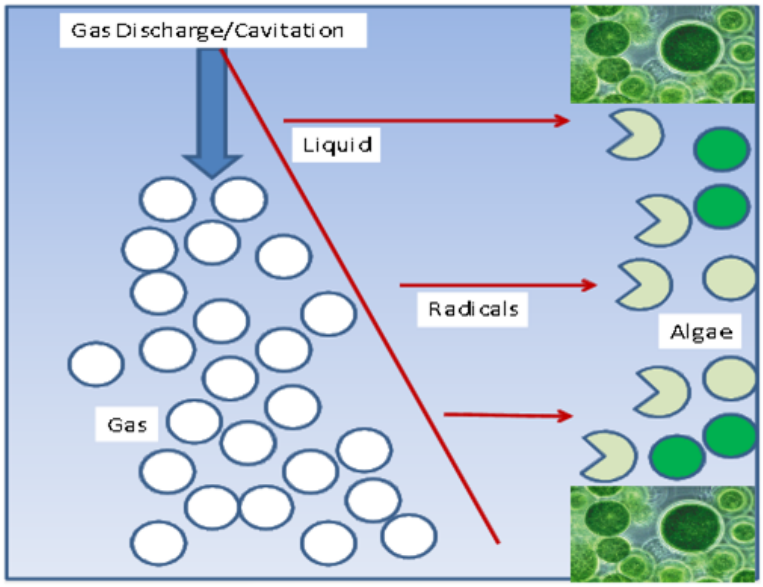
APCRP: Physicochemical Treatment of Cyanobacteria and Microcystins by Hydrodynamic Cavitation and Advanced Oxidation

Capability

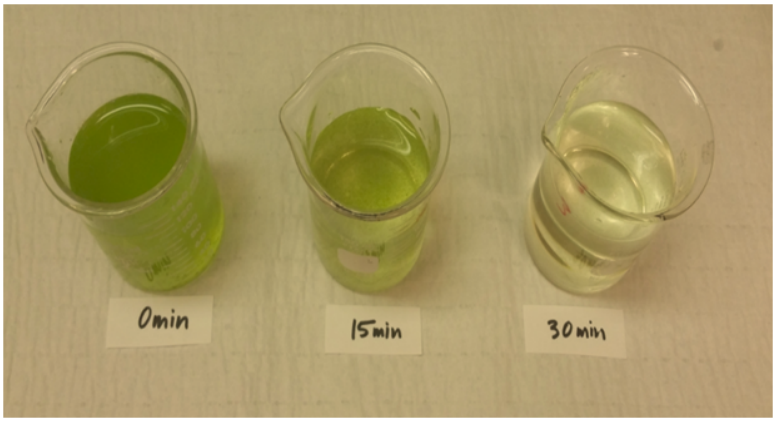


During the hydrodynamic cavitation treatment process, the turbulence from the cavitation field disrupts the alga cells, while the oxygen radicals generated from the cavitation field (particularly during the use of nan-micro bubble diffusers) oxidize the associated toxins.

The Environmental Security Engineering and Green Remediation teams of the Environmental Laboratory's (EL) Environmental Engineering Branch are currently investigating hydrodynamic cavitation for the physicochemical treatment of cyanobacteria and microcystins. In U.S. freshwater ecosystems, harmful algal blooms (HABs) have been occurring with greater frequency due to high inputs of nutrients into surface waters2. Treating HABs in natural waters is often difficult once the algae begin their logarithmic proliferation. HAB occurrences resulted in significant economic loss in 2013 alone1 due to closure of commercial fishing and oyster harvesting areas. Recent developments in hydrodynamic cavitation application have made it possible to treat HAB and their toxins simultaneously.

The primary hindrance in effectively treating HABs is the release of harmful toxins from the algae cells once the algae dies. The cavitation process physically disrupts algal cell membranes, while the oxygen radicals generated from the cavitation field chemically oxidize the toxins, rendering them less harmful to animals and humans. ERDC is currently forging a path toward meso-scale optimization of the cavitation technology used to treat harmful algae.

Application



HAB samples collected from algae tank at Times 0, 15, and 30 minutes after treatment with micro-bubble diffuser.

EL researchers are currently adapting hydrodynamic cavitation treatments to target specific areas affected by HABs, particularly areas near freshwater intakes. In these areas, excess algal cells and toxins can be removed before the cells and toxins enter public water treatment systems. This technology can also be applied in sensitive aquatic ecosystems to treat harmful algae at low concentrations in a preemptive effort to inhibit its proliferation. At present, this technology is not optimized for application in large water bodies affected by HABs.

Status

Hydrodynamic cavitation treatments of HABs are ongoing. This work is funded by the Aquatic Plant Control Research Program (APCRP) through the end of FY 16.

Documentation and References

- Adams, C. Larkin, S. 2013. *Economics of Harmful Algal Blooms: A Literature Review*. University of Florida Food and Resource Economics Department. Gulf of Mexico Alliance Project #: 00100304.
- Li, P., Song, Y., Yu, S. 2014.Removal of Microsystis aeruginosa using hydrodynamic cavitation: Performance and mechanisms. *Water Research* 62: 241-248

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Article Sources and Contributors

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