



Biomonitoring of Effluents

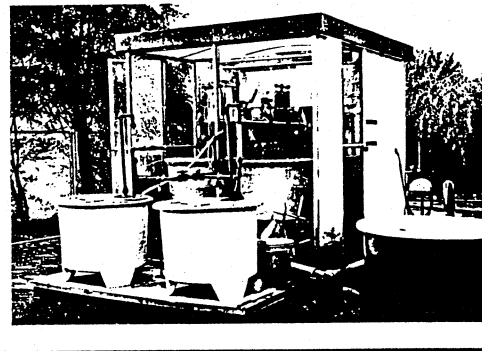
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Introduction

In 1986 an aquatic monitoring system was described by Prof. Hansen, Bundesgesundheitsamt, Berlin. It allows the longtime exposure of water organisms in a continuous flow-through system at various effluent dilutions simulating the conditions of the receiving water. The subtle, sublethal effects on the organisms indicate the longterm consequences of an effluent discharge to the aquatic environment. The resulting information on the No-Effect-Concentration NEC permits preventive

measures to be taken, if necessary, so that the effluent discharge does not endanger the survival and propagation of fish and other aquatic life in the receiving water. Since the end of 1989 a monitoring system is controlling the effluent of the purification plant of CG Grenzach. Starting 1994, effluent monitoring is offered as a service of ecotoxicology to the various CG plants.

Monitoring Station



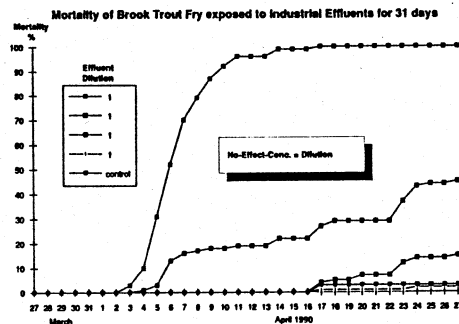
Objectives

- development of a biomonitoring system for CG (1990–1993)
- control of ecotoxicity of effluent discharges
- recognition and monitoring of longterm effects on aquatic organisms
- assessment of No-Effect-Concentration NEC (permitting normal propagation)

Results: typical examples

Effect of Effluent Dilutions to Fish Fry

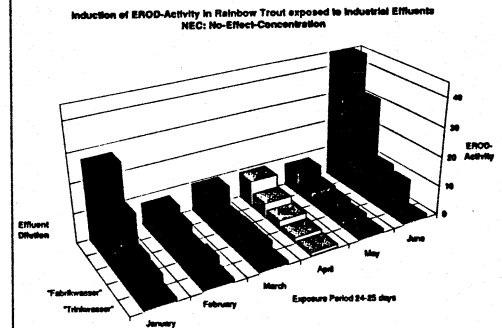
Fish in their early development stage react very sensitive to toxicants. This is due to their high metabolism rate and to detoxifying mechanisms which are not yet fully developed. Therefore fish larvae are very suitable for biomonitoring purposes.



The figure shows that in all but the highest effluent dilution the mortality of fish fry increases significantly with exposure time. No difference to the control is observed in dilution 1:1000 which therefore corresponds to the No-Effect-Concentration NEC for fish fry.

Effect of Effluent Dilutions to the EROD-Activity in the Liver of adult Fish

Hepatic mixed function oxydase (MFO or mono-oxygenase) activity, as indicated by 7-ethoxy-resorufin-O-de-ethylase (EROD) and other measurements of the cytochrome P-450I1 enzyme system, is an indicator of the ability of fish to detoxify certain pollutants. EROD activity is very sensitive and can be related quantitatively to the extent of pollutant exposure. It is used as an index of exposure to environmental pollution.

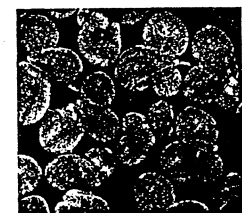


24–25 days exposure in effluent dilutions causes a statistically significant increase in EROD-activity. The No-Effect-Concentrations NEC varied between dilution 1:100 and 1:1000 during the survey. The dilution of the effluent in the river Rhein is at least 1:2500.

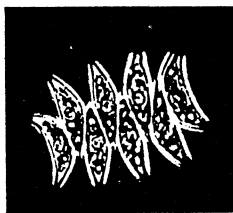


Methods & Parameters

Primary Producers

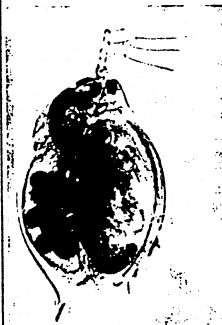


production, discolouration of Lemna



growth of green algae

Primary Consumers



accumulation of adsorbable organic halogens (AOX) in mussels *Dreissena*

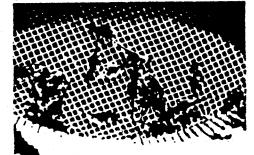
reproduction rate, time of first brood, size of *Daphnia*



feeding rate of *Gammarus*

Secondary & Tertiary Consumers (Fish)

- biotransformation of xenobiotics in liver (EROD: for explanation see results)
- reduction in growth (growth in length, weight, etc.)
- change in blood parameters (hematocrit, leucocrit, clotting, cell counts etc.)
- gill lesions
- change in liver- & viscerosomatic index
- histology of various organs (liver, kidney, gill, skin)
- AOX in liver
- embryo larval survival & teratogenicity (see results)



Benefit for CG

provides security due to:

- comprehensive information on the ecotoxic potential of effluents from purification plants by ecologically relevant results
- recognition of any need for extension of the sewage treatment
- recognition of the effectiveness of restoration measures
- cost effective surveillance of effluents reducing the expense for chemical analysis