Clean drinking water essential for pig health

Clean drinking water is essential for pig health and plays a key role in pig performance. Water is the nutrient of highest importance, making contaminated water a serious threat to animals and profits.

by Lotte Schakel & Erica Bongers, Kanters Special Products BV, The Netherlands. www.kanters.nl

While pig producers are critical about the quality of the feed, the quality of drinking water often does not receive the attention it deserves. Frequent cleaning and monitoring of the drinking system is necessary to maintain good quality drinking water. When products like antibiotics, vitamins, and acids are added to the drinking water this becomes even more important.

Water quality

Water quality can be distinguished in two categories, namely microbial and chemical water quality. Those two characteristics are however closely connected to each other. Microbial quality of water is determined by living organisms.

Although tap water contains a low number of bacteria, the microbial pressure at the drinking nipple can be enormously high through a contaminated water system. Through the drinking water system, pathogenic organisms are excellent in transporting animal-to-animal infection.

The scope of microbial quality in drinking water goes beyond water alone, it is very important that the piping system is also clean.

Chemical quality includes molecules such as iron, manganese, calcium and magnesium, whereof the last two largely determine the hardness of the water.

Too much minerals cause precipitation in the pipes that can cause leakages. Precipitation is also an ideal soil for micro-organisms that form biofilm.

Two minerals that deserve extra attention are iron and manganese.

Iron by itself, in normal concentrations, is not harmful for pigs to consume via drinking water. It can, however, deposit on the inside of water lines by the presence of oxygen, in which soluble iron converts into insoluble iron. The colour of water is mainly caused by the presence of iron.

Manganese is also not harmful to the pig in concentrations in which it is normally present in the water. It can cause black sediment in the water lines, especially when the water flow is low.

Elevated levels of iron and manganese can cause differences in the taste of water and can cause gastrointestinal tract disorders. It will deposit on the inside wall of water lines, clog up nipple-type drinkers or cause them to leak.

A suitable environment is also created for the attachment of microbes and subsequently formation of biofilm, i.e. a structured community of micro-organisms enclosed in a self-produced polymer matrix that is attached to a surface.

Biofilm can harm water equipment, give an odour and unpleasant taste to the water and can spread disease through the herd.

Biofilm as a hiding place

The biofilm serves as a breeding ground for micro-organisms as it contains sugars, proteins, iron, and manganese. As such, it is a serious issue on the pig farm. Forming a biofilm is considered to be a protective mode that allows micro-organisms to survive in a hostile environment.

The biofilm protects micro-organisms against pH stress, UV radiation, chemical exposure, phagocytosis and dehydration. Besides the protective effect of a slimy matrix, biofilm has an important role in the spread of antimicrobial resistance by hiding bacteria which are carrying genes coded for antibiotic resistance.

Biofilm in drinker lines and contaminated water reduces the effectiveness of antibiotic treatments and feed supplements. In fact, infections associated with biofilms are, in public health, proven to be 10 to 1000 times more resistant to the effects of antimicrobial agents.

Five phases of formation

The biofilm formation can be distinguished in five phases.

During the first phase, planktonic bacteria attach to the substrate surface. This is a process which is reversible, as some bacteria attach to the surface and detach from it in a short period of time.

In the second phase, bacteria adhere to the substrate surface and attach to other bacterial cells and lose their mobility.

In the next two phases, the bacteria start to communicate to each other by quorum sensing, and a matrix of extracellular polysaccharide substances (EPS) is produced.

Subsequently, the bacterial colonies start to grow to their maximum size and thickness, the bacterial cells still have no mobility. The biofilm becomes adopted with the external conditions by manipulation of its structure, physiology and metabolism.

In the last phase the bacterial cells inside the biofilm regain their mobility and different enzymes break the biofilm to release bacterial cells, so they can disperse to colonise at new surfaces.

Removing biofilm

To remove a biofilm, a product is needed which can disorganise the slimy extracellular matrix. At the same time it needs to be safe for the animals to drink.

Efficacy, toxicity and corrosiveness are important characteristics to take into account.

To find a good product, producers need to be careful because what seems to be a good product solving one part of the problem may cause other problems.

For example, some acidic sanitisers will kill most of the bacteria in the drinker lines but will also cause corrosiveness and subsequently damage the lines.

Different products have different

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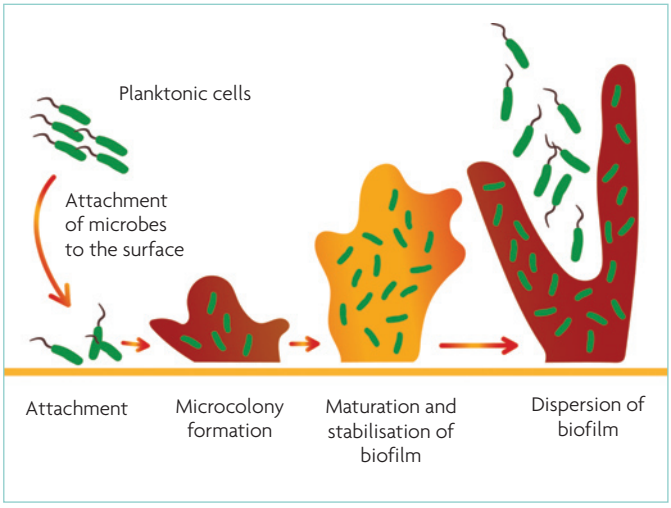
Fig. 1.Biofilm formation



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modes of action, for example chlorine will kill bacteria and micro-organisms that live in the water, but this product will not affect the biofilm in the drinker lines.

Other than that, it will also affect the taste of the water and therefore the animals could drink less.

Taking this into account, a producer needs a product that kills the pathogens and microbes that exist in the water, removes the biofilm by oxidising and will not damage the drinker lines or the supply lines.

One of the most, if not the most effective chemical for biofilm control, is hydrogen peroxide in combination with silver.

Already in 1934 Haber and Weis described the reaction of hydrogen peroxide when exposed to oxygen.

The products of this reaction are highly reactive free oxygen radicals which give a highly reactive reaction. Free oxygen radicals will degrade pollution by their oxidative and disinfectant effect. When using hydrogen peroxide in the drinker lines of the farm a hissing sound can be heard.

This is the oxygen that escapes from this reaction. Hydrogen peroxide is also very strong on the deactivation of lipids, proteins and nucleic acids. In a large number of scientific papers the effect of this oxidation effect is described. One of the catalysers of this reaction is iron or manganese. This will lead to a very strong, quick reaction also known as the Fenton reaction.

We can find iron or manganese in the biofilm of every drinker line and therefore the oxidising effect of hydrogen peroxide is combined with iron and manganese results in a very effective cleaning reaction.

When combining hydrogen peroxide with silver, this exhibited a synergistic action on the viability of, for instance, E. coli.

In some instances, the combined bactericidal effects were 1000-fold higher than the sum of the separate ones.

Fig. 2 shows the results of a trial that compared using no sanitiser (control) with using only hydrogen peroxide and using hydrogen peroxide with silver. As shown, the product Aqua-clean has the best results.

Aqua-clean is a product from Kanters that consists of hydrogen peroxide and a silver complex. It eliminates biofilm and it does not lead to toxicity or corrosion problems.

By being 100% biodegradable, Aqua-clean is considerably more environmentally compatible compared to many other disinfectants used so far. ■

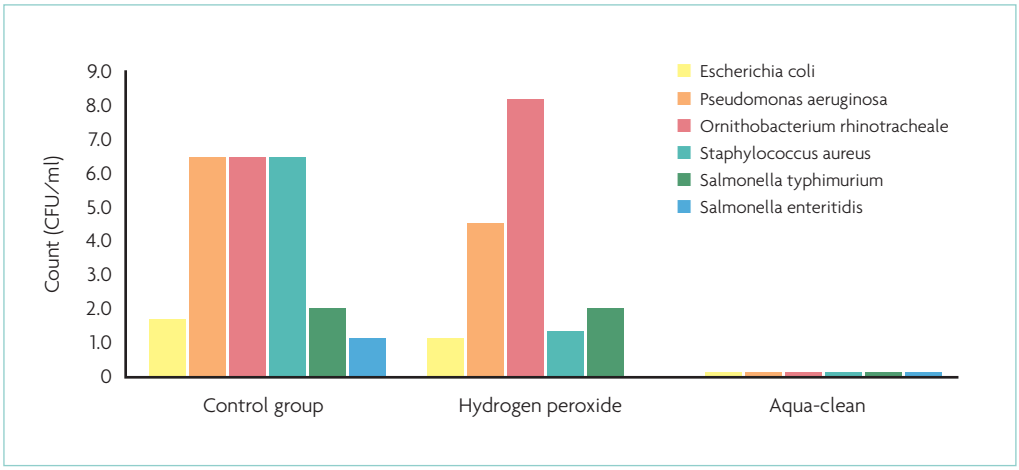

Fig. 2. Growth of pathogens in drinking water when using Aqua-clean, hydrogen peroxide or no product (Animal health services, Department of Bacteriology, Deventer, The Netherlands).

References are available from the author on request