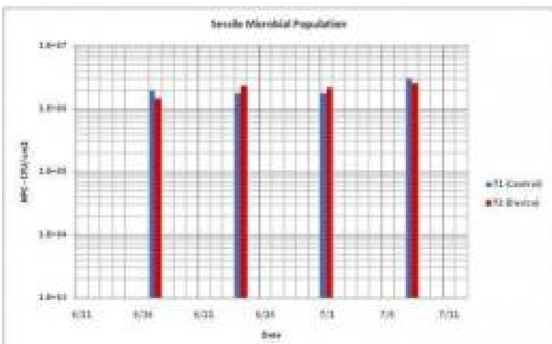
Study finds 'green' water treatments may not kill bacteria in large building cooling systems

December 10 2010



The model cooling tower treated with the pulsed electric-field device (T2) showed no significant difference in bacteria population than the non-treated tower during one month of side-by-side operation. Similar results were observed for all NCDs. Bacterial populations are expressed in density of living cells (colony-forming unit, or CFU) per square centimeter. Credit: University of Pittsburgh

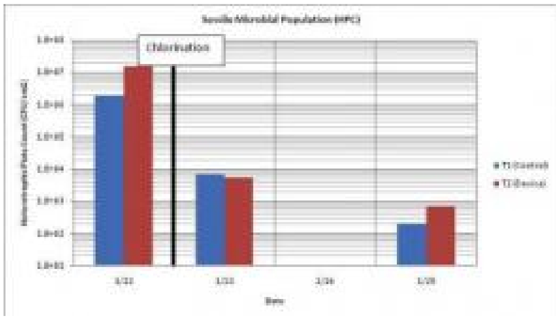
Nonchemical treatment systems are touted as environmentally conscious stand-ins for such chemicals as chlorine when it comes to cleaning the water-based air-conditioning systems found in many large buildings. But a recent study by University of Pittsburgh researchers suggests that this diverse class of water-treatment devices may be ineffective and can allow dangerous bacteria to flourish in the cooling systems of hospitals, commercial offices, and other water-cooled buildings almost as much as they do in untreated water.

The two-year study by a team in Pitt's Swanson School of Engineering is the first to thoroughly investigate the ability of nonchemical treatment devices (NCDs) to control the growth of bacteria in water-based cooling systems. Of the five NCDs tested, none significantly prevented bacterial growth. On the other hand, the researchers found that standard chlorine treatment controlled these organisms, even after bacteria had been allowed to proliferate.

"Our results suggest that equipment operators, building owners, and engineers should monitor systems that rely on NCDs to control microorganisms," said coinvestigator Janet Stout, a research associate in the Swanson School's Department of Civil and Environmental Engineering and director of the Pittsburgh-based Special Pathogens Laboratory. Stout worked with fellow lead investigator Radisav Vidic, chair and William Kepler Whiteford Professor of civil and environmental engineering, and Pitt civil engineering graduate student Scott Duda.

"These cooling systems are energy efficient and, if properly treated, very safe," Stout continued. "But based on our results, nonchemical devices alone may not be enough to control microbial growth. One possible measure is to add chemical treatment as needed to prevent a potential health hazard."

The air systems the team investigated work by piping chilled water throughout a building. The water warms as it exchanges temperature with the surrounding air and becomes a hotbed of microorganisms before returning to a central cooling tower to be cleaned and re-chilled. If the returning water is not thoroughly cleaned, bacteria can spread throughout the system, exposing people within the building to possible infection and hampering the system's energy efficiency.



After a chlorine treatment was administered, the microbial populations in both model cooling towers fell by four orders of magnitude within three days. Credit: University of Pittsburgh

The team constructed two scale models of typical cooling towers. One model remained untreated while the other was treated with five commercially available NCDs installed according to the manufacturers' guidelines. Each device was tested for four weeks. Chlorine was administered three times during the study to demonstrate that an industry-accepted chemical treatment could kill bacteria even in a heavily contaminated system.

The five devices tested represent different classes of NCDs, Vidic said. Pulsed electric-field devices emit electromagnetic energy that, in theory, ruptures bacterial membranes and activates particles that ensnare the bacterium. Electrostatic devices function similarly by producing a constant static field.

Ultrasonic devices pass a mixture of untreated water and high-pressure air through a chamber that purportedly disintegrates the bacterium with sound waves. For hydrodynamic cavitation devices, two cone-shaped water streams collide to form a vacuum region filled with high-friction bubbles that collide with and presumably deactivate the bacteria. Finally, the team tested a magnetic device, although magnetic NCDs are intended to prevent mineral buildup, not control bacterial growth.

Provided by University of Pittsburgh

Citation: Study finds 'green' water treatments may not kill bacteria in large building cooling systems (2010, December 10) retrieved 25 April 2024 from https://medicalxpress.com/news/2010-12-green-treatments-bacteria-large-cooling.html

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