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Avoid Legionellosis Lawsuits over Cooling Towers

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Microbe spread can be prevented by proper maintenance and effective



drift prevention

Editor's comments

Two thoughts crossed my mind when I decided to reprint this article :

1. How is it that Legionellosis has been reported in many countries and quite frequently at that, except in India? Could it be that our microbiologists, doctors and hospitals cannot tell

the difference between Legionellosis and some other disease with similar symptoms?

2. The legal implications brought out in the article, may seem far fetched to some, but not after reading in newspapers here, the path-breaking judgement handed down by the Delhi High Court in April 2003, which adds a new dimension to the law of torts by holding civic authorities equally responsible for the Uphaar cinema fire, as the owners of the cinema, the Ansal brothers.

Punitive damage totalling Rs. 17 crore was imposed to compensate 157 victims of the tragedy, with the Ansal brothers paying 55%, and the balance 45% equally divided between the Delhi Police, Municipal Corporation of Delhi and Delhi Vidyut Board.

Do we have to wait for a large scale infection by Legionella from HVAC cooling towers before we wake up to the threat and take steps to control the source of infection?

Legionellosis, the disease caused by Legionella sp., is common. Although most people might guess it is rare, outbreaks of it, defined as a cluster of three or more cases in a single locale, occur regularly in the United States and much of the developed world. They have been reported in Australia, Holland, Thailand, Japan, England and many other countries. [1-7]

In the U.S., the Center for Disease Control (CDC; Atlanta, Ga.) receives reports of 1,000 cases of Legionellosis annually. The Center believes that this represents 10,000 to 15,000 unreported cases each year. [8,9,10]

Since you can never be certain that Legionella are not present in your cooling tower, it is always possible that someone may become infected. Owners and members of the maintenance team are, therefore, constantly open to legal problems should someone become ill with Legionellosis.

Know your bacterial enemy

Due diligence (box p. 80) is demonstrated by maintaining the cleanest possible tower conditions, along with effective methods of drift prevention. It helps immensely to know the life cycle of Legionella sp. Then we can deal with effective methods of control.

Chances are high that Legionella is present in a given cooling tower. In one study, more than half of the 80 samples collected from cooling towers contained Legionella [18]. Most authorities agree that cooling towers are a principal source of Legionella infection.

Legionella are hardy bacteria that are difficult to kill with normal chemical biocides [19]. They thrive in the backwaters of the system, on submerged equipment and particle surfaces where they become part of the bacterial slime coating.

Embedded in this slime, Legionella are protected from exposure to biocides dissolved in the water. Further protection is afforded by the fact that Legionella are protozoanotic; they live and reproduce within the bodies of other microbes, especially amoebae and paramecia [8]. These protozoa are not very sensitive to the biocides used to control bacteria, and therefore represent a sanctuary for populations of Legionella. Even after a cleaning, Legionella from surviving protozoa can, within weeks, reestablish a population in a cooling tower [20].

For this reason, ASHRAE and other groups [9,10] recommended regular cleaning, water treatment, and monitoring of the tower as the best way to minimize the potential for disease transmission. Since many common biocides are ineffective at eliminating Legionella [19], care must be taken to use those that are most effective, as discussed below. There is some concern that Legionella, through constant exposure, may become resistant to particular effective agents. Consequently some authors recommend rotating biocides [20].

Oxidizing biocides are often reported to be effective. Chlorinebased oxidants seem to work best if used as periodic shock treatment in large doses. However, protozoa are not as susceptible to chlorine as are bacteria, so use chlorine at high levels to ensure these Legionellaprotecting organisms are eliminated.

Ozone also has been proven effective, and can be used continuously [9]. Ozone breaks down the organic constituents of slime, and if concentrations are suitable, denies this protective habitat to Legionella. Though a regular biocidal treatment program cannot guarantee that Legionella are not present in your system, it will ensure the minimum population that can be attained. This will reduce the potential for transmission of the disease.

Legionella growth is stimulated by contaminants in cooling water. Dissolved organic materials serve as nutrients for bacteria and protozoa. Particulates, especially in the finer size ranges, provide surfaces for bacterial colonization, and, if they are organic, can supply an additional source of nutrients. A side stream filtration system will reduce the level of suspended particulates [9,10,21].

Many side stream options exist, including cartridge, bag or sand filters. Centrifugal separators do not remove very small or low-density particles, and are therefore not

appropriate for this purpose. **Table 1** shows the reduction in the number of particles after filtration, especially in the finer size range where most of the surface area and nutrient value exist.

Table 1 : The effectiveness of sand filtration with 5-mm media

Particle size µm	Particle count before filtration*	Particle count after filtration*
1 to 5	44,879,400	346,760
5 to 10	55,88,600	36,920
10 to 25	1,410,600	24,060
Over 25	126,800	8,760

* Data supplied by Process Efficiency Products, Mooresville, NC

Once a proper biocide and filtration program has been instituted, there is no more that can be done to eliminate Legionella. Even then the possibility exists that a viable Legionella population may survive in the tower.

It is also important to minimize the chance of transmitting the diseases by containing the aerosol-drift plume [9,10]. This is accomplished by installation of drift preventers where they have not been installed, as well as positioning the cooling tower for minimum drift potential. Prevailing winds and other factors important to the drift trajectory should be included as primary criteria in determination of an appropriate location.

Recommendations

Implement the following eight suggestions and they will help establish due diligence. This represents the best that present-and-accepted technology can do to prevent infection and the spread of Legionella.

1. Take care when designing a cooling system to avoid dead legs, or other traps, where water may avoid exposure to disinfection procedures.
2. Choose a location for the cooling tower after considering if any aerosol plume may be produced. Insure that the drift trajectory is away from populated areas.
3. Design appropriate disinfection and cleaning protocols, including chemical delivery systems and side stream filtration, into the tower system from the beginning.

Retrofitting a poorly-designed cooling system will significantly reduce the potential

for infection, and will contribute to demonstrating due diligence in the protection of the public

4. Operate the side stream filtration system continuously. Filter systems that remove low-density organic particles must be used, since these particles provide habitat and nutrients that stimulate bacterial growth, including Legionella.
5. General maintenance should include regular and thorough cleaning of the tower sump and fill. At this time remove any sediment accumulations and scrub films off of fill and basin surfaces. If a tower is to be idle for more than a few days, it should be drained. Upon refilling the tower, a shocking dose of an effective biocide should be administered
6. A continued course of regular applications of biocide treatment must be maintained in a protocol consistent with effective Legionella control.
7. Install drift eliminators to discourage formation of any aerosol plume, because inhalation of aerosols containing Legionella cells is the only demonstrated pathway of transmission of this disease [13].
8. Keep detailed records of all maintenance procedures. This is extremely important. A detailed logbook documenting chemical treatment and all other steps and data collection necessary to demonstrate due diligence will be critical evidence should any legal proceedings be initiated.

LEGIONELLOSIS AND THE LAW



Many people are infected by Legionella living in HVAC cooling towers, making Legionella a significant threat to indoor air quality. A building with indoor air contaminated by chemicals or bacteria is called a sick building, and is said to be suffering from Sick Building Syndrome (SBS). Reference [11] specifically lists Legionella infection as one of the effects of sick building syndrome. Representative Waxman of California introduced a bill (HR2919) in Congress to authorize a national program to reduce the threat of disease posed by exposure to contaminants in indoor air. It is still in committee stage.

Data eventually will be gathered covering outdoors and factory installations. It will provide evidence of risk, especially to workers assigned to jobs in proximity to cooling towers. So as long as there are clever lawyers, the risks that apply to buildings will apply everywhere.

Serious legal consequences

The law holds owners and members of building-construction and maintenance teams to a high standard of care. They have a duty to avoid or abate SBS conditions that create an unreasonable risk of physical harm [13], and are required to take a proactive role in identifying and abating SBS conditions, or face expensive and protracted litigation [14]. Similar measures are, obviously, prudent with regard to process plants.

Unfortunately, in our litigious society, should the owner, construction or maintenance management teams fail to meet these high standards of care, attorneys for the plaintiff would certainly include all parties in any suits that are filed. Owners are especially vulnerable, since they are usually remote from the construction and daily maintenance operations and assume that all team members have adequately met their expected standards. Usually owners are considered "deep pockets" to be targeted for suit should any other building team member fail in its responsibilities. It is, therefore, in the best interest of building and process plant owners to insist on the best possible disease-preventing design and technology.

The building team must keep informed of advances in the science of building design and maintenance. Since this technology advances faster than industry standards change, it will be difficult to argue that adherence to traditional methods is adequate to meet the required standard of care. To quote one legal source, "It may become increasingly difficult to convince a jury that building owners, contractors and design professionals have met their respective standards of care simply because they rigorously adhered to traditional industry standards" [15] Possible Legal Action In SBS cases, plaintiffs can consider several causes of action, including breach of contract and express warranty; breach of implied warranty; strict liability; negligence; breach of covenant of quiet enjoyment by constructive action; fraudulent concealment and misrepresentation; nuisance; assault and battery and emotional stress. [12,13]. Recently, personal-injury attorneys have become alerted to the health effects of indoor air pollution, especially in regards to microbial infection.

There have already been several instances of tort action. In one case, everyone, from the architects to the suppliers for a building was sued, when it had to be abandoned due to the effect of indoor air pollution. Building on this precedent, the building owners, their maintenance team and the entire construction team, including architects, engineers,

construction managers, contractors, sub-contractors and building-material suppliers, can be held responsible should anyone contract Legionellosis from a contaminated air-conditioning system. The suit, filed in Texas, claimed \$4.6 billion in damages for the effects of SBS [12].

From the list of possible actions, most attorneys would choose negligence. The others are more difficult to prove or do not allow for significant damage claims. According to the precedent set in *Ward vs. Hobart Manufacturing Co.* [16], to recover damages for negligence four elements must be demonstrated:

1. Duty - The plaintiff must be protected under some rule of law against the defendant's conduct
2. Breach - The defendant's conduct must have violated this duty
3. Causal relationship - The plaintiff's injury must be the result of the defendant's conduct
4. Damage - The plaintiff must have suffered a loss

Due diligence

Due diligence The American Soc. Of Heating, Refrigerating, and Air conditioning Engineers (ASHRAE; Atlanta, Ga.) has studied the problem for several years and in 1998 published a position paper [10]. In this paper the organization emphasizes the need to maintain a clean system as the best protection against an outbreak of Legionellosis. Further, it suggests some technologies useful in maintaining a clean system, and presents a review of the legal benefits in implementing these suggestions. In essence, its argument, and those of others who have published similar reviews recently, is based on the idea of due diligence.

To perform due diligence, one must do everything that can reasonably be done to prevent a problem. If no regulations were violated and no more can be done than was done, then no negligence has occurred. If one has performed due diligence, a tort can still be brought against him or her, but it will have little standing in court.

If owners or members of the building team have not refused to use reasonably priced, effective technologies and practices, a court cannot find there was failure to consider the health and well-being of the building's users. In other words, though an outbreak might still occur, the chance is much less likely, and such an outbreak could not be attributed to any callous and negligent behaviour on the part of the defendants. In all probability, attorneys will decline to pursue a case where due diligence is demonstrable.

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