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Daphnia Toximeter II

Water early warning system
with daphnia



Water quality monitoring



Online Determination of toxicity



Fully automated process
control and analysis



What is a Daphnia Toximeter II?

The DaphniaToximeter II is a fully automated analysis system for rapid Detection of acutely toxic conditions in water.

✓ TASKS AND PERFORMANCE

- ▶ Fully automated early detection of toxic conditions
- ▶ High-resolution alarm software with alarm detectors
- ▶ Continuous monitoring 24/7 in real time
- ▶ Use of standardised test organisms
- ▶ Proven support from bbe Service
- ▶ 25 years of experience in the development and manufacture of toximeters

Changes in the movement profile of water fleas are analysed with the aid of high-resolution camera systems and enable **rapid assessment of the water quality**.

The quality of water used to produce drinking water or in food and beverage production is of paramount importance. Comprehensive measures already make it possible to exclude significant risks from contamination. Does this mean that everything has been done to guarantee the desired water quality? What does modern monitoring look like to indicate the sudden occurrence of undesirable and toxic substances?

Modern laboratories have a whole range of analytical equipment for recognising pollutants. The service extends to the identification and quantification of substances. However, a potentially harmful effect on health – toxicity – cannot be detected in this way. This requires organisms that **react directly to the effects of the pollutants**.

What kind of organisms are these and what are their characteristics? Numerous aquatic organisms such as fish and water fleas (daphnia), which constantly move around in the water in search of food, have proven their worth in toxicity monitoring. Their movement patterns change in the presence of pollutants. One or two days can pass before an incident is recognised without a monitoring system – valuable lost time. If it is possible to detect the changes more quickly, the **organisms** can be used **as an early warning system** and allow targeted countermeasures to be taken

This is where the bbe Daphnia Toximeter II sets new standards. More than 100 bbe Daphnia Toximeters are in use worldwide to assess water quality.



The water flea
Daphnia magna

The measuring principle of the Daphnia Toximeter II

The measurement with the DaphnieToximeter II

The first early warning system based on video observation and image analysis of water fleas, the „bbe Daphnia Toximeter“, was developed and launched on the market 25 years ago. Today, the further developed DaphniaToximeter II offers **convenient and automatic toxicity detection around the clock**.

The Daphnia swim in a chamber through which the sample water flows. Their movements are recorded using a high-resolution video system and analysed for anomalies using various detectors. All measurements are continuously analysed by alarm software.

A deterioration in water quality can be detected at an early stage by a change in swimming behaviour. The simultaneous recording of various behavioural parameters enables a **sensitive analysis in real time**. A traffic light visualises the current status of the water quality at a glance.



MEASUREMENTS

- ▶ Continuous video recording
- ▶ Measurement of individual movement sequences
- ▶ 1 minute measuring cycle with direct evaluation
- ▶ Detectors for rapid evaluation of behavioural changes
- ▶ Adaptive measurement behaviour during growth

Digital image analysis of video recordings of Daphnia

Measurement of the speeds:

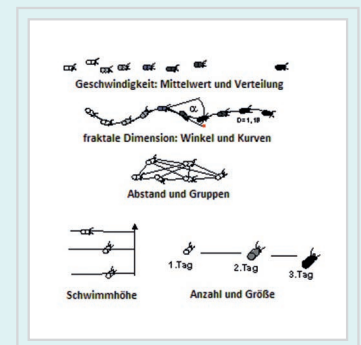
- ▶ Average speed
- ▶ Speed distribution

Observation of swimming behaviour:

- ▶ Swimming height
- ▶ Distances
- ▶ Turns
- ▶ Circular movements

Recording of growth:

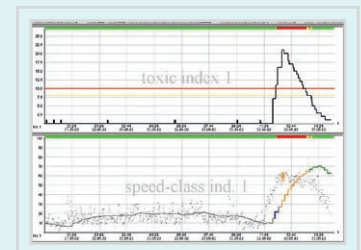
- ▶ Determination of the size of the Daphnia



Parameter evaluation

Toxicity index

The toxicity index is a sum parameter based on the evaluation of various measured variables such as the swimming velocity or the swimming height and their changes. The toxicity index specially developed by bbe is a measure of the current water quality. If several of these measured variables show abnormal values at the same time within a defined period, the toxicity index increases and an alarm is triggered.



Alarm status



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Daphnia, a freshwater crustacean, has been extensively used as a model organism for toxicity testing and its toxicological reactions to environmental pollutants have been being well characterized.

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**Le, Quynh Anh & Sekhon,
Simranjeet & Lee, Lyon & Ko,
Jung & Min, Jiho.**

(2016) *Toxicology and Environmental Health Sciences*. 8. 1-6.

WATER FLEA

- ▶ Active water absorption with permanent movement
- ▶ Constantly high sensitivity
- ▶ Easy to breed
- ▶ Continuous observation
- ▶ Real-time analysis of the undiluted sample water
- ▶ Dwell time in the toximeter app. 7 days

Water fleas are ideal for the Daphnia Toximeter II

Water fleas react sensitively to changes caused by undesirable pollutants that also affect the human organism. It is often not just individual substances or compounds that cause damage. Co-factors such as pH value, temperature and conductivity can intensify the toxic effect.

Water fleas **filter the water as they search for food** and constantly absorb dissolved substances. The substances are quickly distributed in the small body. This results in a short reaction time for toxins, which is also reflected in the short alarm times of the toximeter. In principle, water fleas are therefore well suited for the detection of suddenly occurring „acute“ toxicity. The water flea *Daphnia magna* has proven to be the best test organism.

These water fleas are **easy to breed** and are characterised by a **high sensitivity** to toxins. Genetically defined farmed daphnia react very uniformly and are preferable to free-living daphnia from natural sources. Our laboratory has its own breeding facility for these water fleas and is therefore able to provide **our customers with a constant supply of water fleas for the Daphnia Toximeter II**.

There are several thousand scientific publications documenting the effect of toxic substances on water fleas. *Daphnia magna* is used in static tests in which the Daphnia are exposed to various dilutions of the sample water. After 24, 48 or 96 hours, the surviving Daphnia are counted.

In the Daphnia Toximeter II, observation is continuous. **The undiluted sample water is analysed in real time**. Not only the mortality rate is analysed as in the static test. Changes in behaviour as a result of poisoning occur much earlier and are displayed in the bbe DaphniaToximeter II.

Young Daphnia remain in the flow-through swimming chamber for up to 7 days. They are automatically fed with food algae so that they move actively in the sample water in search of food. To avoid chronic effects, the Daphnia should be replaced after 7 days.

Setup and operation of the Daphnia Toximeter II

The components of the bbe Daphnia Toximeter II



Automatic feeder

Observation chamber

Sample preparation

optional: 2nd chamber

Touchscreen PC

Sample pump



TECHNICAL PROPERTIES

- ▶ 1 or 2 measuring chambers with up to 10 Daphnia
- ▶ Low-maintenance chamber design for keeping the Daphnia
- ▶ Sample preparation by filtration, ultrasound and integrated temperature control of the sample water
- ▶ Feeding the daphnia Integrated, continuously operating machine for adding algae concentrate
- ▶ Touchscreen PC incl. bbe Windows software with graphical display of measured values, live image and intuitive user guidance



INTERFACES

- ▶ LAN
- ▶ 2 x analogue output 4-20 mA
- ▶ 2 x relay output
- ▶ RS232
- ▶ USB

Operation of the bbe Daphnia Toximeter II

Operation of the Daphnia Toximeter II starts fully automatically after the water fleas have been introduced and the number of water fleas has been determined. After a short latency period to determine the normal behaviour, the toximeter is ready for alarm and **continuously analyses the behaviour of the test organisms**. The sample water is filtered, freed of air bubbles and enters the measuring chamber at a stabilised temperature. A feed syringe supplies the water fleas with food so that continuous operation is possible for up to a week. All current information is recorded by sensors and **permanently forwarded to the alarm software**. To rule out chronic effects, the water fleas are replaced after one week. Acute toxicity is automatically displayed when a threshold value of the toxicity index is exceeded and can be forwarded to a higher-level system via interfaces.



Maintenance, service, settings & use

Maintenance of the bbe Daphnia Toximeter II

The DaphniaToximeter II works autonomously and has an automatic feeding system with prefabricated feed syringes. All operating elements, hoses and pumps are easily accessible and can be serviced from the front. The **weekly time required by the operator is approx. 2 hours**:

- ▶ Checking the hose system and changing the feed syringe
- ▶ Checking the Daphnia culture and replacing the Daphnia in the measuring chamber
- ▶ Monthly: Replacement of the pump hoses

Maintenance contracts are recommended for further periodic maintenance work (every six months or all year round).

bbe Service

bbe offers a comprehensive service. Installation by bbe employees and **initial maintenance and training visits** ensure smooth operation. The bbe Moldaenke service team offers a **telephone and e-mail service** that responds quickly to questions and problems and, if necessary, sends a new set of water fleas overnight.

Settings and evaluation

The Daphnia Toximeter II offers a wide range of options for adapting to suitable toxicity monitoring. By setting alarm thresholds, the sensitivity of the alarm and a pre-warning level can be defined. This allows the Daphnia Toximeter II to **be adjusted specifically to the water to be analysed**. In addition, the movement parameters and their weighting can be selected. These can also be adapted to the body of water to be analysed. A further adjustment can be made via the detectors, which analyse the temporal course of the movements for acute toxicity.



Automatic feeder



Daphnia toximeter on the Elbe river

The DaphniaToximeter II is supplied pre-set and therefore fulfils most requirements. The experts at bbe will be happy to assist you with fine-tuning during [installation on site](#).

Toxicity alarms are significantly recognised and statistically evaluated. The simultaneous recording of various movement parameters and their evaluation ensures reliable monitoring over a wide range of water quality. Alarm statuses are shown graphically on the device on a display and with a traffic light indicator. To avoid false alarms (e.g. low water), hardware alarms are analysed and displayed separately. Alarm messages are either analogue or serial via existing interfaces. Sample collectors can be activated via relays to collect sample water for subsequent chemical analysis.

Where are Daphnia Toximeters used?

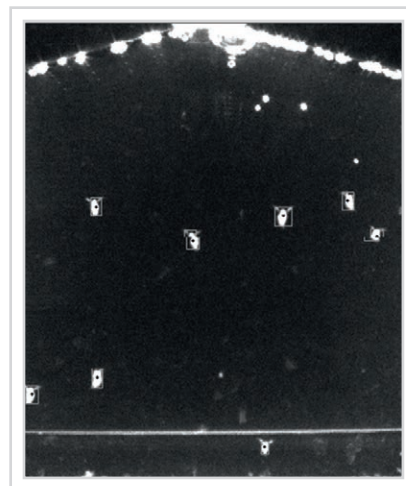
Daphnia toximeters can be found at all important surface water monitoring points, wells, drinking water supplies, rivers, reservoirs and dams. They are used for the rapid detection of pollutant inputs that require immediate measures to limit or prevent damage.

Users include measuring points on rivers, water suppliers, breweries, bakeries and other food producers, environmental agencies and research institutes. In addition, they are also used in sewage treatment plants and in the chemical and pharmaceutical industries to **immediately detect and, if necessary, stop** possible toxic discharges into natural waters. The high sensitivity of Daphnia guarantees the necessary quality requirements of the treatment processes before the water can be discharged into a body of water.

As an established measuring method, the Daphnia Toximeter II with its alarm software is increasingly being used in the training of students at colleges and universities.

The Daphnia Toximeter II is installed in a building or laboratory close to a continuous sample stream – often a ring main – **from which the sample water to be analysed is taken from an overflow vessel without pressure using a peristaltic pump**. All further toxicity determination processes take place without the operator having direct access to the device. Remote access to the Daphnia Toximeter II is usually linked to integration into a higher-level network at the same time.

Conclusion: Daphnia toximeters are used wherever potentially hazardous substances can occur whose type and composition are not known in the field. In these cases, chemical analysis – especially continuous analysis – would be almost unthinkable.



Real picture of the Daphnia



APPLICATION

- ▶ Process water monitoring
- ▶ Drinking water supply
- ▶ Food production
- ▶ Water quality assessment
- ▶ Discharge monitoring
- ▶ Chemical assessment
- ▶ Research and teaching

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The Daphnia Toximeter showed a great sensitivity towards toxic substances in the water considered, according to QC and proficiency testing.

The data confirmed a high biological quality of untreated and finished water in Athens.

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G. Vasilantonopoulou,
18th International Symposium on
Health-Related Water Microbiology,
WaterMicro 2015

Specifications, software and scope of delivery

A complete Daphnia Toximeter II is supplied in a compact IP 54 housing, including software and all necessary accessories for immediate use. A dualchamber system for alarm verification and improved alarm detection is optionally available.

Alarm software:

- ▶ Simple data analysis and management
- ▶ Upper and lower limit value for all relevant measured values
Parameterisation of the measurement
- ▶ Storage of parameters and data in a database
- ▶ Graphical representation of all measured variables
- ▶ Data export to EXCEL and text files
- ▶ Online display in the LAN.



SCOPE OF DELIVERY

- ▶ Daphnia Toximeter II 230/115V, 1- or 2-chamber system
- ▶ Alarm software
- ▶ Integrated touchscreen PC (Windows)
- ▶ Ultrasonic cleaning
- ▶ Automatic algae feeding
- ▶ USB keyboard

Technical details of the Daphnia Toximeter II

DESCRIPTION	VALUES
Measuring method	Video evaluation
Housing material	Painted sheet steel
Weight	60 kg
Dimensions (H x W x D)	800 x 800 x 500 mm
Protection class	IP54
Voltage	110/240V 50/60Hz
Power consumption	600 W
Temperature	Sample: 0 - 30 °C / Environment: 0 - 35° C
Turbidity	Measurements up to 100 FTU
Sample stream	200l/h raw water, 2-3l/h ultrafiltrated water
Maintenance interval	7 days
Sample supply	Peristaltic pump



ADVANTAGES

- ▶ Width and high sensitivity
- ▶ Established pollutant indicator
- ▶ Proven technology
- ▶ Long service life
- ▶ Low maintenance effort
- ▶ Variable place of use
- ▶ Remote access and network capability

Do you have any questions? Please contact us!

Your local representative

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