Concentrates

Chemistry news from the week

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WATER

Legionnaires' disease outbreaks tied to Flint water problems

Corrosion in drinking water pipes allowed deadly bacteria to flourish

The water crisis in Flint, Mich., didn't just poison children with lead; it also likely contributed to two outbreaks of Legionnaires' disease, according to a new study (*Environ. Sci. Technol. Lett.* 2016, DOI: 10.1021/acs.estlett.6b00192).

In 2014, Flint stopped taking drinking water from Detroit and instead started treating water from the nearby Flint River. After this switch, the city's treatment plant didn't adequately control the water's corrosiveness, creating ideal growth conditions for deadly *Legionella* bacteria. The study is a wake-up call to the many cities failing to address corrosion in their aging water pipes, the authors say.

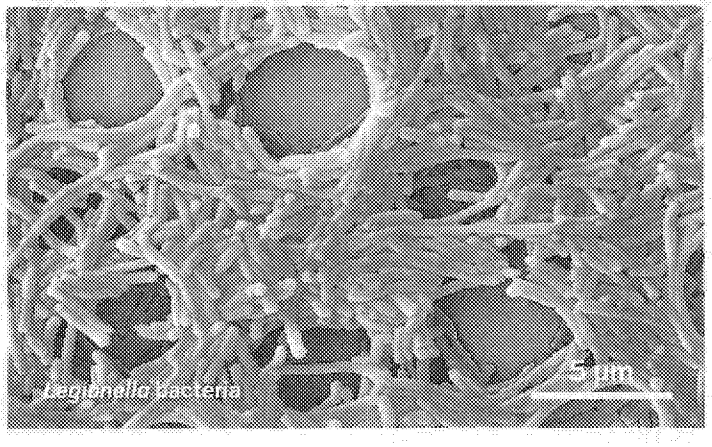
Legionnaires' disease is a deadly pneumonia caused by inhaling *Legionella* bacteria that lurk in the organic matter lining drinking water pipes. "Lab-scale type studies have illustrated that corrosion in drinking water pipes can stimulate the growth of *Legionella*," says Amy Pruden, an environmental microbiologist at Virginia Tech and an author of the study. Corrosive water dissolves the protective mineral lining in pipes and then leaches iron out of old iron pipes. Iron is a micronutrient that boosts *Legionella* reproduction. The metal also reacts with and inactivates chlorine disinfectant that otherwise would kill the bacteria.

The Virginia Tech team thought conditions in Flint were ripe for *Legionella*. So before the city switched back to Detroit water in October 2015, the scientists sampled Flint's water for *Legionella*, iron, and free chlorine. At the time of sampling, Flint had already experienced outbreaks of Legionnaires' disease in June 2014 and May 2015.

Legionnaires' disease 101

- **Cause:** Breathing in small droplets of water containing *Legionella* bacteria
- **Incidence:** 5,000 cases per year in the U.S.
- **Fatality frequency:** One in 10 cases
- **Who's vulnerable?** People over 50, smokers, people with chronic lung disease, and people with compromised immune systems
- **Symptoms:** Cough, shortness of breath, fever, muscle aches, headaches, and more
- **Common sources of infection:** Contaminated water in shower stalls, cooling towers for large air-conditioning systems, decorative fountains, and hot tubs

Source: Centers for Disease Control & Prevention



Legionella bacteria

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The researchers, led by Marc A. Edwards, collected tap water samples from homes and hospitals in and around Flint and determined *Legionella* concentrations using quantitative polymerase chain reaction methods. They compared the measurements to those from baseline U.S. water surveys that they and the Environmental Protection Agency carried out in the absence of outbreaks and to those from Flint buildings that remained on Detroit water.

In homes supplied with Flint River water, the scientists recorded *Legionella* concentrations roughly seven times as high as those found in the baseline surveys. The team found high levels of iron, 51 ppb, in the Flint homes and hospitals using Flint River water, but found no iron in nearby businesses using Detroit water. In more than half the water samples from homes supplied with the treated Flint River water, the researchers could not detect any chlorine. No *Legionella* bacteria were detected in the buildings using Detroit water.

"All this information adds up: The conditions that resulted from the switch in source water were favorable to growth of *Legionella*, and because of that, disease cases occurred after the switch," says Janet E. Stout, director of the Special Pathogens Laboratory in Pittsburgh, the nation's leading *Legionella* testing lab. "Water operators need to understand that when water service is disrupted, the risk of Legionnaires' disease can go up and the community should be notified," she concludes.—JANET PELLEY, special to C&EN