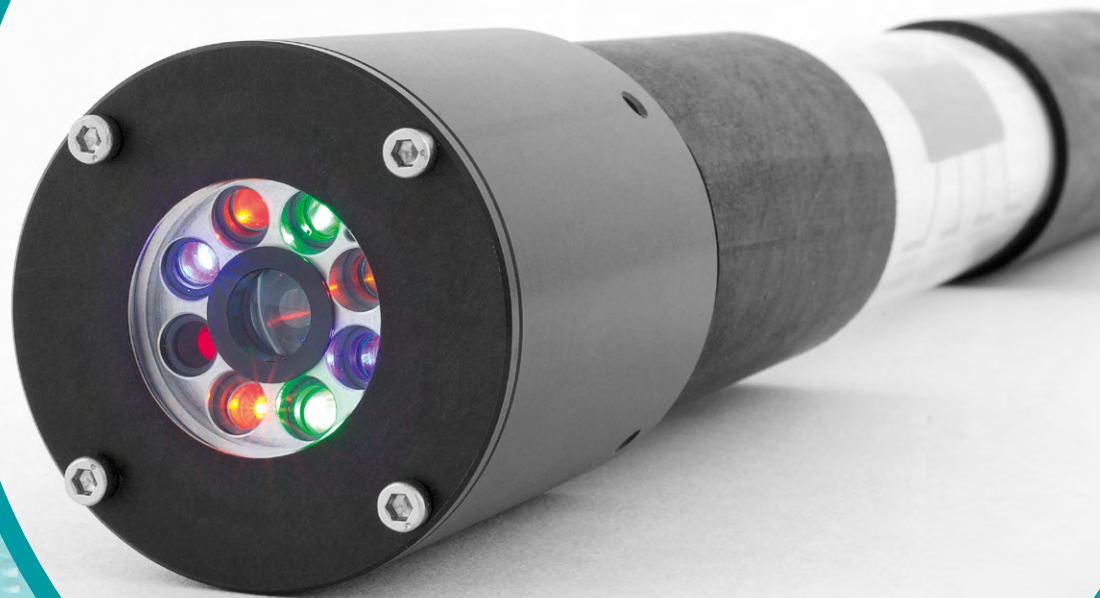


bbe

biological · biophysical · engineering

moldaenke



www.bbe-moldaenke.de

AlgaeTorch

The handy measurement instrument for rapid deployment



Fast and simple algae monitoring



Designed for all types of surface water: lakes, reservoirs, rivers and bathing water



What does the AlgaeTorch offer?

The AlgaeTorch is a handheld instrument for the rapid measurement of chlorophyll-a without sample preparation.



APPLICATION

- ▶ chlorophyll measurement without sample preparation
- ▶ determination of blue-green algae and total chlorophyll
- ▶ water quality assessment
- ▶ surface water inspection
- ▶ bathing water monitoring
- ▶ ecological investigations

The chlorophyll content of microalgae and blue-green algae is measured directly in the water. Algae, as phytoplankton, are an essential component of the biomass which performs photosynthesis in rivers, lakes and seas, and which binds atmospheric carbon dioxide (CO₂ assimilation).

The purpose of chlorophyll determination is a **qualitative and quantitative measurement of phytoplankton**. The chlorophyll content of algae can be used as an aid to estimate the amount or quantity of algae in the water. At the same time, an assessment of phytoplankton which can be seen as potentially harmful takes place. This includes the commonly occurring class of blue-green algae (cyanobacteria). The AlgaeTorch automatically differentiates between the chlorophyll content of blue-green algae (cyanobacteria) and the chlorophyll content of all other microalgae present.

The AlgaeTorch can be used anywhere where an **assessment of water quality** is required in association with algae. The measurement principle is simple and is automatically controlled using the integrated LCD display, from starting a measurement to showing the results. The AlgaeTorch can be used for the assessment of algae blooms at an early stage, the measurement of bathing water quality, the evaluation of ecological status according to the EU Water Framework Directive and the quality of cooling water systems.

The Measurement Principle

The excitation of the photosynthesis apparatus in the living cell using light of little intensity leads to the emission of fluorescent light (*in vivo fluorescence*). The AlgaeTorch determines the algal content via measurement of the fluorescence intensity: this is proportional to the chlorophyll content of the microalgae and blue-green algae. **The results appear in real time**, since the pulsed fluorescence excitation and emission occurs in milliseconds.

The fluorescence measurement corresponds to time-consuming wet chemical analysis according to ISO 10260 and DIN 38412/16. However, in contrast to wet chemical analysis using extraction, the AlgaeTorch needs **no sample preparation** and can even replace the time-consuming method of cell counting using the microscope.

To measure the fluorescence, microalgae in the water are excited by LEDs of **different wavelengths**. In addition to light-collecting chlorophyll, blue-green algae (cyanobacteria) have other pigments which have to be taken into account in the chlorophyll measurement. Using multiple LEDs allows all algae classes to be measured. The amount of total chlorophyll of all microalgae and blue-green algae (cyanobacteria) is then calculated from the fluorescence signals by the appropriate algorithms.

What else does the AlgaeTorch do?

Additional AlgaeTorch Data

The **integrated turbidity measurement and turbidity correction factor** prevents influence of the chlorophyll measurement by reflection and the weakening of the signal strength by particles in the water. This improves the quality of the measurement considerably. In contrast to other chlorophyll measurement instruments, the correction is carried out automatically and is directly included in the chlorophyll determination. The turbidity measured is displayed and stored as an FTU measurement (Formazin Turbidity Unit).

The AlgaeTorch is equipped with a **GPS module**. Geographical coordinates are displayed and stored with each chlorophyll measurement, along with the date and time. All datasets can be transferred from the internal data logger to a PC using the bbe++ software.

MEASUREMENT

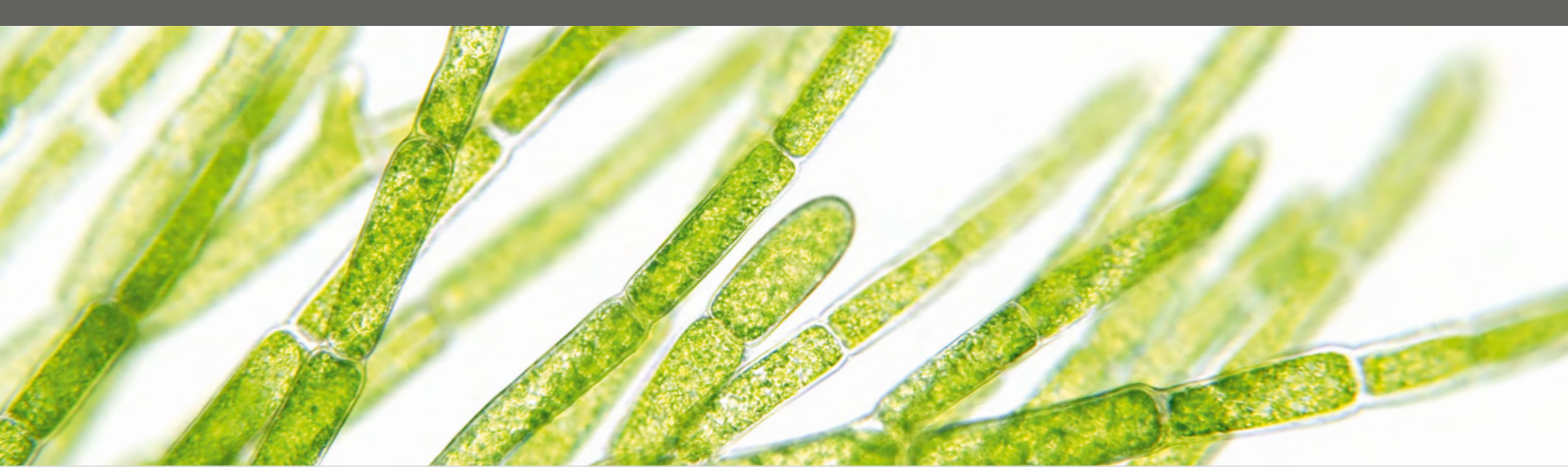
- ▶ *in vivo* fluorescence
- ▶ real-time measurement
- ▶ fluorescence measurement in comparison
- ▶ excitation using three wavelengths
- ▶ blue-green algae detection
- ▶ total chlorophyll-a



The Algae-Torch 100 is the suitable instrument for long-term measurement

FEATURES

- ▶ turbidity measurement and correction
- ▶ GPS
- ▶ data processing and export



✓ FEATURES

- ▶ integrated display
- ▶ sensor keys
- ▶ vibration signal
- ▶ internal power supply
- ▶ robust design
- ▶ cable-free measurement

Exported measurement data can be integrated graphically into Google Earth or Google Maps.

All settings and measurement results are shown on the **integrated display**. The brightness of the display can be regulated and produces good readability even in strong sunlight. Neither a control unit nor a PC is needed for a measurement. The AlgaeTorch is operated by easy-to-use **sensor keys**. Inputs and the end of a measurement are confirmed by a **vibration signal**.

The AlgaeTorch contains rechargeable batteries in a robust housing. Operation in the field is **cable-free**. Mains operation is of course also possible.

The AlgaeTorch in Operation

⏻ OPERATION

- ▶ starting of the AlgaeTorch
- ▶ control
- ▶ long-term measurement

Switch on and read off

The AlgaeTorch has an internal tilt switch and is activated by flipping the instrument or by using a magnet. Operation of the AlgaeTorch is performed by the **integrated** firmware or the bbe++ software supplied. After switching the unit on, it is operated by using **4 capacitive sensor keys** on the housing directly below the display.

All menu items for the measurement are easily and quickly accessible. The measurement program is started immediately by confirming START by pressing the key below the OK. Before each measurement, the LEDs are automatically tuned before the measurement begins. In the standard setting, this lasts approximately 10 seconds, whereby the countdown is shown in the display. When the display is darkened, the AlgaeTorch calculates the chlorophyll values. After a few seconds, the results appear as dark numbers on a light background – easily readable even in bright sunlight.

The **AlgaeTorch 10** is submersible down to 10 m, however, it is not conceived for permanent underwater operation. Long-term measurement campaigns and online measurement can be performed using the **AlgaeTorch 100** down to a depth of 100 m with integrated depth measurement and an external power supply.

⏻ OPERATION

- ▶ underwater operation
- ▶ wiper
- ▶ settings
- ▶ online measurement
- ▶ interfaces
- ▶ shallow water attachment
- ▶ telescopic rod
- ▶ maintenance-free

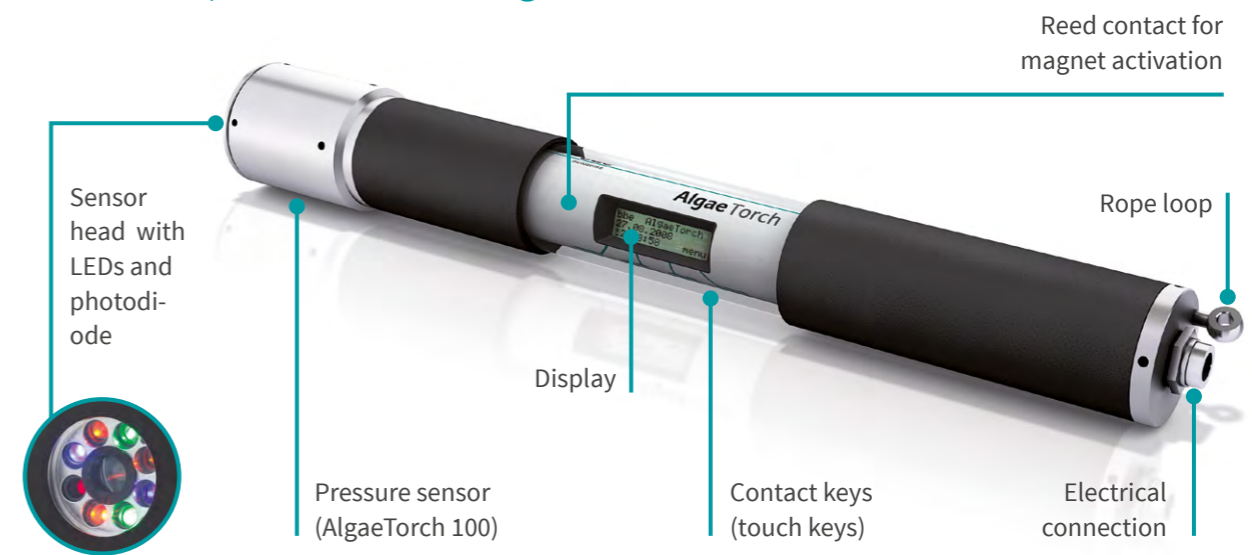
The maximum distance between the PC or notebook and the AlgaeTorch for cable operation is 30 m. A submersible AlgaeTorch 10 with external power supply is also available.

A **motor-operated wiper**, which periodically cleans the optics of the AlgaeTorch, is available as an attachment to prevent biofilms.

All further settings can be changed via the menus in the display: measurement time and measurement interval, display settings and GPS activation, etc. Before a measurement is started, the position is located via GPS and subsequently added to the measurement results. Both AlgaeTorch versions can perform individual, interval or continuous measurements.

The AlgaeTorch is equipped with a **serial interface** (RS232) for data export and for connection to an external computer. It is connected to the PC or notebook via **USB**. The AlgaeTorch 100 has a watertight plug system, which allows online operation in submersed mode.

The Components of the AlgaeTorch



In order to avoid the influence of benthic algae, seaweed or fallen leaves on the measurement values, the AlgaeTorch is supplied with a **shallow water attachment**. This prevents background fluorescence from influencing the measurement results.

For difficult-to-reach-locations a **telescopic rod** is available. The distance of the operator to the measuring site can be increased up to 2.5 m.

The AlgaeTorch is **maintenance-free** and should be rinsed occasionally after use with clean water. An access code prevents the deletion of calibration data. If necessary, the AlgaeTorch can be reset to its factory settings.

Background: spectral analysis

✓ FEATURES

- ▶ pigment and chlorophyll fluorescence
- ▶ LED wavelengths
- ▶ chlorophyll measurement of different algae
- ▶ AlgaeTorch measurement during an algal bloom

How is phytoplankton differentiated?

In addition to chlorophyll, algae contain characteristic pigments to collect energy. All algae show in common chlorophyll-fluorescence with an emission of red light between 680 and 700 nm. The excitation wavelengths, however, can be considerably different according to each algal class.

This characteristic of algae is used to classify the different algae. The AlgaeTorch uses 2 x 3 LEDs at different wavelengths. In order to obtain a fluorescence spectrum, 6 LEDs with wavelengths of 470, 525 and 610 nm were selected for the excitation. The wavelengths of the LEDs are adapted to the absorption wavelengths of the light-collecting pigments of different algal classes such as phycocyanin and chlorophyll.



The AlgaeTorch uses 6 LEDs for excitation of the complete fluorescence spectrum

The excitation of the algal pigments is performed by sequential switching off the LEDs at high frequency. In the intermediary phases, the fluorescence emission of the chlorophyll is measured as a response to the excitation.

Spectra of different algal classes are used as the basis for the evaluation in order to measure the chlorophyll content of blue-green algae (cyanobacteria) and the total chlorophyll. In parallel, the turbidity is determined by measuring the reflection at a wavelength of 700 nm, which does not interfere with the chlorophyll measurement. The turbidity is calibrated at factory and does not require additional correction. It is used automatically for chlorophyll correction but can be deactivated if necessary.

“

The AlgaeTorch is an very practical instrument for the rapid detection of blue-green algae. The in vivo fluorescence measurement enables considerable time-savings and rapid decision-making. It allows us to determine the scattered distribution of blue-green algae (with the built-in GPS module) and thus a differentiated load image. The AlgaeTorch also enables us to intensify observations.

”

Hartmut Wassmann
Engineering Office,
Waterbody Restoration
Environmental Information
and Limnology

Additions and Accessories

The AlgaeTorch is equipped with its own firmware for automatic operation, measurement, data collection and calibration. Updates are provided free of charge as downloads by bbe.

The bbe++ software supplied can be used to operate the AlgaeTorch and view and evaluate the data.

All parameters and data measured are stored in a database. The database can store the data of different instruments and types.

The macro function contains default settings for the graphic and table display in different combinations. Using this function simplifies the selection of commonly used windows and display settings.

The bbe++ software runs on all common Windows operating systems. It is also conceived to operate other bbe fluorescence measurement instruments. Data from the AlgaeTorch can be exported, to be displayed in Excel sheets or satellite maps.

The AlgaeTorch is pre-calibrated and ready for immediate use. The functionality of the instrument can be tested in a few minutes using the



The functionality can be tested directly on the instrument quickly and simply using the optional attachment unit

optionally available performance-test attachment, which is screwed onto the measurement head of the AlgaeTorch.

The attachment contains an auto-fluorescent foil, which is measured by the AlgaeTorch. By additionally measuring the current temperature, the settings of the AlgaeTorch can be checked and compared to the factory settings of the attachment. If deviations are determined, the user can contact bbe service for assistance and advice. A recalibration of the instrument is recommended at two-year intervals. The calibration at factory is performed with live algal cultures from controlled algal breeding under strict quality controls.

SOFTWARE

- ▶ bbe firmware
- ▶ bbe++ software
- ▶ database
- ▶ macro function
- ▶ compatibility

AlgaeTorch Check:

- ▶ function check
- ▶ calibration

SCOPE OF DELIVERY

- ▶ instrument: AlgaeTorch
- ▶ manual
- ▶ PC software
- ▶ mains unit
- ▶ USB-mains supply with cable
- ▶ shallow water attachment
- ▶ cleaning cloth

optional:

- ▶ performance-test unit
- ▶ telescopic rod
- ▶ shoulder bag
- ▶ 10 m rope
- ▶ motor-operated wiper
- ▶ underwater cable

+ ADVANTAGES

- ▶ immediate chlorophyll analysis
- ▶ differentiated blue-green algae detection
- ▶ real-time measurement
- ▶ automatic turbidity correction
- ▶ linked GPS coordinates
- ▶ long operation times, little maintenance
- ▶ simple operation
- ▶ cable-free measurement
- ▶ light, portable and mobile
- ▶ submersible to 10 m, maximum 100 m
- ▶ online option
- ▶ switchable from μg chlorophyll to cell counts
- ▶ calibrated with living algal cultures

Technical Details of the AlgaeTorch

DESCRIPTION	VALUES
Measurands	blue-green algae [$\mu\text{g chl -a/l}$], total chlorophyll [$\mu\text{g chl -a/l}$], turbidity, GPS coordinates
Measurement range	0 - 200 $\mu\text{g Chlorophyll-a/l}$
Resolution	0.1 $\mu\text{g Chlorophyll-a/l}$
Weight	1.3 kg
Dimensions (H x Ø)	500 x 60 mm
Power supply	110/230 V @ 50/60 Hz - 12 V DC
Sample temperature	0 - 40 °C
Turbidity correction	0 - 200 turbidity units
Protection class	IP 68
Depth	AlgaeTorch 10: 10 m AglaeTorch 100: 100 m
Data interface	USB
Data interface	2,000 datasets
Software	bbe++ software for Windows



Do you have any questions? Contact us!

Your local bbe distributor

bbe

biological · biophysical · engineering

moldaenke

bbe Moldaenke GmbH

Preetzer Chaussee 177
24222 Schwentinal
Germany

Tel.: +49 (0) 431 - 380 40-0
Fax: +49 (0) 431 - 380 40-10
bbe@bbe-moldaenke.de

