Evaluation of Cavitation as Potential HAB Management Technology

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USACE Harmful Algal Bloom Research & Development Initiative

Delivering scalable freshwater HAB prevention, detection, and management technologies through collaboration, partnership, and cutting-edge science.

Problem

USACE maintains waterways, reservoirs, and recreational areas that can all be impacted by harmful algal blooms (HABs). Scalable technologies are needed that can minimize HAB severity and duration and thereby reduce HAB impacts to USACE.

Objective

The objective of this project is to explore cavitation as potential HAB management strategy using a phased laboratory to field approach.

Approach

Cavitation releases microbubbles that collapse violently, creating a pressure change that may be effective in destroying cyanobacteria. The bubble collapse creates reactive oxygen species such as superoxide and hydroxyl radical, which have potential to degrade cyanotoxins. Previous studies have shown a reduction of *Microcystis aeruginosa* as measured by chlorophyll and reduction of the toxin Microcystin LR following exposure to cavitation bubbles. Cavitation is a potentially flexible technology in that could be deployed in a number of ways to address cyanobacteria HABs: as a single point; as an array or net to create a barrier; as a fixed system; or as transportable units. It could also potentially be deployed as a towed system, moving across a waterbody while providing treatment. This study featured a laboratory test where cyanobacteria were exposed to a cavitation apparatus.

Results

The laboratory tests involved passing cyanobacteria-containing water through a needle valve tuned to produce cavitation bubbles. A decrease in chlorophyll was measured as the water circulated through the valve repeatedly. However, this experimental design prevented assessment of cavitation bubble exposure versus effect of the needle valve itself on the cyanobacteria. Accordingly, a "no go" decision was made and this approach did not proceed to larger scale or field trials.

Value to USACE Mission

Scaleable technologies that are capable of HAB prevention and management are needed to reduce HAB severity and impact frequency to our nation's freshwater resources. Although this project reached a "no go" decision due to experimental design challenges, cavitation and other technologies that produce reactive species that can neutralize cyanobacteria and their toxins have great potential for further development.

Figure 1. *Equipment used during the experiment.*