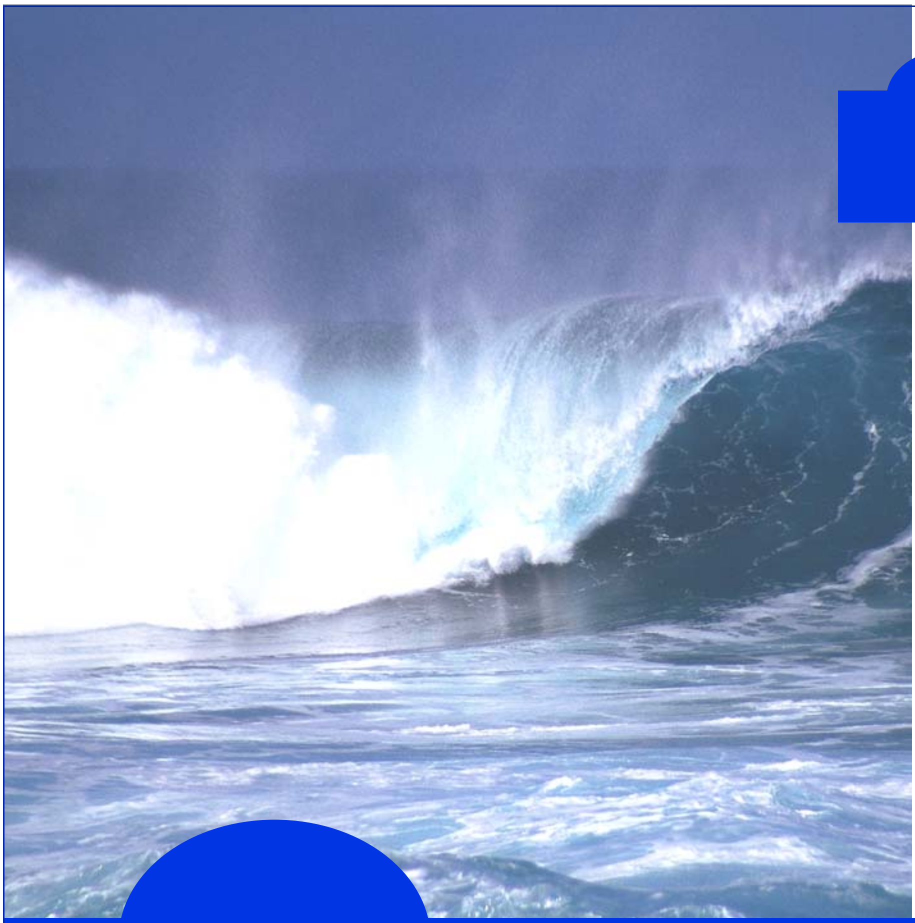

MARINE RISK ASSESSMENT

Euro Chlor Risk Assessment for the Marine Environment OSPARCOM Region - North Sea

1,1-Dichloroethene

May 2006

Euro Chlor
representing the chlor-alkali industry

EURO CHLOR RISK ASSESSMENT FOR THE MARINE ENVIRONMENT

1,1-Dichloroethene (Vinylidene chloride)

OSPARCOM Region – North Sea

1. INTRODUCTION

Euro Chlor, the federation representing 98% of the chlor-alkali production capacity in the enlarged Europe (Euro Chlor, 2003), voluntarily initiated a sustainable development programme as one of the first sectors of the European chemical industry. In this context, several stepwise actions have been taken. In January 2002 the Euro Chlor members (40 companies producing more than 20 million tonnes a year of chlorine, caustic soda and hydrogen) published six commitments to sustainable development (Euro Chlor, 2002). These were turned into 14 measurable goals on environmental protection, safety and socio-economic contribution, published in February 2003 (Euro Chlor, 2003). The environmental protection goals focus on reduction targets set for 2010 which were published early 2004 (Euro Chlor, 2004) and on ‘product knowledge’. In the latter area Euro Chlor has committed to contribute to the HPV initiative (collecting environmental and human health data on high production volume chemicals), the EU existing chemicals risk assessments for prioritised substances and targeted risk assessments for the marine environment focusing on the OSPAR region (Calow, 1998 and 2004). These marine risk assessments are focused on substances that are on lists of concern of European nations participating in the North Sea Conference.

Environmental risk assessment refers to the likelihood of harm being done to ecological targets as a result of the production, use and disposal of a chemical. In principle, it involves comparing likely exposure concentrations with sensitivity distributions of targets (Van Leeuwen and Hermens, 1995). However, in practice there is rarely sufficient information to apply this in a rigorous and detailed manner. As a pragmatic solution, risk quotient analysis is applied. Predicted environmental concentrations (PECs), indices of exposure, are compared with predicted no effect concentrations for the targets (PNECs), indices of effect derived by using application (uncertainty) factors to ecotoxicological endpoints, to give a quotient (PEC/PNEC = RQ). Clearly an RQ of one or more triggers further actions or indicates the likelihood of an adverse effect and gives cause for concern, whereas an RQ of less than one suggests a low to zero likelihood of harm and is usually taken to be acceptable, without the need for further action.

This risk assessment uses the quotient analysis approach and basically follows guidance associated with EU chemicals regulation as laid down in Technical Guidance Document (EC, 2003). The assessment has focused on regional conditions and concentrations rather than concentrations for local circumstances. Local discharges are covered by local authorities and comply with local permits.

This paper carries out a risk assessment of 1,1-dichloroethene in the marine environment paying particular attention to the North Sea. The organisation of the paper reflects the makeup of the risk assessment. It starts with a general description of the substance in terms of its physical and chemical characteristics and hence its potential to be released into, distribute between and to persist within environmental compartments. This is followed by accounts of exposure and effects and a risk assessment carried out as described above. The report closes with some general conclusions.

2. DATA SOURCES

Important general data sources consulted were ECETOC (1985), BUA (1988), IUCLID (EC, 2000) and WHO (2003). The exposure assessment was based on an evaluation of existing literature, database searches and expert contacts as further specified in chapter 5. Effect data were obtained from a literature survey, the references are given in chapter 9.

3. PHYSICO-CHEMICAL PROPERTIES AND FATE

3.1 Compound description

The identity and physico-chemical properties of 1,1-dichloroethene are summarised in Table 1. This information was used for the ‘Mackay level 1’ model (Mackay, 1999, version 2.11), developed by the Environmental Modelling Centre, Trent University, Canada, to determine the environmental distribution of the substance. The results indicated a main tendency of 1,1-dichloroethene to partition to air (99.8 %).

The amount distributed to water, soil and sediment was only 0.2 %, 0.008 % and 0.0002 %, respectively. Taking into account the low tendency of partitioning into sediment this compartment was not included in the marine risk assessment of 1,1-dichloroethene.

3.2 Persistence

In water, volatilisation of 1,1,-dichloroethene is expected to be the major removal process. Dilling (1977) found a half-life of 27.2 minutes at 25°C for evaporation for 1 mg/l of 1,1-dichloroethene from a stirred aqueous solution with a depth of 6.5 cm. Calculated half-lives of 1,1-dichlorethene of 6 days in static pond water and 1 day in mobile river water have been reported (IPCS, 1990). With a log K_{ow} of only 1.32-1.66, losses due to sorption for example to sediments, are likely to be modest.

Table 1: Identity and physico-chemical properties of 1,1-dichloroethene

CAS name	Ethene, 1,1-dichloro
Synonyms	Vinylidene chloride, VDC, 1,1-dichloroethylene
Structural formula	$C_2H_2Cl_2$
CAS nr.	75-35-4
EINECS nr	200-864-0
Appearance	volatile, colourless liquid with a 'sweet' odour
Molecular weight	96.95
Melting point	-122.5 ºC (Budavari, 1989)
Boiling point	31.7 ºC (Budavari, 1989)
Aqueous solubility at 21 °C	2.5 g/kg (De Lassus *et al*., 1981)
Vapour pressure at 20 °C	64.5 kPa (ECETOC, 1985)
Henry's Law constant at 20 °C	23.2 kPa.m^3/mol
Log K_{ow}	1.32 (WHO, 2003) 1.66 calculated by Rekker (1977)
Purity	> 99.9 %
Impurities	trans-1,2-dichloroethylene (≤ 250 ppm) dichloroacetylene (≤ 200 ppm) water (≤ 100 ppm)

Tabak *et al.* (1981) measured a microbial degradation of 78% of 1,1-dichloroethene (5 mg/litre) following 7 days incubation at 25 °C in a static culture flask, in the dark, with settled domestic waste water as microbial inoculum. With subsequent incubations (after adaptation), 100% loss of compound occurred. At 10 mg/l, 45% loss was found in the first 7 days of incubation. Activated sludge treatment of waste water resulted in 97% removal of 1,1-dichloroethene at an inflow concentration of 0.04 mg/l (Patterson and Kodukala, 1981). These data suggest a possible role of biodegradation. However, the evidence is not conclusive and volatilisation may be responsible for some of the measured losses from the hydrosphere.

Recently, a mixed culture of methane-utilising bacteria was found to degrade 1,1-dichloroethene from 630 to 200 µg/l following incubation in sealed culture bottles for 48 h. The products were non-volatile chlorinated substances and the corresponding amount of degradation using a dead culture was from 520 to 350 µg/l. Vogel and McCarty (1987) have reported that anaerobic microorganisms can completely convert 1,1-dichloroethene to vinyl chloride by reductive dehalogenation. Vinyl chloride can subsequently be mineralised to carbon dioxide. Some additional references about biotransformation can be found in WHO (2003).

3.3 Bioaccumulation

A few studies have investigated bioaccumulation in aquatic organisms. Bioconcentration factors (BCFs) measured in these studies are very low; a BCF of 6.9 for an unknown fish species and <13 for carp, *Cyprinus carpio,* have been found (WHO, 2003). This is consistent with the low log K_{ow} and suggests that bioaccumulation of 1,1-dichloroethene in aquatic organisms is unlikely to be of concern and therefore secondary poisoning was not considered further in this targeted risk assessment. In a paper presenting an improved analytical method for body residue analysis, Roose and Brinkman (1998) reported a concentration of 15 ng/g wet weight 1,1-dichloroethene in one eel collected near Antwerp in the Scheldt Estuary. However, the measured level was below the detection limit in 2 other eels from the same site. The measured concentration of 1,1-dichloroethene in eel may be due to aqueous exposure to 1,1-dichloroethene but on the other hand metabolism of other chlorinated substances may result in the formation of 1,1-dichloroethene.

4. PRODUCTION, USE AND EMISSIONS

1,1-Dichloroethene is not known to occur naturally. In Europe 1,1-dichloroethene is currently only manufactured by Solvin in France. In 2004 the total amount produced by Solvin in France was less than 60,000 tonnes.

An amount of 40-50% is used for on-site production of polyvinylidene chloride (PVDC) and for the production of PVDC in Germany (also Solvin). PVDC is mainly used for food and pharmaceutical packaging.

An amount of 40-50% is used on-site in France for the manufacturing of dichlorofluoroethane (HCFC-141b) and 1-chloro-1,1-difluoroethane (HCFC-142b).

Less than 10% of the produced amount of 1,1-dichloroethene is sold (placed on the market) to industrial customers who use it for the production of other chemicals or plastics. They use it, for example, for the production of PVDC and it is also used as an intermediate in the agrochemical and pharmaceutical industry.

The information presented above shows that 1,1-dichloroethene is only used as chemical intermediate and therefore emissions to the environment are expected to be limited. In the past the production capacity was higher and it has been used for other applications (BUA, 1988). Based on the available information 1,1-dichloroethene is not imported in Europe. A small amount of 1,1-dichloroethene seems to be produced and used in Russia.

5. EXPOSURE ASSESSMENT

5.1 Collection of measured data

Information on environmental concentrations of 1,1-dichloroethene was obtained from an on-line literature search, from databases and through personal contacts. The literature search was performed using the Web of Science database, which contains references from online peer-reviewed scientific journals dating back to 1988. The substance name and several synonyms of 1,1-dichloroethene were combined with matrix names, i.e. environmental compartments. The literature search revealed only one publication which reported 1,1-dichloroethene concentrations in water of the river Elbe (Götz *et al.*, 1998).

Additionally, several scientists and institutes involved in monitoring were contacted:
- Mr. P. Roose from MUMM (Management Unit of the North Sea Mathematical Models and the Scheldt Estuary, Belgium),
- Dr. T. Huybrechts (Ghent University, Research group Environment, Organic Chemistry and Technology),
- RIZA (The Netherlands) and their website Waterstat/Waterbase (http://www.waterstat.nl/),
- CEFAS (United Kingdom),
- WRc (United Kingdom)
- the Environment Agency (United Kingdom),
- IFREMER (France) and
- Instituto Español de Oceanografia (Spain).

Monitoring data were kindly provided by Dr. T. Huybrechts (Ghent University) and by Dr. J. Staeb (RIZA).

5.2 Evaluation of measured data

RIZA monitoring data (see Appendix I) show that 1,1-dichloroethene was only detected at sampling stations on the River Meuse at Eijsden (Dutch-Belgian border) and further downstream at Belfeld, where concentrations of 0.01 and 0.02 µg/l were measured in winter. In most cases (85%) the measured concentration was below the detection limit of 0.01 µg/l. Only 7 observations were higher, giving 0.01 µg/l and once 0.02 µg/l.

In the Scheldt Estuary, the concentration of the compound was measured at 14 different locations in 1998, 1999 and 2000 (see Appendix II). Water samples were taken twice a year, April/May and October/November, from these 14 stations along the transect from Vlissingen (location S01) to Temse (location S27). At three sites (S22, S26, S27) 1,1-dichloroethene was detected in all samples at levels between 1.1 and 7.8 ng/l, while at the other sites the measured concentration was lower than the detection limit (1.7 ng/l) in one or several cases. The highest concentration measured was 10.5 ng/l (site S04, 20 May 1998).

In the North Sea 1,1-dichloroethene was measured at 10 different locations and samples were taken in the period 1998-2000 (see Appendix III). In North Sea samples the concentrations ranged from below the detection limit (<1.7 ng/l) to 12.6 ng/l (see Appendix IV). At one location (NS2) 1,1-dichloroethene was detected in all 4 samples with levels between 0.9 and 2.2 ng/l.

Götz *et al*. (1998) reported somewhat higher water concentrations of 27 ng/l in the River Elbe at Zollenspieker near Hamburg in 1992 and 29 ng/l at Seemannshöft sampling stations, probably representing higher impact areas. These concentrations are low compared to German drinking water quality criteria for other chlorinated ethenes (1000 ng/l) reported in the same paper.

5.3 PEC derivation

The environmental concentrations measured for 1,1-dichloroethene indicate concentrations in water in the ng/l range. The data from The Scheldt estuary and the North Sea from Huybrechts represent the most extensive and most accurate dataset from which to derive a regional PEC for the marine environment. The combined data were statistically analysed according to Govaerts *et al*. (2001). The method estimates the parameters of a log-normal distribution at each location (by applying the maximum likelihood approach) and aggregates all local distributions into a regional one. Data below the detection limit (DL) are assumed to be DL/2 which has been demonstrated to give satisfactory results (Govaerts *et al*., 2001). The results of the statistical evaluation are presented in Table 2. The mean value and 90th percentile of the concentration distribution of this combined data set represents the typical and worst case concentrations used for the risk assessment.

Table 2. Results of statistical evaluation of the data presented in Appendices II and IV

Year	Number of data	% above DL	Mean (ng/l)	90-percentile (ng/l)
1998	45	52	2.1	3.7
1999	45	81	1.9	3.8
2000	41	29	1.2	2.4
All	131	54	1.8	3.5

6. EFFECT ASSESSMENT

Because of the high volatility of this chemicals studies carried out in enclosed systems, where volatilisation is restricted and using analysed exposure concentrations, are considered more reliable than those carried out under static conditions in open systems or using nominal concentrations.

In the EC Technical Guidance Document on Risk Assessment (EC, 2003) it was recognised that in the marine environment an important part of any evaluation of data must involve an assessment of the usefulness of the main body of freshwater ecotoxicity data in predicting effects in the marine environment. It was recommended that available data be pooled and freshwater acute and chronic effect data be used in lieu of, or in addition to, saltwater effects data for risk assessment purposes. PNEC values should then be derived from the most sensitive endpoint, regardless of medium. As a consequence, this section summarises and assesses both the marine and the freshwater toxicity data.

All the data provided are for single species laboratory studies in which toxicity was assessed in the absence of sediment. Four taxonomic groups (10 species, including 5 fish) are represented by the freshwater data and three taxonomic groups (4 species, including 2 fish) by the marine data. The majority of the studies with fish and invertebrates were acute toxicity tests. Reported acute effects data for algae, invertebrates and fish are in the 10s to 100s mg/l range and 1-100 mg/l range following chronic exposure. More details are provided below.

6.1 Marine organisms

For the marine environment, data are limited to four species: one alga, one arthropod and two fish species. These are summarised in Appendix V and assessed in more detail below. A 96 hour NOEC (effect on chlorophyll a and cell count) of 712 mg/l has been reported for the marine diatom, *Skeletonema costatum*. However, since a 96 hour EC50 for the same effect is also reported as >712 mg/l this suggests that the NOEC value is in fact the highest concentration tested and therefore concentrations higher than 712 mg/l would not necessary have effects on the algae. An additional test with higher test concentrations could have resulted in a higher NOEC value. For invertebrates, a 96 hour LC50 of 224 mg/l was reported for mysid shrimp, *Mysidopsis bahia*.

Acute toxicity data of 1,1-dichloroethene to marine fish are available for two species. Sheepshead minnow, *Cyprinodon variegatus*, and inland silverside, *Menidia beryllina,* appear to exhibit a very similar sensitivity with 96 hour LC50s of 249-250 mg/l. For sheepshead minnow a 96 hour NOEC of 80 mg/l was also reported. The endpoints of these fish tests were based on nominal concentrations and open test systems were used.

6.2 Fresh water organisms

Freshwater toxicity data are available for bacteria, algae, crustaceans *(D. magna*) and fish. These are summarised in Appendix VI and are assessed below.

Information on the sensitivity of two algal species to 1,1-dichloroethene is available. Brack and Rottler (1994) report the most sensitive algal data with a 72 hour EC10 and EC50 (chlorophyll a content) of 3.94 and 9.12 mg/l respectively, for *Chlamydomonas reinhardtii*. Despite reporting effects data nearly two orders of magnitude lower than other algal studies, the study was carried out in an enclosed system using measured concentrations and can be considered to be of high reliability. A 96 hour EC10 for reduction in cell number of 240 mg/l has been reported for *Scenedesmus subspicatus*. However, this study appears to report unmeasured concentrations and is carried out under static conditions. It may therefore be less reliable, for example because it may underestimate toxicity as actual exposure concentrations are likely to be lower than nominal values.

For freshwater invertebrates, three data from two studies are available for *D. magna* exposed under acute conditions. Effect concentrations (EC/LC50s) have been found in the range 11.6-79 mg/l. The studies were carried out under static conditions, with no analysis carried out and so, again, they should be considered of lower reliability.

With respect to freshwater fish, toxicity data are available for 5 different species. However, the majority of these are concerned with acute exposure. Effect concentrations are in the low to mid mg/l range (i.e. 29 - >500 mg/l range). The lowest of these is a 7 day LC50 of 29 mg/l reported for fathead minnow, *Pimephales promelas*, for which concentrations were measured and exposure was carried out under flow-through conditions. A 13 day LC50 of 29 mg/l has also been reported for fathead minnow (US EPA, 1980).

Two studies report effects following chronic (long-term) exposure. One study (Hawkins *et al.,* 1985) reports hepatic neoplastic lesions in killifish, *Oryzias latipes* and guppy, *Poecilia reticulata*, following 3 months exposure to 40 mg/l 1,1-dichloroethene. However, this is not an appropriate endpoint on which to base an effect assessment, because its ecological significance is not known. Besides, lower effect concentrations have been reported even in acute studies with fish. The other study, which investigates effects on early life stages of fathead minnow (*P. promelas*) reports that no adverse effects were observed at the highest concentration tested, 2.8 mg/l. In the absence of a LOEC, it is not possible to determine whether the value provided is a ‘true’ NOEC. This also appears to be the case (it was not possible to obtain the original paper) for a NOEC of 500 mg/l reported for the zebra fish, *Brachydanio rerio*. In addition, no exposure time could be obtained and therefore the reliability of this result is considered to be low.

6.3 PNEC for marine environment

Data are available for algal, invertebrate and fish species for both the marine and freshwater environment. All data provided are for single species laboratory studies where toxicity was assessed in the absence of sediment. By far the majority of information is concerned with acute exposure, although a few studies are also available for chronic (long-term) exposure. It is clear that, based on acute data, the effects concentration for saltwater species lies in the middle of the range of acute effects concentrations for the freshwater dataset. There is no indication of a difference between fresh and saltwater species sensitivities. On this basis, a combination of the two datasets can be justified.

Because of the high volatility of 1,1-dichloroethene, studies carried out in closed systems where volatilisation is restricted and using analysed exposure concentrations, are considered more reliable than those carried out under static conditions using nominal concentrations. Long-term NOECs (or EC10 that can be effectively considered a NOEC) have only been reported for the salt and freshwater algae, *Skeletonema costatum* and *Chlamydomonas reinhardtii*, respectively and for early-life stages of fathead minnows. This means that insufficient data are available to apply a safety factor of 100 or lower according to the Technical Guidance Document (EC, 2003). In addition, the NOEC reported for fathead minnow was the highest concentration tested and in the absence of a LOEC it is not possible to determine whether the value provided is a ‘true’ NOEC. Consequently, it is also not possible to apply a safety factor of 500 or 1000 (EC, 2003). The absence of data for sufficient taxonomic groups also makes it impossible to apply the safety factor of 1000 based on acute marine data (EC, 2003). Even within the invertebrates, data are restricted to crustacea and to only two species, one of which (*D. magna*) is a freshwater species.

However, sufficiently good quality data are available to apply a safety factor of 10000. This requires the lowest short-term L(E)C50 from fresh or saltwater representatives of three taxonomic groups (algae, crustaceans and fish) of three trophic levels.

The critical studies have already been discussed in Section 6.2 with the lowest, most reliable data being for:

- a 72 hour EC50 (chlorophyll a content) 9.12 mg/l for *Chlamydomonas reinhardtii*
- a 48 hour EC50 11.6 mg/l for *D. magna*
- a 7 day LC50 of 29 mg/l for fathead minnow

From these studies the lowest relevant and reliable concentration is the 72 hour EC50 (chlorophyll a content) 9.12 mg/l for *Chlamydomonas reinhardtii* (Brack and Rottler, 1994). Applying an assessment factor of 10000 to this value, as required by the Technical Guidance Document (EC, 2003), results in a PNEC of 0.9 µg/l, which is proposed as the PNEC for the protection of marine life.

7. RISK ASSESSMENT CONCLUSION

The most extensive dataset, to estimate the exposure of marine organisms to 1,1-dichloroethene in the North Sea, was provided by Huybrechts (Ghent University, Belgium). Based on a total number of 131 samples (period 1998-2000) the typical PEC (average of all samples) was 1.8 ng/l, while the worst-case PEC (90-percentile) was 3.5 ng/l.

The PNEC for the marine environment, derived according to the Technical Guidance Document (EC, 2003) was 900 ng/l. The PNEC was derived from the 72h EC50 of 9.12 mg/l for *Chlamydomonas reinhardtii* (Brack and Rottler, 1994) with a safety factor of 10000.

The results of the PEC/PNEC comparison are presented in Table 3. Both scenarios have considerable safety margins, ranging from 257 to 500. This indicates that the current use of 1,1-dichloroethene does not pose a risk to the marine environment. The highest concentration measured by Huybrechts was 12.51 ng/l. Based on the data from Staeb (RIZA, The Netherlands) the highest concentration of 1,1-dichloroethene measured in surface water from The Netherlands was 20 ng/l. These maximum concentrations are still considerably lower than the PNEC and thus do not suggest any risk for marine organisms living in the North Sea.

Table 3. Overview of the PEC/PNEC ratios for the various scenarios

Scenario	PEC (ng/l)	PNEC (ng/l)	PEC/PNEC	Margin of safety
Marine, typical	1.8	900	0.002	500
Marine, worst-case	3.5	900	0.004	257

8. DISCUSSION

The risk assessment that was carried out used the quotient analysis approach and followed guidance developed for legislation of chemicals in the European Union (EC, 2003). There are two important additional points to note. First, the assessment has focused on regional conditions, using concentrations that reflect this rather than concentrations for local circumstances. There could therefore still be local concerns in certain circumstances that might need to be evaluated. Second, the PNEC was derived on the basis of application factors specified in the Technical Guidance Document from 2003. When updating the 2003 version from the 1996 version extra application factors have been included in the marine assessments to allow for the increased biodiversity in marine as compared with freshwater ecosystems. Such an adjustment is not without contention since, taxa for taxa, there do not appear to be consistent differences in sensitivity between freshwater and marine organisms (ECETOC, 2001). Thus all will depend upon the relative sensitivity of taxa such as ctenophores, anemones and cephalopods, that are unique to the marine environment but for which there are few if any ecotoxicological data. In this risk assessment a careful approach was followed by using the safety factors of the Technical Guidance Document - 2003 version, although there seems currently no scientific basis for those higher factors (ECETOC, 2001; CSTEE, 2002). That means that the calculated risk quotients are probably a factor 10 too high and the actual margins of safety range from 2570 – 5000. However, in all cases this risk assessment has demonstrated that for 1,1-dichloroethene no environmental risks should be expected for either approach.

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Appendix I: Measured concentrations (raw data) of 1,1-dichloroethene in surface water from The Netherlands - Data were provided by Staeb (RIZA, Netherlands)

Location [A]	**Sampling date**	**Concentration (µg/l)** [B]
Belfeld (Meuse)	26-Nov-02	not detected
	23-Dec-02	0.02
	22-Jan-03	0.01
	18-Feb-03	not detected
	18-Mar-03	not detected
	15-Apr-03	not detected
	13-May-03	not detected
	10-Jun-03	not detected
Eijsden (Meuse)	26-Nov-02	not detected
	23-Dec-02	0.01
	21-Jan-03	0.01
	18-Feb-03	not detected
	18-Mar-03	0.01
	15-Apr-03	0.01
	13-May-03	0.01
	10-Jun-03	not detected
Haringvliet	11-Dec-02	not detected
	09-Jan-03	not detected
	05-Feb-03	not detected
	05-Mar-03	not detected
	03-Apr-03	not detected
	01-May-03	not detected
	27-May-03	not detected
	23-Jun-03	not detected
Lobith (Rhine)	27-Nov-02	not detected
	23-Dec-02	not detected
	22-Jan-03	not detected
	19-Feb-03	not detected
	19-Mar-03	not detected
	16-Apr-03	not detected
	14-May-03	not detected
	11-Jun-03	not detected
Maassluis (Nieuwe Waterweg)	04-Dec-02	not detected
	29-Jan-03	not detected
	26-Feb-03	not detected
	26-Mar-03	not detected
	24-Apr-03	not detected
	20-May-03	not detected
	17-Jun-03	not detected
Schaar van Ouden Doel (Scheldt)	20-Nov-02	not detected
	16-Dec-02	not detected
	14-Jan-03	not detected
	11-Feb-03	not detected
	10-Mar-03	not detected
	07-Apr-03	not detected
	06-May-03	not detected
	03-Jun-03	not detected
	01-Jul-03	not detected

[A] Between brackets the river is given. [B] The detection limit was 0.01 µg/l

Appendix II: Measured concentrations (raw data) of 1,1-dichloroethene in surface water from the Scheldt estuary (along transect from Vlissingen to Temse) Data were provided by Huybrechts *et al*., 2003 (Ghent University, Belgium)

Location	Date of sampling	Concentration (ng/l)
S01 (near Vlissingen)	20.5.98	8.08
	15.10.98	< 1.69
	12.5.99	2.28
	3.11.99	1.00
	4.4.00	< 1.69
	13.11.00	< 1.69
S04	20.5.98	10.51
	15.10.98	< 1.69
	12.5.99	1.23
	3.11.99	< 1.69
	4.4.00	1.11
	14.11.00	< 1.69
S07	20.5.98	3.78
	15.10.98	< 1.69
	12.5.99	1.13
	3.11.99	< 1.69
	4.4.00	< 1.69
	14.11.00	< 1.69
S07b	19.5.98	3.71
	14.10.98	< 1.69
	11.5.99	1.44
	2.11.99	< 1.69
	3.4.00	< 1.69
	13.11.00	< 1.69
S09	19.5.98	2.27
	14.10.98	< 1.69
	11.5.99	1.40
	2.11.99	< 1.69
	3.4.00	< 1.69
	13.11.00	< 1.69
S10	19.5.98	< 1.69
	14.10.98	< 1.69
	11.5.99	1.92
	2.11.99	2.29
	3.4.00	< 1.69
	13.11.00	< 1.69
S12	19.5.98	1.61
	14.10.98	< 1.69
	11.5.99	1.90
	2.11.99	3.54
	3.4.00	< 1.69
	13.11.00	< 1.69
S15	19.5.98	2.28
	14.10.98	< 1.69
	11.5.99	1.84
	2.11.99	3.16

	3.4.00	< 1.69
	13.11.00	< 1.69
S15b	19.5.98	2.72
	14.10.98	< 1.69
	11.5.99	3.14
	2.11.99	3.85
	3.4.00	< 1.69
	13.11.00	< 1.69
S18b	19.5.98	2.38
	14.10.98	< 1.69
	11.5.99	3.88
	2.11.99	1.00
	3.4.00	< 1.69
	13.11.00	1.29
S22	19.5.98	3.40
	14.10.98	1.33
	11.5.99	4.55
	2.11.99	1.05
	3.4.00	2.03
	13.11.00	1.55
S24	19.5.98	3.58
	14.10.98	1.09
	11.5.99	< 1.69
	2.11.99	2.07
	3.4.00	3.35
	13.11.00	2.49
S26	19.5.98	3.47
	14.10.98	2.02
	11.5.99	7.78
	2.11.99	2.35
	3.4.00	3.21
	13.11.00	3.17
S27 (near Temse)	19.5.98	5.69
	14.10.98	2.47
	11.5.99	5.96
	2.11.99	2.53
	3.4.00	1.89
	13.11.00	2.28

The detection limit was 1.69 ng/l

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Euro Chlor • Avenue E. Van Nieuwenhuyse 4, box 2 • B-1160 Brussels, Belgium
Tel: +32 2 676 72 11 | Fax: +32 2 676 72 41
e-mail: eurochor@cefic.be | www.eurochlor.org