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Sound Water Practices

Ultrasonic Technology Controls Algae and Biofilm

Ultrasound waves are a natural way to minimize algae-related problems by reducing THM levels, maintenance cycles, and taste and odor problems. BY GEORGE HUTCHINSON

IMPLEMENTING ULTRASOUND, a new "green" technology, is helping utilities improve water quality and decrease operating costs by controlling algae growth in ponds, lakes, and reservoirs and eliminating biofilm growth inside water treatment plants.

ULTRASOUND ZAPS ALGAE

When algae propagation in a water source is controlled, fewer algae are brought into a plant at the intake. Ultrasonic technology controls algae growth by matching the resonance frequency of the algae cells with just enough power to influence cell structure.

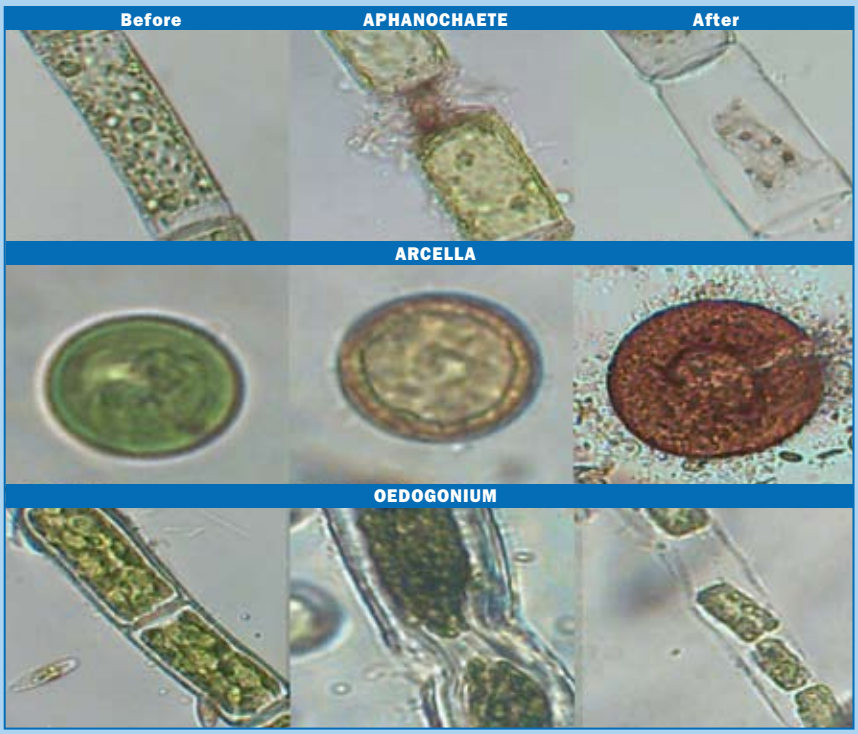
For example, blue-green algae (cyanobacteria) have a gas vesicle system of hundreds to thousands of tiny organelles per cell that's easily broken by ultrasonic sound waves. As a result, the algae lose buoyancy and sink, their life cycle processes are disrupted, and their ability to guard against bacteria is weakened.

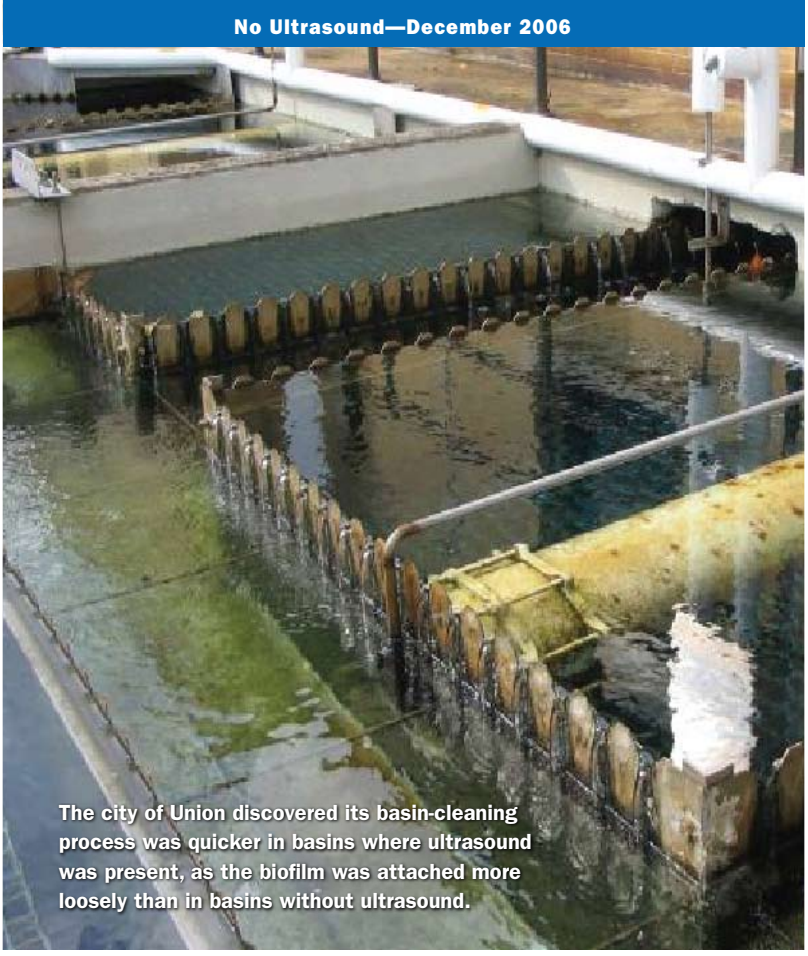
Roaming algae (green, brown, black, filamentous, etc.) don't have gas vesicles, but the ultrasonic unit affects the algal inner cell membrane, causing it to separate from the outer sheath. When separation is complete, the cell can no longer obtain nutrients, control internal pressure, or expel waste products through its contractile vacuole.

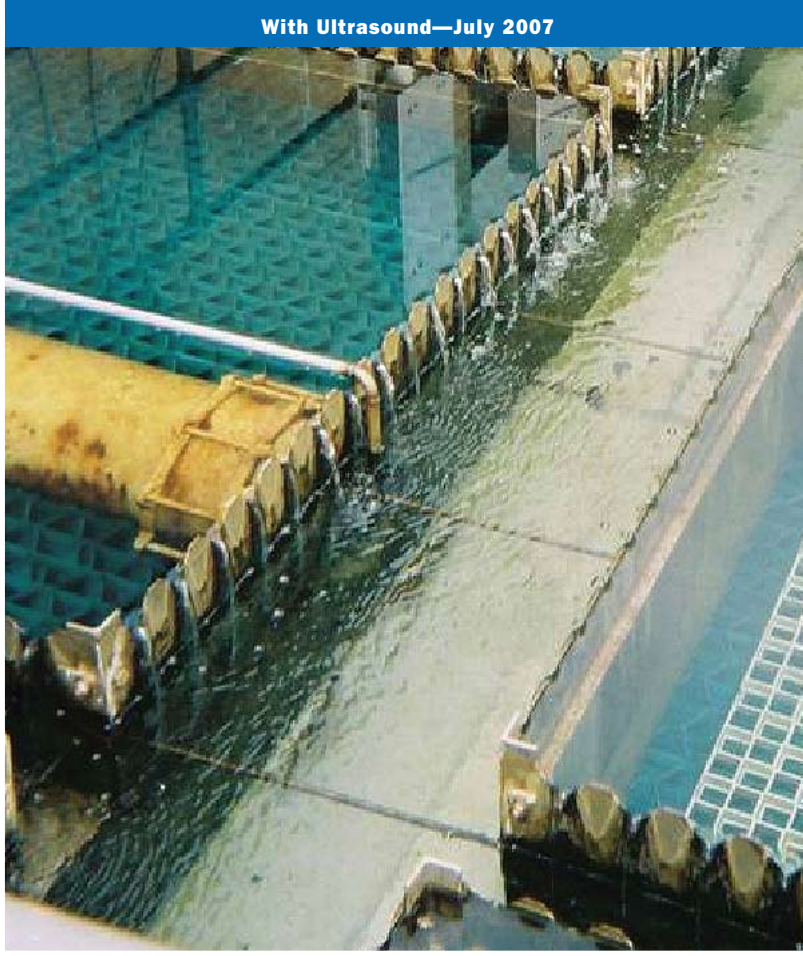
Controlling biofilm growth on equipment surfaces inside the plant eliminates an environment in which algae attach and thrive. Biofilm consists of layers of bacteria that form on host surfaces, creating attachment points for algae. Ultrasound

Before and After Ultrasonic Treatment

Ultrasonic vibrations pose no threat to people, animals, or fish, but devastate algae.







The city of Union discovered its basin-cleaning process was quicker in basins where ultrasound was present, as the biofilm was attached more loosely than in basins without ultrasound.

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waves prevent formation of the biofilm base layer by preventing most free-swimming planktonic bacteria from becoming strongly attached sessile bacteria, which grow on a surface.

Biofilm typically starts forming as quickly as 20 min to 3 hr after cleaning. Recent US Department of Agriculture aquaculture studies conclude that as much as 60 percent of coccoid bacteria—critical to biofilm formation—are killed by ultrasound waves in a 4-day period, though many types of bacteria are unharmed. The ultrasonic sound waves vibrate the bacteria, and the bacterial pili retract as if they are in turbulent water. The bacteria don't excrete the polysaccharide glue necessary to attach to a surface, so biofilm growth is hindered.

A CASE IN POINT

The city of Union, S.C., pumps water 7 mi from the Broad River into its potable water plant and processes 3.2–5.4 mgd, depending on the season. To reduce THM disinfection byproducts in potable water, the city stopped chlorinating at the river intake in the summer of 2006, which resulted in a 50 percent reduction in sodium hypochlorite use. However, by eliminating the chlorination at the intake, bacteria and algae quickly began to adhere to the sedimentation basin walls and v-notch weirs, forming biofilm. The city was concerned that algae growing inside the plant would soon cause taste and odor problems.

To eliminate the biofilm, plant personnel stepped up maintenance by cleaning the basin walls and v-notch weirs every 2 weeks instead of every 6 weeks. The biofilm and algae formation made the task difficult and increased maintenance time and costs. Keeping the plant compliant had turned into a maintenance nightmare.

A TESTING GROUND

After learning about the use of ultrasonic technology for algae control at the SC Rural Water Association annual show, Arnold Franklin, Union's lead water treatment plant operator, arranged for the technology to be tested at the city's plant. The basins and weirs were cleaned thoroughly, and two ultrasonic units—one in a sedimentation basin and another aimed at the v-notch weirs—were installed.

Almost immediately, plant personnel observed that biofilm and algae weren't accumulating in basins or on weirs that were under the influence of the ultrasound waves. Without biofilm, the algae didn't have an environment in which to adhere and propagate. When biofilm did form, the basins and weirs were easier to clean because the biofilm was more loosely attached.

The city subsequently implemented the ultrasound technology plantwide and has continued to reduce THMs and haloacetic acid (HAA) levels. Once again, cleaning can be conducted every 6 weeks, a welcome improvement during the area's summer heat and drought conditions, which necessitate reduced cleaning.

LOOKING AHEAD

November 2007 THM levels measured 34.4 µg/L, well below the regulated threshold of 80 µg/L. In January 2008, THM levels dropped again to 18 µg/L, and HAAs, for which the maximum contaminant level is 60 µg/L, dropped from the November 2007 level of 22 µg/L to 12 µg/L in January 2008. Wastewater Supervisor Donnie Johnson is so pleased with the results that he is planning to install ultrasound technology in the wastewater clarifiers to eliminate biofilm formation and reduce the maintenance cycle from weekly to monthly.