Pipe-dwelling bacteria use slimy strategy

Some infectious microbes can establish thriving colonies in the plastic pipes commonly used to carry water, thwarting all attempts to flush them out. Investigators have now unraveled the mechanism by which one such organism resists even the harshest germicide attacks. Their findings suggest pharmaceutical manufacturers should take aggressive steps to keep their distribution pipes whistle-clean.

The colonizers in question belong to the genus *Pseudomonas* and commonly live in soil and water. Although these bacteria rarely cause disease in healthy people, some can cause serious and even fatal infections in people with compromised immune systems, open wounds or medical implants.

In the past decade, several reports have linked infectious outbreaks among hospital patients to *Pseudomonas*-fouled batches of an iodine solution routinely used to clean medical equipment and to disinfect skin before surgery. Those reports surprised disinfectant manufacturers, who assumed iodine would kill any stray microbes that got into it.

Scientists subsequently found *Pseudomonas* could survive in bottled iodine solution for up to 15 months, and government researchers fingered plastic distribution pipes used in the manufacturing process as the source of the contamination. That federal team has now developed a laboratory model that explains the microbe's extraordinary ability to shield itself against germicides.

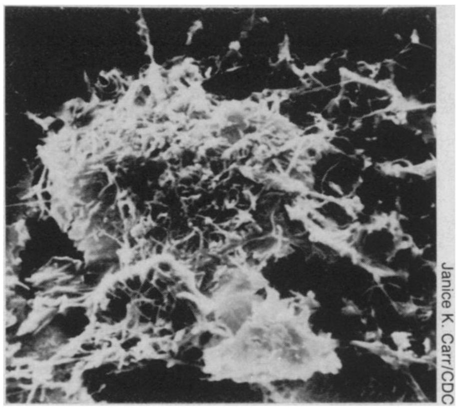
Roger L. Anderson and his colleagues at the Atlanta-based Centers for Disease Control took plastic pipes and filled them with water contaminated with two strains of *Pseudomonas*. After allowing the bacteria to incubate for eight weeks, the scientists emptied out the infested water and doused the pipes with germ-killing chemicals, including chlorine and an iodine disinfectant, for seven days. They then refilled the pipes with sterile water and periodically sampled the "clean" water. In the January AMERICAN JOURNAL OF PUBLIC HEALTH, the team reports that both strains survived in the chemically treated pipes and reestablished colonies there.

The research suggests *Pseudomonas* has a clever way of eluding its attackers: It secretes a sticky slime that builds up on the pipe interior. A germicide flushed through a water distribution system kills free-floating microbes, but it can't touch bacteria embedded in the slimy biofilm. "You have a continuous reservoir of microorganisms that could contaminate water flowing through pipes," Anderson notes.

For manufacturers piping iodine disinfectant from one processing point to another, the findings suggest that free-floating bits of biofilm that break off during production remain impenetrable and can foul the iodine solution itself, Anderson warns.

That's just what happened to one Chicago manufacturer whose disinfectant picked up *Pseudomonas* while flowing through plastic pipes leading from a storage tank to the plant's bottling area. The company eliminated the problem by replacing its plastic pipes with stainless steel ones and regularly flushing them with scalding water to kill floating microbes and prevent biofilm buildup, Anderson says. Firms using plastic pipes – which may not withstand scalding – can instead mechanically scrape away the matrix of microbes and slime that coats interior pipe walls, says biofilm researcher J. William Costerton at the University of Calgary in Alberta.

Scientists already are seeking new types of plastic that prevent bacteria and their slime from adhering to the surface, notes Warren Litsky of the University of Massachusetts at Amherst in an editorial accompanying the research report. Such an advance would reduce the threat of contamination in pipes used to manufacture disinfectant or carry water in hospitals, homes and whirlpool facilities, Anderson adds.



Scanning electron micrograph of the interior surface of a plastic pipe after exposure to Pseudomonas*-infected water. The bacteria secrete a sticky material that adheres to pipe walls and forms a shield against disinfectant treatment.*

A victory over microbial settlers would also reduce infection risks in people who rely on plastic or metal implants such as artificial heart valves or pacemakers, Litsky says. A biofilm can shield microorganisms from antibiotic treatment, causing repeated bouts of infection for such patients, Costerton adds.

– *K.A. Fackelmann*

Rain calms the crash of ocean waves

Crashing waves form walls of white water that can make a sailor beg for mercy. But a driving rain, according to new laboratory experiments, can actually reduce the number of large, breaking waves, its pelting force calming the sea like a sedative. This somewhat counterintuitive finding may change the way scientists interpret radar measurements of wind speed at the ocean surface.

British oceanographer Stephen A. Thorpe of the University of Southampton says he came across his first hint of the calming effect of raindrops a decade ago while recording underwater sound reflected from the ocean's surface. Thorpe found that raindrops, which produce a characteristic, high-frequency hiss when they strike the ocean (SN: 1/4/86, p.4), seemed to reduce the number of breaking waves.

To verify that observation and to learn how raindrops could stop large waves from breaking, he and graduate student Michael Tsimplis recently conducted a simplified experiment. By generating waves in a shallow, 43-foot-long water tank and setting up 3,200 dripping hypodermic needles to simulate steady rainfall, they found that rain exerts its influence through an indirect route.

The researchers report in the Dec. 21/28 NATURE that water droplets in their experiment suppressed the formation of mid-sized water waves – those with about 4 inches between crests. Because wind relies on mid-sized waves to transfer energy to larger waves, eventually causing these giants to crash, rain can help slow or stop the process before it builds force, Thorpe says. Though rain creates its own small ripples, he adds, its ability to dissipate mid-sized waves – probably through the turbulence it creates at the ocean's top layer – has an overall quieting effect.

An understanding of precipitation's tranquilizing properties may offer insights to several phenemona, including the placid, ripple-free appearance of a lake after a rain, Thorpe says. And the relative absence of large, crashing waves means that radar should bounce off the ocean surface with a more crystal-like scattering pattern during a rainstorm. Scientists unaware of rain-induced alterations in the radar signal might incorrectly estimate wind speed, he suggests.

Thorpe calls his water tank experiment "the first step in the investigation" and says he plans next to simulate the effects of wind. But the current evidence, he says, strongly indicates that "rain can be a friend to a sailor."

– *R. Cowen*