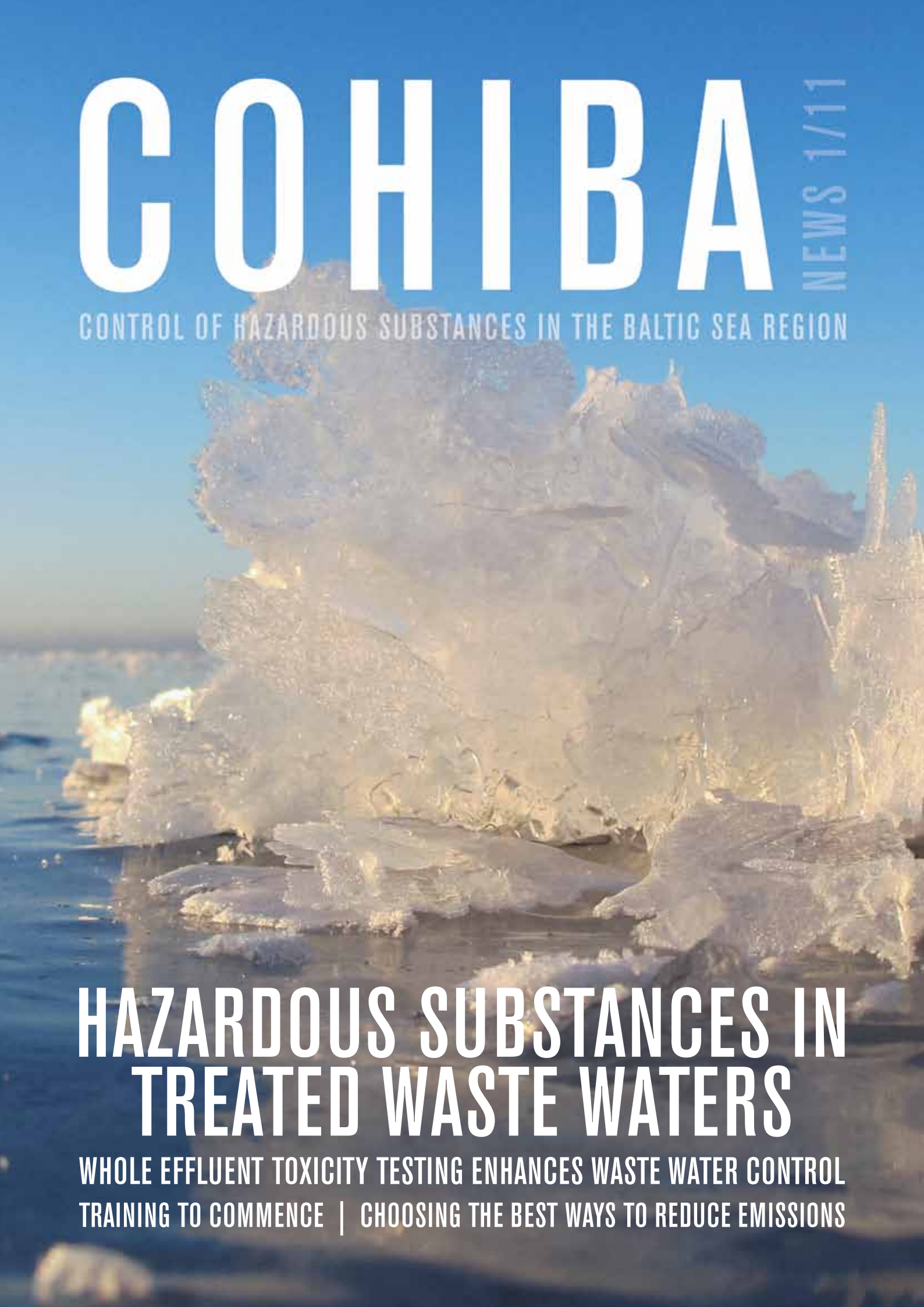
COHIBA

NEWS 1/11

CONTROL OF HAZARDOUS SUBSTANCES IN THE BALTIC SEA REGION



HAZARDOUS SUBSTANCES IN TREATED WASTE WATERS

WHOLE EFFLUENT TOXICITY TESTING ENHANCES WASTE WATER CONTROL

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HAZARDOUS SUBSTANCES IN

The COHIBA project has detected traces of 11 hazardous substances in treated waste waters discharged in the Baltic Sea catchment area. Although none of these compounds is acutely toxic to aquatic organisms at the measured concentrations, the results of the water sampling programme indicated the existence of some toxic effects in treated effluents. However, it is not possible to directly blame these 11 analysed compounds for the harmful effects observed.

The COHIBA project has screened municipal and industrial waste water, landfill leachates and storm water in eight countries around the Baltic Sea, analysing as many as 240 water and sludge samples in a single year. The project has performed biological tests to survey the acute and chronic toxicity of these waste water samples, as well as chemical analyses to identify nine organic substances or substance groups and two heavy metals listed as being of concern in the Baltic Sea.

CHEMICAL ANALYSES

The COHIBA project has tracked the sources of selected substances. The table summarises the occurrence of these substances in different kind of waste water effluent.

BIOTESTS SHOW HIGHER MORTALITY

Harmful acute impacts on aquatic organisms were detected by directly exposing test organisms to series of diluted waste water samples. Although the results of the short-term tests only showed acute toxicity in some cases, long-term tests proved that in most cases the presence of these substances in effluents getting into the environment could harm aquatic organisms.

In some cases treated effluents induced higher mortality rates among fertilised fish eggs and hatched larvae than the controls. In some cases effluents also contained compounds that could cause alterations in the genetic material of organisms through bioaccumulation.

Nearly all of the effluents caused injurious effects on the metabolism of fish liver cells, by interfering with their capability to

	Treated muni waste water
Polybrominated diphenylethers (PBDEs)	hepta- and dec BDEs prevalen
Hexabromocyclododecanes (HBCDs)	x
Perfluorinated substances (PFHxA, PFOS, PFOA, PFDA)	x
Nonylphenols (NP), nonyphenol ethoxylates (NPEs), octylphenols (OP), octylphenol ethoxylates (OPEs)	x
Bisphenol a	x
Endosulfans	x
Mercury	x
Cadmium	x
Chlorinated paraffins; short-chain (SCCP) and medium-chain (MCCP)	x
Dioxins, furans and dioxin-like polychlorinated biphenyls (PCBs)	x in some case
Tributyl- (TBT) and triphenyl-tin (TPhT) compounds	mono- and dibutyltin prevalent

x = substance occurs

TRAINING TO COMMENCE

The COHIBA project involves capacity building and knowledge transfer targeting stakeholders in the newer EU member states and Russia. The project aims to connect the experiences of western and eastern experts and harmonise our understanding of hazard concepts at international level. Training will be provided through the COHIBA project for various stakeholders in Estonia, Latvia, Lithuania and Poland.

The target groups vary according to the topics. Different sessions will benefit industries (including small and medium sized enterprises), wastewater treatment plants, the permit authorities, environment ministry officials, inspectorates, consulting experts, laboratories and agencies providing environmental information. The sessions within the training programme have been planned on the basis of a stakeholder mapping process conducted using questionnaires designed to identify the most crucial needs of different stakeholders in each country.

THE TOPICS FOR THE TRAINING SESSIONS:

- Management of hazardous substances and related permits
- Methodologies for testing selected hazardous substances
- Methods and measures for wastewater treatment plants
- Impacts of hazardous substances in aquatic and marine environments
- Whole Effluent Assessment
- Management measures for substance reduction and substitution in selected industrial sectors

For more details:
www.cohiba-project.net/knowledge/trainings

WHOLE EFFLUENT

The Baltic Sea countries are being advised to increasingly apply whole effluent toxicity testing in waste water control to complement conventional chemical analyses. Controls based only on chemical testing methods cannot guarantee that marine life in the Baltic Sea will be undisturbed by hazardous substances. Discharges must be regulated on the basis of their overall environmental impacts.

The waste water controls currently applied in the countries around the Baltic Sea are mainly based on chemical analyses and

TREATED WASTE WATERS

EVEN LOW CONCENTRATIONS CAN CAUSE SERIOUS EFFECTS

cipal	Treated industrial waste water	Landfill leachates	Storm water
ca-t	hexa-, hepta-, octa- and deca-BDEs prevalent	tetra-, penta- and deca-BDE prevalent	only deca-BDE prevalent
		x	x
	x	x	x
	x	x	
	x	x	x
	x	x	
	x	x	x
	x	x	x
	x	x	x
es		x	x
	monobutyl-, dibutyl- and monooctyltin prevalent	only monobutyltin	only mono-butyltin

eliminate hazardous substances. If organisms' organs cannot eliminate hazardous compounds adequately, these substances will start to bioaccumulate in their tissues.

ESTROGEN ACTIVITY MAKING POPULATIONS POORER

Estrogen activity was detected in all effluent types, and particularly in municipal effluents. Brominated flame retardants, perfluoro compounds, tin compounds and alkylphenols are all known to be estrogenic to aquatic organisms. All of these compounds were present in the municipal effluents tested, although not in extremely high concentrations. However, it is impossible to say that the observed estrogenic effects resulted from these substances, because municipal effluents also contain natural endogenous compounds of human origin including hormones and contraceptive pills. Certain cosmetics and musk compounds are also known to have estrogenic effects on aquatic organisms.

The hormonal activity of effluents was most obviously one of the factors behind the observation that exposed water fleas produced significantly more offspring than the control water fleas in reproduction tests. It was also observed that exposed females were much larger than the control specimens. This could partly be explained by the extra nutrients present in the effluents, but all animals were fed during the tests.

A brief review of the results for water fleas looks very positive, but it must be remembered that water fleas are partenogenetic animals, and offspring hatching during the summer are mainly females. Animals overwinter as fertilised eggs, and in the autumn males also start to be born. If the estrogenic effects induce feminisation among the population, the ecosystem will gradually be impoverished. These observed effects suggest that this feminisation might also be occuring in the environment.

"These results are worrying, as we are talking about treated effluents", says biologist Tarja Nakari of the Finnish Environment Institute.

TOXICITY TESTING ENHANCES WASTE WATER CONTROL

concentration limits defined for individual substances or substance groups. But it is impossible to identify all of the chemicals in effluent and their consequent metabolites, and also impossible to assess the combined effects of the myriad possible mixtures of these chemicals.

The whole effluent assessment (WEA) approach does not require knowledge of an effluent's composition and chemical concentrations. Instead it provides a cost-effective biological method enabling the ecotoxicity of effluents discharged into the Baltic Sea to be assessed comprehensively. WEA provides a more complete picture of an effluent's environmental effects than a conventional chemical approach. WEA can be seen as a link between chemistry and ecology.

PROPOSALS FOR HELCOM RECOMMENDATIONS

The COHIBA project has drafted recommendations on how whole effluent toxicity testing should be adopted around the Baltic. The recommendations will be submitted to the Helsinki Commission for approval. The goal is to define toxicity-based discharge limits with threshold toxicity levels for effluents discharged into the waters of the Baltic Sea. The project has also drafted a recommendation on the harmonising of chemical and ecotoxicological assessment methods, in order to ensure that results from all around the Baltic Sea region are reliable and comparable.

The COHIBA recommendations are based on the results of toxicity and ring tests conducted during the project, as well as the experiences of project partners from the HELCOM countries.

The recommendations are available:
www.cohiba-project.net/identification/recommendations
WEA flyer is available:
www.cohiba-project.net/publications

CHOOSING THE BEST WAYS TO REDUCE EMISSIONS

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The COHIBA project aims to identify the most cost-effective measures for reducing the emissions of hazardous substances that enter the Baltic Sea, by weighing up the advantages and disadvantages of different measures and evaluating various scenarios for emission reductions.

A broad range of potential measures are to be assessed for each substance, including technical measures such as substitutions or end-of-pipe measures, and non-technical measures including regulations. The options will be compared in terms of effectiveness and costs, to ensure that resources will be efficiently allocated.

DIFFERENT MEASURES, DIFFERENT EFFECTS

The effects of technical measures can differ greatly. This can be exemplified by a comparison of substitution and end-of-pipe measures for reducing emissions of perfluorooctane sulfonate (PFOA).

The use of PFOA in fluoropolymer production will be phased out in 2011 through a voluntary agreement. Fluoropolymer producers have developed "drop-in" substitutes for PFOA. This substitution will only affect PFOA emissions and have no positive secondary environmental effects. The substitute chemical may itself cause negative environmental effects.

Contrastingly, the fitting of special AC-filters at municipal waste water treatment plants can reduce PFOA emissions as well as emissions of 11 other hazardous substances of special concern to the Baltic Sea which are typically present in municipal waste water in very low concentrations. This measure could also have considerable positive secondary environmental effects in terms of reducing emissions of phosphates and other pollutants. Its negative secondary environmental effects would include energy use and greenhouse gas emissions during construction and operation.

In the context of sustainability and the ecosystem approach such secondary environmental effects should always be taken into account when comparing different emission reduction options.

DIFFERENT MEASURES, DIFFERENT COSTS

The costs associated with alternative measures are also very different. In substitution, financial resources are needed to develop suitable substitutes. In the case of PFOA, a drop-in substitute was developed, meaning that no additional investments are needed to adapt production processes. Once such a substitute is identified, the additional costs are comparatively low. Over a longer timeframe, substitution will most likely be the economically advantageous measure for reducing emissions of a single hazardous substance. The costs have to be borne by industries, and secondary socio-economic effects may result from price increases.

Contrastingly, AC-filters installed at municipal waste water treatment plants will become effective immediately, but require financial resources throughout their operation, including repairs and eventual replacement. If the emission reduction goal is short-term, and effects on other hazardous substances and secondary environmental effects are also considered, end-of-pipe measures may ultimately prove to be more advantageous economically. The costs have to be borne by municipalities and tax-payers.

Evaluating and comparing different measures and reduction strategies requires taking into account the differences in effects and costs of measures, as well as local boundary conditions, related to the very diverse technical base line and regulative background in the countries bordering the Baltic Sea.

The Federal Environmental Agency of Germany (UBA), supported by Fraunhofer ISI and other partners from 9 countries, are helping to build up a knowledge base for decision-making related to the management of hazardous substances in the Baltic Sea Area.

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