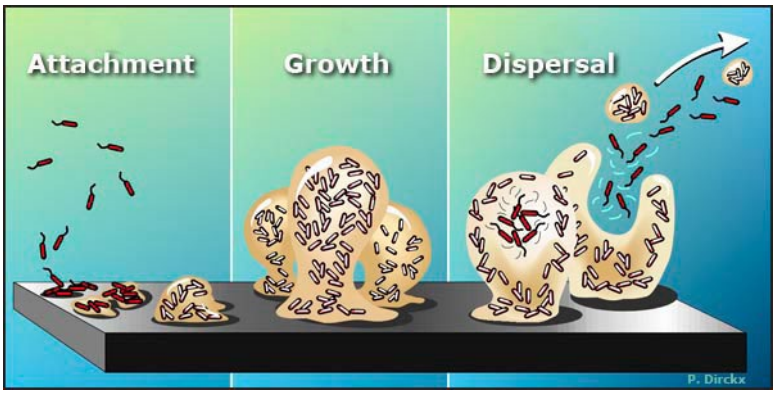
What is a biofilm?

A general definition of a biofilm is a community of microorganisms embedded in an organic polymer matrix, attached to either an inert or living surface and formed by one or more species. (1)

Bacteria have the capacity to attach and colonize the surface of most natural and man-made materials, including plastic, stainless steel, glass, and wood. (4) The bacteria and biofilm will grow and strongly attach to surfaces under the right conditions and over time. (2) Biofilms can be found in every environment inhabited by bacteria, e.g., food production, leading to contamination of products, dairy plants where thermophilic (able to grow at temperatures exceeding 500C) organisms are able to survive the pasteurisation process, and in clinical settings, causing infections from contact lenses, medical devices, and urinary catheters. (3, 5)

Formation of a biofilm occurs over several phases, a) adsorption of inorganic/organic molecules onto a surface forming a conditioning layer, b) bacterial attachment by production of extracellular polymeric substance (EPS), c) development of microcolonies into a mature biofilm, d) dispersal of cells into surrounding environment.



Biofilms can develop rapidly where there is a continuous nutrient source possibly maturing within 24 hours and be several millimetres thick within days. The EPS layer acts as a protective coat for the organisms with the biofilm becoming more difficult to remove as it matures.

Several microorganisms can produce biofilms in food production plants and include *Bacillus sp. Campylobacter jejunii, Escherichia coli, Listeria monocytogenes, Pseudomonas and Salmonella species*. (4)

Bacillus sp

Found in dairy processing plants, capable of surviving the heat process, accumulates in pipework and may be difficult to remove.

Campylobacter jejunii

Can produce biofilms on stainless steel and glass surfaces. The minimum infective dose is very low possibly the reason why it is considered the most common cause of food poisoning in the UK.

Escherichia coli

Can form biofilms on polyvinyl chloride (PVC), polypropylene, polycarbonate, polystyrene and borosilicate glass. (7)

Listeria monocytogenes

Survives in cold, wet environments, has good adhesion ability and requires a short contact time for attachment. Has been found on steel utensils, including slicers, in food processing plants. Also found in milk and dairy products possibly associated with clinical outbreaks.

Pseudomonas species

Can be found in drains and on food e.g., fruit, vegetables, meat and in low acid dairy products. Capable of forming multi-species biofilms with Listeria and Salmonella species on stainless steel.

Salmonella species

Can form biofilms on plastic, cement and stainless steel. Produces cellulose important for the EPS layer.

Several of these human pathogens can cause food poisoning and have been linked to outbreaks due to cross contamination of food products. The presence of biofilms in a food production facility could potentially lead to a risk to human health. (3)

With up to 97% of a biofilm component being water it is evident pipework, drains, floors etc are important areas requiring attention in a food production plant. (4)

Examples of biofilm formation in pipework

How do you remove and prevent biofilms?

We suggest using a two-stage process: cleaning followed by disinfection.

Open Plant Cleaning

This can be a time consuming/labour intensive process associated with cleaning all the external surfaces and equipment used in food processing areas.

On a larger scale, products can be applied using a pressure washer for open-plant cleaning of equipment including conveyor belts, walls & floors.

In smaller processing areas products may require physical mechanical action to clean, such as, brushing, scouring, and wiping.

Evans have several cleaning & disinfectant products in their range suitable for using in food processing areas for open plant application:

https://www.evansvanodine.co.uk/assets/food-hygiene-open-plant.pdf

CIP Cleaning

Clean-in-place (CIP) is automated cleaning method used for the interior surfaces of pipes, vessels, equipment, filters and associated fittings, without major disassembly. CIP is commonly used for equipment such as piping, tanks, and fillers. CIP employs turbulent flow through piping, or spray balls for large surfaces.

Where CIP systems are installed, we recommend using CIP Liquid in the cleaning cycle:

https://www.evansvanodine.co.uk/shop/product/R049KEV

Peradox should be used in the final disinfection stage:

https://www.evansvanodine.co.uk/shop/product/c015hev-c015nev-c015sev-c015eev

Summary

Biofilms can be considered a major problem for food production factories leading to public health issues, damage to equipment and loss of business.

To remove biofilms effectively a combination of chemical, mechanical and thermal action is required. It is also important to consider the frequency of cleaning and disinfection to prevent formation of biofilms, as once they have developed, they can be very difficult to remove.

Cleaning protocols are often be deemed to be Critical Control Points in hygiene processes based on the principles of HACCP (Hazard Analysis Critical Control Points) widely advocated and used in the food and beverage industries.

Evans Vanodine Technical Team
May 2021

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