Jaytech, Inc. E- Newsletter

"A candid conversation about water treatment issues facing today's mechanical engineers."

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Contact Me At:

mjuhl@jaytech.com

Legionella in Mechanical Systems

In the last issue of the Jaytech, Inc. e-newsletter we discussed practical considerations where legionnaires' disease is concerned. In this issue, we are fortunate to have Dr. Watson of MCS, Inc. follow up with a scientific, yet brief look at legionnaires' disease in mechanical systems.

Understanding the Legionella Conundrum

- By Dr. James Watson, MCS, Inc.

Legionellae are aquatic bacteria found primarily in rivers, lakes, streams, and ponds that reside within freshwater protozoa. The cytoplasm of free-living protozoa provides the nutrients required for the survival, growth, and propagation of these unique microbes. When environmental conditions favor protozoa, the engulfed bacteria are digested as a source of food. The relationship between these two microorganisms is one in which each wishes to benefit at the expense of the other.

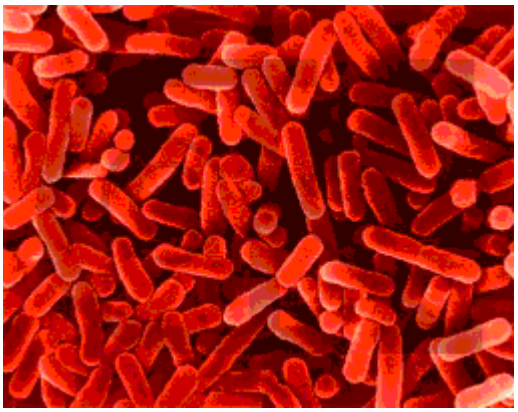
The development of hot water distribution systems, cooling towers / evaporative condensers and other water-based systems altered the natural aquatic environment. Although the level of chlorine used by municipalities to treat freshwater sources controls coli form bacteria, it has little impact on the more resistant legionella bacteria. The primary source of legionella bacteria for cooling towers and domestic hot water systems is a contaminated municipal water network. Water temperatures in the range of 68^0F to 122^0F favor the amplification of these bacteria. Aerosols generated by contaminated cooling towers and domestic hot water systems serve as the major source of legionellae for humans. In their natural state, the opportunity for legionella bacteria to cause disease in humans is quite remote. Due to manipulation of nature's aquatic environment, man becomes an unnatural or accidental host for legionella bacteria.

People are infected by inhaling tiny airborne droplets or particles (< 5 micron in size) containing viable Legionella microbes that are small enough to pass deep into the lungs and be deposited in the air sacks (alveoli). Particles <5 micron in size by-pass the mucociliary defense mechanism of the bronchial tree that traps foreign particles and sweeps them back to the oral cavity. Once in the lung, alveolar macrophages engulf (phagocytize) the invading microbes.

Helpful Links

http://www.cdc.gov/

http://www.nih.gov/



It is within macrophages where the battle rages between the host's cellular immune system and the disease-producing mechanisms of legionella bacteria. If the macrophages prevail, legionella bacteria are eliminated and the only evidence of infection is the appearance of specific antibodies in a person's blood sample. If the host-parasite struggle favors the invading microbes, legionellae overpower the patient's immune system resulting in severe pneumonia.

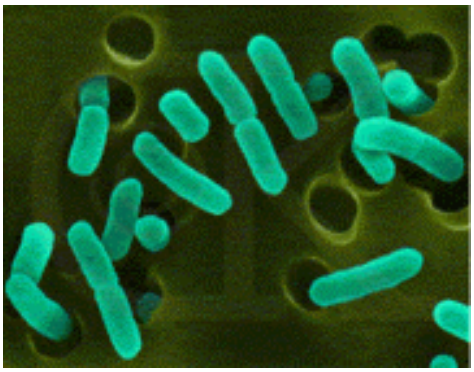
In cooling systems and domestic hot water systems, legionellae live in biofilms, complex communities of microorganisms that attach to solid surfaces. The process begins as bacteria with hair-like attachment structures protruding from their cell walls cling to a solid surface. A scaffold-like architecture forms that supports the attachment of other microorganisms, including protozoa. Adhesion becomes irreversible as some of the bacteria secrete a polysaccharide slime (glycocalyx) that cements the microbial matrix to the solid surface. The adherent bacteria replicate, and once the colonies merge, a biofilm is formed.

The protective shield of the biofilm and safety afforded within the confines of protozoa explain why legionella bacteria are difficult to eliminate from cooling towers and domestic hot water systems. Water treatment specialists must balance the level of biocide required to control legionella with the concentration of chemical that will damage a cooling or domestic hot water system.

Legionella present in a cooling tower water sample are planktonic and originate from sessile organisms that have been washed-off (eluted) from a solid surface by the circulating water. A high level of biocide will reduce the number of live bacteria in the bulk water. Many microorganisms in the biofilm adjacent to the circulating bulk water are probably killed by the biocide. Bacteria residing deeper within the matrix of the growing biofilm are probably protected from these harsh chemicals. Hence, a cooling tower containing an elevated level of biocide could "mask" the presence of legionella bacteria in the system. For this reason, we recommend collecting water samples from cooling towers when the level of biocide is at its lowest point or absent.

The presence of Legionella bacteria in cooling towers is significant and signals the need for implementing an best practice maintenance program and chemical treatment regimen to reduce the health risks associated with these microorganisms.

Low counts of Legionella bacteria do not guarantee safety because Legionella numbers can vary from day to day and may reach dangerously high levels when optimal growth conditions exist. Culture results provide information that can be used to adjust the chemical treatment protocol to maximize control of Legionella in a cooling system.



Currently, there are over 40 species of legionella bacteria, but the most commonly encountered species is Legionella pneumophila. Slight differences in the chemical configuration of the cell walls of L. pneumophila bacteria enable us to divide this species into "serogroups". A good analogy for serogroups is human red blood cells types: "A", "B", "AB", and "C". Red blood cells look the same under a microscope and perform the same biological function, but hey have variations in chemical groups located on their surfaces that allow us to place them into different types.

L. pneumophila serogroup 1 is the cause of legionnaires' disease but a similar respiratory illness also can be caused by the remaining 13 serogroups of L. pneumophila, especially serogroups 6,4, and 2. Approximately 50% of the remaining Legionella species have been associated with disease in humans but they represent a few percent of reported infections. L. pneumophila serogroups 2 through 14 and a small number of non-pneumophila Legionella caused 29% of legionella cases reported to the CDC during the period 1980 – 1989. Review of our data shows that between 35% and 40% of L. pneumophila isolates recovered from cooling towers belong in one of the 13 serogroups – 14. It is for this reason that testing is so important.

Most cases of legionellosis are sporadic, involve one to a few individuals, and are not generally reported to the public. In the U.S. Legionnaires' disease is considered to be fairly common and serious and legionella bacteria are one f the top three causes of community-acquired pneumonia. Approximately 1,000 cases are reported to the CDC each year, but it is estimated that between 8,000 and 18,000 persons are hospitalized annually with legionellosis. Under diagnoses of Legionnaires' disease is due to the fact that the illness cannot be distinguished from other bacterial pneumonias based on symptoms.

Classical Legionella pneumonia has an incubation period of 1 week and is characterized by a high fever, chills, headaches, and muscle pain (flu-like symptoms). Later symptoms include a dry cough, difficulty in breathing, and the formation of patchy legions in the lungs. A third of the patient's develop diarrhea or vomiting and half become confused or delirious. There is no evidence that person-to-person transmission of legionellosis occurs.

Legionella pneumophila and a few other Legionella species can cause a short, flu-like illness without pneumonia known as Pontiac fever. This milder condition has an incubation period of between 5 hours and 3 days. The symptoms of Pontiac fever are similar to those of moderate influenza; headache, fatigue, fever, muscle and joint aches, and in a small percentage of cases, nausea. Unlike Legionnaires' disease, a high percentage (>90%) of those exposed to the organism develop Pontiac fever. The milder disease is self-limiting, lasting 2 to 5 days, and is unaffected by antibiotic therapy.

A proactive approach for reducing the incidence of legionella infections calls for surveying cooling towers and domestic hot water systems for the presence of legionella bacteria and implementing appropriate control measures as necessary. Minimizing risks for legionellosis reduces a facility's culpability and demonstrates concern for an important public health problem.

For more information on legionnaires' disease, legionella testing, biodispersants, and effective water treatment programs, contact your local Jaytech representative or contact me at mjuhl@jaytech.com

Updated Web Site!

Take a moment and check out the latest version of the Jaytech web site at www.jaytech.com. You can now access all technical and Material Safety Data Sheets online 24 hours a day. While you're there, take our short water treatment quiz and win a prize!

Jaytech Tip

"Jaytech Tip-1" When having testing performed for legionella pneumophila, be sure the test includes all the serogroups. In this way, you are getting a complete picture of the status of your system.

"Jaytech Tip –2" When having difficulty controlling legionella, consider the use of a biodispersant. Biodispersants can penetrate the protozoa in the sessile bacteria located throughout the system and significantly improve biocide performance.

Have an idea?

If you have an idea or question you would like more information about, send me e-mail at mjuhl@jaytech.com and we'll answer it! Remember, it must be water treatment related and be of interest to other professionals such as you.

Jaytech, Inc.
1290 Osborne Rd.
Minneapolis, MN 55432
763-795-9331