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# Controlling *Legionella* and *Legionella Pneumophila* in water systems

**This disease-causing bacteria thrive in wet areas where conditions are favorable for growth.**

**Related Information**

- Preventative thinking

Increasing heating charges mean that maintaining hot water systems to the recommended temperature has now become a major cost burden to most organizations. Not only is this not energy efficient, it is not a cost effective way of controlling bacteria. Legionnaires' disease is a severe, progressive form of pneumonia, which is fatal in up to 15 percent of cases. The cause of the disease was first identified in 1978 after an epidemic outbreak of pneumonia amongst American Legion conventioneers in Philadelphia in 1976. The cause was identified as a rod-shaped bacteria later named *Legionella Pneumophila* (LP). Affecting between 10,000 and 20,000 people in the U.S. every year, LP thrives in wet areas where conditions are favorable for growth. In fact LP is present in the water samples of nearly all cooling towers, but is not of a level to cause human health effects.

Several other natural water systems and many man-made systems have been shown to harbor the *Legionella* bacteria. These include mains water supplies, potable hot and cold water systems, recirculation water humidifiers and whirlpools, spas and Jacuzzis.

**Prevention**

LP may be able to colonize certain types of water fittings, pipe work and materials used in the construction of water systems. The presence of such materials and of large quantities of sediment may provide nutrients for *Legionella* and can make eradication difficult.

In practice, LP is found in many recirculation hot and cold water systems particularly in larger, complex systems such as those found in hospitals, hotels, office block and factories.
*Legionella* is transmitted exclusively by inhalation of contaminated water droplets. The organisms must be present in sufficiently high concentration and must be suspended in aerosol between 3 and 5 microns in diameter. There is no evidence of obtaining the disease from ingestion or contaminated water or absorption through the skin. High-risk areas are therefore primarily associated with showers, sprays, spray taps, taps with high water pressure and refrigeration and air conditioning cooling towers.

**Scale**

Scale is a major problem in both hot and cold water systems. Dripping taps can deposit scale in and around the tap and, with high ambient room temperatures, provide an ideal growth medium for LP. In hot systems, scale can trap *Legionella* and biofilms. This provides a perfect growth medium that disinfectants cannot penetrate. Scale deposits colonized by *Legionella* can continuously recontaminate a system, even after disinfection. Trapped biofilms are a source of nutrients for LP and can lead to taste and odor problems from the products of their metabolism.
Scale is a major cause of inefficiency in hot water systems. Scale on heat exchange surfaces dramatically reduces the heat transfer efficiency and promotes corrosion in the calorifiers and pipe work. Descaling of a hot water system is time consuming and expensive. Water softeners can reduce scale, but there is growing concern over the increase to sometimes-high levels of sodium in the water.

**Air conditioning and refrigeration water systems**

Many air conditioning and refrigeration plant systems are water-cooled. The heat generated by cooling coils is removed by water, which is passed through a water-cooling tower. These are recirculating systems, which operate at temperatures ideal for bacterial and algal growth and have plentiful supplies of nutrients. They have been highlighted as a major possible source of Legionnaires' disease mainly because of the large number of people that can be affected. However, in a tower that is well-designed and maintained, chances of problems with LP are greatly reduced.
Most cases of outbreaks have occurred in towers, which were badly designed and had little or no maintenance. In cooling towers, temperature, water hardness, pH, scale and corrosion are all factors which increase the chance of biofilm, algae and *Legionella* colonization. Many agents are used to control these factors, including scale and corrosion inhibitors, dispersants and biocides. Water softeners are sometimes used for soft water, which can cause a problem with foaming.

Biofilms are a major problem in cooling towers. Biofilms and scale can reduce the efficiency of cooling systems to the point where the system no longer functions with regard to heat transfer. Health and safety officers recommend the periodic chlorination and descaling of cooling towers. However, chlorine is not always compatible with other treatment chemicals like corrosion inhibitors, it is not effective in alkaline water and it can cause corrosion. Some biocides are effective against LP if used in sufficient concentration. Strains of LP and other bacteria may become resistant to particular biocides, hence dual or alternating biocides are used.

What is required in all the systems — cold, hot and process — is a method of continuously controlling scale deposition and a water treatment regime which prevents the growth of biofilms, bacteria and, in particular, LP. This method is now available in the form of electronic scale treatment of water to prevent scale deposition together with the chlorination of all water supplied to a building or factory, both hot and cold.

**Electronic water treatment**

Electronic water treatment involves the fitting of electronic water descaling equipment at strategic points in the water system. Water treated by such systems will prevent scale from forming in pipe work and on heat transfer surfaces and will also, over a period of time, remove existing scale deposits. There are many advantages to this non-intrusive engineering solution, including:

- Energy use is greatly reduced due to heat exchange surfaces remaining
- Free of scale deposits (just a ¼-inch of scale increases energy costs by around 40 percent)
- Corrosion caused by scale deposits is eliminated
- Extensive downtime and labor cost involved in descaling systems is eliminated
- A source of colonization by biofilms and LP is removed
- Water distribution efficiency and pressure is increased by removal of scale deposits, which can reduce pipe diameters considerably.