Blue-Green Algae

Information for drinking water system owners and operators

What are blue-green algae?

Cyanobacteria, commonly called blue-green algae, are primitive microscopic organisms that have inhabited the earth for over 2 billion years. They are bacteria, but have features in common with algae. Although often blue-green (their scientific name cyanobacteria comes from the Greek word for blue), they can range in colour from olive-green to red. Blue-green algae occur naturally in a wide variety of environments including ponds, rivers, lakes and streams.

What are blue-green algal blooms?

Normally blue-green algae are not visible in the water, but when conditions are favourable, algal populations can rapidly increase to form a large mass or scum in the water called a bloom. Blooms most commonly occur during the warmer weather of late summer and early fall when there is lots of sunlight and calm water conditions.

What conditions favour algal growth?

Blue-green algae thrive in areas where the water is shallow, slow moving and warm, but they may also be present in deeper, cooler water. One key factor affecting the growth and type of blue-green algae is the amount of available nutrients such as phosphorus and nitrogen. In Ontario water bodies, phosphorus tends to be the nutrient that controls how much algae can grow.

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How do I recognize a blue-green algal bloom?

Dense blue-green algal blooms may make the water look bluish-green or green pea soup or turquoise paint. When the bloom is very dense, algae may form solid-looking clumps. Fresh blooms often smell like newly mown grass; older blooms may smell like rotting garbage.

Is this a new problem?

Blue-green algal blooms occur around the world in fresh and salt water ponds, lakes, rivers, bays and inlets. Occurrences of blue-green algal blooms were recorded as early as 1878 in South Australia. Research shows that some Ontario lakes and bays have historically experienced regular blue-green algal blooms for many years. However, there is evidence that the frequency of algal blooms is increasing globally for several reasons, such as increasing nutrient levels in some areas, climate change and the spread of invasive species.

Ministry staff collect samples of reported blooms to confirm the species of algae present and to test for algal toxins.

Are blue-green algae harmful?

Certain species of blue-green algae can produce toxins that are referred to as cyanobacterial toxins or cyanotoxins. These toxins are contained within the algal cell and are released to the water when the cell wall is broken, which can occur when the cell dies and decomposes or is damaged by physical abrasion, or by chemicals like bleach or algaecides.

Cyanotoxins can impair water quality and affect the health of humans and animals by causing itchy, irritated eyes and skin, flu-like symptoms, liver damage or other symptoms. Higher levels of toxins may occur during blooms when blue-green algal cell numbers are high and concentrated in one area.

Besides producing toxins, cyanobacteria may produce taste and odour compounds and clog filters at drinking water treatment plants.

Can drinking water be contaminated by toxins from blue-green algae?

If drinking water is obtained from a water source that is not subject to appropriate

If I don't see a bloom should I be concerned?

When no bloom is visible, it is not very likely that blue-green algal toxins are present and the risks are low.

treatment during a blue-green algal bloom then it is possible that the water may be contaminated with toxins. Usually people won't drink water contaminated with blue-green algal blooms because of its unsightly pea soup appearance and foul smell. However, drinking water obtained during an algal bloom should be tested for algal toxins because sometimes it's hard to tell from its appearance whether the drinking water has been contaminated.

How much microcystin is allowable in drinking water under the Ontario Drinking Water Quality Standards?

The Ontario Drinking Water Quality Standard for the blue-green algal toxin microcystin-LR is a maximum acceptable concentration of 1.5 micrograms per litre, which is the same as 1.5 parts per billion. It is extremely rare for treated water tests in Ontario to exceed this standard, but precautions should still be taken when a bloom occurs.

Can drinking water be tested for blue-green algal toxins?

The Ministry of the Environment and Climate Change has the only laboratory in Ontario licensed to analyze for microcystin-LR in drinking water samples. An algal toxin screening method known as ELISA will detect the presence of microcystins, but cannot identify microcystin-LR specifically, and so can only be used as a screening technique. Several commercial laboratories have been licensed by the ministry to screen treated drinking water samples using ELISA. If treated water samples from drinking water systems show positive ELISA results equal to or greater than 1.5 micrograms per litre, they must be sent to the ministry's laboratory for a more detailed analysis for microcystin-LR.

Can water containing blue-green algae be treated to make it safe to drink?

Conventional treatment of surface water is effective at removing whole algal cells during settling and/or filtration. These steps remove whole cells early in the treatment process, thereby reducing the potential for additional toxin release. Additionally, the location and depth of the intake itself may prevent the passage of algal cells into the treatment plant since blooms are usually found along the shore and near the surface, although blooms can occur in deeper waters.

Some common treatment processes will reduce toxin levels. Ozone as well as free chlorine are both effective at oxidizing many cyanotoxins. Activated carbon, and high pressure membrane filtration processes will also help remove toxins.

If we get blooms in the area of the intake for our water treatment plant, should we adjust or adapt our treatment processes to deal with algal toxins in water?

Any substantial changes to existing treatment processes should be reviewed by professionals. Generally, to improve removal of toxins, it is important to minimize the risk of upsetting the existing water treatment process. It is critical to maintain a focus on pathogen removal and inactivation, so that treatment is not being compromised by any adjustments. Changes to the water treatment processes may only need to be considered when the drinking water standard for microcystin-LR cannot be sustained.

Oxidation processes that occur prior to filtration steps (e.g. pre-chlorination) may result in algal cell lysis. There is some experience suggesting that potassium permanganate (chemical formula of KMnO4), unlike stronger oxidants such as chlorine, will not result in cell lysis. Cell lysis will result in the fraction of toxins that are cell-bound being released.

Temporary cessation of such oxidative pretreatment steps may help to reduce the level of algal toxins in the treated water and should be considered when the treated drinking water is failing to meet the standard for microcystin-LR. Filtration steps will reduce the number of algal cells passing through the treatment process and may provide small reductions in toxin levels. Post-filtration oxidative processes such as chlorination and ozonation will generally provide substantial reductions in toxin levels.

Contingency planning may examine the possibility and consequences of increasing or maximizing post-treatment chlorine contact to increase the destruction of cyanotoxins. Maximizing chlorination in the contact tank may need to be followed by dechlorination prior to distribution. Changes

Your responsibilities under drinking water regulations

As a provider of drinking water, you need to be aware of the potential risks posed by blue-green algal blooms near your intake, and the kinds of actions you can take in order to mitigate these risks. You should be working closely with the local health unit and the Ministry of the Environment and Climate Change if there is a reported bloom near your intake.

During bloom events and for at-risk systems, it may be appropriate to obtain regular treated drinking water samples for microcystin screening using ELISA at a licensed laboratory. Specific tests for microcystin-LR in treated drinking water are currently only available at the ministry's laboratory. Testing of treated drinking water for microcystin-LR must be discussed with the ministry through the Safe Drinking Water Branch, which can be contacted through the local ministry District Office.

To help you comply with the regulations, information is available by contacting: 1-800-565-4923 or picemail.ene@ontario.ca

A bloom of the blue-green algae Anabaena. Blue-green algae thrives in warm, shallow, slow-moving water. Blooms are commonly found near docks and shoreline areas.

to chlorination must be done while maintaining required residuals in the distribution system and meeting the standards for disinfection by-products.

Other process changes that may help reduce the possibility of elevated levels of cyanotoxins in the treated water include more frequent cleaning of screens and strainers, more frequent back washing of filters, more frequent purging of settled sludge, cessation of recycling of backwash and cessation of the second stage in 2-stage filtration, and more frequent removal of floating scum. The possible benefit of such adjustments must be balanced against the possibility of compromising normal pathogen removal (e.g. more frequent backwashing may reduce time available for filter ripening and may impact pathogen removal).

Treatment plants with the capability to deploy powdered activated carbon addition or granular activated carbon (commonly referred to as PAC and GAC, respectively) filters seasonally for taste and odour may consider using these treatment processes to provide additional toxin removal.

What about smaller treatment systems and private supplies?

Small drinking water systems with modest treatment facilities (such as those often used by resorts) and private home or cottage supplies with either no treatment or minimal water treatment systems are less likely to have the specialized equipment to effectively filter and treat water during algal blooms. The treatment methods most commonly used by these systems are generally ineffective against blue-green

algae contamination. Owners and operators of such systems that have an intake near a bloom should provide an alternative water supply for the duration of the bloom, and should contact the local health unit or the ministry's local office for further directions.

If you suspect a blue-green algal bloom, assume toxins are present and call the ministry's Spills Action Centre at 1-800-268-6060.

Should I be concerned about blue-green algal blooms?

Yes. Although many forms of blue-green algae are relatively harmless, some forms produce toxins that can be harmful to the health of humans and animals.

Algal toxins are released into the water when the algal cell wall breaks, which can occur when the cell dies and decomposes or is damaged by physical abrasion or chemicals like bleach or algaecides.

If large concentrations of algal toxins are swallowed, flu-like symptoms can occur, such as headaches, fever, diarrhea, abdominal pain, nausea and vomiting.

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