

# Shining the Light, *Mixing* the Water

Researchers develop more effective, less costly method of disinfecting water used in food processing.

by GARY GOETTLING

**G**eorgia Institute of Technology researchers are casting new light on the disinfection of water used in food processing. They have developed a method that performs better and is less costly than existing techniques.

Like current technologies, the new Advanced Disinfection Technology System relies on ultraviolet (UV) radiation to eliminate molds, viruses and bacteria. But the new system handles water more efficiently and thus improves the overall effectiveness of the disinfection process.

"We're creating a mixing pattern to ensure that every particle of water is equally exposed to the (UV) lamp," says John Pierson, a senior research engineer at the Georgia Tech Research Institute and co-principal investigator. "By doing a better job of mixing the water, you get better disinfection."

Federal regulations require the disinfection of water used in food processing before it can be reused. In many cases, the lack of cost-effective disinfection means water is used only once and then discarded. When a disinfection system is used, the process is not always effective.

Most existing systems pump water through pipes lined with dozens of UV lamps. The lamps tend to foul quickly, reducing their effectiveness and requiring ongoing cleaning and replacement. More important, UV light has little penetrating power — just about an inch — so used water must be run through long pipes to increase the likelihood that UV light will contact enough of the liquid to affect the microorganisms it carries.

"Water right up against the lamp gets treated, and water farther away gets treated less — or maybe not treated at all," explains Pierson, who is collaborating on the advanced disinfection system

with Larry Forney, project director and an associate professor of chemical engineering at Georgia Tech.

The heart of the new advanced system is a pair of cylinders, one inside the other. The smaller cylinder rotates inside the stationary outer cylinder while water is pumped through the gap separating the two.

Inside the gap, the cylinder rotation causes water to churn and tumble in a well-documented phenomenon called a Taylor vortex. It's actually a number of vortices, which mix water with light shining from four UV lamps embedded in the outside cylinder wall.

UV light penetrates the water thoroughly, so no additional cycles through the system are necessary. Fewer UV lights are required compared to conventional systems, thus saving energy.

"Even if the fluid absorbs radiation, which would normally limit light penetration and thus the effectiveness of conventional UV reactors, the vortex motion in the new design continuously exposes fresh fluid to the radiation surface," Forney explains. "You bring the fluid in contact with just a few lamps in a repetitive basis."

The vortex motion also keeps the lamps free of material buildup.

The device is mechanically simple. Its low rate of revolution — about one cycle per second — means no bearings or special seals are required, Forney adds.

The process was designed for recycling water from fruit and vegetable washing at food-processing plants, but it could be applied in other industrial processes.

"We think it could be useful for a number of water-treatment situations ranging from storm-water runoff to bottle washing to certain industrial-process water recycling applications," Pierson says.

**Right: Georgia Tech researchers John Pierson, right, and Larry Forney have developed a system that disinfects water more effectively than current disinfection systems and at a lower cost.**



BACKGROUND PHOTO COURTESY OF THE GEORGIA DEPARTMENT OF INDUSTRY, TRADE AND TOURISM. INSET PHOTO BY GARY MEEK.

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**Georgia Tech researchers John Pierson, left, and Larry Forney believe their disinfection process may find uses in other industries including soft drinks, brewing, dairy products and fruit juice processing.**

**"We think it could be useful for a number of water-treatment situations ranging from storm-water runoff to bottle washing to certain industrial-process water recycling applications."**

"It fits any application where you could use disinfected water rather than potable water, which would cut down on water use generally and conserve potable water in particular."

The disinfection process developed by Forney and Pierson may find uses far beyond the project's original scope. Virtually anything that flows can run through the system, allowing for applications in the soft drink industry, brewing, dairy products and fruit juice processing. It would work for any kind of fluid for which there are concerns about the existence of pathogens, Forney says. A non-thermal procedure, it could even supplant pasteurization, which is expensive, changes the taste and consumes a lot of energy, he adds.

A variation of the device could even be developed for swimming pools as a non-chemical alternative to keeping water germ-free.

"If you were able to pass pool water through a UV reactor successfully, it would feel like normal water," Forney says. "It would have no taste and wouldn't be irritating to your mouth, eyes and lungs."

Preliminary work with the new lab-scale UV disinfection device shows a reduction in the concentration of viable pathogens by a factor of more than 200, compared to existing technology with the same UV dosage, according to Carolyn Goodridge, a visiting postdoctoral fellow and member of the research team.

"We're also beginning to work with certain kinds of fluids, such as fruit juices, that absorb lots of radiation to see what effect our device has on the inactivation of pathogens in that kind of environment," Forney adds.

The research is sponsored by the state of Georgia through its Traditional Industries Program (TIP), a public-private partnership created by the General Assembly in 1994 to bring university-based research to bear on challenges faced by industry. TIP research and development for the food processing industry is coordinated through the Food Processing Advisory Council. In addition to the food processing industry, TIP also addresses industrywide issues in Georgia's textile and carpet, and pulp and paper sectors.

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