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

1,1,2-Trichloroethane

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Euro Chlor
representing the chlor-alkali industry

EURO CHLOR RISK ASSESSMENT FOR THE MARINE ENVIRONMENT

1,1,2-Trichloroethane

OSPARCOM Region - North Sea

EXECUTIVE SUMMARY

Euro Chlor has voluntarily agreed to carry out risk assessment of 25 chemicals related to the chlorine industry, specifically for the marine environment and according to the methodology laid down in the EU risk assessment Regulation (1488/94) and the Guidance Documents of the EU Existing Substances Regulation (793/93).
The study consists of the collection and evaluation of data on effects and environmental concentrations. Basically, the effect data are derived from laboratory toxicity tests and exposure data from analytical monitoring programs. Finally the risk is indicated by comparing the “predicted environmental concentrations” (PEC) with the “predicted no effect concentrations” (PNEC), expressed as a hazard quotient for the marine aquatic environment.
To determine the PNEC value, three different trophic levels are considered: primary producers (aquatic plants), primary consumers (invertebrates) and secondary consumers (fishes).
In the case of 1,1,2-trichloroethane (T112) 22 data for fish, 44 data for invertebrates and 9 data for algae have been evaluated according to the quality criteria recommended by the European authorities. Both acute and chronic toxicity studies have been taken into account and the appropriate assessment factors have been used to define a final PNEC value of 300µg/l.

All the monitoring data available indicate a progressive decrease of the 1,1,2-trichloroethane concentration in surface waters since 1983 up to now. Most of the available monitoring data apply to rivers and estuary waters and were used to calculate PEC’s. The most recent data (1991-1995) support a typical PEC of 0.01 µg T112/l water and a worst case PEC of 5 µg T112/l water. The calculated PEC/PNEC ratios give a safety margin of 60 to 30,000 between the probable no effect concentration and the exposure concentration. Dilution within the sea would of course increase those safety margins.

Moreover, as the available data on persistence of 1,1,2-trichloroethane indicate a half-life less than two days and as the bioaccumulation in marine organisms can be considered as negligible, it can be concluded that the present use of 1,1,2-trichloroethane does not represent a risk to the aquatic environment.

1. INTRODUCTION : PRINCIPLES AND PURPOSES OF EURO CHLOR RISK ASSESSMENT

Within the EU a programme is being carried out to assess the environmental and human health risks for "existing chemicals", which also include chlorinated chemicals. In due course the most important chlorinated chemicals that are presently in the market will be dealt with in this formal programme. In this activity Euro Chlor members are cooperating with member state rapporteurs. These risk assessment activities include human health risks as well as a broad range of environmental scenarios.

Additionally Euro Chlor has voluntarily agreed to carry out limited risk assessments for 25 prioritised chemicals related to the chlorine industry. These compounds are on lists of concern of European Nations participating in the North Sea Conference. The purpose of this activity is to explore if chlorinated chemicals presently pose a risk to the marine environment especially for the North Sea situation. This will indicate the necessity for further refinement of the risk assessments and eventually for additional risk reduction programmes.

These risk assessments are carried out specifically for the marine environment according to principles given in *Appendix 1*. The EU methodology is followed as laid down in the EU risk assessment Regulation (1488/94) and the Guidance Documents of the EU Existing Substances Regulation (793/93).

The exercise consists in the collection and evaluation of data on effects and environmental concentrations. Basically, the effect data are derived from laboratory toxicity tests and exposure data from analytical monitoring programs. Where necessary the exposure data are backed up with calculated concentrations based on emission models.

Finally the risk is indicated by comparing the "predicted environmental concentrations" (PEC) with the "predicted no effect concentrations" (PNEC), expressed as a hazard quotient for the marine aquatic environment.

2. DATA SOURCES

The data used in this risk assessment activity are primarily derived from the data given in the HEDSET (updated version of 11/95) for this compound. Where necessary additional sources have been used. For interested parties the HEDSET is available at Euro Chlor. The references of the HEDSET and additional sources are given in chapter 10.

3. COMPOUND IDENTIFICATION

3.1 Description

CAS number	: 79-00-5
EINECS number	: 201-166-9

EEC number : 602-014-00-8
IUPAC name : 1,1,2-trichloroethane

1,1,2-trichloroethane is also known as beta-tri and is sometimes abbreviated to T112. Other synonyms which are used include:

- beta-T
- beta-trichloroethane
- ethane trichloride
- vinyl trichloride

1,1,2-trichloroethane has the following formula:

$C_2H_3Cl_3$

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      H     H
       \   /
  Cl - C - C- Cl
        /   \
      H      Cl
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3.2 EU labelling

According to Annex I of Directive 93/72/EEC (1.9.93 - 19th TPA), 1,1,2-trichloroethane is classified as harmful by inhalation, in contact with skin and if swallowed (Xn, R 20/21/22). This classification is applicable for both the pure compound and products containing ≥ 5 % of 1,1,2-trichloroethane.

Environmental labelling was discussed at the EU Working Group; the proposition that 1,1,2-trichloroethane should not be classified as “dangerous for the environment” according to the EU criteria was adopted.

4. PHYSICO-CHEMICAL PROPERTIES

Table 1 gives the major chemical and physical properties of the compound which were adopted for the purpose of this risk assessment.

Table 1 : Physical and chemical properties of 1,1,2-trichloroethane

Property	**Value**
Molecular weight	133.4
Aspect	colourless liquid
Melting point	-35 to -37 °C
Boiling point	113-114 °C at 1013 hPa
Decomposition temperature	> 110 °C
Density	1.44
Vapour pressure	23 hPa at 20°C
log octanol-water partition coefficient log Kow	1.89 (measured)
log Koc (5 % OC)	1.85
Water solubility	4.4-4.5 g/l
Henry's Law constant	100 Pa.m^3/mol

5. COMPARTMENT OF CONCERN BY MACKAY LEVEL I MODEL

The risk assessment presented here focuses on the aquatic marine environment, with special attention to the North Sea conditions where appropriate. Although this risk assessment only focuses on one compartment, it should borne in mind that all environmental compartments are inter-related.
An indication of the partitioning tendency of a compound can be defined using Mackay level I calculation obtained through the ENVCLASS software distributed by the "Nordic Council of Ministers". This model describes the ultimate distribution of the compound in the environment (Mackay et al., 1990; Pedersen et al., 1994).

It should be recognized, however, that this model takes no account of transfer rates between compartments, the compartment into which the chemical is discharged, or any removal processes within compartments. Hence it is not designed to predict environmental concentrations for the purpose of risk assessment.

The results of such a calculation for 1,1,2-trichloroethane are given in Table 2.

Table 2 : Results of a Mackay level I calculation for 1,1,2-trichloroethane

Compartment	**%**
Air	96.04
Water	3.92
Soil	0.02
Biota	0.02

(See *Appendix 2* for details of calculations)

6. USE AND APPLICATIONS

1,1,2-Trichloroethane is produced as a process intermediate and can be found in the streams of some other chemical processes (e.g. 1,2-dichloroethane, chlorinated solvents, …). 1,1,2-Trichloroethane is not a marketable end use product.

7. EFFECT ASSESSMENT

As a first approach, are only taken into consideration in this chapter only considers the following three trophic levels: primary producers (aquatic plants), primary consumers (invertebrates) and secondary consumers (fish). The effects on other organisms are only discussed when indicated.

The evaluation of the data was conducted according to the quality criteria recommended by the European authorities (Commission Regulation 1488/94/EEC).The evaluation criteria are given in Appendix 1.

Documented data from all available sources, including company data and data from the open literature, were collected and incorporated into the HEDSET for 1,1,2-trichloroethane, including their references (updated version of 11/95).
A summary of all data is given in Appendix 3. In total 22 data for fish, 44 data for invertebrates and 9 data for algae are given. Respectively 15, 26 and 7 data were considered valid for risk assessment purposes. For the respective taxonomic groups, 6, 15 and 0 should be considered with care, and 1, 3 and 2 data respectively were judged as not valid for risk assessment.

It is necessary to distinguish the acute studies (LC50/EC50) from chronic studies NOEC/LOEC). In the tables presented in Appendix 3, the data are ranked based on class (fish, invertebrates, algae), criterion (LC50/EC50, NOEC/LOEC), environment (freshwater, saltwater) and validity (1, 2, 3, 4).

The different trophic levels are reviewed hereafter. The reference numbers are those listed in the Table of Appendix 3 and given in Appendix 6.

7.1. Marine fish

Twelve acute toxicity studies are reported for two marine fish species, from which five were performed with early lifestage (eggs, larveae, fry) which are unadequate to assess acute toxicity study (normally based on adult fish). The lowest LC50 value for early lifestage species is observed for eggs/larvae of Pleuronectes platessa with a 7h LC50 of 6 mg/l (Adema et al., 1981). The seven studies conducted with adult or juvenile fish are considered valid as they were performed under semistatic conditions with an adequate analysis of the solutions.

The lowest acute toxicity value is observed for Pleuronectes platessa with a 48h LC50 of 34 mg/l (Adema et al., 1981).

One long-term toxicity study is also available and valid (semistatic conditions, measured concentrations and control of volatility).

This represents the lowest toxicity value for marine fish, Pleuronectes platessa eggs, with a 28d NOEC of 3 mg/l (Adema et al., 1981).

All remaining data are for freshwater organisms.

7.2 Freshwater fish

Seven acute toxicity studies are reported for freshwater fish species; two were conducted in a flow-through system on *Jordanella floridae* and *Pimephales promelas* (Smith et al., 1991 - Ahmad et al., 1984 - USEPA, 1980 - Walbridge et al. 1983); for both studies, the results were based on measured concentrations and are considered valid.

A static study with *Poecilia reticulata* (Adema et al., 1981) used capped vessels to reduce volatility and the test concentration was controlled with an adequate analytical method so that this study is also considered valid.

Two other 7d studies with *Poecilia reticulata* are reported. Both were conducted under semistatic conditions but only one gives results expressed as measured concentrations and is considered valid (Konemann, 1981); the other one was based on nominal concentration and for that reason should be used with care (Adema et al., 1981).

Another static study with *Lepomis macrochirus* (USEPA, 1980 - Buccafusco et al., 1981) was performed in a closed system but results were expressed as nominal concentrations.This study is considered valid but should be used with care and represents the lowest acute toxicity value with a 96h LC50 of 40 mg/l (USEPA, 1980 Buccafusco et al., 1981).
Reliability is not assignable for the remaining study with *Leuciscus idus* (Juhnke and Luedemann, 1978) as the identification of the test compound is undefined (isomer 1,1,1- or 1,1,2 trichloroethane).

Three long-term studies with early life stages of *Jordanella* and *Pimephales* are valid as they were performed in a flow-through system with analysis of test solutions (Smith et al., 1991 - Ahmad et al., 1984).

The lowest toxicity value for freshwater fish is observed for *Pimephales promelas* (eggs) with a 32d NOEC of 15 mg/l (Ahmad et al., 1984).

7.3 Marine invertebrates

Twenty five acute toxicity studies are reported for nine marine invertebrate species ; eight studies were conducted with larvae of *Artemia salina* or *Chaetogammarus marinus*, under static or semistatic conditions, but the results were expressed as measured concentrations so that these studies are considered valid but should be used with care because larval forms were employed (Adema et al., 1981).

The lowest value is observed for larvae of *Artemia salina* with an EC50 of 62, 40 and 36 mg/l after 48h, 96h and 7d exposure, respectively.

The other studies (Adema et al., 1981) were performed with various adult species, under static or semistatic conditions; the test compound was systematically measured by an adequate analytical method; in some cases, the volatility was limited by using capped vessels. The results ranged from 42 up to 190 mg/l as EC50 after 6h up to 14d exposure. These results are considered valid but, in some cases, they have to be considered with care as the exposure period or lifestage are not standard.

There are still two remaining studies; one is non-valid as the test description is lacking (Rosenberg et al., 1975); for the second one, the reliability is not assignable as the isomer used as test compound is undefined (1,1,1- or 1,1,2-trichloroethane) (Pearson et al., 1975).

The lowest acute toxicity value for marine invertebrate is observed for *Crangon crangon* with a 6h and 7d EC50 of 43 and 42 mg/l, respectively (Adema et al., 1981).

Two long-term toxicity studies (Adema et al., 1981) are reported for marine invertebrates. Both were conducted under semistatic conditions and results were expressed as measured concentrations so that they are both considered valid without restriction.

The lowest measured NOEC was observed with *Artemia salina* tested during 21 days for reproduction and for mobility and was 10 mg/l.

7.4 Freshwater invertebrates

Six 24-48h EC50 values are reported for *Daphnia magna* in the range form 18 to 81 mg/l; these results were obtained from studies conducted under static conditions.
For *Daphnia magna*, the lowest 48h EC50 of 18 mg/l (USEPA, 1980 - LeBlanc, 1980) is a nominal concentration and there was no control of volatile losses in the test system so that this study is considered valid but should be used with care.

A 7d EC50 of 43 mg/l (Adema et al., 1978 - Adema et al., 1981 - USEPA, 1980) is also available and considered valid (semistatic conditions and measured concentration).

The 16d study with *Daphnia magna* giving and EC50 of 2.9 mg/l is considered non-valid as obtained by a QSAR method (Hermens et al., 1984).

Five studies were conducted under flow-through conditions with two other species; two of them were early lifestage studies on *Lymnaea stagnalis* and resulted in a measured 96h and 7d EC50 of 170 and 140 mg/l, respectively; they are both considered valid but should be used with care (early life stages). Three other studies on adult on *Dreissena polymorpha* gave measured 96h, 7d and 14d EC50 of 320 mg/l, 190 and 140 mg/l, respectively (Adema et al., 1981). They are considered valid without restriction.

Four long-term studies with two freshwater invertebrate species are reported; the lowest NOEC for reproduction was observed with *Daphnia magna* exposed to 1,1,2-trichloroethane during 21 days under semistatic conditions, giving a measured NOEC of 18 mg/l (Adema et al., 1978 - Adema et al., 1981 - USEPA, 1980). This result is considered valid.

Two lower NOEC are related to other endpoints. Firstly, *Daphnia magna* was evaluated for growth/length during 28 days giving a measured NOEC of 13 mg/l; a control of volatile losses was provided during the study (Ahmad et al., 1984 - Call et al., 1983 - Richter et al., 1983).

Secondly, the mobility of *Lymnaea stagnalis* was tested during 16 days under flow-through conditions; the measured NOEC was 10 mg/l and is the lowest value reported (Adema et al., 1981). Both studies are considered valid without restriction.

7.5 Marine algae

Four studies (Adema et al., 1981) are reported for four marine algae species; 96h EC50 based on growth are in the range 60 to 260 mg/l; these results are based on measured concentration and the test system was controlled for volatile losses. These studies are considered valid without restriction.

The lowest toxicity value for marine algae is observed for *Phaeodactylm tricornutum* with a 96h EC50 of 60 mg/l (Adema et al., 1981).

7.6 Freshwater algae

Reliability is not assignable for two studies with *Microcystis aeruginosa* (Bringmann et al., 1978a, 1978b) and for *Scenedesmus quadricauda* (Bringmann et al., 1980) as the identification of the test compound is not precisely defined (isomer 1,1,1- or 1,1,2-trichloroethane).

The three other studies are all considered as valid even if a non-standard methodology is applied. The lowest observed effect concentration was obtained with *Chlamydomonas reinhardtii* (Brack et al., 1994) tested for 72 hour in a closed system (CO_2 was provided by a buffer $K_2CO_3/KHCO_3$). The measured EC50 and corresponding LOEC for growth were 57 and 26.3 mg/l, respectively.

7.7 PNEC for marine environment

From an evaluation of the available toxicity data for aquatic organisms it is reasonable to conclude that the sensitivity of both marine and freshwater organisms to 1,1,2-trichloroethane is quite similar.

A summary of the valid data selected for the derivation of PNEC values at different levels is given in Table 3.

The final PNEC which is calculated for this risk assessment is 300 µg/l.
If all data are taken into account, no effect is observed below 3 mg/l.

7.8 Bioaccumulation

Bioaccumulation of 1,1,2-trichloroethane in aquatic species is unlikely in view of its physical, chemical and biological properties.

A bioconcentration factor of less than 100 is reported for fresh river fish cyprinus carpio, 39 for rainbow trout, and 17 for bluegill sunfish (Veith at al., 1983). A measured log Pow gives a figure of 1.89 (UBA, 1994).

7.9 Persistence

As indicated by the Henry’s law constant, 1,1,2-trichloroethane entering aquatic systems would be transferred to the atmosphere through volatization. A half life in water ranges from 30 min. (calculated) to 102 min. (experimental with a 1 ppm concentration water) (Barrow et al., 1978). Monitoring in the Rhine river has given a half life of 1.9 day (UBA, 1994).

The tropospheric half life of 1,1,2-trichloroethane is about 2 months.
This relatively short half life implies that no effect of 1,1,2-trichloroethane can be expected on stratospheric ozone depletion and global warming.

7.10 Conclusion

It can be deduced from the above information that 1,1,2-trichloroethane is not a “persistent, toxic and liable to bioaccumulate “ substance as mentioned by the Oslo and Paris Conventions for the Prevention of Marine Pollution (OSPARCOM) according to the criteria currently under discussion and especially those defined by UN-ECE, Euro Chlor and CEFIC.

Table 3 : Summary of ecotoxicity data selected for the PNEC derivation, with the appropriate assessment factors for 1,1,2-trichloroethane

Available valid data	**Assessment factor applied to the lowest LC50/EC50 or NOEC/LOEC**	**Comments**
At least 1 short-term LC50 from each trophic level (fish, daphnia, algae)	1000 **PNEC = 18 µg/l**	– *Lepomis macrochirus*, LC50, 96h = 40 mg/l (nominal concentration); Buccafusco et al, 1981 – *Pleuronectes platessa*, LC50, 48h = 34 mg/l; Adema et al, 1981 – *Daphnia magna*, EC50, 48h = 18 mg/l (nominal concentration); Le Blanc et al, 1980 – *Artemia salina*, EC50, 48h = 62 mg/l; Adema et al, 1981 – *Chlamydomonas reinhardtii*, EC50, 72h = 57 mg/l; Brack et al, 1994 – *Phaeodactylum tricornutum*, EC50, 96h = 60 mg/l; Adema et al, 1981
Long-term NOEC from at least 3 species representing three trophic levels (fish, daphnia, algae)	10 **PNEC = 300 µg/l**	– *Pimephales promelas* (eggs), NOEC, 32d = 15 mg/l; Ahmad et al, 1984 – *Pleuronectes platessa* (eggs), NOEC = 3 mg/l; Adema et al, 1981 – *Lymnaea stagnalis*, NOEC, 16d = 10mg/l; Adema et al, 1981 – *Artemia salina*, NOEC, 21d = 10 mg/l; Adema et al, 1981 – *Chlamydomonas reinhardtii*, LOEC, 72h = 26.3 mg/l; Brack et al, 1994
Field studies	case by case : X **PNEC = -**	No data

8. EXPOSURE ASSESSMENT

The exposure assessment is essentially based on exposure data from analytical monitoring programmes. 1,1,2-trichloroethane has been measured in a number of water systems. These levels in surface waters (river water and marine waters) are detailed in *Appendix 4*.
References of the available monitoring data can be found in HEDSET Data Sheet for 1,1,2-trichloroethane (updated version of 11/95). Additional sources have been also used. All the references are given in *Appendix 7*.

As it is generally not specified if the location of sampling is close to a source of emission (production or processing), it is assumed that the lower levels correspond to the background "regional" concentrations and the higher to contaminated areas, or "local" concentrations, considered as worst cases.

As the only presence of 1,1,2-trichloroethane is as impurity in the stream of some chemical processes, only point sources have to be considered.

8.1 Marine waters

In coastal waters and estuaries, observed concentrations are in a range from below 0.01 µg/l up to 0.06µg/l. Typical recent monitoring data for 1,1,2-trichloroethane in coastal waters and estuaries which are part of the OSPARCOM region are given hereafter and illustrated on the North. Sea map in *Appendix 5*.

Elbe estuary (D)	< 0.01-0.03 µg/l	1992
Weser estuary (D)	< 1 µg/l	1985-1987
Rhine (D/NL Border)	< 5 µg/l	1986-1989
Rhine (NL)	< 0.1 µg/l	1990-1991
Ijsselmeer (NL)	< 0.1 µg/l	1990-1991
Meuse (B/NL Border)	0.02-0.06 µg/l	1993
Coastal water		
Nordsee (D)	0.001-0.024 µg/l	1981
Ostsee	< 0.001 µg/l	1981

Remarks:

1. The symbol < indicates that the value is under the detection limit of the analytical method.
2. Due to the low level of observed concentrations of 1,1,2-trichloroethane, various monitoring programs have been stopped.

8.2 River waters

Background levels of 1,1,2-trichloroethane in typical river in non-industrialized area are in general lower than 0.1 ? g/l. In the Rhine river water and other adjacent industrialized rivers, up to 5 ? g/l is measured (worst case). (See *Appendix 4*).

8.3 Other monitoring data

Data on 1,1,2-trichloroethane levels measured in aquatic organisms and sediments are not available, except that, in 1981-82, T112 was not detected in Elbe sediments from Schnackenburg to Scharhoern (isle in the Elbe mouth); the detection limit was 0.1 ? g/kg. (ARGE Elbe, 1982 in *Appendix 7*).

9. RISK ASSESSMENT CONCLUSION

In the risk characterization of 1,1,2-trichloroethane for the aquatic organisms, the PNEC is compared to the PEC.

A PNEC of 300 µg/l was obtained for the aquatic species exposed to 1,1,2-trichloroethane.

In coastal waters and estuaries, 1,1,2-trichloroethane is observed up to 0.06 µg/l (worst case) and a typical marine water concentration is below 0.01 µg/l.

In non-industrialized areas, a typical river water concentration below 0.1 µg/l was derived from the measured levels; a worst case was also identified in industrialized zone with measured levels up to 5 µg/l.

These selected values allow to calculate the ratios PEC/PNEC which are summarized in Table 4.

Table 4: Calculation of PEC/PNEC ratios for 1,1,2-trichloroethane

Type of water	PEC level	PEC/PNEC
Coastal waters/Estuaries		
• typical water	0.01 µg/l	0.000033
• worst case	0.06 µg/l	0.00020
River waters :		
• typical water	0.1 µg/l	0.00033
• worst case	5 µg/l	0.0167

These calculated ratios, **which do not take into account any dilution factor within the sea**, correspond to a safety margin of 60 to 30,000 between the aquatic effect and the exposure concentrations so that the present use of 1,1,2-trichloroethane should not represent a risk to the aquatic environment. In addition, as stated in section 7.8, there is no sign of accumulation in biosphere and hydrosphere.

10. REFERENCES

10.1 General References

Barrows M.E., Petrocelli, S.R., Macek, K.J., Carroll, J.J. (1978): Bioconcentration and elimiation of selected water pollutants by bluegill sunfish (Lepomis macrochirus) in dynamics, exposure and hazard assessment of toxic chemicals; R. Hague Ed.; Ann Arbor, Science 379-392, Ann Aarbor Michigan

Mackay, D., Patterson, S. (1990); Fugacity models; in: Karcher, W., Devillers, J. (Eds); Practical applications of quantitative structure-activity relations in environmental chemistry and toxicology: 433-460

Pedersen, F., Tyle, H., Niemelä, J.R., Guttmann, B., Lander, L., Wedebrand, A. (1994); Environmental Hazard Classification - Data collection and interpretation guide; TemaNord 1994:589

Umweltbundesamt (1994); Daten zur Umwelt, 1992/93 – Erich Schmidt Verlag GmbH - Berlin

Veith, G.D. et al. (1983); Can. J. Fish Aquat. Sci 40, 743-748

10.2 References to ecotoxicity data: *(see Appendix 6).*

Those references are used in *Appendix 3*.

10.3 References to monitoring data: *(see Appendix 7).*

Those references are used in *Appendix 4*.

APPENDIX 1

20/03/97
T112

Environmental quality criteria for assessment of ecotoxicity data

APPENDIX 2

Ultimate distribution in the environment according to Mackay level I model
(details of calculation)

SUMMARY TABLE OF ECOTOXICITY DATA ON 1,1,2-TRICHLOROETHANE

1.a FISH

Species	Duration d (days) - h (hours)	Type of study	Criterium (LC50/EC50, NOEC/LOEC)	Concentration (mg/l)	Validity	Comments and remarks	Reference
LC50/EC50 STUDIES							
1. FRESHWATER							
Jordanella floridae	96 h	F-T A	LC50	45.12	1	juvenile	Smith et al,1991
Pimephales promelas	96 h	F-T A	LC50	81.6	1		Ahmad et al,1984 USEPA, 1980 Walbridge et al,1983
Poecilia reticulata	24 h	S A C	LC50	70-85	1	juvenile + adult	Adema et al,1981
Poecilia reticulata	7 d	SS A	LC50	40-75	1		Adema et al,1981
Lepomis macrochirus	96 h	S N C	LC50	40	2	juvenile	Buccafusco et al,1981 USEPA, 1980
Poecilia reticulata	7 d	SS N	LC50	94.45	2		Konemann 1981
Leuciscus idus melanotus	48 h	S	LC50	123	4	isomer not defined	Juhnke et al,1978

SUMMARY TABLE OF ECOTOXICITY DATA ON 1,1,2-TRICHLOROETHANE

1.b FISH

Species	Duration d (days) - h (hours)	Type of study	Criterium (LC50/EC50, NOEC/LOEC)	Concentration (mg/l)	Validity	Comments and remarks	Reference
LC50/EC50 STUDIES							
2. SALTWATER							
Pleuronectes platessa	24 h	SS A	LC50	43	1	juvenile + adult	Adema et al,1981
Pleuronectes platessa	48 h	SS A	LC50	34-70	1	juvenile + adult	Adema et al,1981
Pleuronectes platessa	48 h	SS A	LC50	60	1		Adema et al,1981
Gobius minutus	24 h	SS A	LC50	43	1		Adema et al,1981
Pleuronectes platessa	7 d	SS A C	LC50	36-43	1		Adema et al,1981
Pleuronectes platessa	7 d	SS A C	LC50	55	1	juvenile	Adema et al,1981
Gobius minutus	7 d	SS A	LC50	43	1		Adema et al,1981
Pleuronectes platessa	7 d	SS A C	LC50	27	2	juvenile	Adema et al,1981
Pleuronectes platessa	7 h	SS A	LC50	6	2	eggs, larvae	Adema et al,1981
Pleuronectes platessa	48 h	SS A	LC50	125	2	eggs, larvae	Adema et al,1981
Pleuronectes platessa	96 h	SS A	LC50	55	2	yolk sac larvae	Adema et al,1981

SUMMARY TABLE OF ECOTOXICITY DATA ON 1,1,2-TRICHLOROETHANE

1.c FISH

Species	Duration d (days) - h (hours)	Type of study	Criterium (LC50/EC50, NOEC/LOEC)	Concentration (mg/l)	Validity	Comments and remarks	Reference
NOEC/LOEC STUDIES							
1. FRESHWATER							
Jordanella floridae	10 d	F-T A	NOEC	18.16	1	eggs	Smith et al,1991
Jordanella floridae	28 d	F-T A	NOEC	29	1	fry	Smith et al,1991
Pimephales promelas	32 d	F-T A	NOEC	15	1	eggs	Ahmad et al,1984
2. SALTWATER							
Pleuronectes platessa	28 - 56 d	SS A C	NOEC	3	1	eggs; LC50 = 5.5 mg/l	Adema et al,1981

All endpoints of the tests are based on survival/mortality. Other effects are explicitly mentioned in the table.

SUMMARY TABLE OF ECOTOXICITY DATA ON 1,1,2-TRICHLOROETHANE

2.a INVERTEBRATES

Species	Duration d (days) - h (hours)	Type of study	Criterium (LC50/EC50, NOEC/LOEC)	Concentration (mg/l)	Validity	Comments and remarks	Reference
LC50/EC50 STUDIES							
1. FRESHWATER							
Daphnia magna	48 h	S A C	EC50 LC50	78-81 174-186	1	test done on fed and unfed daphnia	Ahmad et al,1984 Call et al,1983 Richter et al,1983
Daphnia magna	48 h	S A C	EC50	43	1		Adema et al,1978 Adema et al,1981 USEPA, 1980
Daphnia magna	24 h	S A C	EC50	70-75	1		Adema et al,1978 Adema et al,1981 USEPA, 1980

SUMMARY TABLE OF ECOTOXICITY DATA ON 1,1,2-TRICHLOROETHANE

2.b INVERTEBRATES

Species	Duration d (days) - h (hours)	Type of study	Criterium (LC50/EC50, NOEC/LOEC)	Concentration (mg/l)	Validity	Comments and remarks	Reference
LC50/EC50 STUDIES							
1. FRESHWATER							
Daphnia magna	7 d	SS A	EC50	43	1		Adema et al,1978 Adema et al,1981 USEPA, 1980
Dreissena polymorpha (mollusc)	96 h	F-T A	EC50	320	1		Adema et al,1981
Dreissena polymorpha (mollusc)	7 d	F-T A	EC50	190	1		Adema et al,1981
Dreissena polymorpha (mollusc)	14 d	F-T A	EC50	140	1		Adema et al,1981
Lymnaea stagnalis (mollusc)	7 d	F-T A	EC50	140	2	eggs	Adema et al,1981
Daphnia magna	48 h	S N	EC50	18	2	NOEC = 1 mg/l	LeBlanc, 1980 USEPA, 1980
Daphnia magna	24 h	S N	EC50	19	2		LeBlanc, 1980 USEPA, 1980

SUMMARY TABLE OF ECOTOXICITY DATA ON 1,1,2-TRICHLOROETHANE

2.c INVERTEBRATES

Species	Duration d (days) - h (hours)	Type of study	Criterium (LC50/EC50, NOEC/LOEC)	Concentration (mg/l)	Validity	Comments and remarks	Reference
LC50/EC50 STUDIES							
1. FRESHWATER							
Daphnia magna	24 h	S A	EC50	23	2	6-24 h old	Freitag et al,1994
Lymnaea stagnalis (mollusc)	96 h	F-T A	EC50	170	2	eggs	Adema et al,1981
Daphnia magna	16 d		EC50 LC50	2.9 7.4	3 3	endpoint = reproduction endpoint = mortality	Hermens et al,1984
2. SALTWATER							
Artemia salina	48 h	S A	EC50	72	1		Adema et al,1981
Artemia salina	96 h	S A	EC50	52	1		Adema et al,1981
Artemia salina	10 d	SS A	EC50	43	1		Adema et al,1981
Crangon crangon	7 d	SS A	EC50	42	1		Adema et al,1981
Chaetogammarus marinus	48 h	S A C	EC50	82	1		Adema et al,1981
Chaetogammarus marinus	7 d	SS A	EC50	62	1		Adema et al,1981
Chaetogammarus marinus	14 d	SS A	EC50	50	1		Adema et al,1981

SUMMARY TABLE OF ECOTOXICITY DATA ON 1,1,2-TRICHLOROETHANE

2.d INVERTEBRATES

Species	Duration d (days) - h (hours)	Type of study	Criterium (LC50/EC50, NOEC/LOEC)	Concentration (mg/l)	Validity	Comments and remarks	Reference
LC50/EC50 STUDIES							
2. SALTWATER							
Palaemonetes varians	7 d	SS A	EC50	43	1		Adema et al,1981
Temora longicornus	96 h	S A	EC50	43	1		Adema et al,1981
Mytilus edulis (mollusc)	96 h	SS A	EC50	110	1		Adema et al,1981
Mytilus edulis (mollusc)	7 d	SS A	EC50	80	1		Adema et al,1981
Mytilus edulis (mollusc)	14 d	SS A	EC50	65	1		Adema et al,1981
Ophryotricha diadema (aunelide)	96 h	S A C	EC50	190	1		Adema et al,1981
Ophryotricha diadema (aunelide)	7 d	F-T A	EC50	200	2	larvae	Adema et al,1981
Crepidula fornicata	7 d	SS A	EC50	170	2	larvae	Adema et al,1981
Crangon crangon	6 h	S A	EC50	43	2		Adema et al,1981
Palaemonetes varians	6 h	S A	EC50	43	2		Adema et al,1981
Artemia salina	48 h	S A	EC50	62	2	larvae	Adema et al,1981
Artemia salina	96 h	S A	EC50	40	2	larvae	Adema et al,1981

SUMMARY TABLE OF ECOTOXICITY DATA ON 1,1,2-TRICHLOROETHANE

2.e INVERTEBRATES

Species	Duration d (days) - h (hours)	Type of study	Criterium (LC50/EC50, NOEC/LOEC)	Concentration (mg/l)	Validity	Comments and remarks	Reference
LC50/EC50 STUDIES							
2. SALTWATER							
Artemia salina	7 d	SS A	EC50	36	2	larvae	Adema et al,1981
Chaetogammarus marinus	48 h	S A C	EC50	72	2	larvae	Adema et al,1981
Chaetogammarus marinus	7 d	SS A	EC50	48	2	larvae	Adema et al,1981
Chaetogammarus marinus	21 d	SS A	EC50	41	2	larvae	Adema et al,1981
Ophryotricha labronica (aunelide)	48 h	SS C	EC50	170	3		Rosenberg et al,1975
Elminius modestus	48 h	S	EC50	7.5	4	isomer not defined	Pearson et al,1975

SUMMARY TABLE OF ECOTOXICITY DATA ON 1,1,2-TRICHLOROETHANE

2.f INVERTEBRATES

Species	Duration d (days) - h (hours)	Type of study	Criterium (LC50/EC50, NOEC/LOEC)	Concentration (mg/l)	Validity	Comments and remarks	Reference
NOEC/LOEC STUDIES							
1. FRESHWATER							
Daphnia magna	28 d	SS A C	NOEC NOEC	26 13	1 1	endpoint = reproduction endpoint = length	Ahmad et al,1984 Call et al,1983 Richter et al,1983
Daphnia magna	21 d	SS A	NOEC NOEC	18 32	1 1	endpoint = reproduction endpoint = mortality	Adema et al,1978 Adema et al,1981 USEPA, 1980
Daphnia magna	21 d	SS A	NOEC	18	1	larvae; endpoint = reproduction EC50 (mobility) = 32 mg/l	Adema et al,1878 Adema et al,1981 USEPA, 1980
Lymnaea stagnalis (mollusc)	16 d	F-T A	NOEC	10	1	juvenile; endpoint = mobility EC50 = 36 mg/l	Adema et al,1981

SUMMARY TABLE OF ECOTOXICITY DATA ON 1,1,2-TRICHLOROETHANE

2.g INVERTEBRATES

Species	Duration d (days) - h (hours)	Type of study	Criterium (LC50/EC50, NOEC/LOEC)	Concentration (mg/l)	Validity	Comments and remarks	Reference
NOEC/LOEC STUDIES							
2. SALTWATER							
Artemia salina	21 d	SS A	NOEC	10	1	larvae; endpoint = reproduction + mobility EC50 = 15 mg/l	Adema et al,1981
Ophryotricha labronica	9 d	SS A	NOEC	150	1	eggs; endpoint = mobility	Rosenberg et al,1975
Ophryotricha labronica	9 d	SS A	NOEC	50	1	eggs; endpoint = hatching	Rosenberg et al,1975
Ophryotricha labronica	9 d	SS A	LOEC	75	1	eggs; endpoint = hatching	Adema et al,1981

All endpoints of the tests are based on survival/mortality. Other effects are explicitly mentioned in the table.

SUMMARY TABLE OF ECOTOXICITY DATA ON 1,1,2-TRICHLOROETHANE

3. AQUATIC PLANTS

Species	Duration d (days) - h (hours)	Type of study	Criterium (LC50/EC50, NOEC/LOEC)	Concentration (mg/l)	Validity	Comments and remarks	Reference
1. FRESHWATER							
Chlorella pyrenoidosa	96 h	A C	EC50	170	1		Adema et al,1981
Scenedesmus subspicatus	72 h	A	EC50	200	1		Freitag et al,1994
Chlamydomonas reinhardtii	72 h	A C	EC50 LOEC	57 26.3	1		Brack et al,1994
Microcystis aeruginosa	8 d		EC50	350	4	isomer not defined	Bringmann et al,1978a Bringmann et al,1980
Scenedesmus quadricauda	8 d	A	LOEC	430	4	isomer not defined	Bringmann et al,1980
2. SALTWATER							
Chlamydomonas sp.	96 h	A C	EC50	260	1		Adema et al,1981
Chlorella sp.	96 h	A C	EC50	200	1		Adema et al,1981
Dunaliella sp.	96 h	A C	EC50	200	1		Adema et al,1981
Phaeodactylum tricornutum	96 h	A C	EC50	60	1		Adema et al,1981

All endpoints of the tests are based on growth.

LIST OF ABBREVIATIONS USED IN TABLES

A	**=**	**analysis**
C	**=**	**closed system or controlled evaporation**
h	**=**	**hour(s)**
d	**=**	**day(s)**
N	**=**	**nominal concentration**
S	**=**	**static**
SS	**=**	**semistatic**
F-T	**=**	**flow-through**

Validity column :

1 = valid without restriction

2 = valid with restrictions : to be considered with care

3 = invalid
4 = not assignable

APPENDIX 4

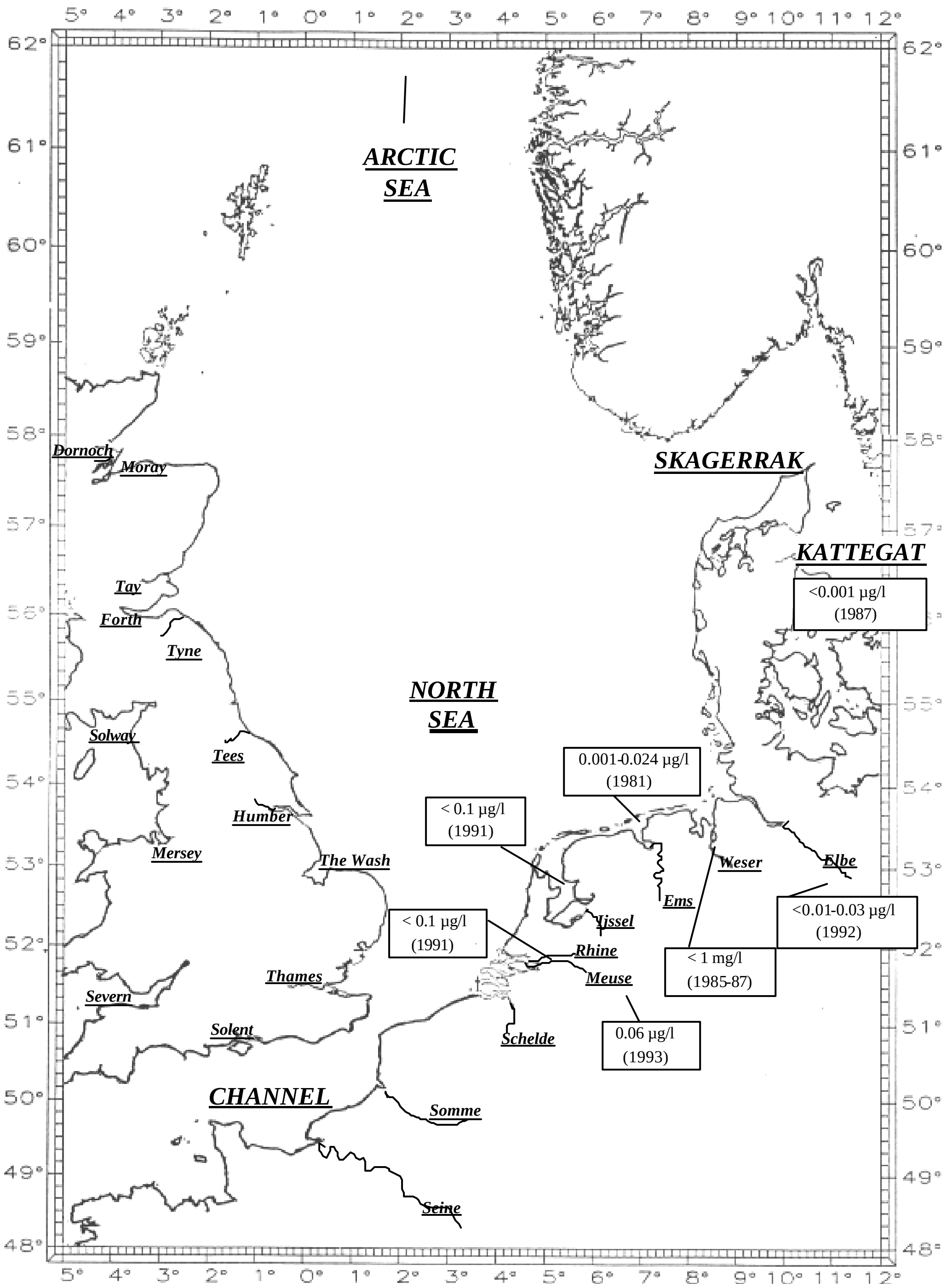
BACKGROUND LEVELS OF 1,1,2-TRICHLOROETHANE IN NATURAL SURFACE WATERS

Area	Year of measurement	Average or medium concentration (µg/l)	Reference
1. Coastal waters and estuaries			
Germany : • Nordsee, Schleswig-Holstein	1981	0.001 - 0.024	Atri, 1985
• Schlei, Schleswig-Holstein, Kappeln	1981	< 0.001 - 0.027	Atri, 1985
• Ostsee	1981	< 0.001	Atri, 1985
2. River waters			
Germany : • Rhine at Bad Honnef, Düsseldorf, Götterswickersham, Kleve-Bimmen (at D/NL borderline, mean flow : 2270 m^3/s)	1986 - 89	< 0.5	LWA, 1987-88-99
• Rhine affluents (mean flow 730 m^3/s) : Sieg, Wupper, Erft, Ruhr, Emscher	1986 - 89	< 0.5	LWA, 1987-88-99
• Rhine, Bimmen, km 865	1988 - 89	< 5	Malle, 1991
• Unterweser, lower part, km 362-28 (flow : 330 m^3/s)	1985 - 87	< 1	Bohlen et al, 1989
• Elbe, Schnackenburg (mean flow : 730 m^3/s)	1991	< 0.01 - 0.03	ARGE Elbe, 1992
• Elbe, Geesthacht, Teufelsbrück, Stader Sand, Brunsbüttel, Scharhoern, Glückstadt	1991	< 0.1	ARGE Elbe, 1992

APPENDIX 4

Area	Year of measurement	Average or medium concentration (µg/l)	Reference
Netherlands : • Rhine/Lekwater, Stellendam	1990	< 0.1	RIWA, 1990-91
• Rhine, Hagestein (flow : 183 m^3/s)	1991	= 0.1	RIWA, 1990-91
• Ijsselmeer, Andijk	1991	< 0.1	RIWA, 1990-91
• Maas, Eijsden (flow : 249 m^3/s)	1993	0.06	RIWA, 1995
Belgium : • Meuse, Tailfer (flow : 159 m^3/s)	1993	0.02	RIWA, 1995

NORTH SEA monitoring data on 1,1,2-Trichloroethane



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