

Solutions to reduce the risk of biofilms and associated pathogens at hospital hand wash stations.

Summary:

Biofilm is a layer of micro-organisms that live together. By living in a biofilm, microorganisms, such as *Legionella* bacteria, are better protected and better able to survive disinfecting treatments. At a meeting at Plymouth University, solutions to reduce biofilms were discussed. A research project on biofilm formation was presented that showed that the choice of materials and design of hand wash taps can make a major difference in the amount of biofilm that is formed. It was concluded that health care facilities should avoid the use of flexible hoses lined with EPDM but that PEX containing flexible hoses might be a suitable alternative.

Biofilm

The definition of biofilm is “a complex structure, consisting of microorganisms that form a slimy protective layer in which they shelter”. It can form in wet and damp environments such as domestic water system. Biofilms can harbour pathogens, such as *Legionella* bacteria, and are typically more resistant to conventional methods of disinfection.

The formation and growth of biofilm in domestic water systems depends on a number of factors. First, surfaces within the system need to be conditioned. This happens for example by corrosion and scale formation. The conditioning attracts nutrients and bacteria and helps these bacteria stick to the surface. The bacteria then produce a slimy matrix to which other bacteria and microorganism can attach. Once the biofilm is formed, the organisms in the biofilm can communicate with each other. They can share characteristics and exchange genetic material, making all within the biofilm better at enduring changing environments.

Factors that allow biofilm to grow are well known. Bacteria need nutrients and benefit from stagnant conditions. Most bacteria fair better in warm conditions and start to die above temperatures of 55°C. The material on which the biofilm forms is also important. For example, if the surface of the material is smooth, it will be more difficult for bacteria to attach to the surface. Rough surfaces make attachment much easier.

Effect of materials on biofilm/ flexible hoses

A research study by Paul Waines of the University of Plymouth looked into the difference of biofilm formation between copper and 2 types of plastics used in flexi hoses, ethylene propylene diene monomer (EPDM) and cross-linked polyethylene (PEX). All material used in the study were WRAS approved. Electron microscope (EM) pictures, used to create highly magnified images,

were taken of the 3 materials and showed a major difference in surfaces. Whilst copper and PEX were smooth, EPDM had a rougher surface with holes and tunnels. Similar pictures taken after 1, 2 and 3 months exposure to mains water showed that biofilm formed and matured much quicker on EPDM than on copper or PEX. These observations were confirmed with biochemical measurements and bacteriological counts. It is thought that due to the structure of EPDM, bacteria can attach better to EPDM and shelter better from conditions that harm the biofilm. Nutrient release by EPDM might also play a role in the increased biofilm formation.

Investigation on where biofilm formed within the water system also gave some interesting insights. Although copper has some anti-microbial properties, this is only temporary and biofilm will form on copper once it has been conditioned. When components of domestic water systems were tested, most biofilm was found on the tap outlets. It was found that the addition of flow straighteners and other tap inserts increase the surface area on which biofilm can grow and retain water, resulting in more microbiological growth. Hand wash basins with self-draining outlets, no inserts and TMVs in the tap seem to be the best way forward.

Conclusion

It was concluded that total prevention of biofilm formation using only temperature control and regular usage is not possible. However, the choice of materials within and design of a domestic water system can have a major impact on formation of biofilm. Ultimately, the right materials and design will make it more difficult for pathogens, such as *Legionella* bacteria to colonise domestic water systems, making it safer for all that use them.