

# 1,2-Dichloroethane

UN N°: 1184

SEBC Classification: S/D (Sinker/Dissolver)

MARPOL classification: B until 31/12/2006  
Y from 01/01/2007

E.U. Classification:



F: Highly flammable



T: Toxic



Cedre

# 1,2-Dichloroethane

*PRACTICAL GUIDE*  
*INFORMATION*  
*DECISION-MAKING*  
*RESPONSE*

This document was drafted by *Cedre* (the Centre of Documentation, Research and Experimentation on Accidental Water Pollution) with financial support from ARKEMA and TOTAL, and technical assistance from ARKEMA.

The information contained in this guide is the result of research and experimentation conducted by *Cedre*, which cannot be held liable for the consequences resulting from the implementation of the information contained herein.

Translated by Sally Ferguson.

## Purpose of this guide

As part of the research funded by TOTAL and ARKEMA, *Cedre* (the Centre of Documentation, Research and Experimentation on Accidental Water Pollution) has produced a series of response guides for chemical hazards. They can be used to assist in emergency response in the event of an incident involving a vessel carrying hazardous substances which may cause water pollution.

These guides are updates of the 61 "mini response guides" published by *Cedre* in the early 1990s.

These guides are designed to allow rapid access to the necessary initial information (see chapter entitled "First line emergency data"), in addition to providing relevant bibliographical sources to obtain further information.

They also contain the results of scenarios relating to incidents which have occurred in the Channel, the Mediterranean and in rivers. These scenarios are only intended to provide response authorities with indications of what to do in an emergency. Each accident should be analysed individually and the response authorities should not underestimate the importance of in-situ measures (air, water, sediment and marine fauna) in order to determine exclusion areas.

These guides are intended primarily for specialists who know about the techniques to use in the event of an emergency in addition to the relevant operational response measures. The main concern is to mitigate the consequences of a spill, however we cannot afford to overlook responder safety and human toxicology.

**To contact the duty engineer at Cedre (24/7)**  
Please call: + 33 (0)2 98 33 10 10

### National toxicology surveillance system in the event of a major toxicological threat.

A hotline is manned around the clock by Division 7 of the General Department of Health (SD7/DGS).

During opening hours please call:

Tel.: + 33 (0)1 40 56 47 95

Fax: + 33 (0)1 40 56 50 56

Outside normal working hours please call the relevant authority.

### Poison Control Centres in France

Angers (Centre Hospitalier d'Angers) Tel.: + 33 (0)2 41 48 21 21

Bordeaux (Hôpital Pellegrin-Tripode) Tel.: + 33 (0)5 56 96 40 80

Grenoble (Hôpital Albert Michallon) Tel.: + 33 (0)4 76 76 56 46

Lille (Centre Hospitalier Régional Universitaire) Tel.: + 33 (0)8 25 81 28 22

Lyon (Hôpital Edouard Herriot) Tel.: + 33 (0)4 72 11 69 11

Marseille (Hôpital Salvator) Tel.: + 33 (0)4 91 75 25 25

Nancy (Hôpital Central) Tel.: + 33 (0)3 83 32 36 36

Paris (Hôpital Fernand Widal) Tel.: + 33 (0)1 40 05 48 48

Reims (Hôpital Maison Blanche) Tel.: + 33 (0)3 26 78 48 21

Rennes (Hôpital de Pontchaillou) Tel.: + 33 (0)2 99 59 22 22

Rouen (Hôpital Charles Nicolle) Tel.: + 33 (0)2 35 88 44 00

Strasbourg (Hôpitaux Universitaires) Tel.: + 33 (0)3 88 37 37 37

Toulouse (Hôpital de Purpan) Tel.: + 33 (0)5 61 77 74 47

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# What you need to know about 1,2-dichloroethane

A

## Definition

1,2-dichloroethane (MARPOL category Y from 01/01/2007) is a colourless, sinking (density of 1.247) liquid, which is highly flammable, toxic for humans and harmful for the environment. Commercial 1,2-dichloroethane is a stable product at room temperature.

## Uses

1,2-dichloroethane is mainly used as an intermediary in forming vinyl chloride. It is also used in the production of chlorinated solvents such as 1.1.1-trichloroethane, trichloroethylene and tetrachloroethylene.

It is also used in various other areas, as outlined below.

Production of:

- ethylenediamide, ethylene glycol, polyvinyl chloride, nylon, rayon and various plastics.
- solvents for fats, oils, waxes, resins, rubber and for the extraction of spices.

Used in:

- treatment by fumigation of grain (cereals), fruit trees, agricultural buildings and mushroom production areas.
- paint, varnish, soap, cleaning products and wetting agents.

## Risks

- Explosion: Vapours can form explosive mixtures with air. It reacts violently with aluminium, alkaline metals, ammonia, strong bases and oxidants. 1,2-dichloroethane attacks a large number of metals in the presence of

water. Heating the recipient provokes an increase in pressure with a risk of bursting.

- Toxicity: 1,2-dichloroethane is toxic and an irritant, whatever the means of absorption.

- In the short term, vapours irritate the eyes, the skin and respiratory tract. Inhalation of vapours can cause pulmonary oedema. The substance can have an effect on the central nervous system, the kidneys and the liver, causing functional deficiency.

- In the long term, repeated or prolonged contact with the skin can cause dermatitis. This chemical can also lead to cancer in humans (ICSC, 1999).

- Fire: Electrostatic shocks can be brought on by movement or agitation and can cause the ignition of the vapours. The substance decomposes by strong heating and burning, and produces toxic, corrosive fumes made up of hydrogen chloride and phosgene.

## Behaviour in the environment

When poured into water, 1,2-dichloroethane settles, then gradually dissolves. It is volatile both as a pure product and as an aqueous solution. When poured on the ground, it evaporates. The vapours are heavier than air and can spread out at ground level. According to its Kow and BCF values, 1,2-dichloroethane is not bioaccumulable in aquatic organisms.

# First line emergency data

- First aid information \_\_\_\_\_ B1
- ID card \_\_\_\_\_ B2
- Physical data \_\_\_\_\_ B3
- Flammability data \_\_\_\_\_ B4
- Toxicological data \_\_\_\_\_ B5
- Ecotoxicological data \_\_\_\_\_ B6
- Persistence in the environment \_\_\_\_\_ B7
- Classification \_\_\_\_\_ B8
- Particular risks \_\_\_\_\_ B9
- Transportation, handling, storage \_\_\_\_\_ B10

B

## First aid information (ICSC, 1993; ARKEMA SDS, 2004)

**Immediately remove all soiled or spotted clothes**

### **Intoxication by inhalation**

- Take victim outside into the open air
- Prop the person up to a half-sitting position
- Apply artificial respiration if necessary
- Consult a doctor

### **Skin contact, depending on seriousness**

- Remove contaminated clothing
- Rinse and wash the skin with soap and plenty of water
- Consult a doctor

### **Eye contact**

- Rinse first of all with plenty of water for at least 15 minutes
- Remove contact lenses if possible
- Consult a doctor.

### **Intoxication by ingestion, depending on seriousness**

- Do not give the person anything to drink
- Do not induce vomiting
- Consult a doctor.

Do not administer catecholamines due to the possibility of sensitisation of the heart by the vinyl chloride.



# 1,2-Dichloroethane

Gross formula:  $C_2H_4Cl_2$

Semi-developed formula:  $CH_2Cl - CH_2Cl$

## Synonyms

Ethylene chloride  
Ethylene dichloride  
EDC  
Ethyl dichloride  
Ethylene bichloride  
 $\alpha$ ,  $\beta$  - dichloroethane  
Dichloro 1,2 ethane  
1,2-ethylene dichloride  
Sym-dichloroethane  
Glycol dichloride  
Dutch oil

## E.U. Classification

T: Toxic.  
F: Highly flammable.  
R11: Highly flammable.  
R22: Harmful if swallowed.  
R45: May cause cancer.  
R36/37/38: Irritating to eyes, respiratory system and skin.  
S45: In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).  
S53: Avoid exposure, obtain special instructions before use.

CAS N°: 107-06-2  
EC N° (EINECS): 203-458-1  
Index N°: 602-012-00-7

## Classification for transportation

UN N°: 1184  
Class: 3

<sup>1</sup> Additional data and sources in annex 1

## Physical data

Conversion factor in air at 20°C: 1 ppm = 4.11 mg/m<sup>3</sup>  
 1 mg/m<sup>3</sup> = 0.24 ppm  
 1 atm = 1.013×10<sup>5</sup> Pa

|                                      |  |
|--------------------------------------|--|
| Melting point                        | -35.6°C  |
| Boiling point at 1 atm               | 83.4°C   |
| Critical temperature                 | 288.4°C  |
| Relative density (water = 1)         | 1.247 at 20°C  |
| Relative vapour density (air = 1)    | 3.42   |
| Solubility in seawater               | 7.01 ± 0.15 g/L at 15°C<br>7.53 ± 0.21 g/L at 25°C           |
| Solubility in fresh water            | 8.7 g/L at 20°C  |
| Vapour pressure/tension              | 8.5 kPa at 20°C  |
| Olfactory threshold                  | 6 -100 ppm in air<br>20 mg/L in fresh water *                |
| Evaporation rate (diethyl oxide = 1) | 4.1 (takes 4.1 times longer to evaporate than diethyl oxide) |
| Diffusion coefficient in water       | 9.90×10 <sup>-6</sup> cm <sup>2</sup> /s                     |
| Diffusion coefficient in air         | 1.04×10 <sup>-1</sup> cm <sup>2</sup> /s                     |
| Henry's law constant                 | 97.7 Pa m <sup>3</sup> /mol at 20°C                          |

\* An odour can be detected when concentrations of 1,2-dichloroethane in fresh water are of the order of 20 mg/litre.

Definitions in the glossary

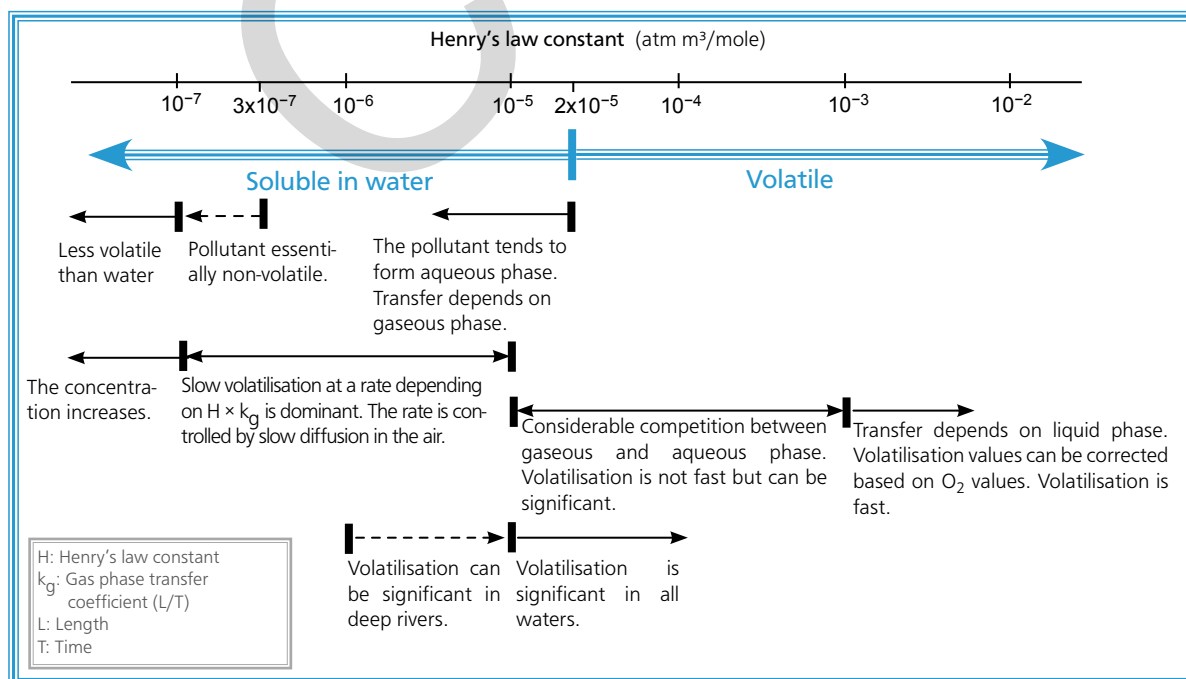
Sources in Annex 1

## Flammability data

|   |                                    |
|---|------------------------------------|
| <ul style="list-style-type: none"> <li>• <b>Explosive limit by volume</b> (% in air):<br/>Lower limit: 6.2% or 62,000 ppm<br/>Upper limit: 16% or 160,000 ppm</li> </ul>  | INRS, 1997                         |
| <ul style="list-style-type: none"> <li>• <b>Regression speed:</b> 1.6 mm/min</li> </ul>   | CHRIS, 1999                        |
| <ul style="list-style-type: none"> <li>• <b>Flash point</b> (in a closed capsule): 13°C</li> </ul>  | ARKEMA SDS, 2004                   |
| <ul style="list-style-type: none"> <li>• <b>Self-ignition point:</b> 413°C</li> </ul>   | ARKEMA SDS, 2004                   |
| <ul style="list-style-type: none"> <li>• <b>Dangerous decomposition products:</b> thermic decomposition forming toxic and corrosive products. Gaseous hydrogen chloride and phosgene are formed.<br/>Between 340 and 515°C, formation of vinyl chloride, hydrogen chloride and traces of acetylene. Possible formation of carbonyl dichloride.</li> </ul> | ARKEMA SDS, 2004<br><br>INRS, 1997 |

Definitions in the glossary

\*SDS: Safety Data Sheet



Characteristics of volatilisation associated with different Henry's law constant values (Lyman *et al.*, 1990)

## Toxicological data

### Acute human toxicity

- Ingestion: burning sensation in the mouth, pharynx, oesophagus and stomach, neuropsychic troubles, vomiting, abdominal pains, possibility of liver/kidney lesions, pulmonary oedema, can be life threatening.
- Skin contact: redness.
- Eye contact: redness, pain, affected sight, possibility of burns on the cornea.
- Inhalation: abdominal pain, cough, dizziness, drowsiness, headaches, nausea, sore throat, loss of consciousness, vomiting, symptoms of delayed effects.  
Inhalation of strong concentrations: risk of pulmonary oedema, liver/kidney lesions, can be life threatening.

- Repeated exposure by inhalation: nervous irritation, gastro-intestinal troubles, liver and kidney problems.
- Prolonged or repeated contact with the skin can cause dermatitis. This substance is probably carcinogenic for humans.
- Little information is known about the chronic toxicity of 1,2-dichloroethane for humans. The problems encountered by workers exposed to this chemical are anorexia, nausea, abdominal pains, drowsiness, liver and kidney deterioration and orthoergic contact dermatitis.

B5

### Chronic human toxicity

#### Threshold toxicological values

|  |
|--|
| <b>Occupational exposure values</b>                      |
| MEV: 10 ppm (40 mg/m <sup>3</sup> ) (France)             |
| TLV-TWA ACGIH: 10 ppm (40 mg/m <sup>3</sup> ) (USA)      |
| MRL chronic inhal.: 0.6 ppm (3 mg/m <sup>3</sup> ) (USA) |
| <b>Risk management values for the population</b>         |
| IDLH*: 50 ppm (205.5 mg/m <sup>3</sup> ) (USA)           |
| ERPG 1: 50 ppm (205.5 mg/m <sup>3</sup> ) (USA)          |
| ERPG 2: 200 ppm (822 mg/m <sup>3</sup> ) (USA)           |
| ERPG 3: 300 ppm (1233 mg/m <sup>3</sup> ) (USA)          |

#### Specific effects

|  |
|--|
| Carcinogenic effects: suspected of being carcinogenic for humans (E.U. category 2) |
| Effects on fertility: not demonstrated   |
| Teratogenic effects and/or effects on foetal development: not demonstrated         |
| Genotoxic effects: not classed as genotoxic by the E.U.                            |
| Mutagenic effects: suspected in animals  |

\* IDLH is a value commonly used by fire brigades and first aid services when no Lethal and Irreversible Effect Thresholds are available.

## Ecotoxicological data

### Acute ecotoxicity

|  |   |
|--|---|
| Methanogenic bacteria                    | EC <sub>50</sub> (48h) = 25 mg/L (fresh water)  |
| Algae ( <i>Scenedesmus subspicatus</i> ) | EC <sub>50</sub> (72h) = 166 mg/L (fresh water) |
| Crustacean ( <i>Daphnia magna</i> )      | EC <sub>50</sub> (48h) = 155 mg/L (fresh water) |
| Crustacean ( <i>Crangon crangon</i> )    | LC <sub>50</sub> (96h) = 85 mg/L (seawater)     |
| Mollusc ( <i>Elimininius modestus</i> )  | LC <sub>50</sub> (48h) = 186 mg/L (seawater)    |
| Fish ( <i>Limanda limanda</i> )          | LC <sub>50</sub> (96h) = 115 mg/L (seawater)    |
| Fish ( <i>Gobius minutus</i> )           | LC <sub>50</sub> (96h) = 186 mg/L (seawater)    |
| Fish ( <i>Pimephales promelas</i> )      | LC <sub>50</sub> (96h) = 116 mg/L (fresh water) |

### Chronic ecotoxicity

|  |   |
|--|---|
| Methanogenic bacteria                    | EC <sub>10</sub> (11 d) = 860 mg/L (sediment) |
| Algae ( <i>Scenedesmus subspicatus</i> ) | LOEC (8 d) = 710 mg/L (fresh water)           |
| Crustacean ( <i>Daphnia magna</i> )      | NOEC (28 d) = 11 mg/L (fresh water)           |
| Fish ( <i>Pimephales promelas</i> )      | NOEC (32 d) = 29 mg/L (fresh water)           |

### PNEC (Predicted No-Effect Concentration)

PNEC (Predicted No-Effect Concentration): according to the *Technical Guidance Document* applying the EC regulation 1488/94 on risk evaluation of existing substances, the calculated PNEC for water is 1.1 mg/L. A safety factor of 10 is applied to the lowest value of each of the three trophic levels (three chronic data items).

## Persistence in the environment

### Photo-oxidation (INERIS, 2003)

In the troposphere, 1,2-dichloroethane undergoes photo-oxidation and forms chloromethanal, chloroacetyl chloride, hydrochloric acid, carbon monoxide and carbon dioxide. This process is slow. In the stratosphere, it undergoes photolysis.

### Abiotic degradation (INERIS, 2003)

In the aquatic environment, its chemical degradation is very slow. It is highly resistant to hydrolysis. In surface waters, losses are mainly caused by evaporation.

### Biodegradation

1,2-dichloroethane is not readily biodegradable as:

- On water surfaces, only 18% degradation was measured in a biodegradation test (meas-

uring the dissolved oxygen consumption) (PRICE *et al.*, 1974)

- In soil, no biodegradation has been observed (WILSON *et al.*, 1983).

- In anaerobic conditions, biodegradation occurs in the presence of methanotrophic bacteria which transform 1,2-dichloroethane into ethane (HOLLINGER *et al.*, 1990).

### Volatilisation (INERIS, 2003)

This chemical is highly volatile, both pure and as an aqueous solution. Losses are mainly due to evaporation in surface waters.

### Bioaccumulation

According to its Kow and BCF values, 1,2-dichloroethane is not bioaccumulable in aquatic organisms.

**Partition coefficient for organic carbon and water**

Koc = 11-76 L/kg

INERIS, 2003

**Partition coefficient for octanol and water**

log Kow = 1.45-1.76

INERIS, 2003

**Bioconcentration factor (aquatic organisms)**

BCF (fish) = 3.5 (calculated value)

INERIS, 2003

Definitions in glossary

Sources in Annex 1

B7

## Classification

### IBC Classification (IMO, 2001)

- Risk: S/P (safety/pollution risk).
- Type of vessel: 2.
- Type of tank: 2G (integral gravity tank).
- Tank clearance: controlled
- Checking tank atmospheres: no.
- Electrical equipment
  - class i': T2
  - class i'': IIA
  - class i''': no.
- Tank level gauge: R (restricted opening type).
- Vapour detection: F-T (flammable and toxic vapours).

### - Fire extinguishing equipment

A: Alcohol-resistant foam or multipurpose foam.

B: Ordinary foam, comprising all the foams that do not resist alcohol, in particular fluoro-protein foams and those that form an aqueous film (AFFF).

### - Construction materials

N4: Neither copper nor alloys containing copper should be used for manufacturing tanks, piping, valves, accessories and other elements likely to come into contact with the products or vapours.

SEBC Classification: S/D (sinker/dissolver)

### E.U. Classification



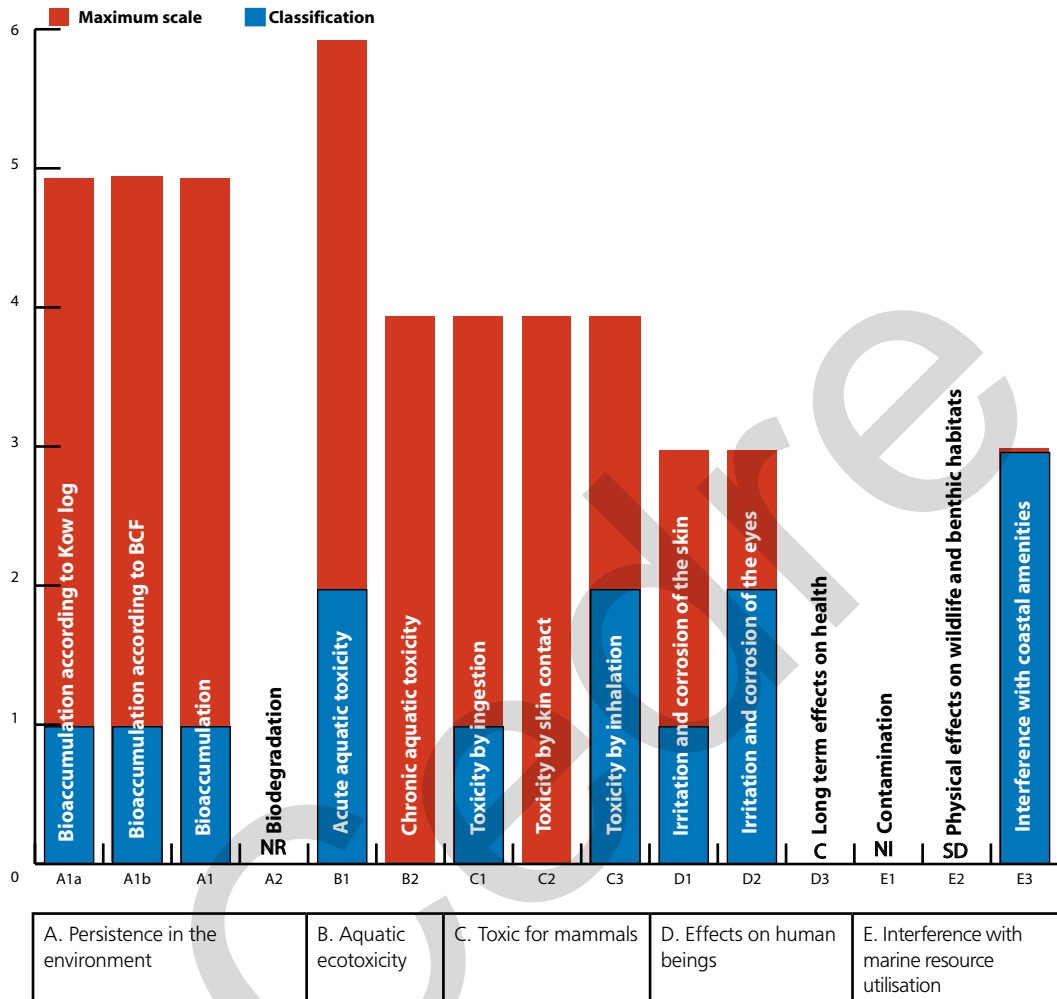
F: Highly flammable



T: Toxic

|            |   |
|------------|---|
| R 11       | Highly flammable.   |
| R 22       | Harmful if swallowed.   |
| R 36/37/38 | Irritant for eyes, respiratory system and skin.   |
| R 45       | May cause cancer.   |
| S 45       | In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). |
| S 53       | Avoid exposure, obtain special instructions before use.   |
| 203-458-1  | E.C. N° (EINECS)  |

## GESAMP Classification



A1a: Very slight potential to bio accumulate in aquatic organisms  
 A1b: Very slight potential to bio accumulate in aquatic organisms  
 A1: Very slight potential to bio accumulate in aquatic organisms  
 A2: Not readily biodegradable (NR)  
 B1: Slight acute aquatic toxicity  
 B2: Negligible chronic aquatic toxicity  
 C1: Slightly toxic when ingested by mammals  
 C2: Negligible toxicity by skin contact with mammals  
 C3: Moderate toxicity when inhaled by mammals  
 D1: Moderate skin irritant  
 D2: An eye irritant  
 D3: Carcinogenic (C)  
 E1: No Information (NI)  
 E2: Sinks/Dissolves  
 E3: Highly disagreeable, amenities must be closed down

**MARPOL classification:** B (definition in annex 3) until 31/12/2006  
 Y (definition in annex 3b) from 01/01/2007



## Particular risks

### Polymerisation

No

### Danger (CEFIC, 2003)

- Heating the recipient can cause an increase in pressure and the recipient may burst.
- Toxic and irritating smoke may be released from combustion.
- 1,2-dichloroethane can form explosive mixtures with air.
- Vapours are invisible and heavier than air. They spread out at ground level and can enter sewage systems and underground areas.
- Vapours can cover a large distance as far as a source of ignition and produce flashback.

(ENVIRONMENT CANADA, 1984).

### Stability and reactivity (ARKEMA SDS, 2004)

- Conditions to be complied with: keep away from light and store in a cool, dry place.
- Avoid the following due to risk of explosive reactions: acids, bases, oxygen, oxidants (may form explosive compounds or compounds sensitive to shocks), finely divided metals, aluminium, magnesium, zinc, titanium.
- Dangerous decomposition products: thermic decomposition into toxic and corrosive products (gaseous hydrogen chloride and phosgene).
- Sensitive to light (formation of gaseous hydrogen chloride).
- Stable at ambient temperatures.

B9

## Transportation, handling, storage

### Transportation (ARKEMA SDS, 2004)

UN N°: 1184

Land transportation: RID (rail) /ADR (road)

Hazard classification: 336

Class: 3

Packaging group: II

Classification code: FT1

Labels: 3+6.1

Transportation via inland waterways: ADN/  
ADNR

Hazard classification: 336

Class: 3

Classification code: FT1

Labels: 3+6.1

Maritime transport: IMDG

Class: 3

Packaging group: II

Marine pollutant (MP): No

Labels: 3+6.1

Air freight: IATA

Class: 3

Packaging group: II

Labels: 3+6.1

### Handling (ARKEMA SDS, 2004)

- Ventilate and evacuate appropriately.
- Provide showers and eye washers.
- Provide self-contained breathing apparatus nearby.
- Keep away from flames.
- Do not use air for transferring the product.
- Do not use air to dry equipment.
- Only use the product in a closed system (if possible).
- Only use explosion-proof equipment.

### Storage (ARKEMA SDS, 2004)

- Keep away from light.
- Store in a cool, dry place.
- Provide a diked area.
- Use electrical equipment suitable for explosive atmospheres and ensure it is earthed.

**Incompatible with:** acids, bases, oxygen, oxidants, finely divided metals.

**Recommended packaging material:** iron, steel including for the equipment in contact with the product.

# Results of accident scenarios

- Reminder of properties  C1
- Accident scenarios  C2
- Consumption scenarios  C3

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## Reminder of properties

### Transportation

1,2-dichloroethane is transported in tanks without any additives.

### Vapour density and tension

- Relative density: 1.247 at 20°C
- Vapour density: 3.42
- Vapour tension: 8.5 kPa at 20°C

### Solubility

The solubility of 1,2-dichloroethane in seawater is 7 g/L at 15°C. Its density in water and

solubility mean that it is classed as S/D, sinks and dissolves.

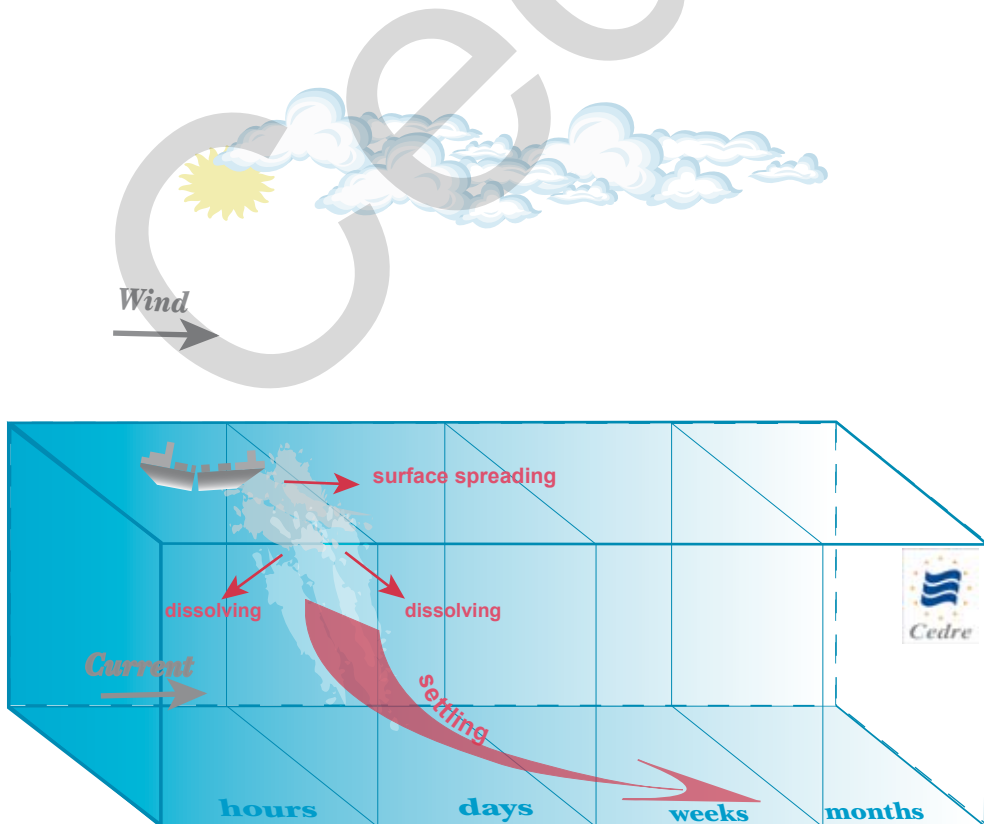
### Behaviour of 1,2-dichloroethane in the event of a spill

When spilt in water, dichloroethane settles quickly on the bottom.

It is pale yellow in colour, slightly viscous and slightly visible on the bottom.

A droplet 1 cm in diameter will sink at a rate of 4 to 6 m/min and will dissolve as it sinks.

C1



## Accident scenarios

When a chemical tanker is rammed sideways, it may puncture a wing tank containing 1,2-dichloroethane.

Bearing this assumption in mind, three spill scenarios have been defined with four different quantities of 1,2-dichloroethane.

- 10 kg/5h
- 1000 kg/5h
- 100 t/5h
- 500 t (instantaneous spill)

### The scenarios

#### Channel

- Location 50°N, 3°W
- Air and water temperature: 10°C
- Two wind speeds: 3 and 10 m/s (NW)
- Spill depth: 1 m
- Duration of spill: 5 hours
- Model time step: 15 min (except for the 10 kg spill for which it is 1 minute)

#### Mediterranean

- Location 43°10' N, 5°20' E (30 km from Marseille)
- Air and water temperature: 20°C
- Two wind speeds: 3 and 10 m/s (W/NW)
- Spill depth: 1 m
- Duration of spill: 5 hours
- Model time step: 15 min

#### River

- Depth of river: maximum 10 m
- Width of river: average 300 m
- Spill depth: 1 m
- Air and water temperature: 10°C
- Two current speeds: fast and slow
- Wind speed: 6 m/s
- Duration of spill: 5 hours
- Model time step: 30 min

### The case of a wreck

A wreck is lying on the seabed 100 metres below the surface not far from an inhabited coastline.

The decision-making process must take into account several factors:

- The actual solubility of the chemical in the prevailing conditions
- Leakage rate and droplet diameter
- Currents
- Access to tanks

If the wreck is leaking:

- Take measurements in the water column and the sediment
- Plug the holes as a temporary measure.

If the wreck is not leaking (or no longer leaking):

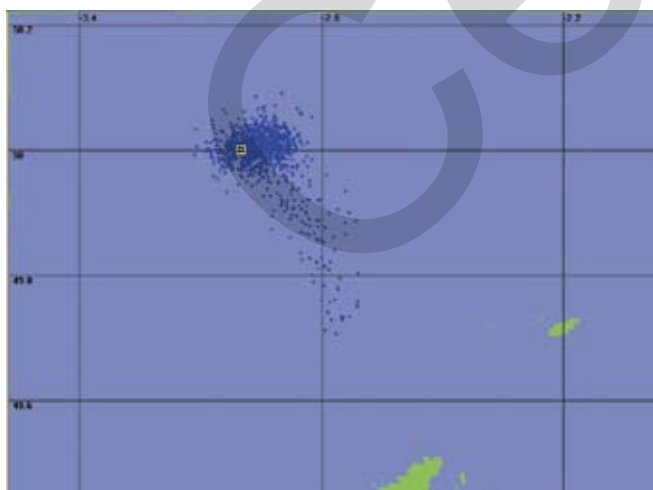
- Begin recovery procedures (MARPOL B product until 31/12/2006).

## Modelling

CHEMMAP software was used to model hypothetical spillages of 1,2-dichloroethane in the aquatic environment.

This is a chemical spill model designed by ASA (Applied Science Associates, Inc - USA) which predicts the movement and fate of the spill product in fresh and sea water.

This model indicates both the movement of the product on the water surface and its distribution in the environment (evaporation, dissolution in the water column...).



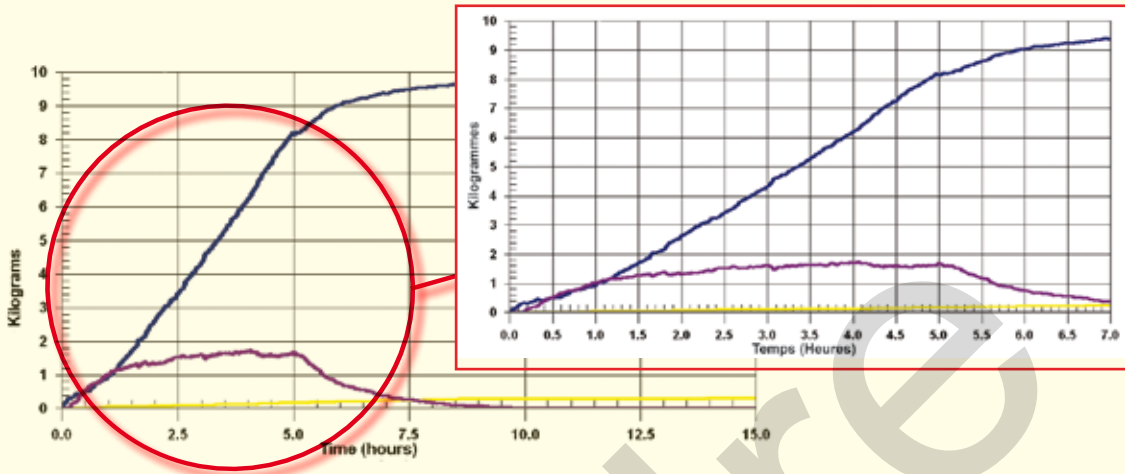
Cross-section



Results obtained after a 500 tonne spillage of 1,2-dichloroethane over 5 hours in the Channel, with 10 m/s winds.

View of the dissolved part.

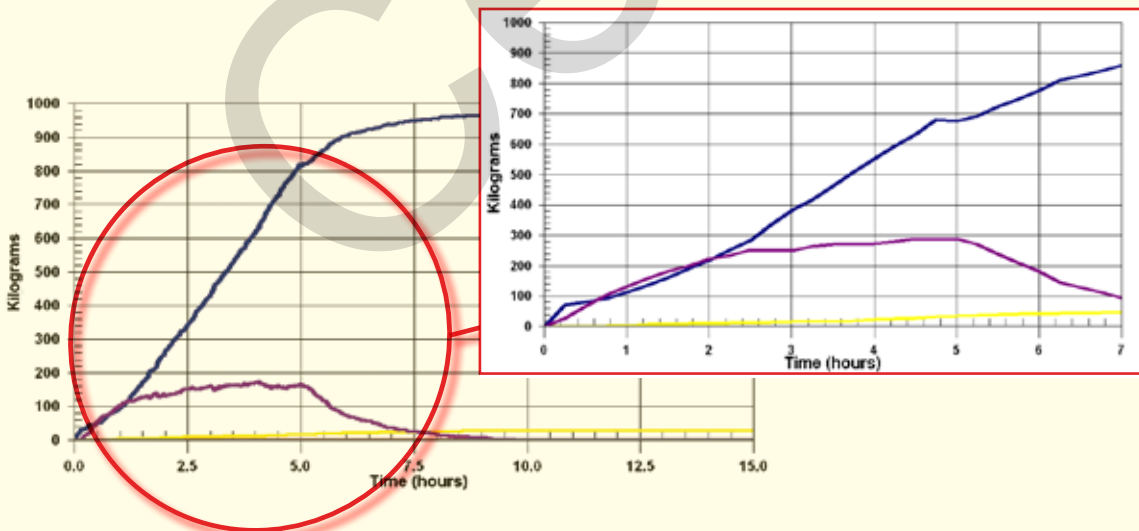
Results of the Channel scenario



Spillage of 10 kg of 1,2-dichloroethane over 5 hours

*The results are similar no matter what the wind speed (3 and 10 m/s).*

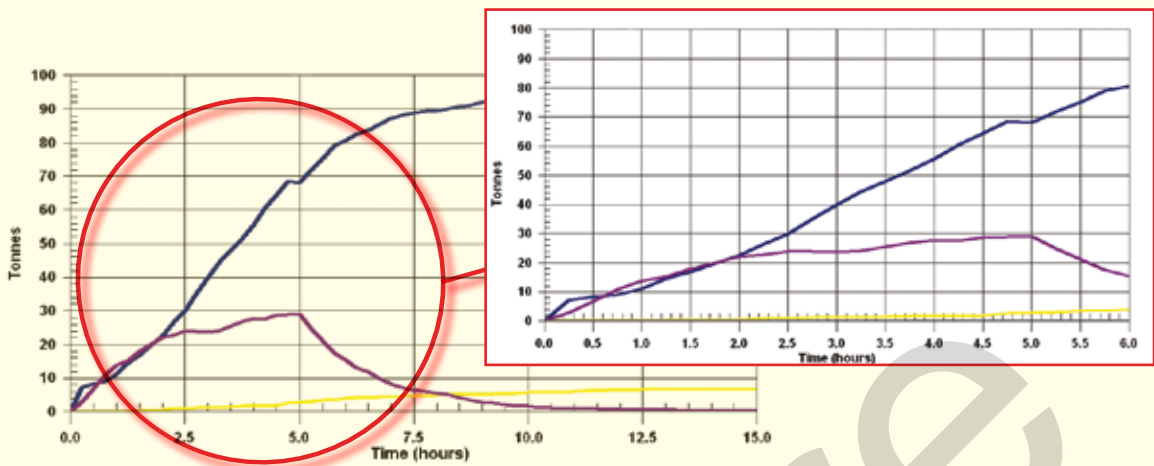
*Four hours after the beginning of the spillage, 8 kg of 1,2-dichloroethane have been released. 6 kg have dissolved in the water column, almost 2 kg have sedimented and about a hundred grams have evaporated.*



Spillage of 1,000 kg of 1,2-dichloroethane over 5 hours.

*The results are similar no matter what the wind speed (3 and 10 m/s).*

— Quantity evaporated — Quantity sedimented — Quantity in the water column



Spillage of 100 kg of 1,2-dichloroethane over 5 hours

The results obtained are proportionately identical to those for the 10 kg, 100 kg and 100 tonne spills. The only differences observed concern the evaporated part. With a 3 m/s wind, the evaporated quantity is around 10% and 15% with a 10 m/s wind.

— Quantity evaporated — Quantity sedimented — Quantity in the water column

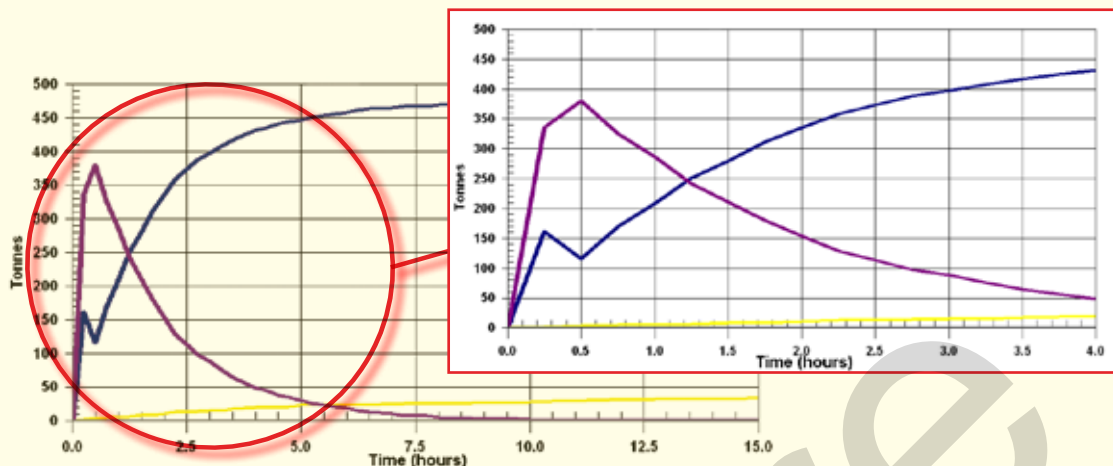


Representation of the dissolved part after a spill of 100 tonnes of 1,2-dichloroethane over 5 hours. 3 m/s wind.

Results obtained 48 hours after the start of the spillage.

The highest concentration observed of dissolved product, between 10 and 100 mg/m<sup>3</sup>, is located within a 4.7 km radius around the spillage point. The concentration of 1,2-dichloroethane is between 10 and 100 mg/m<sup>3</sup>. A wider area, with a radius of approximately 9.7 km around the spillage point, contains a concentration of between 1 and 10 mg/m<sup>3</sup>.

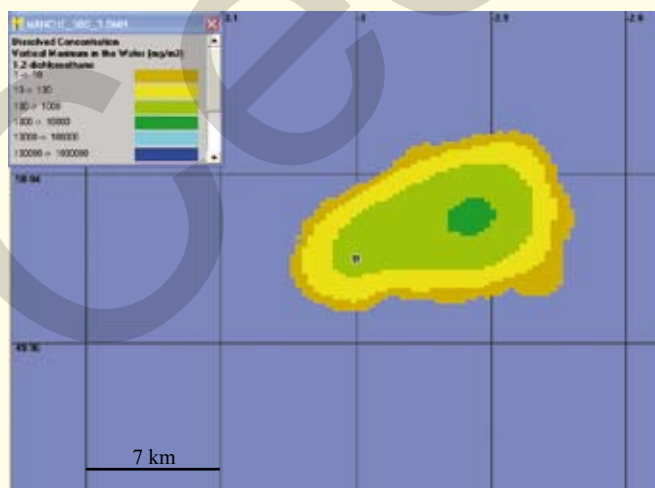




Instantaneous spillage of 500 kg of 1,2-dichloroethane.

The results are similar, for the dissolved and sedimented parts, whatever the wind speed (3 and 10 m/s). As for the three other quantities spilt, the evaporated quantity is 10% with a 3 m/s wind and 15% with a 10 m/s wind.

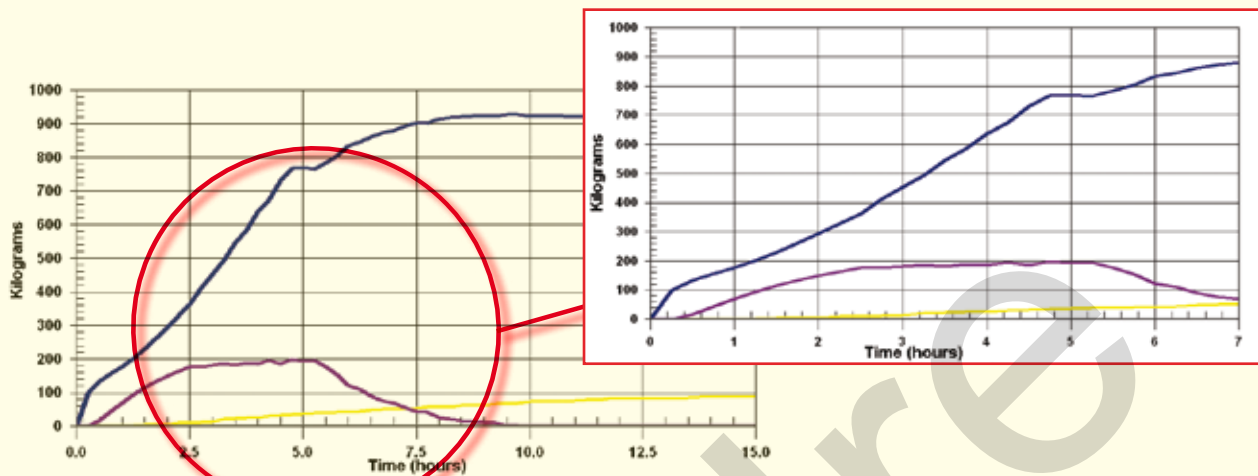
— Quantity evaporated — Quantity sedimented — Quantity in the water column



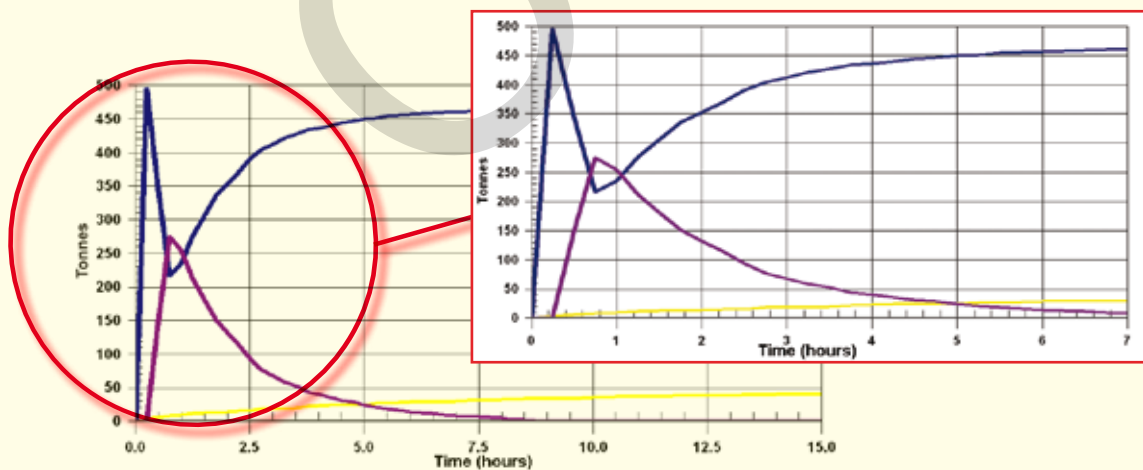
Representation of the dissolved part after an instantaneous spill of 100 tonnes of 1,2-dichloroethane. 3 m/s wind.  
Results obtained 7 hours after the spillage.

After such a spill, the 1,2-dichloroethane is found in the water column in a 10 km area, west of the spillage point. The highest concentration (between 1,000 and 10,000 mg/m<sup>3</sup>) is found 6 km west of this point, in an area 2.3 km in diameter. Around this area, a lower concentration, between 100 and 1 000 mg/m<sup>3</sup>, is found around 9 km west of the spillage point. Up to 10 km, the concentration of 1,2-dichloroethane is from 10 to 100 mg/m<sup>3</sup>, then between 1 and 10 mg/m<sup>3</sup> up to 10.7 km from the spillage point.

### Results of the Mediterranean scenario



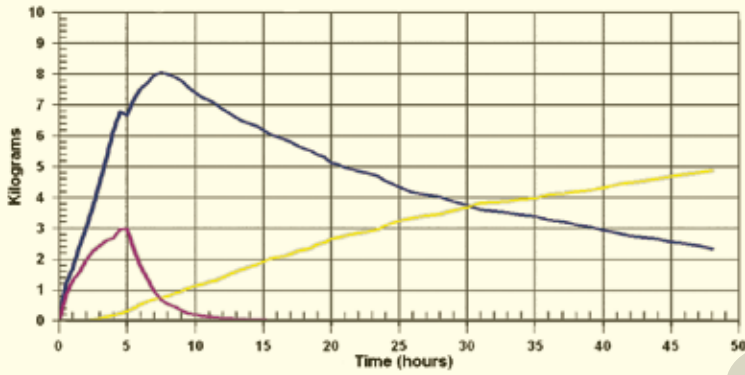
Spillage of 1000 kg of 1,2-dichloroethane over 5 hours. 3 m/s wind.



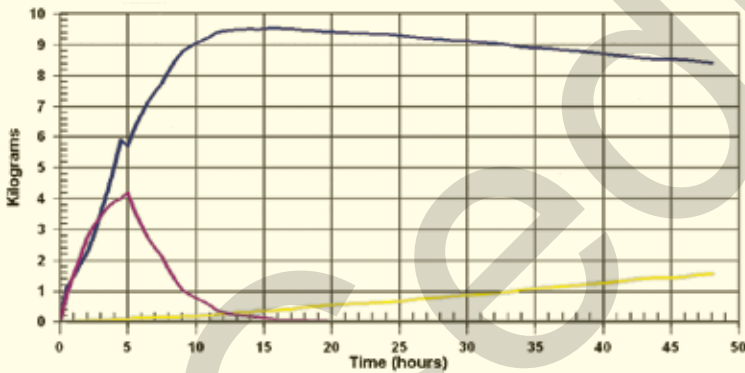
Instantaneous spillage of 500 kg of 1,2-dichloroethane. 3 m/s wind.

— Quantity evaporated — Quantity sedimented — Quantity in the water column

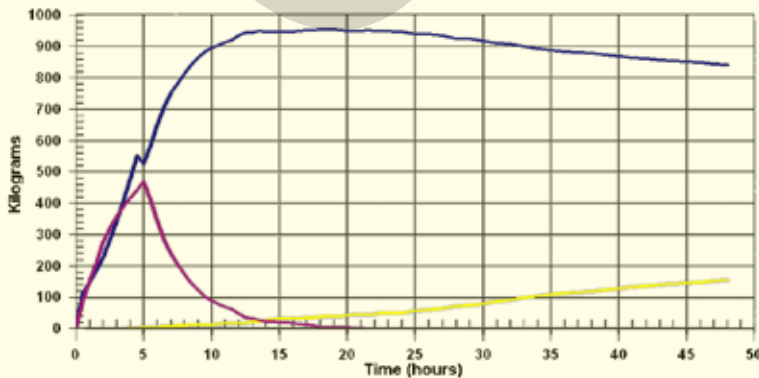
### Results of the river scenario



Spillage of 10 kg of 1,2-dichloroethane over 5 hours.  
Fast current.

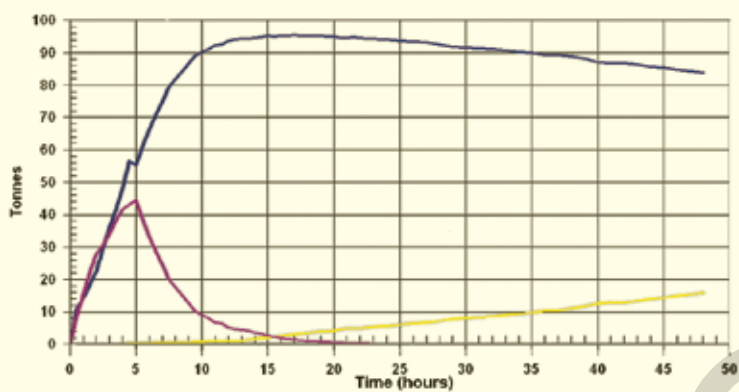


Spillage of 10 kg of 1,2-dichloroethane over 5 hours.  
Slow current.

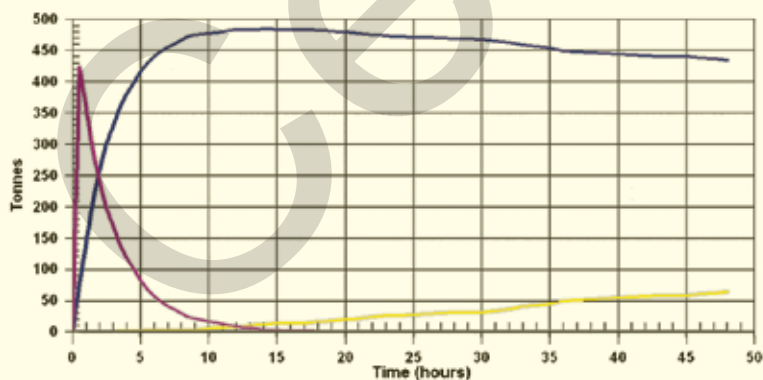


Spillage of 1,000 kg of 1,2-dichloroethane over 5 hours.  
The current speed has very little effect on the results.

— Quantity evaporated — Quantity sedimented — Quantity in the water column



Spillage of 100 tonnes of 1,2-dichloroethane over 5 hours.  
The current speed has very little effect on the results.



Spillage of 500 tonnes of 1,2-dichloroethane over 5 hours.  
The current speed has very little effect on the results.

— Quantity evaporated — Quantity sedimented — Quantity in the water column

## Consumption scenarios

Due to the very low tendency of 1,2-dichloroethane to bioaccumulate in the trophic chain, it is unlikely that this chemical will exist in sufficiently large quantities to have an impact on humans who consume contaminated fish or seafood.

Cedre

# Response

- Feedback: the *Alessandro Primo* \_\_\_\_\_ **D1**
- Examples of 1,2-dichloroethane spills \_\_\_\_\_ **D2**
- Response recommendations \_\_\_\_\_ **D3**
- Response techniques \_\_\_\_\_ **D4**
- Choosing personal protective equipment (PPE) \_\_\_\_\_ **D5**
- Measuring equipment and waste treatment \_\_\_\_\_ **D6**

## Feedback: the Alessandro Primo

(BONN AGREEMENT, 2000; HOOKE, 1997)

An exclusion zone covering a radius of 10 nautical miles was set up around the wreck of the *Alessandro Primo*. The vessel was leaning to starboard. The first images showed a breach in an acrylonitrile pipe. This leak was plugged using epoxy resin.

After two months of closely examining the wreck and its tanks, the recovery scenario and selected procedures were carried out:

- pumps were distributed over the seabed (40 - 60 m<sup>3</sup>/h)
- the tanks were linked up to the pumps using deck cargo lines.

Some three months after the wreckage, 2,733 tonnes of 1,2-dichloroethane were recovered from the tanks of the wreck, as well as 2,850 m<sup>3</sup> of water and dichloroethane mixture. The pumping operations lasted a week.

A fleet was made available by SMIT TAK, made up of a diving support vessel, a lifeboat (and hospital) for 50 people with a helideck and recovery barges (one for each product).

## Examples of 1,2-dichloroethane spills

### Storage reservoir rupture, Brazil

(CEDRE, 1995)

On 5th May 1983, a tanker collided with a storage reservoir. 500 m<sup>3</sup> of carbon tetrachloride, chloroform, 1,2-dichloroethane and 1.1.2-trichloroethane were released into the Pinheirinho and Avecuia rivers (Brazil).

Pumping operations began with the deep waters near the spillage area. In 5 days, 20 m<sup>3</sup> of substances were recovered. Dredging operations removed a layer of between 0.5 and 1 metre of mud from the bottom of the lake. The decontamination system for the mud was made up of two 50 m<sup>3</sup> drains with walls at a 45° angle.

### Derailing of a train (British Columbia, 1982) (ENVIRONMENT CANADA, 1987)

In British Columbia in 1982, a train was derailed and 16 freight cars containing a total of 630 m<sup>3</sup> of 1,2-dichloroethane were projected into a river (North Thomson river), which was a source of drinking water.

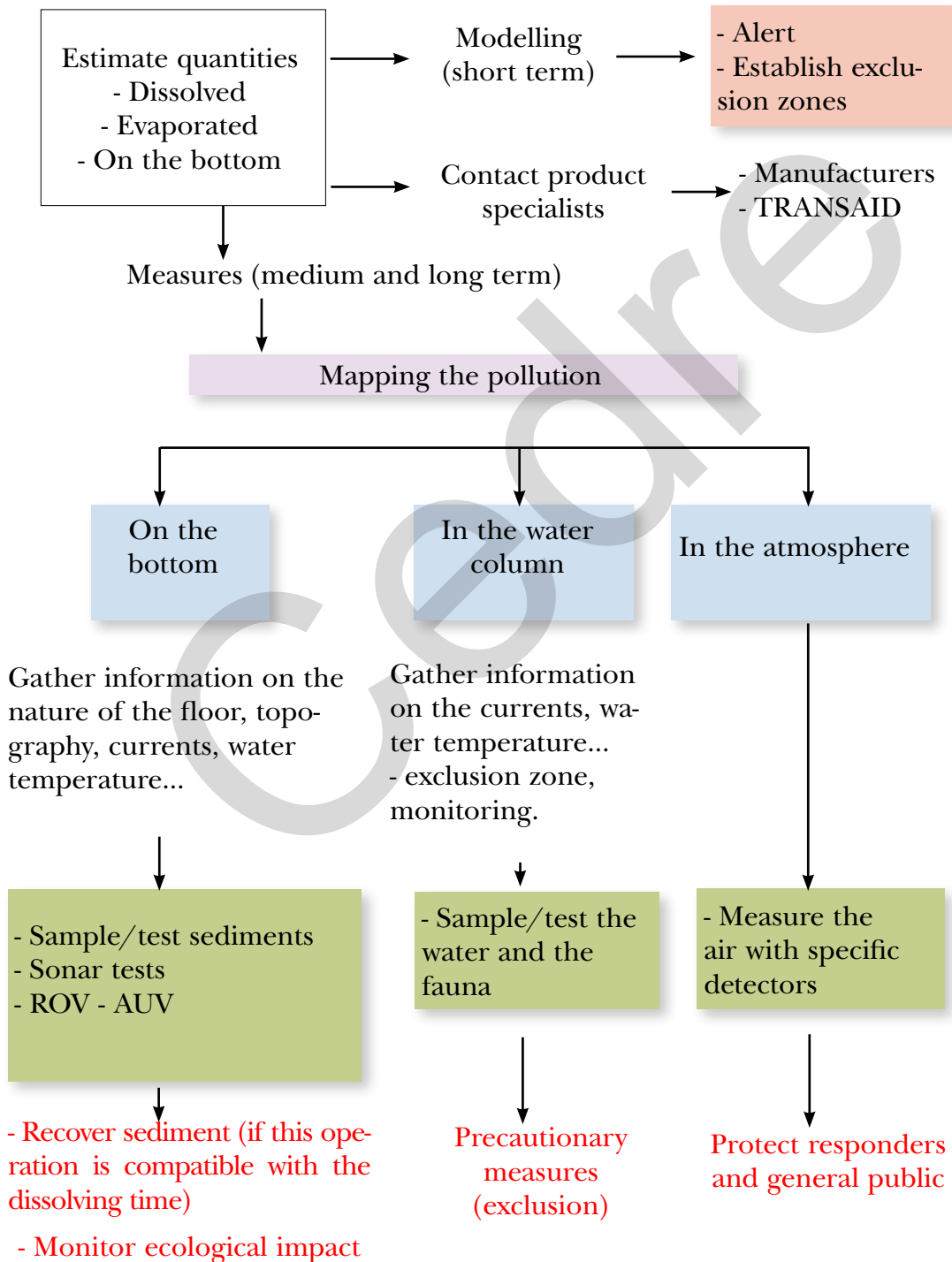
The water intakes were closed as there was a risk of concentrations of 20 ppm (concentration at which taste and odour are affected). The river flow rate at the spillage point (30 m<sup>3</sup>/s) and the average flow velocity (5 km/h) shifted the pollutant 16 km in the first 24 hours and 40 km the following day.

The water and sediment were sampled from pipes and intakes. The specialists indicated that volatilisation is the main factor in the elimination of 1,2-dichloroethane.



## Response recommendations

Diagram of spill response action plan



D3

**Is response possible?** (CEPIC, 2003)

Approach the accident area from upwind (wind behind you), equipped with personal protective equipment (PPE). The number of responders in the risk area should be kept to a minimum.

**Emergency measures in the event of a leak or a spill**

- Plug the leak if this operation is not dangerous.
- Establish an exclusion zone around the accident location.
- Activate alert systems.
- Dyke the area to avoid spreading.

**On land**

- Remove all sources of ignition. Only use anti-explosion tools and equipment with intrinsic safety.
- Control the explosive limits.
- Hose vapours down with water.
- Pump into an inert safety reservoir.
- Absorb the liquid using an inert sorbent (sand, earth or other suitable material) or cover with alcohol-resistant foam.
- Eliminate the product by incineration (see chapter D6).

**In water**

- Establish an exclusion zone.
- Remove all sources of ignition.
- Check the threshold values (explosive limits, IDLH, TLV-TWA).
- Close the nearby drinking water intakes.
- Set up a sampling system on the bottom.
- Pump off the water close to the bottom (if possible, dredge the mud).

## In the event of a fire

### Safety risks

People in the nearby area should remain indoors with all doors and windows closed. All ventilation should be stopped.

Consider evacuating the people in immediate danger.

### Emergency measures

**ALWAYS stay well away from the tank ends.**

|   |   |
|---|---|
| <ul style="list-style-type: none"> <li>- Do not smoke, remove all sources of ignition.</li> <li>- Cool the container using water.</li> <li>- Extinguish the fire using alcohol-resistant foam if possible, if not use pressurised water or dry powder, then ensure safety by covering with foam.</li> <li>- Do not use a solid water stream to extinguish the fire.</li> <li>- Hose down the smoke with pressurised water if possible.</li> </ul>   | (CEFIC, 2003)   |
| <ul style="list-style-type: none"> <li>- Suitable extinction products are: carbon dioxide, foam, dry powder and pressurised water.</li> </ul>   | (ARKEMA SDS, 2004 and ICSC, 1999)   |
| <ul style="list-style-type: none"> <li>- Avoid excessive use of potentially polluting extinction means.</li> <li>- Remove containers from the fire area if this can be done safely. Keep away from the tank ends.</li> </ul>  | (ENVIRONMENT CANADA, 1984)  |
| <p><b>Small fires:</b></p> <ul style="list-style-type: none"> <li>- Use dry chemical powder, CO<sub>2</sub>, pressurised water or alcohol-resistant foam.</li> </ul> <p><b>Large fires:</b></p> <ul style="list-style-type: none"> <li>- Use pressurised water or mist, or alcohol-resistant foam</li> <li>- Do not use a hose</li> <li>- Remove containers from fire area if this can be done safely.</li> </ul> <p><b>Tank fire:</b></p> <ul style="list-style-type: none"> <li>- Fight the fire at a maximum distance or use remote controlled hoses or water canons. Where possible, move away immediately and leave to burn</li> <li>- Cool the containers with plenty of water for a long time after the fire has been extinguished. Do not let water enter the containers.</li> <li>- Move away if the hissing of the safety mechanisms becomes louder or if the tank discolours.</li> </ul> | (TRANSPORT CANADA, UNITED STATES DEPARTMENT OF TRANSPORTATION, SECRETARIAT OF TRANSPORT AND COMMUNICATIONS OF MEXICO, 2001) |

## Response techniques

### Detection (CEDRE 2004)

Sampling in the water column and from the bottom helps detect the products.

Many different techniques are available for sampling the area in question. The depth is not a limiting factor. However in high seas, sampling is made difficult by the surrounding environment, wave height and current speed.

In the event of a major spill, the possible results that could be obtained by sonar (towed, multibeam or frontal) for 1,2-dichloroethane spread on the bottom are unknown. If the results obtained by sonar for heavy oil are positive, these techniques cannot be ignored in the event of 1,2-dichloroethane pollution.

However, where the current is strong, the product will generally dissolve before a detection method on the bottom can be put into action.

### Submarine vehicles

There are two types of remote controlled vehicles: remotely operated underwater vehicles (ROV), linked to the ship by a cable, and autonomous underwater vehicles (AUV). Both types are equipped with high quality video cameras and lighting of varying efficiency. The range and discrimination obtained are often inferior to those of divers. Nevertheless, some ROVs and AUVs could be fitted with frontal sonars to increase their effectiveness. Other specific sensors can be used (conductivity meters, mass spectrometers...). Only AUVs allow good manoeuvrability and a good safety system between the vessel and the vehicle, ensuring reconnaissance missions near the coast in normal sea conditions.

Sampling vehicles are either large ROVs fitted with a grappling arm or classic sample-taking apparatus operated from a surface vessel. Using ROVs means that samples are not taken blindly, however operations are quite time-consuming. The advantage of this method is that the vehicle can dig down into the sediment to see if any pollutant is trapped.

## Recovery of spilt substances in shallow waters

(CEDRE, 2001 AND BALTIC MARINE ENVIRONMENT PROTECTION COMMISSION, 1991)

**Caution, polluted water and sediment should be handled and treated according to health and safety standards.**

1,2-dichloroethane can only be recovered from the bottom if the sediments are polluted or sheltered from currents, meaning that the product will not dissolve as rapidly.

Before beginning operations, the concentrations of the product in the atmosphere of the polluted zone must be controlled.

The choice of techniques depends not only on availability but on the depth, the type of floor, the polluted surface and the concentration on the bottom.

### Major spills

#### • Depression operated pumping system (system in a vacuum)

This is the most environmentally friendly technique. The most important factor is to provide large storage facilities so as to be able to recover large quantities of polluted water. For this, sanitation lorries and their screw pumps can be boarded onto barges. Compounds that are too viscous or solid cannot be pumped.

#### • Dredging

Conditions of use:

- Establish in advance what the impact of the sediment and products in suspension would be on the marine environment.
- Consider the handling, treatment and storage costs for recovered solids and water.
- The chemicals should be concentrated enough and of sufficient volume to justify the use of this technique.

The different techniques involve:

#### - Mechanical dredgers

Advantages: the contact between the outside surface of the bucket and the pollutant is minimal, causing little contamination of the water column when it is brought to the surface. If the pollutant is eliminated using a vibrating screen, the bucket can be washed and decontaminated.

#### - Hydraulic dredgers

Very effective and commonly used. Limitations: limited depth of use (20 to 30 m).

#### - Stationary suction and discharge dredgers

This type of dredger is attached by cables or chains, or fixed to piles, and sweeps the area through movements back and forth.

#### - Anchor suction dredgers

This type of dredger is fixed to the anchors and sweeps the area by movements back and forth around its anchorage point.

#### - Trailing suction dredgers

Speed of 2 to 5 knots. It has two lateral towing chains and is fitted with immersed pumps and occasionally a cutter. Limitations: depth of use is limited to 15 m. Current speed is limited to 5 knots with a flow velocity of 1,000 tonnes per hour.

#### - Pneumatic dredgers:

Sediment is sucked towards the surface in a stream of air bubbles generated by submersible compressed air pumps.

Advantages:

- In theory, no depth limit.
- These pumps can recover a significant quantity of contaminated sediment with very low water content (20%).

Drawbacks:

- The surface compressed must be very powerful to dredge at over 50 m deep.
- The suction forces are considerable.
- The system is difficult for divers to manoeuvre.

### Small spills

- Set up bubble booms (made available in advance).

- Physico-chemical treatments

- Sorbents

A possible technique, which, to the best of our knowledge, has never been used, would be to use sorbent materials on the substance lying on the bottom.

Absorption capacity for liquid test on 1,2-dichloroethane (g/g) (ENVIRONMENT CANADA, 1988)

| Material                              | Name of sorbent   | Absorption capacity |
|---------------------------------------|-------------------|---------------------|
| Natural fibre with polypropylene mesh | Conwed Pad        | 11.3                |
| Natural treated peat fibre            | Oclansorb         | 3.8                 |
| Treated polyurethane foam             | Graboil           | 22.5                |
| Closed cell polyurethane foam         | Conwed-D          | 13.9                |
| Polypropylene                         | Matasorb          | 10.1                |
| Polyethylene                          | 3-M type 156 pads | 13.7                |
| Cross-linked polymer beads            | Dow imbiber beads | 7.7                 |
| Activated carbon                      | Type F-300 8*30   | 1.1                 |
| Polynorbornene                        | Norsorex          | 18                  |

- Gelling agents

The purpose of gelling agents is to immobilise the slick to avoid further contamination of the environment and to condition the product for mechanical recovery (dredging).

These products tend to float on the surface.

(ENVIRONMENT CANADA, 1989)

- Multipurpose gelling agents transform liquids into semi-solid masses.

1,2-dichloroethane is immobilised using polyacrylonitrile-butadiene copolymer, which is contained in multipurpose gelling agents.

(SOLSBERG ET PARENT, 1986)

## Choosing personal protective equipment (PPE)

In the event of a spill on land, ensure maximum protection if concentrations are high.

### Choosing breathing apparatus

(FINGAS, M., 2000)

According to maximum use concentrations (MUC)<sup>2</sup>:

- Chemical cartridge respirator: up to a concentration of 50 ppm. The cartridge absorbs vapours and offers adequate protection when pollutant content does not exceed 2% of the overall volume.
- Self-contained breathing apparatus: no concentration limit (ENVIRONMENT CANADA, 1984).

### Choosing protective clothing

- Hands: wear polyethylene, neoprene or polyvinyl alcohol gloves.

See the table below for information on the chemical resistance of different types of gloves (NATIONAL TOXICOLOGY PROGRAM, 2004).

| Type of gloves    | Thickness | Resistance time |
|-------------------|-----------|-----------------|
| Viton             | 0.28 mm   | 480 min         |
| Polyvinyl alcohol | 0.34 mm   | 480 min         |
| Butyl             | 0.61 mm   | 175 min         |
| Latex             | 0.15 mm   | 0.5 min         |

**Note:** This chemical resistance table is intended simply to give an indication of relative values. An assessment in the real conditions of usage should be carried out.

- Eyes: wear safety glasses in areas where splashes may reach the eyes.
- Clothing: wear waterproof clothing. Wear protective clothing designed for chemicals and consider wearing classic fire clothing underneath (CEFIC, 2003).
- Use self-contained breathing apparatus (SCBA) and vapour-proof clothing, following the manufacturer's recommendations.
- Protective clothing designed for house fires is not effective enough.

(TRANSPORT CANADA, UNITED STATES DEPARTMENT OF TRANSPORTATION, SECRETARIAT OF TRANSPORT AND COMMUNICATIONS OF MEXICO, 2001)

<sup>2</sup> Note that the MUC can vary from one manufacturer and model to another. You should therefore contact the manufacturer for more information.

### Recommendations for use in the event of a spill (FINGAS, M., 2000)

- Pressure demand open-circuit SCBAs give the best safety protection. Their protection factor is around 10,000 (e.g. ELV = 20 ppm, protection up to 200,000 ppm of product in ambient air temperatures).
- Use SCBA to face unknown situations or to enter an area with unknown or high concentrations of a toxic substance or areas where there may be a lack of oxygen (an enclosed space).
- Caution, certain facial characteristics such as a scar, a narrow face shape or facial hair may lead to poor adjustment of the mask and impair the level of protection.
- Problems due to temperature  
In hot weather, excessive perspiration diminishes the watertightness of the seal between the mask and the skin. In cold weather, ice may form on the regulator and the mask may steam up.
- Problems due to corrective lenses  
Ordinary glasses cannot be worn under the mask (special frames exist). Contact lenses are permitted with new models of masks which allow gas exchange (as the lenses therefore do not dry out or stick to the eye).
- Mask adjustment tests are recommended for new users and regular tests for other users.



## Measuring devices and waste treatment

### • Measuring devices

In the field, to map a slick on the bottom, the conductivity can be measured (see chapter D1). The infrared method (3200 cm<sup>-1</sup> to 2700 cm<sup>-1</sup>) can also be used after acidifying the sample (ENVIRONMENT CANADA, 1984).

In the laboratory, it is possible to measure out concentrations of 1,2-dichloroethane greater than or equal to 0.10 µg/L in water by purging and trapping using a gas-liquid chromatograph fitted with a specific halogen detector. The quantitative assessment threshold of 1,2-dichloroethane in practice is 5 µg/L.

### Air detection methods (INRS, 1997)

Measurements are carried out using Dräger instantaneous response apparatus, fitted with a reactive tube of methyl bromide. The colorimetric method is based on a modified Fujiwara reaction, involving the absorption of pyridine into an aqueous solution, heating, cooling, the addition of soda and colorimetric or photometric determination.

Sampling is carried out on activated carbon, desorption with carbon bisulphide and analysis by chromatography in the gaseous phase. A reduction of 81.1% in comparison to the initial concentration can be observed.

The absorption rate increases with the temperature and the molar mass. Simultaneously, the solubility and polarity decrease.

To eliminate problems of turbidity and to facilitate cleaning, the activated carbon is placed in teabags.

Suggested treatment of sinking substances: fill the bags with activated carbon with a relative density greater than 1 or add weights.

### • Recommendations for the treatment of waste waters

The substances resulting from pumping operations (water, sediment, dichloroethane/sorbent mixture) must be treated. Activated carbon is considered the best chemical agent to neutralise chemical spills. For 1,2-dichloroethane, the absorption rate is 0.163 g of compound per gram of carbon.

### Incineration (ANRED, 1989)

When the chlorine content is greater than 1 to 2%, waste can only be incinerated in facilities equipped with an acid gas neutralisation system.

### • Addresses of special industrial waste treatment plants in France

The organisations able to treat this type of waste are listed at the following address:  
<http://www.observatoire-dechets-bretagne.org>  
(French only).

### • 1,2-dichloroethane manufacturers Arkema, WACHER, SOLVAY, EVC, DOW...

## Further information

- Bibliography E1
- Glossary E2
- Acronyms E3
- Useful websites E4

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# Glossary

## Acceptable Daily Dose (ADD)

For humans this dose is the quantity of a substance that can be ingested by an organism per day for its entire lifetime without presenting a health hazard for the organism in question.

## Adsorption

Elevation of the concentration of a substance dissolved at the interface of a condensed phase and a liquid phase under the influence of surface forces. Adsorption can also occur at the interface of a condensed phase and a gas phase.

## AEGLs (Acute Exposure Guideline Levels)

Defined by the National Research Council's Committee on Toxicology (USA), AEGLs are three levels above which the general population may experience certain effects. These three AEGLs are given for five exposure times: 10, 30 min, 1, 4 and 8 hours.

**AEGL 1:** is the airborne concentration (expressed as ppm (parts per million) or mg/m<sup>3</sup> (milligrams per cubic metre) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic non sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

**AEGL 2:** is the airborne concentration (expressed as ppm or mg/m<sup>3</sup>) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

**AEGL 3:** is the airborne concentration (expressed as ppm or mg/m<sup>3</sup>) of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

## Bioaccumulation

Continued retention of a substance in the tissue of an organism throughout the course of its existence (the bioaccumulation factor increases all the time).

## Bioamplification

Retention of a substance in the tissue at increasingly higher concentrations the higher one goes in the food chain.

## Bioconcentration

Retention of a substance in the tissue of an organism to the extent that the content of the substance in the tissue exceeds that found in nature at one point in the lifetime of the organism.

## Bioconcentration factor, BCF

According to EPA guidelines, "the BCF is defined as the ratio of chemical concentration in the organism to that in surrounding water. Bioconcentration occurs through uptake and retention of a substance from water only, through gill membranes or other external body surfaces. In the context of setting exposure criteria it is generally understood that the terms "BCF" and "steady-state BCF" are synonymous. A steady-state condition occurs when the organism is exposed for a sufficient length of time that the ratio does not change substantially."

## Biotransformation

Biological transformation of substances in a living organism via enzymatic processes.

## BLEVE (Boiling Liquid Expanding Vapour Explosion)

A violent vapour explosion of a liquid that is significantly above its usual boiling point at atmospheric pressure after a tank has failed.

## Boiling point

(measured at a pressure of 1 atmosphere)

Temperature at which a liquid begins to boil. More specifically, when the temperature at which saturating vapour pressure of a liquid is equal to standard atmospheric pressure (1,013.25 hPa). The boiling point measured depends on atmospheric pressure.

## Critical pressure

Maximum pressure for which the distinction can be made between a gas and a liquid.

## Critical temperature

Temperature at which, when boiling, there is no longer any clear cut transition between the liquid and the gas state.

#### Daily exposure dose

Dose (internal or external) of a substance in an organism compared to the weight of the individual and the number of days of exposure (in the case of a non carcinogenic substance) and the number of days lived by the organism (for a carcinogenic substance).

#### Decomposition products

Products stemming from chemical or thermal disaggregation of a substance.

#### Diffusion coefficient in air (and in water)

A constant that describes the movement of a substance in the gas phase (or liquid phase) in response to a concentration differential in the gas phase (or liquid phase).

#### Effective concentration 50 (EC<sub>50</sub>)

Concentration causing a given effect (mortality, growth inhibition...) for 50% of the population under consideration during a given period of time.

#### Emergency Response Planning Guidelines (ERPG)

The American International Health Alliance, AIHA set three maximum concentrations in 1988 below which a category of effects is not expected for an exposure duration of one hour, in a bid to protect the general public.

**ERPG1:** is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly identifiable odour.

**ERPG2:** is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to protect themselves.

**ERPG3:** is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

#### Exposure limit value (ELV)

Ceiling exposure value measured for a maximum duration of 15 minutes.

#### Flash point

The lowest temperature at which a substance generates vapours that ignite or burn immediately when in contact with a flame.

#### Foam

The foam layer absorbs most of the vapours, physically eliminates vapours and isolates the chemical from sunlight and ambient air which reduces the amount of heat and subsequent vaporisation.

#### Henry's law constant

Property of a substance to divide itself into two distinct phases of a binary air/water system.

#### Immediately Dangerous to Life or Health (IDLH)

Level below which a worker can escape to safety in thirty minutes in the event of sudden exposure to a dangerous atmosphere, without respiratory protection and without impairing his ability to escape.

#### Irreversible effect threshold (IET)

Concentration, for a stated exposure duration, above which irreversible effects can occur in the exposed population.

#### Lethal effect threshold (LET)

Concentration, for a stated exposure duration, above which mortality can be observed in the exposed population.

#### Lower Explosive Limit (LEL)

Minimum airborne concentration above which vapours ignite.

#### Lowest Observed Effect Concentration (LOEC)

Lowest concentration at which an effect is observed.

#### Marine pollutant

Substance, object or matter likely to cause serious damage to the marine environment when spilled.

#### MARVS (Max Admissible Relief Valve System)

Indicates the maximum admissible calibration of pressure relief valves of a cargo tank.

#### Mean exposure value (MEV)

Value that has been measured or estimated for a work station lasting 8 hours and is intended to protect workers from long term effects. MEV can be exceeded for very short periods providing the ELV value (should there be one) is not exceeded.

#### Median lethal concentration (LC<sub>50</sub>)

Concentration of a substance deduced statistically that should, during or after exposure and for a given period of time, cause the death of 50% of the animals exposed during a given time period.

### **Melting point**

Temperature at which solid and liquid state coexist. The melting point is a constant for a pure substance and is usually calculated at standard atmospheric pressure (one atmosphere).

### **Minimum Risk Level (MRL)**

This level is an estimate of daily human exposure to a chemical which probably has no appreciable risk of non-carcinogenic noxious effect on health for a specific exposure duration.

### **Miscible**

Matter that mixes readily with water.

### **No Observed Effect Level (NOEL)**

The highest dose of a substance that causes no distinct changes as compared with those observed in control animals.

### **N-octanol/water partition coefficient (Kow)**

Ratio of the equilibrium concentrations of a substance dissolved in a two phase system made up of two solvents that virtually do not mix.

### **Olfactory threshold**

Minimum air or waterborne concentration to which the human nose is sensitive.

### **Organic carbon/water partition coefficient (Koc) (for organic substances)**

Ratio of the amount of compound absorbed per unit mass of organic carbon in the soil or in a sediment and the concentration of the same compound in a water solution in a state of equilibrium.

### **Photo-oxidation**

Oxidation of a chemical compound caused by exposure to light energy.

### **Polymerisation**

This term describes the chemical reaction generally associated with the production of plastics. Fundamentally, the individual molecules of a chemical (liquid or gas) react together to form a long chain. These chains can be used for many applications.

### **Protective equipment**

This refers to the respiratory or physical protection of a human being. Protection levels have been defined, including both protective clothing and breathing apparatus as accepted by response authorities such as the USCG, NIOSH and the EPA (US).

Level A: an SCBA (Self contained breathing apparatus/respirator) and fully air and chemical-tight suit (that resists permeation).

Level B: an SCBA and a suit that protects against liquid spray (splash proof).

Level C: a full face mask or goggles and a suit that protects responders against chemicals (splash proof).

Level D: overalls without a respirator.

### **Rate of evaporation or volatility (ether = 1)**

The rate of evaporation expresses the number of times that a product takes to evaporate as compared with a control substance (ether for instance). This rate varies with the nature of the product and the temperature.

### **Regression speed**

Speed at which a burning liquid slick reduces in thickness. For a given liquid, this speed is constant regardless of the slick surface (slick diameter greater than 2 metres). Regression speed allows the total duration of a fire to be estimated if no attempt is made to extinguish it. For instance for a 1,000 mm thick slick, where the regression speed is 10 mm/minute

→ duration of fire = 1000/10 = 100 minutes.

### **Relative density**

Ratio of the mass of a substance to that of water for a liquid or to that of air for a gas.

### **Relative vapour density**

Weight of a volume of vapour or pure gas (without air) compared to that of an equal volume of dry air at the same temperature and pressure. A vapour density lower than 1 indicates that the vapour is lighter than air and will have a tendency to rise. When the vapour density is higher than 1, vapour is heavier than air and will tend to stay near ground level and spread.

### **Self-ignition temperature**

Minimal temperature at which vapours ignite spontaneously.

### **Solubility**

Quantity of a substance dissolved in water. It will depend on salinity and temperature.

### **Source of ignition**

Examples of sources of ignition: heat, sparks, flame, static electricity and friction. Sources of ignition should always be eliminated when handling flammable products or responding to an emergency in risky areas (use explosion proof pumps and VHF walky-talkies).

**Surface roughness**

Length of a transfer area between the atmospheric layer and a contact surface. This will depend on the average size of the roughness of the contact and atmospheric parameters near the water surface. When the sea is calm it is of the order of 0.02 to 0.06 cm.

**Surface tension**

A constant that expresses the force owing to molecular interaction exerted at the surface of a liquid when it comes into contact with another surface (liquid or solid) and that affects surface dispersion.

**Temporary Emergency Exposure Limits (TEEL)**

Exposure times when there is no ERPG.

TEEL 0 is the threshold concentration below which a large part of the population will experience no effect on health.

TEEL 1 is equivalent to ERPG1, TEEL 2 is equivalent to ERPG2 and TEEL 3 is equivalent to ERPG3.

**Threshold Limit Value (TLV)**

Average limit value (weighted as a function of time) that people can be exposed to regularly at work 8 hours a day, 5 days a week without experiencing noxious effects. This value was defined and determined by ACGIH.

**TLV-STEL**

Mean weighted 15 minutes concentration that must never be exceeded at any time during the day.

**TLV-TWA**

Mean weighted values for an eight hour period per day and forty hours a week.

**TLV-ceiling**

Ceiling values never to be exceeded not even for an instant.

**Unconfined Vapour Cloud Explosion (UVCE)**

Explosion of a gas cloud or slick of combustible vapours in an unconfined environment.

**Upper Explosive Limit (UEL)**

Maximum airborne concentration of a compound above which vapours will not ignite for lack of oxygen.

**Vapour pressure or tension**

Partial pressure of gas molecules in a state of equilibrium with the liquid phase for a given temperature.



## Acronyms

|         |   |
|---------|---|
| ACGIH   | American Conference of Governmental Industrial Hygienists                                       |
| ADD     | Acceptable Daily Dose   |
| ADNR    | European Agreement concerning International Carriage of Dangerous Goods on the Rhine river      |
| ADR     | European Agreement concerning the International Carriage of Dangerous Goods by Road             |
| AEGLs   | Acute Exposure Guideline Levels   |
| AFFF    | Aqueous Film-Forming Foam   |
| AFSSA   | French National Agency for Food Safety  |
| AIHA    | American International Health Alliance  |
| ALOHA   | Areal Locations of Hazardous Atmospheres  |
| ATSDR   | Agency for Toxic Substances and Disease Registry  |
| AUV     | Autonomous Underwater Vehicle   |
| BCF     | Bio Concentration Factor  |
| BLEVE   | Boiling Liquid Expanding Vapour Explosion   |
| CAS     | Chemical Abstracts Service  |
| CEA     | French Atomic Energy Commission   |
| CEDRE   | Centre of Documentation, Research and Experimentation on Accidental Water Pollution             |
| CEFIC   | European Chemical Industry Council  |
| CHRIS   | Chemical Hazards Response Information System  |
| CSST    | French Occupational Health and Safety Commission  |
| CSTEE   | French Scientific Committee on Toxicity, Ecotoxicity and the Environment                        |
| DDASS   | French Departmental Health and Social Action Directorate  |
| DDE     | French Departmental Equipment Directorate   |
| DRASS   | French Regional Department of Health and Social Affairs   |
| DRIRE   | French Regional Directorates for Industry, Research and Environment                             |
| EC      | Effective Concentration   |
| ECB     | European Chemicals Bureau   |
| EINECS  | European Inventory of Existing Chemical Substances  |
| ELV     | Exposure Limit Value  |
| EPA     | Environmental Protection Agency   |
| ERPG    | Emergency Response Planning Guidelines  |
| ETC     | Environmental Technology Centre   |
| HSDB    | Hazardous Substances Data Bank  |
| IATA    | International Air Transport Association   |
| IBC     | International Bulk chemical Code  |
| ICSC    | International Chemical Safety Cards   |
| IDLH    | Immediately Dangerous to Life or Health concentrations  |
| IFREMER | French Research Institute for Exploitation of the Sea   |
| IGC     | International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk |
| IMDG    | International Maritime Dangerous Goods  |
| IMO     | International Maritime Organization   |
| INCHEM  | International Chemical industries, Inc.   |
| INERIS  | National Institute for Industrial Environment and Risks   |
| INRS    | French National Research and Safety Institute for occupational risk prevention                  |
| IPCS    | International Programme on Chemical Safety  |
| IPSN    | French Institute for Nuclear Safety and Protection  |
| IUCLID  | International Uniform Chemical Information Database   |

|             |  |
|-------------|--|
| LC          | Median Lethal Concentration  |
| LEL         | Lower Explosive Limit  |
| LET         | Lethal Effect Threshold  |
| LLDPE       | Linear Low Density PolyEthylene  |
| LOEC        | Lowest Observed Effect Concentration   |
| MARPOL      | Marine Pollution   |
| MARVS       | Maximum Allowable Relief Valve Setting   |
| MCA         | Maritime and Coastguard Agency   |
| MEDD        | Ministry of Ecology and Sustainable Development                                      |
| MEV         | Mean Exposure Value  |
| MP          | Marine Pollutant   |
| MRL         | Minimum Risk Level   |
| MUC         | Maximum Use Concentrations   |
| NIOSH       | National Institute for Occupational Safety and Health                                |
| NOAA        | National Oceanic and Atmospheric Administration                                      |
| NOEC        | No Observed Effect Concentration   |
| OCDE        | Organisation for Economic Co-operation and Development                               |
| PEC         | Predicted Effect Concentration   |
| PID         | Photo Ionisation Detector  |
| PNEC        | Predicted No-Effect Concentration  |
| PPE         | Personal Protective Equipment  |
| ppm         | Parts per million  |
| PTBC        | Para-tertiary-butylcatechol  |
| PVC         | Polyvinyl chloride   |
| PVDC        | Polyvinylidene chloride  |
| PVDF        | Polyvinylidene fluoride  |
| ROV         | Remoted Operated Vehicle   |
| SCBA        | Self-Contained Breathing Apparatus   |
| SDS         | Safety Data Sheet  |
| SEBC        | Standard European Behaviour Classification system of chemicals spilled into the sea  |
| SIDS        | Screening Information Data Set   |
| SIW         | Special Industrial Waste   |
| TEEL        | Temporary Exposure Limits  |
| TGD         | Technical Guidance Document  |
| TLV-ceiling | Threshold Limit Values – Ceiling   |
| TLV-STEL    | Threshold Limit Values - Short Term Exposure Limit                                   |
| TLV-TWA     | Threshold Limit Values - Time Weighted Average                                       |
| TNO         | Netherlands Organisation for Applied Scientific Research                             |
| TRANSAID    | Agreement between UIC (French Chemical Industry Association) & the French Government |
| UEL         | Upper Explosive Limit  |
| UIISC       | French Unit of Instruction and Intervention on Civil Security                        |
| US EPA      | United States Environmental Protection Agency  |
| UVCE        | Unconfined Vapour Cloud Explosion  |
| VCM         | Vinyl chloride monomer   |
| VHF         | Very High Frequency  |
| v/v         | Volume to volume   |
| WHO         | World Health Organisation  |

## Useful websites

**AFSSA** (French National Agency for Food Safety) (French only)

<http://www.afssa.fr>

**ARKEMA**

<http://www.arkema.com/sites/group/en/home.page>

**ATSDR** (Agency for Toxic Substances and Disease Registry)

<http://atsdr1.atsdr.cdc.gov/toxprofiles/#-D->

**Bonn Agreement**, European Classification System

[http://www.bonnagreement.org/eng/html/counter-pollution\\_manual/chapter26\\_hazardousmaterials.htm](http://www.bonnagreement.org/eng/html/counter-pollution_manual/chapter26_hazardousmaterials.htm)

**Cedre** (Centre of Documentation, Research and Experimentation on Accidental Water Pollution)

[http://www.cedre.fr/index\\_gb.html](http://www.cedre.fr/index_gb.html)

**CEFIC** (European Chemical Industry Council)

<http://www.ericards.net>

**Chemfinder**

<http://chemfinder.cambridgesoft.com>

**CHRIS** (Chemical Hazards Response Information System)

<http://www.chrismanual.com>

**CRIOS** (Carcinogenic Risk In Occupational Settings)

<http://cdfc00.rug.ac.be/healthrisk/main.htm>

**CSST** (Occupational Health and Safety Commission)

<http://www.reptox.csst.qc.ca>

**CSTEE** (Scientific Committee on Toxicity, Ecotoxicity and the Environment)

<http://europa.eu.int/comm/food/>

**Environment Canada**: Pollution calculation

[http://www.etcentre.org/databases/fuelcalc\\_e.html](http://www.etcentre.org/databases/fuelcalc_e.html)

**ETC** (Environmental Technology Centre)

[http://www.etc-cte.ec.gc.ca/etchome\\_e.html](http://www.etc-cte.ec.gc.ca/etchome_e.html)

**European Chemicals Bureau**, Risk Assessment

<http://ecb.jrc.it/existing-chemicals>

**ICSC** (International Chemical Safety Cards)

<http://www.cdc.gov/niosh/ipcs/ipccard.html>

**IDLH** Documentation for Immediately Dangerous to Life or Health concentrations, List of 387 products (original and amended)

<http://www.cdc.gov/niosh/idlh/intridl4.html>

**INCHEM** (INternational CHEMical Industries, Inc.)

<http://www.inchem.org> and <http://inchem.org/pages/ilodb.html> (list of ERPGs)

**INERIS** (National Institute for Industrial Environment and Risks)

<http://www.ineris.fr>

**INRS** (National Research and Safety Institute for Occupational Risk Prevention)

<http://en.inrs.fr/> and <http://www.inrs.fr/produits/pdf/nd2098.pdf> (French only) (list of ELVs and MUCs)

**IPCS** (International Programme on Chemical Safety)

<http://www.ilo.org/public/english/protection/safework/cis/products/icsc>

**Lyondell**, chemical company

[http://www.lyondell.com/html/products/product\\_selector.shtml](http://www.lyondell.com/html/products/product_selector.shtml)

**NIOSH** (National Institute for Occupational Safety and Health)

<http://www.cdc.gov/niosh/>

**NOAA** (National Oceanic and Atmospheric Administration), historical incident search page

<http://www.incidentnews.gov/>

**Sécaline** (Système d'informations et de conseils sur les produits et déchets toxiques)

<http://www.secaline.alison-envir.com> (French only)

**SHELL**, Material Safety Data Sheets (MSDS)

<http://www.euapps.shell.com/MSDS/GotoMsds>

**UIC** (French Chemical Industry Association)

<http://www.uic.fr/index-us.htm>

**University of Nancy-Metz**, Fiche de sécurité

[http://www.ac-nancy-metz.fr/enseign/physique/chim/sc\\_fds.htm](http://www.ac-nancy-metz.fr/enseign/physique/chim/sc_fds.htm) (French only)

**US Department of Energy**, Chemical Safety Program, list of ERPGs

[http://tis.eh.doe.gov/web/chem\\_safety/teel.html](http://tis.eh.doe.gov/web/chem_safety/teel.html)

**U.S.-EPA** (Environmental Protection Agency)

<http://www.epa.gov> and <http://www.epa.gov/oppt/aegl/chemlist.htm> (list of AEGLs)

## **ANNEXES**

**Annex 1:** Summary and additional physical and toxicological data

**Annex 2:** Fax format data card

**Annex 3:** Classification of noxious liquid substances

**Annex 3b:** New classification of noxious liquid substances

## Annex 1: Summary and additional physical and toxicological data

### Classification

(CHRIS, 1999 and INRS, 1997)

CAS N°: 107-06-2  
EC N° (EINECS): 203-458-1  
UN N°: 1184  
Index N°: 602-012-00-7  
Class: 3

### Physical data

**Conversion factor:** in air

1 ppm = 4.11 mg/m<sup>3</sup>

1 mg/m<sup>3</sup> = 0.24 ppm

**Molar mass:** 98.96 g/mol

**Liquid volumic mass**

At 20°C: 1253 kg/m<sup>3</sup>

**Volumic mass of vapour**

At 15°C: 4.1 kg/m<sup>3</sup> (hPa)

**Physical state**

In normal temperature and pressure conditions

Appearance: viscous, oily liquid which sinks.

Colour: colourless at room temperature.

Odour: similar to that of chloroform.

**Density**

Density of liquid (water = 1): 1.247 at 20°C

Density of gas (air = 1): 3.42

Relative density in seawater: 3.88 (at boiling point)

Relative density of air/vapour mixture (air = 1): 1.2 at 20°C

**Dispersion in seawater:** (g / L)

|                  |  |   |
|------------------|--|---|
| Mixed dispersion | Without filtration<br>(Solubilised and emulsified fractions) | 7.96 ± 0.02 at 10°C<br>7.97 ± 0.08 at 25°C                        |
|                  | With filtration<br>(Solubilised fraction)                    | 6.93 ± 0.17 at 10°C<br>7.01 ± 0.15 at 15°C<br>7.53 ± 0.21 at 25°C |

Salinity 34 ‰

ATSDR (1990), GUIDE DE LA CHIMIE (1999), HSDB (2001), Lide (1997), in INERIS, 2003

ARKEMA SDS, 2004

ARKEMA SDS, 2004

ARKEMA SDS, 2004

INRS, 1997 and ICSC, 1999

INRS, 1997

INRS, 1997

ENVIROGUIDE CANADA, 1984

ICSC, 1999

### Solubility

In fresh water: 8.7 g/L at 20°C  
8.509 g/L at 20°C  
(Range: 8 - 8.690 at 20°C)

ARKEMA SDS, 2004

GUIDE DE LA CHIMIE (1999), ATSDR (1990), HSDB (2001), INRS (1997), OMS IPCS (1995), IUCLID (2000), KIRK-OTHMER (1979), PRAGER (1995), ULLMAN (1986), VERSCHUEREN (1996) in INERIS, 2003

### In other compounds

Soluble in alcohols, acetone, ethyl ether, carbon tetrachloride and aromatic hydrocarbons.

ARKEMA SDS, 2004

Solubility of water in 1,2-dichloroethane: 0.16 % in mass

ARKEMA SDS, 2004

**Emulsification:** fraction dissolves and emulsifies with a lot of agitation (ultra turax) for a salinity of 34 ‰: 8.43 ± 0.53 g / L at 10°C  
8.81 ± 0.6 g / L at 25°C

### Vapour tension

85 hPa at 20°C  
213 hPa at 40°C  
320 hPa at 50°C

ARKEMA SDS, 2004

INRS, 1997

ARKEMA SDS, 2004

### Important temperatures

Boiling point at 1 atm: 83.4°C  
Melting point: - 35.6° C  
Flash point (in closed capsule): 13°C  
Self-ignition temperature: 413°C  
Critical temperature: 288.4°C

DIPPR DATABASE

DIPPR DATABASE

INRS, 1997

INRS, 1997

DIPPR DATABASE

### Other properties

Henry's law constant: 97.7 Pa.m<sup>3</sup>/mol at 20°C

ARKEMA SDS, 2004

Diffusion coefficient in air: 1.04×10<sup>-1</sup> cm<sup>2</sup>/s  
(Range: 0.091-0.104 cm<sup>2</sup>/s)

HEMPFLING *et al.*, (1997), US EPA (1996) in INERIS, 2003

Diffusion coefficient in water: 9.90×10<sup>-6</sup> cm<sup>2</sup>/s

US EPA (1996) in INERIS, 2003

Dynamic viscosity: 0.84×10<sup>-3</sup> Pa.s at 20°C

GUIDE DE LA CHIMIE (1999), HSDB (2001), IUCLID (2000), KIRK-OTHMER (1979), ULLMANN (1986) in INERIS, 2003

CHRIS, 1999

Critical pressure: 50 atm

HSDB(2001), IUCLID (2000), KIRK-OTHMER (1979), ULLMANN (1986) in INERIS, 2003

Surface tension: 32×10<sup>-3</sup> N/m at 20°C

CHRIS, 1999

Interface tension/liquid water: 0.03 N/m at 25°C

INRS, 1997

Evaporation rate (diethyl ether = 1): 4.1

### Olfactory threshold:

In air: 6 -100 ppm  
In fresh water: 20 mg/L

ATSDR (1990), PRAGER (1995) in INERIS, 2003

ATSDR (1990) in INERIS, 2003

## Toxicological data

### Threshold toxicological values

#### Chronic

MEV: 10 ppm (40 mg/m<sup>3</sup>) INRS, 1997 and INERIS, 2003  
TLV-TWA: 10 ppm (40 mg/m<sup>3</sup>) CHRIS, 1999 and ICSC, 1999  
MRL chronic inhalation: 0.6 ppm (3 mg/m<sup>3</sup>) ATSDR, 2001 in INERIS, 2003

#### Acute

IDLH: 50 ppm (205.5 mg/m<sup>3</sup>) CHRIS, 1999  
TLV-STEL: 15 ppm (60 mg/m<sup>3</sup>) TLV, 1983 in Enviroguide, 1984  
ERPG 1: 50 ppm (205.5 mg/m<sup>3</sup>) US DEPARTMENT OF ENERGY'S CHEMICAL SAFETY PROGRAM, 2002  
ERPG 2: 200 ppm (822 mg/m<sup>3</sup>)  
ERPG 3: 300 ppm (1233 mg/m<sup>3</sup>)

## General toxicity

**Acute human toxicity:** INRS, 1997 and ICSC, 1999

- Ingestion: burning sensation in the mouth, pharynx, oesophagus and stomach, neuropsychic troubles, vomiting, abdominal pains, possibility of liver/kidney lesions, pulmonary oedema, can be life threatening.
- Skin contact: redness.
- Eye contact: redness, pain, affected sight, possibility of burns on the cornea.
- Inhalation: abdominal pain, cough, dizziness, drowsiness, headaches, nausea, sore throat, loss of consciousness, vomiting, symptoms of delayed effects.  
Inhalation of strong concentrations: risk of pulmonary oedema, liver/kidney lesions, can be life threatening.

**Chronic human toxicity:** ARKEMA SDS, 2004; INRS, 1997 and ICSC, 1999

- Repeated exposure by inhalation: nervous irritation, gastro-intestinal troubles, liver and kidney problems.
- Prolonged or repeated contact with the skin can cause dermatitis. This substance is probably carcinogenic for humans.
- Little information is known about the chronic toxicity of 1,2-dichloroethane for humans. The problems encountered by workers exposed to this chemical are anorexia, nausea, abdominal pains, drowsiness, liver and kidney deterioration and orthoergic contact dermatitis.



## Specific effects

Carcinogenic effects: suspected of being carcinogenic for humans (E.U. category 2)

Effects on fertility: not demonstrated (INERIS, 2003)

Teratogenic effects: not demonstrated (INERIS, 2003)

Genotoxic effects: not classed as genotoxic by the E.U. (INERIS, 2003)

Mutagenic effects: suspected in animals (CSST, 1997)

## Ecotoxicological data

### Acute ecotoxicity INERIS, 2003 and OECD, 2002

|  |                          |                        |                                |
|--|--------------------------|------------------------|--------------------------------|
| Methanogenic bacteria                    | EC <sub>50</sub> (48h) = | 25 mg/L (Fresh water)  | BLUM and SPEECE, 1991          |
| Algae ( <i>Scenedesmus subspicatus</i> ) | EC <sub>50</sub> (96h) = | 166 mg/L (Fresh water) | BEHECHTI <i>et al.</i> , 1995  |
| Crustacean ( <i>Daphnia magna</i> )      | EC <sub>50</sub> (48h) = | 155 mg/L (Fresh water) | AHMAD <i>et al.</i> , 1984     |
| Crustacean ( <i>Crangon crangon</i> )    | LC <sub>50</sub> (96h) = | 85 mg/L (Seawater)     | ADEMA, 1976                    |
| Mollusc ( <i>Elimininius modestus</i> )  | LC <sub>50</sub> (48h) = | 186 mg/L (Seawater)    | PEARSON and McCONNEL, 1975     |
| Fish ( <i>Limanda limanda</i> )          | LC <sub>50</sub> (96h) = | 115 mg/L (Seawater)    | PEARSON and McCONNEL, 1975     |
| Fish ( <i>Gobius minutus</i> )           | LC <sub>50</sub> (96h) = | 186 mg/L (Seawater)    | ADEMA, 1976                    |
| Fish ( <i>Pimephales promelas</i> )      | LC <sub>50</sub> (96h) = | 116 mg/L (Fresh water) | WALBRIDGE <i>et al.</i> , 1983 |

### Chronic ecotoxicity

|  |                           |          |                                     |
|--|---------------------------|----------|-------------------------------------|
| Methanogenic bacteria                    | EC <sub>10</sub> (11 d) = | 860 mg/L | VAN VLAADINGEN and VAN BEELEN, 1992 |
| Algae ( <i>Scenedesmus quadricauda</i> ) | LOEC (8 d) =              | 710 mg/L | BRINGMANN and KÜHN, 1980            |
| Crustacean ( <i>Daphnia magna</i> )      | NOEC (28 d) =             | 11 mg/L  | RICHTER <i>et al.</i> , 1983        |
| Fish ( <i>Pimephales promelas</i> )      | NOEC (32 d) =             | 29 mg/L  | BENOIT <i>et al.</i> , 1982         |

### PNEC (Predicted No-Effect Concentration)

|                            |                          |
|----------------------------|--------------------------|
| PNEC water                 | 1.1 mg/L                 |
| PNEC sediment (calculated) | 3.51 mg/kg (dry weight)  |
| PNEC soil (calculated)     | 0.877 mg/kg (dry weight) |

## Annex 2: Fax format data card

|   |                           |
|---|---------------------------|
| <b>1,2-dichloroethane</b>   | CAS N°: 107-06-2          |
| Ethylene chloride, Ethylene dichloride, ECD, Ethyl dichloride, Ethylene, bichloride, $\alpha$ , $\beta$ - dichloroethane, Dichloro 1.2 ethane, 1.2-ethylene dichloride, Sym-dichloroethane, Glycol dichloride, Dutch oil. | EC N° (EINECS): 203-458-1 |
|   | Index N°: 602-012-00-7    |
|   | UN N°: 1184               |
|   | Class: 3                  |

### First aid information

**Inhalation:** take victim outside into the open air; prop the person up to a half-sitting position; apply artificial respiration if necessary; consult a doctor.

**Skin contact:** remove contaminated clothing; rinse and wash the skin with soap and plenty of water; consult a doctor.

**Ingestion:** do not give the person anything to drink; consult a doctor.

**Eye contact:** rinse first of all with plenty of water for several minutes; remove contact lenses if possible; consult a doctor.

### Physico-chemical data

Conversion factor: 1 ppm = 4.11 mg/m<sup>3</sup>  
1 mg/m<sup>3</sup> = 0.24 ppm

Relative density (water = 1): 1.247 at 20°C

Relative vapour density (air = 1): 3.42

Solubility in fresh water: 8.7 g/L at 20°C

Solubility in seawater: 7 ± 0.15 g/L at 15°C

Vapour pressure/tension: 8.5 kPa at 20°C

Olfactory threshold: in fresh water: 20 mg/L  
in air: 6 - 100 ppm

Evaporation rate (diethyl oxide = 1): 4.1

Diffusion coefficient in water: 9.9 × 10<sup>-6</sup> cm<sup>2</sup>/s

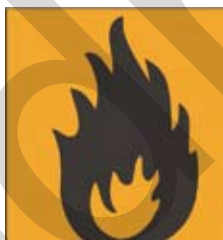
Diffusion coefficient in air: 1.04 × 10<sup>-1</sup> cm<sup>2</sup>/s

Henry's law constant: 97.7 Pa m<sup>3</sup>/mol at 20°C

Flash point: 13°C

Melting point: - 35.6°C

Boiling point: 83.4° C at 1 atm



**F: Highly flammable**

R11: Highly flammable

R22: Harmful if swallowed.

R45: May cause cancer.

R36/37/38: Irritating to eyes, respiratory system and skin.

S45: In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

S53: Avoid exposure, obtain special instructions before use.



**T: Toxic**

### Toxicological data

#### Threshold toxicological values

|  |  |
|--|--|
| IDLH: 50 ppm (205.5 mg/m <sup>3</sup> )      | MEV: 10 ppm (40 mg/m <sup>3</sup> )        |
| TLV-TWA (8h): 10 ppm (40 mg/m <sup>3</sup> ) | ERPG 1: 50 ppm (205.5 mg/m <sup>3</sup> )  |
| MRL inhal.: 0.6 ppm (3 mg/m <sup>3</sup> )   | ERPG 2: 200 ppm (822 mg/m <sup>3</sup> )   |
| for chronic exposure                         | ERPG 3: 300 ppm (1,233 mg/m <sup>3</sup> ) |

#### Specific effects

Carcinogenic effects: suspected of being carcinogenic for humans (E.U. category 2)

Effects on fertility: not demonstrated

Teratogenic effects and/or on foetal development: not demonstrated

Genotoxic effects: not classed as genotoxic by the E.U.

Mutagenic effects: suspected in animals

#### Acute human toxicity

- Ingestion: burning sensation in the mouth, pharynx, oesophagus and stomach, neuropsychic troubles, vomiting, abdominal pains, possibility of liver/kidney lesions, pulmonary oedema, can be life threatening.
- Skin contact: redness.
- Eye contact: redness, pain, affected sight, possibility of burns on the cornea.
- Inhalation: abdominal pain, cough, dizziness, drowsiness, headaches, nausea, sore throat, loss of consciousness, vomiting, symptoms of delayed effects. Inhalation of strong concentrations: risk of pulmonary oedema, liver/kidney lesions, can be life threatening.

#### Chronic human toxicity

- Repeated exposure by inhalation: nervous irritation, gastro-intestinal troubles, liver and kidney problems.
- Prolonged or repeated contact with the skin can cause dermatitis. This substance is probably carcinogenic for humans.
- Little information is known about the chronic toxicity of 1,2-dichloroethane for humans. The problems encountered by workers exposed to this chemical are anorexia, nausea, abdominal pains, drowsiness, liver and kidney deterioration and orthoergic contact dermatitis.

### Ecotoxicological data

|  |   |
|--|---|
| <ul style="list-style-type: none"> <li>• <b>Acute ecotoxicity</b> (in mg/L)</li> </ul> | <ul style="list-style-type: none"> <li>• <b>Chronique ecotoxicity</b> (mg/L)</li> </ul> |
| Algae ( <i>Scenedesmus subspicatus</i> ) EC <sub>50</sub> (72h) = 166                  | Algae ( <i>Scenedesmus quadricauda</i> ) LOEC (8 d) = 710                               |
| Crustacean ( <i>Daphnia magna</i> ) EC <sub>50</sub> (48h) = 155                       | Crustacean ( <i>Daphnia magna</i> ) NOEC (28 d) = 11                                    |
| Mollusc ( <i>Eliminius modestus</i> ) LC <sub>50</sub> (48h) = 186                     | Fish ( <i>Pimephales promelas</i> ) NOEC (32 d) = 29                                    |
| Crustacean ( <i>Crangon crangon</i> ) LC <sub>50</sub> (96h) = 85                      | • PNEC  |
| Fish ( <i>Limanda limanda</i> ) LC <sub>50</sub> (96h) = 115                           | PNEC water 1.1 mg/L   |
| Fish ( <i>Gobius minutus</i> ) LC <sub>50</sub> (96h) = 186                            | PNEC sediment (calculated) 3.51 mg/kg (dry weight)                                      |
| Fish ( <i>Pimephales promelas</i> ) LC <sub>50</sub> (96h) = 116                       | PNEC soil (calculated) 0.877 mg/kg (dry weight)   |

### Persistence in the environment

**Photo-oxidation:** in the troposphere, 1,2-dichloroethane forms chloromethanal, chloroacetyl chloride, hydrochloric acid, carbon monoxide and carbon dioxide. In the stratosphere it undergoes photolysis.

**Abiotic degradation:** in the aquatic environment, its chemical degradation is very slow. It is highly resistant to hydrolysis (half-life of 72 years at pH7 and 25°C). In surface waters, losses are mainly caused by evaporation.

**Biodegradation:** not readily biodegradable.

**Volatilisation from water:** highly volatile, both pure and as an aqueous solution.

**Bioaccumulation and metabolism:** not bioaccumulable in aquatic organisms.

• **MARPOL classification:** B until 31/12/2006  
Y from 01/01/2007

• **SEBC Classification:** S/D (sinker/dissolver)

• **Partition coefficient for octanol and water:**

log Kow = 1.45 - 1.76

• **Partition coefficient for organic carbon and water:**

Koc = 11 - 76 L/kg

BCF (fish) = 2

BCF (fish) calculated value = 3.5

### Particular risks

**Polymerisation:** No  
Stable product.

**Danger**

- Heating the recipient can cause the recipient to burst.
- Toxic and irritating smoke may be released from combustion.
- 1,2-dichloroethane can form explosive mixtures with air.
- Vapours are invisible and heavier than air. They spread out at ground level and can enter sewage systems and underground areas.
- Vapours can cover a large distance as far as a source of ignition and produce flashback.
- When exposed to air, ultraviolet light or humidity, colourless 1,2-dichloroethane gradually darkens and forms phosgene and hydrogen chloride.

**Fire:**

- Explosive limit by volume (% in air): LEL: 6.2% UEL: 16%
- Flash point (in a closed capsule): 13°C
- Self-ignition point: 413°C

**Stability and reactivity:**

- Conditions to be complied with: keep away from light and store in a cool, dry place.
- Avoid the following: acids, bases, oxygen, oxidants (may form explosive compounds or compounds sensitive to shocks), finely divided metals, aluminium, magnesium, zinc, titanium (risk of explosive reactions).
- Dangerous decomposition products: thermic decomposition into toxic and corrosive products (gaseous hydrogen chloride and phosgene).
- Sensitive to light (formation of gaseous hydrogen chloride).
- Stable at ambient temperatures.

### Transportation

UN N°: 1184

General information: Class: 3  
Labels: 3+6.1

Land transportation

RID/ADR Hazard classification: 336  
Packaging group: II  
Classification code: FT1

ADN/ADNR Hazard classification: 336  
Classification code: FT1

Maritime and air transportation

IMDG IATA Packaging group: II

### Handling

- Ventilate and evacuate appropriately.
- Provide showers and eye washers.
- Provide self-contained breathing apparatus nearby.
- Keep away from flames.
- Do not use air for transferring the product.
- Do not use air to dry equipment.
- Only use the product in a closed system (if possible).
- Only use explosion-proof equipment.

### Storage

- Keep away from light.
- Store in a cool, dry place.
- Provide a dyked area.
- Use electrical equipment suitable for explosive atmospheres and ensure it is earthed.

**Incompatible with:** acids, bases, oxygen, oxidants, finely divided metals.

**Recommended packaging material:** iron, steel including for the equipment in contact with the product.

### Annex 3: Classification of noxious liquid substances

#### Dangerous goods (IMO, 2002)

Regulations governing the carriage in bulk of hazardous liquid substances (MARPOL Annex II) provide valuable indications on the hazards that such substances can produce during transportation.

Noxious liquid substances are divided into 4 categories (A, B, C and D) starting with the most dangerous substances (MARPOL A) and ending with the least dangerous ones (MARPOL D).

The MARPOL classification system is based on risk assessment profiles for chemicals transported in bulk by sea, as defined by a GESAMP working group (Group of Experts on the Scientific Aspects of Marine Pollution).

**Category A** - Noxious liquid substances which, if discharged into the sea from tank washing or deballasting operations, are deemed to present a major hazard to marine resources or human health or can cause serious harm to amenities or other legitimate uses of the sea and therefore justify the implementation of strict pollution response measures.

**Category B** - Noxious liquid substances which, if discharged into the sea during tank washing or deballasting operations, are deemed to present a hazard to marine resources or human health and can harm amenities or other legitimate uses of the sea and therefore justify the implementation of special pollution response measures.

**Category C** - Noxious liquid substances which, if discharged into the sea during tank washing or deballasting operations, are deemed to be a minor risk for marine resources or human health or cause, to some extent, harm to amenities or other legitimate uses of the sea and therefore require special operating conditions.

**Category D** - Noxious liquid substances which, if discharged into the sea during tank washing or deballasting operations, are deemed to be a noticeable risk for marine resources or human health or have a very slight effect on amenities or other legitimate uses of the sea and therefore require certain precautions concerning operating conditions.

## Annex 3b: New classification of noxious liquid substances

### Revised MARPOL Annex II (IMO, 2005)

The revised Annex II Regulations for the control of pollution by noxious liquid substances in bulk was adopted in October 2004. It includes a new four-category categorization system for noxious and liquid substances. The revised annex entered into force on 1 January 2007.

The new categories are:

**Category X:** Noxious Liquid Substances which, if discharged into the sea from tank cleaning or deballasting operations, are deemed to present a major hazard to either marine resources or human health and, therefore, justify the prohibition of the discharge into the marine environment;

**Category Y:** Noxious Liquid Substances which, if discharged into the sea from tank cleaning or deballasting operations, are deemed to present a hazard to either marine resources or human health or cause harm to amenities or other legitimate uses of the sea and therefore justify a limitation on the quality and quantity of the discharge into the marine environment;

**Category Z:** Noxious Liquid Substances which, if discharged into the sea from tank cleaning or deballasting operations, are deemed to present a minor hazard to either marine resources or human health and therefore justify less stringent restrictions on the quality and quantity of the discharge into the marine environment; and

**Other Substances:** substances which have been evaluated and found to fall outside Category X, Y or Z because they are considered to present no harm to marine resources, human health, amenities or other legitimate uses of the sea when discharged into the sea from tank cleaning or deballasting operations. The discharge of bilge or ballast water or other residues or mixtures containing these substances are not subject to any requirements of MARPOL Annex II.