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APPLICATION NOTE

Complementary Technologies for HAB Monitoring and Remediation

IN THIS APPLICATION NOTE

- The benefits of continuous algae monitoring while mitigating and remediating harmful algal blooms (HABs).
- Case study: New Jersey drinking water treatment facility detects failure in ultrasonic algae mitigation devices by simultaneously monitoring algae using the FlowCam. HAB is mitigated once detected by the FlowCam.

Imaging flow cytometry plays an essential in combating HABs. As warm summer waters increase the risk of HABs and other algae blooms, it is critical to quickly identify algae, track population growth, determine when to initiate treatment, and monitor the efficacy of treatment methods.

Depending on the type and concentration of the algae species, algaecides and ultrasonic buoys are two methods used to proactively prevent algae populations from blooming, and to remediate blooms. Imaging flow cytometry delivers immediate feedback on the efficacy of the treatment measures taken, documenting the taxa present as well as their relative abundance.

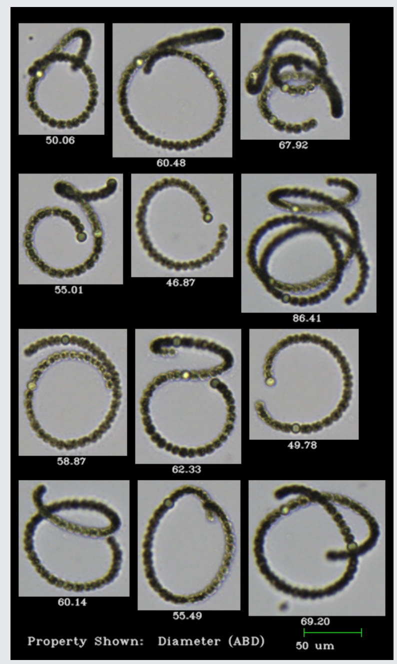

Figure 1. *Anabaena* imaged by the FlowCam at 10X

CASE STUDY

Continuous monitoring and ultrasonic remediation

Algal blooms have historically been treated by broad applications of an algaecide, such as copper sulfate. Modern technologies, such as ultrasonic buoys (Fig. 2), have been developed and provide preventative advantages for at-risk HAB ecosystems.

Figure 2. (Right) Ultrasonic frequencies released from buoy into the water to alter algal buoyancy. Modified image from LG Sonic.

CASE STUDY CONTINUED ON REVERSE

Ultrasonic algae remediation trial

In the summer of 2015, a New Jersey drinking water treatment facility conducted a study to test the efficacy of ultrasonic algal control buoys to prevent HABs within their reservoir. Four ultrasonic buoys were placed in the reservoir, each with the capacity to affect the surrounding 500-meter diameter area. These buoys release sound waves into the water body which, at the correct frequency, disrupt the internal flotation mechanisms of the targeted algae taxa and limit the algae's ability to control their buoyancy. These buoys have shown to be effective at controlling HABs by interfering with the cyanobacteria's evolutionary advantage to rise to the lake surface and block the sun's rays from reaching the aquatic ecosystem and create hypoxic zones in the water column. While the buoys can be effective, their method of identifying algae is limited to simple pigment detection.

Paired monitoring and remediation

The ultrasonic buoys have onboard optical sensors to detect the pigments of the algae populations and adjust the sound wave frequency to target specific algae taxa. However, pigment detection only indicates general algae population trends and does not identify the taxa present. The FlowCam was used during the sonic buoy testing to aid identification, and monitor the efficacy of the buoys for HAB remediation by counting cells and measuring biovolume.

The importance of continuous monitoring

A spike in *Anabaena* (imaged in Fig. 1) and *Aphanizomenon* (imaged in Fig. 3) populations occurred in mid- to late-summer. The buoys successfully mitigated the *Anabaena* population before it entered a bloom state. However, the buoy's optics failed to detect the presence of *Aphanizomenon* and counts as high as 40,000 units/mL were detected using the FlowCam. Upon detection by the FlowCam, the buoys' ultrasonic frequency was adjusted to target the bloom. The *Aphanizomenon* population dropped to 2,000 units/mL three days after initial detection. Simultaneous FlowCam monitoring during this trial enabled the municipality to identify and target the growing *Aphanizomenon* populations when the ultrasonic buoy optics failed and to mitigate the bloom before it reached a critical state.

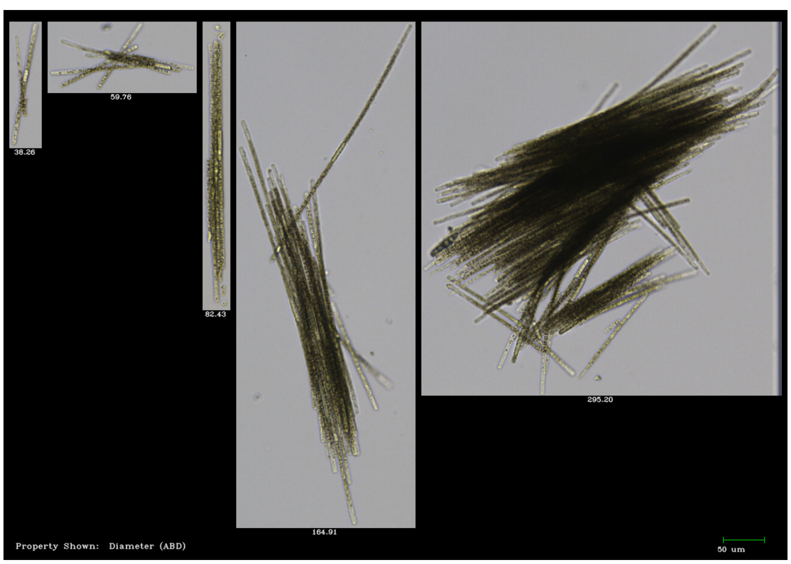

Figure 3. *Aphanizomenon* imaged by the FlowCam at 10X.

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