The OSPAR Strategy against the Introduction of Hazardous Substances into the Marine Environment

In 1998, the contracting parties to the OSPAR Convention for the "Protection of the Marine Environment of the North East Atlantic" agreed on a strategy to make every effort to cease discharges, emissions and losses of hazardous substances to the marine environment. Its objective is to prevent pollution of the maritime area by continuously reducing and eliminating discharges, emissions and losses of hazardous substances within one generation. The OSPAR working group DYNAMEC has subsequently developed a transparent and methodically-reliable procedure for the identification and prioritisation of hazardous substances. Accordingly, the OSPAR Commission has so far agreed to include 42 hazardous substances on the OSPAR List of Chemicals for Priority Action.

Marine ecosystems function as sinks for substances emitted and discharged by atmosphere and rivers. Among these are numerous hazardous substances. Their degradation during transport is very slow and some can be detected nowadays in substantial concentrations in the marine environment, especially if they accumulate in organisms and in the food chain. As a counter measure, the governments of states bordering the North-East Atlantic have therefore agreed in Sintra (Portugal) on a strategy within the framework of the OSPAR Convention on the cessation of discharges, emissions and losses of hazardous substances to the maritime area [1, 2]. By the year 2020, i.e. within one generation (about 25 years), discharges, emissions, and losses of hazardous substances shall be reduced. The objective is to achieve concentrations near background values for naturally occurring substances, and concentrations close to zero for man-made synthetic substances. Hazardous substances are defined as [2]:

- PBT-substances, which are **p**ersistent, liable to **b**ioaccumulate and **t**oxic; or
- substances requiring a similar approach, even if they do not meet all the criteria for the three PBT properties, e.g. heavy metals and substances that interfere with the hormonal systems of humans and animals, i.e., endocrine disrupters.

The OSPAR Strategy

The strategy comprises the following elements:

- the development of a dynamic procedure for the selection and prioritisation of hazardous substances;
- the establishment of a priority list of hazardous substances;
- the development of assessment tools for hazardous substances in the marine environment;
- the elaboration of criteria and methods for the identification and the development of less hazardous and environmentally sound products and substitutes;
- the development of appropriate measures to reduce hazardous substances and an assessment of the advantages, disadvantages and effectiveness of such measures;
- a broad social involvement of groups and organisations concerned;
- the implementation of adopted measures and reporting.

Selection and Prioritisation Method

The method for selection and prioritisation of hazardous substances was developed by the OSPAR working group DYNAMEC and comprises of basically three steps [3, 4]:

- initial selection,
- establishment of a ranking list for potentially hazardous substances,
- final selection of the chemicals for priority action.

The flow chart in figure 1 gives an overview of the main steps in this process.

Initial selection of hazardous substances

As starting point for the selection of hazardous substances, available databases of substances were consulted. These comprised a Nordic Substance Database with 18,000 registered substances, the QSAR database of the Danish Environmental Agency with 166,000 entries and the Dutch BKH/Haskoning database with 180,000 entries. Based on the PBT selection criteria (Tab. 1), a preliminary list of relevant substances was established. At the same time,

Category	Limiting values used		
	Persistence	Bioaccumulation	Toxicity
Initial selection	Half life >50 days or measured/estimated biodegradation	log K_{OW} ≥4 or bioconcentration factor ≥500	*Aquatic Organisms:* acute LC_{50} or EC_{50} ≤1 mg/l, NOEC ≤0.1 mg/l *Mammals:* Carcinogenic, mutagenic, toxic to reproduction or chronically toxic
Final selection	Non-biodegradable	log K_{OW} 5 or bioconcentration factor ≥5000	*Aquatic Organisms:* acute LC_{50} or EC_{50} ≤0.01 mg/l, NOEC ≤0.01 mg/l *Mammals:* same criteria as in initial selection

Tab. 1: Selection criteria of the initial and final selection.
K_{OW} = 1-octanol/water partition coefficient;
LC = lethal concentration, EC = effect concentration, index 50 = 50% of the organisms studied are affected;
NOEC = no observed effect concentration.

the "safety net procedure" was used to screen substances for hazardous properties not selected by the PBT criteria set. Substances thus determined to be of similar concern were also added to this preliminary list [4].

In a further evaluation step, experts scrutinised the individual entries on the list for plausibility and concluded on the preliminary selection list of approx. 400 substances of possible concern (Fig. 1). To complete the subsequent prioritisation, data profiles have been established.

Prioritisation of Pollutants on the Basis of their Hazard and Risk

Prioritisation aims at determining the relative hazard and risk of the 400 selected substances, which lead to their ranking according to their potential hazard and risk. The COMMPS-method (Combined modelling and monitoring priority settings) was applied. This method was developed [5] by the Fraunhofer Institute Schmallenberg within the scope of the preparatory work to the Water Framework Directive of the European Union (EU), and is currently used as standard methodology within the EU. It includes both a modelling approach, originally developed for the "European Union Risk Ranking"-methodology (EURAM) [6, 7], and a monitoring approach to statistically evaluate measured data and calculate the relative priority ranking for each individual substance. To calculate the priority ranking, an algorithm is used to classify the substances according to their persistency, bioaccumulation and (eco)toxicity.

Within the context of the OSPAR work, the COMMPS method was modified for specific marine environmental conditions and the selection was adapted to substance-based data and model parameters [8, 9]. For example, when modelling the exposure range, the loads of substances discharged into the marine waters (water column + sediment) were considered. Both direct (toxicity) and indirect (bioaccumulation) effects on marine organisms were taken into account when calculating the range of effects. Compared with the limnic model, more attention was given to the indirect effects, as retention and exposure times of hazardous substances are significantly higher in marine ecosystems. The ranking, however, also took into account effects of so-called CMR substances (**c**arcinogenic, **m**utagenic, toxic to the **r**eproductive system) on human health. CMR substances can, for example, enter into the human body through consumption of contaminated seafood. Furthermore, increased consideration was given to persistence in the calculation of the overall ranking score, and the differentiation of biodegradation was spread in the scaling. Four ranking lists were established on the basis of the results of these calculations:

- the *ranking list Water I* is based on measured environmental concentrations and effect data,
- the *ranking list Water II* is based on modelled data and effect data,
- the *ranking list Sediment I* is based on measured environmental concentrations and effect data,
- the *ranking list Sediment II* is based on modelled data and effect data.

Of the total of 400 substances on the preliminary selection list, only approximately 200 could be placed on one of the four ranking lists. Since the remaining 200 substances exhibit substantial gaps pertaining to effects, measured concentrations and discharge quantities, calculation of their relative risks and ranking was not possible. As soon as the data gaps are filled, these substances will be ranked according to the DYNAMEC method.

Final Selection

To facilitate the approach, a shorter sub-list was created containing a maximum of 80

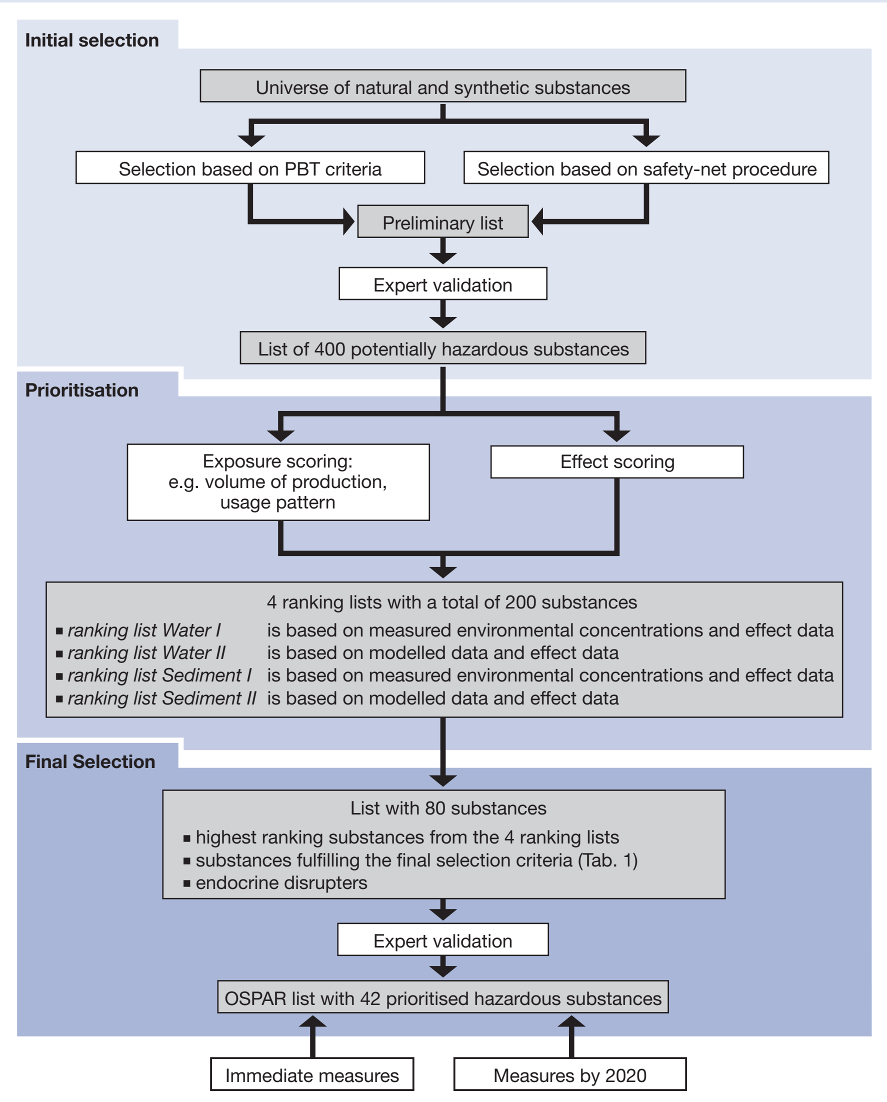

Fig. 1: Flow chart of the OSPAR method for the selection and prioritisation of hazardous substances developed by the OSPAR working group DYNAMEC.

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OSPAR strategy: Cease the introduction of hazardous substances by 2020.

substances. This list includes substances of the four lists with the highest ranking scores, substances which fulfil the stringent final selection criteria (Tab. 1) and endocrine active substances. In a further round of expert revisions, the list was completed, containing a total of 42 priority hazardous substances, which the OSPAR Commission adopted as OSPAR List of Chemicals for Priority Action [10].

For these substances, so-called OSPAR lead countries will compile background documents including risk assessment [11], substance and application characteristics, sources of emissions, as well as suggestions for reduction measures and possibilities for substitution.

Legal Implementation of Measures

For EU Member States being Contracting Party to the OSPAR Convention as well, the implementation of OSPAR measures takes place within the context of the relevant EU Directives. An important legal basis is provided by the EU Water Framework Directive, which came into effect in December 2000 and should be implemented similar to the OSPAR strategy by the year 2020. The Water Framework Directive lists 32 priority chemicals. According to Article 16 of the Directive, quality standards have to be developed for these substances. Some of these substances are also found on the OSPAR List of Chemicals for Priority Action. As for the OSPAR substances, concentration levels of close to zero or background levels are required by the year 2020, the development of quality standards can in these cases only be regarded as intermediate objectives.

Implementation of these measures can include extensive discharge limits for point sources of pollution and restrictive internal market regulations for diffuse sources. Both types of emission sources will be addressed by the application of best available techniques (BAT) and best environmental practice (BEP), respectively. It can be concluded that the Water Framework Directive offers an overall concept for marine coastal and freshwater waters, thereby also taking into account the protection demands of the oceans with respect to hazardous substances discharged by water from land-based sources.

Prospects

The OSPAR Strategy on the cessation of discharges, emissions and losses of hazardous substances to the marine environment pursues the challenging goal of eliminating such inputs by the year 2020 [12]. This requires great efforts from OSPAR Contracting Parties but also from social groups, companies and organisations involved. Therefore, it was of primarily importance to develop an indisputable method for the selection and prioritisation of hazardous substances. The working group DYNAMEC has successfully elaborated a transparent and methodically reliable procedure. The OSPAR List of Chemicals for Priority Action was therefore accepted by all stakeholders involved, and the implementation of the OSPAR Objective can take place effectively.

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[3] DYNAMEC (1998): Development of a dynamic selection and prioritisation mechanism for hazardous substances with regard to the marine compartment. Presented by Germany, DYNAMEC 98/4/1, Berlin, 14–16 September.

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[11] DYNAMEC (1999): Summary record DYNAMEC (2) 99, Annex 6: Draft framework for a common OSPAR/EC approach on risk assessment methodology for the marine environment. Stockholm, 7–13 September.

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