. Harmful impact of Biofilm

Biofilm is the ideal nutrient source for pathogenic substances. The development of Biofilm is influenced in water conduits by initial germ infiltration, temperature, water quality, nutrition supply and operating method of the water system (well, cistern, flow, stagnant). The entrance of one single microbial organism with pathogenic characteristics in the water system is enough to initiate Biofilm or to settle on existing Biofilm. Henceforth the Biofilm is contaminated and serves as habitat for all types of pathogenic organisms and therefore becomes a rapidly increasing hygiene problem.

3. Problem solving through physical water treatment with Aqua-4D®

Agricultural water conduits are sensitive to pathogenic Biofilm settlements. In wells with induction pipes, pumps and water reservoirs there is no hermetic sealing. The settlement of Biofilm takes place already in the induction pipe and gets carried on by the water flow. Little notches and holes in the pipes and recipients induce the infiltration so that Biofilm can grow from fixtures (feeding nipple, water basin, ect.) into the pipes. This is the reason why even systems run by city water have the same Biofilm problems as in the own home borehole.

The Aqua-4D® water physical treatment system developed in Switzerland by **Planet Horizons Technologies** treats the cause of the problem at its source with the elimination and the prevention of the creation of Biofilm.

In fact the physical water treatment inhibits the deposit of organic material on the conduits walls, whichever material they are made of (steel, PVC, glass, etc...). The existing biofilm detaches itself and all new creation of biofilm becomes impossible.

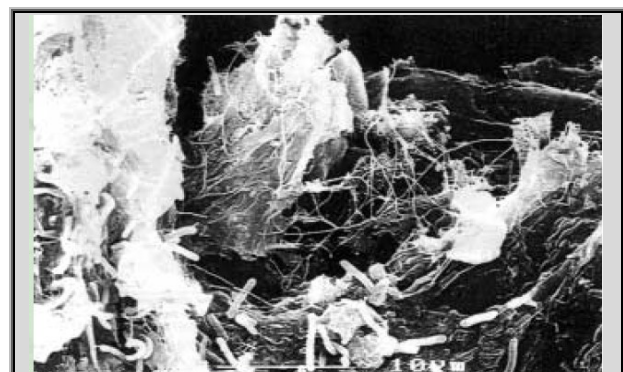


Abb. 1: Gram-negative Bakterien in Biofilm-Matrix mit fadenförmigen Polysaccharid-Micellen [24]
Gram-negative bacterias in Biofilm population

Another danger caused by Biofilm is the transfer of exo- and endotoxins within that environment. Bacterial endotoxins evolve through the so-called Lipid A into a toxic substance which reaches the animal through the water and settles in its intestine. The toxin is able to break the intestine wall and get into the blood stream of the animal. The outcome is fatal, a result of the Mastitis-Metritis-Agalactiae-complex (MMA-complex), well known amongst pig breeders and in other livestock breeding sectors as an indicator of health problems (i.e. digestion, growth, reproduction).

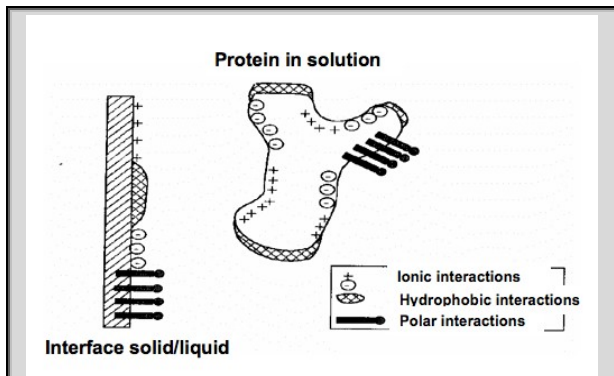
The application of medication, especially antibiotics is often counterproductive. The administration of MMA prophylaxis such as phyto-gene additives in animal feed in disturbed and stagnating digestion cases alleviate the symptoms, but not the cause. The animal still drinks the contaminated water to keep the digestion going. It's a vicious circle.

Planet Horizons Technologies (PHT) developed for this purpose a specific standard device Aqua-4D[®], which has been used and proven to work in farms for over 10 years. The equipment consists of one high-tech controller (Command 60 or Command 360) and one or multiple pipes (Tube 60 or Tube 360 according to water flow), with two integrated copper inductors, which modify the electromagnetic character of water.



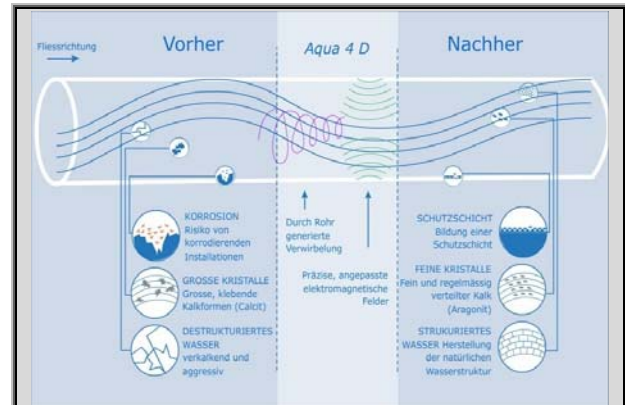
Command 360 with Tube 360

The influence of the crusting prevents the deposit of limescale in the pipes. Therefore the Biofilm loses grip, because the surface is more slippery than before. The necessary conditions for Biofilm reproduction and settlement disappear.



Interaction of proteins with surfaces and liquids

The appropriate electromagnetic treatment affects the molecular interaction in the water: Effect on the hydrophilicity/hydrophobicity behavior, dilution capacity, ionic interactions (Zeta-Potential), but especially the size and shape of the water cluster, which encloses the protein and sits on the surface area. The consequence is that the extracellular matrix development of the Biofilm produced protein cannot adhere to the pipe walls anymore. The existing Biofilm dissolves and it also prevents the development of new Biofilm.



Physical water treatment - Mode of action

The electromagnetic structure of water causes in principle a diminution of the cluster structure. By releasing the so-called crystal nucleation centers. This is the prerequisite for the transformation of calcite crystals (big crystals, crusted, corrosion lift, limescale) into powdery aragonite (little crystals, not clustered). Additional effect is the break-up of chemical additives (medications, detergents), which are transformed into little cluster structures. The doses needed for the animals decrease notably.

4. Installation of Aqua-4D[®] systems in livestock operations

In order to get the best efficient and affordable solution, one has to install the standard Aqua-4D[®] system directly after at the water well (borehole) or the water reservoir. This way Biofilm is eliminated directly after the well before it enters the pipe system. For installation with municipal water it is essentially to place the Aqua-4D[®] directly behind the water meter. This in order to cover all conduits feeding the water network of the livestock quarters.



Installation in stock farming / Cloppenburg
 (March 2007)

5. Experience shows : Biofilm dissolves

Since March 2007 more than 70 Aqua-4D[®] systems in breeding- and dairy farms have been in operation. The penetration of the market is steadily increasing.

The consistent experience is that within 4 - 6 weeks the existing Biofilm dissolves and no new Biofilm resettles. The only additional requirement is a daily rinse of the water installation at least during the first weeks of operation. It prevents the clogging of pipes, mountings and water appliances by detached Biofilm which might reach the actual water drunk by the animals.

Improved feed conversion

Due to computerized analysis, animals (pigs and dairy) water consumption can be measured and has been shown to increase by up to 20%. This is a clear evidence of a higher metabolism rate. Water is not just the provider of nutrients, but also decontaminates the digestion residues. Animals organisms before the treatment were not able to defend themselves against the toxic substances emanating from the Biofilm and instead had to endure the dissolving and deposit of these substances in their digestive systems. The treated water regulates the water needs of the animal: Nutrients can be absorbed, utilized and excreted with a healthy biological rhythm.

A chicken farm in Emsland (county of Lower Saxony, Germany) clarifies the lasting effect of Aqua-4D[®] technology.

In parallel testing proceedings of four production cycles with 37.000 chickens each cycle per barn, it was possible to decrease the chickenfeed utilization ratio with Aqua-4D[®] treated water down to 1.62 . Barn number one with no water treatment remained with 1.76 on a costly high level of chickenfeed utilisation. Within 6 months, the treated barn commanded an increased revenue of € 7881 compared to the non treated barns.

Simplified cleaning

The Aqua-4D[®] electromagnetic treatment eliminates limescale and residual dirt related to it. Aggressive limescale is transformed into powdery aragonite and easily flushed away with the water. Due to the modified character of the water, dirt particle can be enclosed through H₂O molecules and with the water flow sedimentation

can be prevented. Dirt and limescale does not stick to surfaces in contact the treated water. With Aqua-4D[®], water installations have considerable fewer cleaning and maintenance needs. Crystallized residues on fixtures and appliances disappear. In Aqua-4D[®] equipped livestock barns it is enough to simply wash out and hose down the water and feed bins inside barn facilities. Aggressive chemical cleaning supplies and time consuming scrubbing is not necessary anymore.

In the above-mentioned chicken barn number two (treated) the ground bedding became drier, the ground in barn one remained continuously humid. The hygienic situation in barn two clearly improved compared to the non treated barn.

Literature:

1. All about Biofilm: Montana State University, Bozeman MT
www.erc.montana.edu/default.htm
2. Bildung, Funktion und intraspezifische Kommunikation von Biofilmen, TU Graz, 8.5.07
3. Biofilm – Die etwas andere Lebensweise, Ulrich Szewzyk, TU Berlin, und Regina Szewzyk, Umweltbundesamt, 28.04.03
4. Definition von Biofilmen, in: Formen des Biofilms, Deutsche Biofilmforschung, 18.05.06
5. Der Biofilm – Bildung, Eigenschaften, Wirkungen, Teil 1 und 2, Prof. Dr. Dieter Kreysig, in: Sonderdruck Bioforum, 9.3.04
6. Der MMA-Komplex, in: Tiergesundheit im Internet, AHO, animal-health-online, 2000
7. Der Effekt von elektromagnetisch konditioniertem Wasser in der Landwirtschaft, Dr. Eric Valette, Leiter Forschung & Entwicklung PHT, 18.10. 2007

Contact :

Planet Horizons Technologies
Technopôle 5
3960 Sierre
Switzerland

Tel : +41(0)27/480 30 35
Fax : +41(0)27/480 30 36

E-mail : info@planethorizons.com
Homepage : www.planethorizons.com