

Introduction

Ice machines are an extremely common piece of equipment and can be found around the world in a variety of settings and applications. While ice is classified as food, ice makers are frequently not treated with the same handling protocols that other food and beverage equipment is.

The cleanliness of ice machines is a known issue to manufacturers of these devices, as well as an increasing number of the general public. Several studies have been conducted on the matter and show that the issue of unsanitary ice machines is widespread and can have devastating implications. Ice machines are prone to issues with sanitation because they provide an environment where sludge, slime and mold can thrive, and their maintenance is often overlooked or improperly done.

To combat issues regarding the sanitation of ice machines, operators and owners must be diligent in ensuring equipment is properly cleaned regularly or have outside contractors perform the service for them. This leads to additional costs that do not guarantee the water in ice machines is adequately purified and safe for consumption at all times. There are some options on the market for automating ice machine cleaning, but there are disadvantages such as not removing smaller bacteria, requiring frequent maintenance, or the addition of unwanted chemicals into the water supply. UV-LED technology is a newer innovation and can provide a compact and simple solution that effectively disinfects water without a hassle.

Biofilm and Mold

What is Biofilm?



Biofilm from ice machine¹

The notorious sludge and slime often found on the surfaces of ice machines is a substance called biofilm. Biofilms are comprised of microorganisms (mainly bacteria) that grow in a matrix of polymers and develop into large amounts of buildup¹. The bacteria within biofilms poses a health hazard that can cause illness or even death. There is a misconception that because ice is frozen, bacteria cannot survive in it - In reality it can and also grows on the surfaces in the machine that end up touching the ice. A buildup of biofilm can also affect the performance of ice makers and decrease the lifespan of the machine.

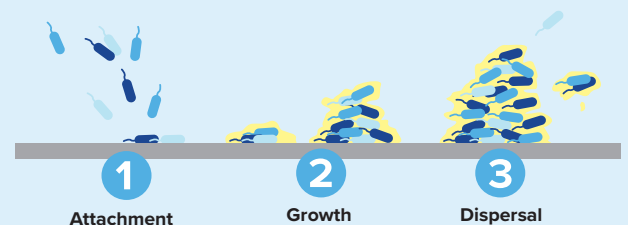
How do Bacteria and Other Organisms get into Ice Makers?

Bacteria in ice makers comes from several sources and can come from contamination in the water as well as from air in and around the machine. Bacteria in the water can come directly from the water source or be introduced in other ways such as release from contaminated plumbing or inline water filters, and improper handling. Air borne particles are another source of contamination that can cause mold to develop. Yeast and mold are examples of common air borne particles found in ice machines which contribute to the development of mold and slime.

Disinfecting both the water and air in ice machines means that bacteria and other microorganisms are eliminated and reduces biofilms and mold buildup. To have the greatest impact on maintenance frequency, the number of microorganisms entering the ice machine must be reduced to a minimum in combination with following safe handling protocols.

How do Biofilms Form?

1. Free bacteria attach to a surface
2. The bacteria grow and secrete polymers
3. The biofilm develops, the microorganisms are able to disperse, repeating the cycle and creating more biofilms²



¹ Image Source: <https://tigermechanical.net/blog-2/what-is-this-slimy-stuff/>

What Sort of Problems do Biofilms and Mold in Ice Machines Cause?

The bacteria in biofilms pose a health risk and include illness such as listeria, legionella, and salmonella³. The biofilm creates a protective shield around the bacteria, meaning it becomes much harder to remove – As an example, when encased in a biofilm, listeria becomes 1000X more difficult to remove, resulting in a constant source of pathogens². Because of this risk, people who are immune compromised, young, or elderly are most at risk to this sort of bacteria and are often told to avoid ice machines.

A build up of biofilm and mold can also impact the performance and lifespan of ice machines. Some of these substances result in ice that has an unpleasant taste or odour and also has the potential to cause blockages or other physical problems with the machine³.

With an automated cleaning system that disinfects both the water and air in ice makers there is an increase in the machine's consistency, efficiency, and protection from the associated health risks.

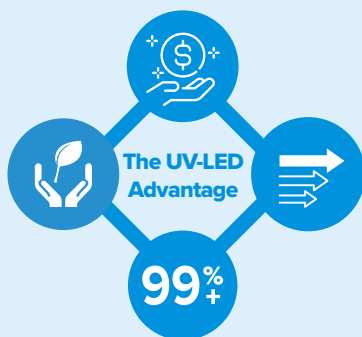
UV-LED Technology

How can UV-LED Technology Prevent Bacteria and slime in ice makers?

Ultra violet (UV) purification is the most trusted water treatment technology and is used in many major cities around the world. UV-LED takes UV purification and combines it with light emitting diodes (LED) to deliver UV into water. This method can be applied in ice makers to consistently and powerfully eliminate bacteria and other microorganisms, preventing them from entering the machine, preventing biofilm build up, and reducing cleaning and maintenance frequencies.

Key Benefits of UV-LED

UV-LED has several significant benefits for the improvement of ice machine sanitation.



Ultra-Low Maintenance

Without having to change bulbs or cartridges, UV-LEDs require no maintenance long term. Keeping a machine sanitary can also extend the lifespan of ice machines, decrease long term maintenance costs, and significantly reduce cleaning time. UV-LED also has minimal energy requirements, making the cost of operation low.

Long - Lasting

A stainless steel build and a 5+ year lifetime for the LED result in technology that is built to last.

Sustainable

UV-LED uses a very small amount of energy, so there is little environmental impact when running it. Traditional UV lamps also contain mercury that need to be changed regularly but UV-LEDs do not contain mercury and can last for 5-10 years – Providing a method of disinfection that is toxin free safe for the planet.

High Effectiveness

UV-LED has a very high rate of disinfection at 99.9%+ and is able to eliminate even the smallest microbial pathogens (see table below).

| Bacteria | Acuva's Strike Module* |
|-------------|------------------------|
| Legionella | >99.999% |
| Salmonella | >99.999% |
| Pseudomonas | >99.999% |
| Listeria | >99.99% |

*Verified Performance with In-House and Third-Party Analysis

What Advantage Does UV-LED Have Over Other Available Options?

With there being more awareness on the cleanliness of ice makers, various methods of disinfection have begun to appear on the market. Filters, ozone purification, chemicals, and manual cleaning are some of the current options all have varying levels of efficacy and maintenance.

Manual Cleaning: It is recommended that ice machines be cleaned at least once a month, but preferably weekly¹. This task must be performed properly by someone who has knowledge of how the equipment works and understands what cleaning products are appropriate, but may not be enough to avoid biofilm buildup since some parts prone to contamination cannot be accessed for proper manual cleaning, i.e. the water inlet plumbing

Ozone: Small amounts of ozone is pushed into the water supply to disinfect it and is dissipated within the ice machine. This method is marginally effective at eliminating microbes but has the disadvantage of adding chemicals into the water that has the potential of formation of carcinogens in the presence of naturally occurring bromine, and poses the risk of ozone air toxicity if the build-up of ozone exceeds of safe levels.

Filters: While filters are great for preventing mineral scaling and for chlorine removal, they are generally not able to filter out virus and bacteria that are small enough to pass through them. Filters also need to be replaced frequently and on a schedule, to avoid bacteria buildup and secondary contamination of water

Chemicals: Chemical cleaners are available, but this method of sanitation requires frequent maintenance and does not prevent contamination in the first place. Some of the chemicals used may also leave a unpleasant taste or odour in the ice.

Comparison of Cleaning Methods for Ice Makers

| |  UV-LED |  Manual Cleaning |  Ozone |  Chemicals |  Filters |
|---------------------------------|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Removes Bacteria & Cysts | ✓ | | ✓ | ✓ | |
| Nutritious, Great Tasting Water | ✓ | ✓ | ✓ | | ✓ |
| Easy to Install | ✓ | | ✓ | ✓ | ✓ |
| Low Maintenance | ✓ | | | | |
| Eco-Friendly | ✓ | ✓ | ✓ | | ✓ |

References

¹ www.foodsafetymagazine.com/magazine-archive1/junejuly-2012/biofilms-impact-on-the-food-industry/

² www.foodsafetymagazine.com/magazine-archive1/augustseptember-2013/the-sanitation-of-ice-making-equipment/

³ www.bloomingtonmn.gov/sites/default/files/Biofilms-WhatTheyRandPrevention.pdf