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ANTI-MICROBIAL HEAT EXCHANGER FIN CONSTRUCTION ®

Background

Extended surface compact heat exchangers have been used for several decades to heat and cool air in food cooking, chilling, and freezing equipment. By definition these heat exchangers have a very large amount of surface area contained in a relatively small spatial volume. For example, it is not uncommon for an industrial blast freezer heat exchanger to have over 20,000 square feet of surface area exposed to the air stream in a spatial volume of only 234 cubic feet (6'H x 20'W x 2'D)!

Air passages between fins and tubes in these heat exchangers are typically small (1/4 to 1/3" wide) and difficult to clean. Food particles can lodge in these small passages where bacteria can subsequently grow. Food processing companies are particularly concerned with minimizing the presence of harmful bacterial pathogens such as E.coli and Listeria monocytogenes on heat exchanger surfaces to avoid contaminating the foods being processed. To minimize contamination of food during processing, the USDA requires companies to regularly clean and sanitize these heat exchanger surfaces. Cleaning and sanitizing is typically done with harsh chemicals that kill pathogens effectively, but which also can corrode and ultimately damage the surface of some metals. For example potassium hydroxide (caustic soda) and sodium hypochlorite (chlorine bleach) are commonly used cleaners that act quickly to kill bacteria, but which can severely corrode galvanized steel and aluminum heat exchanger surfaces.

Because of the small passages and large amounts of surface area found in food processing heat exchangers, complete and thorough cleaning and sanitizing is often difficult if not impossible to do. Also, if care is not taken when selecting and using cleaning and sanitizing chemicals, aluminum and galvanized steel heat exchanger surfaces can be damaged or destroyed.

Another Breakthrough from Colmac

To address this critical need for heat exchanger designs which mitigate the growth of harmful pathogens on coil fin surfaces, Colmac engineers have developed a proprietary new type of heat exchanger construction which utilizes a metal alloy having specific anti-microbial properties. This proprietary alloy has been shown to actively kill E.coli, Listeria monocytogenes, and other harmful bacterial pathogens that come into contact with the surface of the metal. At the same time, the new alloy is not adversely affected by harsh cleaning and sanitizing chemicals typically used in the food processing industry (such as potassium hydroxide and sodium hypochlorite).

Additionally, this new breakthrough technology provides a means of completely covering the coil tube surfaces exposed to the airstream between the fins by means of a full-length self-spacing fin collar made of the same anti-bacterial alloy as the fins. This type of fin construction effectively covers all of the hard-to-reach and hard-to-clean surfaces found in these heat exchangers with the new proprietary anti-bacterial alloy.

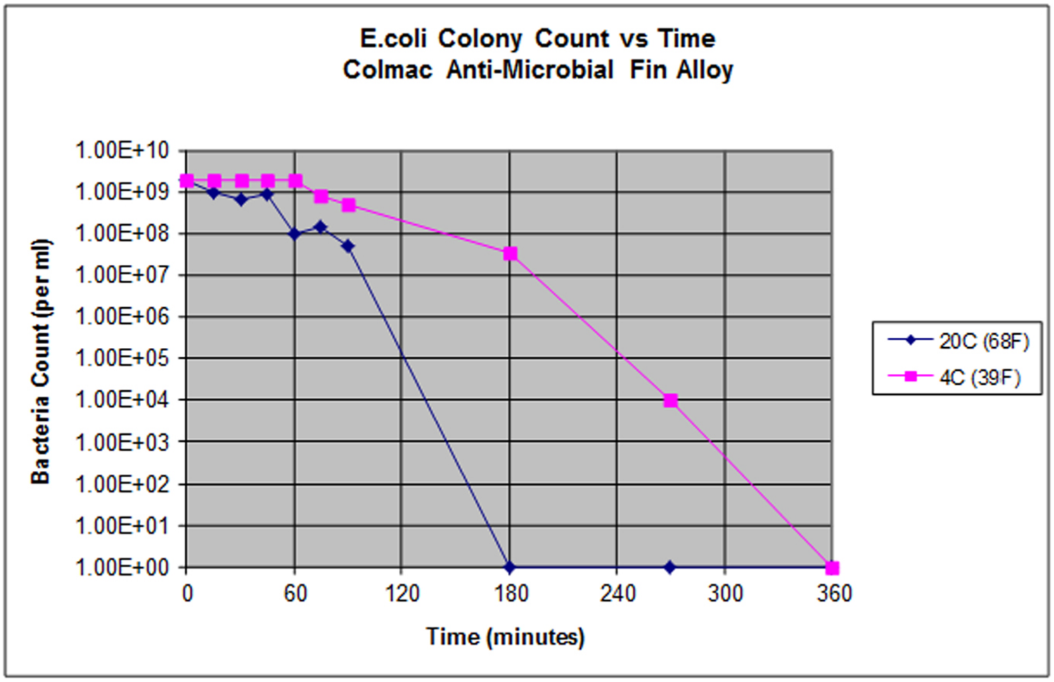
Proven Technology

Recent research has shown that exposure to the surfaces of certain metal alloys will kill cultured colonies of E.coli within just a few hours at temperatures as low as 39F (4C). Colmac has developed a new fin construction based on this research and an alloy which exhibits not only aggressive anti-microbial behavior, but also corrosion resistance to harsh chemicals commonly used as cleaners (such as potassium hydroxide and sodium hypochlorite). Stainless steel and aluminum alloys are widely used for heat exchanger tubes and fins, however, neither of these alloys exhibit any type of anti-microbial behavior. Additionally, aluminum alloys commonly used for heat exchanger fins and/or tubes are quickly corroded by high concentrations of potassium hydroxide and/or sodium hypochlorite.

Colmac is now offering heat exchangers designed specifically for food processing equipment which are constructed with stainless steel tubes and fins made of Colmac's new proprietary anti-microbial alloy (patent pending). This new heat exchanger technology is compatible with all commonly used refrigerants including ammonia, CO2, halocarbons, glycols, and brines. This new coil construction technology exhibits aggressive anti-microbial behavior, good corrosion resistance, and reasonable heat transfer performance.

Figure 1. illustrates the viability of E.coli O177:H7 on the surface of Colmac's proprietary new fin alloy at two different temperatures, 68F (20C) and 39F (4C).

Figure 1. Viability of E.coli on the Surface of Colmac Anti-Microbial Fin Alloy



Kills Coronaviruses

Newly emerging zoonotic viral pathogens (viruses found in wild animals which transfer to humans), such as the novel coronavirus COVID-19, pose a significant global health risk. Most of these are RNA viruses which are transmitted through the mucal or respiratory route and manifest as respiratory disease such as pneumonia. The World Health Organization (WHO) has estimated there are 450 million cases of pneumonia per year resulting in 4 million deaths, with approximately 200 million of these starting with viral infections.

In 2003, the coronavirus SARS which emerged in Guangdong Province in China and infected over 8,000 people was believed to have originated in bats and palm civet cats transferred to humans. In 2012 the coronavirus Middle East Respiratory Syndrome (MERS) appeared in the Arabian Peninsula and was thought to have been transferred from bats and possibly camels to humans. This virus was found to have a very low infectious dose which suggests that transmission of very few virus particles person-to-person or contact with contaminated surfaces may be an infection risk. Most recently COVID-19, also a coronavirus thought to have been transferred from bats and possibly pangolins to humans originated in Hunan Province in China. The spread of this highly contagious coronavirus has resulted in a global pandemic which is ongoing as of this writing (2020).

Research performed at the University of Southampton (UK) in 2015 showed that samples of the human coronavirus HuCoV-229E, which is associated with a wide range of respiratory disease from mild colds to severe pneumonia in immune-compromised people, were very quickly inactivated (killed) when placed in contact with the same alloy used in Colmac Anti-Microbial fins. It is known that coronaviruses persist in an infectious state on common surfaces such as stainless steel, glass, and plastics for several days, however, the metal alloy used in Colmac Anti-Microbial fins releases copper ions which then generate reactive oxygen species (ROS) which quickly inactivate the coronavirus. This process results in fragmentation of the viral genome, ensuring that inactivation of the virus is irreversible. It was shown that samples of the coronavirus placed in contact with the Anti-Microbial fin alloy were completely inactivated in less than 30 minutes. This latest research has shown that both bacterial and viral pathogens are quickly killed when placed in contact with Colmac Anti-Microbial fins.

Conclusion

Colmac has developed a new breakthrough technology for air cooling and heating coils used in food processing equipment where there is concern about possible contamination of food with pathogens such as E. coli and Listeria monocytogenes. It has been shown that these *pathogens cannot exist* on the surfaces of this proprietary new fin design (patent pending) developed by Colmac.

When combined with the advantages of stainless steel tubes, the new coil construction also resists corrosion when exposed to normal concentrations of cleaning chemicals commonly used in the food processing industry such as potassium hydroxide (caustic soda) and sodium hypochlorite (chlorine bleach). Finally, this new coil technology from Colmac is compatible with all refrigerants including ammonia, CO2, halocarbons, glycols, and brines.

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