

The risk of biofilms to the food processing industry (Part 1)

By *iTram Higiene* on 24 April 2017



Biofilms represent a significant hygiene risk to the food processing industry. They are colonies of different types of microorganisms that are covered in a protective polymer coat; this is a natural barrier that protects against heat, mechanical damage, disinfectants and desiccation. Biofilms are able to adhere very strongly to a surface.

Biofilm formation

Biofilm formation is an adaptive strategy for microorganisms, as biofilm growth offers four important advantages:

1. it protects microorganisms from the action of adverse agents,
2. increases the availability of nutrients for their growth,
3. facilitates the use of water, reducing the possibility of dehydration and
4. allows the transfer of genetic material (DNA)

All these circumstances can increase their survival skills. As a consequence, the usual cleaning and disinfection methods are ineffective against biofilm bacteria (Costerton et al., 1999; Donlan, 2002), which makes it difficult to eliminate them. At the same time, being able to contain pathogenic microorganisms increases the likelihood of contamination of the product resulting in foodborne diseases. For this reason, the presence of biofilms in food contact areas of the food industry is considered an obvious health risk.

Some bacterial pathogens with special importance in food safety that have the capacity to form biofilms are: *Listeria monocytogenes*, *Salmonella spp*, *Escherichia coli*, *Pseudomonas spp*, *Campylobacter jejuni*, and *Bacillus cereus* among others.

As the colony grows it releases new infection into the immediate environment that can then form new biofilm colonies, and so acts as a continuing reservoir of infection.

Biofilms are difficult to see or to identify.

Often the first signs of a biofilm are unexplained spikes in TVC counts combined with repeating and unpredictable outbreaks of infection. These are typically in several locations, and do not respond to traditional disinfection materials and techniques.

To treat biofilms successfully it is necessary first to identify where they are present. iTram have created a product, called Biofinder, that gives rapid visual confirmation of the presence of a biofilm; this requires no special training, is food-safe and can be used on all surfaces.

In studies, a number of areas that commonly showed high TVCs were identified, and for the assessment these were treated with Biofinder to identify which, if any, were due to biofilms. The object of the assessment was to demonstrate whether known high micro counts were due to poor cleaning or due to biofilms.

Where biofilms are not implicated these could be addressed by closer controls on the details of methods and frequencies of cleaning and disinfection, and the outcomes then monitored routinely to maintain an improved disinfection status. The action plan would then be to eradicate existing colonies and to introduce regular monitoring for future biofilm development.

Biofilm formation and significance

While most microorganisms can grow as free-floating (planktonic) cells, the optimal growth for most tends to be on a surface. Many can anchor themselves to that surface, either with small cytoplasmic extensions or with secreted coatings, often complex polysaccharides.

A biofilm can form when several different forms of microorganism grow in close proximity; they secrete a polymer that covers all of the cells and that attaches the entire colony to the surface. This provides the colony with a significant degree of protection against drying-out or the effects of biocides.

The significance of biofilms is that they act as a reservoir for repeated infections, while the majority of the microorganisms within them are unaffected by even extremes of heat, mechanical action, drying-out and chemical attack from biocides. There is a degree of cell-to-cell communication that can coordinate a localised breakdown of the EPS to release next-generation microorganisms that go on to form new colonies and biofilms.

Once established, biofilms are extremely difficult to eradicate. The initial attachment of any cells is a reversible process of adsorption onto the surface - rougher surfaces provide a better anchorage – and this can happen within just a few minutes.

A true biofilm begins as the EPS forms, typically in days but in optimal condition this can take just hours. At this stage it is still relatively easy to remove the new biofilm. As more types of microorganism become incorporated within the biofilm, including species which on their own cannot form biofilms, it becomes multi-layered and increasingly difficult to remove.

This difficulty is exacerbated as biofilms are frequently hard to see and are, almost by definition, in hard-to-access areas.

In Part 2 of this article we will look at Biofilm Detection and Treatment

About the Authors

Many thanks to Dr Irene Ylla (Itram Higiene, Spain) and Neil Brown (Freedom Hygiene, UK) for this article.