

Photosynthetic Growth & Water Quality

The rapid growth of algae occurs naturally when runoff, water currents or upwelling increase the supply of limiting nutrients. However, blooms can also be induced when nutrients are supplied from anthropogenic sources such as fertilizer, animal waste or sewage. Whatever the nutrient source, algae blooms can create a variety of problems both for the environment and for water resource managers including hypoxic dead zones and harmful algal blooms/toxins. These events can cause human health issues such as the poisoning of seafood and the closing of recreational waters, but they also pose challenges to water treatment systems. In water treatment systems algal blooms in the source water can affect drinking water taste & odor while clogging or otherwise damaging filtration systems and putting a strain on the systems designed to remove algal toxins from the source water.

The LiquID™ station makes several measurements that are useful for better understanding algal and related photosynthetic growth and how it affects water quality. The most definitive components of different photosynthetic products are the pigments. The standard suite of pigment-related parameters loaded onto a LiquID source water machine is the following:

Chlorophyll-a: all plants, algae (including diatoms), and cyanobacteria that photosynthesize

Chlorophyll-b: only in green algae

Chlorophyll Phycobilin: cyanobacteria and rhodophyta

Interrelation of Water Quality Parameters

However, the LiquID station measures not only Chlorophyll pigments, but also other relevant water quality measurements at the same time. Ancillary concurrent parameters such as UVT, turbidity, TOC, nitrate and iron can be used to further evaluate the effects of algal blooms on water quality.

Chlorophyll-a is indicative of overall plant growth and the first indication of eutrophication. Because diatoms only produce the ‘-a’ chlorophyll pigment, it is also possible to gain insight into the onset and development of diatom blooms by looking the ratio of CHL-a to CHL-b. Additionally, pigments are colors and the LiquID offers COLOR@440nm (Pt-Co units) as a standard measurement that complements the Chlorophyll data.

Of course plant growth also affects the turbidity of the water. The ZAPS approach to Turbidity is to monitor light attenuation at several frequencies. Since attenuation is dependent on particle size it is possible to develop a mathematical solution as a semi-quantitative measure of ‘size’ (a LiquID parameter). In simple terms, diatoms are relatively large while algal plants and bacteria are relatively small. Changes in the Size parameter can therefore be indicative of composition but also such related processes as settling and filtration.

Photosynthetic products are composed of organic carbon and as such have an impact on larger scale parameters, in particular Total Organic Carbon (TOC) and Total Suspended Solids (TSS). The LiquID station’s minimum detection

The LiquID™ Station

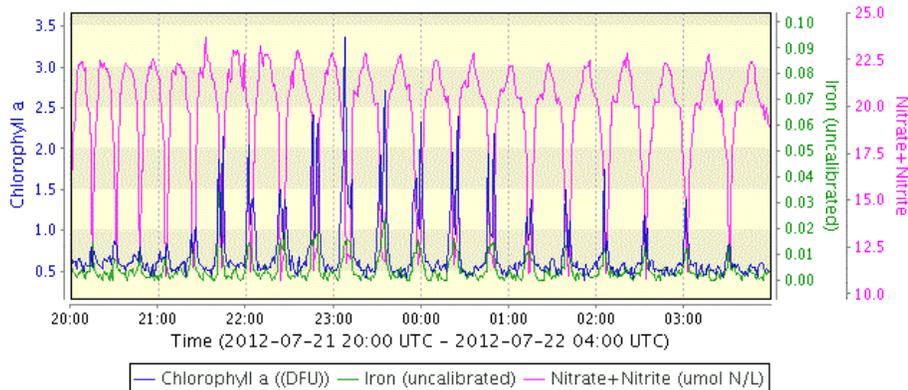
The LiquID Station from ZAPS Technologies (pictured below) is an innovative, optical instrument for continuous water quality monitoring. The automated online instrument analyzes a continuous flow-through stream from a pressurized water sample line using multi-spectral light and software algorithms, and uses no reagents nor produces any waste other than the original sample (which is returned or wasted as appropriate). With this method LiquID is capable of monitoring a wide range of water quality parameters in a number of different industry applications, including those relevant to municipal water and wastewater treatment, water reuse systems and industrial process control.



limits for these parameters are quite low, 0.02 mg/L and 0.08 mg/L for TOC and TSS, respectively. Finally nitrate and iron are required by all plants and are known to be major players in the photosynthetic process, more often than not one of these is the limiting nutrient. ZAPS offers these major nutrients as the parameters Nitrate + Nitrite and TDFe (total dissolvable or bioavailable iron).

Environmental Monitoring

These parameters combine to provide an environmental context to the data in a particular location at a specific time. In this example, a LiquID station, installed on an oceanographic research vessel and fed seawater samples pumped up from different depths while the ship was in motion, was used to construct a continuous and highly-detailed record of the contents of the water as a function of depth and position off the Oregon coastline. The LiquID functions in salt and fresh water, and – as seen below – works continuously to provide a real time profile of the subject water which can be used for research, source water monitoring, water security or process control purposes. In the chart below, the LiquID station was measuring chlorophyll a (blue line), dissolved iron (green line), and nitrate + nitrite (magenta line) in the seawater as the ship's path took it by chance through a diatom bloom near the surface. Because the diatoms contain chlorophyll, their sudden appearance caused the chlorophyll-a detection channel in the LiquID station to respond each time the sled's path rose up into the cloud of floating diatoms. The extent of the diatom bloom and the distribution of diatoms in the water column show clearly in the LiquID station's data log.



Summary

Continuous records of these parameters from the LiquID Station can be used alone or in combination as predictors of forthcoming blooms or to help develop strategies for dealing with adverse effects. The list of LiquID parameters related to photosynthetic process is substantial and include:

- Chlorophyll-a
- Chlorophyll-b
- Chlorophyll Phycobilin
- Color (@440 standard)
- Size
- TOC
- TSS
- Nitrate+Nitrite
- Biologically Available Iron

Understanding the profile of source water is an important element of protecting the safety and security of our natural water resources for purposes from recreation to agricultural to water treatment. The LiquID station is a reagent-less 100% optical continuous monitoring instrument that is capable of monitoring multiple parameters including major indicators of algal activity such as Chlorophyll-a, Chlorophyll-b and Phycobilin. Capable of unattended, automated operation for extended periods, the LiquID station is ideally suited for this role as an ever vigilant sentinel of source water quality.

Contact ZAPS For More Information

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