

Ultrasound in water treatment: suppressing algal growth and biofilm formation

● Recent research projects have underlined the potential of ultrasound as a chemical-free treatment in water-related applications. **DUDDY HEVIANDI OYIB** reviews the use of one such system, with a focus on wastewater, irrigation and aquaculture applications.

Among the numerous applications of ultrasound, the approach is used in the field of water treatment. In this scenario, forces other than cavitation forces are being used to achieve a certain goal. An example of such ultrasound systems which can be found on the market are the LG Sonic systems, which are manufactured to suppress algal growth and biofilm formation.

The ultrasounds produced by using the LG Sonic technology does not induce any stable (non-inertial) nor unstable cavitations. They do not even come close to reaching cavitation levels. Other mechanical forces induced by the produced mechanical pressure waves are used to suppress algal growth and reduce biofilm growth, e.g. resonance forces, longitudinal and transverse sound wave forces.

To reach this goal, the LG Sonic systems for example use a 'blend' of very specific ultrasound frequencies of certain power which are emitted into the water by specific transducers. This will enhance the specificity and selectivity of the ultrasonic treatment. The algae are treated with ultrasonic sound waves set in precise frequencies that directly target the cellular structure of the algae. The amount of algae in the water is reduced and controlled in an efficient, cost-effective manner, and further growth is inhibited. Green layers disappear, biofilm formation is prevented, and the appearance and clarity of the water is visibly improved. The continuous use of such a device prevents the water from becoming polluted again.

These kind of ultrasound algae control systems can be used in all situations where water is stored, from large industrial water applications to small private pools or ornamental ponds. These systems range from large capacity units to small ones, enabling a 'tailor-made' solution to all purposes.

The amount of time needed to see

improvements depends on parameters, such as the type of the algae present in the algal population, water temperature, the amount of light, the amount of nutrients present (especially phosphate and nitrate), size and depth of the water body, Total Suspended Solids (TSS) levels, Total Dissolved Solids (TDS) levels, turbidity, retention time, etc.

To obtain the successful treatment of the water, one should first know that no water body is the same – every water body is unique and should be



LG Sonic system.
Credit: LG Sound

treated uniquely.

Ultrasound systems like the LG Sonic do not use chemicals, only needs a low supply of electrical energy, and does not harm plants, fishes, zooplankton, and other types of life present in the water, thus having a low environmental impact.

Wastewater application

Wastewater is any water that has suffered in quality by human intervention. Often, wastewater is being treated for re-use as drinking water or for other purposes. As high levels of nutrition are available in these waters, algae may grow rapidly as well as other micro-organisms such as bacteria. Algae can compete for nutrients against the bacteria in charge of sludge reduction and can also clog complete systems. LG Sonic uses the newest ultrasound techniques to remove the threat of algae from wastewater treatment plants and reclaimed water reservoirs.

A research project executed by LG Sound (the producers of the LG

Sonic systems) to study the effect of ultrasound in the treatment of wastewater was the Chem-Free project, a three-year project that ended late last year. This was a European project (of about €2 million (\$2.6 million)) which focused on the development of a chemical-free water treatment system for the treatment of (secondary treated) municipal wastewater. Chem-Free is a Co-operative Research Project (CRAFT) funded within the European Union (EU) 6th Framework Programme Horizontal Research Activities.

Briefly, some of the results achieved in wastewater applications using the LG Sonic systems are:

- Strong reduction in algae concentration (\pm 90% reduction of chlorophyll-a)
- Reduction of biofilm formation
- Reduction of TSS, turbidity, BOD, COD levels etc.
- Reduction of free bacterial counts (*E. coli*, Enterococci etc.)
- Ultrasound vibrations make it more efficient for bacteria present in the sludge to obtain nutrients, and speeds up the utilisation of nutrients, accelerating the degradation of organic waste and the consumption of nitrate and phosphates.
- Secondary effect, improvement of the UV/ozone performance in elimination of microorganisms

The LG Sonic systems can be applied, for example in DAF (dissolved air floatation) tanks, flocculation tanks, clarifiers, sedimentation ponds, etc.

Irrigation

Water used for irrigation can contain high levels of nutrients. Some of these nutrients are beneficial for the plants watered, but they can also lead to extensive algal growth. Algae in irrigation tanks can clog the irrigation system and can also be spread over the irrigated area. In addition, some types of fungi (e.g. *Pithium*, *Fusarium* and *Phytophthora*), which can also be present in these waters, can be harmful for the plants being cultivated. Therefore, the quality of water in an irrigation system can be critical to the performance of a nursery.

The overall results obtained when applying the LG Sonic systems to irrigation were:

- Strong reduction in algae concentration (about 90% reduction)

- Reduction of biofilm formation
- Reduction of TSS, Turbidity, BOD, COD levels etc.
- Reduction of total aerobic bacterial counts.
- Reduction of fungus (*Pithium*, *Fusarium* and *Phytophthora*) concentration
- Reduction of iron and sulfur related problems (conserving irrigation network system).

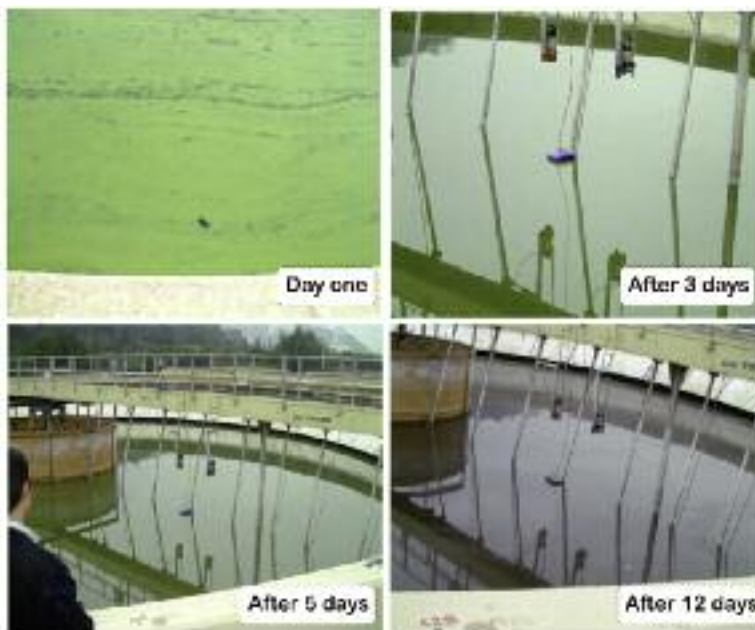
Aquaculture application

On the basis of the results obtained from two projects, Chem-Free (mentioned above) and a research project executed in 2007 in collaboration with USDA-ARS (US Department of Agriculture Agricultural Research Service) and Catfish Genetics Research Unit (USA) using the LG Sonic ultrasound systems, LG Sound developed and launched a new LG Sonic system, LG Sonic Aquaculture, especially designed for aquaculture purposes.

Some of the results achieved in the aquaculture using the LG Sonic Aquaculture models are:

- Strong reduction in algae concentration (about 90% reduction)
- Reduction of biofilm formation

Algae removal at a wastewater treatment plant.
Credit: LG Sound



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- Reduction of fouling and other growth on fish cages (inland and open sea)
- Reduction in β -cyclocitrol, 2-methylisoborneol concentration
- Reduction in microcystines (cyanobacteria toxins)
- Reduction of TSS, turbidity, BOD, COD levels etc.
- Reduction of free bacterial counts (*E. coli*, Enterococci, total coliforms etc.)
- Reduction of ammonium and nitrite
- Slightly heavier fish yield ●

PUBLICATIONS

Industrial Water Quality 4th edition

Authors: *W Wesley Eckenfelder Jr, David L Ford and Andrew J Englande Jr*

The fourth edition of Industrial Water Quality provides the technical approaches, latest information, and current regulations which guide the reader to conceive, design, and operate industrial pollution control facilities, either as an upgrade or as a newly developed industrial complex. Advanced technologies are discussed as well as updating existing approaches to control, troubleshooting, and solving the complex issues of controlling industrial wastewaters and residuals.

Water Environment Federation Press, 2008
896pp. Hardback
ISBN: 9780071548663
WEF members price: \$140
List price: \$160
To order, visit: www.wef.org

Calcium and Magnesium in Drinking-water Public Health Significance

Can calcium and magnesium ('hardness') in drinking water contribute to preventing disease? This book documents the outputs of an unprecedented group of experts

assembled by the World Health Organization to address this question. It includes their comprehensive consensus view on what is known and what is not about the role and possible health benefit of calcium and magnesium in drinking water.

In both developed and developing countries, diets are often deficient in calcium and magnesium, essential minerals which are necessary for the development of strong bones and teeth, and for cardiovascular function. At the same time, there is evidence that drinking 'hard' drinking-water may be associated with reduced risk for some diseases.

World Health Organization, 2009
191pp. Paperback
ISBN: 9789241563550
Price: \$40
In developing countries: \$28
To order, visit: www.who.int/bookorders

Rainwater harvesting: a lifeline for human well-being

This report has been prepared for the United Nations Environment Programme (UNEP) by the Stockholm Environment Institute (SEI). Achim Steiner, Executive Director of UNEP states: 'This

publication highlights the link between rainwater harvesting, ecosystems and human well being and draws the attention of readers to both the negative and positive aspects of using this technology and how the negative benefits can be minimized and positive capitalized.'

UNEP and SEI, 2009
This report can be downloaded free from: www.unep.org/Themes/Freshwater/PDF/Rainwater_Harvesting_090310b.pdf

Water Safety Plan Manual: Step-by-step risk management for water suppliers

In 2004, the WHO Guidelines for Drinking Water Quality recommended that water suppliers develop and implement 'Water Safety Plans' (WSPs) in order to systematically assess and manage risks. Since this time, governments and regulators, water suppliers and practitioners have increasingly embraced this approach, but they have also requested further guidance. This much-anticipated workbook answers this call by describing how to develop and implement a WSP in clear and practical terms. Stepwise advice is provided through 11 learning

modules, each representing a key step in the WSP development and implementation process.

World Health Organization, 2009
This report can be downloaded free from: www.who.int

The World's Water 2008-2009: The Biennial Report on Freshwater Resources

Authors: *Peter Gleick, Heather Cooley, Michael Cohen, Mari Morikawa, Jason Morrison, and Meena Palaniappan*

Produced biennially by the Pacific Institute, The World's Water provides a timely examination of the key issues surrounding freshwater resources and their use. Each new volume identifies and explains the most significant trends worldwide, and offers the best data available on a variety of topics related to water. This new volume contains an updated chronology of global conflicts associated with water, as well as brief reviews of issues regarding desalination, the Salton Sea, and the Three Gorges Dam.

Island Press, 2008
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