Biofilms

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ABSTRACT

Biofilms are nothing new to our world. They can be found in any environment that has a flow of water and a contact surface. Biofilms can be deleterious or beneficial depending on where they are found and which organisms they are comprised of. As a society, however, we most commonly associate the issue of biofilms with their related infections. Examples of these are otitis media and bacterial endocarditis, which are caused by bacteria entering a fluid filled part of the body. Accelerated Hydrogen Peroxide® (AHP®) is relatively new yet proven technology that has gained a reputation as being one of the most effective yet safe technologies on the market. In fact, two studies have been conducted using AHP highlighting its ability to kill and remove biofilms. This document will help you and decision makers to better understand what Biofilms are and the relevance of using a disinfectant capable of killing and removing them.

BAKGROUND

The literal meaning of Biofilm is “life-slime”. The scientific definition of Biofilm is “the film or thin layer composed of cells of microorganisms such as bacteria, fungi, yeasts, protozoa and other microorganisms that are attached to a surface”. When the bacteria or fungi adhere to surfaces, they begin to excrete a slimy, glue-like substance (technically called extracellular polysaccharide) that helps them stick to all kinds of surfaces such as metals, plastics, rocks, implanted medical devices and even tissue. This slime layer also provides a protective environment in which to live. In fact the general structure of a biofilm consists of 85 percent polysaccharide and 15 percent microorganisms.

The bacteria & slime layer can now trap other materials such as clay, organic materials, dead cells or any other particle that floats over of the biofilm, which adds to the size and diversity of the biofilm colony. This growing biofilm now serves as a focus for attachment and growth of new organisms, which continues to increase its diversity.

It is interesting to note, that more than 99 percent of all bacteria exist as part of a biofilm community, however, traditionally microbiologists have only studied free-floating (planktonic) bacteria. This may not seem entirely significant, but research has shown that once a microorganism attaches to the surface of a biofilm it “turns on” a previously unused set of genes. This effectively makes it a significantly different organism to deal with. Studies conducted to date have shown that the antibiotic dose that kills free-floating bacteria need to be increased as much as 1000 times to kill a biofilm colony. Herein lies the problem. A biofilm colony provides a number of advantages for microorganisms; it provides environmental protection from adverse elements like UV light, drying and antimicrobials. If you have an antibacterial agent, the rule of thumb is that for every unit it takes to kill a planktonic organism, it will take 1000 times as much to kill a biofilm organism. It also acts to attract nutrients based upon its negative charge. Many nutrients (particularly cations) are attracted to the biofilm surface. This provides bacteria cells within the biofilm with nutrients greater than compared to being in the surrounding water

THE RISKS

Biofilms are a growing concern In North America. Monitoring the presence of a biofilm and its relative size can be difficult. A biofilm will shed planktonic cells at various rates. Shearing forces (mechanical or hydrodynamic) applied to the biofilm will literally "shave off" slices or shards of potentially infectious material. If stress is applied to the location of the biofilm, suddenly a shower of bacterial shards is dislodged from the biofilm. If you happen to be taking a water sample just after disinfection, it is likely you will find a higher than acceptable bacterial CFU count because the biofilm has been traumatized by the disinfectant. If you take repeated samples over the course of a month your results might display a strange pattern of high counts and low counts. This variation can be a result of a number of factors such as time of day the sample was taken, and when the surface was last disinfected. This variation can identify there is a problem and a biofilm is present but it does not identify what the actual size or level of biofilm contamination exists. This can only be done by taking an actual sample (scraping) from the surface of the biofilm.

HOW TO DEAL WITH A BIOFILM

The good news is that biofilms can be removed or destroyed by chemical and physical treatments. Chemical treatments using oxidizing chemistries such as chlorine or hydrogen peroxide have been recognized as being efficacious in both removing & destroying biofilms while quaternary ammonium compounds (QAC) are not. Depending on the level of contamination, physical treatments such as heat or mechanical removing (good old-fashioned scrubbing) can also be used to help remove the biofilm and dislodge it from the surface. Either way, the consensus is proper disinfection of pumps, water lines and jets cannot be overemphasized. Consistent cleaning and disinfecting procedures must be adhered to. Remember, it only takes a very short time for a biofilm to re-establish itself and then you are starting the battle all over again.

HOW COULD AHP BE USED TO TREAT BIOFILM CONTAMINATION

Accelerated Hydrogen Peroxide can be used as the cleaning technology (lifts and removes soil load and pathogens) as it is a proven excellent cleaner (CGSB 2:16-87 and ASTM 4488-89,5343) while also being a fast-acting bactericide. In fact, two studies have been conducted using AHP and studying its ability to kill and remove biofilms. In 2000, a study titled "Hydrotherapy tub usage (Infection risks – cleaning and disinfecting)" was published in the Canadian Nursing Home journal. This collaborative study between Public Health and Infection Control reviewed an outbreak of *Pseudomonas aeruginosa* that was attributed to hydrotherapy tubs. The study reviewed three disinfectant chemistries (Quats, Chlorine and AHP) and found AHP to have more advantages for use over the other two chemistries with respect to contact time, effectiveness and occupational health and safety advantages.

The second study was conducted by MBEC Biofilms Technologies Ltd of Calgary Alberta. Dr. Howard Ceri is a biofilm research scientist who compared AHP to a QAC product and evaluated both products on their ability to kill biofilms in dental water lines consisting of several different bacteria. AHP was proven to be effective against all biofilms tested and significantly outperformed the QAC product used in the study.

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