OSPAR COMMISSION

# Background Document on nonylphenol/nonylphenol ethoxylates

Hazardous Substances Series

2009

### OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the “OSPAR Convention”) was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. It has been ratified by Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Sweden, Switzerland and the United Kingdom and approved by the European Community and Spain.

### Convention OSPAR

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. La Convention a été ratifiée par l'Allemagne, la Belgique, le Danemark, la Finlande, la France, l’Irlande, l’Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d’Irlande du Nord, la Suède et la Suisse et approuvée par la Communauté européenne et l’Espagne.

## Acknowledgement

This report has been prepared by Mr Bo Nyström for Sweden as lead country.

Secretariat note: This Background Document was prepared by Sweden as lead country and first adopted in 2001. A monitoring strategy for lead was added in 2004 (annex 1). The document was updated in 2009.

# Contents

# Executive Summary

Nonylphenol ethoxylates (NPEs) are part of the alkylphenol ethoxylate group of non-ionic surfactants. All NPEs degrade relatively easily to form short-chained NPEs and (particularly in anaerobic conditions) nonylphenol (NP). NP and short-chained NPEs are toxic to aquatic organisms. Since they are lipophilic, they accumulate in sewage sludge and sediments, and bioaccumulate in aquatic species. NP/NPEs also possibly have endocrine-disrupting properties. NP/NPEs were included in the 1992 OSPAR Action Plan, and were therefore added to the List of Chemicals for Priority Action in 1998.

NPEs are used as emulsifiers, dispersive agents, surfactants and/or wetting agents and are the primary source of inputs to the sea of NP and NPEs. The main users are the industrial, institutional and domestic cleaning sectors (30% of EU use). Other significant sectors are emulsion polymerisation (12%), textiles (10%), chemical synthesis (9%) and leather (8%). Estimated use in Western Europe in 1997 was 76 600 tonnes.

Concentrations in the environment have decreased significantly, at least in some areas, over the last 15 - 20 years. Levels of around 0.08 – 3.1 µg/l of dissolved NP and 0.09 – 5.2 µg/l total extractable NP have been found in a UK estuary. Levels of up to 9.5 mg/kg dry weight of NPEs have been measured in the livers of river fish.

The existing OSPAR measure is PARCOM Recommendation 92/8 on Nonylphenol-Ethoxylates which required the phasing out of the use of NPEs as cleaning agents for domestic uses (1995) and industrial uses (2000) and initiated further study on other uses of NPEs and similar substances. National initiatives have been taken in some OSPAR States on the use of NPEs in water-based paints, agricultural pesticides, and emulsion polymers. EC action on NPEs has been made under the EC directive relating to the restriction on the marketing and use of certain dangerous substances and preparations, prohibiting the use of NPE for some critical applications. NP is included on the list of priority hazardous substances under the EC Water Framework Directive.

The action recommended is: to implement the EC risk-reduction measures on NP/NPE use in agricultural pesticides, emulsion polymers for the textile industry and coatings, detergents, metal working, pulp and paper manufacturing and some other minor uses; to support an EC limit on NP/NPE concentrations in sewage sludge applied to agricultural soil; to implement the OSPAR monitoring strategy; to take action to prevent the substitution for NP/NPEs of other alkylphenols with similar properties; a review by OSPAR of the need for further OSPAR measures to supplement the EC measures; and to ask other relevant international forums to take account of the background document.

# Récapitulatif

Les éthoxylates nonylphénoliques (NPE) sont des agents tensioactifs non-ioniques du groupe des éthoxylates alkylphénoliques. Tous les NPE se dégradent assez facilement pour former des NPE à chaîne moléculaire courte et (en particulier en milieu anaérobie) du nonylphénol (NP). Le NP et les NPE à chaîne courte sont toxiques pour les organismes aquatiques. Lipophiles, ils s'accumulent dans les boues des égouts et dans les sédiments, et s'accumulent biologiquement chez les espèces aquatiques. Il est aussi possible que les NP/NPE possèdent des propriétés de perturbation du système endocrinien. Les NP/NPE ont été inclus dans le Plan d'action OSPAR 1992, et ont de ce fait été inscrits en 1998 sur la Liste des produits chimiques devant faire l'objet de mesures prioritaires.

Les NPE sont utilisés comme émulsifiants, agents de dispersion, agents tensioactifs et/ou agents mouillants et sont la principale source d'apports de NP et de NPE à la mer. Les principaux utilisateurs sont le secteur du nettoyage industriel, des bâtiments publics et des ménages (30 %) de la consommation dans l'Union européenne. Les autres secteurs importants sont la polymérisation par émulsion (12 %), les textiles 10 %), la synthèse chimique (9 %) et le cuir (8 %). En 1997, l'on estimait que la consommation en Europe occidentale était de 76 600 tonnes.

Les teneurs dans l'environnement ont très sensiblement baissé, à tout le moins dans quelques secteurs, au cours des 15 à 20 dernières années. Des teneurs de l'ordre de 0.08 à 3.1 µg/l de NP en solution, et de 0.09 à 5.2 µg/l de NP extractible total dans un estuaire du Royaume-Uni. Des teneurs atteignant 9.5 mg de NPE/kg de poids à sec ont été mesurées dans le foie du poisson d'eau fluviale.

La mesure OSPAR actuelle est la Recommandation PARCOM 92/8 sur les éthoxylates nonylphénoliques, qui prévoyait l'abandon de l'utilisation des NPE comme agents de nettoyage à usage ménager (1995) et à usage industriel (2000), et lançait de nouvelles études portant sur d'autres applications des NPE et de substances analogues. Des initiatives nationales ont été prises dans certains Etats d'OSPAR, sur l'intégration des NPE dans les peintures à base aqueuse, les pesticides agricoles et les polymères fabriqués par émulsion. Dans le cadre de la CE, des mesures visant les NPE ont été prises en conséquence de la Directive communautaire européenne relative aux substances dangereuses dans l'eau, interdisant l'utilisation des NPE pour quelques applications critiques. Les NP figurent sur la Liste de substances dangereuses prioritaires issue de la Directive communautaire cadre relative aux eaux.

Les mesures recommandées sont les suivantes : effectuer des mesures communautaires européennes de réduction des risques suscités par les NP/NPE dans les pesticides agricoles et les polymères par émulsion destinés à l'industrie des textiles et aux revêtements, les détergents, la fabrication de papier et de pulpe, la métallerie et quelques autres utilisations ayant une moindre importance ; soutien à un plafond communautaire de teneur en NP/NPE dans les boues des égouts répandues sur les terres agricoles ; effectuer la stratégie OSPAR de surveillance ; prise de mesures visant à empêcher le remplacement des NP/NPE par d'autres alkylphénols ayant des propriétés analogues ;étude par OSPAR de la question de savoir si de nouvelles mesures OSPAR s'imposent pour compléter les mesures communautaires; et demander aux autres instances internationales compétentes de prendre en considération le document de fond.

# Nonylphenol/Nonylphenol ethoxylates

In PARCOM Recommendation 92/8 on Nonylphenol Ethoxylates Contracting Parties agreed to phase out the use of Nonylphenol/Nonylphenolethoxylates (NP/NPEs) as cleaning agents for domestic and industrial uses. They also agreed to study other uses.

Occurrence of nonylphenol (NP) and nonylphenolethoxylates (NPEs) in the aquatic environment of industrial areas and non-industrial areas as well as in aquatic and terrestrial organisms were reasons for concern. NPEs degrade relatively easily in the environment to form short-chained NPEs and (especially under anaerobic conditions) NP, which are toxic to aquatic organisms. As NP and NPEs are lipophilic, they accumulate in sewage sludge and sediment. Furthermore, NP bioaccumulates in aquatic species. Toxicity to aquatic organisms and possible endocrine disrupting properties are further reasons for concern.

Since 1998 NP/NPEs are also found on the OSPAR List of Chemicals for Priority Action.

NPEs are part of the alkylphenol ethoxylate (APE) group of non-ionic surfactants. Structurally, the APEs can be described with the formula CmH2m+1-C6H4OH(CH2CH2O)n. The alkyl group is a branched chain with m=2 - 20. The number of ethoxylate groups varies between 2 and approximately 80. For NPEs, m=9 and n=2 - 50, normally between 6 and 12. Consequently, there exist several NPs and NPEs. The commonly used CAS numbers are 25154-52-3 and 9016-45-9 respectively.

# 1. Identification of sources and pathways to the marine environment

## 1.1 Production and use

According to the risk assessment carried out under Council Regulation (EEC) No 793/93 of 23 March 1993 on the evaluation and control of the risks of existing substances (UK is Member State Rapporteur), the EU production of NP was 73 500 tonnes in 1997. Around 78 500 tonnes of NP were used in Europe in 1997. Most of this was manufactured in Europe. NP is used almost exclusively as an intermediate in the production of other chemicals, with some 60% (47 000 tonnes) used to make NPEs and the remainder to make other NP derivatives.

The EU-production of NPEs has been estimated to 118 000 (tonnes) in 1997. Around 77 600 tonnes of NPEs were used in Europe in 1997.

Depending on their precise make-up (*i.e.* chain length), NPEs may be used as emulsifiers, dispersive agents, surfactants and/or wetting agents. In certain applications, NPEs are also used because of the other properties they confer. Given their versatility, NPEs are used in a wide range of industrial sectors.

NPEs represent some 90 – 95% of APEs in tonnage used. The wetting properties of NPE surfactants are of particular importance for degreasing (*i.e.* cleaning), where the surface tension of the cleaning solution has to be low enough in order to wet the entire surface of the material to be degreased. Likewise, NPEs are important in situations where chemical or cleaning formulations need to be dispersed to every part of the component or product.

The most important sector is the industrial and institutional cleaning sector (including domestic cleaning) which consumes some 30% of the NPEs used in the EU. Other sectors, which use significant amounts of NPEs include emulsion polymerisation (12%), textiles (10%), ‘captive use’, *i.e.*

use in the chemical industry, for example synthesis of nonylphenol ether sulphates and nonylphenol ether phosphates (9%) and leather (8%).

***Table 1**. Estimates of uses of NPEs in Western Europe in 1997 (UK). Figures are expressed in kilo tonnes (Kt)*

| Category | NPE Usage (Kt) | % of NPE Usage |
|---|---|---|
| Industrial & institutional & domestic cleaning | 23 | 29.6 |
| Other niche markets & Unaccounted for | 12.6 | 16.2 |
| Emulsion polymerisation | 9 | 11.6 |
| Textile auxiliaries | 8 | 10.3 |
| Captive use | 7 | 9.0 |
| Leather auxiliaries | 6 | 7.7 |
| Agriculture | 5 | 6.4 |
| Paints | 4 | 5.2 |
| Metal industry | 2 | 2.6 |
| Pulp & paper | 1 | 1.3 |
| **Total** | **77.6** | **100** |

Twenty-four per cent of the total NP burden associated with 'other niche markets & unaccounted for' are mostly unknown. A part of this, 9%, is attributable to personal domestic (personal care products). The remaining 15% of the total NP burden associated to the relatively large sector "unaccounted for" are, in the EU draft Risk Assessment, assumed to be covered by already identified industrial sectors. According to the Swedish Product Register, there are industrial sectors not covered by the risk assessment. This is for example the use of NPEs in glues. More information might therefore be needed to further specify the use category "unaccounted for".

The use of NPEs in the glue industry referred to above is as water-based adhesive for end use in different industrial sectors. This is mainly in the textile industry, but also for example in the industry for pulp and paper and paper products, in printing-works and other industry for recorded media, construction industry and industry for plastic products. In the construction industry NPE uses are for example for sealing compounds, insulating materials, floor covering materials and dispersion adhesives.

Information on discharges of alkylphenols and alkylphenol ethoxylates by the offshore industry (see documents SEBA 00/10/3 and OIC 01/4/2) indicates that NP/NPEs are used by the offshore industry of some Contracting Parties. The main application is as a dispersive agent.

## 1.2 Sources of emissions and discharges

NP is used almost exclusively as an intermediate in the production of various NP derivatives, mostly ethoxylates. Releases of NP from these production processes are estimated to be very low. As a result, very little NP enters into the environment directly. Rather, the primary source of NP in the environment is considered to be NPEs, which can break down into NP after being released into the environment during their production, their formulation into various other products, and the use of such products.

The main compartments to which releases occur are surface waters (rivers, lakes, seas and their sediments) via industrial and municipal waste water and waste water treatment plants, soil via sewage sludge containing NP/NPEs spread on land, and air.

Different products containing NPEs are potential sources of emissions of NPEs and NP. This can be the case during production, use and waste management.

No references have been found of useful data concerning emissions of NPEs, and its degradation products, contained in articles. Elaborated methods to estimate such emissions are presently lacking in the Technical Guidance Document (TGD) used for risk assessment under the EU Existing Substances Regulation.

There are some recent studies concerning the emission of NP and NPEs from goods and products (Månsson *et al.* 2008; Andersson and Sörme 2007). Textiles treated by cleaning agents have recently been pointed out as an important source of NP to the water treatment plants. The use of NPEs in the textile industry is banned in the EU, and hence this is assumed to be imported goods. Other sources such as *e.g.* cleaning agents, paints and concrete may constitute a source of NP and NPEs to the environment.

The project "Releases from products, compilation of existing information and possibilities to include this information into the national Pollutant Release and Transfer Register (PRTR)", founded by the Nordic Council of Ministers, the Product and Waste Group is now performed in order to support the OECD PRTR work with Nordic know-how on releases of chemicals from products. Within this project, a case study on releases of NP from use-phase of end-product has been carried out (Hansson *et al*., 2008 in press). This Nordic project will be finished during the year 2009.

## 1.3 Pathways to the Marine Environment

If NP/NPEs reach the marine environment they will generally do so via industrial waste water from different industrial activities *e.g*. production of NP and NPEs, when using NP and NPEs in the formulation of other chemical products and articles and via municipal waste water and storm water.

# 2. Monitoring data, quantification of sources and assessment of the extent of the problem

## 2.1 Monitoring data

Monitoring data from the UK draft risk assessment and the updated final risk assessment from 2002. A Dutch study “Endocrine-disrupting compounds in water systems: A pilot study of the occurrence of estrogenic compounds in surface and waste water in the Netherlands”, carried out during 1997/98 is also taken into consideration.

The relatively high environmental concentrations found 15 to 20 years ago have decreased significantly, in most cases below the freshwater PNEC, especially in those areas where there have primarily been voluntary industry initiatives to curtail waste water relevant uses. Monitoring data from Germany, Switzerland, and Austria demonstrate this.

Recent monitoring data about the occurrence of NP/NPE in the aquatic environment in the North-East Atlantic was hard to find in the literature. Available monitoring data considering NP/NPE in surface waters and sediments in Sweden and Norway have therefore been summarised, since some comparisons with older data nevertheless can be made.

### 2.1.1 Concentrations in the Environment

Surface water:

As a result of the industry-led voluntary agreement, and the later ban in the EU countries and Switzerland to use nonylphenol ethoxylates in domestic and institutional detergents, the concentration has decreased in recent years. Some of the older monitoring results (notably the data from the River Glatt in Switzerland) may therefore not reflect the current levels of nonylphenol, particularly where the major source was thought to be the nonylphenolethoxylate use in detergents.

In a Swiss study, levels of NP of around 0.1 - 0.3 µg/l have been measured in the River Glatt in Switzerland. The corresponding levels in the year 1984, before the Swiss ban on the use of NPEs in detergents, were 0.3 - 45 and 0.3 - 99 µg/l, of NP and NPEs, respectively.

- Levels of NP of <1.6 - 180 µg/l, 0.5 - 12 µg/l, 0.2 - 2.7 µg/l, 0.8 - 2.3 µg/l and 0.6 - 5.3 µg/l have been measured in six rivers in the United Kingdom. The highest concentration <1.6 - 180 µg/l, was measured in the River Aire, which received a high input of industrial surfactants from the textile industry.
- Levels of NP of 0.1 - 0.8 µg/l have been measured in a Finnish lake, 1 km from a sewage treatment plant (car washing facility using NPE surfactants discharging into this plant).
- Average levels of NP of 0.038 - 0.12 µg/l were measured in the River Main in Germany in the years 1989 - 1991.
- Levels of NP up to 0.14 µg/l have been measured in surface waters in a canal in the Netherlands.
- Average levels of NP of 0.013 µg/l have been measured in surface waters in Germany in the year 1998.
- The maximum concentrations in rivers in Austria were found to be 0.3 µg/l in the years 1998 to 1999.
- Nonylphenols were detected in unfiltrated and filtrated water in 9 coastal/marine and 67 limnic sites in a screening study performed in Sweden in 2006 - 2007 (SWECO VIAK 2007). NP was measured frequently at levels above the EQS in the Water Framework Directive of 0.3 µg/l. The measured concentrations were between <0.01 - 0.78 µg/l in unfiltrated surface water and <0.1 - 0.34 µg/l in filtrated water. The highest levels of NP were measured in limnic waters; while the concentration in marine/coastal sites were generally lower (Table 2).

***Table 2.*** *The concentration of NP in surface waters in Sweden (SWECO VIAK 2007).*

| µg/l | Baltic Sea region | | Skagerrak/Kattegat region | |
|---|---|---|---|---|
| | Limnic | Marine | Limnic | Marine |
| Unfiltrated water | <0.01 - 0.78 | <0.1 - 0.11 | <0.1 - 0.42 | <0.1 |
| Filtrated water | <0.1 - 0.34 | <0.1 - 0.16 | 0.2 - 0.31 | <0.1 |

Seawater:

- Levels of NP of 0.08 - 3.1 µg/l dissolved NP and 0.09 - 5.2 µg/l total extractable NP in the Tees Estuary in the UK.

Groundwater:

- Average levels of NP of 0.96 µg/l, 0.40 µg/l, 0.44 µ/l and 0.20 µg/l were found 2.5m, 5m, 7m and 13m, respectively from the River Glatt, due to infiltration of river water to groundwater.
- NP was detected in groundwater from Norrtälje, Sweden at a concentration of 2.5 µg/l. At the same station, levels of NPEs varied between 0.2 and 0.4 µg/l (Junestedt *et al*., 2003).

Suspended matter:

- Levels of NPEs and NP of 0.70 - 8.0 µg/g dry weight and 0.21 - 0.62 µg/g dry weight, respectively, have been measured in a canal in the Netherlands.

Sediment:

- Levels of NP of 0.51 - 5.61 mg/kg have been measured in the River Glatt in Switzerland in the year 1984.
- Levels of NP of 180 - 890 µg/kg dry weight were found in a Finnish lake, close to a sewage treatment plant.
- Average levels of NP of 7.7 - 9.5 mg/kg dry weight were found in the River Main in Germany in the year 1991. In 1998 the levels were <0.1 mg/kg.
- Levels of NPEs and NP of 2.6 - 5.7 µg/g dry weight and 0.63 - 1.70 µg/g dry weight, respectively, were found in the Netherlands.
- A survey of several groups of organic compounds was undertaken in 1995 in 22 estuaries in Western Europe (van Zeijl *et al.*, 1997). In the Liffey Estuary (Ireland) and Schelde (Belgium), no NP was detected. The highest levels were found in the estuaries of the Rivers Rhine (Netherlands), Seine (France), Mersey (UK), Ems and Elbe (Germany). NPEs were found at all studied locations with levels varying between 12 and 400 ng/g dry weight. The highest levels were found in the Rivers Mersey, Seine, Liffey, Schelde and Rhine. There is a relation between NPEs and NP because all NPEs will end up as NP after degradation.
- A screening study of alkylphenols and other groups of phenols was performed in Sweden in 2003 - 2004 (Remberger *et al*., 2004). The concentration of NP and NPEs in coastal sediment in Kattegat in 2003 (outside the city of Helsingborg, Sweden) was 560 and 540 ng/g dry weight respectively. Levels of NP and NPEs in marine sediments from Skagerrak (outside the city of Stenungsund, Sweden) varied between 7.3 - 17 and 14 - 42 ng/g dry weight respectively.
- NP was measured in the topmost sediment (0 - 1 cm) from the National Swedish Status and Trends Monitoring Program (SSTMP) stations in the North Sea and the Baltic Sea in 2003. The levels of 4-n-nonylphenol typically varied between 10 and 20 µg/kg dry weight in Skagerrak, the Kattegat and the southern Baltic proper. The sites from the central Baltic Proper around the island of Gotland were more contaminated, typically with concentrations between 100 and 200 µg/kg dry weight and a maximum of 360 in the Landsort Deep outside Stockholm (Cato and Kjellin, 2008).
- In a recent Norwegian study performed in 2007, NP was not detected in any of the 11 coastal and sea sediments from the Barents Sea. NPEs (n=10 - 40) were detected in 6 of the 11 samples with levels varying between 14 - 60 µg/kg dry weight (Bakke *et al*., 2008).

Municipal waste water treatment plants:

- Levels of NP in municipal waste water in the Zürich area were 14 µg/l and after treatment 8 µg/l. Levels of NP of 470 µg/l and 1000 mg/kg dry weight respectively, were measured in an anaerobic

sludge digester and in anaerobic digested sludge. Levels of NP in activated sludge were 128 mg/kg dry weight.

- Levels of NPEs and NP of 2.1 - 170 µg/l and levels up to 23 µg/l were measured before treatment of municipal waste water in the Netherlands. After treatment levels fell to 6.1µg/l and up to 1.0 µg/l respectively. Levels of NPEs and NP of 0.7 - 880 µg/l and levels up to 125 µg/l have been measured in sewage sludge. The corresponding data for OPEs and OPs in sewage sludge were measured in levels up to 28 µg/l and up to 2 µg/l, respectively.
- The main levels of NP in Germany in waste water before and after sewage treatment plants were 40 µg/l and <0.1 mg/kg.
- Levels of NP and NPEs in influent waste water in Sweden in 2003 varied between 0.99 - 3.5 and <0.6 - 6.1 µg/l respectively. Concentration of NP and NPEs in effluent waste water in the same survey varied between 0.00 - 6.2 and <0.04 - 2.6 µg/l respectively (Remberger *et al*., 2004).

Industrial waste water treatment plants:

- In Finland, levels of NP and NPEs of 100 - 200 µg/l and 30 000 - 70 000 µg/l respectively, were measured in untreated waste water in a sewage treatment plant. After treatment levels were 4 - 34 µg/l and 4 600 - 12 900 µg/l respectively.
- Levels of NP of <1 - 214 mg/kg dry weight and <1 - 39 mg/kg dry weight in sewage sludge from domestic waste water treatment plants and industrial waste water treatment plants respectively were measured in Eastern Germany between the years 1993 to 1994.
- Levels of NPEs and NP of levels up to 2270 µg/l and levels up to 400 µg/l have been measured in untreated industrial waste water in the Netherlands and after treatment levels of around 0.9 - 15 µg/l and up to 1.2 µg/l, respectively. Levels of NPEs and NP up to 2400 µg/l and levels up to 2500 µg/l have been measured in sewage sludge. The corresponding data for OPEs and OPs in sewage sludge were measured in levels up to 50 µg/l and up to 24 µg/l, respectively.

Sewage sludge:

- Levels of NP of 10 mg/kg have been measured in Germany in the year 1998. The corresponding levels in the year 1989 were 264 mg/kg.
- Levels of NP of around 90 mg/kg (digested sludge) have been measured in Switzerland in the year 1997. The corresponding levels in the year 1984 were 1010 mg/kg.
- Levels of 4-NP in digested sludge from two sewage treatment plants in Stockholm, Sweden in the year 2002 varied between 0.031 to 0.044 mg/kg dry weight (Sternbeck *et al*., 2003).
- Concentration of NP and NPEs in 21 sewage treatment plants in Sweden was measured in year 2003 and 2004. The levels of NP and NPEs varied between 2 and 440 mg/kg dry weight and 1.1 - 180 mg/kg dry weight respectively (Remberger *et al*., 2004).

Concentrations in Biota:

- Levels of NP in the range from <0.03 to 1.6 mg/kg dry weight have been measured in fish tissues taken from the River Glatt in Switzerland.
- Levels of NP up to 1.2 mg/kg dry weight were found in samples from ducks (muscle) taken from the River Glatt in Switzerland.
- Levels of NP and NPEs of 1.0 mg/kg and 9.5 mg/kg dry weight respectively, were measured in chub liver and in chub muscle 0.18 mg/kg and 0.31 mg/kg respectively in River Aire in Great Britain and in the River Glatt in Switzerland (CEFAS 1998; Ahel 1993).

- A screening study of alkylphenols was performed in Sweden in 2003-2004 (Remberger *et al*., 2004). Herring and flounder from Kattegat were analysed in this survey, but NP and NPEs were not detected in any of the samples.

## 2.2 Quantification of sources

### 2.2.1 Releases to the environment

The UK risk assessment contains a number of release estimates. The releases are most likely substantially different in 2009, but a similar comprehensive assessment has not been made since the UK risk assessment. In summary the UK risk assessment from 2002 indicate the following continental releases of NP and NPEs in the EU:

Total continental releases of NP:

- 2856 kg/day of NP to surface water. Which means 0.1 kg/day from production of NP, 165.1 kg/day from NPE-production, 0.55 kg/day from production of resins, plastics, stabilisers and from different use categories using NPEs 2690 kg/day.
- 80.45 kg/day of NP to waste water. Which means 78.3 kg/day from production of NPEs and 2.15 kg/day from production of resins, plastics and stabilisers.
- 946 kg/day of NP emissions to air.
- 20 980 kg/day of NP absorbed to sewage sludge, due to treatment in waste water treatment plants.

***Table 3**. UK estimates of contribution to the continental burden of NP attributed to various industry sources of NPEs in Western Europe in 1997.*

| **Category** | **% Total NP Burden** |
|---|---|
| Industrial & institutional & domestic cleaning | 44.7 |
| Other niche markets & Unaccounted for | 23.7 |
| Textile auxiliaries | 14.7 |
| Leather auxiliaries | 6.1 |
| NPE production | 5.8 |
| Emulsion polymerisation; Pulp&Paper; Metal industry; Agriculture, Paints etc. | 5.0 |
| **Total** | 100 |

Total continental releases of NPEs:

- 107 602 kg/day of NPEs to waste water from different uses of products containing NPEs.
- 2273 kg/day of NPEs emissions to air, due to treatment in waste water treatment plants.

The sum of emissions (environmental burden), from a given sector where these substances are being used is determined by the fate of NPEs, *i.e.* whether the main part is released to water and/or air (*e.g.* detergents) or incorporated in the product/process (*e.g*. paint). This explains why the industrial and institutional cleaning, textile and leather industries alone contribute some 65% of the total continental burden, compared to their 48% contribution to the uses. Also the NPE production itself contributes significantly to the burden. More than 90% of the burden is associated with the final use of NPE-based products.

### 2.2.2 Human exposure

Occupational exposure may occur during the manufacture of NP, and during use of NP as an intermediate. This is the case for example in the production of NPEs, in the manufacturing of paints, and when using such paint.

Dermal exposure can occur during the production and use of NP, where operators come into contact with surfaces contaminated from splashing or condensed vapour, or as a result of direct contact onto the skin. As processing is a closed system, dermal exposure is only likely during activities such as sampling and coupling and uncoupling of pipe work for filling the product into tins.

## 2.3 Assessment of the extent of problems

As recognised by the Paris Commission (PARCOM), the occurrence of NP and NPEs in the aquatic environment of industrial areas and non-industrial areas as well as in aquatic and terrestrial organisms was cause for concern. NPEs degrade relatively easily in the environment to form short-chained NPEs and (especially under anaerobic conditions) NP, which are toxic to aquatic organisms. NP and NPEs are accumulated in sewage sludge and sediment. Furthermore, NP bioaccumulates in aquatic species. The toxicity to aquatic organisms and possible endocrine disrupting properties are further reasons for concern.

In the EU environmental risk assessment it is concluded that aquatic, terrestrial and secondary poisoning (*e.g.* bioaccumulation) risks were unacceptable. In terms of lowest observable effect levels (LOEL), the most sensitive of these “endpoints” is the aquatic environment (including sediment). It is stated that background concentration levels must be reduced significantly, while local concentrations must also be controlled. It could however be noted that the current TGD does not yet comprise certain methods to assess the risks for the marine environment.

It is also concluded that concerns have been identified for some occupational exposure scenarios. Exposure for sources on a local level is of concern, whereas the exposure on a regional level is of no concern. Regarding consumers, no risk is expected.

# 3. Desired reduction

Extended work to phase out the use of NP/NPEs and related substances were proposed within OSPAR, but postponed to allow account to be taken of measures taken in the EU and other international forums.

The adopted, interim targets for the years 1995 and 2000 are outlined in PARCOM Recommendation 92/8. According to this, the use of NP/NPEs as cleaning agents for domestic uses should be phased out by the year 1995; and the use of NP/NPEs as cleaning agents for industrial uses should be phased out by the year 2000.

Contracting Parties also agreed:

- to study all uses of NP/NPEs and similar substances, which lead to the discharge of these substances to sewer or to surface waters with a view to a reduction of such discharges;
- that care shall be exercised to ensure that replacement materials for the current uses of nonylphenol ethoxylates are less damaging to the aquatic environment. Contracting Parties should exchange information on acceptable substitutes.

The objective for NP/NPEs, in the framework of the OSPAR Strategy with regard to Hazardous Substances is to make every endeavour to move towards a target of the cessation of discharges,

emissions and losses with the ultimate aim of achieving concentrations in the marine environment close to zero in 2020.

# 4. Identification of possible measures

## 4.1 Initiatives within the European Union

The Risk Reduction Strategy (RRS), within the framework of the EU Existing Substances Regulation (ESR), mainly aimed at a reduction of direct emissions to the aquatic environment. The following was recommended in the RRS:

- The marketing and use of NPEs should be banned for sectors responsible for the majority of the environmental burden under Council Directive 76/769/EEC. These sectors include industrial, institutional and domestic cleaning, textile processing, leather processing, agriculture (biocidal products, in particular use in teat dips), metal-working, pulp and paper industry and personal domestic uses (cosmetics and other personal care products).
- When granting authorisation for the use of NPEs in pesticides, and in particular in cases where significant environmental impact is already experienced at local level, national authorities should take into consideration the results of the risk assessment. In such cases the development and use of alternatives to nonylphenol and nonylphenol ethoxylates should be encouraged. For the use of NPEs as an adjuvant/co-formulant, measures aimed at modifying consumer behaviour should also be taken into account. A similar approach is recommended for uses in veterinary medicinal products.
- Permits subject to Council Directive 96/61/EC concerning integrated pollution prevention and control should contain emission limit values for the following uses: production of NPEs; captive use; production of phenol/formaldehyde resin; production of other plastic stabilisers and emulsion polymerisation.
- Limit values (EQS) for residual risks in remaining use categories should be established. It is proposed to use the Water Framework Directive (2000/60/EC) or national measures.
- It is recommended that consideration should be given to the development of limit values for NP and NPEs in the framework of Council Directive 86/278/EEC on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture.

The suggested marketing and use restrictions have also been put into place in 2003 for all the purposes mentioned in the first bullet of the previous paragraph (See Directive 2003/53/EC). The emissions of NPEs should therefore have been reduced substantially in Europe from the following areas:

- industrial, institutional and domestic cleaning,
- textiles processing,
- leather processing,
- agriculture (biocidal products, in particular use in teat dips),
- metal working,
- pulp and paper industry,

- cosmetics, including shampoos and other personal care products.

In the framework of Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy (Water Framework Directive) the Council reached on 7 June 2001 a common position on the establishment of a list of priority substances including substances identified as priority hazardous substances. Nonylphenols and octylphenol are included in this list with an indication that nonylphenols are identified as priority hazardous substances. With respect to the priority substances, the European Commission shall submit proposals of controls for the progressive reduction of discharges, emission and losses of substances concerned, and, in particular the cessation or phasing out of discharges, emissions and losses of priority hazardous substances. Hazardous substances are defined in the Water Framework Directive as "substances or groups of substances that are toxic, persistent and liable to bio-accumulate, and other substances or groups of substances which give rise to an equivalent level of concern". In drawing up the above list in its proposal, the European Commission has taken into account OSPAR work on the prioritisation of hazardous substances. The daughter directive 2008/105/EC in addition establishes an Environmental Quality Standard (EQS) for NP where the annual average should not exceed 0.3µg/l.

The UK is the lead country for octylphenol in OSPAR and the background document was adopted in 2003 and updated 2006. The UK risk assessment for octylphenol has also been reviewed under the working group of Existing Substances Regulation.

## 4.2 National initiatives within some Contracting Parties

### 4.2.1 Water-based paints

Concerning the use of NPEs in the binding polymer emulsion of water-based paints for domestic and industrial use, a large part of the substitution and reformulation has already been carried out in Denmark and Sweden. Most of the companies associated to the Swedish Paint and Printing Ink Manufacturers Association have fulfilled the goal set up to reduce the use of alkyl ($C_8$-$C_{10}$) phenol ethoxylates by approximately 90% between 1995 – 2000. The Swedish paint industry had a timetable to phase out the use of NPEs in water-based paints for the building sector by the end of year 2001. All newly developed paints do not contain APEs. However, difficulties remain in replacing APEs or NPEs in paints for the metal and wood working sectors. Therefore, the replacement of APEs or NPEs will be achieved at a later date in paints for these sectors.

In a Danish Product Policy Programme project studying substitution, the cost for substitution of NPEs or APEs in paints was found to mainly concern the identification of alternatives, environmental and health screening of alternatives, formulation and technical testing of the product. The total cost for one product was expected to be 40 000 - 80 000 DKK.

According to information from the European Producers Association of Alkylphenols and Derivatives, the total cost for substitution of NPEs in paint is estimated at US$ 100 000 - 150 000.

### 4.2.2 Emulsion polymers

According to the Swedish adhesives industry the use of NPEs in water-based adhesives has been reduced by 98% between 1995 - 1999. The aim in Sweden is to achieve the use of alternative products, which do not contain NPEs and APEs, in various industrial sectors such as pulp and paper, textile, paints, adhesives and plastics by 2005 at the latest.

## 4.3 Alternatives

According to industry the substitutes in the use area 'detergents and cleaning agents' are mostly alcohol ethoxylates. In terms of environmental risk, alcohol ethoxylates appear to present a clear advantage over NPEs, mainly owing to issues of biodegradability. According to industry the substitutes in the use area 'detergents and cleaning agents for domestic and industrial uses' are mixtures of anionic and nonionic surfactants, such as linear alcohol ethoxylates, fatty acids and derivatives, fatty amines or unsaturated hydrocarbons.

Specifically, alcohol ethoxylates biodegrade more readily than NPEs in the environment. Furthermore, alcohol ethoxylates tend to degrade fully to carbon dioxide and water in a relatively short time, while NPEs degrade to form NP, the toxicity and slow biodegradability of which have been identified in the risk assessment. In terms of human health risks, no data have been found which favour either alcohol ethoxylates or NPEs as a group.

Nevertheless, when substituting an NPE with an alcohol ethoxylate, it is important to look at the toxicity of the specific chemicals under consideration, as toxicity may vary substantially depending on the alkyl chain lengths, chain branching and the degree of ethoxylation.

According to the paint industry in Sweden, mostly fatty alcohol ethoxylates, but also esterified linseed oil, different kinds of nonionic tensides, phosphate esters, and potassium polycarboxylates are used as alternatives to alkylphenol etoxylates in the binding polymer emulsion of water-based paints. .

According to the adhesive industry, fatty alcohol ethoxylates are mostly used as alternatives in the polymer emulsion of water- based adhesives and the major difficulties are in replacing NPEs in acrylic and chloroprene rubber dispersions.

According to the textile industry, APEs, alcohol ethoxylates and other ethoxylates are mostly used as alternatives to NPEs.

In the leather industry alternatives to APEs are available, mostly based on fatty alcohol ethoxylates and blends thereof, mixtures of alcohol ethoxylates or anionic surfactants.

Concerning NP/NPE-containing pesticides, alternatives are available in Sweden, at least for some uses. Efforts to develop alternatives are being made. It has however not been possible to obtain information on the substitute(s), while the composition information is seen as company property.

Octylphenols (OPs) are known substitutes for NP in the manufacture of derivatives other than NPEs. The use of OPs is not expected to yield any reduction in risk over the use of NP. A Swedish risk assessment of APEs (KemI Report 1/00) has been published by the National Chemicals Inspectorate. Since data on other APEs are scarce, this assessment focuses on octylphenol and butylphenol. It is stated that octylphenol is one of the most potent APs to produce estrogenic effects in vitro and that estrogenic effects have also been demonstrated in vivo in young rats. In addition, and according to CEPAD, neither the cost (much higher than NP) of octylphenol, nor its performance and availability makes it suitable as a substitute for NP.

At the OECD Expert Meeting on NP/NPEs, hosted by Switzerland on 8 - 10 November 1999, it was agreed that some form of exchange of information on substitute chemicals and processes is desirable. A password protected web site has been established by the OECD Secretariat.

## 4.4 Possible OSPAR measures

It can be concluded that the EU Directive 2003/53/EC on a risk reduction strategy fulfils the requirements in PARCOM Recommendation 92/8.

Further measures may however be needed with the aim of reaching the 2020 target. Interim targets concerning other use areas of NP/NPEs could therefore be introduced by OSPAR. Such measures should preferably be based on the work made in the EU risk assessment and the risk reduction strategy.

### 4.4.1 Some uses in products

Marketing and use restrictions within the use category 'other niche markets & unaccounted for' are proposed for personal care products in the EU Risk Reduction Strategy. For some of the uses within this category, *e.g.* non-agricultural pesticides, correction fluids, inks and other office products and the relatively large sector 'unaccounted for', the use of limit values (EQS) is proposed.

The quantity of NP/NPEs in sewage sludge is a result of the many non-industrial uses and industrial uses of NPE-based products. However, the dumping of sewage sludge in the marine environment has been banned and all risks to the aquatic environment have been addressed in the ESR. Bearing this in mind, OSPAR could consider if measures like limit values, proposed for several uses of NP/NPEs in products, are sufficient to protect the marine environment.

OSPAR should therefore examine if other uses, because of the risk posed to the marine environment, should be added to those uses recommended for restrictions on marketing and use. Restrictions on marketing and use are to be preferred in cases where the use is widespread and therefore hard to control with other measures. In such cases, for example, voluntary agreements can hardly be effective. Among others, there might be too many and too small companies, divided into several branches, involved in the negotiations for such agreements. However, it must be recognised that voluntary agreements by producers and distributors of substances have led to significant reductions in the use of NPEs in industrial and domestic detergents.

### 4.4.2 Use in the Offshore Industry

The use of NP/NPEs by the offshore sector seems to be decreasing (or already has decreased) in some countries on a voluntary basis. It might be beneficial to review the use of NP/NPEs by the OSPAR Harmonised Mandatory Control Scheme (HMCS) for Offshore Chemicals, in order to ensure that the OSPAR 2020 target for NP/NPEs will also be met by the offshore sector.

In the United Kingdom the use of NP/NPEs, as well as other known endocrine disrupters, in the offshore sector were phased out in 1999.

Norway has banned OP/OPE and NP/NPE in a number of products including those used in the offshore industry, but derogations are made for some products like paint and varnishes and greasing oil.

# 5. Choice for actions/measures

Earlier measures taken within the EC have partly fulfilled the requirements of PARCOM Recommendation 92/8, but not fully covered the OSPAR 2020 target for hazardous substances. Further measures seem to be necessary and some additional measures have been proposed within the European Union. In particular the occurrence of NPE in imported textiles has been noted as a potential source for NP in sewage water.

The EC measures do not cover uses of NPEs where the function is carrying and emulsifying, as in water-based products and preparations of emulsion polymers. There is a need to work towards a reduction of NP/NPE emissions from such uses. This is particularly the case where alternatives are already available or under development. Therefore,

- OSPAR Contracting Parties that are also EU Member States are recommended to work towards further EC risk-reduction measures for uses in coatings (*e.g*. paint resins, adhesives).

The Council Directive 86/278/EEC (Directive on the protection of the environment when sewage sludge is used in agriculture) will be revised. Therefore,

- OSPAR Contracting Parties that are also Member States should seek to include in Council Directive 86/278/EEC a limit value for concentration of NP and NPEs in sewage sludge applied to agricultural soil.

Under the EC Water Framework Directive a list of priority substances, including the identification of priority hazardous substances, has been established. Nonylphenols are included on that list as priority hazardous substances, with an EQS of 0.3 µg/l. Contracting Parties that also are EU Member States should seek further measures for these substances as appropriate.

PARCOM Recommendation 92/8 states that "care shall be exercised to ensure that replacement materials for the current uses of NP/NPEs are less damaging to the aquatic environment". In the light of this,

- States that are OSPAR Contracting Parties are recommended to take action to prevent other alkylphenols with similar properties being substituted for NP/NPEs. In this context, it should be noted that butylphenol is on the fourth EU priority list and has been assessed by Norway. The draft report from 2007 has identified some concerns for the aquatic environment; the UK has produced an OSPAR background document on octylphenol; that NP is included as priority hazardous substances in the list of priority substances under the Water Framework Directive; and that octylphenols are on this list as priority substances.

The work in the European Union is considerably contributing to the OSPAR 2020 target to be achieved for NP/NPEs. Monitoring information show that recent action and previous voluntary agreements have reduced environmental concentrations considerably. NP is however still detected in surface water and in marine waters and sediments at concentrations above the EQS in the Water Framework Directive. OSPAR CPs also being EU member states will have to consider further measures to gradually reduce the emissions of NPE to the aquatic environment. OSPAR should also consider the need to:

- review what is likely to be achieved by the EC measures that have been adopted; including remaining uses of NPE for which risks for the aquatic environment were identified in the EU risk assessment.
- support the extension of the ban of NPE in textile processing to imported, finished textiles since recent information suggests emissions to sewage water from imported textiles

It is likely that the OSPAR 2020 target will be reached provided that also the planned additional measures are implemented.

In order to provide a sound basis both for future decisions and assessments of the quality status of the marine environment,

- OSPAR should note the monitoring strategy for NP and NPEs attached to this document.

To ensure that the information in this background document and the conclusions reached by OSPAR are formally communicated to the European Commission:

To ensure that the information in this background document can be considered in the context of other international agreements which deal with hazardous substances and to which OSPAR Contracting Parties are a party,

- OSPAR should send copies of this background document to the appropriate bodies dealing with those agreements and invite Contracting Parties who are common parties to OSPAR and those other agreements to promote action to take account of this background document by those other international bodies in a consistent manner.

# List of references

OSPAR documents SEBA 00/10/3 (Status of Reporting on the Discharge of the Most Harmful Chemicals from the Offshore Industry) and OIC 01/4/2 (Examination by OIC of the Draft OSPAR Background Document on Nonylphenols and Nonyl Phenol Ethoxylates (NP/NPEs).

EU Draft Risk Assessment of 4-NP and NP (UK) Aug 1999.

Risk Reduction Strategy (Council Regulation (EEC) 793/93, Brussels, 03.01.2000.

Risk Assessment Reports with Conclusion (i)´s for Human Health, Doc. ECB4/11/00_tm100_hh, June 22, 2000.

Risk Reduction Strategy Meeting (Council Regulation (EEC) 793/93), Doc Env/D/720194/00.

Risk Assessment Doc.ECB4/09/99_Add 1. TM II´99.

Hormoonontregelaars in water "Orienterende studie naar de aanwezigheid van oestrogeen-active stoffen in watersystemen en afvalwater in Nederland", Directoraat-Generaal Rijkswaterstaat.

van Zeijl, H. (1997). Report of the results of the one-off DIFFCHEM survey. OSPAR SIME 1997.

Andersson Å. and Sörme L. (2007): "Substansflödesanalys - av alkylfenoler och alkylfenoletoxilater i Stockholm stad 2004". Miljöförvaltningen, Stockholm Vatten, Sweden.

Bakke T., Boitsov S., Brevik E., Gabrielsen G., Green N., Helgason L., Klungsøyr J., Leknes H., Miljeteig C., Måge A., Rolfsnes B., Savinova T., Schlabach M., Skaare B., Valdersnes S., (2008): "Mapping selected organic contaminants in the Barents Sea 2007", Norwegian Pollution Control Authority, SPFO-report: 1021/2008.

Cato I. and Kjellin B., (2008): "The National Swedish Status and Trend Monitoring Programme based on Chemical Contamination in Offshore Sediment – an overview of the results from 2003", An updated version 2008, SGU Rapport 2008:19

Hansson K., Skårman T. and Brorström-Lundén E., (2008): Releases of Nonylphenol and Nonylphenol Ethoxylates from the use phase of end products - A case study on nonylphenols and nonylphenol ethoxylates as a part of the project founded by the Nordic Council of Ministers", SMED report, in press.

Junestedt C., Solyom P., Palm A. and Öman C., (2003): "Karaktärisering av utsläpp - jämförelse av olika utsläpp till vatten", IVL report B1544, Sweden.

Månsson N., Sörme L., Wahlberg C., Bergbäck B. (2008): Sources of Alkylphenols and Alkylphenol Ethoxylates in Wastewater – a Substance Flow Analysis in Stockhom, Sweden. Water Air Soil Pollution: Focus. DOI 10.1007/s11267-008-9186-6.

Remberger M., Kaj L., Palm A., Sternbeck J., Kvernes E., Brorström-Lundén E., (2004): "Screening tertiary butylphenols, methylphenols, and long-chain alkylphe-nols in the Swedish environment", IVL report B1594, Sweden.

Sternbeck J., Brorström-Lundén E., Remberger M., Kaj L., Palm A., Junedahl E. and Cato I., (2003): "WFD Priority substances in sediments from Stockholm and the Svealand coastal region", IVL report B1538, Sweden.

SOCOPSE - "Source Control of Priority Substances in Europe", www.socopse.eu

SVECO VIAK (2007): "Nationwide screening of WFD priority substances", SWECO VIAK Screening Report 2007:1, Sweden.

# Annex 1: Monitoring strategy for nonylphenol/nonylphenolethoxylates

As part of the Joint Assessment and Monitoring Programme (OSPAR agreement 2003-22), OSPAR 2004 adopted an Agreement on monitoring strategies for OSPAR Chemicals for Priority Chemicals (OSPAR agreement 2004-15) to implement the following monitoring for tracking progress towards the objectives of the OSPAR Hazardous Substances Strategy (OSPAR agreement 2003-21) with regard to nonylphenol/nonylphenol ethoxylates. The Monitoring Strategy for nonylphenol/nonylphenol ethoxylates will be updated as and when necessary, and redirected in the light of subsequent experience.

The sources of NP/NPEs are, in general, well characterised and have been set out in the OSPAR Background Document on NP/NPEs and the HARP-HAZ Guidance document on NP/NPEs. Methodologies for environmental monitoring of NP/NPEs are available.

Monitoring that has been carried out in the marine environment shows concentrations above the detection limit in the individual environmental compartments water, biota and sediment. There are currently no monitoring programmes for NP/NPEs in the OSPAR framework.

The source oriented approach may offer the best option for tracking the progress on moving towards the 2020 cessation target, although some data suggest that non-point sources have been increasingly important. The HARP-HAZ Guidance Document on Nonylphenols and related Substances would in principles offer the most appropriate option for tracking the progress on the cessation of discharges, emissions and losses of NP/NPEs. However, not all Contracting Parties have the resources to contribute to such reporting.

There are a number of relevant controls (*e.g*. regulations, directives, recommendations and decisions) on a) marketing and/or use, b) emissions and/or discharges of NP/NPEs which have been agreed by Contracting Parties both in OSPAR and in other international forums and have been highlighted as important measures for achieving the OSPAR Hazardous Substances objective with respect to NP/NPEs in the “choice for actions” chapter of the Background Document. Evidence from reports on the implementation of such measures will be used to make an initial judgement of the extent to which the amounts of these substances emitted or discharged are reduced.

On the evidence available, it would not appear to be sensible to include NP/NPEs in the RID or CAMP programmes. If any monitoring is to take place, it could be in the form of periodic surveys on sediments in specific locations known to be at risk, possibly identified through the WFD catchment assessments. However, nonylphenols are priority substances under the WFD, and OSPAR will in the first instance seek to periodically compile the results of WFD monitoring in coastal and transitional waters in relation to an environmental quality standard.

Due to the endocrine disrupting potential of nonylphenol, biological effects monitoring may be appropriate and should be borne in mind.

OSPAR will consider the need to develop an EAC taking into account the development of an environmental quality standard under the WFD.

OSPAR will seek to co-ordinate the monitoring programmes for NP/NPEs and octyphenol.

| **NONYLPHENOL/NONYLPHENOL-ETHOXYLATES MONITORING STRATEGY** | |
|---|---|
| *Implementation of actions and measures* | • Examination of progress in the implementation of regulations on marketing and/or use or emission and/or discharge which have been agreed, or are endorsed, by the Background Document |
| ***Maritime area:*** | |
| *Concentrations **in** sediments* | • Where available, data will be periodically compiled from EC WFD monitoring<br>• The need for EACs and BRCs will be considered |
| *Concentrations in water* | • Where available, data will be periodically compiled from EC WFD monitoring |

OSPAR COMMISSION

New Court
48 Carey Street
London WC2A 2JQ
United Kingdom

t: +44 (0)20 7430 5200
f: +44 (0)20 7430 5225
e: secretariat@ospar.org
www.ospar.org

**OSPAR's vision is of a healthy and diverse North-East Atlantic ecosystem, used sustainably**

ISBN 978-1-906840-36-5
Publication Number: 396/2009