Hazardous Substances Series

Trichlorobenzenes

OSPAR Commission

2005 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.

ISBN 1-904426-10-7
Publication Number: 2005/170

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EXECUTIVE SUMMARY

Trichlorobenzenes are cyclic aromatic compounds formed by the addition of 3 atoms of chlorine to the benzene ring. There are 3 isomers: 1,2,3-trichlorobenzene (1,2,3-TCB), 1,2,4-trichlorobenzene (1,2,4-TCB) and 1,3,5-trichlorobenzene (1,3,5-TCB). TCBs are not readily biodegradable and very toxic to aquatic organisms and may cause long term adverse effects in the aquatic environment. The bioaccumulation potential is very high. Furthermore, recent reports have shown that TCBs have reproductive and endocrine disrupting effects and therefore TCBs have been included in the EU List of Substances with Suspected Endocrine Effects.

The EU production of TCBs was estimated 7 000-12 000 tonnes in 1994. 50 - 80% of the amount of TCBs produced is exported outside Europe. Industry predicts that in 2003 the EU production will not exceed 4 000 tonnes. The mixture of the three isomers and 1,2,4-TCB are used as an intermediate for the production of herbicides, pigments and dyes (79%), as a process solvent (14%) or as a dye carrier, a process regulator (additive or lubricant) (7%). 1,2,3-TCB is used as an intermediate for pesticide production, as a solvent, as a dye carrier or as a heat transfer medium. 1,3,5-TCB is not marketed commercially.

TCBs can be released to the environment directly from production, from their uses, final treatment and waste disposal (e.g. leakage from landfills) and through other sources such as combustion of plastics, degradation of higher chlorinated benzenes. TCBs have been detected in fresh water in concentrations lower than 0,4 µg/l, whereas concentrations from 0,002 – 0,007 µg/l were detected in marine waters in open sea areas and concentrations from 0,02 – 0,03 µg/l in dispersion zones of rivers or important waste water treatment plants. High TCB-concentrations have been detected occasionally in river sediment on specific locations. The available monitoring data in the marine environment and marine biota were evaluated but due to the lack of knowledge on occurrence in the marine environment the need for further monitoring of TCB-concentrations in sediment and biota is recommended.

The action recommended is: the lead countries for TCBs (Belgium and Luxembourg) to develop a proposal for a monitoring strategy; the EU Advisory Committee for the IPPC Directive and the European Polluting Emissions Register (EPER) to consider in their work on monitoring the case for monitoring TCBs as specific substances in water; the lead countries for polychlorinated biphenyls (PCBs) (Belgium and Germany) to report in their revision on the PCB background document on the current situation on substitution of PCBs in transformers with TCBs; Contracting Parties to consider the requirements for investigation of remediation needs of sites historically acting as TCB sinks; the rapporteur within the EU on TCBs (Denmark) to present this background document to the appropriate EU meeting as a contribution to the risk assessment of these substances; OSPAR Contracting Parties that are also EU Member States to support the development of appropriate measures to control discharges, emissions and losses of TCBs through the implementation of the Water Framework Directive; the OSPAR lead countries for examining BREFs on fine chemicals and the textile industry (respectively the Netherlands and Belgium) to seek to ensure that those BREFs take appropriate account of the conclusions of this background document, and to report to OSPAR on this in their reports on these BREFs; 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 trichlorobenzenes is attached to this background document.

RECAPITULATIF

Les trichlorobenzènes sont des composés aromatiques cycliques formés en ajoutant 3 atomes de chlore à l'anneau de benzène. Il en existe trois isomères: 1,2,3-trichlorobenzène (1,2,3-TCB), 1,2,4-trichlorobenzène (1,2,4-TCB) et 1,3,5-trichlorobenzène (1,3,5-TCB). Les TCB ne sont pas directement biodégradables, sont très toxiques pour les organismes aquatiques, et sont susceptibles d'avoir des effets préjudiciables de longue durée dans le milieu aquatique. Leur potentiel de bioaccumulation est très élevé. De plus, de récents rapports ont démontré que les TCB perturbaient la reproduction et le système endocrinien, d'où le fait qu'ils aient été inscrits sur la Liste communautaire européenne des substances suspectes d'avoir des effets sur le système endocrinien.

En 1994, la production de TCB était estimée se situer entre 7 000 et 12 000 tonnes. De 50 à 80 % de la production est exportée en dehors de l'Europe. L'industrie prévoit qu'en 2003, la production de l'Union européenne ne dépassera pas 4 000 tonnes. Le mélange des trois isomères et le 1,2,4-TCB sont utilisés comme des intermédiaires dans la fabrication d'herbicides, de pigments et de teintures (79 %), comme solvants dans les procédés (14 %) ou comme vecteurs de teinture, et enfin comme régulateurs de procédé (adjuvants ou lubrifiants) (7 %). Le 1,2,3-TCB sert d'intermédiaire dans la fabrication de pesticides, comme solvant, comme vecteur de teinture ou comme médium de transfert de chaleur. Le 1,3,5-TCB n'est pas commercialisé.

Les TCB peuvent être libérés dans l'environnement directement à la fabrication, du fait de leurs utilisations, du traitement final et de l'élimination des déchets (p.ex. du fait des fuites dans les décharges) ainsi que par d'autres sources telles que la combustion des matières plastiques ou la dégradation de benzènes à taux de chlore plus important. Des TCB ont été décelés dans l'eau douce à des teneurs inférieures à 0,4 µg/l, tandis que des teneurs de 0,002 à 0,007 µg/l ont été détectées dans les eaux de zones de haute mer, et des teneurs de 0,02 à 0,03 µg/l dans des zones de dispersion des eaux fluviales ou dans de grandes stations d'épuration des eaux usées. L'on a parfois décelé de hautes teneurs en TCB dans les sédiments fluviaux en des lieux précis. Bien que les données disponibles du fait de la surveillance exercée dans le milieu marin et dans le milieu vivant marin aient été évaluées, du fait de l'absence de connaissances que l'on a de sa présence dans le milieu marin, il est recommandé de continuer à surveiller les teneurs en TCB dans les sédiments et le milieu vivant.

Les actions recommandées sont les suivantes : que les pays pilotes (Belgique et Luxembourg) élaborent un projet de stratégie de surveillance continue ; que le Comité consultatif de l'Union européenne, chargé de la Directive IPPC et du Registre européen des émissions polluantes (EPER) envisagent d'intégrer à leur mission de surveillance celle des TCB comme des substances spécifiques dans l'eau; que les pays pilotes chargés des polychlorobiphényles (PCB) (Belgique et Allemagne) rendent compte, dans la nouvelle version du document de fond sur les PCB, de l'état actuel de la substitution des PCB dans les transformateurs par des TCB; que les Parties contractantes considèrent les études de restauration qu'il y a lieu de faire sur les sites servant historiquement de puisards à TCB ; que le rapporteur chargé des TCB au sein de l'Union européenne (Danemark) présente le présent document de fond à la réunion appropriée de l'Union européenne, à titre de contribution à l'évaluation des risques suscités par ces substances ; que les Parties contractantes à OSPAR qui sont également des Etats membres de l'UE apportent leur soutien à l'élaboration de mesures propres à combattre les rejets, émissions et pertes de TCB, ceci par la mise en application de la Directive-cadre sur l'eau ; que les pays pilotes OSPAR chargés d'examiner les BREF portant sur les produits chimiques fins et sur l'industrie des textiles (respectivement, les Pays-Bas et la Belgique) s'efforcent de faire en sorte que ces BREF tiennent dûment compte des conclusions du présent document de fond, et rendent compte de ce point à OSPAR dans les rapports qu'ils présenteront sur ces BREF ; 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 les trichlorobenzènes est jointe à ce document de fond.

1. COMMONLY USED ABBREVIATIONS

1,2,3-TCB	1,2,3-trichlorobenzene
1,2,4-TCB	1,2,4-trichlorobenzene
1,3,5-TCB	1,3,5-trichlorobenzene
DCB	dichlorobenzene
WHO	World Health Organisation
HSDB	Hazardous substances database
TRI	Toxic release inventory by US Environmental Protection Agency
EU RAR	EU risk assessment report on 1,2,4-trichlorobenzene
POP	persistent organic pollutant
γ-HCH	gamma hexachlorohexane, lindane
PTB	persistent, toxic and bioaccumulative
LC50	concentration in the environment lethal to 50% of the population.
EC50	concentration in the environment where an effect can be observed in 50% of the population.
pTCA	provisional tolerable concentration in air
STP	sewage treatment plant
TDI	tolerable daily intake
PEC	predicted environmental concentration
PNEC	predicted environmental no effect concentration

2. INTRODUCTION

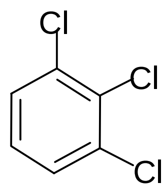
The three isomers of trichlorobenzene (TCB) 1,2,3-TCB, 1,2,4-TCB and 1,3,5-TCB were selected as chemicals for priority action at the meeting of the OSPAR Commission held in Copenhagen in June 2000. TCBs were prioritised on the basis of their intrinsic properties, high production and use volumes and their occurrence in surface water.

The three isomers of TCBs are chlorinated cyclic aromatic compounds with moderate volatility, have slight to moderate water solubility and moderate to high octanol-water partition coefficients (CEPA, 1993). TCBs are likely to bioconcentrate. 1,2,4-TCB is economically the most important isomer. TCB is used as an intermediate in chemical synthesis, as a solvent, a coolant, a lubricant and a heat-transfer medium. It is also used in polyester dying, in termite-control preparations and as insecticide. TCBs are rather stable in the environment as they are not hydrolysed and are unlikely to biodegrade significantly. They do not leach appreciably into groundwater (WHO, 1996).

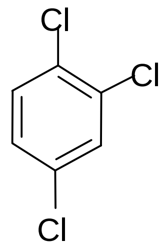
2.1 Physical, chemical and toxicological properties

Trichlorobenzenes are cyclic aromatic compounds formed by the addition of 3 atoms of chlorine to the benzene ring. There are 3 isomers: 1,2,3-trichlorobenzene (1,2,3-TCB), 1,2,4-trichlorobenzene (1,2,4-TCB) and 1,3,5-trichlorobenzene (1,3,5-TCB). Commercial trichlorobenzene was available as a mixture of three isomers or as pure 1,2,3- and 1,2,4-TCB respectively. Currently, only the two pure isomers are produced in EU.

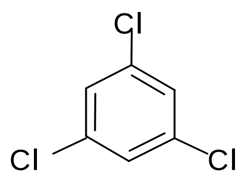
1,2,3-trichlorobenzene (CAS number: 87-61-6)
1,2,3-TCB is a white crystalline solid at room temperature. The solubility in water is poor (12,2 mg/litre at 25°C), flammability is low, the octanol/water partition coefficient is high (log 4,04) and the vapour pressure is moderately low (17,3 Pa at 25°C). The Henry's Law constant is low (0,306 kPa m^3/mol) and the soil sorption is high (3 680 Koc) (WHO, 1991).



1,2,4-trichlorobenzene (CAS number: 120-82-1)
1,2,4-TCB is a colourless liquid at room temperature. The solubility in water is poor (45,3 mg/litre at 25°C), flammability is low, the octanol/water partition coefficient is high (log 3,98) and vapour pressure is moderately low (45,3 Pa at 25°C). The Henry's Law constant is low (0,439 kPa m^3/mol), and the soil sorption is high (2 670 Koc) (WHO, 1991).



1,3,5-trichlorobenzene (CAS number: 108-70-3)
1,3,5-TCB is a white crystalline solid at room temperature. The solubility in water is poor (3,99 mg/litre at 25°C), flammability is low, the octanol/water partition coefficient is high (log 4,02), vapour pressure is moderately low (24,0 Pa at 25°C). The Henry's Law constant is low (0,233 kPa m^3/mol), (WHO, 1991), . Measured log Koc values for 1,3,5-TCB of 2,8 and 3,2 were reported in soil (HSDB, 2000).



In general, chlorobenzenes released into the aquatic environment will be redistributed preferentially to the air and to sediment (particularly organically rich sediments). Retention of chlorobenzenes in soil increases with the organic content of the soil. Trichlorobenzene is found to have low mobility and to biodegrade slowly in soils (WHO, 1991).

Toxicology
Most of the data on TCBs is restricted to 1,2,4-TCB, the most widely used isomer. There are no epidemiological studies of exposed populations (RIVM, 2001; WHO, 1991).

In a multigeneration reproductive study with 1,2,4-TCB in rats fertility was not affected. The study was administered in drinking water; study ended at 32 days of age of the F2 generation (Robinson et al., 1981).

No evidence of teratogenic effects was reported when rats were given oral doses up to 600 mg/kg bw/day of either 1,2,3-, 1,2,4- or 1,3,5-TCB on days 6-15 of gestation. The toxicity of chlorobenzenes for micro-organisms, invertebrates and fish are comparable.

None of the TCB-isomers was mutagenic (RIVM, 2001).

TCBs are not considered to express systemic genotoxic effects in vivo, in line with the conclusions of IPCS (1991) and WHO (1996) (RIVM, 2001).

Only 1,2,4-TCB has been tested for carcinogenic effects (RIVM, 2001). The results do not fulfil the criteria for classification for carcinogenicity according to EU classification criteria (EU RAR, 2003).

Studies on mammals indicate that all TCBs have an effect on the liver and the blood system, but are not to be expected carcinogenic, teratogenic or mutagenic (HSDB, 2000). Some toxicity values are listed in the following table.

Table 1: Short term toxicity of fish in brackish and marine environments (IUCLID, 2000)

Species	**Environment**	**Exposure**	**LC_{50}**	**Validity***
Cyprinodon variegatus	estuary, marine	24-72 h	> 47 mg/l	2
		96 h	21 mg/l	2
Salmo gairdneri	estuary, freshwater	48 h	1,95 mg/l	1
		96 h	4,2 mg/l	2
		96 h	1,3 mg/l	1
		96 h	1,32 mg/l	1

* 1: valid without restrictions - 2: valid with restrictions

Table 2: Short term toxicity of other organisms (extracted from EU RAR, 2003)

Species	**EC_{50}**
Crustaceans	0,45 – 3,39 mg/l
Algae	1,4 – 18,9 mg/l

RIVM concluded that the available data do not provide evidence for the mutagenicity or carcinogenicity of TCBs, in line with IPCS (1991) and WHO (1996) (RIVM, 2001).

For oral exposure, the WHO derived its tolerable daily intake (TDI) of 7,7 µg/kg bw for total TCBs (WHO, 1996).

IPCS based its oral limit value (a rounded value of 20 µg/kg bw/day) on all three isomers (IPCS, 1991).

CEPA based its TDIs for 1,2,4-TCB (2,3 µg/kg bw/day) and 1,3,5-TCB (1,0 µg/kg bw/day) on the results of inhalation studies which are considered to be the most relevant exposure route (CEPA, 1993).

For 1,2,3-TCB, CEPA derived a TDI of 0,77 µg/kg bw/day (CEPA, 1993).

US-EPA derived its oral limit value for 1,2,4-TCB of 10 µg/kg bw/day.

For inhalation exposure, limit values were derived by IPCS. IPCS estimated limit values of 0,2 mg/m^3 for 1,3,5-TCB, and 0,05 mg/m^3 for 1,2,4-TCB (IPCS, 1991).

The Dutch Expert Committee on Occupational Standards (DECOS) derived a MAC value (maximum acceptable concentration) for TCBs of 15,1 mg/m^3 (2 ppm); the 15 minutes time-weighted average MAC value is 37,8 mg/m^3 (5 ppm).

Conclusion: for all 3 TCB isomers (RIVM, 2001):

TDI	8	µg per kg body weight per day.
pTCA	50	µg per m^3
Background exposure	< 0,04	µg per kg body weight per day.

2.2 Risks for human health and the environment

By the end of 2002 the number of known producers of TCBs in Western Europe was limited to only one producer. The direct exposure to workers and the environment during production of TCB is very limited. The remaining producer does however not sell TCB directly to retailers, but only to producers of intermediate where exposure risks for workers are negligible at present.

Adverse effects due to repeated dose toxicity after inhalation and/or dermal exposure can not be excluded for workers (or consumers) involved in the production of TCB, the production of TCB containing products or using TCB-containing products. It should be noted that it is uncertain whether these products are in fact used at all by consumers.

Long term exposure of workers has shown liver problems and development of blood diseases such as anaemia (HSDB, 2000).

Trichlorobenzenes are compounds which are not readily biodegradable. The most likely degradation mechanism being photochemical reactions and microbial action. Soils that are rich in organic matter and aquatic sediments are probably the major environmental sinks for these compounds.

The use of TCB may cause local problems for aquatic organisms in the proximity of releases. Further away from the point of release, the availability of TCB for bio-accumulation is expected to be low, since TCB will preferably be transferred to the air and the soil (see section 3.4).

In general, studies have indicated that there is no significant difference in pollution tolerance in organisms in a marine environment and in organisms in a freshwater environment. This is only valid for organisms tested in their own environment (personal communication, Prof. dr. ir. R. Merckx, 1994). This is in line with the conclusion drawn in the recently revised TGD[1] which is that no marked difference in sensitivity between freshwater and saltwater biota appears. However, the TGD further implies that due to greater species diversity in the marine environment, compared to freshwaters, higher assessment factors than for freshwaters should be applied, to reflect the greater uncertainty.

Since TCB is suspected to have a PBT-borderline profile and perhaps POP-like properties, risks for long distance exposure cannot be excluded. These risks will be discussed in section 4.3.

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1 The EU Technical Guidance Document (TGD) was revised and has been published in April 2003 on the web site of the European Chemicals Bureau. It contains a new chapter on marine risk assessment and criteria for the assessment of persistence, bioaccumulation potential and toxicity (PBT) of substances, which may pose a risk for the marine environment. This risk assessment methodology has been formally agreed by the EC in April 2003 and has been adopted by the OSPAR Commission in June 2003 as the common EU/OSPAR risk assessment methodology for the marine environment.

TCB has recently been reported to be a chemical having reproductive and endocrine disrupting effects and was included in the EU candidate list of substances with suspected endocrine effects; however, TCB is categorised as a substance with insufficient data to allow an identification of endocrine disruption or potential for endocrine disruption (EU, 2001).

Metabolites of TCB (DCB) can have an endocrine disruptive effect on human and wildlife (personal communication, 2002, Prof. Comhaire, University of Ghent).

In the EU RAR (2003) it was proposed that the substance should be classified as follows:

Table 3: TCB-classification

R22	Harmful if swallowed
R50-53	very toxic to aquatic organisms, may cause long term adverse effects in the aquatic environment
R38	Irritating to skin
Xn	Harmful
Xi	Irritant
N	dangerous for the environment

Currently, TCB has not been identified by the FAO/UNEP as a hazardous chemical under the Prior Informed Consent (PIC)-Convention, an international binding regulation for the control of international trade with specific hazardous chemicals.

3. IDENTIFICATION OF SOURCES AND PATHWAYS TO THE MARINE ENVIRONMENT[2]

3.1 Production

Several production methods exist. The most important are direct chlorination of benzene and cracking of hexachlorocyclohexane. All processes result in a mixture of all isomers and higher and lower chlorinated benzenes and separation by distillation is necessary. In the past, TCB was commercially available as a mixture of all 3 isomers or as 1,2,4-TCB, 1,2,3-TCB, 1,3,5-TCB and other chlorinated benzenes are considered as by-products.

Table 4: Repartition of 3 isomers

1,2,4-TCB	85%
1,2,3-TCB	15%
1,3,5-TCB	< 1%

There is only one producer known in Western Europe: Bayer AG in Germany. Esar and Rhodia (now Atofina) in France ceased their production in 2002.

From December 1999 to November 2001, IHOBE, the Public Society for the Environmental Management depending of the Bask Government, produced 1,072 tonnes of TCB through cracking of HCH. IHOBE is

2 Natural sources of trichlorobenzenes in the global environment have not been identified.

a waste management company and their production of TCB was in fact a remediation of lindane-waste. All TCB produced was exported to India. IHOBE ceased their production in November 2001 (IHOBE, 2001).

The EU production of 1,2,4-TCB in 1994 was estimated at 7 000-10 000 tonnes. The production of 1,2,3-TCB was estimated to be less than 2 000 tonnes, and of 1,3,5-TCB less than 200 tonnes. 50 - 80% of the amount of TCBs produced is exported outside Europe (EU RAR, 2003).

Table 5: Production, import and export of trichlorobenzenes in Western Europe

Tonnes	1983	1988	1993	1995	2003*
Production	17 000	14 000	9 000	6 000	4 000
Imports	500	-	-	-	-
Exports	7 000	7 000	5 000	3 500	3 000

* Bayer forecast.

3.2 Uses

The mixture and 1,2,4-TCB is used as an intermediate for the production of herbicides, pigments and dyes (79%), as a process solvent (14%) or as a dye carrier (7%). 1,2,3-TCB is used as an intermediate for pesticide production, as a solvent, as a dye carrier or as a heat transfer medium. 1,3,5-TCB is not marketed commercially. The only remaining producer in the OSPAR area has stopped the delivery of TCB for all other uses other than but as for use as an intermediate.

Table 6: Use estimation per category in 1996

Use	1,2,4-TCB
Intermediate	1 100 tonnes
Process solvent	200 tonnes
Dye carrier	1,4 tonnes
Process regulator	98,6 tonnes

Trichlorobenzene was often used as a dye carrier in textile industries for temperature sensitive textiles such as wool and polyester/wool blends. Carriers are absorbed to a great extent onto the polyester fibres. They improve fibre swelling and encourage colourant migration. During dyeing and rinsing, a significant amount of carriers is however emitted to waste water. The fraction that remains on the fibre may be emitted to air during subsequent drying and heatsetting or even remain on the fibre. The application of high temperature-dyeing processes avoids the use of carriers. This technique is currently widely applied when dyeing pure polyester and wool-free polyester blends. However, due to the sensitivity of the wool substrate to high temperatures, it is still necessary to use carriers when dyeing polyester blends and, in particular, polyester/wool blends (EU BREF Textiles Industry, 2003).

According to textile branch federations, TCB is more and more replaced by dichlorotoluene. In Belgium it is not used in the textile industry since 1995 (Centexbel, 2001).

Based on information from industry, the "Scientific Committee for Toxicity, Ecotoxicity, and the Environment" states that the substance is no longer used in the textile industry in the EU. A recent project in Denmark from 2000 shows, that both 1,2,3-TCB and 1,2,4-TCB were found in textiles (certain trousers made of polyester/wool). However, it is not known whether the textiles were imported or produced in the EU (EU, 2002).

TCB has been used on a widespread basis as an additive to polychlorinated biphenyls (PCBs) for insulating and cooling dielectric fluids. The content of TCB in dielectric fluids was in between 20 and 40%. The use for transformer fluid production is stated to have been discontinued in Germany since 1984, but the use of older equipment containing TCB still occurs (personal communication of the Belgian Federal Department for Environment, 1999).

Minor uses for which the exact amount used today is unknown may include:

- metal working/cutting fluids;
- anti-corrosive paint and maintenance products;
- corrosion inhibitor in sprays;
- additive in the manufacturing of high performance insulation for use in wire and cable products;
- as a blend in the production of a brightener solution for use in lead/tin plating baths.

It can not be excluded that the following former uses of TCB may still be relevant in the EU:

- in degreasing agents;
- in septic tanks;
- in drain cleaners;
- in wood preservatives;
- in abrasive formulations;
- as a termite exterminator;
- dry cleaning.

For several years, the policy of Bayer AG is to produce TCB for use as an intermediate only. There are two major uses as an intermediate: 1,2,3-TCB for the production of the herbicide aclonifen in France, and 1,2,4-TCB for the production of the herbicide dicamba in the USA. Further, there are only a few customers that use TCB as an intermediate for other chemicals (below 1% of the total volume). Bayer AG asks all its customers for written use-statements.

3.3 Sources of emissions and discharges

TCBs can be released to the environment in four different ways:

- directly from production;
- from uses;
- from final treatment and waste disposal (e.g. leakage from landfills);
- from other sources as a side-effect, such as combustion of plastics, degradation of higher chlorinated benzenes.

During production most releases can be expected due to accidental spilling during filling of barrels for transport of the end product.

Where TCB is used as an intermediate or in textile dyeing (open use), most of the releases will be deviated to the wastewater and consequently to the sewage treatment plant (STP).

Current uses of TCB as a dye carrier are expected to disappear gradually in the coming years in Europe.

The amounts of releases resulting from:

- degradation processes of higher chlorinated hydrocarbons, especially lindane and hexachloro-benzene;
- landfills and contaminated sites;
- imported goods (e.g. textiles) containing TCBs

are unknown. Releases may be however significant.

3.4 Pathways to the marine environment

If TCBs reach the aquatic environment through industrial discharges or pesticide use, they will preferably evaporate to the air or adsorb to sediments.

TCB has a high adsorption potential and the mobility in soil is expected to be low. However, because the degradation is slow in soil, TCB may leach through sandy soils which have a low organic carbon content and may therefore reach groundwater in the longer term (EU RAR, 2003).

The volatilisation of TCB in clean water may be high but will be reduced in natural surface water according to the depth of the water body, possible stratification or turbulence of the water body and the content of dissolved organic carbon (DOC) and particulate organic carbon (POC). The volatilisation from soil and sludge is slow due to adsorption to organic carbon.

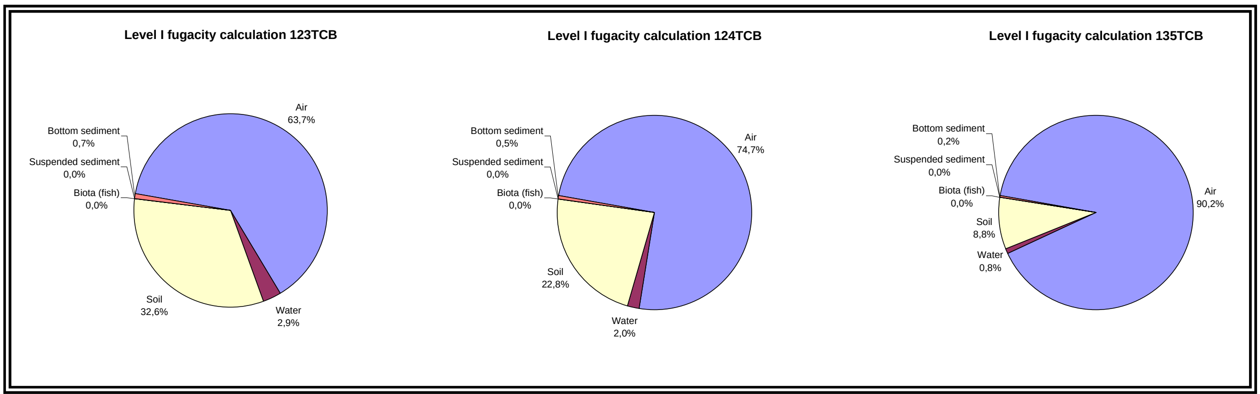
In marine waters, the dissipation of trichlorobenzenes is assumed to be primarily dissipation by volatilisation and not biodegradation (EU RAR, 2003).

According to the fugacity model of Mackay, trichlorobenzenes preferably move to the air and soil compartment. Distribution percentages are shown in the figure below. The parameters used for this model can be found in Annex 1.

Table 7: Level I fugacity calculation

Compartment	1,2,3-TCB	1,2,4-TCB	1,3,5-TCB
Air	63,72%	74,69%	90,22%
Water	2,93%	2,04%	0,79%
Soil	32,61%	22,75%	8,79%
Biota (fish)	0,00%	0,00%	0,00%
Suspended sediment	0,02%	0,02%	0,01%
Bottom sediment	0,72%	0,51%	0,20%

Figure 1: Level I fugacity calculation by Mackay model



From the fugacity calculation, it can be assumed that river sediment could be a pathway to the marine environment.

4. MONITORING DATA, QUANTIFICATION OF SOURCES AND ASSESSMENT OF THE EXTENT OF THE PROBLEM

4.1 Monitoring data

According to the responses to a questionnaire, it appeared that only a few OSPAR Contracting Parties have included TCB in their national monitoring programmes. When TCB is monitored regularly, it has only been detected in very low concentrations or not at all. In the USA, monitoring data available from the US EPA Toxic Release Inventory show that the overall releases of 1,2,4-TCB are decreasing, but the discharges to water are increasing. This can however be due to a higher number of discharge points detected and not an increase in releases as such. One of TCB producers in the USA closed in 2002.

Within the International Commission for the Protection of the Rhine monitoring data on 1,2,3-TCB, 1,2,4-TCB and 1,3,5–TCB were collected from 1990 up till 1999. All 3 isomers of TCBs were systematically monitored since 1991 in the river Rhine (IKSR, 1999).

4.1.1 Concentrations in the environment

Within the COMMPS-database monitoring data for surface water and sediments were collected. There is little data available on 1,2,3-TCB and 1,3,5-TCB. Other results were extracted from the 1,2,4-TCB EU RAR, published in 2003, in particular recent Belgian monitoring data and data from the International Commission for the Protection of the Rhine.

SURFACE WATER

All TCB-isomers
From the IKSR report (Section 7.1 – Vergleich des Istzustandes des Rhein 1990 bis 1999 mit Zielvorgaben), an important number of monitoring data is available, showing concentrations significantly below 0,1 µg/l for all 3 isomers (IKSR, 1999).

1,2,4-TCB
A peak concentration of 1,3 µg/l was detected in 1998 in Greece in the river Axios. All other concentrations detected in Germany, Greece, the Netherlands and Great Britain from 1994 until 1998 were lower than 0,4 µg/l. However, 87% of the 1 201 samples taken in Germany were reported to be lower than the detection limit. Detection limits vary from 0,6 to 70 ng/l.

Recent monitoring data (1998-2000) in Flanders show 2 positive samples out of 568 with TCB concentrations of 0,33 and 2,16 µg/l.

1,3,5-TCB
A peak concentration of 0,27 µg/l was detected in 1997 in Greece in the river Bistoni. All other concentrations detected in Germany and Greece from 1994 until 1998 were lower than 0,06 µg/l. However, 96% of the 1 187 samples taken in Germany were reported to be lower than the detection limit. Detection limits vary from 0,5 to 60 ng/l.

1,2,3-TCB
Recent monitoring data (1998-2000) in Flanders don't show values above the detection limit in 568 samples.

SEAWATER

Ranges from 0,002 – 0,007 µg/l were detected in open sea and higher concentrations (0,02 - 0,03µg/l) in the dispersion zones of rivers or important sewage treatment plants.

GROUNDWATER

No recent data are available; however two decades ago, concentrations were found at or below the detection limit (< 0,001 µg/l).

SUSPENDED MATTER

In German rivers concentrations were detected in the range of 5 - 145 µg/kg dw.

In the mouth of the river Scheldt, the following concentrations (µg/kg d.w.)were measured from 1998-2000:

Isomer	**1,2,3-TCB**	**1,2,4-TCB**	**1,3,5-TCB**
Maximum	16	48	3,8
Mean	2,9	11,0	1,9
Median	2,7	4,8	2,0

SEDIMENT

1,2,4-TCB
Levels of TCB range from less than 1 µg/kg dw sediment to more than 200 µg/kg dw. In general a reduction is observed in more recent data, except for measurements from highly polluted areas (e.g. harbours). This latest observation means that TCB is not only released from production sites, but also from downstream uses. Of particular interest is the lake Ketelmeer (Netherlands, Rhine estuary) where depth sampling performed in 1994 demonstrated concentrations of 70 µg/kg dw in 1985-layers and 240 µg/kg dw in 1960-layers.

Peak concentrations of 2 700 µg/kg and 785 µg/kg were detected in 1994 and 1996 respectively in the river Elbe near Dessau in Germany. All other concentrations detected in Germany, Denmark, the

Netherlands and France from 1994 until 1998 were lower than 60 µg/kg. In Germany, 687 samples were registered in the COMMPS database and only 26% of them were reported to be lower than the detection limit. However, 90% of the samples taken were reported to be lower than 5 µg/kg.

1,2,4-TCB concentrations ranging from 10–270 µg/kg dw sediment were detected in 20 out of 120 samples in a recent monitoring project in Flanders (1999-2000). It should be noted that all samples were taken downstream of important industrial activities.

1,2,3-TCB
1,2,3-TCB concentrations ranging from 0,01 – 0,06 mg/kg sediment were detected in 18 out of 125 samples in this monitoring project in Flanders (see above). It should be noted that all samples were taken downstream of important industrial activities.

1,3,5-TCB
In Germany peak concentrations of 460 and 451 µg/kg were detected respectively in 1994 and 1996 in the river Elbe near Dessau. In the COMMPS database 742 samples were registered of which only 46% were reported to be lower than the detection limit. However, 90% of the samples taken were reported to be lower than 32 µg/kg.

MUNICIPAL WASTEWATER TREATMENT PLANTS

Mostly historical data are available, reflecting previous uses. Recent data demonstrate that the contribution to the TCB-load originating from municipal sewage treatment plants is significant where also industrial wastewater is treated.

INDUSTRIAL WASTEWATER TREATMENT PLANTS

Ranges from 10-300 µg/l are observed with possible peak concentration for specific industries such as textile mills and electronic industry in the early 80's. Also for this segment a decreasing tendency is expected.

Recent monitoring data in the Flemish Region (2001) identified a significant presence of the 3 isomers in different industrial effluents.

4.1.2 Concentrations in marine biota

There are only few monitoring studies on marine biota. An overview of the data found is given in Table 8.

Table 8: TCB concentrations in marine biota

Location	Species	Year	Tissue	Concentration	Ref	Environment
Slovenia, Gulf of Trieste	Trout (*Salmo Trutta*)	1978	muscle	1 µg/kg fat	EU RAR	brackish + marine
	Whiting (*Leuciscus cephalus*)	1978	muscle	15 µg/kg fat	EU RAR	brackish
	Pilchard (*Sardina pilchardus*)	1978	muscle	7 µg/kg fat	EU RAR	brackish
Calcasieu Estuar, Lousiana, USA	Atlantic croaker (*Micropogonias*)	1988	?	2,3 µg/kg fat	IUCLID	brackish + marine
	Blue Crab (*Callinectes*)	1988	?	3,2 µg/kg fat	IUCLID	
	Spotted sea trout (*Cynoscion*)	1988	?	0,14 µg/kg fat	IUCLID	marine
	Blue catfish (*Ictalurus furcatus*)	1988	?	1,9 µg/kg fat	IUCLID	brackish
Bayou, Louisiana, USA	Blue catfish (*Ictalurus furcatus*)	1988	?	3,9 µg/kg fat	IUCLID	brackish

The results show that concentrations of TCBs are higher in biota living in a brackish environment than in biota living in the marine environment. This may prove that TCBs move to the sediments of rivers, as they migrate to the sea. This pathway could give the explanation how TCBs enter the food chain and consequently be taken up by other species and humans.

4.1.3 Conclusion on monitoring data

The two major conclusions are the following:

- although some marine monitoring data have been retrieved, in order to evaluate the concentrations in the marine environment and marine biota, the monitoring data are considered not representative;
- high TCB concentrations have been detected occasionally in river sediment on specific locations.

Due to the lack of knowledge on the marine situation (concentrations in the environment and biota) there is a the need for further monitoring of TCB-concentrations in these compartments. As indicated above, TCB will find its primary sink in river sediment, appropriate measures to establish an inventory of these hot spots is recommended.

4.2 Quantification of sources

4.2.1 1,2,4-TCB

Releases of 1,2,4-TCB are shown in Table 9.

An important conclusion from the table above is that the major part (86%) for 1,2,4-TCB is released to the aquatic system through open uses. Further, the rough estimation of the environmental releases of 1,2,4-TCB from dielectric fluids in existing electrical equipment indicates that this may be in the same order of magnitude as the total release from the current production and processing of this substance. Due to EU and national legislation regarding destruction of PCBs and other chlorinated compounds in dielectric fluids in electrical equipment, the future level of environmental release of 1,2,4-TCB from this source will decrease significantly in Europe. On the other hand, as treatment costs are high, illegal dumping of these products might give rise to uncontrolled releases.

Table 9: Calculated total releases and releases to environmental compartments of 1,2,4-trichlorobenzenes based on production volumes of 1994 in Europe (EU RAR, 2003)

Release 1,2,4-TCB (tonnes /year)	Production / Uses (tonnes/yr)	Total releases (tonnes/yr)	Environmental Compartment	Releases (tonnesyr)	Releases (kg/d) ***
During production	7 000	0,35 (measured)	Air	0,23	0,63
			Water	0,1245	0,415
			Soil	0	0
Processing					
Intermediate	1 100	7,70 (worst case assumption by TGD approach)	Air	0,01	0,04
			Water	7,7	25,7
			Soil	0	0
Process solvent	200	4,30	Air	0,2	0,67
			Water	4,0	13,33
			Soil	0,1	0,25
Others	100	2,50	Air	1,0	4,95
			Water	1,0	4,95
			Soil	0,5	5,0
Dye carrier	1	1,0	Air	0,05	0,525
			Water	0,85	8,93
			Soil	0,005	0,002
TOTAL		**15,80**	**Air**	**1,50**	
			Water	**13,7**	
			Soil	**0,6**	
Other sources					
Dielectric fluids		50 (**)	Air		
			Water	50 (**)	
			Soil		
Waste Combustion		< 1,0	Air		
			Water		
			Soil		
Kraft paper bleaching		< 1,0	Air		
			Water		
			Soil		
Chlorinated organic compounds (cracking and biodegradation of lindane, hexachlorobenzene…)		(*)	Air		
			Water	(*)	
			Soil		
Disposal sites and leachate from landfills		(*)	Air		
			Water	(*)	
			Soil		

* Impossible to predict accurately but considered to be significant

** Worst case scenario where total TCB content is released in water compartment. Is not taken into account in total release amounts.

*** By the transition from releases in tonnes/year to kg/d, discontinuous discharges and accidents are also considered.

4.2.2 1,2,3-TCB

The releases of 1,2,3-TCB are shown in the table below and are based on the calculated releases of 1,2,4-TCB. The production and total releases are calculated as 15% of the 1,2,4-TCB and for the distribution in the environmental compartments, Mackay repartition coefficients have been taken into account. The presented data are indicative.

Table 10: Calculated total releases and releases to environmental compartments of 1,2,3-trichlorobenzenes based on production volumes of 1994 of 1,2,4-TCB in Europe

Release 1,2,3-TCB	Production / Uses (t /yr)	Total releases (t/yr)	Environmental Compartment	Releases (t/yr)	Releases (kg/d) ***
During production	1 050	0,05	Air	0.03	0.08
			Water	0.02	0.06
			Soil	0	0
Processing					
Intermediate	165	1,16	Air	0.01	0.01
			Water	1.16	3.86
			Soil	0	0
Process solvent	30	0,645	Air	0.03	0.09
			Water	0.60	2
			Soil	0.02	0.05
Others	15	0,375	Air	0.13	0.63
			Water	0.15	0.74
			Soil	0.11	1.09
Dye carrier	0,15	0,15	Air	0.01	0.07
			Water	0,13	1,34
			Soil	0	0
TOTAL		**2,37**	**Air**	**0.19**	
			Water	**2.05**	
			Soil	**0.13**	
Other sources					
Dielectric fluids		7,5 (**)	Air		
			Water	7.5 (**)	
			Soil		
Waste Combustion		< 1,0	Air		
			Water		
			Soil		
Kraft paper bleaching		< 1.0	Air		
			Water		
			Soil		
Chlorinated organic compounds (cracking and biodegradation of lindane, hexachlorobenzene…)		(*)	Air		
			Water	(*)	
			Soil		
Disposal sites and leachate from landfills		(*)	Air		
			Water	(*)	
			Soil		

*: Impossible to predict accurately but considered to be significant.

4.2.3 1,3,5-TCB

Releases for 1,3,5-TCB are considered not to be significant, as the production ratio of this isomer is less than 1% of the total-TCB amount, and no specific uses have been identified for 1,3,5-TCB.

TCB-MIXTURE

For the 5th North Sea Conference, March 2002, releases of TCBs to air- and water were reported in order to obtain an indication whether the 50% reduction target was achieved. Only four North Sea States could confirm the achievement of the target for both pathways, which is a sign of an apparent lack of data for TCB.

Table 11: Achievement of the 50% reduction target[3] for TCB and the reported releases by North Sea States (W: discharges to water; A: emissions to air.)

	B		CH		D		DK		F		N		NL		S		UK	
Substance	A	W	A	W	A	W	A	W	A	W	A	W	A	W	A	W	A	W
trichlorobenzene	3	3	5	5		5							1	1	5	5		4
1985	800	0	-	-	-	-	-	-	-	-	-	-	780	561	-	-	-	-
1999	1 300	0	-	-	-	-	-	-	-	-	-	-	194	346	-	-	-	-

The 50/70% reduction target has been achieved. This includes cases where the substance is phased out or not in use
The 50/70% reduction target has not been achieved
No reporting or no accurate figures given to calculate the percentage reduction

Categorisation of the approach and level of detail contained in national reports:

1- quantitative data assigned to main sources and their sub-sources;
2- quantitative data assigned only to main sources (SOA);
3- total quantitative data only (based on sources);
4- quantitative data assigned to main entry routes (LOA);
5- only percentage reduction reported for the period 1985-1999/2000.

Note that the high number for Belgium is due to the fact that Belgium has included storage of TCB in 1999 and did not include this figure in 1985.

4.3 Assessment of the extent of the problem

1,2,4-TCB should be considered fulfilling the P-criterion, just fulfilling the B-criterion and failing to meet the T-criterion. However, some values are close to the cut-off value for the T-criterion, and some uncertainty still remains with respect to this cut off value. 1,2,4-TCB is therefore considered to have a borderline PBT-profile, but might also be considered a POP-like substance (EU, 2002). The other isomers can be considered having similar properties.

Therefore the risk is assessed by comparing the 'predicted environmental concentrations' PEC to the 'predicted no effect concentrations' PNEC, expressed as a hazard quotient for the marine aquatic environment.

3 The 50% reduction target was included in the 1990 The Hague Declaration for the first time for substances at Annex 1A of the Declaration.

PNEC FOR THE MARINE ENVIRONMENT

Although there is relatively little valid marine toxicity information, it is assumed in this assessment that the sensitivity of marine and freshwater organisms to 1,2,4-trichlorobenzene is similar. Hence, for the assessment, the predicted no effect concentration (PNEC) for the marine environment is set equal to the freshwater values as derived by the Fraunhofer Institute when establishing the COMMPS database in order to give a first indicative approximation.

Table 12: PNEC values for surface water and sediment (COMMPS database derived for the European Commission by the Fraunhofer Institute

Isomer	PNECwater (mg/l)	PNECsed (mg/kg ww)
1,2,3-trichlorobenzene	0,017	0,66
1,2,4-trichlorobenzene	0,004	0,10
1,3,5-trichlorobenzene	0,020	0,63

PBT-PROFILE OF TCB

As demonstrated by the Mackay model (level 1) the major fraction (64 – 90%) of TCBs will enter the atmosphere, and only a minor fraction (< 3%) will enter the water compartment. In the environmental compartments natural degradation will take place resulting in the half-life times listed below.

Table 13: Process Half-life-time on 1,2,4- TCB (1) EU RAR – (2) Eurochlor RAR – (3) Masunaga *et al*. (Wat Sci Technol 33: 173-80, 1996) – (4) Bartholomew & Pfaender (1983, Influence of spatial and temporal variation on organic pollutant biodegradation rates in the estuarine environment. Appl. Environ. Microbiol. 45:103-109) – (5) Simmons et al. (1977, cited in EU RAR)

Process	Half-life-time	Reference
Marine biotic degradation	No data available	
Marine abiotic degradation	No data available	
Atmospheric photo-degradation	5 – 53 days	(1) (2)
Removal in STP (volatilization)	7 hrs	(1)
Surface water	150 days (worst case TGD default for inherently degradable substances); 23,8 – 57,5 days for primary degradation; < 10 days degradation with adapted inoculum	(1) (4) (5)
Soil	300 days (worst case TGD default for inherently degradable substances)	(1)
Sediment	300 days (worst case justified) 202-210 days (reported in EU-RAR) 23-41 days (measured)	(1) (1) (3)

In degradation studies (Masunaga et al., 1996), the formation of dechlorinated intermediate metabolites have been reported which are dichlorobenzene and monochlorobenzene.

Organisms have been shown to accumulate chlorobenzenes from water, soil and aquatic sediment. The octanol/water partition coefficients indicate that TCBs have the potential to bio-accumulate. Bioconcentration factors for all isomers are in the same magnitude. Log BCFs for 1,2,4-TCB are reported from 2,09 (rainbow trout, wet weight basis) up to 4,38 (rainbow trout, lipid weight basis, Geyer et al. 1985, Chemosphere 14:545).

Eurochlor concluded that despite the BCF values ranging from 120 to 24 000 with an average of about 2 000 (as mentioned above), trichlorobenzenes do not biomagnify due to their relative high elimination rate constants. Furthermore, tests with TCB contaminated feed also revealed that biomagnification is low.

The Danish EPA concluded that 1,2,4-TCB should be regarded as a substance fulfilling the PBT-criteria and even controlled as a POP-like substance. It is recognised though that 1,2,4-TCB is a borderline case with regard to the B-criterion and does not meet the T-criterion although some aquatic toxicity data are very close to the cut-off value and some uncertainty remains regarding mammalian toxicity. The overall conclusion is however drawn taking into account supporting evidence relating to the very high long range environmental transport potential of this substance (EU, 2002).

The exposure assessment is based on the ratio of the PEC/PNEC, and results are given in Annex 1.

4.4 Preliminary conclusions

PEC/PNECwater ratios in local surface water for 1,2,4-TCB vary from 0,01 for the production sites situations to 17 for the scenarios where TCB is used as a dye carrier. This underlines that TCB can cause local problems for aquatic organisms and that the risks are related to the downstream uses (EU RAR, 2003).

A similar observation can be made for the PEC/PNEC sediment ratios in local surface water ranging from 0,02 for the production site scenario to 21 for the scenario where TCB is used as a dye carrier.

According to the Further Guidance on the Role of Marine Risk Assessment within the Framework of the OSPAR Strategy with regard to Hazardous Substances (OSPAR 2002), the PEC/PNEC ratios for estuaries (0,0075 in the water compartment and 0,6 in the sediment compartment) indicate that there is ‘no actual risk’ and that TCB can be considered as a ‘substance requiring action by OSPAR before 2020.

For the open sea, with ratios of 0,000075 and 0,006, TCB may be considered to have ‘no or negligible risk’ and to be a ‘substance requiring action by other stakeholders before 2020’. However more information is required to validate the deductions on both, the PEC and the PNEC determination.

There is no representative detailed data on 1,2,3 TCB and 1,3,5 TCB available for the marine environment.

The deduction made above for the assessment on the extent of the problem for the marine environment is mainly based on data from freshwater and terrestrial scenarios. In order to confirm this assessment, there is a need for new validated marine data regarding environmental concentrations (seawater, sediment and biota) and reliable ecotoxicological data for marine species.

Concerning the isomers 1,2,3-TCB and 1,3,5-TCB, it is expected that the environmental impact will be lower than for 1,2,4-TCB, because respective PNEC values are higher and releases to the environment are lower.

5. DESIRED REDUCTION

The OSPAR Strategy with regard to Hazardous Substances sets out that the objective is "to prevent pollution of the maritime area by continuously reducing 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".

The timeframe given in the Strategy states that "every endeavour will be made to move towards the target of cessation of discharges, emissions and losses of hazardous substances of concern by the year 2020."

As trichlorobenzenes are toxic, persistent and bioaccumulative, it is imperative from the OSPAR Strategy that appropriate measures, commensurate with the risks, should be taken to achieve concentrations close to zero for man-made hazardous substances.

6. IDENTIFICATION OF POSSIBLE MEASURES

Two types of measures can be distinguished:

- measures aiming at the reduction of environmental TCB concentrations;
- measures aiming at the improvement of understanding the environmental concern, which means reducing the current lack of knowledge.

6.1 Measures aiming at the reduction of environmental TCB concentrations

Risk reduction measures should be considered that would ensure a reduction in the levels of TCB found in the environment.

In a first step, the uses with a significant risk of TCB release will be listed, further, the relevant uses will be assessed and a generic scenario analysis will be made, and at last, the different possibilities of reduction measures will be pointed out. The following uses of TCB are evaluated in function of potential releases of TCB to the environment and, where relevant, required reduction measures can be developed:

- for the production and processing by the main manufacturers there is no identified need for further information, testing, or risk reduction measures beyond those which are already being applied;
- for open uses, there can be a need for risk reduction. Risks for the local aquatic environment have been demonstrated above and might proceed towards the marine environment (food chain accumulation and or discharge through rivers and coastal sewage treatment plants);
- reduction of risk of TCB-release from former uses of TCB as dielectric fluid (together with PCBs).

In a second step, the risk for TCB release is evaluated for each environmental compartment.

Table 14: Summary of the risk assessment for the environment (extracted from EU risk reduction strategy for TCB; EU, 2002)

Scenarios:	Aquatic environment			Atmosphere**	Terrestrial environment	Secondary poisoning by fish eating mammals
	local surface	local sediments	local STPs*		local soil	
Production	ii	ii	ii	ii	ii	ii
Intermediate	ii	ii	iii	ii	iii	ii
Process solvent	ii	ii	iii	ii	iii	ii
Others	iii	iii	iii	ii	iii	iii
Dye carrier	iii	iii	iii	ii	iii	iii

* STP: sewage treatment plant.

** It may be justified to consider 1,2,4-TCB further in relation to the POP criteria and in relation to other national and international regulations.

i) There is need for further information and/or testing.

ii) There is at present no need for further information or testing or risk reduction measures beyond those, which are being applied already.

iii) There is a need for limiting the risks; risk reduction measures, which are already being applied, shall be taken into account.

In the EU-risk reduction strategy, an assessment was made of possible measures. The conclusions are shown in table 15 (EU, 2002).

Table 15: Possible reduction measures

Proposed measure	**Conclusion**
Classification	The classification is recommended.
Limit values for wastewater	This measure can be applied by local authorities in the Member States.
New limit values for working environment	A new limit value for 1,2,4-TCB in the working environment may be considered, but it is outside the scope of the strategy to point out a limit.
Agreement on a voluntary basis regarding dye carrier	This measure is not likely to be very effective.
Information programmes and technical standards and authoritative guidance	By speeding up the process of elaborating BAT-notes and implementing of the IPPC-directive in the Member States a decrease in the emissions of TCB can be expected.
Ban	Ban of all open uses and import of products/articles containing 1,2,4-TCB may be recommended.
Taxes	This measure can not be recommended.

It is further proposed that industry could develop process integrated measures aiming at the substitution of TCB. With regard to the remediation of possible "river-sinks", appropriate dredging strategies should be developed to avoid an uncontrolled disturbance of concentrated sediment layers which could cause acute risk. This could be a starting point to control remediation of hot spots (landfills, estuaries, harbours, and rivers) with potential risk for the marine environment, through releases from former sinks.

6.2 Other measures aiming at the reduction of the current lack of knowledge

Further measures aiming at the reduction of the current lack of knowledge could be:

a. development and implementation of a common EU/OSPAR approach on the Risk Assessment Methodology for the Marine Environment;[4]

b. development of a practical guideline on substitution in co-operation with the appropriate EC bodies in the line with the redaction and development of the related BREF documents;

c. investigation of appropriate remediation strategies regarding former (river)sinks of TCB and landfills including:
   - inventory of hot spots;
   - monitoring of the identified hot spots;
   - development of controlled remediation techniques (e.g. dredging);

d. research on risks on the basis of intrinsic properties of the substances as such but also of the known metabolites as they might induce a significant risk for the environment (e.g. endocrine disruption);

e. extension of monitoring programmes to gather representative data to validate the above deduction, or to comment accordingly. This monitoring extension should focus on the marine environment and biota.

6.3 UN POP Convention

Within the UN, the new UN Persistent Organic Pollution (POP) Convention has been signed in Stockholm, May 2001. The final text includes measures for the elimination or restriction of the use, production, import or export of hazardous substances. TCB has not been identified initially by UNEP as a POP. T Until now no POP has been identified beyond the initial list of 12 POPs. In the Convention, criteria for inclusion of new substances have been developed. Depending on those criteria, TCB might be considered for inclusion in the future. Therefore a possible action could be a proposal to UNEP to evaluate the relevance of TCB as POP and eventually to review the listing of chemicals of annexes A, B and C of the POP-Convention. As shown in the table below. TCB has the potential to be evaluated as a POP according to different UNEP-POP-criteria.

[4] The EU Technical Guidance Document (TGD) was revised and has been published in April 2003 on the web site of the European Chemicals Bureau. It contains a new chapter on marine risk assessment and criteria for the assessment of persistence, bioaccumulation potential and toxicity (PBT) of substances, which may pose a risk for the marine environment. This risk assessment methodology has been formally agreed by the EC in April 2003 and has been adopted by the OSPAR Commission in June 2003 as the common EU/OSPAR risk assessment methodology for the marine environment.

Table 16: UNEP POP criteria

Criteria	UNEP POP	TCB
Persistence in water	> 2 months	5 months
Persistence in soil	> 6 months	10 months
Persistence in sediment	> 6 months	10 months
Bioaccumulation	> 5 000	120-24 000
Long range transport per air	> 2 days	30 – 53 days

6.4 UN ECE Convention on Long-range Transboundary Air Pollution

Within the UN, new Protocols for heavy metals and persistant organic pollutants under the UN ECE Convention on Long Range Transboundary Air Pollution Convention (LRTAP) have been signed in Aarhus, June 1998. The final text includes measures for the elimination or restriction of the use and production of 16 persistent organic pollutants. TCB has not been identified yet as a POP. Until now no further LRTAP POP has been identified beyond the initial list of 16 POPs.

Therefore a possible action could be a proposal to UN ECE to evaluate the relevance of TCB as POP and to review eventually the listing of chemicals of Annexes I, II and III of the POPs Protocol under the LRTAP-Convention.

6.5 North Sea Conference

In 1990, Ministers at the 3rd North Sea Conference (NSC) agreed to achieve a significant reduction (50% or more) of TCB with respect to:

(i) inputs via rivers and estuaries between 1985 and 1995;

(ii) atmospheric emissions by 1995, or by 1999 at the latest, provided that the application of best available techniques (BAT), including the use of strict emissions standards, enables such a reduction.

In 1995, Ministers at the 4th NSC also made the following political commitment (see paragraph 22 of the Esbjerg Declaration): "The Ministers confirm the goal set in the final declaration of the OSPAR 1992 Meeting at Ministerial level, i.e. of reducing by the year 2000, discharges and emissions of substances which are toxic, persistent and liable to bioaccumulate (especially organohalogens) and which could reach the marine environment to levels that are not harmful to man or nature with the aim of their elimination".

The progress report of the 5th NSC, March 2002, has indicated that for TCB the reduction targets have not been met yet by all countries, and that actions are underway in the EU framework that may lead to the achievement of the target. Further Ministers invited OSPAR to develop an effective and efficient monitoring and assessment process for the chemicals selected for priority action, in order to demonstrate publicly, clearly and transparently whether and how progress towards the cessation of discharges, emissions and losses is being achieved. The monitoring and assessment process should draw on the experience gained in the implementation of the Water Framework Directive and with the application of the newly developed Harmonised Quantification and Reporting Procedure for Hazardous Substances (HARP-HAZ prototype). It should provide for periodic assessment of progress for the chemicals selected for priority action towards the “one-generation” target, and the publication of such assessments.

6.6 European Union

Activities will be listed regarding measures directly linked to trichlorobenzene. Other activities will be listed which are not directly related to trichlorobenzene but who have a relevant impact on trichlorobenzene.

Trichlorobenzene is listed on the second priority list of substances (Commission Regulation (EC) No 2268/95 of 27 September 1995) as foreseen under Council Regulation (EEC) No 793/93.

Trichlorobenzene is further listed on the pollutant list in Decision 2000/479/EC concerning the implementation of the European Pollutant Emission Register (EPER) according to Art. 15 of Council Directive 96/61/EC concerning integrated pollution prevention and control (IPPC). This means that Member States shall report on emissions to water and air of all facilities according to the IPPC Directive. This data will be made publicly accessible (internet). The reporting of emissions should be done according to the list of pollutants for which the threshold values are exceeded. TCB is specified as a pollutant for air emissions with a threshold value of 10 kg/yr. For water-discharges, TCB is not specified but will be reported as AOX (adsorbed halogenated organic compounds) with a threshold value of 1 000 kg/yr. A first database consultation is expected by the end of 2003.

6.6.1 General measures

CLASSIFICATION AND LABELLING

TCBs are not yet listed on “The List of Dangerous Substances” (Annex 1 of Council Directive 67/548/EEC) but have been classified by the authorities with Xn (harmful) or Xi (irritant) and N (dangerous for the environment).

ECO-LABELLING OF TEXTILES

The European Commission Decision of 17 February 1999 establishing the ecological criteria for the award of the Community eco-label for textile products (1999/178/EC) states that halogenated carriers can not be used.

6.6.2 Environmental legislation

DISCHARGE INTO THE AQUATIC ENVIRONMENT

Under Council Directive 76/464/EEC on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community discharges of TCBs (as the sum of the 3 isomers) into the aquatic environment are regulated. Organohalogens are on List I in Directive 76/464/EEC, and any discharge of substances into the aquatic environment from this List I requires prior authorisation by the competent authority of the Member State concerned. The authorisation shall lay down emission standards with regard to discharges of any such substance (Article 3).

Council Directive 90/415/EEC amending Directive 86/280/EEC on limit values and quality objectives for discharges of certain dangerous substances in List I of Directive 76/464/EEC includes explicitly 1,2,4-TCB and a mixture of all three isomers. Member States shall draw up specific programmes to avoid or eliminate pollution from significant sources of these substances (including multiple and diffuse sources) other than sources of discharges subject to Community limit value rules or national emission standards. The programmes shall include the most appropriate measures and techniques for the replacement, retention and/or recycling of the substance (Article 5 of Council Directive 86/280/EEC).

Limit values for emissions and quality standards have been established for all three TCB isomers. Limit values for discharges from production of TCB and/or conversion of TCB and/or chlorobenzene are shown in table 17.

Table 17: Limits of total TCB in emissions from industry. Council Directive 90/415/EEC amending Directive 86/280/EEC

Type of industrial plant	**Limit values [1] expressed as**		**To be complied with as from**
	Weight	Concentration	
Production of TCB by dehydrochlorination of HCH and/or processing of TCB	25 g per tonne [2] 10 g per tonne [2]	2,5 mg/l [4] 1,0 mg/l [4]	1. 1. 1993 1. 1. 1995
Production and/or processing of chlorobenzene by chlorination of benzene [6]	5 g per tonne [3] 0,5 g per tonne [3]	0,5 mg/l [5] 0,05 mg/l [5]	1. 1. 1993 1. 1. 1995

1) The limits indicate the highest permissible amount and concentration of TCB, which on average may be discharged per month. Here it applies that the highest permissible amount and concentration on one day may not exceed twice the amount in the table.
2) The limits for discharge of TCB are given compared to the total production capacity of TCB.
3) The limits for the discharge of TCB are given compared to the total production and processing capacity of mono- and dichlorobenzenes.
4) The limits for concentrations of TCB are given compared to the reference volume of 10 m^3/ton of produced or processed TCB.
5) The limits for concentrations of TCB are given compared to the reference volume of 10 m^3/ton of produced or processed mono- and dichlorobenzenes.
6) For existing companies which discharge less than 50 kg/year from January 1, 1995, the limits apply on that date, which equal half the limits, which apply from January 1, 1993.

QUALITY OBJECTIVES IN THE AQUATIC ENVIRONMENT

Council Directive 76/464/EEC amended by Directive 90/415/EEC, sets a quality objective for surface water, estuaries, coastal zones and territorial seas equal to 0,4 µg/l applicable from 1.1.1993. A review of this quality objective was foreseen by the end of 1998. However, no further review was carried out by that date.

The European Commission Scientific Advisory Committee on Toxicity and Ecotoxicity of Chemicals (CSTE) recommends that the total concentration of trichlorobenzenes in fresh and marine water should be as low as possible and should not exceed 0,1 µg/l. The recommendation is related to Article 6(2) of Council Directive 76/464/EEC.

The CSTE/EEC List 1 includes TCB. The water quality standards referring to the maximum concentration level in the environment close to the point of discharge is 0,1 µg/l.

In the Water Framework Directive 2000/60/EC (WFD) – amended by Council Decision 2455/2001/EC, TCB was identified as a priority substance and is listed in the respective Annex X. TCB is subject to a review for identification as a possible “priority hazardous substance”. The Commission will make a proposal to the European Parliament and Council for the final classification not later than 12 months after adoption of this list. However the final classification was delayed to the end of November 2003. The objective of the WFD is the phasing-out of discharges, emissions and losses of the priority hazardous substances, with the ultimate aim of achieving concentrations in the marine environment close to zero for man made substances within 20 years of the adoption of proposals from the European Commission for emission controls. For this purpose, a specific programme of measures shall be proposed not later than

November 2003 (i.e. 2 years after inclusion on the list) by the Commission, which is expected to be delayed because of the delay in the final classification. Further the Commission has to submit proposals for Environmental Quality Standards applicable to the concentrations of priority substances in surface water, biota and sediments.

SOIL AND GROUNDWATER

No EU-regulation has been identified in this area, except for Council Directive 80/68/EEC of 17 December 1979 on the protection of groundwater against pollution caused by certain dangerous substances which prohibits the direct discharge of organohalogens to groundwater.

6.6.3 Other activities having an indirect relation with TCBs

PCBS

TCB has been used together with PCB in electrical equipment. In existing electrical equipment a rough worst-case estimate of the amount of TCB related to this application in the EU is around 5 000 tonnes. Based on this amount it has been calculated that it may represent a release of 50 tonnes/year of TCB (sum of isomers), which is assessed to be the largest release of TCB. The Council Directive 96/59/EC on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCB/PCT) should regulate these discharges.

PARCOM Decision 92/3 on the Phasing Out of PCBs and Hazardous PCB Substitutes aims at preventing PCBs and hazardous PCB substitutes from entering the marine environment. Measures shall be taken to phase out and to destroy in an environmentally safe manner all identifiable PCBs as soon as possible with the aim of complete destruction, including the interim options of safe deep underground disposal in dry rock formation of capacitors and empty transformers.

DIOXINS

The focus on dioxin emission from waste incineration is also likely to reduce the emission of TCB. Council Directive 2000/76/EC on the incineration of waste sets an emission limit for dioxins and dibenzofurans of 0,1 ngTEQ/m^3.

LINDANE

As mentioned above, TCB is considered as a possible degradation product of lindane. This source has not been quantified. All measures undertaken to reduce the emissions of lindane into the environment will reduce (prevent) the potential risk of TCB formation through degradation processes.

In 2000 it was decided (Commission Decision 2000/801/EC), that lindane is not any further permitted as active ingredient in crop protection products under Council Directive 91/414/EEC concerning the placing of plant protection products on the market.

Further, lindane has been designated as a priority hazardous substance on the List of priority substances of the Water Framework Directive (Annex X).

HEXACHLOROBENZENE

As mentioned above, TCB is considered as a possible degradation product of hexachlorobenzene. This source has not been quantified. All measures undertaken to reduce the emissions of hexachlorobenzene into the environment will reduce (prevent) the potential risk of TCB formation through degradation processes.

Further, hexachlorobenzene has been designated as a priority hazardous substance on the List of priority substances in the field of water policy of the WFD . Hexachlorobenzene also is identified as a UNEP-POP.

6.7 National initiatives in some Contracting Parties

All OSPAR Contracting States have been asked in an initial inquiry whether they have special regulations for TCB. Based on the answers received and the EU-risk reduction strategy (EU, 2002), and a search on the EU-Celex website, the implementation of the EU legislation was evaluated.

The table below shows a general overview of the national initiatives according to Directives 76/464/EEC and 86/280/EEC amended by 90/415/EEC:

Table 18: Overview of national implementation of EU-Directives related to TCB

Member State	Discharges regulated	Limit values discharges	Quality objective surface water	National list	Groundwater target values
Belgium	X	X	X	X	
Netherlands	X	X	X	X	X
Denmark	X		X	X	
Sweden	X	X	X		
Germany	X	X			
France	X	X			
Luxembourg	X	X			
Finland	X				

The Flanders and Brussels Region apply 0,4 µg/l TCB as quality objective for surface water.

Denmark applies 0,4 µg/l TCB as quality objective for surface water and 0,1 µg/l as target value. Denmark has included trichlorobenzenes in the "list of undesirable substances". This is a signal list of substances with the purpose to promote substitution by less harmful substances.

Norway has included trichlorobenzenes in a priority list B. The goal for substances on the list are to reduce the emission significantly before 2010. Action plans have been set up to reach this goal.

Ireland regulates the control of TCB discharges in their Statutory Instrument n° 245 of 1994. Permitted discharges are related to the type of industry and production volumes.

The Netherlands apply target and limit values for TCB-emissions as described in the following table.

Table 19: Target and limit values for environmental waters in the Netherlands

	Target values		Limit values	
TCB	Water (μg/l)	Sediment (μg/kg)	Water (μg/l)	Sediment (μg/kg)
individual isomers and for the total of isomers	0,7	0,002	67	7

6.8 Alternatives

One of the guiding principles of the OSPAR Strategy on Hazardous Substances is the principle of substitution (the substitution of hazardous substances by less hazardous substances or preferably non-hazardous substances where such alternatives are available).

Substitution of TCB by another substance requires consideration of the following:

- the substitute is less harmful and poses a lower risk;
- the physical behaviour of the substance and thus the nature of the processes used to produce these substances;
- the price difference between these substances and TCB, based on processes and resulting performance of the product;
- the efficacy of substitutes and the volumes required.

Substitution has been discussed by various OSPAR subsidiary bodies in the 1999/2000 inter-sessional period. A draft guidance document on the substitution of hazardous substances was developed by Sweden as lead country. This draft guidance[5] described an assessment model to evaluate the need for, and the feasibility of substitution. The model comprised the following three steps:

- identification: inventory of specific characteristics;
- evaluation of these characteristics in an international framework of knowledge and legislation;
- priorities for decision – based on economical assessment.

In textile industries, TCB is used as a dye carrier in low temperature dyeing (wool), but it is recommended to use butylbenzoate esters as a substitute or to dye under high pressure without usage of carriers. A new technique, supercritical dyeing, is in an early stage of application by industry, but it is promising. In Germany, the textile industry has plans to completely ban chlorides from textile processing, in the UK, mono-chlorobenzenes are suggested as a substitute for TCB (VITO, 1998).

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5 Following a general policy discussion on the appropriate role for OSPAR in this area of work, OSPAR 2002 agreed, *inter alia*, that:

a. there was no role for OSPAR to develop general guidance on the substitution of hazardous substances and OSPAR should not generally develop measures on substitution;

b. the need to promote substitution in specific cases could best be addressed in background documents for OSPAR priority substances with a view to identifying available substitutes in the form of alternative substances and/or products.

According to the BREF for textiles industry (EU BREF Textile Industry, 2003), TCB-carriers can be replaced by chlorine-free substances with improved toxicological and environmental characteristics. New carriers are based on:

- benzylbenzoate;
- N-alkylphthalimide.

6.9 Possible OSPAR measures

At the sixteenth joint meeting of the Oslo and Paris Commissions in June 1994, Contracting Parties agreed on PARCOM Recommendation 94/5 concerning BAT and BEP for Wet Processes in the Textile Processing Industry, in order to prevent marine pollution from these land-based sources.

Further possible OSPAR actions could be the reinforcement of ongoing monitoring programmes regarding hazardous substances with a focus on TCB, especially in the marine environment (water, sediment and biota) to fill this significant gap in knowledge. These monitoring activities should give answers to the actual (and future) concentrations of hazardous substances in general and TCB specifically. This programme should support the load-oriented approach to the marine environment through data collection in estuary zones. The monitoring activities could be assured by Contracting Parties and data could be collected in a centralised database.

The EU Advisory Committee under Council Directive 96/61/EC (IPPC-Directive) – and Commission Decision 2000/479/EC (EPER) could be invited to consider the relevance of TCB in their review as a specific substance for monitoring in water (and not only as AOX).

The common EU/OSPAR approach on the Risk Assessment Methodology for the Marine Environment adopted by OSPAR 2003 could incite the development of an appropriate ecotoxicological research programme to cope with the gaps in knowledge.

A practical guideline on substitution in co-operation with the appropriate EC bodies in the elaboration of the BREF documents could be developed.

Initiatives could be developed regarding investigation programmes on appropriate remediation strategies for former riversinks and landfills of TCB including:

- inventory of hot spots;
- monitoring of the identified spots;
- development of controlled remediation techniques (e.g. dredging);
- controlled remediation of hot spots (estuaries, harbours, and rivers) with potential risk for the marine environment, through releases from former sinks where necessary.

These initiatives could be further developed within the framework of the OSPAR guidelines on the management of dredged materials.

Further, known degradation products should be considered in risk assessments, and not only the intrinsic product as such, as they might induce a significant risk for the environment (ecotoxicological and endocrine disruption).

EU measures could be developed in coherence with the OSPAR goal on cessation of emission, losses and discharges and achievement of concentrations close to zero by 2020. Concerning the risk for the aquatic environment, following possibilities could be envisaged:

- reduction of emissions of TCB, especially for the local environmental compartments soil, water and sludge from sewage treatment plants;
- reduction of indirect exposure, as TCB can provoke local problems to aquatic organisms, i.e. when TCB is applied in open downstream industrial uses. For production sites there is at present no need for further information or testing or risk reduction measures beyond those which are being applied already;
- marketing and use restriction for all open uses including use as process solvent, dye carrier, corrosion inhibitor, products containing TCB, etc.. This will eliminate the risk for human health and the environment as well as the need for further information on occupational exposure for the following scenarios: use as a dye carrier, use as process solvent, production of dielectric fluids, and production of wire and cabling;
- ban of articles containing TCB. Imported textiles can contain TCB from the use as a dye carrier;
- setting a limit value for wastewater, lower the occupational exposure limit, and elaboration of BAT-notes for production facilities.

7. CHOICE FOR ACTION/MEASURES

In order to improve the material available for assessing the load on the marine environment from all sources of trichlorobenzenes (TCBs),

- the lead countries for TCBs (Belgium and Luxembourg) should be invited to develop a proposal for a monitoring strategy for TCBs within JAMP product HT2 and HM1 (monitoring strategies and reporting systems for priority chemicals), in particular taking into account the assessments in this background document of the need to concentrate effort on biota and sediments;
- the EU Advisory Committee for the IPPC Directive and the European Polluting Emissions Register (EPER) should be invited to consider in their work on monitoring the case for monitoring TCBs as specific substances in water (and not merely through the AOX parameter).

In order to identify possible needs for action to address emerging problems or for remediation:

- the lead countries for polychlorinated biphenyls (PCBs) (Belgium and Germany) should be invited to report in their follow-up reports on the PCB background document on the current situation on the substitution of PCBs in transformers with TCBs and the possible associated problems;
- Contracting Parties should consider the requirements for investigation of remediation needs of sites historically acting as TCB sinks (river beds, contaminated sites and landfills), for example through inventories of “hot spots” and pilot feasibility projects.

In order to ensure consistency with action within the European Community,

- the rapporteur within the EU on TCBs (Denmark) should be invited to present this background document to the appropriate EU meeting as a contribution to the risk assessment of these substances;
- OSPAR Contracting Parties that are also EU Member States should support the development of appropriate measures to control discharges, emissions and losses of trichlorobenzenes through the implementation of the Water Framework Directive;

– the OSPAR lead countries for examining BREFs on fine chemicals and the textile industry (respectively the Netherlands and Belgium) should be invited to seek to ensure that those BREFs take appropriate account of the conclusions of this background document, and to report to OSPAR on this in their reports on these BREFs;

– OSPAR should communicate this background document 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 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.

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ANNEX 1: PEC/PNEC CALCULATIONS

Substance	Compartment		PEC µg/l or µg/kg dw	PNEC µg/l or µg/kg dw	PEC/PNEC	Comment
1,2,3-trichlorobenzene	Surface water	Water	?	17	?	
		Sediment	?	660	?	
	Sea	Water	?	17	?	
		Sediment	?	660	?	
1,2,4-trichlorobenzene	Surface water	Water	0,4	4	0,10	PEC is maximum detected except peak concentration of 1,3 µg/l
		Sediment	60	100	0,60	PEC is maximum detected except peak concentrations above 750 µg/kg
	Sea	Water	0,03	4	0,0075	PEC is maximum detected in dispersion zones of river
		Sediment	?	100	?	PNEC value is set equal to the surface water sediment.
1,3,5-trichlorobenzene	Surface water	Water	0,06	20	0,003	PEC is maximum detected except peak concentration of 0,27 µg/l
		Sediment	32	630	0,05	PEC is maximum detected except peak concentrations above 450 µg/kg
	Sea	water	?	20	?	
		sediment	?	630	?	

PEC/PNEC ratios for surface water and seawater

1,2,4 TCB

It can be concluded that, although no PEC levels, nor PNEC levels in the marine environment are directly available from monitoring data or research, a good indication of the PEC/PNEC ratios can be deduced through the application of the above mentioned assumptions. Further, these calculations do not take into account any dilution factor within the sea, hence resulting in the coastal (estuary) situation approach.

The calculated ratios are:

$PEC/PNEC_{\text{sea water estuary}}$ = 0,0075
$PEC/PNEC_{\text{sea sediment estuary}}$ = 0,6 (assumption: set equal to surface water)

We may assume a dilution factor for discharges to a coastal zone of 100, which seems to be representative of a realistic worst case scenario bringing the ratios to:

$PEC/PNEC_{\text{sea water}}$ = 0,000075
$PEC/PNEC_{\text{sea sediment}}$ = 0,006

(cf. workgroup on common approach EU/OSPAR on risk assessment methodology for the marine environment).

ANNEX 2: MONITORING STRATEGY FOR TRICHLOROBENZENES

As part of the Joint Assessment and Monitoring Programme *(reference number 2003-22),* OSPAR 2005 adopted a revised Agreement on Monitoring Strategies for OSPAR Chemicals for Priority Action *(reference number 2004-14)* to implement the following monitoring for tracking progress towards the objectives of the OSPAR Hazardous Substances Strategy *(reference number 2003-21)* with regard to trichlorobenzenes. The monitoring strategy for trichlorobenzenes will be updated as and when necessary, and redirected in the light of subsequent experience.

The sources of trichlorobenzenes are well known and have been detailed in the Background Document, the EC Water Framework Directive fact sheet on trichlorobenzenes and the HARP-HAZ guidance document on trichlorobenzenes. Some relevant controls on marketing and/or use as well as on emissions and/or discharges of trichlorobenzenes have been agreed in the EU and other international forums and have been highlighted in chapter 6 of the Background Document. Evidence from reports on the implementation of such measures will be used to make an initial judgment of the extent to which the amounts of these substances emitted or discharged are reduced.

In the EU, the substances are currently produced only for the use as intermediate in closed systems. Point sources are likely to be small or insignificant. Diffuse sources still exist due to historical uses of trichlorobenzenes e.g. as pesticide, additive in transformers or as a dye carrier. Leachate from landfills still can cause significant releases. Trichlorobenzenes are still used as dye carrier in the textile industry outside the OSPAR Convention area, for example, in China whose products might now enter the EU market following the termination of the Agreement on Textile and Clothing and the trade restrictions thereunder on 1 January 2005. Production, sales and uses of trichlorobenzenes will be monitored and related information in the Background Document updated.

The Background Document reports that trichlorobenzenes have been detected in fresh and marine waters. Concentrations were higher in dispersion zones of rivers or near important waste water treatment plants. High concentrations have been detected occasionally in river sediment on specific locations. Trichlorobenzenes are volatile, POP-like substances, water soluble, and have a potential to bioaccumulate. They preferably evaporate or absorb to sediments or suspended matter. The most appropriate matrix for monitoring is (estuarine) sediments and organisms living in brackish water. Currently, trichlorobenzenes are not monitored under OSPAR monitoring programmes. Data on concentrations in air and in rivers are available from most Contracting Parties who, so far, have carried out only very limited monitoring for concentrations of trichlorobenzenes in sea water, marine sediment and biota.

For emissions to air, OSPAR will examine and assess the annual reporting to EPER of emissions to air from IPPC sources with a view to establishing trends in emissions of trichlorobenzenes to air.

For discharges to water, OSPAR will seek to make use of data reported in other forums. OSPAR will examine and assess data on sources subject to IPPC activities reported annually to the EPER database. No additional monitoring of non-IPPC sources are considered necessary due to the minor importance of point sources. OSPAR will also examine and assess data on trichlorobenzenes reported under the Water Framework Directive in order to establish trends in discharges.

For concentrations in water, OSPAR will periodically compile monitoring data regularly reported under the Water Framework Directive for concentrations of trichlorobenzenes in transitional, coastal and territorial waters in the water phase. For measuring progress towards the targets of the OSPAR Hazardous Substances Strategy to cease discharges and losses and to achieve concentrations close to zero for man-made substances, monitoring would need to check at certain intervals (e.g. every 5th year) whether trichlorobenzenes can still be detected in the environment. This is best done on a voluntary basis and in a matrix where trichlorobenzenes accumulate such as in biota and historical sinks (e.g. estuaries) as well as in dredged material and sediments.

TRICHLOROBENZENES MONITORING STRATEGY

TRICHLOROBENZENES 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
Emissions to air	• Examination and assessment of trends in emissions to air from IPPC sources in data reported annually by Contracting Parties to EPER.
Discharges and losses to water	• Examination and assessment of trends in discharges to water from IPPC sources in data reported annually by Contracting Parties to EPER. • Examination and assessment of trends in discharges to water from WFD directive required by EC.
Production/use/sales /figures	• The lead countries will update information on production, sales and use of trichlorobenzenes during review of the Background Document. The next review is planned for 2007/08
Atmospheric inputs	• Currently no monitoring in OSPAR
Riverine inputs	• Currently no monitoring in OSPAR
Inputs from the offshore industry	• Currently no monitoring in OSPAR
Maritime area:	
Dredged Materials	• Currently no monitoring in OSPAR • *Voluntary monitoring in estuaries recommended.*
Concentrations in sediments	• Currently no monitoring in OSPAR • *Voluntary monitoring in estuaries recommended.*
Concentrations in water	• Where available, data will be periodically compiled from EC WFD monitoring
Concentrations in biota	• Currently no monitoring in OSPAR • *Voluntary monitoring in biota at certain intervals (e.g. every 5th year) recommended.*