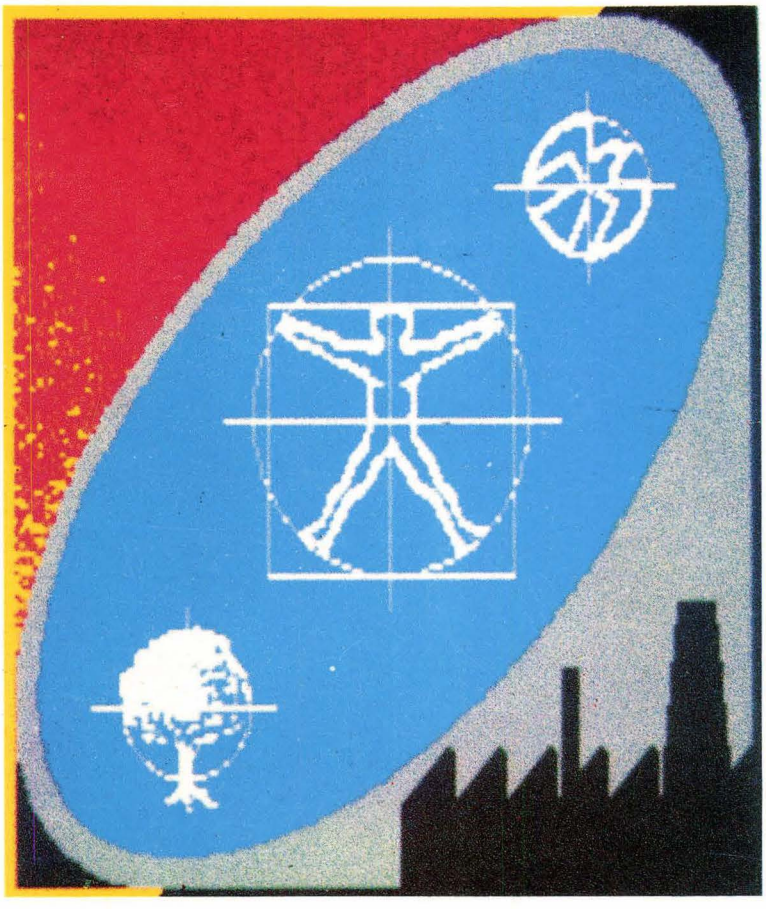
INSTITUTE FOR SYSTEMS ENGINEERING
AND INFORMATICS

SER DIVISION

Support Activities for the Directorate-General Environment, Nuclear Safety and Civil Protection
on the Implementation of the Council Directive
on the Major Accident Hazards of Certain Industrial Activities

COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK

Review of Environmental Accidents and Incidents



JOINT RESEARCH CENTRE

EUR 14002 EN

COMMISSION OF THE EUROPEAN COMMUNITIES

1992

INSTITUTE FOR SYSTEMS ENGINEERING
AND INFORMATICS

SER DIVISION

Support Activities for the Directorate-General Environment, Nuclear Safety and Civil Protection
on the Implementation of the Council Directive
on the Major Accident Hazards of Certain Industrial Activities

COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK

Review of Environmental Accidents and Incidents

P. Lindgaard-Jørgensen, K. Bender

Water Quality Institute - Research Centre
11, Agern Allé
DK-2970 Horsholm Denmark

CDCIR reference No · 776-DKb1-IV.3
Contract No. 4073-90-08 ED ISP DK

JOINT
RESEARCH
CENTRE

EUR 14002 EN

COMMISSION OF THE EUROPEAN COMMUNITIES

1992

Published by the
COMMISSION OF THE EUROPEAN COMMUNITIES
Directorate-General
Telecommunications, Information Industries and Innovation
Bâtiment Jean Monnet
L-2985 LUXEMBOURG

LEGAL NOTICE

Cataloguing data can be found at the end of this publication

Luxembourg Office for Official Publications of the European Communities, 1992
ISBN 92-826-3535-X Catalogue number CD-NA-14002-EN-C

Printed in Italy

Foreword

The aim of this study was to gather information from literature or database on accidents with environmental consequences.

This should help to get a clearer definition of environmental hazard to be used with the Directive 82/501 and its fundamental revision. Accidents from transport, storage and processing hazardous chemicals were covered for the period 1975 to 1990. An accident reporting form had to be developed.

The low number of accidents reported is remarkable. Probably the number of real accidents is much higher. This shows the high number of fishkills for unknown reasons, reported by the Rhine Commission, too. An important result is the fact that the number of accidants involving only man is much higher and that the chemicals involved are quite different in case of a normal and an environmental accident. Further study in environmental accidents is necessary especially in the field of long term hazards. A great hazardous potential seems to have fires (and fire extinguishing waters) of storages of chemicals and pesticides. In this field other studies are in progress.

G. Mutzbaur

Table of Contents

1. Introduction

The study was initiated in October 1990, with the aim to review available information in the literature on various accidents and incidents involving chemical substances. Emphasis has exclusively been placed on accidents with described ecological consequences.

The review covers accidents at fixed production/processing installations, isolated storages, and transportation/transfer facilities. A broad range of chemicals was surveyed, not just those mentioned in the Seveso Directive.

2. Accident Data Presentation Form

Table 1 presents the accident data presentation form developed in the project. Information found in the literature is categorized under the five topics: accident identification, substance identity, ecological consequences, preventive action, and comments of significance.

Under the subsection "Substance identity", physical/chemical and ecotoxicological data are included if they were presented in the literature. This information is important for the evaluation of ecological consequences, but is seldom mentioned in the descriptive literature.

The subsection "Ecological consequences" includes the expected time of recovery, a parameter that to large extent expresses the long-term consequences for the ecosystem. In a few cases, when this information was not given in the literature, but ecotoxicological and ecological data were otherwise extensive, a recovery time has been estimated.

Table 1

Presentation card. Accidents.

Accident identification.

Date:

Location:

Type of accident:

Causes:

Substance(s) identity.

Chemical(s):

Amount (stored, transported):

Amount released:

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected:

Environmental concentrations:

Environmental effects,
Short term:

Long term:

Expected time of Recovery:

Preventive actions:

Comments of significance:

References:

In most cases, the information needed to complete the accident presentation form proved to be available in single references. An important exception, however, was the physical/chemical and ecotoxicological data, which was seldom mentioned.

3. Results of Review

An on-line data base literature search has been performed in a number of data bases. Reviews of accidents involving chemicals have been surveyed for information on ecological consequences, and national authorities have also been consulted in some cases. More than one thousand references on chemical accidents, of which approximately 50% specifically included the term "environment", have been reviewed. Annex 2 gives the details of the data search.

Although the literature dealing with chemical spills is extensive, only a minor part (less than 5%) describes the ecological consequences. Most of the literature concerns case studies, i.e., scenarios of how a spill might develop in case of discharge of specific chemicals under specific circumstances. Descriptions of actual chemical spills have focused mainly on human health and safety problems.

Ecological consequences are often described in general terms, for example, "All the fish in the lake were dead", or, "The vegetation turned brown for some distance". Only in a minor part of the environmental investigations were data and descriptions given in precise terms.

The accident presentation forms were filled out whenever ecological consequences had been investigated and mentioned in the literature. Annex 1 is the presentation cards for the accidents with reported ecological consequences, presented in chronological order. The following evaluation of accidents is based completely on the information compiled.

3.1 Number of Accidents

Only 56 descriptions of accidents in the period 1974 to 1990 included the specific information that ecological consequences of the accidents had been investigated or observed. Of these, 49 stated that consequences were observed, whereas 7 concluded that an investigation had revealed no effects on the environment. Generally, the investigations or observations were on short-term effects, such as the killing of fish and birds and damage to vegetation. The literature, however, shows that evaluation of ecological consequences was more frequently performed at accidents occurring after about 1985. Evaluation of long-term effects also appeared more frequently in the investigations of recent accidents.

3.2. Types of Accidents

The types of accidents with observed ecological consequences, compiled from Annex 1, are given in Table 2.

Table 2 Numbers and types of accidents with mentioned ecological consequences

Type of accident	Number of accidents with observed effects
Ship collisions (ship/ship or ship/land)	22
Leaks or unintentional discharge from industrial storage tanks or process equipment	17
Fire or explosions in storages	5
Leaks on pipelines	3
Train derailment	2

The causes of the accidents were most often human or mechanical failure, similar to the causes of accidents with direct consequences for human beings.

Ecological effects were most frequently observed in accidents relating to transportation, storage, and processing of chemicals (Table 2). The predominant route of the chemicals to the environment appears to be via the liquid phase, most often dissolved in water. Only three of the accidents involved air-bourne chemicals.

3.3 Ecosystems Affected

Most accidents affected river ecosystems, followed by marine and terrestrial ecosystems (Table 3). Beaches, river beds, and wetlands were often affected by the accidents. Table 3 shows a higher total than 49 because some of the accidents affected more than one of the ecosystems.

Table 3 Ecosystems affected by the accidents

Ecosystems affected	Number of accidents (included in Annex 1)
Marine ecosystems, including beaches	16
Rivers and lakes, including river beds and shores	31
Terrestrial	3
Both terrestrial and rivers	4
Groundwater	1

Only one accident (a tetrachloroethylene spill) reported a measured pollution of groundwater.

3.4 Environmental Concentrations

The investigations performed after 16 of the accidents included the determination of environmental concentrations by chemical analysis. Of these, 12 involved analyses of surface water and sediment, 2 of soil, and 2 of plants. Only 4 of the investigations involved analyses of concentrations in the fauna, and then primarily in fish.

Table 4 presents the chemicals released (by descending order of amount released) and the highest environmental concentrations monitored in water, which were found in samples taken close to the location of the accident. Only 9 accidents are presented, because data on amounts released were lacking in other cases.

Table 4 Environmental concentrations resulting from accidents involving chemicals

Chemical	Amounts released	Ecosystem affected	Environm. concentrat.
Ammonium sulphate	300 ton	River	1.5 mg/l
Perchloroethylene	16 ton	River	5.0 mg/l
Methylparathion	10 ton	Marine	0.096 mg/l
1,2 Dichloroethane	8 ton	River	0.3 mg/l
Pesticides (various)	6 ton	River	up to 1 mg/l
Dichlorvos	3 ton	River	0.6 mg/l
Chlorobenzene	0.6 ton	River	0.6 mg/l
Dichlorprop	0.5 ton	River	0.0006 mg/l
Fungicide	0.1 ton	River	0.0002 mg/l

The environmental concentrations were evidently dependent on the released amount, i.e., high amounts released gave high environmental concentrations. The environmental concentrations, however, also depended on local conditions (e.g., the dilution), as exemplified by the low environmental concentration of methylparathion in marine water.

For chemicals reaching the aquatic environment, the dilution was the most important parameter in determining the concentration close to the location of the accident. It can also be seen from the accident reports in Annex 1 that the physical and chemical properties and degradability of the chemicals had significant influence on concentrations at locations more distant from the accident.

For releases to terrestrial ecosystems, the data are too limited to allow a generalization.

3.5 Environmental Effects

Table 5, compiled from Annex 1, states the chemicals released, the amount released, and the short-term environmental effects.
Of 49 references to accidents with reported ecological consequences, 35 references specified the consequences for the species affected, primarily in the short term and only occasionally in the long term. In the other 14 accident references, information on amounts released or short-term effects was too vague to allow the incidents to be included in the table.

Table 5 Ecological consequences of accidents involving chemicals

Chemicals involved	Amount released	Ecosystems affected	Short term effects
Oil, Crude	326,000 barrels	River and terrestrial	Effects on vegetation
Oil, North Slope Crude	258,000 -	Marine, shores	Wild life affected
Oil, Crude	250,000 -	Marine, shores	Mass death/all tropic level
Oil, Diesel	17,800 -	River	2000-4000 dead birds
Oil, No. 2 heating	13,500 -	Marine, wetlands	600 dead birds
Fuel oil	20,000 l=125 bar.	River	Fish kills
Fuel oil	8,000 l= 50 bar.	River	Fish kills
Oil, Venezuelan crude	10,000 barrels	Marine, shores	350 dead birds
Oil, Crude	9,458 -	River and terrestrial	500 dead birds, fish kills
Oil, Crude	9,400 -	Tidal zone	Birds and animals killed
Oil, No. 6	7,300 -	River, banks	Vegetation affected
Oil, Bunker C	6,000 -	Marine, shores	6000 dead birds
Oil, Crude	4,000 -	River, riverbeds	Vegetation/birds affected
Oil, Mixture crude	3,500 -	Marine, shores	Dead birds
Oil, Used crank grease	83 -	River, Riverbeds	Fauna on riverbeds affected
Pest.(methylparathion)	10.0 tons	Marine	Fish killed
Pesticides (mixture)	2.3 tons	River	Extensive fish kills
Pesticides (mixture)	tons	River	Extensive fish kills
Pesticides (mixture)	hundreds of kg	River	Extensive fish kills
Pesticides (toxaphene)	> 22.7 kg	River	Fish kills
Pest.(herbicide solut.)	> 6,500 l	Marine	14 tons of fish killed
Perchloroethylene	16.0 tons	River	Several species killed
Household/toiletries	5.0 tons	River	17,000 fish killed
Potassium salts	tons	River	2,000 tons of fish killed
Xylene	0.5 tons	River	Large fish kills
Chlorobenzene	0.6 tons	River	None, but long-term bioacc.
Acetic Anhydride	4,000 l	Terrestrial and river	Vegetation and fish killed
Polyelectrolyte	4,000 l	River	More than 1,000 fish killed
Chromic trioxide	unknown	Terrestrial and river	Vegetation and fish killed
Pentachlorophenol	unknown	Rivers and lakes	Extensive fish kills
Sodium cyanide	15 kg	River	100 kg fish killed
Lindane and sodium-pentachlorophenate	40 kg	River	15 tons fish killed
Nitric acid	500 l	River	500 kg fish killed
Paranitrochlorobenzene & paramethoxyphenol	unknown	River	Extensive fish kills
Ammonia & urea solution	5,000 l	River	Fish kills
Cyanides, heavy metals, hydrocarbons, etc.	unknown	River	15-20 tons fish killed

From Table 5, it is seen that oil (various types) and pesticides (various types) predominated in accidents of environmental consequence, probably because these substances were transported in such large amounts that the probability of accident for oil and pesticides was greater than for many other substances. Similar conclusions have been drawn in other review reports on accidents /7,8/.

Table 5 indicates no simple correlation between the amount released and the consequences observed, implying that the properties of the chemicals as well as local conditions on the spill site have great importance for the scope of the environmental consequences from any given accident. Similar conclusions have also been drawn in other accident reviews /7,8/.

Described environmental consequences in accidents involving oil have never been associated with open waters. Nevertheless, vulnerable ecosystems - such as river banks, wetlands, beaches, and locations where spawning and reproductive activities for many species take place at specific times of the year - may suffer considerable short-term ecological effects even with a minor amount of contamination, for instance, with oil.

For pesticides of high toxicity, the direct toxic effect exerted on the biota is the main cause of environmental consequences. For chemicals belonging to other chemical groups, the environmental consequences are mainly caused by toxic effects, but other properties, such as carcinogenicity and the tendency to bioaccumulate, are of significance in the longer term.

From Table 5, it is also seen that accidents often involve mixtures of chemicals released to the environment.

In most cases, the time of recovery of the ecosystems after an accident was not stated. When given, the expected time of recovery was often several months or even years. The sparsity of information regarding the recovery of ecosystems after accidents is an indication of a general lack of knowledge of long-term effects. A good deal of experience and understanding can be gained if investigations of long-term consequences of accidents are performed more frequently.

Preventive Action

When chemicals reached the environment, immediate remedial action was taken in many cases to minimize the ecological consequences. The action taken depended on the type of chemical involved as well as the ecosystem affected.

For chemicals floating on aquatic surfaces, oil, for instance, booms were often used to collect the oil, and suction equipment to gather the oil into containers. Cleansing of birds and beaches were in some cases performed to minimize the ecological consequences. In the case of polluted soil, the top layers were removed and disposed of or burned.

For chemicals dissolved in water, for instance, pesticides, authorities were often informed so that people could be warned. However, immediate remedial action to minimize effects on the environment were generally not taken at the onset of a chemical release. In just one case, fire-fighting water was collected and discharged at "safe" concentrations to the environment.

In the accidents involving fixed or processing installations, there is often some time between the occurrence of the incident and the release of chemicals to the environment. If proper warning systems could be established, it might be possible to prevent pollution from reaching the environment, for instance, through collection of fire water in extra basins.

4. Discussion

The review of accidents with ecological consequences shows that they differ significantly from accidents with immediate consequences for human beings.

First of all, the chemicals enter the environment predominantly through the liquid phase, either as a liquid or dissolved in water. Only in a very few cases did accidents having ecological consequences also affect human beings immediately, and then the effects on humans and the effects on the environment were not caused by identical chemicals or by identical release routes. For example, fires in the storage of pesticides caused chemicals to be released to the air, which immediately affected human beings. The same accident had immediate environmental consequences for surface water ecosystems because fire-fighting water was discharged and not collected for later disposal.

In the review of more than 500 major industrial accidents, many of which affected human beings, only 5 references mentioned the environment in the discussion, and only 3 references cited effects on the environment /1/.

Other reviews, the "Lessons Learned from Accidents Notified, Major Accident Reporting System" of the Joint Research Centre /7/ and the "Acute Hazardous Events Data Base" /8/, came to a similar conclusion: Environmental damage was reported in 3% of accidents, no environmental damage in 10% of accidents, and no information in 87% of accidents.

The Rhine Commission, which records accidents involving chemicals released to the Rhine, reported more than 250 accidents from 1985-1989, 8 of which had described ecological consequences. Whether some of these accidents affected human beings directly and immediately was not reported /2/.

The French inventory of accidents /4/ reported 1518 accidents in the period 1987-1989, of which 426 involved chemicals released to the environment, primarily to the aquatic environment. Nevertheless, causes and ecological consequences (in terms of identified chemicals and released

amounts) were described in only 8 of the 426 accidents or incidents.

A remarkably high number (40-50) of observations of massive fish kills, where the cause could not be established, were recorded in the Rhine River and French surveys /2,4/. This probably shows that, although this report only shows a few cases of observed ecological effects caused by accidents, the actual number might be much higher, because a number of accidents are not recorded at all, or the causes are not explained.

Generally, it can be concluded that the properties of a chemical, the dilution of the amount released, and the environmental conditions at the spill site are the parametres that determine the short-term environmental consequences.

To evaluate the long-term effects - which have almost never been studied in the accidents reviewed - persistence, the tendency to accumulate in sediment and biota, and the long-term sub-lethal and chronic effects are the main parameters to be considered /3/.

5. Recommendations

The review indicates that there is increasing understanding and acceptance that professional assessments of chemical release accidents should also address environmental effects. Furthermore, the review indicates that high priority in the development of methodologies to assess environmental consequences should be given to:

- Chemicals entering the environment through the liquid phase, either as a liquid or dissolved in water.

- Chemicals that are highly toxic or floating on the aquatic surface, such as oil.

- Development of scenario models for river, lakes, marine areas, and shores, which can forecast the environmental consequences and the environmental concentrations of the chemicals involved.

- Development of a battery of preventive actions that can be used to hinder the chemicals from reaching the aquatic and terrestrial environments and to minimize the environmental consequences of the chemicals that are released.

Finally, while ecological consequences of accidents have been investigated more frequently in recent years, there has been no consistency in reporting methodology, making accident comparison difficult, and important information has often not been collected. An accident investigation methodology and a reporting format should therefore be developed and implemented on a broad international scale.

References

/1/ Wunderlich.
Major Accidents of Industrial Activities. Information on Dangerous Chemicals.
Contract no. XI-B6614-2-24-88, 1989.

/2/ a-e
Internationale Kommission zum Schutze des Rheins gegen Verunreinigung, Postfach 309, D-5400 Koblenz.
1985, 1986, 1987, 1988, 1989.

/3/ B.K.H. Consulting Engineers.
Inventory of Ecotoxicological Data and Hazard Assessment. Report to the Ministry of Housing, Physical Planning, and Environment.
The Netherlands, June 1989.

/4/ a-c
Inventaire des Accidents Industriels et Pollution Accidentelle. Direction de l'Eau de la Prévention des Pollutions et des Risques.
Service de l'Environnement Industriel. France, 1987, 1988, 1989.

/5/ Rapport sur le Sinistré "Protex" du 8. juni 1988. Secretariat d'État à l'Environnement.
Mission de l'Inspection Specialisé pour l'Environnement, France, juillet, 1988.

/6/ Rapport de la Commission d'Évaluation des Conséquences de l'Incendie de l'Usine Protex. (Pollution de la Brenne, de la Cisse et de la Loire).
Rapport à Monsieur Brice LaLonde, Sécrétaire d'État auprès du Premier Ministre Chargé de l'Environnement, octobre 1988.

/7/ Drogaris, G. Major Accident Reporting System. Lessons Learned from Accidents Notified. Institute for Systems and Engineering and Informatics, Joint Research Centre, EUR 13385 EN, 1991.

/8/ Acute Hazardous Events Data Base. Report prepared for EPA, Washington, D.C., by Industrial Economics, Inc., Cambridge, December 1985.

Annex 1

PRESENTATION CARDS, ACCIDENTS WITH OBSERVED ECOLOGICAL CONSEQUENCES

Presentation card. Accidents.

Accident identification.

Date:	July 14, 1974
Location:	5.6 km southeast of Otranto Cape, Adriatic Sea
Type of accident:	Ship sank after collision with another Italian vessel
Causes:	Unknown

Substance(s) identity.

Chemical(s):	Tetramethyl lead (TML) and tetraethyl lead (TEL)
Amount (stored, transported):	900 drums, about 325 tons
Amount released:	23 tons
Physical/chemical data:	
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	Marine. Water depth at position of wreck: 94 m
Environmental concentrations:	Water samples close to wreck, about 3.7 μg Pb. Measurement April 1978
Environmental effects, Short term:	Contamination of biota with organic lead
Long term:	" " " " " "
Expected time of Recovery:	Unknown, probably a few months after salvage operation
Preventive actions:	In summer of 1978, the wreck was salvaged to avoid further potential leakage from the side.
Comments:	Difficulties in organic lead analysis.
References:	Tiravanti, G. and R. Tassino. Tetraalkyl Lead Accident in Sea Water. In: ECO ACCIDENTS ed. J. Cairns, Jr. Plenum Press, New York 1985.

Presentation card. Accidents.

Accident identification.

Date:	August 9, 1974
Location:	Clarksburg Inn, Clarksburg, N.J. USA
Type of accident:	Leakage of a herbicide through soil to a fresh water ecosystem
Causes:	By accident, concentrated herbicide was released to stop the growth of weeds in a parking lot.

Substance(s) identity.

Chemical(s):	Dinitrobutyl-phenol (DNBP)
Amount (stored, transported):	Unknown
Amount released:	Not stated
Physical/chemical data:	
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	Terrestrial and freshwater
Environmental concentrations:	Intake 8 $\mu g/l$. Soil at parking lot 0.48%!
Environmental effects,	
Short term:	Besides death of terrestrial vegetation, which was anticipated, the fish in a lake were killed.
Long term:	Not known.
Expected time of Recovery:	Because of immediate remediation, short.
Preventive actions:	Water in lake was cleaned by activated carbon adsorption using the EPA Hazardous Materials Spill Treatment Trailer. Soil in parking lot was scraped off, and remaining soil was "washed" down and treated.
Comments:	Clean up cost was 30,000 US $.
References:	Lafornara, Y.P. Clean-up after spills of toxic substances. Journal/Water Pollution Control Federation. April 1978.

Presentation card. Accidents.

Accident identification.

Date:	December 15, 1974
Location:	Hattiesburg, Mississippi
Type of accident:	Discharge to a lake and a river
Causes:	Unexpected overflow in wastewater pond

Substance(s) identity.

Chemical(s):	Pentachlorophenol (PCP)
Amount (stored, transported):	
Amount released:	Unknown
Physical/chemical data:	
Ecotoxicological data:	Many fish species, 0.2 - 0.6 ppm (TLm)

Ecological consequences.

Ecosystem affected:	Fresh water: lake and river
Environmental concentrations:	Maximum in sediment, 28 June 1975: 1300 µg/kg day Maximum in water, 6 December 1975: 76 µg/l
Environmental effects, Short term:	Intensive fish kills
Long term:	Fish contaminated for at least 6 months
Expected time of Recovery:	PCP was found in sediment and leaf litter 18 months after contamination
Preventive actions:	None described
Comments:	None
References:	Pierce, Dr., R.H. et al. Pentachlorophenol distribution in a fresh water ecosystem. Bull. Environ. Contam. Tox., Vol. 18, No. 2, 1977.

Presentation card. Accidents.

Accident identification.

Date: March 2, 1975

Location: The Plains, Virginia, USA.

Type of accident: Release of a pesticide to a pond, which was connected to a fresh water reservoir.

Causes: Intentional dumping, as a harassment against the pond's owner.

Substance(s) identity.

Chemical(s): Toxaphene

Amount (stored, transported): Unknown.

Amount released: Unknown, but more than 22.7 kg, the amount that remained in the sediment.

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected: Fresh water and soil.
Size of the pond: 30 x 30 m., max. depth 2.3 m.

Environmental concentrations: In water, max. 36 μg/l. In pond sediment, undissolved toxaphene solids.

Environmental effects,

Short term: All the fish in the pond were reported to be killed, so the whole ecosystem was probably affected.

Long term: Probably none, owing to treatment.

Expected time of Recovery: 1/2 year, because of physical removal of sediment and treatment of water.

Preventive actions: Water from the pond was pumped through filters containing activated carbon. After some time, concentration in water was reduced to 1 μg/l. Mud and undissolved toxaphene was physically removed and placed in lined barrels for disposal.

Comments: The cost of the clean up operation was 21.000 US$.

References: Lafonara, J.P., Journal/Water Pollution Control Federation. Pub. No. 01007638

Presentation card. Accidents.

Accident identification.

Date: July 21, 1975
Location: Carney Run near Strongstown, Pennsylvania, USA.
Type of accident: Leaking of pesticides from basement and soil via drain pipe to a nearby stream.
Causes: A treatment for termites in a private residence

Substance(s) identity.

Chemical(s): Chlordane, Hystachlor, Dieldrin and Aldrin
Amount (stored, transported): not applicable
Amount released: 9.5 l of the pesticide "Termide" mixed with 900 liters of water was injected around the foundation of the house and through its basement floor.
Physical/chemical data:
Ecotoxicological data: See later

Ecological consequences.

Ecosystem affected: A small river and soil were contaminated with the pesticide

Environmental concentrations:

Pesticide μg/l	Chlordane	Hepttachlor	Dieldrin	Aldrin
Raw stream water	13	6.1	11	8.5
Effluent after treatment	0.35	0.06	not detect.	0.19

Environmental effects;
Short term: All life immediately downstream in the small river was dead, including shore-dwelling semiaquatic vertebrates. Young trouts in a downstream nursery were killed.
Long term: None, owing to extensive treatment
Expected time of Recovery: 3 months, owing to extensive treatment

Preventive actions: Treatment of contaminated water. Removal of contaminated sediment. Removal of source of contamination. Treatment of residual contamination at the site of the trout nursery.

Comments: According to treatment effectiveness, the mixed media filtration/carbon adsorption process proved very effective. Precise data given in reference. Cleanup cost approximately 73,500 US $.

References: Lafornara, J.P. Journal/Water Pollution Control Federation. Publ. No. 010072638

Presentation card. Accidents.

Accident identification.

Date:	July 10, 1976.
Location:	ICMESA plant at Seveso, 20 km north of Milan.
Type of accident:	Rupture of a chemical reactor safety valve.
Causes:	An uncontrollable exothermic process started during production of trichlorophenol.

Substance(s) identity.

Chemical(s):	Several. Of most concern was the discharge of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD).
Amount (stored, transported):	Not applicable.
Amount released:	Unknown. Probably in the order of 2 kg TCDD to air.
Physical/chemical data:	
Ecotoxicological data:	LD-50 rat test. 0.023 ppm

Ecological consequences.

Ecosystem affected:	Air and soil in surroundings of ICMESA plant.
Environmental concentrations:	In vegetation: 200 m from plant, 10 ppm. 800 m from plant, 1 ppm. 2000 m from plant, 0.01 ppm. In soil: close to factory > 50 $\mu g/m^2$. 5 km SE of plant: 5 $\mu g/m^2$.
Environmental effects,	
Short term:	Death of vegetation, fauna and domestic animals. Human health effects.
Long term:	
Expected time of Recovery:	10 years after: Still some contamination.
Preventive actions:	Evacuation of people. Prohibition of consumption of local agricultural products. Various soil detoxication techniques used, but not described in reference.
Comments:	Information about this accident can be found in several references.
References:	Pocchiari, F. and V. Silano. The Chemical Risk Management Process in Italy. A case study: The Seveso Accident.

Presentation card. Accidents.

Accident identification.

Date: April 9, 1980

Location: Cooks Point, Texas, USA

Type of accident: Transport by train, impact failure

Causes: Faulty brakes, causing train derailment.

Substance(s) identity.

Chemical(s): Carbon tetrachloride

Amount (stored, transported): 90 tons

Amount released: 45 tons

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected: Topsoil

Environmental concentrations:

Environmental effects,
Short term: Minimal environmental damage

Long term:

Expected time of Recovery: Short, due to removal of topsoil.

Preventive actions: Topsoil removed for disposal.
Comments:

References: MHIDAS 2424

Presentation card. Accidents.

Accident identification.

Date:	July 23, 1980
Location:	Northern Sweden
Type of accident:	Leaking of fungicides into river and lake
Causes:	Rupture of a container, perhaps deliberately (to get rid of substance)

Substance(s) identity.

Chemical(s):	Mixture. Pentachlorophenol (30%) 2,3,4,6-tetrachlorophenol (60%) 2,4,6-trichlorophenol (10%)
Amount (stored, transported):	Unknown
Amount released:	3 m^3 of aqueous solution containing 0.8% of mixture
Physical/chemical data:	-
Ecotoxicological data:	-

Ecological consequences.

Ecosystem affected:	Rivers and lakes in system to 15 km downstream
Environmental concentrations:	Chlorophenol highest value in water. 560 µg/l (7 July near discharge), 4.7 µg/l (5 August) 14 km downstream 3 µg/l (5 August)
Environmental effects,	
Short term:	Contamination of fish, values given for several species. No death.
Long term:	Unknown. After 6 months, PCP occasionally measured in water and organism, probably due to PCP leaking from contaminated area.
Expected time of Recovery:	Probably a few months.

Preventive actions: After one day, leaking was stopped.

Comments:	In Sweden, use of chlorophenols was banned in 1978. However, this substance is still stored at some locations, creating potential environmental hazards.
References:	Renberg, L. et al. Level of chlorophenols in natural waters and fish after an accidental discharge of a wood impregnation solution. AMBIO 1983.

Presentation card. Accidents.

Accident identification.

Date: January 2, 1981

Location: Alaska, USA

Type of accident: Pipeline, mechanical failure

Causes: Leaking Valve

Substance(s) identity.

Chemical(s): Crude oil

Amount (stored, transported):

Amount released: 850 tons

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected:

Environmental concentrations:

Environmental effects,

Short term: Low temperature prevented spread. Minimal damage in tundra area.

Long term:

Expected time of Recovery:

Preventive actions: Vacuum trucks sucked up jellied oil. 90% of oil was found in 5-cm upper layer of snow.

Comments:

References: MHIDAS 616

Presentation card. Accidents.

Accident identification.

Date:	July 3, 1981
Location:	2 1/2 miles east of Thorp, Wisconsin, USA
Type of accident:	Puncture of a train tank car
Causes:	Derailment of 13 rail cars. One punctured.

Substance(s) identity.

Chemical(s):	Acetic anhydride (acetyl-oxid) $(CH_3CO)_2O$
Amount (stored, transported):	About 20,000 gallons
Amount released:	All, except 1,200 gallons
Physical/chemical data:	Specific gravity: 1.82 at 20°C. Colourless. Boiling point at 1 atm., 139°C. Penetrating odour (acetic acid). Corrosive. In combination with water, acetic acid is formed.
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	Soil and fresh water
Environmental concentrations:	6000 mg/kg soil
Environmental effects;	
Short term:	Vegetation on nearby land "burned". Fish killed in river, probably due to acidity.
Long term:	None
Expected time of Recovery:	3 1/2 month

Preventive actions:	Evacuation of area (4 x 18 miles) in front of vapour cloud. Vapour cloud sprayed with water. Attempt to neutralize at spill site by spraying with lime. Building of dam in an attempt to avoid discharge to river.
Comments:	Absence of <u>one</u> leading authority in charge of cleaning operation was apparent. Cleanup cost: about 500,000 $.
References:	Miller, Y. and Y. Paddock. Acetic anhydride spill at Thorp, Wisconsin, 1984. Hazardous Material Spills Conference Proceedings. Nashville, Tennessee, USA.

Presentation card. Accidents.

Accident identification.

Date: February 1, 1982
Location: Mediterranean Sea. North of entrance to Suez Canal, Port Said. Egypt.
Type of accident: Discharge of methyl parathion to the sea.
Causes: Collision of two ships, one of which sank.

Substance(s) identity.

Chemical(s): Methyl parathion (0,0 dimethyl-0-p-nitro-phenyl phosphorothioate)

Amount (stored, transported): 31,000 kg

Amount released: 10,000 kg
Physical/chemical data:
Ecotoxicological data:

Ecological consequences.

Ecosystem affected: The surrounding seawater and sediment

Environmental concentrations:
Stations with highest concentration:

Date:	18.02	28.02	10.03	28.03	6.4.	24.4.
Sediment µg/kg	400.5	450.	481.2	145.2	40.3	7.4
Water µg/kg	96.0	40.1	10.8	4.4	5.4	1.6

Environmental effects,
Short term: Contamination of biota (death not reported, but likely. Only concentration in fish (4 species) measured.
Long term:
Expected time of Recovery: Not directly stated. However, detection limit in water is

indicated as 0.1 μg/l. After three months, this value was measured at all stations except one (see above).

Preventive actions: No information in reference

Comments:

References: Badawy, H.J. et al. Spill of Methyl parathion in the Mediterranean Sea: A Case Study of Port Said, Egypt. Bull. Environ. Contam. Toxicol., 1984.

Presentation card. Accidents.

Accident identification.

Date:	March 18, 1982
Location:	Knagstrup, Rosenholm kommune, Århus, Denmark.
Type of accident:	Rupture of a storage facility
Causes:	Unknown

Substance(s) identity.

Chemical(s):	Perchlorethylen, C_2Cl_4
Amount (stored, transported):	Not stated
Amount released:	13,000 litres
Physical/chemical data:	Solubility in water = 150 ppm. Smells like chloroform. Specific gravity 1.63 g/cm^3 at 20°C
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	Soil and a fresh water stream
Environmental concentrations:	In fresh water stream close to discharge point, up to 5 ppm
Environmental effects,	
Short term:	Lethal effects on several species of invertebrates, avoidance reactions in trouts
Long term:	None as far as known
Expected time of Recovery:	Several months. Six months after the discharge, C_2C_4 could still be measured in stream.
Preventive actions:	9,000-11,5000 l were recovered from soil and water systems.
References:	Forureningsuheld i Knagstrup, Rosenholm kommune. Datarapport. Water Quality Institute, 1983. (in Danish only).

Presentation card. Accidents.

Accident identification.

Date:	June 7, 1982
Location:	N-NW of the Hook of Holland
Type of accident:	Discharge of oil
Causes:	Collision between the Greek Tanker M/S Katina and a French ship

Substance(s) identity.

Chemical(s):	Heavy fuel oil
Amount (stored, transported):	In the damaged tank, 6,300 m^3
Amount released:	1,630 m^3
Physical/chemical data:	Specific gravity 0.995. Viscosity 5,000 seconds, Redwood I. Flash point 77 C°. Tour point 1°C, Asphaltene content 9.4%. Trace metals: Va 340 ppm, Ni 57 ppm.
Ecotoxicological data:	None referred

Ecological consequences.

Ecosystem affected:	Beaches
Environmental concentrations:	Beaches
Environmental effects, Short term:	Almost none
Long term:	none
Expected time of Recovery:	

Preventive actions:	Mechanical recovery at sea, about 50% of the amount spilled initially recovered. The rest was washed on shore, except for a minor part which had evaporated.
Comments:	The very high specific gravity of the oil created problems. After initial evaporation, the oil was floating under the surface of the sea.
References:	Koops, W. et al. The Katina oil spill 1982, combating operations at sea. Proceedings, 1985 Oil Spill Conference. American Petroleum Institute. Publication no. 4385.

Presentation card. Accidents.

Accident identification.

Date: September 14, 1983

Location: Memphis, Tennessee, USA

Type of accident: Ship/ship collision

Causes: Impact failure

Substance(s) identity.

Chemical(s): Styrene

Amount (stored, transported): 1200 tons

Amount released: < 1200 tons

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected: Mississippi River

Environmental concentrations: Low, because of rapid current and high dilution

Environmental effects,

Short term: No environmental damage observed.

Long term:

Expected time of Recovery:

Preventive actions:

Comments:

References: MHIDAS 2384

Presentation card. Accidents.

Accident identification.

Date:	March 19, 1984
Location:	Columbia River, approximately 10 miles downstream of Portland, Oregon, U.S.A.
Type of accident:	Discharge of oil
Causes:	Grounding in the river by the tank vessel, "Mobil-oil".

Substance(s) identity.

Chemical(s):	A mixture of no. 6 fuel oil, heavy residual, and industrial fuel
Amount (stored, transported):	No information in reference.
Amount released:	4,000 bbl.
Physical/chemical data:	no data referred
Ecotoxicological data:	no data referred

Ecological consequences.

Ecosystem affected:	River banks
Environmental concentrations:	No information
Environmental effects,	
Short term:	Vegetation and bird population. Bird rescue operations were undertaken. 450 birds treated, 284 later released alive.
Long term:	No data given
Expected time of Recovery:	No data given

Preventive actions: Mechanical response to the spill

Comments: Disposal of large amounts of oily debris proved to be a major problem. However, it was finally solved by using portable incinerators.

References: Park III, W. C. Response to the Mobil Oil spill Incident, Proceedings, 1985 Oil Spill Conference American Petroleum Institute, Publication No. 4385.

Presentation card. Accidents.

Accident identification.

Date:	July 30, 1984
Location:	Calcasieu River bar channel. 11 nautical miles S-SE of Cameron, Louisiana, USA.
Type of accident:	Discharge of crude oil to the sea.
Causes:	Grounding of the tank vessel Alverus.

Substance(s) identity

Chemical(s):	Venezuelan "Merey and Polin" crude oil
Amount (stored, transported):	350,000 barrels
Amount released:	65,500 barrels
Physical/chemical data:	Only information about the crude oil is that it is "highly viscous".
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	A well-defined 75-mile slick of oil travelled west from the grounding point. The slick affected Texas beaches and a salt marsh. However, because of the time between release and deposition, preparations were made and the environmental damage was minimal.
Environmental concentrations:	
Environmental effects,	
Short term:	Bird nesting area and salt marsh were effected, but the damage was minimized due to booms placed in defensive positions.
Long term:	None can be documented.
Expected time of Recovery:	By the end of August, most equipment and labour force were released. Minor impact of oil continued some time thereafter in the form of tar balls. Minor cleanup operations lasted until April 1985.
Preventive actions:	After tests and discussions, dispersants were not used. Instead, mechanical recovery was carried out using booms and beach cleanup by removal of sand.
Comments:	Cleanup costs not stated.
References:	A.C. Alejandro. M/V Alverus: Anatomy of a major oil spill. Proceedings, 1987 Oil Spill Conference. American Petroleum Institute. Publ. No. 4452.

Presentation card. Accidents.

Accident identification.

Date: January 16, 1985.

Location: Portland, Oregon.

Type of accident: Discharge of 3500 gal. used crank grease.

Causes: Malfunction in a separator pond.

Substance(s) identity.

Chemical(s): Mixture of oil and grease (waste oil from a recycling facility).

Amount (stored, transported): Not applicable

Amount released: 3,500 gallons

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected: A lake and wetlands near the spill point.

Environmental concentrations: Described as high in the soil where the oil had entered the lake.

Environmental effects,

Short term: Trees and vegetation, a combination of effects from oil and clean up operation.

Long term:

Expected time of Recovery: Not stated.

Preventive actions: Containment of oil by booms. Rope mop and belt mop skimmers picked oil up thereafter at a rate of 320 gallons per day.

Comments: Altogether, 10,000 gallons of emulsified oil mixture was recovered. Topsoil was removed and replaced.

References: Y.B.H. Smith. Adapting techniques to conditions: Cleanup of a waste oil spill. Proceedings 1987 Oil Spill Conference. American Petroleum Institute, Publication No. 4452.

Presentation card. Accidents.

Accident identification.

Date:	April 12, 1985
Location:	Yarravill, Mewlbourne, Australia
Type of accident:	Fire at storage plant
Causes:	Explosion

Substance(s) identity.

Chemical(s):	Pesticides (not specified)
Amount (stored, transported):	2,300 tons
Amount released:	same
Physical/chemical data:	-
Ecotoxicological data:	-

Ecological consequences.

Ecosystem affected:	River polluted by run-off waters
Environmental concentrations:	Not stated
Environmental effects, Short term:	Significant environmental damage
Long term:	
Expected time of Recovery:	Not stated
Preventive actions:	Fire extinguished. Run-off water not collected.
Comments:	
References:	MHIDAS 1942

Presentation card. Accidents.

Accident identification.

Date:	July 29, 1985
Location:	Thunderbolt reef. S of Cape Recife. South Africa.
Type of accident:	Discharge of fuel oil to the sea.
Causes:	Grounding of a tanker.

Substance(s) identity.

Chemical(s):	Heavy fuel oil, marine diesel and lubricating oil.
Amount (stored, transported):	917 m^3 heavy fuel, 91 m^3 marine diesel, 27 m^3 lubricating oil.
Amount released:	513 m^3 (mixture of the above)
Physical/chemical data:	
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	Marine: sea and beaches.
Environmental concentrations:	No measurement in water or sediment. However, measurement in mussels close to spill site (Table in reference).
Environmental effects,	
Short term:	Effects on populations of Jackson penguins and other sea birds. Deaths and sub-lethal effects reported.
Long term:	None.
Expected time of Recovery:	Not stated.

Preventive actions: Salvage operations of cargo and fuel oil.

Comments:	Case demonstrates that even a limited amount of oil potentially may course environmental effects.
References:	B.A. Lord et al. The Kapodistrias grounding and oil spill. Cape Recife, South Africa. Proceedings, 1987 Oil Spill Conference. American Petroleum Inst. Publication No. 4452.

Presentation card. Accidents.

Accident identification.

Date:	September 15, 1985
Location:	Drogobych, Ukraine, USSR
Type of accident:	Waste container wall collapsed
Causes:	Mechanical failure, trough overloading

Substance(s) identity.

Chemical(s):	Potassium salt (powder)
Amount (stored, transported):	Not stated
Amount released:	Tons
Physical/chemical data:	
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	Dnestrand River and farmland
Environmental concentrations:	
Environmental effects,	
Short term:	2000 tons of fish killed, 360 miles of river polluted, 500 acres of farmland flooded.
Long term:	
Expected time of Recovery:	Short
Preventive actions:	None
Comments:	
References:	MHIDAS 3543

Presentation card. Accidents.

Accident identification.

Date:	November 6, 1985
Location:	7 miles SE of Ranger, Texas, USA
Type of accident:	Discharge of oil over land.
Causes:	Blowout of oil well Ora B. Jones # 3 belonging to Ray Richey and Co. Inc.

Substance(s) identity.

Chemical(s):	Crude oil, gas paraffin and salt water.
Amount (stored, transported):	Not applicable.
Amount released:	326,000 bbl. of crude oil, 32,600 bbl of salt and paraffin, and 176 mill. cubic feet of gas.
Physical/chemical data:	"Blow out fluid": 90% 42 gravity curde oil and 10% salt water and paraffin.
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	Fresh water ponds, pasture lands, pecan groves, and a forest area, in all, a 1-square-mile area surrounding the well site.
Environmental concentrations:	
Environmental effects,	
Short term:	Effects on vegetation and crops.
Long term:	Not stated.
Expected time of Recovery:	One year.
Preventive actions:	Several. Primarily, a higher capacity "Blowout Preventer" was installed.
Comments:	Owing to modern technology and advanced well-drilling procedures, failure under these types of operation are rare. However, as this example proves, they can happen.
References:	C.L. Quina et al. Containment and Cleanup of a major oil well blowout in Texas. Proceedings, 1987 Oil Spill Conference. American Petroleum Inst., Publication No. 4452.

Presentation card. Accidents.

Accident identification.

Date:	February 6, 1986.
Location:	Crown Bay, western side of Charlotte Amalie Harbour, US Virgin Islands.
Type of accident:	Discharge of oil.
Causes:	A steel piling protruded into an oil barge during a harbour operation.

Substance(s) identity.

Chemical(s):	No. 6 fuel oil.
Amount (stored, transported):	2400 bbl.
Amount released:	600 bbl.
Physical/chemical data:	
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	Seawater and adjacent islands.
Environmental concentrations:	
Environmental effects,	
Short term:	Minor. The only wild life reported to be affected by the discharge was one iguana .
Long term:	None as far as known.
Expected time of Recovery:	Not applicable.

Preventive actions: Booms, skimmers, and absorbents. Major problems: lack of disposal sites and unauthorized use of dispersants by boat owners.

Comments: Main concern was possible effect on a desalination plant. A separate article describes this problem.

References: A.E. Tanos and T.E. Hart. Response to Major Oil Spill - Tank Barge St. Thomas. Proceedings, 1987 Oil Spill Conference. American Petroleum Institute. Publication No. 4452.

Presentation card. Accidents.

Accident identification.

Date: June 25, 1986

Location: Ludwigshafen, Germany

Type of accident: Leaking cooling system

Causes:

Substance(s) identity.

Chemical(s): 1,2-dichloroethan

Amount (stored, transported): -

Amount released: 8 ton

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected: Rhine River

Environmental concentrations: 0.3 mg/l

Environmental effects,

Short term: No observed toxic effect

Long term: Carcinogenic substance may have a long-term effect

Expected time of Recovery: Short

Preventive actions: International warning to the authorities

Comments:

References: Internationale Kommission zum Schutze des Rheins Gegen Veruneinigung, Tatigheitsberich, 1986.

Presentation card. Accidents.

Accident identification.

Date:	November 1, 1986
Location:	Schweizerhalle near Basel, Switzerland
Type of accident:	Contamination with pesticides of atmosphere, surrounding soils and the Rhine River
Causes:	Fire in a pesticide storehouse adjacent to the Rhine

Substance(s) identity.

Chemical(s):	See appendix to this card
Amount (stored, transported):	See appendix to this card
Amount released:	
Physical/chemical data:	See appendix to this card
Ecotoxicological data:	See appendix to this card

Ecological consequences.

Ecosystem affected:	Atmosphere, soil and the river Rhine
Environmental concentrations:	See appendix to this card
Environmental effects,	
Short term:	Massive kill of life in the Rhine. Benthic organisms and eels were completely eradicated at a distance of 400 km downstream.
Long term:	Decrease of eel population for years in the Rhine
Expected time of Recovery:	After one year, most of the fish species and benthic organismns had recovered

Preventive actions: Attempts were made to minimize the amount of water used for fire combating to be discharged into the river

Comments: The accident was originally viewed as a very large environmental catastrophe for the river Rhine. The self-purification process proved to be stronger than originally expected.

References: Capel, P.D. et al. Accidental input of pesticides into the Rhine River. Environ. Sci. Technol., Vol. 22, No. 9, 1988, pp. 992-997.

Appendix to Presentation Card

Environmental Accident

Schweizerhalle near Basel, Switzerland, November 1, 1986

TABLE 1
PESTICIDES INVOLVED IN THE SANDOZ STOREHOUSE FIRE

	Quantity stored (metric tons)	Estimated discharge (kg)[a]	Rhine River water concentrations at Village-Neuf (μg/L)[b]		LC_{50} (μg/L)[c]	EC_{50} (μg/L)[d]
ORGANOPHOSPHORUS INSECTICIDES						
Dichlorvos	0.1	1-3	0.15-0.65	(calc)[b]	1000[g]	0.2-6.6
Disulfoton	298	3000-8900	600	(meas)[b]	6000	13
Etrimfos	59.6	290-1800	50	(meas)	24[h]	3.8
Fenitrothion	9.9	2.5-300	15-65	(calc)	1000-10,000[i]	0.4
Formothion	0.3	3-6	5-20	(calc)[b]	2-3	--
Parathion	9.7	50-290	200	(meas)[b]	2000	0.6-2.5
Propetamphos	63.5	160-1900	100	(meas)	4700[j]	--
Quinalphos	0.6	6-20	1-4	(calc)[b]	2800	--
Thiometon	130	1200-3900	500	(meas)	8000	8000
MERCURY-BASED PESTICIDES						
Ethoxyethylmercury hydroxide	1.4	18-200[e]	12	(meas)[b]	(Hg^{2+}):3-1000[h]	2.2-2000
Phenylmercury acetate	1.5	(Hg)				
ZINC-BASED PESTICIDES						
Zineb	0.7	5-15[f]	1-5	(calc)	72-250,000[h]	--
Zinc phosphide	0.45	(Zn)			40,000[h]	
OTHER PESTICIDES						
Captafol	0.16	2-5	0.2-1	(calc)	500[h]	2000-11,000
DNOC	65.9	660-2000	100-430	(calc)	66-1250[h]	14
Endosulfan	2.0	20-60	3-13	(calc)	1.4	53
Metoxuron	11.5	100-350	17-75	(calc)[b]	19,000	215
Oxadixyl	25.2	250-1900	80	(meas)	>320,000	530,000
Scillirosid	0.03	0.3-0.9	0.05-0.02	(calc)	--[h]	--
Tetradifon	2.3	20-70	3.5-15	(calc)	100-1500	10

a Input mass range includes the estimates from the Swiss, German, and French authorities or 1-3% of the quantity of pesticide stored in the warehouse at the time of the fire.
b Measured water concentrations (meas) are from the sample taken Nov. 1, 1986 at 15:15 at Village-Neuf. The other water concentrations are calculated (calc) based on the ratio of the water concentration (μg/L) to amount stored (metric tons). Eliminating the minimum and maximum values, the range of ratios observed is 1.5-6.5.
c LC_{50} = lethal concentration for 50% of rainbow trout, except where noted.
d Daphnia
e As mercury
f As zinc
g Estuarine fish
h Species of fish not identified
i Catfish
j Carp

From: Capel, P.D. et al. Accidental input of pesticides into the Rhine River. Environ. Sci. Technol., Vol. 22, No. 9, 1988, p. 993.

Presentation card. Accidents.

Accident identification.

Date:	December 4, 1986
Location:	Garden City Terminal. Savannah River. Georgia, USA.
Type of accident:	Discharge of no. 6 fuel oil to the river
Causes:	Unknown

Substance(s) identity

Chemical(s):	No. 6 fuel oil
Amount (stored, transported):	Unknown
Amount released:	500,000 gallons from a cargo tanker
Physical/chemical data:	Specific gravity 0.98 at 15°C. Pour point +2°C. Viscosity in this particular case unknown, normally in the order of 300-3000 cSt at 38° C.
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	Marsh vegetation along the river banks were coated with oil
Environmental concentrations:	Unknown, almost no water soluble fraction in this oil
Environmental effects,	
Short term:	Coating of vegetation with this heavy oil. A few oiled birds, mainly cormorants
Long term:	Not stated
Expected time of Recovery:	Because of the oil type, 1/2 - 1 year
Preventive actions:	Deployment of containment- and sorbent booms and shoreline cleaning on rocks. Cleaning of wetlands was not recommended. Instead new vegetation emerged in spring, replacing oil-contaminated vegetation.
Comments:	Containment booms proved effective on water surfaces, but ineffective in creeks and marsh areas because of tidal forces.
References:	Biedenberder, P.L. and J. Michel. Response strategies in a high tidal range estuarine system: The Savannah River Oil Spill. Proceedings, 1989 Oil Spill Conference. San Antonio, Texas. USA.

Presentation card. Accidents.

Accident identification.

Date: April 11, 1987

Location: Murraysville, West Virginia, USA

Type of accident: Ship/land collision

Causes: Impact failure

Substance(s) identity.

Chemical(s): Caustic soda

Amount (stored, transported): 1400 ton

Amount released: 1400 ton

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected: Ohio River

Environmental concentrations:

Environmental effects,

Short term: Minimal impact

Long term:

Expected time of Recovery:

Preventive actions: High dilution/dispersion by fast flowing waters minimized the impact

Comments:

References: MHIDAS 2750

Presentation card. Accidents.

Accident identification.

Date: April 23, 1987

Location: Stockport, Cheshire, U.K.

Type of accident: Release from storage pool

Causes: Not stated

Substance(s) identity.

Chemical(s): Xylene

Amount (stored, transported): 0.5 tons

Amount released: Several hundred gallons

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected: River Etherow

Environmental concentrations: High

Environmental effects,

Short term: Large fish kills

Long term: Bioaccumulation

Expected time of Recovery: Not stated

Preventive actions: Not taken

Comments:

References: MHIDAS 2798

Presentation card. Accidents.

Accident identification.

Date:	September 29, 1987
Location:	Figeac, France
Type of accident:	Accidental spill
Causes:	Human failure

Substance(s) identity.

Chemical(s):	Sodium cyanide
Amount (stored, transported):	15 kg
Amount released:	15 kg
Physical/chemical data:	
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	Le Cele River
Environmental concentrations:	-
Environmental effects;	
Short term:	100 kg of fish killed
Long term:	
Expected time of Recovery:	Short

Preventive actions:

Comments:

References: Principeaux Accidentes et Pollution Accidentelles. Survey en France en 1987.

Presentation card. Accidents.

Accident identification.

Date:	October 8, 1987
Location:	Punta Davis, Isla Desolacion, Magellan Strait
Type of accident:	Grounding
Causes:	Not stated

Substance(s) identity.

Chemical(s):	Light crude oil (ENAP) and fuel oil
Amount (stored, transported):	70,347.8 m^3 crude oil
Amount released:	approx. 6,000 m^3 crude + 522 m^3 fuel
Physical/chemical data:	for crude: specific gravity 0.83. Pour Point +6°C. Viscocity 9.0 at 38°C
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	Marine and shore line
Environmental concentrations:	Not measured
Environmental effects, Short term:	Seaweed contaminated. Intertidal organisms exterminated in vicinity of spill. Impact to seabird minimal. No impact on king crabs.
Long term:	Very limited, intertidal organisms in minor area.
Expected time of Recovery:	6 months, except for minor areas.

Preventive actions: Use of dispersants. 65 (200 L) drums slick-gone LTE. 10 drums Corexit 9527. (Both type 3, concentrate). Estimated amount crude treated; 600 m^3 about 400,000 US $

Comments: Value for pour point seems to be far too high. Total clean-up and environmental study cost about 400,000 US $.

References: Pizarro, F. The Cabo Pilar Grounding and Oil Spill. Proceedings 1989 Oil Spill Conference. San Antonio, Texas, USA.

Presentation card. Accidents.

Accident identification.

Date:	January 2, 1988
Location:	Ashland Oil Terminal in Floreffe, PA
Type of accident:	Collapse of an oil storage tank
Causes:	A combination. Main problem a failure in a ground level plate in tank.

Substance(s) identity.

Chemical(s):	No. 2 diesel fuel
Amount (stored, transported):	Not stated in reference (probably equal to amount released)
Amount released:	3,881,841 gallons. Created a wavelike surge of oil that passed over the banks of the facility's containment booms and into a nearby storm drain. 750,000 gal. were discharged into the Monongahela river, and carried further to the Ohio River.
Physical/chemical data:	Specific gravity 0.85. Flash Point 55° C. Pour point -20°C. Viscosity 15 cSt. at 38°C.
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	Rivers and thereby public freshwater supply
Environmental concentrations:	Analysis was carried out at many sites. The reference does not give results.
Environmental effects, Short term:	2,000-4,000 birds died, e.g., ducks, looms, cormorants, Canada geese. Many birds were cleaned and saved. Fish were killed. Impact on population of an endangered species of mussel (pink Mucket) was monitored.
Long term:	Data not given.
Expected time of Recovery:	No data.
Preventive actions:	Initially, efforts were made to limit the amount entering the river by blocking storm drains. Later, containment booms were deployed in the river. Owing to dispersion and emulsification, only a small amount of oil was recovered.
Comments:	The weather was unusually cold. Communication problems because of power line failure. Many agencies involved in response action. Lack of overall coordination.
References:	Stanley, L. et al. The Ashland Oil Spill of January 1988: An EPA Perspective. Proceedings 1989 Oil Spill Conference. San Antonio, Texas, USA. American Petroleum Inst.

Presentation card. Accidents.

Accident identification.

Date: February 1, 1988

Location: Floreffe, Pennsylvania, USA

Type of accident: Instantaneous release, storage tank

Causes: Reassembled old storage tank fell apart during refill.

Substance(s) identity.

Chemical(s): Diesel oil

Amount (stored, transported): $3 \times 9 \cdot 10^9$ gallons

Amount released: 750,000 gallons

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected: River

Environmental concentrations:

Environmental effects,

Short term: Disruption of water supplies and environment

Long term:

Expected time of Recovery: Not stated

Preventive actions:

Comments:

References: MHIDAS 02752

Presentation card. Accidents.

Accident identification.

Date:	April 23, 1988
Location:	Shell Oil Manufacturing Complex, Martinez, California
Type of accident:	Leakage from facility
Causes:	Not stated

Substance(s) identity.

Chemical(s):	Heavy crude oil (San Yoaquin Valley)
Amount (stored, transported):	not stated
Amount released:	9,400 barrels
Physical/chemical data:	API gravity 13.5 viscosity 266 cST at 38°C Pour Point -1°C. Sulfur content 1.17%
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	Salt- and fresh water marsh (tidal current)
Environmental concentrations:	High sediment concentration in marsh close to complex, 150 ppm (after cleaning of visible oil)
Environmental effects, Short term:	Partial destruction of marsh vegetation. 455 oiled birds, mammels, reptiles and amphibians treated and recovered. 191 dead animals collected in the area.
Long term:	Environmental studies continued.
Expected time of Recovery:	Unknown for the time being

Preventive actions: Containment. Booms, skimmers (sorbent belt type used in marsh), cutting of vegetation. High pressure hot water used to clean rock at coastline. More than 90% of spilled oil judged to be recovered within the first four weeks after spill.

Comments: Recovery rate of oil exceptionally good. Organization worked excellent.

References: Fraser, Y.P. et al. Response to the April 1988 Oil Spill at Martinez, California. Proceedings, 1989 Oil Spill Conference, San Antonio,Texas.

Presentation card. Accidents.

Accident identification.

Date: June 8, 1988

Location: Auzouer En Touraine

Type of accident: Fire

Causes: -

Substance(s) identity.

Chemical(s): Phenol derivatives, toluene, heavy metals, etc.
Amount (stored, transported): -
Amount released: -
Physical/chemical data: -

Ecotoxicological data:

Ecological consequences.

Ecosystem affected: Rivers: Brenne, Cisse, and Loire

Environmental concentrations:

Environmental effects;
Short term: 15-20 tons of fisk killed. Invertebrates, birds, and other species also killed.

Long term:

Expected time of Recovery:

Preventive actions: A dike was built to minimize the release of fire-fighting water into the Brenne River.

Comments:

References: /5/ Rapport sur le Sinistre "Protex"
/6/ Rapport de la Commission d'Évaluation des Conséquences de l'Incindie de l'Usine Protex.

Presentation card. Accidents.

Accident identification.

Date: August 22, 1988

Location: Gueugnon, France

Type of accident: Accidental spill during decanting

Causes:

Substance(s) identity.

Chemical(s): Nitric acid

Amount (stored, transported):

Amount released: 500 liters

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected: Arroux River

Environmental concentrations: -

Environmental effects;

Short term: 500 kg fish killed

Long term:

Expected time of Recovery:

Preventive actions: Bathing and fishing forbidden

Comments:

References: Principeaux Accidentes et Pollution Accidentelles, Survey en France, 1988.

Presentation card. Accidents.

Accident identification.

Date: August 27, 1988

Location: Mulhouse Dornach, France

Type of accident: Explosion and fire in production

Causes: Not known

Substance(s) identity.

Chemical(s): Paranitrochlorbenzen and paramethoxyphenol

Amount (stored, transported): Not known

Amount released:

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected: River affected for 3 km by fire-extinguishing water

Environmental concentrations:

Environmental effects;

Short term: High mortality among fish in 3 km of the river

Long term:

Expected time of Recovery:

Preventive actions:

Comments:

References: Principeaux Accidents et Pollutions Accidentelles, Survey en France en 1988.

Presentation card. Accidents.

Accident identification.

Date:	September 9, 1988
Location:	Bad Honnef, Germany
Type of accident:	Explosion
Causes:	-

Substance(s) identity.

Chemical(s):	Dichlorprop
Amount (stored, transported):	-
Amount released:	0.5 ton
Physical/chemical data:	
Ecotoxicological data:	Effect limit (fish) 100-220 mg/l

Ecological consequences.

Ecosystem affected:	Rhine River
Environmental concentrations:	6 µg/l
Environmental effects, Short term:	No observed effect
Long term:	
Expected time of Recovery:	
Preventive actions:	None
Comments:	
References:	Internationale Kommission zum Schutze des Rheins Gegen Veruneinigung, Tatigheitsberich, 1988.

Presentation card. Accidents.

Accident identification.

Date: October 10, 1988

Location: Dampniat, France

Type of accident: Accidental spill

Causes: Human or technical failure

Substance(s) identity.

Chemical(s): Lindane and sodium pentachlorophenate

Amount (stored, transported):

Amount released: 40 kg

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected: La Correze River, 14 km

Environmental concentrations: Not monitored

Environmental effects;

Short term: 15 tons of fish died.

Long term:

Expected time of Recovery:

Preventive actions:

Comments:

References: Principeaux Accidents et Pollutions Accidentelles, Survey en France en 1988.

Presentation card. Accidents.

Accident identification.

Date: December 19, 1988

Location: Veidingen, Germany

Type of accident: Accidental spill from storage

Causes: Human error

Substance(s) identity.

Chemical(s): Methylene chloride and chlorobenzene

Amount (stored, transported): -

Amount released: 600 - 700 kg

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected: Rhine River

Environmental concentrations: 7.5 µg/l (methylene chloride)
2 µg/l chlorobenzene

Environmental effects,
Short term: No short term effects on the exposed organisms

Long term: Bioaccumluation of cholorbenzene

Expected time of Recovery:

Preventive actions: None

Comments:

References: Internationale Kommission zum Schutze des Rheins Gegen Veruneinigung, Tätigheitsbericht, 1988.

Presentation card. Accidents.

Accident identification.

Date:	December 22, 1988
Location:	Grays Harbor, Washington, USA
Type of accident:	Discharge of oil to the sea
Causes:	Puncture of the barge Nestucca's cargo tank by the tugboat Ocean Service.

Substance(s) identity.

Chemical(s):	Bunker C oil
Amount (stored, transported):	70,000 bbl
Amount released:	5,500 bbl
Physical/chemical data:	
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	Marine, including "all types of shoreline"
Environmental concentrations:	
Environmental effects, Short term:	6,000 dead birds initially. In addition, 3000 oiled birds were treated: of these, 2000 succumbed and 1000 were released.
Long term:	
Expected time of Recovery:	6 months
Preventive actions:	Mechanical recovery/beach cleaning. Bird rehabilitation efforts.
Comments:	The oily waste collected was land-filled, with a minor part burned at a local pulp mill.
References:	Yaroch, G. N. The Nestucca major oil spill: A Christmas story. Proceedings, 1991. Oil spill Conference, San Diego, USA. American Petroleum Institute, publication no. 4529.

Presentation card. Accidents.

Accident identification.

Date:	February 8, 1989
Location:	Wallach, Germany
Type of accident:	Ship/ship collision
Causes:	Low visibility (fog)

Substance(s) identity.

Chemical(s):	Ammonium sulphate
Amount (stored, transported):	-
Amount released:	300 ton
Physical/chemical data:	
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	Rhine River
Environmental concentrations:	1.5 mg ammonia/l
Environmental effects, Short term:	Toxic effects, fish
Long term:	
Expected time of Recovery:	Short
Preventive actions:	None
Comments:	
References:	Internationale Kommission zum Schutze des Rheins Gegen Veruneinigung, Tätigheitsbericht, 1989.

Presentation card. Accidents.

Accident identification.

Date: March 10, 1989

Location: Birsfelden, Switzerland

Type of accident: Break of pipeline

Causes: Not stated

Substance(s) identity.

Chemical(s): Diesel oil

Amount (stored, transported):

Amount released: 5,000 liter

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected: Rhine River

Environmental concentrations: 5 km oil film covering the whole surface

Environmental effects,

Short term: Fauna on the river beds affected

Long term:

Expected time of Recovery: Medium

Preventive actions: Dispersion agent and oil blockading

Comments:

References: Internationale Kommission zum Schutze des Rheins Gegen Veruneinigung, Tätigheitsbericht, 1989.

Presentation card. Accidents.

Accident identification.

Date: March 20, 1989

Location: Saint André de Majencoules, France

Type of accident: Transport accident with lorry

Causes: Human failure

Substance(s) identity.

Chemical(s): Oil fuel

Amount (stored, transported): 20,000 l

Amount released: 20,000 l

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected: l'Herault River

Environmental concentrations:

Environmental effects;

Short term: Dead fish

Long term:

Expected time of Recovery: Short

Preventive actions: None

Comments:

References: Principeaux Accidents et Pollutions Accidentelles, Survey en France en 1989.

Presentation card. Accidents.

Accident identification.

Date:	March 24, 1989
Location:	Blight Reef, Price William Sound, Alaska
Type of accident:	Discharge of oil to the sea.
Causes:	Grounding of the tanker Exxon Valdez

Substance(s) identity.

Chemical(s):	North Slope crude oil
Amount (stored, transported):	1.24 mill. bbl.
Amount released:	258,000 bbl.
Physical/chemical data:	
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	Marine and shore area
Environmental concentrations:	More than 2000 water samples have been analyzed, but values were not given in references.
Environmental effects,	
Short term:	Substantial effects on wildlife
Long term:	Under examination
Expected time of Recovery:	After one year, the bulk of the damage had disappeared, and recovery was well under way even on the most severely impacted beaches.
Preventive actions:	Booming, skimming, and burning of oil emulsion at sea. Several types of beach cleanup, e.g., development of a new chemical beach cleaner and bioremediation used on large scale for the first time.
Comments:	Cleanup cost not finally assessed, but in the order of several hundred million USD. Compensation cost in the order of 600 million USD. Fine (penalty) 100 million USD.
References:	Several articles in Proceedings, 1991 Oil Spill Conference, San Diego, USA. American Petroleum Institute. Publication no. 4529.

Presentation card. Accidents.

Accident identification.

Date: March 28, 1989

Location: Vierzon

Type of accident: Accidental spill by loading of a lorry

Causes:

Substance(s) identity.

Chemical(s): Fuel oil

Amount (stored, transported):

Amount released: 8,000 liter

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected: River

Environmental concentrations:

Environmental effects;

Short term: Fish kill

Long term:

Expected time of Recovery:

Preventive actions:

Comments:

References: Principeaux Accidents et Pollutions Accidentelles, Survey en France en 1989.

Presentation card. Accidents.

Accident identification.

Date: June 19, 1989

Location: Cartagena, Colombia

Type of accident: Storage plant, storage vessel opened

Causes: Human error

Substance(s) identity.

Chemical(s): Lorsban (herbicide)

Amount (stored, transported): 6 tons

Amount released: 6,500 1 of herbicide solution

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected: Marine bay

Environmental concentrations:

Environmental effects,
Short term: 14 tons dead fish

Long term:

Expected time of Recovery: Short

Preventive actions: None

Comments:

References: MHIDAS 3977

Presentation card. Accidents.

Accident identification.

Date:	June 24, 1989
Location:	Delaware River South of Marcus Hook, Pennsylvania, USA
Type of accident:	Discharge of oil
Causes:	Grounding of the tanker Presidente Rivera

Substance(s) identity.

Chemical(s):	no. 6 oil
Amount (stored, transported):	19 million gallons of oil
Amount released:	307,000 gallons
Physical/chemical data:	The viscosity of this oil type is very high. The pour point was extremely high (96°F). Evaporation little and the water-soluble fraction less than 10 ppm. Specific gravity 0.95.
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	River banks and marshes
Environmental concentrations:	
Environmental effects,	
Short term:	Marsh grass and mud contaminated, as well as some water fowls.
Long term:	None
Expected time of Recovery:	Not stated, but shoreline cleanup continued until the following spring.

Preventive actions: Mechanical recovery. The tar-like consistency of this oil made the operation difficult, necessitating special pumps and containment booms. Nevertheless, most of the spilled oil was recovered.

Comments:

References: Wilkshire, G. A. and L. Cororan. Response to the President Rivera major oil spill, Delaware River. Proceedings, 1991 Oil Spill Conference, San Diego, USA. American Petroleum Institute. Publication no. 4529.

Presentation card. Accidents.

Accident identification.

Date: July 7, 1989

Location: Saint Paul, France

Type of accident: Accidental spill

Causes: -

Substance(s) identity.

Chemical(s): Ammonia and urea solution

Amount (stored, transported):

Amount released: 5,000 liters

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected: Avelon River

Environmental concentrations:

Environmental effects;

Short term: Fish kill

Long term:

Expected time of Recovery:

Preventive actions:

Comments:

References: Principeaux Accidents et Pollutions Accidentelles, Survey en France en 1989.

Presentation card. Accidents.

Accident identification.

Date:	August 19, 1989
Location:	approximately 3 km S of Tarnmere oil terminal, Mersey Estuary, England.
Type of accident:	Discharge of oil
Causes:	A fracture in a pipeline

Substance(s) identity.

Chemical(s):	Venezuelan crude oil
Amount (stored, transported):	150 tons oil
Amount released:	
Physical/chemical data:	
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	Shores and salt marshes along the Mersey Estuary
Environmental concentrations:	
Environmental effects,	
Short term:	Vegetation affected and 350 birds killed by oil.
Long term:	As far as intertidal sediment and bird population are concerned, studies show no effect.
Expected time of Recovery:	As far as salt marsh is concerned, it still remains undetermined.

Preventive actions: Cleanup, using both mechanical equipment and dispersant, lasted one month.

Comments: Results of studies on invertebrate populations, algal studies, and salt marsh studies were not available when references were written.

References: Taylor, P.M. A pipeline spill into the Mersey Estuary, England. Proceedings 1991. Oil spill conference, American Petroleum Institute. Publication no. 4529.

Presentation card. Accidents.

Accident identification.

Date:	September 28, 1989
Location:	Yorkshire, U.K.
Type of accident:	Over-filling of storage plant, discharge to river
Causes:	Human error

Substance(s) identity.

Chemical(s):	Polyelectrolyte
Amount (stored, transported):	0.4 ton
Amount released:	100 gallons
Physical/chemical data:	-
Ecotoxicological data:	-

Ecological consequences.

Ecosystem affected:	River
Environmental concentrations:	
Environmental effects,	
Short term:	More than 1,000 fish killed
Long term:	None
Expected time of Recovery:	Short
Preventive actions:	None
Comments:	Local water works prosecuted, fined USD 1,000 and forced to pay cost of incident.
References:	MHIDAS 3901

Presentation card. Accidents.

Accident identification.

Date:	October 22, 1989
Location:	Maribo Froe near Holeby, Lolland, Denmark.
Type of accident:	Fire in pesticide storage facilities
Causes:	Water used to put out fire leaked from containment basins to a nearby stream

Substance(s) identity.

Chemical(s):	Several pesticides, active components, methiocarb, thiram, Hymexasol, Iprodion, Carbofuran
Amount (stored, transported):	Approximately 6 tons
Amount released:	Unknown. However, all was destroyed during fire
Physical/chemical data:	
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	A fresh water stream
Environmental concentrations:	0.01-1.0 ppm for individual substances
Environmental effects,	
Short term:	Fish in the stream were killed. Effect on invertebrates unknown.
Long term:	As far as known, none
Expected time of Recovery:	3 months

Preventive actions: Fire-fighting water was collected in special basins. Afterwards, the sediment from the basins was brought to the chemical waste treatment plant "Kommunekemi A/S" for ultimate storage.

Comments: Extensive cooperation from the damaged company Maribo Froe, especially regarding information about substances and analytical procedures and facilities, limited the extent of environmental effects.

References: Tørsløv, J. et al. Brandulykken på Maribo Frø. Vand og Miljø No. 7, November 1990 (In Danish only).

Presentation card. Accidents.

Accident identification.

Date: October 27, 1989

Location: Schweizerhalle.

Type of accident: Accidental release from storage tank.

Causes: Human failure

Substance(s) identity.

Chemical(s): Penconazol (fungicide)

Amount (stored, transported): -

Amount released: 100 kg

Physical/chemical data:

Ecotoxicological data: LC_{50} 2-5 mg/l (fish)

Ecological consequences.

Ecosystem affected: Rhine River

Environmental concentrations: 0,2-0,25 µl/l

Environmental effects,

Short term: No effects observed on exposed organisms

Long term:

Expected time of Recovery:

Preventive actions: None

Comments:

References: Internationale Kommission zum Schutze des Rheins Gegen Veruneinigung, Tätigheitsbericht, 1989.

Presentation card. Accidents.

Accident identification.

Date: November 17, 1989

Location: New Tredegar, Wales

Type of accident: Fire in storage

Causes:

Substance(s) identity.

Chemical(s): Unknown, household chemicals

Amount (stored, transported):

Amount released: 5 tons fire-fighting run-off water

Physical/chemical data:

Ecotoxicological data:

Ecological consequences.

Ecosystem affected: Stream

Environmental concentrations:

Environmental effects,
Short term: 17,000 fish in stream killed

Long term:

Expected time of Recovery: Short

Preventive actions: None

Comments:

References: MHIDAS 3897

Presentation card. Accidents.

Accident identification.

Date:	January 2, 1990
Location:	Arthur Kill Waterway, between Staten Island and New Jersey, USA
Type of accident:	Discharge of oil to marine environment
Causes:	Leaking from an underwater pipeline

Substance(s) identity.

Chemical(s):	No. 2. heating oil
Amount (stored, transported):	Not applicable
Amount released:	13,500 bbl
Physical/chemical data:	
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	Island wetlands and shore
Environmental concentrations:	
Environmental effects,	
Short term:	600 dead birds and 100 oiled birds, which were treated. Many recovered.
Long term:	None
Expected time of Recovery:	1 year
Preventive actions:	Booms and skimmers. Treatment of oiled birds. Beach clean-up, including use of bioremediation.

Comments:

References: B.G. Bubar and Y.R. Czarnecki. Response to the January 1990 Arthur Kill Waterway heating oil spill. Proceedings, 1991 Oil Spill Conference, San Diego, USA. American Petroleum Institute. Publication no. 4529.

Presentation card. Accidents.

Accident identification.

Date:	February 7, 1990
Location:	Off Huntington Beach, California, USA.
Type of accident:	Discharge of oil
Causes:	During mooring operations, the tanker hit one of its own anchors.

Substance(s) identity.

Chemical(s):	Alaskan North Slope Crude Oil
Amount (stored, transported):	567,966 bbl
Amount released:	9,458 bbl
Physical/chemical data:	API gravity 27.5
Ecotoxicological data:	No data referred

Ecological consequences.

Ecosystem affected:	Coastline
Environmental concentrations:	
Environmental effects,	
Short term:	1,017 birds brought to rescue center. 502 were dead or died during treatment. 515 released later. 141 brown pelicans and endangered species among the 1017 birds. 68 of these died. Fish kills were also observed.
Long term:	Impact will be estimated at a later date, when all results from investigations have been evaluated.
Expected time of Recovery:	Unknown. Special concern for pelican population.

Preventive actions: Mechanical recovery. Request for use of dispersants not approved.

Comments: Mechanical recovery relatively effective in relation to the spill.

References: Card, Y.C. & Y. A Meehan. Response to the American Trader oil spill. Proceedings, 1991 Oil Spill Conference, San Diego, California, U.S.A. American Petroleum Institute. Publication No. 4529.

Presentation card. Accidents.

Accident identification.

Date:	June 8, 1990
Location:	57 miles off the coast of Texas, USA
Type of accident:	Fire and discharge of oil to the sea.
Causes:	During a lightening operation, an explosion occurred in the tanker Mega Borg.

Substance(s) identity.

Chemical(s):	Angolan "Palanca" crude oil
Amount (stored, transported):	935,000 bbl
Amount released:	93,000 bbl
Physical/chemical data:	
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	High seas extended the threat to the coastline -some oil reached the shore of Louisiana.
Environmental concentrations:	
Environmental effects, Short term:	No measurable environmental damage
Long term:	
Expected time of Recovery:	

Preventive actions:	Dispersants (corixit 9527) were applied from aircraft. Beams and skimmers were also used as the oil slick moved towards the coast.
Comments:	Public and media interest in this spill was substantial, and media relations required a lot of resources.
References:	Leveille, T.P. The Mega Borg fire and oil spill: a case study. Proceedings, 1991, Oil spill conference. San Diego, USA. American Petroleum Institute. Publication no. 4529.

Presentation card. Accidents.

Accident identification.

Date:	July 28, 1990
Location:	Houston Ship Channel; Galveston Bay, Texas, USA
Type of accident:	Discharge of oil
Causes:	Collision between a Greek tanker and 2 tank barges

Substance(s) identity.

Chemical(s):	Catalytic feedstock oil
Amount (stored, transported):	
Amount released:	692,000 gallons
Physical/chemical data:	
Ecotoxicological data:	

Ecological consequences.

Ecosystem affected:	Marine area (Galveston Bay) and some shorelines along the bay.
Environmental concentrations:	
Environmental effects, Short term:	Minor. As a precaution, a ban was issued on shellfish, shrimp, and finned fish from the bay.
Long term:	Probably none.
Expected time of Recovery:	The area was declared as clean on August 17.
Preventive actions:	Mechanical oil combatting equipment was used, and bioremediation for marsh cleaning. Visually, the condition of the marsh improved.
Comments:	On August 4, the ban on finned fish was lifted. The reference did not state at what time the bans on shrimp and shellfish were lifted.
References:	Grene, T.C. The apex barges spill, Galveston Bay, July, 1990. Proceedings, 1991 Oil Spill Conference, San Diego, USA. American Petroleum Institute. Publication no. 4529.

Annex 2

DATA SEARCH

DATA SEARCH

The search for data was performed in data bases giving literature references and in accident recordings like MHIDAS, the Rhine Commission Reports 1985-1989, the French Survey of Accidents 1987-1989, and Wunderlich, who covered the period 1970-1988.

The data-base search was performed as an on-line search in the following data bases:

- Pollution Abstracts
- Enviroline
- CA SEARCH (Chemical Abstracts)
- NTIS (National Technical Information Service)
- Aqualine.

The indexes of the Marine Pollution Bulletin were also surveyed.

In all cases, the word "environment" and the words "accident" as well as "incident" were used in combination.

The search was limited to the period 1975-1990.

Pollution Abstracts provided the most references (50), followed by NTIS (30) and Chemical Abstracts and Enviroline (both less than 20). The Marine Pollution Bulletin proved to be a good source of oil pollution references. Other references were found in MHIDAS (11), Rhine Commission (6), Publications from American Petroleum Institute (10), French Survey of Accidents (7).

A thorough study of the references showed that only 25 of them fulfilled the criteria for inclusion in the report (i.e., description of amounts released, chemicals involved, ecological consequences).

European Communities - Commission

EUR 14002 — Review of Environmental Accidents and Incidents

P. Lindgaard-Jorgensen, K. Bender

Luxembourg: Office for Official Publications of the European Communities

1992 - 86 pp. — 21.0 x 29.7 cm

Series: Environment and Quality of Life

ISBN 92-826-3535-X

Catalogue number. CD-NA-14002-EN-C

Price (excluding VAT) in Luxembourg: ECU 7,50

The aim of this study was to gather information from literature or databases on accidents with environmental consequences.

This should help to get a cleaner definition of environmental hazard to be used with the Directive 82/501 and its fundamental revision. Accidents from transport, storage and processing hazardous chemicals were covered for the period 1975 to 1990. An accident reporting form was developed.

Only 56 accidents with described ecological consequences have been registered. Most involve transportation and storage of oil, followed by pesticides and other chemicals A comparison is made with accidents having consequences to human beings. Conclusions are drawn and recommendations are given, especially for preventive actions.

Venta y suscripciones • Salg og abonnement • Verkauf und Abonnement • Πωλήσεις και συνδρομές
Sales and subscriptions • Vente et abonnements • Vendita e abbonamenti
Verkoop en abonnementen • Venda e assinaturas

BELGIQUE / BELGIE

Moniteur belge / Belgisch Staatsblad
Rue de Louvain 42 / Leuvenseweg 42
1000 Bruxelles / 1000 Brussel
Tél. (02) 512 00 26
Fax 511 01 84
CCP / Postrekening 000-2005502-27

Autres distributeurs /
Overige verkooppunten

Librairie européenne/ Europese Boekhandel
Avenue Albert Jonnart 50 /
Albert Jonnartlaan 50
1200 Bruxelles / 1200 Brussel
Tél. (02) 734 02 81
Fax 735 08 60

Jean De Lannoy
Avenue du Roi 202 /Koningslaan 202
1060 Bruxelles / 1060 Brussel
Tél. (02) 538 51 69
Télex 63220 UNBOOK B
Fax (02) 538 08 41

CREDOC
Rue de la Montagne 34 / Bergstraat 34
Bte 11 / Bus 11
1000 Bruxelles / 1000 Brussel

DANMARK

J. H. Schultz Information A/S
EF-Publikationer
Ottiliavej 18
2500 Valby
Tlf. 36 44 22 66
Fax 36 44 01 41
Girokonto 6 00 08 86

BR DEUTSCHLAND

Bundesanzeiger Verlag
Breite Straße
Postfach 10 80 06
5000 Köln 1
Tel (02 21) 20 29-0
Fernschreiber
ANZEIGER BONN 8 882 595
Fax 20 29 278

GREECE

G.C. Eleftheroudakis SA
International Bookstore
Nikis Street 4
10563 Athens
Tel. (01) 322 63 23
Telex 219410 ELEF
Fax 323 98 21

ESPAÑA

Boletín Oficial del Estado
Trafalgar, 27
28010 Madrid
Tel. (91) 44 82 135

Mundi-Prensa Libros, S.A.
Castelló, 37
28001 Madrid
Tel. (91) 431 33 99 (Libros)
431 32 22 (Suscripciones)
435 36 37 (Dirección)
Télex 49370-MPLI-E
Fax (91) 575 39 98

Sucursal:

Librería Internacional AEDOS
Consejo de Ciento, 391
08009 Barcelona
Tel. (93) 301 86 15
Fax (93) 317 01 41

Llibreria de la Generalitat de Catalunya
Rambla dels Estudis , 118 (Palau Moja)
08002 Barcelona
Tel. (93) 302 68 35
302 64 62
Fax 302 12 99

FRANCE

Journal officiel
Service des publications des Communautés européennes
26, rue Desaix
75727 Paris Cedex 15
Tél (1) 40 58 75 00
Fax (1) 40 58 75 74

IRELAND

Government Publications Sales Office
Sun Alliance House
Molesworth Street
Dublin 2
Tel. 71 03 09

or by post

Government Stationery Office
EEC Section
6th floor
Bishop Street
Dublin 8
Tel. 78 16 66
Fax 78 06 45

ITALIA

Licosa Spa
Via Benedetto Fortini, 120/10
Casella postale 552
50125 Firenze
Tel. (055) 64 54 15
Fax 64 12 57
Telex 570466 LICOSA I
CCP 343 509

Subagenti.

Libreria scientifica Lucio de Biasio - AEIOU
Via Meravigli, 16
20123 Milano
Tel. (02) 80 76 79

Herder Editrice e Libreria
Piazza Montecitorio, 117-120
00186 Roma
Tel. (06) 679 46 28/679 53 04

Libreria giuridica
Via XII Ottobre, 172/R
16121 Genova
Tel. (010) 59 56 93

GRAND-DUCHÉ DE LUXEMBOURG

Abonnements seulement
Subscriptions only
Nur fur Abonnements

Messageries Paul Kraus
11, rue Christophe Plantin
2339 Luxembourg
Tél. 499 88 88
Télex 2515
Fax 499 88 84 44
CCP 49242-63

NEDERLAND

SDU Overheidsinformatie
Externe Fondsen
Postbus 20014
2500 EA 's-Gravenhage
Tel (070) 37 89 911
Fax (070) 34 75 778

PORTUGAL

Imprensa Nacional
Casa da Moeda, EP
Rua D Francisco Manuel de Melo, 5
P-1092 Lisboa Codex
Tel. (01) 69 34 14

Distribuidora de Livros Bertrand, Ld.ª
Grupo Bertrand, SA
Rua das Terras dos Vales, 4-A
Apartado 37
P-2700 Amadora Codex
Tel (01) 49 59 050
Telex 15798 BERDIS
Fax 49 60 255

UNITED KINGDOM

HMSO Books (PC 16)
HMSO Publications Centre
51 Nine Elms Lane
London SW8 5DR
Tel. (071) 873 9090
Fax GP3 873 8463
Telex 29 71 138

Sub-agent

Alan Armstrong Ltd
2 Arkwright Road
Reading, Berks RG2 0SQ
Tel (0734) 75 18 55
Telex 849937 AAALTD G
Fax (0734) 75 51 64

ÖSTERREICH

Manz'sche Verlags- und Universitätsbuchhandlung
Kohlmarkt 16
1014 Wien
Tel. (0222) 531 61-0
Telex 11 25 00 BOX A
Fax (0222) 531 61-81

SVERIGE

BTJ
Box 200
22100 Lund
Tel. (046) 18 00 00
Fax (046) 18 01 25

SCHWEIZ / SUISSE / SVIZZERA

OSEC
Stampfenbachstraße 85
8035 Zurich
Tel. (01) 365 51 51
Fax (01) 365 54 11

MAGYARORSZÁG

Agroinform
Kozpont
Budapest I , Attila út 93. H-1012

Levélcím
Budapest, Pf 15 H-1253
Tel 36 (1) 56 82 11
Telex (22) 4717 AGINF H-61

POLAND

Business Foundation
ul. Wspólna 1/3
PL-00-529 Warszawa
Tel. 48 (22) 21 99 93/21 84 20
Fax 48 (22) 28 05 49

YUGOSLAVIA

Privredni Vjesnik
Bulevar Lenjina 171/XIV
11070 - Beograd
Tel 123 23 40

TURKIYE

Pres Dagitim Ticaret ve sanayi A.Ş.
Narlibahçe Sokak No 15
Cağaloğlu
Istanbul
Tel. 512 01 90
Telex 23822 DSVO-TR

AUTRES PAYS
OTHER COUNTRIES
ANDERE LANDER

Office des publications officielles des Communautés européennes
2, rue Mercier
L-2985 Luxembourg
Tél 49 92 81
Télex PUBOF LU 1324 b
Fax 48 85 73
CC bancaire BIL 8-109/6003/700

CANADA

Renouf Publishing Co. Ltd
Mail orders — Head Office:
1294 Algoma Road
Ottawa, Ontario K1B 3W8
Tel (613) 741 43 33
Fax (613) 741 54 39
Telex 0534783

Ottawa Store.
61 Sparks Street
Tel. (613) 238 89 85

Toronto Store
211 Yonge Street
Tel (416) 363 31 71

UNITED STATES OF AMERICA

UNIPUB
4611-F Assembly Drive
Lanham, MD 20706-4391
Tel. Toll Free (800) 274 4888
Fax (301) 459 0056

AUSTRALIA

Hunter Publications
58A Gipps Street
Collingwood
Victoria 3066

JAPAN

Kinokuniya Company Ltd
17-7 Shinjuku 3-Chome
Shinjuku-ku
Tokyo 160-91
Tel. (03) 3439-0121

Journal Department
PO Box 55 Chitose
Tokyo 156
Tel. (03) 3439-0124

CD-NA-14002-EN-C

NOTICE TO READER

All scientific and technical reports published by the Commission of the European Communities are announced in the monthly periodical **«euro abstracts».** For subscription (1 year: ECU 110) please write to the address below.

Price (excluding VAT) in Luxembourg: ECU 7,50

ISBN 92-826-3535-X

OFFICE FOR OFFICIAL PUBLICATIONS
OF THE EUROPEAN COMMUNITIES
L-2985 Luxembourg