PennState Extension

Biofilms in the Dairy Industry

Effective control of biofilms in dairy processing facilities is critical to prevent contamination of food with spoilage and pathogenic bacteria.

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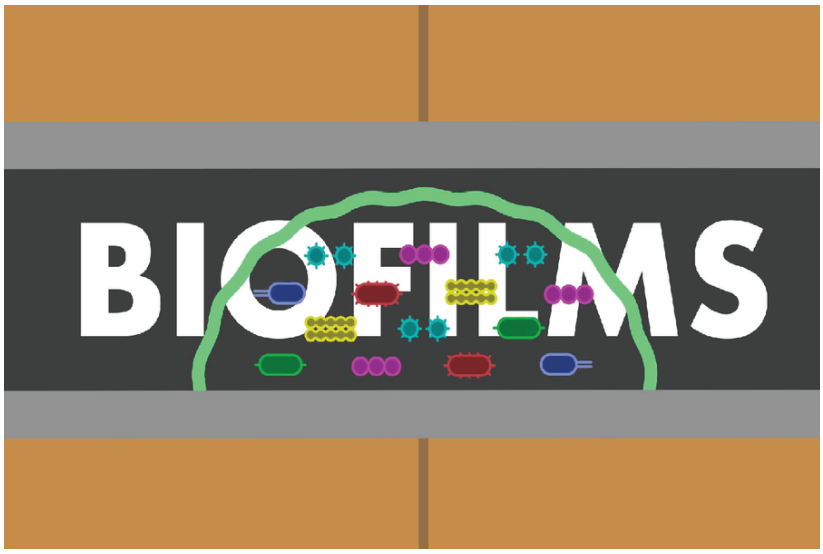

Image credit: Food Safety CTS, LLC

In this article and the accompanying video, you will learn about biofilms, how they form, what challenges they pose, and how to control their presence in dairy food processing environments. The article provides additional information to that presented in the video.

Dairy processing facilities and equipment provide optimal places for many microorganisms to live. The temperature, humidity, presence of water, and organic material allows bacteria to grow and find a home in a dairy processing facility.

When bacteria find a place to settle down, they build cities in the form of biofilms. Biofilms consist of groups of microorganisms that attach to a surface and secrete a slimy substance called exopolymeric substances, or EPS, that serves as a protective layer. You can think of biofilms as a fortress that microbes build to protect themselves from the environment. Biofilms are typically a mixture of different species of bacteria, which can contain spoilage organisms and pathogenic bacteria like *Listeria monocytogenes*.

Listeria can form a new biofilm or join existing biofilms which protects it from the antimicrobial action of sanitizers. Once *Listeria* is established within a biofilm it can survive for many years and can shed from biofilms to contaminate food products.

Cleaning and sanitizing are the most effective ways to control the development of biofilms in dairy facilities. Careful consideration must be taken to select the optimal cleaning and sanitizing procedures that are most compatible with the plant design, equipment, types of soils, and daily operations. There are four critical steps for optimal cleaning and sanitizing:

1. Remove visible soils with a warm water rinse. Removal of visible soils will enhance the action of the cleaning chemicals applied in the next steps.
2. Wash with appropriate cleaning chemicals and conditions to remove soils such as proteins, fats, and minerals that may be on the surfaces of equipment and the environment.
3. Rinse the cleaners thoroughly with water.

4. Sanitize to inactivate microorganisms remaining after cleaning. This step is crucial to delay or prevent the formation of biofilms in the processing environment.

Developing effective cleaning procedures results from careful evaluation of your facility to determine what is optimal for each piece of equipment and processing area. Specifically, the selection of chemicals that can disintegrate the protective EPS matrix and the use of enhanced mechanical action will aid in the removal of biofilms from the environment and equipment.

Equipment that is designed for cleanability is key to efficient cleaning and sanitizing to prevent biofilms. Equipment design should be made of high-quality materials, such as stainless steel, and avoid areas with dead ends where dirt and bacteria can accumulate.

Biofilms are constantly being formed in dairy processing environments. Detection of biofilm niches can be added to Environmental Monitoring Plans, through traditional methods including plate counts and ATP measurements, or by using specific products that react with biofilms. Using good cleaning and sanitizing practices regularly will ensure that their formation is controlled and will limit the presence of *Listeria* in the environment.

Additional resources:

- Key Concepts in Cleaning and Sanitizing(https://extension.psu.edu/key-concepts-of-cleaning-and-sanitizing) (Article)
- Sanitation Tips for Small-Scale Cheese Plants(https://extension.psu.edu/sanitation-tips-for-small-scale-cheese-plants) (Article)
- Facilities for the Value-Added Dairy Foods Processor(https://extension.psu.edu/facilities-for-the-value-added-dairy-foods-processor) (Webinar, recorded)
- Cleaning Small-Scale Dairy Plants: Cleaning the Facility (https://extension.psu.edu/cleaning-small-scale-dairy-plants-cleaning-the-facility) (Video)
- Cleaning Small-Scale Dairy Plants: Cleaning Drains(https://extension.psu.edu/cleaning-small-scale-dairy-plants-cleaning-drains) (Video)
- Cleaning Small-Scale Dairy Plants: Cleaning Equipment (https://extension.psu.edu/cleaning-small-scale-dairy-plants-cleaning-equipment) (Video)
- Equipment for the Value-Added Dairy Foods Processor (https://extension.psu.edu/equipment-for-the-value-added-dairy-foods-processor) (Webinar, recorded)

Key references:

- Comprehensive review on biofilm formation in food processing facilities. Chmielewski and Frank. (2003). Comprehensive Reviews in Food Science and Food Safety(https://ift.onlinelibrary.wiley.com/doi/abs/10.1111/j.1541-4337.2003.tb00012.x) 2:22-32.
- Biofilm formation by *L. monocytogenes* in the food industry. Colagiorgi et al. (2017). *Listeria monocytogenes* in the Wonderland of Food Industry.(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5617998/) Pathogens 6(41).

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