

The link between chemical and biological water quality assessment

Bioassays measure the toxic risks of
pollutants to surface water ecosystems

What are bioassays?

Bioassays are toxicity tests on living organisms that measure the adverse effects of substances on the surface water ecosystem.

These effect measurements are a valuable addition to the standard chemical and biological assessments. They reveal the links between the compounds present in the water and the resulting toxic risk to the ecosystem.

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The advantages of bioassays

The Water Framework Directive requires the member states of the European Union to monitor the quality of surface waters by assessing their chemical composition (concentrations of substances) and biological communities (which species are present). Although chemical analyses can reveal which substances are present in the water and at what concentrations, this in itself says nothing about the effects these substances have on the ecosystem at the measured concentrations.

In contrast, bioassays measure the total effect of all the substances present in the water. This gives a much better picture of the combined effect of the substances on the ecosystem, including the effects of low concentrations and unknown compounds. A single set of bioassays is enough to estimate the toxic effects of the substances present on the ecosystem. By doing so they make the connection between chemical and biological water quality assessments. This procedure can save time and money. Knowing the full effects of the mixture of pollutants makes it possible to take more targeted measures to improve surface water quality.

Who benefits?

Bioassays are a useful tool for water management organisations, such as water boards, government agencies and ministries. They are also useful for testing the quality of treated waste water from hospitals and industrial sites. In the Netherlands bioassays are already used by the National Institute for Public Health and the Environment (RIVM), the Rijkswaterstaat Water Service and several water boards. The tests can also be performed by commercial laboratories.



Uses of bioassays

- To determine the toxic effects of known and unknown substances in surface water
- To identify locations where water quality needs to be improved
- To select the measures needed to improve the ecology of surface water (prioritising), which can cut costs
- To evaluate the effects of these measures
- To determine the effects of known and unknown substances in treated waste water from hospitals or the final effluent from sewage treatment plants
- To determine the effects of a mixture of substances in surface water when the concentrations of the individual substances are just within permitted levels
- To determine the effects of substances for which standards are not available



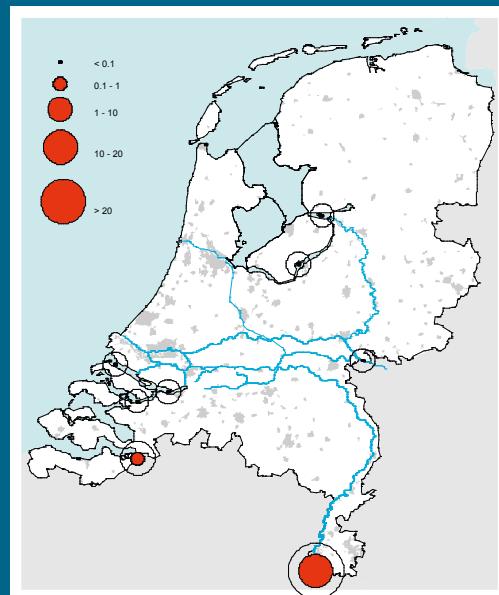
The method

The organic compounds in surface water samples are concentrated by binding them to certain resins. Among the chemicals concentrated by this procedure are polycyclic aromatic hydrocarbons (PAHs) and endocrine disruptors. The toxic effects these compounds have on common aquatic organisms, such as bacteria, algae, water fleas and crustaceans, can then be measured.

There are several methods for determining the general toxicity (toxic potency) of surface water or treated waste water. One of these is the pT method, which measures the effect of the mixture of known and unknown organic compounds in surface water. The Whole Effluent Assessment (WEA) method can be used to trace sources of toxicity in treated waste water or sewage. It is also possible to determine the toxicity of specific groups of compounds, such as endocrine disruptors and antibiotics. Special bioassays are needed for these tests. More information on the methods can be found at <http://www.rivm.nl/milieuportaal/dossier/bioassays/>

Bioassays are used to monitor the quality of major Dutch rivers and water bodies

The toxic potency of surface water samples from various locations in the Netherlands determined using the pT method (July 2005). The size of the circles indicates the level of toxic potency. Numbers above 5 indicate an increased toxic risk to the ecosystem. By comparing the toxic potency at various places, locations can be selected for priority action.



Interview

Connie Dekker on the use of bioassays at the Zuiderzeeland Water Board in the Netherlands

Connie Dekker

Senior officer

Water system information,
Zuiderzeeland Water Board

'What stands out most for me from our use of bioassays is that we were lucky to find no surface waters that were directly lethal to the organisms used in the bioassays, and therefore to the aquatic ecosystem as a whole. But we cannot rule out all possible adverse effects with this method. We took our samples from large ditches and watercourses and not from ditches where the organic pollutants are less diluted.'



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For more information, see

www.rivm.nl/milieuportaal/dossier/bioassays

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