Tower Tech Modular Cooling Towers And Legionella Control

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Introduction

There are six events that must ensue in order for a Legionellosis case to occur: (1) An environmental reservoir must exist; (2) multiplication to high cell counts must occur; (3) there must be a mechanism to disseminate bacteria; (4) the disseminated strain must be virulent; (5) infection must occur at susceptible site on a host; and (6) the host must be susceptible.

Being reservoirs of water and dust, all cooling towers can potentially harbor Legionella sp. bacteria thereby satisfying event (1). Events (4) through (6) are beyond the control of cooling tower manufacturers and operators. Thus we have events (2) and (3) in which to exert a protective influence. The environmentally friendly and operator friendly design of the Tower Tech Modular Cooling Tower™, especially when combined with a judiciously administered and monitored biocidal treatment regimen, effectively addresses events (2) and (3).

Controlling Multiplication

Flow-Thru Basin

The enclosed Flow-Thru Basin™ design of the Tower Tech Modular Cooling Tower greatly reduces the entry of dust and other airborne debris into the tower. The use of an optionally available cyclone filtration system can further remove suspended solids. Unlike conventional sand filtration systems, cyclone filters provide no breeding ground for bacterial growth to occur, nor a seed reservoir for continual re-infection of the cooling loop. This reduction in overall solids loading reduces the nutrient load in the system needed for Legionella to grow. Furthermore a reduction in solids reduces the effective biocide demand. Oxidizing biocides are non-targeted that is they can oxidize any system carbon matter just as effectively as bacteria. This results in biocides being used up indiscriminately within the system.

The enclosed design of the Flow-Thru Basin™, in contrast to conventional louvered (cross-flow) and/or conventional open basin (counter-flow) designs, also prevents the entry of sunlight into the basin, deterring the growth of algae which are predominantly photosynthetic. Algae can serve as a food source for bacteria, as well as the protozoa known to harbor Legionella allowing them to evade biocidal treatment.

Water flow through this Flow-Thru Basin is ~5–7 fps, preventing the settling of any remaining debris. Further this higher velocity flow impairs the attachment of bacteria to surfaces, the first step in biofilm formation. The high velocity water creates shear stress on any attached forms impairing further growth of the biofilm layer. High velocity water also impairs diffusion of nutrients into the biofilm layer making it difficult to sustain life. Legionella are more easily inactivated by biocides when in a free-living state rather than embedded in a protective biofilm.

Rapid System Turnover

The Modular Cooling Tower's Flow-Thru Basin reduces the total amount of system volume contribution compared to conventional towers using large basins. This reduced overall system volume increases cooling water turnover time, that is, it decreases holding time. This results in dilution of nutrients, as well as system bioloads. (Note: Use of external or auxiliary basins may lessen or eliminate this design benefit.) Due to rapid system turnover, biocide dosing regimens must be more frequently administered, preferably using continuous dosing schemes (for example, brominators). Infrequent slug administrations should be avoided.

Controlling Dissemination

High Efficiency Drift Eliminators

Drift eliminators are a key means of reducing tower drift. Tower Tech utilizes state-of-the-art, high efficiency drift eliminators employing a sinusoidal-shaped wave configuration. This configuration allows three forced changes in airflow direction resulting in a minimum escape of water particulates which in an infected tower may harbor bacteria.

Absence of Side Air Louvers and Open Basins

In addition to concerns about tower drift one also needs to be aware of the potential for Legionella dissemination through tower windage. In open reservoir designs when the tower fan is idle, a reverse airflow condition can be established so that if water is circulating (as in free cooling) droplets can become entrained in the air, exiting the tower at the reservoir air intake opening. In fact, windage was considered the vector for an outbreak of Legionnaire's disease in Staffordshire, England in 1985.

Lower Exiting Air Velocities

The use of Tower Tech's Bottom Mounted Fan™ technology results in lower exiting air velocities and consequently less drift. Tower Tech's cooling tower module drifts on average less than 0.002% compared to the cooling tower industry's average of 0.01%.

Other Considerations

Site Considerations

The separation distance between cooling towers and air intakes should be the maximum possible (no less than 25 feet) to avoid the ingestion of tower drift into building air-handling systems. This separation will also improve thermal efficiency by reducing the opportunity for recirculation and also the ill effects of starving the system of intake air. It is important to consider prevailing winds in this assessment as they may increase the distance requirement significantly depending on their velocity. It is also wise to avoid locating towers near populated or highly trafficked outdoor areas.

Operational Considerations

It pays to operate a cooling tower at the lowest possible cold water temperature. This reduces workload on chillers and other process equipment, thus significantly improving energy efficiency and improving the biosafety of the tower. Researchers have noted that the single best predictor of Legionella in cooling towers is warmer reservoir temperatures. Temperatures below 61°F prevent rapid proliferation of Legionella, keeping counts to a safer level. The Modular Cooling Tower's ability to successfully vary water flow by the use of its Variable-Flow Rotary Spray Nozzle™ results in the ability to use all fill material rather than shutting off flow to a given cell. The end result is often cooler, biologically safer water at a lower energy cost.

Water Treatment Considerations

When using a conventional chemical treatment regime it is critical that an oxidizing biocide be included in the control regimen. Non-oxidizers have little or no efficacy in controlling Legionella. Furthermore these non-oxidizers may control competing microorganisms providing an ecological foothold for which Legionella can multiply in an unabated fashion. Maintaining a continuous residual of at least 0.1 ppm to 0.3 ppm bromine or 0.3 ppm to 0.5 ppm chlorine is necessary for proper control, hence well calibrated control equipment (ORP) is critical. Lastly, conventional scale inhibitors such as polymers, phosphonates, and phosphates can enhance biocidal effectiveness by eliminating the scale layers under which Legionella can safely lurk, guarded from direct contact with system biocides.