AQUADECT

MOSSELMONITOR®

MUSSELMONITOR

The biological early warning system

What you don't look for, you won't find!

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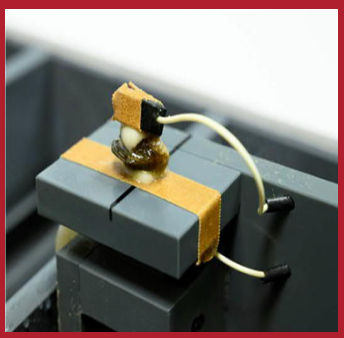
Biological early warning systems

Biological early warning systems (BEWS) have been developed to provide a rapid warning of the occurrence of contaminants in water at concentrations which could be of immediate threat to living organisms. In order to allow a rapid response, a BEWS must be based on biological functions that allow fast changes. Therefore, all BEWS are based on the monitoring of either a physiological or a behavioral function. Of course, the function should change when the organism is exposed to one or more contaminants and a defined cause-effect relation should be established.

Where chemical monitoring measures only selected compounds ("What you don't look for, you don't find!"), biological monitoring offers the potential to monitor a truly wide spectrum of chemicals, even those that escape chemical monitoring.

The MOSSELMONITOR®

The MOSSELMONITOR is such a biological sensor for continuous on-line monitoring of water. The system performs all tasks: measurement, evaluation and communication. The monitor makes use of 8 bivalves (such as mussels, clams). Two electromagnetic sensors follow the movement of the shells of each mussel. Abnormal behavior is detected by the monitor. For example, if all mussels are closed for a longer period (*e.g.* >4min), an alarm is generated. Alarms can also be used to induce automated sampling for further proof by chemical analysis.



The MOSSELMONITOR is a broad spectrum sensor that operates unattended for weeks, 24 hours per day, 7 days per week. Its application includes monitoring of surface waters, effluents, drinking water intakes, seawater, even of (chlorinated) drinking water. The user can set the sensitivity (and thus the reliability!) of the monitoring system to allow for optimum conditions for his or her application. False alarms can thus be minimized. Maintenance is low; replacement of the mussels is every 2-3 months, reducing operational costs. The very robust system is available as *in situ* instrument or as flow through system.

Biological functioning

Under normal environmental conditions mussels are submerged and their shells are open to allow for feeding and respiration. Bivalves filter the food particles from the water. The typical behavior may vary from species to species, but almost all species tested close their shells only occasionally for a short period, e.g. to defecate. Closure of the shells for longer periods is to be considered as escape behavior. If one bivalve is closed for a prolonged time, e.g. for 5 min, this is not considered as unusual; but if several mussels do this simultaneously, say 5 out of 8 mussels, this is highly unusual and a reason for alarm.

The valve opening of each mussel is continuously monitored by the MOSSELMONITOR by high frequency electromagnetic induction sensors that are attached to the shells of the mussels. From laboratory studies it has become clear that, provided the behavior of each mussel was compared with its own behavior of, *e.g.* one hour previously, there was no need to middle out reactions by using relatively large numbers of specimens: natural variability is largely reduced when using the same individual as his own control. As a result, measurement and evaluation are carried out on individuals and when averaged results are displayed this is only after full evaluation of the data. Thus the use of eight mussels proved to be sufficient.

Significant changes in behavior are detected, which triggers the alarm function. Different behavioral patterns may be detected by the Mosselmonitor: full closure of the shells, reduced opening (linked to retraction of the siphons), increased valve movement activity, and extreme opening (indicating the organism is dead). Provided pre-set criteria are met (*e.g.* number of mussels showing response, time closed), each of these behavioral patterns can create an alarm.

Freshwater species tested include the zebra mussel (*Dreissena polymorpha*), painter's mussel (*Unio* sp.) and swan mussel (*Anodonta* sp.); for the marine environment the blue mussel (*Mytilus edulis*) or oyster species have been applied successfully.

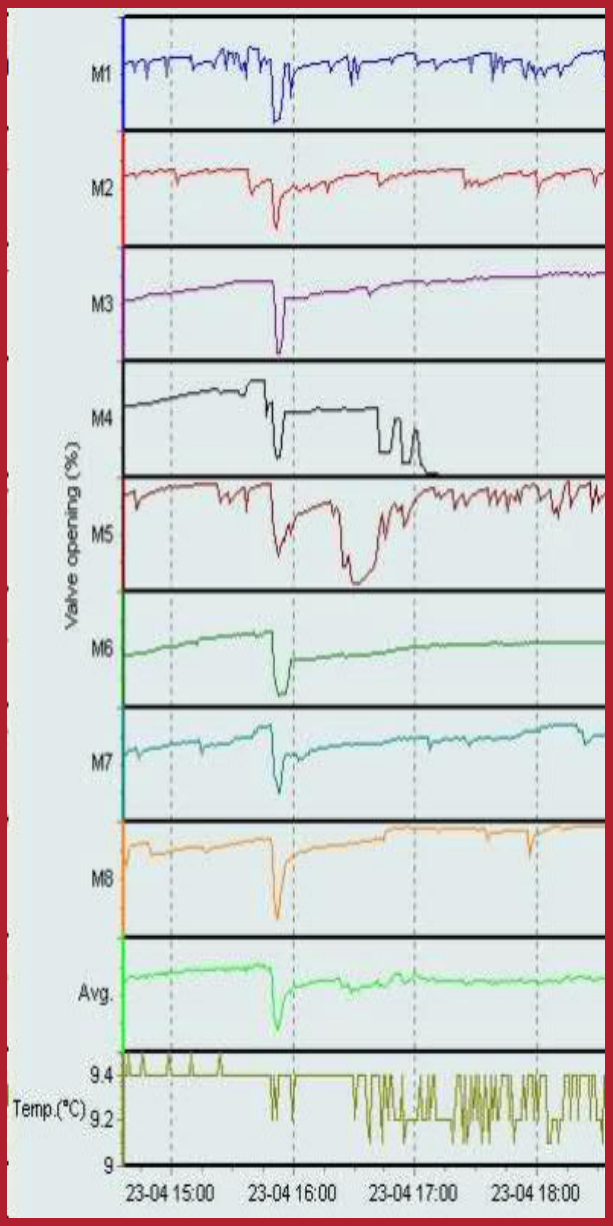
Automated Food Device (AFD)

In situations where there is no or limited food available in the water, bivalves will suffer from starvation, and mussels will not always have their shells open. This hampered proper application of the MOSSELMONITOR in e.g. ground- or drinking water. This problem was solved by continuous feeding of the mussels with an algal suspension, produced in this device

The algae cultivated in the AFD are planktonic and unicellular. Nutrients, trace elements, CO_2 and light are the key elements necessary for algal growth. In the AFD algae (*e.g. Chlorella* sp.) are cultivated to a high density by a chemostat lag-phase approach. Nutrients are continuously added, the algal suspension is offered as food for the bivalves in the Mosselmonitor. With this continuous supply of food mussels keep their shells open (even in drinking water).

PRESENT IT 3

The data presentation software program PRESENT IT 3 was developed in co-operation with the users of the MOSSELMONITOR to obtain a visual tool for data evaluation. The program converts information from the Mosselmonitor into a graphical presentation. The user can select from many possibilities to allow the results displayed on the PC screen to best suit their demands. For example, one can display one, a few or all mussels (full scale or in stacked mode) or only the averaged signal, view the water temperature, user define the time axis.



With this program the user can view current on-line information of the Mosselmonitor , and/or view files that have been recorded previously. Automated data storage is taken care of by the program; Present IT 3 facilitates communication with the MOSSELMONITOR.

The program is installed on a PC, which is connected directly to the MOSSELMONITOR via a communication port. The software is simple to use and incorporates handy tools for data evaluation and presentation. As data sets can be exported in different formats (original .log format, CSV) and charts can be printed or exported (.bmp, .emf, .wmf), reporting becomes easy.

For further information please contact:
AquaDect., Badhuisstraat 3, 4306 BB Nieuwerkerk, The Netherlands
Phone:+31 (0)623057562 e-mail: info@mosselmonitor.com
The MOSSELMONITOR was developed in co-operation with:TNO, KEMA, RIVM, MERMAYDE and Delta Consult.

Specifications

In-situ and flow through instrument

Mechanical (in situ version)
HD-PE container dimensions h=420, Ø 320 mm
easy replaceable mussels
maximum depth: 15 m
weight 22 kg

Mechanical (flow through version)
PVC container lwh = 760x420x350 mm
volume 35 litres
inlet pvc Ø 20 mm, outlet pvc Ø 40 mm

Options

*Custom made Mosselmonitor® version
*Solar panels
*Automated food device
*Installation (optimization) taken care of by our staff
*On-site demonstration and training data evaluation by our experts
*Expert biological and technical advise

*Leasing possibilities for on-site demonstration and training
*Short period monitoring feasibility studies