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The Growth of Microbes and Biofilm on Surfaces\*

Why the removal of biofilm using PSF 110 is crucial for safer surfaces.

The control of the growth of microbes, such as bacteria, fungi, yeast and algae, in nature is one of the fundamental concepts for the survival of higher species. Plants, animals, even microbes themselves have developed a great variety of mechanisms that keep microbes at bay. In human society these control mechanisms often do not work efficiently, which makes microbial infections the number one killer in the world. The treatment of microbial infections becomes more and more difficult, because the number of resistant microbial strains as well as that of antibiotic-immune patients grows a lot faster than the number of useable antibiotics.

Man-made materials completely lack defense against microbial growth. Thus, microbial cells attached to any artificial surface in a moist environment can survive and proliferate. While the cell number increases on the surface the microbial cells usually start to build up a biofilm, which consists of a polysaccharide matrix with embedded cells. Such biofilms allow microbial cells to survive under harsh conditions and the embedded cells are up to 1,000 times less susceptible to most antibiotics and other biocides. Further, many toxins excreted from biofilms make the latter pathogenic and resilient infections are spread. Further, antibiotic genes can be exchanged between bacteria within biofilms, which additionally enhances the formation of multi-resistant bacterial strains. Almost every man-made material can be degraded by microbial biofilms. Therefore, the control of microbial growth on surfaces is one of the key issues in material science as well as medicine.

**Figure 1.** Typical biofilms: (**a**) mold in households, (**b**) algae growth on a ship’s hull, (**c**) bacterial biofilm on a catheter.



One way to prevent surface contamination is to keep the environment sterile, for instance by using disinfectants, such as hypochlorite, hydrogen peroxide or other reactive oxygen species (ROS). Alternatively, silver salts, quaternary ammonium compounds or alcohols are in use. Another widely used disinfectant is triclosan. Unfortunately, the sterile state does not last for long and the frequent use of such disinfectants poses a great environmental problem, particularly dramatic in the case of triclosan. Further, disinfectants have been shown to support the formation of resistant antimicrobial strains, e.g., methicillin resistant *Staphylococcus aureus* (MRSA), which causes the majority of hospital originated infections and notably causes more deaths in the USA than HIV.

The proper solution is regular applications of PSF 110 which organically and biologically breaks down and destroys the biofilm providing for a longer lasting surface free of microbes.

\*-Excerpt taken from a review in Polymers Journal: Antimicrobial Polymers in Solution and on Surfaces by Felix Siedenbiedel and Joerg C. Tiller.