# Blue-Green Algae & Microcystin

#### Village of Skaneateles, NY

GHD

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### Introductions

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# **Presentation Outline**

- What is Blue Green Algae/ Microcystin?
- Regulations & Health Advisories
- Treatment Technologies and Village Alternatives
- Next Steps?
- Open Discussion/ Questions



# Blue Green Algae Cyanobacteria and Microcystin Toxin

- Blue Green Algae are actually cyanobacteria
- Cyanobacterial blooms have been detected for several years in the finger lakes
- Blooms can vary significantly each year based on environmental factors



 Cyanotoxins are produced within the bacteria (intracellular) and released when the bacteria die or are lysed (extracellular)



# Blue Green Algae Cyanobacteria and Microcystin Toxin

- There are many types of cyanotoxins microcystin being one of the most toxic
- In a typical bloom 60 90% of microcystin is intracellular
- Microcystin is water soluble and is not effectively removed by conventional treatment





# A Growing Public Health Concern Microcystin – Emerging, Unregulated Contaminant

- No US water quality criteria or regulations for cyanobacteria or any cyanotoxins
- In 2015, the USEPA issued a microcystin health advisory limit of 0.3 µg/L (children <6 and other vulnerable populations); 1.6 µg/L adults
- EPA has included cyanotoxins on its Contaminant Candidate List 4 (CCL4)
- WHO recommended guideline is 1.0 µg/L for microcystin-LR









# **EPA Health Advisories (HA)**

- "HAs are non-regulatory values that serve as informal technical guidance to assist federal, state and local officials, and managers of public or community water systems to protect public health from contaminants." – U.S.EPA
- Advisory levels are health based
- "EPA found there are adequate health effects data to develop HAs for microcystins and cylindrospermopsin" – U.S.EPA
- Levels are based on 10-day average exposure

#### SEPA United States Environmental Protection

#### 2015 Drinking Water Health Advisories for Two Cyanobacterial Toxins

#### Summary

EPA has issued 10-Day Drinking Water Health Advisories (HAs) for the cyanobacterial toxins microcystins and cylindrospermopsin. EPA recommends HA levels at or below 0.3

micrograms per liter for microcystins and 0.7 micrograms per liter for cylindrospermopsin in drinking water for children pre-school age and younger (less than six years old). For school-age children through adults, the recommended HA levels for drinking water are at or below 1.6 micrograms per liter for microcystins and 3.0 micrograms per liter for cylindrospermopsin. Young children are more susceptible than older children and adults as they consume more water relative to their body weight.

HAs are non-regulatory values that serve as informal technical guidance to assist federal, state and local officials, and managers of public or community water systems to protect public health from contaminants. EPA has also published health effects support documents for the cyanobacterial toxins microcystins and cylindrospermopsin. These documents contain the health effects basis for the development of HAs for the protection of human health. In addition, EPA has published a health effects support document for anatoxin-a but concluded that there was not adequate information to support a health advisory for this toxin.

#### Background

What are cyanobacterial toxins? Cyanobacteria, common to freshwater and marine ecosystems, can under certain conditions (high nutrient concentrations and high light intensity) form scums or "blooms" at the surface of a water body. These blooms can produce toxic compounds (cyanobacterial toxins or "cyanotoxins") that are harmful to the environment, animals and human health. Winds and water currents can transport cyanobacterial blooms within proximity to drinking water intakes at treatment plants that, if not removed during treatment, can cause odor, taste and color problems in treated drinking water and can be harmful to human health.

What is a health advisory?

The Safe Drinking Water Act provides the authority for EPA to publish health advisories for contaminants not subject to any national primary drinking water regulation. Health advisories describe nonregulatory concentrations of drinking water contaminants at or below which adverse health effects are not anticipated to occur over specific exposure durations (e.g., one-day, 10-days, several years, and a lifetime). They serve as informal technical guidance to assist federal, state and local officials, and managers of public or community water systems by providing information on the health effects of and methods to sample and treat cyanobacterial toxins in drinking water. HAs are not legally enforceable federal standards and are subject to change as new information becomes available.

Why has EPA taken this action?

There are no U.S. federal guidelines, water quality criteria, standards or regulations for cyanobacteria or cyanotoxins in drinking water under the Safe Drinking Water Act or in surface waters under the Clean Water Act. However, FPA has insted cyanotoxins including microcystin-LR, cylindrospermopsin, and anatoxin-a on the previous and current Contaminant Cnahldate Lists (CCL), which identify contaminants that may need regulation under the Safe Drinking Water Act.



### **Treatment Options** Technology Screening

- Intracellular Removal (Intact Cells)
  - Conventional coagulation/sedimentation/filtration
  - Flotation i.e. Dissolved Air Flotation (DAF)
  - Pretreatment oxidation (prior to rapid mix)
  - Membranes (microfiltration/ultrafiltration)
  - \*\*Each require additional extracellular treatment\*\*
- Extracellular Removal/Destruction
  - Chlorination
  - Potassium Permanganate
  - Powder Activated Carbon
  - Granular Activated Carbon
  - Ozone
  - UV Advanced Oxidation (H<sub>2</sub>O<sub>2</sub>)
  - Membranes (reverse osmosis or nanofiltration)





# **UV Advanced Oxidation**

- Destruction technology
- Hydrogen peroxide combined with high intensity UV light
- Involves
  - Hydrogen peroxide storage and feed system
  - Chlorine storage and feed system
  - UV Reactors
- Advantages
  - Pump station already designed for UV reactors
  - Village already familiar with UV
  - Can be switched between standard UV photolysis and UV AOP for seasonal use
  - No waste stream



# **UV Advanced Oxidation**

- Disadvantages
  - Chlorine demand:
    - Removes existing free chlorine from water
    - Post-chlorination for removal of excess hydrogen peroxide
    - Post-chlorination for secondary disinfection
  - Energy intensive (5-10x the lamp power vs photolysis)
  - Existing UV System not capable of advanced oxidation (additional sidestream reactor needed)
  - Hazardous Chemical
  - Limited full scale experience



# **Granular Activated Carbon (GAC)**

- Removal technology
- GAC is a granular adsorbent created from various carbonaceous materials such as coal, wood, peat, coconut shell, etc.
- Commonly used in drinking water plants for filtration, taste and odor control and removal of contaminants
- GAC has been shown as an effective treatment method for microcystin and other cyanotoxins when enough contact time is achieved.





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# **Granular Activated Carbon (GAC)**

- Involves
  - Carbon contactors: steel pressure vessels
  - Chlorine storage and feed system
- Empty Bed Contact Time (EBCT): Target Range 10-15 minutes
- Advantages
  - Removes cyanotoxins and cyanobacteria
  - No disinfection byproducts
  - Optional year-round or seasonal usage
- Disadvantages
  - Will remove incoming free chlorine residual
  - Generates backwash waste.





# **Chlorine Oxidation**

- Destruction technology
- Involves
  - Chlorine storage and feed system
  - Dedicated transmission main and Operation of Village tanks in series for contact time
- Advantages
  - Village already has ability to provide large CT
  - Village has a small backup sodium hypochlorite feed system
  - Likely to be lowest cost alternative
- Disadvantages
  - Increased disinfection byproducts
  - Impact on fire protection



### **Non-Treatment Options**



# **Next Steps?**

- Future recurrence of harmful algae bloom
- Temporary vs. permanent solution
- Engineering study required to evaluate treatment efficacy.
- Testing to define species.
- Response procedures for future events
- Start now



#### **Questions/ Discussion?**



### www.ghd.com