

## IT'S NOT JUST MOLD

By Michael S. Greene

Ever since Steve and Melinda Ballard gained worldwide attention for their claims due to the mold contamination of their house, the focus on indoor environmental health has seemingly remained on molds and fungal contamination. Indoor environmental professionals have focused their training and practices on the study, analysis and remediation of mold to the detriment of other risks to health arising from the human occupation of buildings. This has resulted in a single-minded focus at the risk of human health.

Risks from chemicals, including household chemicals, chemicals used in components of construction and bacteriological risks also present serious health hazards. Of the latter, one of the most serious risks is posed by the disease commonly known as "Legionnaires' Disease" and, in its lesser form, "Pontiac Fever". Both diseases are primarily linked to the bacteria *legionella pneumonephilia*, and are sometimes collectively referred to as legionellosis. *Legionella pneumonephilia* is a gram negative bacteria that generates flu-like symptoms and can infect the lower respiratory tract. The risk from these diseases can be severe. While many would argue that death from Legionnaires' Disease is limited to elderly persons or persons with immuno-compromised conditions, there have been a significant number of deaths of seemingly normal, healthy individuals. With an average of 8,000 to 18,000 diagnosed cases of Legionnaires' Disease every year, and an unknown number of cases which are not properly diagnosed or reported, *legionella pneumonephilia* presents a significant risk that in many cases could be dramatically reduced or eliminated. According to the Center for Disease Control (CDC) only 2 to 10 percent of cases are reported.

Symptoms of Legionnaire's Disease include a high fever, chills, coughing and other pneumonia-like symptoms. Often, Legionnaire's Disease is first diagnosed as pneumonia. Tests for the disease include chest X-rays or blood, urine or sputum tests. The symptoms generally appear with 2 days to 2 weeks from exposure. According to the CDC death occurs in 5 to 30 percent of Legionnaire's Disease cases, with a much higher percentage arising from nosocomial (those contracted in hospital or hospital-like settings) outbreaks.

Pontiac Fever (named after the city in which an outbreak was revealed) is a milder version of legionellosis, for which the symptoms include fever, headaches, and muscle aches, but without the conditions of pneumonia.

*Legionella pneumonephilia* was only first identified in 1976, when CDC analyzed the cause of illness and death of members of the American Legion at their convention in Philadelphia. 29 persons were known to have died as a result of the *legionella pneumonephilia* outbreak, out of 180 identified cases, and when the CDC identified a newly discovered genus of bacteria, it was named after the Legionnaires.

As a result of the analysis, the CDC identified *legionella pneumonephilia* as a true building-related illness. As a primarily water-borne bacteria, *legionella pneumonephilia* found a host in air conditioning chillers, plumbing systems, pools, spas, humidifiers, water fountains, decorative fountains, dental hygiene sprayers, and other water containing vessels and devices. There did not seem to be a basis for human-to-human transmission. The general route of transmission seems to be from aspirating

aerosolized water containing the bacteria, although as I will note below, there are some cases of ingestion-caused illness. Both are a significant concern as *legionella pneumonephilia* is fairly ubiquitous.

Because *legionella* cannot be seen with the naked eye, smelled, or otherwise be readily patent to building maintenance personnel, it is, unfortunately, usually discovered when an outbreak occurs in the building. As *legionella* infections must be reported to the health department, and in Florida is a listed disease requiring notice from doctors and hospitals, the health department will generally perform an epidemiological study seeking to determine the source of the contamination. Sometimes this may be readily identified, such as in a common workplace, or may be more difficult to identify if persons were made ill at a hotel, convention or other gathering place where people arrive from different locations and soon disperse. If a common source is identified, the result may be the closing of an office building, hotel or other facility until the contamination can be found. The closing of a building can result in severe economic harm to the enterprises that occupy the closed facility. Sometimes, contamination may be difficult or impossible to find. *Legionella* contamination in traps in a piping system may be released due to an air hammer or a shift in pressure, and then either be dispersed or again sealed in its reservoir. In this event, even water sampling may not reveal the exact location. If that is the case, often extreme and expensive measures must be undertaken to ensure that all potential sources have been decontaminated. This may result in a further closure of the facility.

The CDC has noted some disparate cases where *legionella pneumonephilia* has caused serious illness or death with seemingly unrelated sources of contamination:

1. In one Italian study (see <http://www.cdc.gov/ncidod/EID/vol10no3/02-0707.htm>) more than 22% of tested residences showed evidence of *legionella* contamination of hot water systems. The study found that *legionella* could survive in temperatures in excess of 140 degrees Fahrenheit.
2. In 1994, a Bermuda-bound cruise ship was the site of an outbreak of Legionnaire's Disease (see <http://www.cdc.gov/mmwr/preview/mmwrhtml/00032265.htm>). Fourteen cases were confirmed with 28 suspected. Links were made to the whirlpool spa on the ship. Samples were taken from the sand filter for the spa, confirming the contamination, and steps were taken to eliminate the contamination, including hyperchlorination of the ship's potable water supply, removal of the whirlpool filters, and discontinuation of the whirlpool baths.
3. Spas can be an active source of legionella contamination. In a 1996 event, 23 people contracted Legionnaire's Disease from exposure to a spa on display at a home improvement center. Many of the victims were customers with only a limited exposure to the spa. While testing was performed on spa filters, a greenhouse sprinkler system, a decorative fish pond and fountain, potable water fountains, urinals, and hot and cold water taps in the store's restrooms, it was testing on a filter on a spa that had been on display and then sold that confirmed the original source of contamination.
4. Cooling towers present a common source of *legionella* contamination. In 1993, the CDC identified outbreaks in Massachusetts, Rhode Island and Michigan, with cooling towers identified as the source.
5. One of the more unusual sources of contamination identified by the CDC is commercial potting soil. Several individuals merely potting plants were identified as suffering from exposure to

*legionella pneumonephilia* with the soil as the link. In these cases, the species was identified as *legionella longbeachae*, and in one reported case, a 45-year old man died from legionellosis.

6. In 2001, 2 workers died and many more were made ill at an automotive plant in Cleveland, Ohio. Testing revealed that the source of *legionella pneumonephilia* was a finishing tank in the plant.

Responding to a *legionella* outbreak and promptly treating the disease will require educating physicians and use of tests such as urine antigen. The CDC believes that use of culturing is key to recognition of infections. The primary difficulty noted by the CDC is identifying the source of legionellosis in sporadic cases, but that rapid detection is critical to prevent further disease transmission. Improving the sensitivity of testing procedures are needed in order to more rapidly identify the condition, and remediate the source of contamination.

Treating patients with Legionnaire's Disease is difficult due to the limited effectiveness of various antibiotics. The preferred antibiotics are known as macrolides, and include azithromycin, erythromycin, and clarithromycin.

Eliminating *legionella pneumonephilia* from a water source can be more problematic. First, identifying the source may be difficult if not impossible. In a recent contamination associated with a resort property, neither the local health department nor expert consultants could detect any *legionella pneumonephilia* in any water supply, whether plumbing systems, pool, or spa. Because *legionella pneumonephilia* is easily aspirated, it is possible that a neighboring property's cooling tower could have led to the outbreak in the adjacent property. Because of the potential severity of the outbreak, the property, in an abundance of caution, undertook to remediate all potential sources of contamination, including replacing every shower head in the facility. While many of the steps taken were likely unnecessary, the potential risks associated with *legionella pneumonephilia* often result in extreme measures being taken. This case indicates the difficulty in preventing outbreaks of Legionnaire's Disease. Even if regular testing on water systems had been undertaken, it is highly likely that no potential for the presence of *legionella* would have or could have been detected.

The report "LEGIONELLA 2003: An Update and Statement" produced by the Association of Water Technologies notes the following optimal conditions that promote *Legionella* growth and amplification:

- "1. Stagnant water conditions and/or system design configurations that produce stagnation, such as side-arm and dead-leg piping;
2. Warm water temperatures between 20 and 50oC (68 to 122oF);
3. Optimal growth is at temperatures between 35 and 45oC (95 to 113oF);
4. Bulk water pH in the range of 5.0 to 8.5;
5. Sediment, scale, deposits, biofilm – support not only Legionella growth, but also that of the very important supporting microbiota for Legionella;
6. Microbiota, including algae and many bacteria that supply essential nutrients for growth of Legionella;
7. Certain amoebae and other protozoa that harbor *Legionella* as endosymbionts – allowing them to thrive, resist harsh environmental conditions (including biocides) and to significantly amplify. "

*Legionella* bacteria are found living in certain amoebae and protozoa as parasites and in the host biofilm often found in water systems. This can make the bacteria more difficult to treat and eradicate in the water system. The Association of Water Technologies notes in its report that "chlorination, UV irradiation and chemical biocides all offer temporary means by which laboratory and planktonic *Legionella* can be eradicated from a water source. However, the majority of *Legionella* do not exist as free-swimming (planktonic) bacteria. Instead they reside, well-protected, inside protozoan hosts and in the matrix of biofilm. Eventually, they are released from their hosts in the form of small vesicles that may contain hundreds or a thousand or more *legionellae* per vesicle. In terms of survival, the amoeba-grown bacteria are better able to withstand their aquatic environment and may be more virulent. This adaptation and endosymbiotic relationship with amoebae and other protozoa allows *Legionella*, among other things, to survive typical potable water chlorination (disinfection) and appear in many finished water supplies to homes, buildings and industry. '

The Environmental Protection Agency (EPA) has generally identified certain treatment methods for entire systems, including:

1. Thermal disinfection (super heat and flush);
2. Hyperchlorination; and
3. Copper-silver ionization.

Treatment and control methods to disinfect only a limited portion of a water distribution system include:

1. Ultraviolet light sterilization;
2. Ozonation; and
3. Instantaneous steam heating

The EPA notes that utilizing a combination of the disinfection methods may be best for eradicating *legionella* growth and in preventing regrowth.

It is key for environmental professionals to understand the risks of limiting their knowledge, and training, to one potential cause of disease. Without an understanding of the multiple impacts the built environment can have on occupants, the environmental professional may leave a serious condition undetected and undiagnosed, result in significant health exposure to people, and will expose himself or herself to liability for not identifying the potential conditions. Improved understanding of the host source of *Legionella* can increase the effectiveness of prevention and control measures in buildings and enable the building owner to better protect its occupants. The indoor environmental profession should seize the opportunity to prevent and rapidly identify the sources of this potentially deadly disease.