Implementation of the OSPAR-Strategy on Hazardous Substances (Persistent, Toxic, Bioaccumulative-PTB-Substances)

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Introduction

The OSPAR Convention /1/ (Oslo and Paris Convention for the Protection of the Marine Environment of the North East Atlantic), signed in 1992, got into force in March 1998 after the complete ratification by all OSPAR Contracting Parties.

It is one of the main objectives of this Convention to prevent and to eliminate any marine pollution in the Convention Area by applying the precautionary principle, the Best Available Technique (BAT) and/or the Best Environmental Practice (BEP).
The OSPAR- Convention (OSPAR-Oslo Paris Convention for the Protection of the North-East Atlantic) developed and established a selection and prioritisation procedure for hazardous substances in the marine environment.

Main Elements of the OSPAR Strategy on Hazardous Substances

Objective

OSPAR /2/ adopted in June 1998 the following objective on hazardous substances which are persistent, toxic and bioaccumulative:

The prevention of pollution of the maritime area should be reached by continuously reducing discharges, emissions and losses of hazardous substances by moving towards the target of their cessation within one generation (25 years, year 2020) and the ultimate aim of concentrations in the environment near background values for naturally occurring substances and close to zero concentrations for man-made synthetic substances.

Definitions

Hazardous Substances are defined as substances which:

- are toxic, persistent and liable to bioaccumulate
- do not meet all of the above mentioned criteria but which give rise to an equivalent level of concern.

Further definitions relate to synergistic effects, impurities and additives, group of substances and other effects including endocrine effects.
The definition for groups of substances allows a comprehensive approach to deal with several related hazardous substances which show a similar level of hazard. This could support a much more efficient priority setting and risk evaluation procedure than in the past and would eliminate some of the drawbacks of a single substance approach.

Strategy

The key elements of the strategy itself comprise:

- a dynamic selection and prioritization mechanism
- the establishment of a list for Priority Action
- the development of assessment tools for the evaluation of risks in the marine environment

- the development of criteria and methods which could be used for identification and development of less hazardous, or preferably non-hazardous substances which could be used as substitutes for hazardous substances
- the aspects of feasibility for the implementation of measures
- the close cooperation with all relevant parties and international organizations
- implementation of measures on national basis
- assessment of implementation.

The first step was to develop of a dynamic selection ad prioritization mechanism and the selection of chemicals for priority action /3/.The development of criteria and methods for less or preferably non-hazardous substances as substitutes for identified hazardous substances is considered as most important for achieving the medium to long-term goals. This could facilitate the risk management processes and the implementation of envisaged measures.

Implementation of the Strategy

The implementation will start from the OSPAR-List of Chemicals for Priority Action which was agreed by OSPAR including carrying forward the drawing up of programmes and measures by the year 2003 for the control of discharges, emissions and losses of the substances on that list and their substitution with less hazardous or non-hazardous substances where feasible. This first OSPAR-List of Chemicals for Priority Action is comprising the following:

- Polychlorinated dibenzodioxins (PCDDs)
- Polychlorinated dibenzofurans (PCDFs)
- Polychlorinated biphenyls (PCBs)
- Polyaromatic hydrocarbons (PAHs)
- Pentachlorophenol (PCP)
- Short-chained chlorinated paraffins (SCCP)
- Hexachlorocyclohexane isomers (HCH)
- Mercury and organic mercury compounds
- Cadmium
- Lead and organic lead compounds
- Organic tin compounds
- Nonylphenol/ethoxylates (NP/NPEs) and related substances
- Musk xylene
- Brominated flame retardants
- Certain Phthalates - Dibutylphthalate and Diethylhexylphthalate

Principles for Priority Setting

Criteria for selecting the hazardous substances for further detailed assessment and prioritization activities include that these substances or group of substances:

- due to their highly hazardous properties are a general threat to the aquatic environment
- show strong indications of risks for the marine environment
- have been found widespread in one or more compartments of the marine area or may endanger human health via consumption of food from the marine environment
- reach, or are likely to reach, the marine environment from a diversity of sources through various pathways.

Dynamic Selection and Prioritization Scheme

A selection and prioritization procedure needed to be developed. The European Union Risk Ranking Method , the COMMPS /6/ (Combined Monitoring-based and Modelling-based Procedure) approach were taken as the basis for further development. It comprises the following steps:

Step 1: Selection of candidates for priority-setting

Step 2: Elaboration of a priority list based on an exposure assessment by using data from monitoring and effects assessment and scoring by applying a modified EURAM procedure
Step 3: Elaboration of a priority list based on predicted exposure data modelled from production volume, use pattern, distribution within the environmental compartments, persistence and effects and scoring again by applying the modified EURAM procedure
Step 4: Consolidation/Validation of the higher ranking substances through a comparison of the modelling-based list by additional expert judgement and consideration of additional information
Step 5: Further detailed consideration by expert judgement on the highest risk-ranking substances and establishing finally a priority list

Exposure Assessment for Monitoring-based Ranking

Measured concentrations are used as input for the monitoring-based ranking. The 90. and 50.percentiles and the arithmetic means plus standard deviation are considered for further evaluation. The aggregated concentrations are scored (max. score = 10). They are logarithmically scaled as an exposure index for each substance:

$I_{exp} = A \times \log (C/C_{min}) / \log (C_{max}/C_{min})$; A = 10

Exposure Assessment for Modelling-based Ranking

The scale of the model is at an European level which corresponds to the "continental scale" defined in the EU-Technical Guidance Document /4/ (EU Council Regulation No. 793/93).
The Emissions, Distribution and Degradation (EEXV) is estimated by /5/:

1. Emission: production volume x main use category and fractions of release (e.g. closed system, wide dispersive use)
2. Distribution: using the Mackay Level 1 model
3. Degradation (DEG): taking the results of biodegradability testing, e.g. Ready Biodegradability: 0.1 DEG, Inherent Biodegradability: 0.5 DEG, Persistent: 1.0 DEG, Default: 1.0 DEG

The EURAM aquatic exposure score is calculated as follows:

$I_{exp} = 1.37 [\log (EEXV) + 1.301]$; EEXV = Emission x DIST x DEG

Effects Assessment of Organic Substances

The direct and indirect effects on aquatic organisms are considered as well as selected endpoints for effects on humans. PNECs (Predicted No-Effect Concentrations) for direct aquatic effects are estimated by using specific test results by considering the number of taxonomic groups and by applying extrapolation/assessment factors.
The indirect aquatic effects are calculated from the log P_{OW} as a measure for the bioaccumulation potential. They are scaled from log $P_{OW} < 3$ until log $P_{OW} > 5$ and respective scores are allocated.
Indirect effects on humans are assessed by considering CMT properties (carcinogencity, mutagenicity, teratogenicity) as well as chronic effects. These properties are also scored and all effec-related scores lead to:
Direct ecological effects:

$EFS_d = B \times \log (PNEC/PNEC_{max}) / \log (PNEC_{min}/PNEC_{max})$ B = 5

Indirect effects: EFS_i = (0 .... 3) derived from log P_{OW}
Human toxicity: EFS_h = (0 .... 2) derived from R-phrases, CMT-properties
$I_{eff} = EFS_d + EFS_i + EFS_h$
The final index for combining exposure and effects will lead to: $I_{fin} = I_{exp} \times I_{eff}$

Conclusions

The COMMPS approach /7/ could form as basis for a priority-setting approach on PTB-substances relevant for the marine environment. Monitoring data for coastal and marine waters, sediments

and biota should be included into the monitoring-based step. The distribution modelling has to include specific characteristics of the marine environment.
Furthermore, the criteria persistence and bioaccumulation and other adverse (e.g. endocrine effects, tainting) effects represent a significant relevance in the marine environment so that they should be included separately as additional criteria into the modified priority-setting scheme /8/.
The EC (European Community) recently finalized the updated version of the "Technical Guidance Document on Risk Assessment" by incorporating a methodology for the Marine Risk Assessment. This method will also apply to Biocidal Products, including Antifouling Agents, which are to be registered and authorized under the EC-Regulation on Biocidal Products (EC-Directive 98/8/EC). The methods comprise Local (e.g. harbours), Regional (e.g. estuaries, coastal areas) and Open Sea (large scale, global) scenarios for exposure and effects assessments.
The Local and Regional Risk Assessments are based on the "Quotient Method"(PEC/PNEC-Ratio) including Bioaccumulation and Secondary Poisoning whereas the Open Sea Risk Assessment is based on a PBT-(Persistence/Bioaccumulation/Toxicity) Risk Assessment.
Both, the OSPAR Selection/ Prioritization Procedure and the EC /OSPAR-harmonized Risk Assessment methodology could provide guidance and criteria for the further development of less-or preferably non- hazardous substances.

References

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