



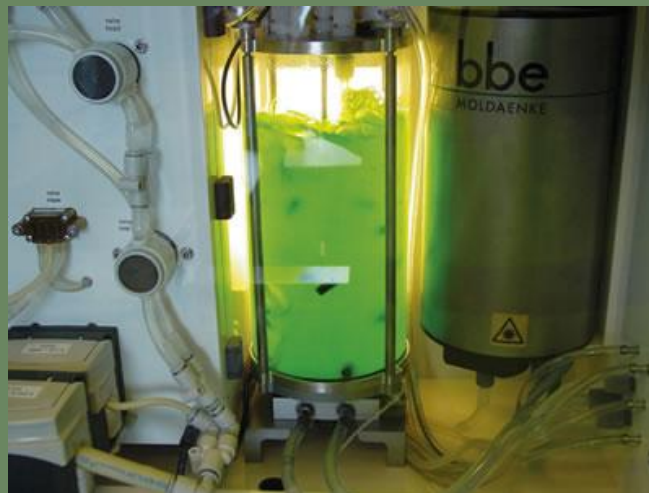
Biomonitors do what chemicals analysis cannot

Algae and Daphnia (waterfleas) forewarn drinking water sector

Biomonitors, instruments which measure the biological effects of different substances on organisms, detect substances which cannot be detected using chemicals analysis methods. This is also valid for combinations of substances which are present in the water in large concentrations. A well-functioning monitor is necessary since our modern society uses over one hundred thousand different substances. It is unlikely whether they can all be measured using chemical analysis. In the measuring plants in Eijsden and Lobith biomonitors are used as alarm systems.

On 24th and 25th September 2006, the **Algae Toximeter** in Eijsden triggered an alarm.

Algae convert sunlight (photo). Chlorophyll needs sunlight to convert the cells to a higher energy level, to makes the growth of algae possible. The chlorophyll does not absorb all the sunlight but gives some off as energy (i.e. fluorescence). Algae Toximeters measure fluorescence and on these two days the fluorescence emitted by the algae increased considerably. And this means that the algae absorbed less sunlight and thus produced less growth.



The heart of the Algae Toximeter (photo: RWS)

"Rotting" Algae

Obviously, at other measuring plants only a decrease in the oxygen concentration was shown. Upon closer inspection there was a small peak to be seen in the measurement of clearly observable substances. A similar increase before was due to the herbicide *terbutryn*. Further analysis confirmed that in Eijsden there was indeed a concentration of $0.7 \mu\text{g/l}$ *terbutryn* found. This was also reproducible in the **Algae Toximeter** by adding $0.7 \mu\text{g/l}$ *terbutryn* to the water to show exactly the known increase in fluorescence.

This also explains the decrease in the oxygen concentration in the river. Since algae growth was inhibited, oxygen production decreased. In addition, some of the algae died. This "rotting process" needs oxygen, which is why the oxygen concentration in the river continued to decrease.

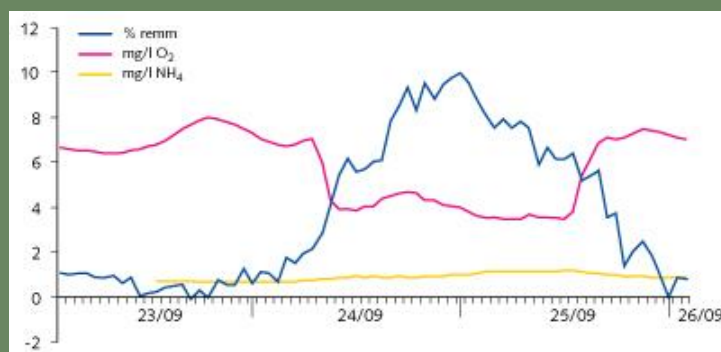
On Friday 20th April, the **Daphnia Toximeter** in Eijsden emitted a signal that the waterfleas were having difficulties. Additional waterfleas were added. On Sunday morning, 22nd April, they were dead. Even in this example the automatic chemical measuring device did not indicate any peculiarities.

For verification, the results of the **Daphnia Toximeter** were compared with chemically analysed samples taken directly at the river. A calculation was made of where the water was at that moment on Friday and Saturday and samples were taken. The laboratory in Lelystad measured amounts of herbicides at increased concentrations and subsequently exceeded the alarm threshold for drinking water ($1 \mu\text{g/l}$): chloropyrifos.

In both cases, the **biomonitors** warned the authorities of substances which at first glance had not been detected by chemical monitoring. Thus it was possible to stop the drinking water uptake in time in order to avoid subsequent damage. Without the biomonitors this would not have been detected.

Concentrations of herbicides found at Eijsden in $\mu\text{g/l}$

Concentratie bestrijdingsmiddelen bij Eijsden in $\mu\text{g/l}$			
	18 april	20 april riviermonster	Norm Maximaal Toelaatbaar Risico (MTR)
Chloorpyrifos	0,001	1,623	0,003
Diazinon	0,005	0,169	0,037
Dimethoate	0,032	0,204	23,000



Concentration of oxygen (magenta), % inhibition of fluorescence measured with the Algae Toximeter (blue) and ammonium (yellow).
Calamiteit Eijsden, Algae Toximeter 24th Sept 2006)

LATEST NEWS

Daphnia Alarm - August 2007

In August 2007, the **Daphnia Toximeter** proved its worth again and reacted to a toxic substance. After analysis had taken place, a solution of chloropyriphos was found to be the cause. The herbicide was dumped by a chemical company upstream at Luik (B). As a result, swimming and fishing were prohibited and the drinking water intake was improved.



Daphnia (photo: Daan Kalmeijer)

Further Information:

Jaap van Steenwijk (RWS RIZA)

tel. 0320-298649

[jaap.van.steenwijk @ rws.nl](mailto:jaap.van.steenwijk@rws.nl)

RWS: Centre for Water Management & Regional Directorate Limburg