Ohio Environmental Protection Agency

Division of Drinking and Ground Waters
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Generalized Cyanotoxin Treatment Optimization Recommendations

The following are general recommendations for source water and treatment adjustments to improve the ability of the treatment plant to address cyanotoxins. Not all will apply to, or be feasible for, every water system with the existing infrastructure in place. Other treatment objectives must be considered, such as maintaining compliance with disinfection byproducts and corrosion control plans and recommendations for lead and copper. Approved detail plans are required before any substantial change can be made to the source or treatment plant processes (for example, a new source of water not previously approved or the addition of new or increased chemical feed facilities).

Recommendations when cyanotoxin is primarily INTRAcellular (inside cyanobacteria cell) and conventional treatment can be optimized to enhance intact cell removal

Source

- If a Harmful Algal Bloom (HAB) is present and producing intracellular cyanotoxins on a reservoir currently in use, do not apply algaecide.
- Consider opportunities to switch sources or to blend sources (for example, different reservoir, interconnections with other systems, ground water). If a reservoir with a HAB can be isolated, consider algaecide application after isolation. Sample isolated reservoirs that have been subjected to an algaecide prior to placing back online. Supplementing reservoirs with significant amounts of ground water may result in water quality changes (for example, pH, hardness, silica, etc.) that need to be considered and may impact dominant cyanobacteria species.
- Consider using alternate intake depths. Lower cyanotoxin concentrations are typically observed at lower intake levels (but not always — sample each intake depth and select intake depth based on current source water conditions).
- Consider physically removing scums (manually or with vacuum trucks, etc.), especially scums located in proximity to intake structures.
- For systems that do not pump 24-7, consider timing pumping of water into the plant when cyanotoxin concentrations are lowest at intake depth. Cyanobacteria that regulate buoyancy (Microcystis, Anabaena, etc.) change their position in the water column typically on a diurnal cycle. If this cycle can be monitored using phycocyanin sensors or other water quality measurement and is predictable in the source water, pump water when the bloom is present on the surface and less concentrated at intake depths. This strategy would not work for most Planktothrix or Cylindrospermopsis blooms that are typically distributed throughout the water column and do not vary their position.

Treatment

- Ensure all treatment and monitoring equipment is fully functional, regular maintenance is conducted, and critical spare parts are available on-site. A HAB event may cause additional stress on mechanical equipment.
- Reduce or eliminate pre-oxidant (for example, potassium or sodium permanganate, chlorine dioxide or chlorine before filtration) as this can result in lysing of cells. If pre-oxidant (prior to filtration) must be added for other treatment objectives, then permanganate is a better option as it is less likely to lyse cells while also having some ability to degrade microcystins. A dose of less than 1 mg/L of permanganate is recommended to minimize lysing.
- Maximize coagulation for particulate removal. Do jar testing.
- Increase the sludge removal frequency.
- Increase the filter backwash frequency.
- Do not recycle backwash. Have other approved means of disposal (sanitary sewer, lagoon, or NPDES permitted discharge).

continued

Generalized Cyanotoxin Treatment Optimization Recommendations

Recommendations when cyanotoxin is primarily INTRAcellular (inside cyanobacteria cell) and conventional treatment can be optimized to enhance intact cell removal

Treatment *(continued)*

- Increase PAC feed and ensure adequate mixing. Having a feeder capacity capable of feeding a dosing rate up to 40 mg/L - 50 mg/L is recommended. Consider PAC type. For microcystins, wood based PAC with higher mesopore volume is more effective. For saxitoxin, however, coal-based PAC with a higher micropore volume (similar to the type used for taste and odor compounds), is more effective due to the smaller size of the saxitoxin molecule. Iodine number is not a good indicator of microcystins, or saxitoxin, adsorption capacity. Evaluate whether additional feed points are possible to optimize contact time of toxins with PAC. Maintain separation between pre-oxidant feed location and PAC feed location to prevent potential interference. Maintain an adequate supply of PAC on-site to be able to quickly respond to a HAB event.
- If corrosion control can still be maintained, consider a slight reduction in pH where chlorine contact time is provided to target microcystins destruction. For microcystins, chlorine is more effective at toxin degradation as the pH decreases with an ideal pH less than 8. Do not reduce pH if it will impact corrosion control strategy. Approved corrosion control plans must be maintained and a reduction in pH may not be possible. The opposite applies to saxitoxin, however, such that increasing pH may be beneficial for saxitoxin destruction.
- Maximize post-filtration chlorine feed and contact time to assist in toxin destruction. Consider increasing free chlorine residual by an additional 0.5 to 1.0 ppm in clearwell, up to a maximum measurable residual of 4.0 ppm (so as not to exceed a maximum disinfectant residual of 4.0 mg/L measured as total chlorine). If possible, maintain higher water operating levels in clearwells to increase contact time.
- Reduce water demand. Decreasing flowrate to hold a constant flowrate through the plant is recommended in order to reduce loading on processes and increase contact times, while avoiding stagnation. Consider extending operating time to decrease flowrate by going to a 24-hour operation if the plant normally runs less than 24 hours.

Additional considerations ONLY if cyanotoxin is primarily EXTRAcellular (outside of cyanobacteria cell) and conventional treatment is generally ineffective at toxin removal

- In some instances, algaecide treatment may be beneficial if primarily extracellular toxins are present. Algaecide application can only be done after consultation with Ohio EPA and in conjunction with conducting additional source water cyanotoxin monitoring (to ensure pesticide application general permit conditions are not violated and situation is not worsened).
- Since intact cell removal is not the treatment focus when the cyanotoxins are extracellular, utilize existing pre-filtration feed points for chlorine or permanganate to maximize contact time for destruction of cyanotoxins. If chlorine dioxide is used as a pre-filtration oxidant, switch to chlorine and/or permanganate. Free chlorine or permanganate is the better choice as a pre-filtration oxidant for microcystins destruction, since chlorine dioxide and chloramines are much less effective.

For More Information

Consult the joint Ohio AWWA – Ohio EPA Cyanotoxin Treatment White Paper at ***epa.ohio.gov/portals/28/documents/HAB/AlgalToxinTreatmentWhitePaper.pdf*** or contact your Ohio EPA representative.