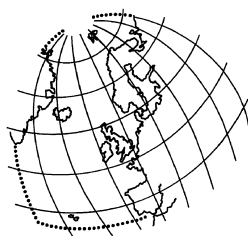


# 2,4,6-tri-*tert*-butylphenol<sup>1</sup>



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<sup>1</sup> Secretariat's note: A review statement on 2-4-6-tri-*tert*-butylphenol (Publication 401/2009) was adopted in 2009, highlighting new developments since the adoption of the Background Document.

# OSPAR Commission 2003 (2006 Update)

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.

*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.*

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ISBN 1-905859-01-5  
ISBN 978-1-905859-01-6

Publication Number: 274/2006

## contents

Executive Summary	5
Récapitulatif	6
1. Basis and Rationale for Action	7
2. Identification of all sources of the substances and pathways to the marine environment	8
2.1 Production and use	8
2.2 Sources of emissions and discharges	9
2.3 Pathways to the marine environment	9
3. Monitoring Data, Quantification Of Sources And Assessment Of The Extent Of Problems	10
3.1 Monitoring data	10
3.1.1 Aquatic inputs to the marine environment	10
3.1.2 Atmospheric inputs	10
3.1.3 Concentrations in the marine environment	10
3.1.4 Concentrations in biota	10
3.2 Quantification of sources	11
3.2.1 Releases to the environment	11
3.2.2 Human exposure	11
3.3 Assessment of the extent of the problem	11
3.3.1 Summary of persistence, bioaccumulation and toxicity data	11
4. Achieving Desired Reductions	13
4.1 OSPAR Targets	13
5. Identification Of Possible Measures	13
5.1 Ongoing activities within the European Union	13
5.2 National initiatives within some Contracting Parties	13
6. Choice for Actions	13
Annex 1: Physico-chemical data	14
Annex 2: OSPAR fact sheet for 2,4,6-tri- <i>tert</i> -butylphenol	18
Annex 3: Monitoring strategy for 2,4,6-tri- <i>tert</i> -butylphenol	21
Annex 4: Exchange of information on 2,4,6, tri- <i>tert</i> -butylphenol in resins	22

## EXECUTIVE SUMMARY

At OSPAR 2000, the substance known as “dodecylphenol” (CAS number 732-26-3) was identified as a substance for priority action. However, the correct name of the chemical with CAS number 732-26-3 is 2,4,6-tri-*tert*-butylphenol. OSPAR 2001 therefore agreed that “dodecylphenol” should be renamed as 2,4,6-tri-*tert*-butylphenol in official OSPAR documentation.

Information provided by OSPAR Contracting Parties indicates possible uses at an annual amount of 33 tonnes in Denmark and 1 tonne in Norway. According to the Finnish Product Register, 2,4,6-tri-*tert*-butylphenol is listed, but no products, production or import is noted in 2001. The Swedish Product Register includes 19 registrations of products containing 2,4,6-tri-*tert*-butylphenol which correspond to a use of 1 tonne in 2001. There is still some uncertainty about the precise use pattern of 2,4,6-tri-*tert*-butylphenol, but five categories of potential production and use have been identified or suggested and discussed: as a chemical intermediate in the production of antioxidants used in rubber and plastic; as a lubricating agent in the transport sector; as a by-product in the production of 4-*tert*-butylphenol; as an additive for gasoline and fuel oil distillate and use in the offshore sector. As available data for 2,4,6-tri-*tert*-butylphenol are very limited, only the confirmed use as an intermediate is considered with respect to possible pathways to the marine environment.

No measured monitoring data are available for concentrations of 2,4,6-tri-*tert*-butylphenol in the marine environment. However, some marine PECs have been estimated using EUSES default modelling and the EU Technical Guidance Document on marine risk assessment methodology.

The data indicate that 2,4,6-tri-*tert*-butylphenol may be toxic, persistent and bioaccumulative, although data are limited and may need further validation. However, since this substance may not be manufactured and used in sufficient quantities to be likely to pose a significant concern to the open sea and is only likely to cause very local problems if indeed discharges do occur, the risk for the marine environment is considered low.

The action recommended is: to report confirmation that the operations of plants where 2,4,6-tri-*tert*-butylphenol is being used as an intermediate is controlled according to the best available techniques (BAT); industry to provide further data to clarify the use pattern of 2,4,6-tri-*tert*-butylphenol, particularly with respect to lubricants but also with respect to the other indicated uses, with review if significant sources are shown; the lead country UK to develop and propose an appropriate monitoring strategy; industry to provide the data needed to allow a completion of the risk assessment; OSPAR should publish, as a later supplement to this Background Document, the outcome of the exchanges of information within its Offshore Industry Committee on the presence of 2,4,6-tri-*tert*-butylphenol as a production residue in resins and the possible effects of this; OSPAR to communicate this background document to the European Commission and to other appropriate international organisations which deal with hazardous substances to take account of this background document in a consistent manner.

A monitoring strategy for 2,4,6-tri-*tert*-butylphenol is annexed to this background document.

## RECAPITULATIF

A OSPAR 2000, la substance connue sous le nom de « dodecylphénol » (N° CAS 732-26-3) a été déterminée comme une substance devant faire l'objet de mesures prioritaires. Toutefois, le nom exact du produit chimique portant le N° CAS 732-26-3 est 2,4,6-tri-*tert*-butylphénol. OSPAR 2001 est en conséquence convenue que le « dodecylphénol » serait rebaptisé 2,4,6-tri-*tert*-butylphénol dans les documents officiels d'OSPAR.

Les renseignements communiqués par des Parties contractantes à OSPAR donnent des consommations annuelles possibles de 33 tonnes au Danemark et de 1 tonne en Norvège. Suivant la Nomenclature finnoise des produits, si le 2,4,6-tri-*tert*-butylphénol figure bien dans la Nomenclature finnoise des produits, en revanche, aucun produit, ni production ni importation n'y est signalé en 2001. Dans la Nomenclature suédoise des produits sont notés 19 produits contenant du 2,4,6-tri-*tert*-butylphénol, ce qui correspond à une consommation de 1 tonne en 2001. Bien qu'une incertitude persiste sur le profil exact de la consommation du 2,4,6-tri-*tert*-butylphénol, cinq catégories de fabrication et de consommation potentielles ont été déterminées ou suggérées et discutées : comme produit chimique intermédiaire dans la fabrication d'antioxydants présents dans le caoutchouc et dans des matières plastiques, comme lubrifiant dans le secteur du transport, comme sous-produit de la fabrication du 4-*tert*-butylphénol, comme adjuvant de l'essence et du distillat du mazout, tandis qu'il également est employé dans le secteur de l'offshore. Le volume de données à disposition sur le 2,4,6-tri-*tert*-butylphénol étant très restreint, en ce qui concerne les voies de pénétration éventuelles dans le milieu marin, seule l'application, celle-ci certaine, d'intermédiaire est prise en compte.

L'on ne dispose d'aucune donnée, qui aurait été obtenue grâce à des mesures faites lors de la surveillance, sur les teneurs en 2,4,6-tri-*tert*-butylphénol dans le milieu marin. Cependant, l'on a procédé à des estimations des PEC sur le modèle EUSES par défaut ainsi que grâce à la méthode d'évaluation des risques pour le milieu marin, figurant dans le Document d'orientation technique de l'Union européenne.

Les données indiquent que le 2,4,6-tri-*tert*-butylphénol est susceptible d'être toxique, persistant et bioaccumulatif, bien que les données soient limitées et qu'il faille peut-être les valider plus avant. Cependant, puisque cette substance n'est peut-être pas fabriquée ni consommée en quantités suffisantes pour avoir des chances de faire naître des préoccupations sérieuses pour la haute mer, et qu'elle n'est susceptible de donner lieu qu'à des problèmes très localisés, dans la mesure où des rejets ont effectivement lieu, le risque pour le milieu marin est considéré comme faible.

Les actions recommandées sont les suivantes : confirmer que l'exploitation des installations où du 2,4,6-tri-*tert*-butylphénol est utilisé comme intermédiaire a lieu selon les meilleures techniques disponibles (BAT) ; il convient que l'industrie fournisse des données complémentaires afin de clarifier le profil de consommation du 2,4,6-tri-*tert*-butylphénol, en particulier dans ses applications comme lubrifiant, quoique également en ce qui concerne les autres applications signalées, avec un réexamen si des sources significatives sont mises en évidence ; il convient aussi que le Royaume-Uni, pays pilote, élabore et propose une stratégie de surveillance appropriée ; que l'industrie fournisse les données nécessaires pour qu'une évaluation des risques puisse être menée à bien, qu'OSPAR publie, en supplément à posteriori au présent document de fond, le résultat des échanges d'informations au sein de son Comité industrie de l'offshore sur la présence du 2,4,6-tri-*tert*-butylphénol comme résidu de fabrication dans des résines ainsi que sur les effets éventuels de cette situation ; il convient aussi qu'OSPAR communique le présent document de fond à la Commission européenne et aux autres organisations internationales compétentes chargées des substances dangereuses, afin qu'elles tiennent compte du présent document de fond dans des conditions cohérentes.

Une stratégie de surveillance sur le 2,4,6-tri-*tert*-butylphénol est annexée à ce document de fond.

## 1. BASIS AND RATIONALE FOR ACTION

The objective stated in the OSPAR Strategy with regard to Hazardous Substances ('the Strategy'), which was adopted in Sintra in 1998<sup>2</sup> and endorsed by Ministers is:

*"to prevent pollution of the maritime area by continuing to reduce discharges, emissions and losses of hazardous substances, with the ultimate aim of achieving concentrations in the marine environment near background values for naturally occurring substances and close to zero for man-made synthetic substances".*

Setting out the basis for OSPAR's work for achieving this objective, the Strategy also includes a timeframe which states that:

*"every endeavour will be made to move towards the target of cessation of discharges, emissions and losses of hazardous substances by the year 2020".*

2,4,6-tri-tert-butylphenol (CAS no. 732-26-3) is on the OSPAR List of Chemicals for Priority Action, and the UK is the lead country for drawing up this background document on 2,4,6-tri-tert-butylphenol.

This background document has the following aims:

- identifying the main sources of 2,4,6-tri-tert-butylphenol and its various pathways into the marine environment;
- reviewing the various controls to limit discharges, emissions and losses of 2,4,6-tri-tert-butylphenol;
- assessing what further activities should be undertaken by OSPAR, or other relevant international organisations, in order to achieve the various OSPAR commitments.

This background document takes into account the "Interim Guidance on how to address Hazardous Substances for Priority Action" agreed at OSPAR 1999 (see Annex 7 of Summary Record OSPAR 99/15/1) and uses the basic structure for OSPAR background documents outlined in that document.

At OSPAR 2000, the substance known as "dodecylphenol" (CAS number 732-26-3) was identified as a substance for priority action. However, subsequent investigation by the UK, and further discussion at the 2001 meetings of the Working Group on Priority Substances and the Hazardous Substances Committee, revealed that this chemical had been misnamed when identified for priority action at OSPAR 2000. The correct name of the chemical with CAS number 732-26-3 is 2,4,6-tri-tert-butylphenol. OSPAR 2001 therefore agreed that "dodecylphenol" should be renamed as 2,4,6-tri-tert-butylphenol in official OSPAR documentation. 2,4,6-tri-tert-butylphenol was suspected to be produced in relatively small volumes in the EU (around 10 tonnes per annum or less) and understood to be used principally as a chemical intermediate.

In the UK investigations, it became clear that a High Production Volume Chemical (HPVC) known as dodecylphenol does exist, which is known to be commercially important and is manufactured and used in the EU at tonnages of  $\geq 1\ 000$  tonnes per annum. This HPVC is used to make oil and lubricant additives and phenolic resins and lacquers and is likely to have a wide dispersive use.

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<sup>2</sup> Amended by the 2003 Ministerial meeting of the OSPAR Commission.

This background document deals with the low volume substance originally identified by OSPAR as “dodecylphenol” but which has now been renamed as 2,4,6-tri-tert-butylphenol. A summary of the properties and data available for this substance is given in Annex 1 and the OSPAR fact sheet for this substance which is at Annex 2.

## 2. IDENTIFICATION OF ALL SOURCES OF THE SUBSTANCES AND PATHWAYS TO THE MARINE ENVIRONMENT

### 2.1 Production and use

2,4,6-tri-tert-butylphenol is not thought to be produced in sufficient quantity to classify it as a High Production Volume Chemical (HPVC) and production within the EU has been reported as being in the order of 10 tonnes per annum. However, information provided by OSPAR Contracting Parties indicates possible uses at a volume of 33 tonnes in Denmark and 1 tonne in Norway. According to the Finnish Product Register, 2,4,6-tri-tert-butylphenol is listed, but no products, production or import is noted in 2001. The Swedish Product Register includes 19 registrations of products containing 2,4,6-tri-tert-butylphenol which correspond to a use of 1 tonne in 2001. The substance is imported to Sweden and used in the manufacture of products which in some cases are exported.

There is still some uncertainty about the precise use pattern of 2,4,6-tri-tert-butylphenol, but five categories of potential production and use have been identified or suggested:

- as a chemical intermediate in the production of antioxidants used in rubber and plastic;
- as a lubricating agent in the transport sector;
- as a by-product in the production of 4-tert-butylphenol;
- as an additive for gasoline and fuel oil distillate;
- use in the offshore sector.

**Chemical intermediate:** The only use reported by industry is as a chemical intermediate for the production of antioxidants used in rubber and plastic. As an intermediate, it should not enter the environment provided that robust abatement controls are in place in the plant where it is being used in the production of other materials. However, for precautionary reasons it has been assumed that some emissions, discharges and losses may occur. These estimates may change if additional information is provided by industry. The potential for release as an impurity in, or degradation product of, final formulations and/or articles has not been assessed due to a lack of information.

**Lubricating agents:** It appears possible that the substance may be present (as a substance rather than as a derivative) in lubricant anti-oxidant products, though whether this is as an impurity or as an intentional component is not clear. The extent to which such products containing 2,4,6-tri-tert-butylphenol are currently used is also not clear, nor whether the substance is imported (either as the substance or in products). Norway provided information that a product containing 2,4,6-tri-tert-butylphenol was included on its “Produktregister”. This product was a lubricating agent in the transport sector. Information from the company registering the product indicates that one of their products contained 2,4,6-tri-tert-butylphenol at a level of 0,0225%. Since July 2001 the level of the substance in any product from this company has been below 10 ppm, due to a change in the source material. The UK has made contact with a second company, whose product range includes a lubricant anti-oxidant containing 5% of 2,4,6-tri-tert-butylphenol. Further information from the company is expected. If this indicates a substantive use of the substance under this use, the UK will add a risk assessment scenario for this use.



**By-product in production of 4-*tert* butylphenol:** German experts have expressed the view that 2,4,6-tri-*tert*-butylphenol may be formed as a by-product in the manufacture of 4-*tert*-butylphenol<sup>3</sup>. Germany has asked VCI (the German Association for the Chemical Industry) for more information on this possibility. In the meantime, the IUCLID files for 4-*tert*-butylphenol, 2,4-di-*tert*-butylphenol and 2,6-di-*tert*-butylphenol have been consulted to see if the presence of 2,4,6-tri-*tert*-butylphenol is indicated in these substances. 2,4,6-tri-*tert*-butylphenol is listed as an impurity in 2,6-di-*tert*-butylphenol, at a concentration of 0,003%. It is not listed as an impurity for the other two substances.

**Additive for gasoline and fuel oil distillate:** It has also been suggested that 2,4,6-tri-*tert*-butylphenol is used as an additive for gasoline and fuel oil distillate. It has not been possible to find further details of this use.

**Use in the Offshore sector:** 2,4,6-tri-*tert*-butylphenol is not used by the offshore industry. The Offshore Industry Committee is exchanging information on its possible presence in resins, and its possible effect.

## 2.2 Sources of emissions and discharges

Available data for 2,4,6-tri-*tert*-butylphenol are very limited, and so the information for sources of emissions and discharges is based on the emission scenarios provided by Annex 1 (Tables A and B) of Part II of the EU Technical Guidance Document (TGD) to give default releases for the different life cycle stages identified.

For the present document, only the confirmed use as an intermediate is considered. The scenario selected is as follows:

- industry category 3, Chemical Industry: chemicals used in synthesis;
- use category 33, Intermediates.

Production and use of 10 tonnes in this use pattern is assumed for the later calculations.

It is important to note that for 2,4,6-tri-*tert*-butylphenol all environmental release data and environmental concentrations are predicted values. There are no available measured data for use from site-specific situations or at a regional level for this substance. Predicted environmental concentrations (PECs) have been calculated using the EUSES software programme<sup>4</sup>.

## 2.3 Pathways to the marine environment

2,4,6-tri-*tert*-butylphenol used as an intermediate is likely to reach the marine environment via a single main route, namely the discharge of wastewater from the limited number of land-based production processes where the substance is produced or formulated/processed into products. Diffuse sources might include releases due to its presence as an impurity in, or degradation product of, final formulations and/or articles, and use of products in the transport industry. There is insufficient information available at present to assess the relative importance of these potential sources.

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<sup>3</sup> 4-*tert*-butylphenol is being assessed by Norway under the Existing Substances Regulation (EEC) 793/93.

<sup>4</sup> The European Union System for the Evaluation of Substances (EUSES) is a decision-support instrument which enables government authorities, research institutes and chemical companies to carry out rapid and efficient assessments of the general risks posed by chemical substances.

### 3. MONITORING DATA, QUANTIFICATION OF SOURCES AND ASSESSMENT OF THE EXTENT OF PROBLEMS

#### 3.1 Monitoring data

##### 3.1.1 Aquatic inputs to the marine environment

No data are available on loads of 2,4,6-tri-tert-butylphenol entering the OSPAR Convention waters and the Greater North Sea.

##### 3.1.2 Atmospheric inputs

No data are available on atmospheric inputs of 2,4,6-tri-tert-butylphenol but considering the fact that it appears to be used as an intermediate in closely controlled systems and its low vapour pressure and tendency to adsorb to soils and sediments, it can be expected that atmospheric concentrations will be low. Any 2,4,6-tri-tert-butylphenol released to the atmosphere is likely to be degraded rapidly by reaction with hydroxyl radicals (estimated half-life in air is ca. 24 hours) and deposition of the substance from the atmosphere is likely to be negligible with resulting rainwater concentrations being low. The lifetime of 2,4,6-tri-tert-butylphenol in the atmosphere is thus predicted to be very short and it is unlikely to be transported a long distance from its point of emission. Therefore concentrations due to atmospheric washout by precipitation from the atmosphere are likely to be greatest near the point of emission and, in any case, very low.

##### 3.1.3 Concentrations in the marine environment

No measured data are available for concentrations of 2,4,6-tri-tert-butylphenol in the marine environment. However, some marine PECs have been estimated using EUSES default modelling and the TGD marine risk assessment methodology, and these are provided in Table 1. Some of the key data used to produce these estimates, for example Henrys Law Constant and water solubility were estimated using QSARs (see Annex 1).

**Table 1: Predicted environmental concentrations (PECs) for 2,4,6-tri-tert-butylphenol**

SCENARIO	PECs for water (microgram per litre)	PECs for sediment (mg kg <sup>-1</sup> wet wt)
Local – Production	13	29
Local – Processing	15	33

It should be noted that these estimated concentrations relate to the direct discharge of industrial waste water to the sea, without intermediate treatment. The default assumptions mean that discharges occur only for a short period each year (nine and eight days for production and processing respectively) and hence discharges during these periods are high. The annual average concentrations for these two scenarios are 0,32 and 0,33 µg/l. The model required to estimate regional concentrations for the marine environment is not yet developed. For information, the regional concentration in water for the freshwater environment is calculated as  $3,7 \times 10^{-4}$  µg/l.

##### 3.1.4 Concentrations in biota

There are no reported measured concentrations of the substance in biota. A measured bioconcentration factor of 23 200 is available, and a value of 12 620 has been obtained from measurements and extrapolation to a 5% lipid content in fish. These values are supported by predicted values of 3 282 and 34 600 based on the log Kow value. Although it has not been possible to obtain the original study reports

for the measurements and so fully validate them, the information as a whole indicates that appreciable accumulation could occur.

### 3.2 Quantification of sources

The absence of monitoring data precludes the quantification of emissions to the environment from measured emissions data and measured concentrations in the environment. Consequently, the following sections include estimated default release data according to the Technical Guidance Documents and using the EUSES software tool.

#### 3.2.1 Releases to the environment

2,4,6-tri-tert-butylphenol is considered to be produced and/or used in the EU in amounts of only 10 tonnes per annum or less (although information provided by Denmark suggests a higher usage in products, possibly through importation). No site-specific information is available on releases to the environment at present.

##### *Total continental releases of 2,4,6-tri-tert-butylphenol*

The values in Table 2 are the summed values of those estimated using EUSES default modelling for each of the life-cycle stages of 2,4,6-tri-tert-butylphenol.

**Table 2: Total continental emissions of 2,4,6-tri-tert-butylphenol (predicted using EUSES)**

Compartment	Total Continental Emissions, kg/day
Air	0
Wastewater	0,069
Surface Water	0,029
Industrial Soil	0,0014

These figures may be refined in the light of any further information that becomes available from industry on amounts produced and use patterns. They currently represent the production and use of the substance in a limited quantity, but use default emission factors.

#### 3.2.2 Human exposure

Occupational exposure may occur during manufacture of 2,4,6-tri-tert-butylphenol and during its use as an intermediate. This is most likely to be dermal exposure occurring as a result of spillage although this should be minimised by the use of appropriate Personal Protective Equipment (PPE).

The limited assessment undertaken for this substance by the UK considered indirect exposure of predators via the environment (secondary poisoning). This assessment suggested that there may be potential adverse effects for predators following dietary exposure via the food chain (based on a default release pattern and a single mammalian toxicity study that has not yet been properly assessed (only an abstract is currently available)). Thus people may be exposed via the food chain route, although this has not been quantified.

### 3.3 Assessment of the extent of the problem

#### 3.3.1 Summary of persistence, bioaccumulation and toxicity data

In order to provide an assessment of the extent of the problem it is necessary to consider the substance's persistence (P), bioaccumulation potential (B) and toxicity (T). On the basis of a ready biodegradability

test result in the OSPAR dataset, the substance cannot be considered readily biodegradable. On this basis, it meets the EU screening criterion for consideration as a persistent (and potentially 'very persistent', vP) substance. The validity of this test has not been assessed since the report has not been made available, but the conclusion is consistent with information available on other alkyl phenols. There is currently no information about abiotic degradation in the aqueous environment.

The bioconcentration data summarised in section 3.1.4 indicate that the substance meets the EU screening criterion for consideration as a 'very bioaccumulative' (vB) substance ( $BCF > 5\,000$ ). Although the two experimental BCF studies have not been fully assessed for validity, the agreement between the values from these studies and their agreement with predicted values gives some confidence to the conclusion.

Experimental toxicity data available are only for freshwater fish (a 96-hour  $LC_{50}$  value of  $0,061\text{ mg l}^{-1}$  was measured for the fathead minnow *Pimephales promelas*). The study is considered to be valid, and meets the EU criterion for consideration as a toxic substance (acute aquatic  $L(E)C_{50} < 0,1\text{ mg l}^{-1}$ ). QSAR predictions suggest that algae might be similarly sensitive (predicted freshwater algal 96-hour  $EC_{50} = 0,033\text{ mg l}^{-1}$ ). It should be noted that the water solubility of the substance has not been reported. However, the predicted water solubility is above the reported  $LC_{50}$ .

In summary, the substance meets the criterion for T and the screening criterion for vB. On the basis of unchecked test reports it also appears to meet the screening criterion for P/vP, and confirms the criterion for vB. An environmental simulation test might clarify the potential for persistence. However, there are large uncertainties in the assessment due to limitations in the dataset. The EU marine risk assessment strategy would indicate testing on persistence (simulation testing for the marine environment) as the next step to refine the assessment.

Indicative PEC values for the marine environment have been calculated using default assumptions from the EU Technical Guidance Document. An initial PNEC for the marine environment has also been derived (see Annex 1). Using the local scenario PECs the resulting PEC/PNEC ratios are 3 900 – 4 500, although it should be stressed that the PECs are based on default values and the PNEC on a very limited set of laboratory data. Ratios for sediment would be increased by a factor of ten to allow for possible uptake through ingestion as well as from the water. Thus these initial calculations indicate a possible local risk from the production and use of the substance as an intermediate. The low PEC for the regional freshwater environment indicates that there should be no risk on the larger scale for this use pattern. Calculated concentrations in biota indicate risks to predators, also from the local scenario.

It is concluded that, given the present information about the use of the substance, there is at present a need for further information and/or testing with regard to the risks to the aquatic and sediment compartments and from secondary poisoning (that is through bioaccumulation). In the first instance measured physico-chemical data (e.g. for water solubility), more ecotoxicity test data, an appropriate micro-organism toxicity test, the full mammalian toxicity study report, detailed information on tonnage and emissions (particularly from production) and preferably measured concentrations in the environment are required. In view of the possible use in lubricants used in transport, with a wide range of potential uses for some of the products, a more complex emission scenario could be constructed once further data are evaluated. The substance would appear to meet the criteria for consideration as a potential PBT substance; further assessment of the study reports would be useful to confirm this. In relation to ecotoxicity testing, it would be valuable to extend the data set to confirm the predicted values. However, the assessment factor used will only change if either a range of marine organisms are tested for acute toxicity, or longer term tests are performed. The highest PNEC value possible based on the acute fish toxicity value (the only experimental result) is  $6\text{ ng/l}$ , which would have little effect on the assessment above.

## **4. ACHIEVING DESIRED REDUCTIONS**

### **4.1 OSPAR targets**

The data indicate that 2,4,6-tri-*tert*-butylphenol may be toxic, persistent and bioaccumulative, although data are limited and may need further validation. However, a key consideration in considering the appropriate action for this substance is that it may not be manufactured and used in sufficient quantities to be likely to pose a significant concern to the open sea and is only likely to cause very local problems if indeed discharges do occur. Further data on production and use is needed. Any OSPAR actions should recognise this fact.

## **5. IDENTIFICATION OF POSSIBLE MEASURES**

### **5.1 Ongoing activities within the European Union**

There are no on-going activities in the EU related to 2,4,6-tri-*tert*-butylphenol.

### **5.2 National initiatives within some Contracting Parties**

OSPAR is not aware of any on-going national initiatives within Contracting Parties related to the control of 2,4,6-tri-*tert*-butylphenol.

It is not known if there are alternative chemicals that can be used for this chemical in its role as an intermediate. Information from industry and other Contracting Parties and OSPAR's ongoing work on substitution would help to clarify this situation.

## **6. CHOICE FOR ACTIONS**

A proper evaluation of the appropriate choices for action can only be made when all the relevant information has been collected and assessed. Information on the potential use, or occurrence, of 2,4,6-tri-*tert*-butylphenol in anti-oxidant lubricants is needed to clarify the risk to the marine environment. If significant use is confirmed, then further testing should be carried out to clarify several factors (for example, persistence in the marine environment). In particular, there needs to be a better understanding of the risks posed by the various substitutes which are available to replace 2,4,6-tri-*tert*-butylphenol. However, on the basis of the information available, the following actions are already thought to be justified:

- OSPAR Contracting Parties which have plants where 2,4,6-tri-*tert*-butylphenol is being used as an intermediate should check that the operations of the plants is controlled according to the best available techniques (BAT) and that any releases are eliminated or minimised to the greatest extent possible;
- OSPAR should request that industry provide further data to clarify the use pattern of 2,4,6-tri-*tert*-butylphenol, particularly with respect to lubricants but also with respect to the other indicated uses. If significant uses are reported, OSPAR should review the production and use data for this substance, consider the need for any further testing and decide whether any further action is necessary to reduce emissions and discharges of this substance to the marine environment.

In order to evaluate whether discharges, emissions and losses of 2,4,6-tri-*tert*-butylphenol are significant, and whether any additional action is necessary regarding the achievement of the OSPAR 2020 cessation target for this substance,

- OSPAR welcomes the offer of the UK to develop and propose an appropriate monitoring strategy. Current thinking is to carry out a "one-off survey" at estuaries adjacent to the known production sites;
- industry should be requested to provide the data needed to confirm fully the use pattern and the tonnage supplied in the EU/OSPAR area, the availability of alternatives, the cost implications and the PBT properties, in order to allow a completion of the risk assessment. Further actions to reduce emissions are to a large extent dependent on the full details of the uses, substitutes and possible pathways to the marine environment being known;
- OSPAR should publish, as a supplement to this Background Document, the outcome of the exchanges of information within its Offshore Industry Committee on the presence of 2,4,6-tri-*tert*-butylphenol as a production residue in resins and the possible effects of this.

Any associated measures which might be justified should be addressed through the background document review process.

To ensure that the information in this background document and the conclusions reached by OSPAR are taken into account in the approach of the European Community,

- OSPAR should communicate this background document to the European Commission for information.

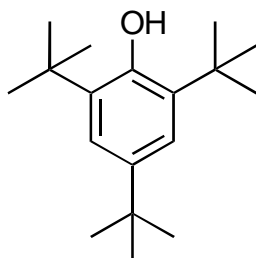
To ensure that the information in this background document can be considered in the context of other international agreements which deal with hazardous substances, and with which Contracting Parties are associated,

- 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.

## ANNEX 1

### PROPERTY DATA

CAS Number: 732-26-3  
 EINECS Number: 211-989-5  
 IUPAC Name: phenol, 2,4,6-tris (1,1-dimethylethyl)-  
 Synonym: 2,4,6-tri-*tert*-butylphenol  
 Molecular formula: C<sub>18</sub>H<sub>30</sub>O  
 Structure:



A summary of the physico-chemical data for the substance is provided in Table A.

**Table A: Physico-chemical properties**

Property	Value and comment
Molecular weight	262,4 g mole <sup>-1</sup>
Melting point	131°C
Boiling point	278°C
Vapour pressure	2,65 x 10 <sup>-5</sup> Pa at 25°C 0,088 Pa (from ICCA submission)
n-Octanol-water partition coefficient	log K <sub>ow</sub> = 6,06 log K <sub>ow</sub> = 6,35 (KOWWIN prediction)
Water solubility	0,512 mg l <sup>-1</sup> at 20°C (QSAR derived) 35 mg l <sup>-1</sup> (from CERI database)
Henry's Law constant	2,42 Pa.m <sup>3</sup> .mol <sup>-1</sup> (QSAR derived)

The majority of the physico-chemical data are derived from the Nordic Substances Database, Danish QSAR databases and IUCT QSAR Fraunhofer Institute database.

The values available for vapour pressure and for solubility differ by a large degree. They are also not consistent with the other properties. There are few details about the methods used to obtain the measured values. The predicted and measured log Kow values are in agreement with each other. These would tend to support a relatively low solubility. Combining either of the solubility values with the vapour pressure values gives predicted Henry's law constants which are different from that predicted with the SRC program (in the table). The vapour pressure predicted by the SRC program is 2,65x10<sup>-5</sup> mmHg, so the low vapour pressure in the table may have the wrong units. This value is equivalent to 3,5x10<sup>-3</sup> Pa, which with the predicted solubility gives a Henry's law constant of 1,8 Pa m<sup>3</sup> mole<sup>-1</sup>, which agrees well with that predicted directly.

A reasonably consistent set of values can therefore be selected as: log Kow 6,06; solubility 0,512 mg/l; vapour pressure 3,5x10<sup>-3</sup> Pa; Henry's law constant 2,42 Pa m<sup>3</sup> mole<sup>-1</sup>.

### *Environmental fate and behaviour*

Based on the nature of the substance and the environmental partition coefficients calculated for the HPVC dodecylphenol, it can be expected that 2,4,6-tri-tert-butylphenol is poorly soluble in water, and will not be likely to volatilise. If released directly to the atmosphere, degradation will occur through hydroxyl radical attack. The most significant fate process for this substance on release to water or soil is likely to be adsorption to organic matter, and it is predicted to be relatively immobile in soil and in sediment. Degradation processes (biotic and abiotic) within these media are predicted to be slow and the substance is characterised in EUSES as 'not biodegradable' based on a ready biodegradability test result (MITI(I) test) in the OSPAR dataset. This value is included in the database on the CERI web-site<sup>5</sup>. Also on this site are results from a bioconcentration study with carp. Although details of the specific test with this substance are not available, a general description of the method used in the bioconcentration tests is available. These involved flow-through exposures for eight weeks, with monitoring of concentrations. Exposure was at two levels, for this substance 1 and 10 µg/l. The range of BCF values for 2,4,6-tri-tert-butylphenol is 4 830 - 16 000 (high concentration) and 4 320 - 23 200 (low concentration). From information on tests with other substances, it is likely that the lower values in each range relate to measurements at two weeks and the higher values relate to eight weeks.

A second experimental determination has been identified (Tadokoro and Tomita 1987<sup>6</sup>). Exposure took place in a flow through system over four weeks (preliminary tests showed that this was sufficient time to reach equilibrium). The exposure level was 13,9 µg/l, and both phases were analysed. The reported value for the bioconcentration factor is 2 524. This was for fish with 1% lipid content, described as a normalised BCF in the paper. An equation was derived to estimate the BCF at other lipid contents. For 5% lipid the BCF was 12 620.

The bioconcentration factor has also been estimated from the octanol-water partition coefficient. The SRC BIOWIN program (V2.14) gives a value of 3 282; the equation in the EU TGD gives a value of 34 600.

For both experimental studies the full details of the tests are not available. However the results are consistent with each other, and reasonably consistent with the predicted values from QSAR. All of these values suggest that appreciable bioaccumulation could occur.

### *Experimental toxicity test results*

Two experimental results for freshwater fish have been located for 2,4,6-tri-tert-butylphenol. The first is a 96-hour LC<sub>50</sub> value of 0,061 mg l<sup>-1</sup> for the fathead minnow (*Pimephales promelas*). This appears to be a valid study, based on the report available, and so the results are assumed to be appropriate for use. The second value is a 48 hour LC<sub>50</sub> value for killifish (*Oryzias latipes*) of 128 mg/l. This value is considerably higher than the solubility estimated above, and must therefore be treated with caution. Few specific details of the test are available.

### *QSAR-derived toxicity data*

In view of the limited aquatic toxicity test data set for this substance, information has also been generated for supporting purposes using the quantitative structure-activity relationships (QSARs) described in the main report (TGD and ECOSAR sources). The resulting data derived are given in Table B below.

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<sup>5</sup> CERI web-site at [www.cerij.or.jp/ceri\\_en/index\\_e.shtml](http://www.cerij.or.jp/ceri_en/index_e.shtml).

<sup>6</sup> Tadokoro, H and Tomita, Y (1987). The relationship between bioaccumulation and lipid content of fish. In: QSAR in Environmental Toxicology II, ed K.L.E. Kaiser, D Reidel Publishing Company, p363-373.



**Table B: Experimental and estimated (QSAR) aquatic toxicity data**

Trophic level (test type)	End point	Experimental concentration (mg l <sup>-1</sup> )	TGD QSAR-based concentration (mg l <sup>-1</sup> )	ECOSAR SRC QSAR-based concentration (mg l <sup>-1</sup> )
Freshwater fish (lethality test)	96 h LC <sub>50</sub>	0,061	0,07	0,122
Freshwater fish (chronic)	28-32 d NOEC	No data	No data	0,017
Freshwater invertebrates	48 h EC <sub>50</sub>	No data	0,17	0,309
Freshwater invertebrates (growth and reproduction test)	21 d NOEC	No data	No data	0,013
Fresh water algae	96 h EC <sub>50</sub>	No data	No data	0,033
Fresh water algae (growth inhibition)	72 - 96 h NOEC	No data	No data	0,035

The ECOSAR predictions for fish and Daphnia toxicity are made using equations derived from data on phenols. The ECOSAR algal predictions use equations derived from data on general chemicals. The TGD predictions use the equations for polar narcosis, which are applicable to phenols.

#### *Evaluation and use of QSAR data*

The QSAR data would appear to support the lower experimental value for freshwater fish. There is some uncertainty over the solubility of the substance, but the predicted toxicity values are below the selected solubility (recognising that this is a predicted value). The predicted toxicity values for fish are in agreement with each other and with the lower measured value, and the two predicted Daphnia toxicity values are similar.

In addition to predicting the effect concentrations for 2,4,6-tri-tert-butylphenol, the ECOSAR program was also used to predict effect concentrations for 2,4-di-tert-butylphenol and 2,6-di-tert-butylphenol as related compounds. For the 2,6 compound the predicted Daphnia acute value was 1,1 mg/l, compared to the measured value of 0,45 mg/l. For the 2,4- compound the values for acute fish toxicity were 1,8 mg/l (measured) and 0,23 mg/l (predicted). The predictions are of the same order of magnitude as the measured values.

In the light of the above discussion it is proposed to use the predicted values along with the measured value in the PNEC derivation.

#### *Calculation of PNEC<sup>7</sup><sub>aquatic</sub>*

The only experimental value available is for the fathead minnow, an acute 96-hour LC<sub>50</sub> of 0,061 mg l<sup>-1</sup>. In the absence of other data, values derived by QSAR have been used to fill the gaps for other trophic levels as follows:

Daphnid 48-hour EC<sub>50</sub> = 0,17 mg l<sup>-1</sup> (TGD)  
Green alga 96-hour EC<sub>50</sub> = 0,033 mg l<sup>-1</sup> (ECOSAR)

From these data, the lowest value is the algal 96-hour EC<sub>50</sub> of 0,033 mg l<sup>-1</sup> (derived by QSAR). This is very similar to the experimental fish value. Using an assessment factor of 1 000 with this value gives a

<sup>7</sup> Calculated according to the TGD.

$PNEC_{\text{aquatic}}$  of  $0,033 \mu\text{g l}^{-1}$ . For the marine risk assessment draft in the TGD, the assessment factor for three acute results is 10 000, which would give a marine  $PNEC$  of  $3,3 \text{ ng l}^{-1}$ .

*Calculation of  $PNEC_{\text{sediment}}$*

No toxicity data are available for sediment-dwelling species. The provisional  $PNEC_{\text{sediment}}$  calculated using the value for surface water and equilibrium partitioning is  $0,0334 \text{ mg kg}^{-1}$  wet weight.

*Food chain effects (secondary poisoning)*

2,4,6-tri-tert-butylphenol is not readily biodegradable and is likely to bioconcentrate in aquatic species. Only one mammalian toxicity study has been located which provided a No Observed Effect Concentration (in the diet) for this substance over the longer-term. This value was  $30 \text{ mg kg}^{-1}$  (diet) in the rat for liver effects seen over 2 years, and this was converted for use as oral NOAEL data. A  $PNEC_{\text{oral worm/fish}}$  of  $3 \text{ mg kg}^{-1}$  (using an assessment factor of 10). The quality and adequacy of the data are questionable as few details are available (the paper was only available as a detailed abstract).

## ANNEX 2: OSPAR FACT SHEET FOR 2,4,6-TRI-TERT-BUTYLPHENOL

0	<b>NAME</b>	<b>phenol, 2,4,6-tris(1,1-dimethylethyl)-</b>		<b>VERSION: 2002-04-15</b>
1	<b>IDENTIFICATION</b>			
1.1	<i>CasNo</i>	732263		
1.2	<i>EINECS/ELINCS</i>	211-989-5		
1.3	<i>Synonym</i>	2,4,6-tri-tert-butylphenol		
1.4	<i>Group/Function</i>	Pesticide		
1.5	<i>Initial selection</i>	<b>PBT</b> NSDB(I), QSAR-DK(V),		
1.6	<i>Prioritised for action</i>	Date: OSPAR 2000; Lead Country: United Kingdom; Background document: OSPAR 2003		
	<b>Parameter</b>	<b>Value</b>	<b>Source/Reference</b>	<b>Remarks</b>
2	<b>PHYSICAL/CHEMICAL PROPERTIES</b>			
2.1	<i>Molecular weight, g/mole</i>	262,44	QSAR-DK:	
2.2	<i>Water solubility, mg/l</i>	5,12E-01	QSAR-DK: EPIWIN 3.02	
2.3	<i>Vapour pressure, Pa</i>	2,67E-02	QSAR-DK: EPISUITE program MpBpVp v1.40	
3	<b>ABIOTIC/BIOTIC DEGRADATION PROPERTIES</b>			
3.1	<i>Abiotic OH-oxidation t<sup>1</sup>/<sub>2</sub> d</i>	0,669	QSAR-DK: EPIWIN 3.02	
3.2	<i>Photolysis t<sup>1</sup>/<sub>2</sub> d</i>			
3.3	<i>Ready Biodegradability</i>	0	Biodegradation and bioaccumulation data of existing chemicals based on the CSCL Japan. Ed. by Chemicals Inspection & Testing Institute Japan, Tokyo, Japan Chemical Industry Ecology-Toxicology & Information Center (JETOC), 1992.	not readily biodegradable (<20%)
3.4	<i>Half-life</i>			
3.5	<i>Inherent Biodegradability</i>			
3.6	<i>Biodeg-QSAR</i>	0,1866	QSAR-DK: BIOWIN1	not readily biodegradable (50-70%)
3.6		2,0392	QSAR-DK: BIOWIN3	
3.6		Not inherent	QSAR-DK: Interpretation of BIOWIN1 and BIOWIN3	not inherently biodegradable (20-70%)
3.6		0,2186	QSAR-DK: Environ.Tox.Chem. 18(8): 1763-1768. Environ.Tox.Chem. 19(10): 2478-2485. (Syracuse version of H. Loonen's Simca Fragment linear MITI model.)	not readily biodegradable (20-50%)

3.6		0,0497	QSAR-DK: Environ.Tox.Chem. 18(8): 1763-1768. Environ.Tox.Chem. 19(10): 2478-2485. (Syracuse version of H. Loonen's Simca Fragment non-linear MITI model)	not readily biodegradable (20-50%)
4	<b>BIOACCUMULATION/BIOCONCENTRATION</b>			
4.1	<i>logKow</i>	6	QSAR-DK: EPIWIN 3.02	high potential for bioaccumulation
4.1		6	Biodegradation and bioaccumulation data of existing chemicals based on the CSCL Japan. Ed. by Chemicals Inspection & Testing Institute Japan, Tokyo, Japan Chemical Industry Ecology-Toxicology & Information Center (JETOC), 1992.	high potential for bioaccumulation
4.2	<i>Bcf</i>	3 311	QSAR-DK: EPIWIN 3.02	high bioconcentration factor
4.2		23 200	Biodegradation and bioaccumulation data of existing chemicals based on the CSCL Japan. Ed. by Chemicals Inspection & Testing Institute Japan, Tokyo, Japan Chemical Industry Ecology-Toxicology & Information Center (JETOC), 1992.	very high bioconcentration factor
5	<b>AQUATIC TOXIC PROPERTIES</b>			
5.1	<i>Acute toxicity algae IC50, mg/l</i>			
5.2	<i>Acute toxicity daphnia EC50, mg/l</i>			
5.3	<i>Acute toxicity fish LC50, mg/l</i>	0,0609	Geiger, D.L., Brooke, L.T. and Call, D.J. (1990) Acute Toxicities of Organic Chemicals to Fathead Minnows xx s), Vol. 5 Center for Lake Superior Environmental Studies, University of Wisconsin, Superior, WI: 332 p. (Contains data also found in 1018)	very toxic (<0,1 mg/l)
5.3		128	Biodegradation and bioaccumulation data of existing chemicals based on the CSCL Japan. Ed. by Chemicals Inspection & Testing Institute Japan, Tokyo, Japan Chemical Industry Ecology-Toxicology & Information Center (JETOC), 1992.	low toxicity (100-1000 mg/l)
5.4	<i>Chronic toxicity daphnia NOEC, mg/l</i>			
5.5	<i>Chronic toxicity fish NOEC, mg/l</i>			
5.6	<i>Aquatox-QSAR</i>	0,17	QSAR-DK: Draft Advisory list for self-classification of dangerous substances 2001. Danish EPA p. 39. Acute fish, Danish EPA Multicase Acute LC50 Fathead Minnow model. <a href="http://www.mst.dk/activi/01050000.htm">http://www.mst.dk/activi/01050000.htm</a> .	very toxic (01-1 mg/l)
5.6		3,06	QSAR-DK: Acute Daphnia, Danish EPA Multicase Acute EC50 Daphnia model.	toxic (1-10 mg/l)
5.6		0,0646	QSAR-DK: Fish NOEC, Lethal Body Burden NOEC mg/l (A:C ratio 10:1) for fish based on EPIWIN 3.02 BCF	very toxic (<0,1 mg/l)
5.7	<i>Aquatic toxicity - other species</i>			

6	<b>HUMAN TOXIC PROPERTIES</b>		
6.1	<i>Acute toxicity</i>		
6.2	<i>Carcinogenicity</i>		
6.3	<i>Chronic toxicity</i>		
6.4	<i>Mutagenicity</i>		
6.5	<i>Reprotoxicity</i>		
7	<b>EXPOSURE</b>		
7.1	<i>Production Volume</i>	LPVC IUCLID:	10-1000
7.2	<i>Use/Industry Category</i>	FUEL INDUSTRY, FUEL ADDITIVES, OTHER: Automotive and industrial lubricant blending, LUBRICANTS AND ADDITIVES	Source: IUCLID
7.3	<i>Use in articles</i>		
7.4	<i>Environm.Occur. Measured</i>		(Compartment)
7.5	<i>Environm.Occur. Modelled</i>		(Compartment)
8	<b>EU-LEGISLATION</b>		
8.1	<i>Dir 67/548/EEC (Classification)</i>	Annex 1, Dir 67/548/EEC	
8.2	<i>Reg 793/93/EEC (Existing substances)</i>		
8.3	<i>Dir 2000/60/EEC (WFD)</i>		
8.4	<i>Dir 76/769/EEC (M&amp;U)</i>		
8.5	<i>Dir 76/464/EEC (water)</i>		
8.6	<i>Dir 91/414/EEC (ppp)</i>		
8.7	<i>Dir 98/8/EEC (biocid)</i>		
9	<b>ADDITIONAL INFORMATION</b>		
9.1	<i>Hazard assessment-OECD</i>		
9.2	<i>Other risk assessments</i>		

### ANNEX 3: MONITORING STRATEGY FOR 2,4,6-TRI-TERT-BUTYLPHENOL

As part of the Joint Assessment and Monitoring Programme (*reference number 2003-22*), OSPAR 2004 adopted an Agreement on monitoring strategies for OSPAR Chemicals for Priority Chemicals (*reference number 2004-15*) to implement the following monitoring for tracking progress towards the objectives of the OSPAR Hazardous Substances Strategy (*reference number 2003-21*) with regard to 2,4,6 tri-tert-butylphenol. The Monitoring Strategy for 2,4,6 tri-tert-butylphenol will be updated as and when necessary, and redirected in the light of subsequent experience.

The sources of 2,4,6 tri-tert-butylphenol are currently not well characterised. 2,4,6 tri-tert-butylphenol is believed to be a low tonnage chemical (less than 10 tonnes per annum) with its main use as a chemical intermediate. It is probably not manufactured and used in sufficient quantities to pose a significant concern to the open sea and is only likely to cause very local problems if indeed discharges do occur.

OSPAR will continue to work with industry to seek to develop a more accurate characterisation of production and use. OSPAR will also seek to estimate quantities of 2,4,6 tri-tert-butylphenol imported to, and exported from the OSPAR Convention Area.

With respect to the offshore industry OSPAR will organise an exchange of information on the presence of 2,4,6 tri-tert-butylphenol in resins used offshore in 2006.

No monitoring data is available, either in surface or marine waters and sediments, and no monitoring for 2,4,6 tri-tert-butylphenol appears to have been carried out in the OSPAR framework or in national or international programmes. Therefore, in order to establish whether the substance is actually found in the marine environment, OSPAR will carry out an exploratory one-off survey.

<b>2,4,6 TRI-TERT-BUTYLPHENOL MONITORING STRATEGY</b>	
<i>Implementation of actions and measures</i>	<ul style="list-style-type: none"> <li>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</li> </ul>
<i>Production/use/sales/figures</i>	<ul style="list-style-type: none"> <li>The lead country will seek more precise information on production and uses from industry</li> <li>Estimate quantities imported to, and exported from, the OSPAR region</li> </ul>
<i>Inputs from offshore industry</i>	<ul style="list-style-type: none"> <li>Exchange information on presence in resins used offshore</li> </ul>
<b>Maritime area:</b>	
<i>Concentrations in sediments</i>	<ul style="list-style-type: none"> <li>An exploratory one-off survey will be carried out</li> </ul>

## **ANNEX 4: EXCHANGE OF INFORMATION ON 2,4,6-TRI-TERT-BUTYLPHENOL IN RESINS**

As a follow up to the chapter “Choice for actions”, this annex summarizes the outcome of the exchange of information within the Offshore Industry Committee (OIC) on the presence of tri-*tert*-butylphenol as a production residue in resins and the possible effects of this.

### **Information exchanged**

Results of the following studies were presented at OIC 2004 and 2005 (OIC 05/3/9):

- a. The UK Department of Trade and Industry undertook a survey in 2004 to confirm the pattern of use of alkyl phenol (formaldehyde) resin (APR) on the United Kingdom continental shelf (UKCS);
- b. Studies commissioned by the European Oilfield Speciality Chemicals Association (EOSCA):
  - (i) Screen test for the presence of oestrogenic activity in chemicals for offshore use, 1999;
  - (ii) Testing 5 chemicals (oxyalkylated alkylphenolic resins) for oestrogenic activity, 2000;
  - (iii) A Review of the Degradation and Bioavailability of Phenol Formaldehyde Condensation Polymers (resins) as applied in the OSPAR Region;
  - (iv) Alkylphenol Based Demulsifier Resins and their Continued Use in the Offshore Oil and Gas Industry.

### **Conclusions of the studies**

APR chemistry was introduced in the offshore oil and gas industry around 1990, and represented a step-change improvement in primary demulsifier technology. Alkyl phenols are reacted with formaldehyde to form condensation polymers, popularly referred to as resin demulsifiers. These products offered low ecotoxicity and, at that time, there were no concerns associated with their use. Since then, the move to a precautionary approach has led to some concerns about their use, on the grounds that they may contain, or degrade to, their precursors, the alkyl phenol ethoxylates, which have been reported as potential endocrine disruptors.

The United Kingdom survey showed that alkylphenol formaldehyde resins were present in a number of demulsifier formulations used on the UKCS, and were considered to be particularly important for the processing of certain types of oil. All of the operators currently using APRs confirmed that they were aware of the unsubstantiated concerns relating to their use, and that they had investigated alternative chemistries. The survey indicated that:

- a. alkyl phenol formaldehyde resins currently represent the best available chemistry to treat heavier cold crudes (i.e. crude oils) with a relatively high water cut (i.e. water content), and;
- b. that alternative chemistries offer no net environmental benefit, and may result in increased chemical use and discharge, greater environmental impact and increased operating costs.

The EOSCA studies indicated that:

- a. alkyl phenol formaldehyde resins do not exhibit endocrine disrupting properties;
- b. the resins do not contain any un-reacted precursors;
- c. it is unlikely that the resins would degrade to the precursors in the operating environments of offshore production;
- d. there is no evidence that alkyl phenol formaldehyde resins are environmentally damaging.

The United Kingdom chemical and offshore industries would continue to investigate alternative chemistries. The results of those investigations and the results of any further ecotoxicological studies relating to alkyl phenol formaldehyde resins would be reported to OIC.