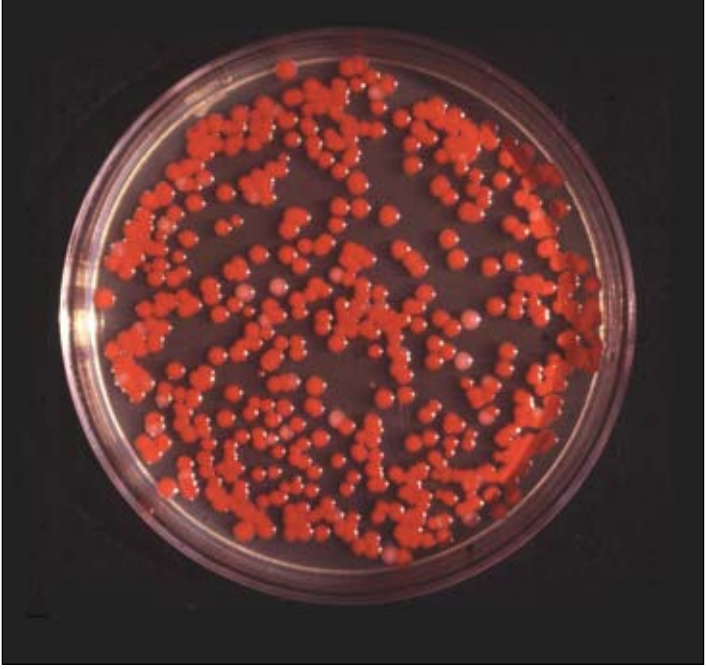

Although pink staining is often caused by the bacterium *Serratia marcescens* (above), other bacteria may be to blame. *Photo by Wikimedia*

Customer Service

Avoiding Pink Stain Pain

by William J. Soucie and Bill Schuler

Customers often complain about pink "stains" on wet surfaces in the bathroom, laundry room, or kitchen sink. Central Lake County Joint Action Water Agency in Lake Bluff, Ill., developed an investigative approach to identify the organisms that occasionally appear and cause stains and consternation in our community's homes. We also followed up with a series of countermeasures for frustrated homeowners.

Most pink staining reported by customers is caused by a pink biofilm. Biofilm is typically composed of many different microorganisms and bacteria held together by biological polymers that improve the ability of bacteria to adhere to and proliferate on wet surfaces. Most often found in shades of yellow or brown, biofilms can be many colors, including pink, orange, salmon, or coral. Because they thrive in the presence of water and the most minute trace of nutrients, biofilms are found virtually everywhere there is water, including water mains, humidifiers, dental water units, ice makers, and pharmaceutical water purification systems.

In the northern United States, where winters are cold and heated indoor air can have less moisture than the Sahara Desert, biofilm staining complaints usually can be isolated to poorly maintained humidifiers. Summers are different. Warm and humid conditions encourage biofilm development. Toilet bowls, faucets, sinks, tubs, showerheads, shower curtains, laundry tubs, and plastic surfaces in washing machines all present damp surfaces on which biofilms may incubate. The proximity of biofilms to tap water often leads a customer to question water quality.

Investigating a Clean Home

Last summer CLCJAWA received a customer complaint about pink staining on a showerhead, around a tub drain, and in the laundry machine in a new home. The homeowner was particularly concerned because, despite maintaining an immaculate residence, she could not permanently eliminate the pink staining.

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We usually satisfy similar customer concerns by verifying that the home's tap water is coliform free and explaining the typical cause of pink staining. In this case, a satisfactory coliform sample, a copy of "What's This Pink Stuff in My Bathroom?" (*Opflow*, November 2000, Question of the Month), and a discussion about the issue did not completely allay the homeowner's concerns about the pink discoloration. So we decided to prove the discoloration was from the suspected culprit, the bacterium *Serratia marcescens*.

Historically, most experts have blamed pink staining on *S. marcescens*, which is described in the *Opflow* column as thriving "on moisture, dust, and phosphates. … The conditions for the survival of *S. marcescens* are minimal, and the bacteria may even feed upon itself in the absence of other nutrients." Additionally, *S. marcescens* staining is common after the bacteria-laden dust accompanying construction activities settles on generally moist surfaces.

A flaky salmon-pink biofilm on the showerhead in the customer's home was sampled. Much like taking a throat culture, a sterile cotton swab was used to remove some of the bacteria from the film. And, just like the human throat, a showerhead surface contains numerous kinds of bacteria. Pink spots inside the washing machine's fabric softener dispenser were also swabbed. A light pink stain in the white finish around the tub drain was observed but not sampled, because no film was visible. In addition to sampling stained surfaces, hot and cold water samples were collected from the otherwise clean laundry sink faucet.

Laboratory Analyses

Our laboratory conducted coliform testing and heterotrophic bacteria counts (HPCs) on

the samples. Both hot and cold water samples were negative for coliform bacteria. As expected, the HPC tests were positive for both samples; heterotrophic bacteria are a group of bacteria found everywhere — on hands, in the air, in food and liquids. When grown in the lab, these bacteria grow as clumps or dots, called "colonies," on agar, a clear growth medium. The colonies can be as big as a nickel or as small as a pin tip. They are usually white, but can be almost any color.

The samples from the stained showerhead produced colonies that were yellow, beige, and white. The samples from the stained washing machine dispenser had white and cream-colored colonies. The cold water sample produced colonies that were many colors, including salmon and orange. The hot water sample also produced multicolored colonies, including our primary target color, pink. After processing them, bacteria from the showerhead, hot water, and cold water were sent to an independent laboratory for identification.

The independent lab identified four organisms through fatty acids found in the bacteria cells. Bacteria use fatty acids to store energy, and each species of bacteria has a unique fatty acid profile. Once the profile is identified in a sample, it is compared to profiles in a database of known bacteria. This type of analysis costs between $55 and $90 per sample.

The bacteria from the hot water sample that produced pink colonies were from the *Methylobacterium* species. The bacteria found on the showerhead were species *Sphingobium* and *Brevundimonas*. And the salmon- and orange-colored colonies found in the cold water were suspected to be species *Novosphingobium*.

Because none of the bacteria were of the suspected species, *S. marcescens,* we had to investigate the species that were identified. Through the Internet, we found an article, "Molecular Analysis of Shower Curtain Biofilm Microbes," by Dr. Scott T. Kelley, Dr. Largus T. Angenent, and Dr. Norman R. Pace, in the scientific journal *Applied and Environmental Microbiology*. The article describes how whitish-pink flakes from a dry shower curtain, pink film from a wet shower curtain, and pinkish-orange film from a second wet shower curtain were analyzed using DNA. The authors found that the shower curtain film "is in fact a lush bed of microbes," and the bacteria detected most frequently in the samples taken from shower curtain film were *Methylobacterium*, which is what we found in our hot water sample.

The article explains that *Methylobacterium* have been known to produce pink films in wet environments. The authors did not know exactly what the organisms use as a food source on a shower curtain, but surmised that it may be "soap products, sloughed-off human debris,

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Pink Stain (from page 27)

and bath-area volatiles." In addition to occurring in water, *Methylobacterium* are commonly found in the air and on dust in residences. Our research also turned up articles suggesting that these bacteria are chlorine resistant, are found virtually everywhere, and may be pathogenic to people who are already sick or immune-compromised.

We concluded that *Methylobacterium* are common bacteria that are not known to make healthy people sick. Our search for information about the other lab-identified organisms revealed that although none were known to produce pink staining, they, too, were common bacteria found in wet environments and not known to cause sickness in healthy individuals.

Advice to Customers

Determining that the organisms we had isolated from the biofilm and water are not normally a health concern for healthy individuals was reassuring to us and the customer. However, such bacterial growth should not go unchecked. Like mold growth, biofilm growth should be discouraged. Unfortunately, biofilms may never be completely eliminated. So what is the homeowner to do?

The co-authors of the shower curtain study all responded to e-mail questions about pink staining. Their responses reinforced what we have told our customers all along: Good old-fashioned scrubbing is the best solution. The researchers warned, however, that the bacteria may return a month or two after scrubbing, no matter how valiant the cleaning effort.

CLCJAWA recommends to our customers that they vigorously scrub the affected area, rinse with water, apply a disinfectant, scrub, rinse a second time, and air dry the area. We also suggest slowing biofilm redevelopment by keeping otherwise wet areas dry. For example, dripping faucets, wet shower curtains that are folded over on themselves, shower stalls and washers that are left closed, and water that is always puddled around the kitchen sink all support biofilm growth.

Dripping faucets and showerheads support biofilm growth. Homeowners can slow biofilm development by keeping otherwise wet areas dry.

Prior to this investigation, the homeowner expressed a hunch that the source of the pink biofilm in her home was the hot water system. This hunch was corroborated with the discovery of *Methylobacterium* in the hot water.

The water heater is a holding tank designed to produce hot water, not drinking water. The total chlorine residual in the water supply may or may not persist in a residential hot water system. Bacteria can grow in the heater because the environment is wet and warm, and they find protection from the chlorine in the water.

If the water heater's temperature is not kept hot enough, problem bacteria can grow and cause problems. The hot water should not be so hot, though, that it could burn someone. The Uniform Plumbing Code recommends that to avoid scalds hot water should not exceed 120° F (49° C) at the tap. The Occupational Health and Safety Administration recommends that residential hot water be maintained at a minimum of 122° F (50° C) at the tap and 140° F (60° C) at the water heater to reduce the risk of *Legionella pneumophila* bacterial growth, the cause of Legionnaire's disease. When discussing hot water systems, we always discourage the consumption of water from the hot water tap.

Minimizing Pink Staining

1. Keep it dry. Leaking faucets provide moisture for growth.
2. Keep it clean. Scrubbing keeps biofilms at bay.
3. Keep it real. Where there is water, there is biofilm.

The homeowner asked about disinfecting the water heater to kill the bacteria. Whether this would eliminate the problem was uncertain, because the bacteria could be safely embedded in the protective biofilm found in all plumbing systems. However, both thermal and chlorine disinfection methods have been used successfully in water heaters for other organisms. We recommended that the homeowner contact a licensed plumber for assistance, because tampering with hot water systems can cause serious injury.

Armed with the information gleaned from the investigation, a report was produced and provided to the homeowner. In a followup phone call, the customer indicated relief that nothing dangerous was found in the water. She also indicated that drying otherwise wet surfaces had helped minimize the staining.

Some homeowners may be alarmed to learn that tap water contains bacteria; they may have never before considered that tap water is not sterile. Yet, neither is the air we breathe nor the food we eat sterile. By thoroughly investigating the problem, being honest and straightforward, and by using our expertise to put our customer's situation in perspective, we restored her confidence in her water.

For More Information

An excellent source of information is the National Institute of Health and National Library of Medicine, which maintains the National Center for Biotechnology Information website. This library of technical papers is searched by typing in a keyword. Many articles are available for free download. Newer articles are only available in abbreviated abstract form. Either way, authors' names and e-mail addresses are usually available. Most authors hope their work has some practical value and are therefore responsive to questions from interested parties.

A copy of the report sent to the homeowner is available by e-mailing the author, Bill Soucie, soucie@clcjawa.com.

Also the AWWA Bookstore has several publications with advice on investigating customer complaints, including

- *Water Quality Complaint Investigators' Field Guide*
- *Taste and Odor: An Operator's Toolbox*
- *Top Consumer Questions About Drinking Water*, video
- *Sound Procedures for Drinking Water Sampling*, video
- *Water Quality Complaint Management: Selected Papers*, CD-ROM