Biofilms-Why good and bad bacteria can't be eliminated in your pond?
By Mathew Vangel

Let's take a shot at the fables handed down through the years to Koi Pond Enthusiasts around the world. **Number one-** It was told to me that using certain chemicals would devastate my filter and pond of "beneficial bacteria". **Number two-** It was told to me that washing out my filter media with anything but pond water would wash off the "beneficial bacteria". **Number three-** It was told to me that major water changes would eliminate most of the disease pathogens in my pond. Well…… DON'T BELIEVE IT!

Why it isn't so………

Most of these beliefs are based on the idea that all pond microbes are planktonic (free-floating), and that simply is not true. Many of the microbes in your pond have the capability to adhere to surfaces, and actually demonstrate cell-communications to determine which medium to thrive on. Surface-designed Microbial Ponds have the capability to perform all of the functions for a successful Nitrogen Cycle without the use of a filter. Our verification test pond has enough surface area alone to maintain negligible nitrates, nitrites, and ammonia levels with the filter turned off for days. Although, filtration is usually required for fugitive particulate, and waste removal.

I will start explaining why this isn't the case by explaining what a Biofilm is, and that this formation is virtually indestructible. A Biofilm is a community of microorganisms attached to a solid surface. These microbes (bacteria, fungi, algae, etc.) can form on a solid surface that comes in contact with water such as- pond liners, foam filters, rocks, hoses, piping, human skin, FISH (Slime Coat), plants, pots, etc. It is the leading cause of many nosocomial infections in hospitals growing inside of catheters, and implanted devices. The formation of a Biofilm starts with the adhesion of a microbe to the surface. Some microbes stay attached by proteinaceous appendages referred to as fimbraiae (filament type legs). Once a number of fimbraie have glued the microbe to the surface, dislodging the microbe is highly unlikely. They form a spider-web formation on the surface (see below Figure 1-1 and Figure 1-2).

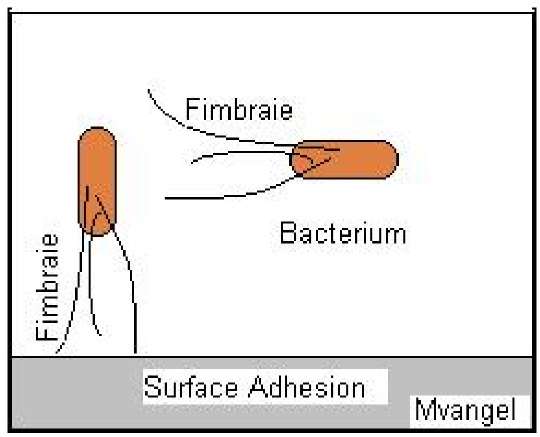

Figure 1-1

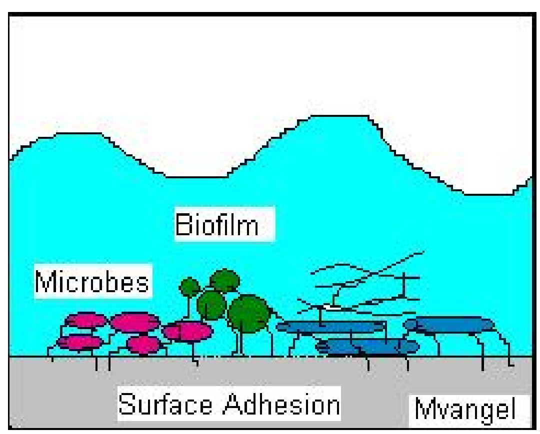

Figure 1-2

The next Biofilm process initiated is the creation of the extra cellular biopolymer consisting primary of polysaccharides and water. But between us lets call it plain old "slime". This protective environment can exceed the mass of the microbe cell by over 100X, which makes it a very protective environment from the outside world. This is the same substance that may now be coating your teeth as you read this due to the bacteria metabolizing sugar into plaque. The industry has found that Biofilms are so resistant to destruction that is some cases water treatment plants have had to sand-blast the microorganisms from surfaces.

How does this apply to your pond?

First- medications that are commonly used in Koi Ponds to eradicate parasites will not fully penetrate these Biofilms in your filter systems to kill all of the beneficial, or bad bacteria. This includes all of the colonizing bacteria adhering to every hard surface in your pond. The free-floating cells (planktonic) have a much higher kill rate with non-intrusive medication methods than non-suspended cells (Biofilm). The introduced microbial agent has many defenses to overcome in Biofilms. It usually is stopped in the beginning when it becomes depleted to inefficient levels coming into contact with the Biofilm. A certain amount of growing Biofilm layers may be penetrated, or sloughed off during this attempt to kill the microbes that lay beneath. The newly exposed underneath layers begin to grow that previously laid dormant due to the starvation from nutrients. The Biofilm now starts to rebuild its lost layers. Antimicrobial failure of penetration can be seen in Figure 1-3.

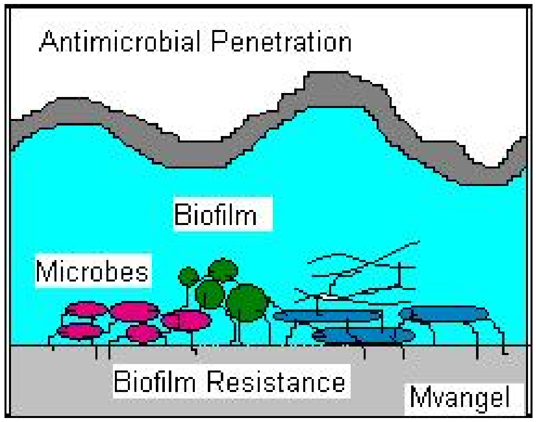

Figure 1-3

The microbial agent may find it impossible to be successfully transported any further into the cellular walls. The most common result is a partial microbe kill. That means you will never positively kill everything you want, or do not want to eradicate. The best you can expect are small Biofilm log kill rates, and large planktonic kill rates. That result most often times is favorable for the hobbyist.

No Wonder !

Ever contemplate why your pond recovers so fast after water, and disease treatments? The microbes in the Biofilm as we said are almost bulletproof in this sphere of slime. You can punch a few holes into the slime, but almost never fully remove their existence from the face of the EPDM, or in certain fortunate areas of the country "cement ponds".

Biofilms can stay active for days and even weeks when dry….I mean fully dried out (see below in Figure 1-3).

Figure 1-3 Are Microbes Dead or Alive?

The filter media shown above was dried out for 3-days, and the replaced with no noticeable difference to water quality. If this leads you to believe that dehydration does not kill everything, then you have understood this concept very well. **For example-** Do you know how long Hepatitis B can remain viable in a smear of dried blood? **Answer-** Up to one week where it can be rehydrated back to it's active pathogenic state. Where it is fully capable to infect you through an open sore, as one transport method.

Summary

Microbes have many methods of survival. Now you know why ponds recover so well after water changes, and why diseases are never fully eradicated due to Biofilm existence in your pond. Biofilms will always be a friend and foe in your aquatic environment. Balancing microbe colony levels are the key to managing a successful ecosystem. My follow-up article will describe the "Best Practices of Disinfection" that you should follow when handling, and cleaning surfaces relating to your hobby.

Author's Background- Mathew Vangel is an Advanced Technology Research Engineer, and licensed Medical Researcher in Massachusetts studying Infectious Disease Control, cross-contamination from aquatic to human environments, blood pathogens, Biofilm Structures, and Endocrinology. For more information and additional article references write to- info@pondanalysis.com or www.pondanalysis.com

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