FOREWORD INTRODUCTION

PHOSPHORUS TRICHLORIDE

CAS N°: 7719-12-2

SIDS Initial Assessment Report

For

SIAM 19

Berlin, Germany, 19-22 October 2004

1. Chemical Name:	Phosphorus trichloride
2. CAS Number:	7719-12-2
3. Sponsor Country:	Germany Contact Point: BMU (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit) Contact person: Prof. Dr. Ulrich Schlottmann Postfach 12 06 29 D- 53048 Bonn
4. Shared Partnership with:	
5. Roles/Responsibilities of the Partners:	
• Name of industry sponsor /consortium	Bayer AG, Germany Contact person: Dr. Burkhardt Stock D-51368 Leverkusen Gebäude 9115
• Process used	The BUA Peer Review Process : see next page
6. Sponsorship History	
• How was the chemical or category brought into the OECD HPV Chemicals Programme?	by ICCA-Initiative
7. Review Process Prior to the SIAM:	last literature search (update): 8 April 2004 (Human Health): databases medline, toxline; search profile CAS-No. and special search terms 5 March 2004 (Ecotoxicology): databases CA, biosis; search profile CAS-No. and special search termsOECD/ICCA
8. Quality check process:	As basis for the SIDS-Dossier the IUCLID was used. All data have been checked and validated by BUA. A final evaluation of the human health part has been performed by the Federal Institute for Risk Assessment (BfR) and of the ecotoxicological part by the Federal Environment Agency (UBA).
9. Date of Submission:	Deadline for circulation: 23 July 2004
10. Date of last Update:	Last literature search: IUCLID Chapters 1-4: 2002-07-26, Chapter 5: 2003-05-01

11. Comments:

OECD/ICCA - The BUA* Peer Review Process

Qualified BUA personnel (toxicologists, ecotoxicologists) perform a quality control on the full SIDS dossier submitted by industry. This quality control process follows internal BUA guidelines/instructions for the OECD/ICCA peer review process and includes:

– a full (or update) literature search to verify completeness of data provided by industry in the IUCLID/HEDSET

– Review of data and assessment of the quality of data

– Review of data evaluation

– Check of adequacy of selection process for key studies for OECD endpoints, and, where relevant, for non-OECD endpoints by checking original reports/publications

– Review of key study description according to robust summary requirements; completeness and correctness is checked against original reports/publications (if original reports are missing: reliability (4), i.e. reliability not assignable)

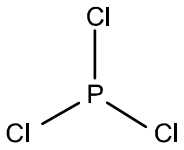
– Review of validity of structure-activity relationships

– Review of full SIDS dossier (including SIAR, SIAP and proposal for conclusion and recommendation for further work)

– In case of data gaps, review of testing plan or rationale for not testing

* BUA (GDCh-Beratergremium für Altstoffe): Advisory Committee on Existing Chemicals of the Association of German Chemists (GDCh)

SIDS INITIAL ASSESSMENT PROFILE

CAS No.	7719-12-2
Chemical Name	Phosphorus trichloride
Structural Formula	

SUMMARY CONCLUSIONS OF THE SIAR

Human Health

Phosphorus trichloride is quickly hydrolysed at first contact with water. It is, therefore, very unlikely that phosphorus trichloride will reach tissues distant from the portal of entry and become systemically available. The products of hydrolysis, hydrochloric acid and phosphorous acid, also act at the portal of entry.

The acute toxicity of phosphorus trichloride is high. It is characterised by immediate irritation/corrosion at the portal of entry in experimental animals and humans due to the irritant/corrosive properties of the products of hydrolysis. After inhalation (4h in some studies, unspecified in others) the LC_{50} was determined in rats as 226 to >500 mg/m³. The oral LD50 presumably by gavage in corn oil or vegetable oil (data for mode of application and for vehicle sometimes not given) was 18 to 550 mg/kg bw. in rats showing a very steep dose/mortality-curve in individual studies. The dermal LD_{low} in rabbits is 500 mg/kg bw. The most relevant route of exposure is inhalation. Therefore, the primary target tissues are the mucous membranes of mouth, eyes and respiratory tract. After oral exposure stomach ulceration is to be expected.

Phosphorus trichloride is corrosive to the skin and mucous membranes of the eyes and the respiratory tract. Data on sensitisation for phosphorus trichloride have not been identified. The hydrolysis product hydrochloric acid gave no indication for a sensitising potential in humans and experimental animals. Data on phosphorous acid, the second hydrolysis product, are not available, but no specific effects are expected due to its structure.

After 4-weeks of whole-body inhalation exposure to 0.5, 3, or 10 ppm (2.8, 17.1 or 56.8 mg/m^3) phosphorus trichloride (6h/day, 5d/wk for 4 weeks), irritation of the eyes and the respiratory tract (suppurative inflammation, and inflammation and squamous metaplasia of respiratory epithelium) was observed in rats. There were no other symptoms not related to the irritant properties of phosphorus trichloride. The NOAEC in rats was 3 ppm (17 mg/m³). Chronic bronchitis can develop in humans. Repeated dose toxicity studies employing other routes were not identified in the literature. Because phosphorus trichloride as well as its hydrolysis products are toxicants acting at the portal of entry, and because phosphorus trichloride is unlikely to reach tissues distant from the portal of entry due to rapid hydrolysis, direct systemic toxicity is not likely to occur following exposure to phosphorus trichloride by any route.

Phosphorus trichloride did not show mutagenic activity in a bacterial mutagenicity assay. Neither micronuclei nor chromosomal aberrations were induced in mouse bone marrow and human blood cells in vivo.
As phosphorus trichloride decomposes to acid within seconds in aqueous media the resulting acidity of the hydrolysis products may cause unspecific effects of low pH in in-vitro tests. The change in pH may induce chromosomal aberrations and other DNA damage.

In vivo, reduced pH levels could lead to chromosomal changes and DNA damage at the portal-of-entry of phosphorus trichloride. However, it is unlikely that systemic changes in pH would occur after exposure to phosphorus trichloride that are sufficient in magnitude to induce this effect in distant tissues or organs. The excess phosphate produced by hydrolysis of phosphorus trichloride may play a role in the development of effects on kidney, bone and calcium levels. Also by other routes (oral, dermal) phosphorous trichloride is expected to produce effects at the site of first contact (irritation, corrosion). The long term effects observed in humans (chronic bronchitis) are considered as sequelae of the irritation in the lungs which after prolonged periods may lead to an impairment of lung function (i.e.

oxygen availability).

No carcinogenicity studies with phosphorus trichloride were identified. The hydrolysis product hydrochloric acid (rats and mice) gave no indications for an increased tumour incidence after life-time exposure by inhalation. The other product of hydrolysis and subsequent partial neutralisation of phosphorus trichloride, mono sodium phosphite, gave also no indication of a carcinogenic potential after long term oral exposure. At low concentrations the hydrolysis products, phosphoric and hydrochloric acid, will be neutralized immediately in the physiologic medium at the portal of entry. Nevertheless prolonged irritation could give rise to a constant stimulus to local cell proliferation.

The repeated treatment of male animals with phosphorus trichloride via gavage or inhalation did not induce sperm morphology aberrations in rats and mice. There were no significant effects on intra-uterine development in rats. No malformations were detected. Skeletal development in treated fetuses was retarded but without a dose effect relation. The NOAEL was 19.3 mg/kg bw/day.

Due to the rapid hydrolysis it is unlikely that PCl_3 could reach the reproductive organs or the embryo/fetus. At high concentrations major toxic effects (severe irritation and/or corrosion) on the parents are expected that could influence reproductive success. Specific toxicity to reproduction or developmental toxicity in mammals are not likely to occur following exposure to phosphorus trichloride by any route.

As, due to the corrosive nature of the substance, exposure is limited to the technically feasible extent in industrial settings, no consumer exposure is anticipated and it is unlikely that PCl_3 could reach the reproductive organs, reproductive toxicity studies in animals are not warranted. No recommendation will result for further testing within the context of the SIDS program.

Environment

Phosphorus trichloride is a moisture/water sensitive fluid with a melting point of -93.6 °C, a boiling point of 76.1 °C, and a density of 1.575 g/cm³ at 20 °C. The vapour pressure of the substance is 129.7 hPa at 20 °C. The log K_{ow}, the water solubility and several other parameters cannot be determined due to hydrolysis. Phosphorus trichloride hydrolyzes completely in water with a $t_{1/2}$ of less than 10 seconds at 20 °C, forming phosphonic acid and hydrochloric acid. In the atmosphere, PCl_3 is oxidised by several photooxidants. Any emission into water, air, or the terrestrial compartment would be affected by humidity and also results in the formation of the hydrolysis products. Hydrochloric acid dissociates readily in water causing a pH shift which determines the impact of phosphoryl trichloride on aquatic life. The tolerance of water organisms towards pH is diverse. Recommended pH values for test species listed in OECD guidelines are between 6 and 9. Phosphonic acid (pK_a = 2.0)/ phosphoric acid (pK_a = 2.1) is of medium acidity and partly dissociates in water causing a pH shift. Phosphoric acid and phosphates may affect aquatic life due to eutrophication.

Several aquatic toxicity tests have been undertaken in non-buffered solution. The observed toxicity effects in these studies can be attributed to the acidity of the degradation products and are not used for the hazard assessment. Acute toxicity of phosphorus trichloride (buffered) to fish (*Danio rerio*) tested according to the German guideline proposal "Lethal effects on Brachydanio rerio", was ≥ 1000 mg/l (96 h-LC_0, nominal concentration), which equals a LC_0 of ≥ 597 mg/l of (buffered) phosphonic acid. With *Daphnia magna* an EC_{50} (48 h) of > 100 mg/l in buffered solution was determined (92/69/EEC, method C.2). Algal toxicity was determined in a growth inhibition test with *Desmodesmus subspicatus*(92/69/EEC, method C.3). In buffered solution no effect was observed at 100 mg/l (nominal). There are no results available on chronic toxicity. With activated sludge a 3 h-EC_{50} of 9450 mg/l (nominal) and an EC_0 of 3520 mg/l (nominal) were measured according to the ISO 8192 (pH not reported).

There are test results available for acute testing from three trophic levels (all in buffered media). Using the lowest acute test result, a 48 h-EC_{50} of ≥ 100 mg/l (*Daphnia magna*, nominal concentration of buffered solution), and an assessment factor of 1000, a $PNEC_{aqua}$ ≥ 0.1 mg/l was obtained.

Exposure

In 2002, the global production capacity of phosphorus trichloride is estimated to be 0.8 million tonnes by about 20 producers. The global distribution of this capacity was approximately 0.5 million tonnes/year in OECD countries and 0.3 million tonnes /year in non-member countries.

Phosphorus trichloride is used as an intermediate for the manufacturing of wide range of chemicals (percentages

reported for the USA 2001):

- Pesticide intermediate (70 %)
- Phosphorus oxychloride (12 %)
- Surfactants and sequestrants, including phosphorus acid, used primarily for water treatment chemicals (11 %)
- Plastics additives, including flame retardants, plasticizers, phosphite antioxidants, and stabilizers (5 %)
- Miscellaneous, including lube oil and paint additives (2 %)

At one company in the Sponsor country phosphorus trichloride is manufactured and processed in closed systems. The exhausts from manufacturing and processing (including filling) of phosphorus trichloride are connected to air washing units. Thus, at this company, during production and processing virtually no phosphorus trichloride is emitted into the atmosphere. ue to water-free production, processing, and rapid hydrolysis phosphorus trichloride is not detectable in the wastewater.

In this company, the exposure of workers is well below the maximum admissible concentration of phosphorus trichloride in the workplace air (MAK) of 2.8 mg/m^3 (0.5 ppm). The exposure of workers to the hydrolysis product hydrochloric acid is also well below the MAK value of 8 mg/m^3 (5 ppm) for hydrogen chloride. Immunoglobulines against phosphorus trichloride have been detected.

No direct use of phosphorus trichloride is known. There is no exposure of consumers. Phosphorus trichloride is not listed in the Finnish, Norwegian and Swiss product registers. In the Swedish product register it is listed as an industrial chemical intermediate. Product register entry is confidential for Denmark. Phosphorus trichloride can be converted by chemical synthesis to nerve gases. Therefore the production and export of phosphorus trichloride is stringently controlled under the International Chemical Weapons Convention.

RECOMMENDATION AND RATIONALE FOR THE RECOMMENDATION AND NATURE OF FURTHER WORK RECOMMENDED

Human Health: The chemical possesses properties indicating a hazard for human health (acute toxicity, corrosiveness). Based on data presented by the Sponsor country (relating to production by one producer which accounts for 1-6% of global production and relating to the use pattern in several OECD countries), exposure is limited to the technically feasible extent in occupational settings in the sponsor country. There is no exposure of consumers. No recommendation for further testing within the context of the SIDS program is therefore warranted. Although there are no valid data regarding reproductive effects, due to the fast hydrolysis it is unlikely that PCl_3 could reach organs and tissues distant from the site of first contact, therefore, and due to the corrosive properties studies in animals are not warranted. The chemical is currently of low priority for further work.

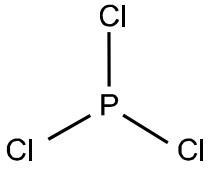
Environment: The chemical is currently of low priority for further work due to its low hazard profile. One of the degradation products, hydrochloric acid, has already been assessed within the OECD SIDS-Program.

SIDS Initial Assessment Report

1 IDENTITY

1.1 Identification of the Substance

CAS Number: 7719-12-2
IUPAC Name: Phosphorus trichloride
Molecular Formula: PCl_3
Structural Formula:



Molecular Weight: 137.33
Synonyms: Chloride of phosphorus
Phosphorus chloride
Phosphorus trichloride
Phosphorus(III)chloride
Trichlorophosphine

1.2 Purity/Impurities/Additives

Technical phosphorus trichloride has a purity of > 99.7 % w/w (Buechel, Moretto and Woditsch, 2000; Bayer AG, 2002). The following impurities have been reported:

- Phosphorus oxychloride ≤ 0.3 % w/w (Bayer AG, 2002)
- Distillation residue ≤ 0.1 % w/w (Bayer AG, 2002)
- Iron ≤ 0.0001 % w/w (Bayer AG, 2002)
- Arsenic 0.000002 % w/w (Bayer AG, 2002)

1.3 Physico-Chemical properties

Table 1 Summary of physico-chemical properties

Property	Value	Reference	IUCLID
Substance type	Inorganic compound	Buechel, Moretto and Woditsch (2000)	1.1.1
Physical state	Colourless liquid, pungent odour	Bayer AG (2002)	1.1.1
Melting point	–93.6 °C	Riess (2002)	2.1
Boiling point at 1013 hPa	76.1 °C	Riess (2002)	2.2
Density at 20 °C	1.575 g/cm³	Riess (2002)	2.3
Vapour pressure at 20 °C	129.7 hPa	Riess (2002)	2.4
Conversion factors at 25 °C (calculated)	1 ppm = 5.6 mg/m^3 1 mg/m^3 = 0.18 ppm	HSDB (2002)	2.14
Octanol/water partition coefficient (log Kow)	Not applicable*		2.5
Water solubility	Not stable in water due to hydrolysis*		2.6.1
pH value at 25 °C	Approximately 1 (at 5 g/l)*	Bayer Chemicals (2003)	2.14
Vapour density in relation to air	4.75	Sax (1979)	2.14

*Rapid hydrolysis, *cf.* Chapter 2.2.3

2 GENERAL INFORMATION ON EXPOSURE

2.1 Production Volumes and Use Pattern

Phosphorus trichloride is manufactured by the strongly exothermic reaction of white phosphorus with chlorine

$P_4 + 6\ Cl_2 \rightarrow 4\ PCl_3$

Phosphorus trichloride is manufactured in several ways:

- Chlorine is led into a suspension of phosphorus in phosphorus trichloride. Due to the heat released during the reaction, phosphorus trichloride evaporates. Phosphorus trichloride is condensed in reflux condensers and is partly returned into the phosphorus suspension.
- Phosphorus is burnt with stoichiometric amounts of chlorine.

Raw phosphorus trichloride is purified by fractional distillation (Buechel, Moretto and Woditsch, 2000).

In 1995 the phosphorus trichloride manufacturing capacities were about 0.2 million tonnes in the USA, 0.2 million tonnes in Western Europe, and 0.02 million tonnes in Japan. The phosphorus

trichloride consumption of the USA increased from 73 000 tonnes in 1983 to about 142 500 tonnes in 1994 (Buechel, Moretto and Woditsch, 2000). The US production capacity was reported to be about 315 000 tonnes and the US consumption to be about 277 000 tonnes in 2001 (TIG, 2004).

The global production capacity was estimated to be 0.8 million tonnes for about 20 producers in 2002. Approximately 0.5 million tonnes/year of the manufacturing capacity are in OECD countries and 0.3 million tonnes/year in non-member countries. In Western Europe there are 5 producers of phosphorus trichloride. Three of them have production plants in Germany. In 2003, Bayer manufactured 10 000 - 50 000 tonnes of phosphorus trichloride in the Bayer Leverkusen industrial park (Bayer Chemicals, 2004a).

Phosphorus trichloride is a basic chemical which is used industrially as an intermediate. Because of its reactivity phosphorus trichloride participates in a large number of chemical reactions (Greenwood and Earnshaw, 1988), e.g.

- Addition of sulfur
- Reaction with carbonic acids or acetic acid anhydrid
- Oxidation with oxygen or chlorine, to yield $POCl_3$ or PCl_5
- Substitutions with e.g. ammonia, amines, alcohols, thiols, esters
- Hydrolysis with water to produce phosphorus acid (H_3PO_3)
- Halogen ligand exchange with ZnF_2, PBr_3, HI
- Friedel-Crafts-alkylations
- Grignard-reactions
- Formation of adducts e.g. with BBr_3 or $Ni(CO)_4$.

Due to these properties phosphorus trichloride is used as an intermediate for the manufacturing of wide range of chemicals (percentages reported for the USA 2001; TIG, 2004):

- Pesticide intermediate (70 %)
- Phosphorus oxychloride (12 %)
- Surfactants and sequestrants, including phosphorus acid, used primarily for water treatment chemicals (11 %)
- Plastics additives, including flame retardants, plasticizers, phosphite antioxidants, and stabilizers (5 %)
- Miscellaneous, including lube oil and paint additives (2 %)

No direct use is known (Bayer Chemicals, 2004a). Phosphorus trichloride is not listed in the Finnish, Norwegian (SPIN, 2004) and Swiss product registers (Swiss Product Register, 2003). In the Swedish product register, 5 products are mentioned to be used as industrial products for the manufacture of chemicals and chemical products in closed systems (SPIN, 2004). According to SPIN (2004) entries in the Danish Product Register are confidential.

Phosphorus trichloride can be converted by multistage chemical synthesis to nerve gases. Therefore the production and export of phosphorus trichloride is stringently controlled under the International Chemical Weapons Convention (1993). The Chemical Weapons Convention lists phosphorus trichloride as precursor to chemical weapons.

2.2 Environmental Exposure and Fate

2.2.1 Sources of Environmental Exposure

Information on exposure from manufacturing and processing of the chemical is available for the Bayer production plant at Leverkusen, Germany.

Phosphorus trichloride is manufactured, processed and filled in closed, waterfree systems (e.g transport via pipeline, sampling without dead volume, gas shuttle pipe for filling processes). There is no direct wastewater in connection with the phosphorus trichloride production process itself. Cleaning of the reactors takes place only in the case of maintenance (Bayer Chemicals, 2004a).

The exhaust from manufacturing and processing of phosphorus trichloride is connected to a central gas washing unit. Water from the air washing unit is led to the industrial biological waster water treatment plant. There is no detectable emission of phosphorus trichloride into the atmosphere. For this reason, phosphorus trichloride is not listed in the official Emission Declaration of Bayer in 2000 (Bayer Chemicals, 2004a).

Waste from the manufacturing and processing of phosphorus trichloride is incinerated in a incinerator for hazardous wastes equipped with an exhaust air cleaning device (Bayer Chemicals, 2004a).

The wastewater from the Bayer production plant is lead to the Leverkusen industrial and municipal wastewater treatment plant. During the wastewater treatment at neutral pH (hydraulic retention time about 3 d) a rapid hydrolysis of phosphorus trichloride (half-life < 10 s, *cf.* Chapter 2.2.3) occurs. The hydrolysis products are neutralized (Bayer Chemicals, 2004a). Additionally, phosphorus acid is slowly oxidised by oxygen (air) to phosphoric acid (Merck, 2001). The pH value of the outlet is monitored continuously and so possible reduction of pH caused by phosphorus trichloride can be detected (Bayer Chemicals, 2004a).

The concentrated sewage sludge of the wastewater treatment plant is incinerated in a hazardous waste incinerator especially constructed for this sludge (Bayer Chemicals, 2004a).

There is no information available on environmental exposure from production and use as synthesis intermediate at other manufacturing and processing sites. Because of the hydrolytic properties a relevant entry of phosphorus trichloride into the environment is unrealistic.

2.2.2 Photodegradation

Estimation of the photodegradation of phosphorus trichloride is not applicable by current assessment models due to the inorganic character of the substance. Due to its reactivity, it is expected that phosphorus trichloride will be oxidised by several agents in air (e.g. ozone, oxygen radicals). In aerosol phosphorus trichloride will be affected by air humidity, which leads to hydrolysis of the substance (*cf.* Chapter 2.2.3).

2.2.3 Stability in Water

In water, phosphorus trichloride hydrolyzes within seconds to phosphonic acid and hydrochloric acid (Melhem and Reid, 1998; Riess 2002). This reaction is the basis of the industrial production of phosphonic acid (Buechel, Moretto and Woditsch, 2000).

$PCl_3 + 3\ H_2O \rightarrow H_3PO_3 + 3\ HCl$

Phosphonic acid and phosphorus acid are tautomeric molecules (Roempp, 1999). Phosphorus acid is slowly oxidised by oxygen (air) to phosphoric acid (Merck, 2001).

Since HCl, which is formed in a ratio of 3:1 with regard to H_3PO_3, is a much stronger acid than H_3PO_3 (pKa –7.0 versus 2.0) all effects on pH shift are mainly caused by HCl.

The reaction of phosphorus trichloride and water was studied by adding small amounts of neat phosphorus trichloride (purity > 99 %) into an excess of well stirred water, and following the generation of acidic reaction products using a pH electrode. With this experimental set up it is not possible to distinguish the apparent reaction rate from, e.g., the mixing delay or the inertia of the measuring system. However, the half-life of phosphorus trichloride in water was estimated to be less than 10 seconds at 23 °C (Bayer Chemicals, 2004b).

This result is in line with several other studies. Mitchell (1925) observed that phosphorus trichloride released most of its acidity (98 %) within about 15 seconds. He suggests that intermediate stages of hydrolysis are $P(OH)_2Cl$ and $P(OH)_3$. $P(OH)_2Cl$ reacts within seconds to $P(OH)_3$. The tautomerisation of $P(OH)_3$ to $HP(O)(OH)_2$ may take minutes to hours (Mitchell, 1925). Motorova and Noseko (1989) measured the rate of hydrolysis in dilute aqueous-organic solvent (dioxan) using calorimetric techniques. The half-life of phosphorus trichloride was found to be 1 - 13 seconds, for PCl_3 concentrations between 0.61 and 1.8 mmol/l dioxan and water concentrations in the range 4 – 350 mmol/l dioxan.

In general, adding small amounts of phosphorus trichloride to water (molar ratio of water to phosphorus trichloride > 3), the hydrolysis products of phosphorus trichloride are phosphonic acid and hydrochloric acid (Melhem and Reid, 1998). If the molar ratio of water to phosphorus trichloride is between 2.5 and 3, a mixture of phosphorus and pyrophosphonic acid is formed. A molar ratio below 2.5 results in a product of indefinite composition, called lower oxides of phosphorus (Kirk-Othmer 1996). When the molar ratio of water to phosphorus trichloride is low, traces of phosphine may be formed in hot water (Geuther, 1872).

Thus, an environmental impact of phosphorus trichloride itself is not likely, but its impact is determined by the pH effect of the hydrolysis products. Phosphonic acid (pK_a = 2.0) / phosphoric acid (pK_a = 2.1) is of medium acidity and partly dissociates in water causing a pH shift. Since hydrochloric acid is a much stronger acid than phosphonic acid/phosphorus acid and their oxidation product phosphoric acid, the environmental effects of the hydrolysis products are due to hydrochloric acid. However, phosphoric acid and phosphates may affect aquatic life due to eutrophication.

For assessment of the environmental impact of the hydrolysis product hydrochloric acid, it is referred to the validated results of the hazard assessments on hydrochloric acid within the OECD SIDS-Program:

Hydrochloric acid (CAS-No. 7647-01-0):

Hydrochloric acid is a strong mineral acid, that dissociates readily in water to chloride ions and hydrated protons, and it is miscible with water. Dilute hydrochloric acid is nearly totally dissociated. This total ionisation also implies that hydrochloric acid will not adsorb on particulate matters or surfaces and will not accumulate in living tissues. For assessment of the environmental impact of hydrochloric acid it is referred to the validated results of the hazard assessments within the OECD SIDS-Program OECD, 2002).

2.2.4 Transport between Environmental Compartments

Since phosphorus trichloride hydrolyzes rapidly in water (*cf.* Chapter 2.2.3), no transfer coefficients can be measured.

2.2.5 Biodegradation

Since phosphorus trichloride hydrolyzes rapidly in water (*cf.* Chapter 2.2.3), no biodegradation can be measured. Hydrochloric acid is an inorganic degradation product which is not further degradable. Phosphonic acid is oxidized to phosphoric acid.

2.2.6 Bioaccumulation

Since phosphorus trichloride hydrolyzes rapidly in water (*cf.* Chapter 2.2.3), no BCF can be measured. Bioaccumulation of hydrochloric acid is not expected (OECD, 2002). Phosphonic acid is oxidized to phosphoric acid. Phosphoric acid is used by organisms as an essential nutrient.

2.2.7 Environmental Monitoring

No monitoring data available.

2.3 Human Exposure

Experience with human exposure is described in Chapter 5.10 of the IUCLID and Chapter 3.1.2 of this SIAR.

2.3.1 Occupational Exposure

Workplaces

During manufacturing and processing of phosphorus trichloride workers may be exposed, with the dermal and inhalational routes being the primary routes of exposure. In accordance with the principles of Responsible Care and Sustainable Development, at Bayer Chemicals the exposure of workers is reduced to the lowest technically practicable level (Bayer Chemicals, 2004a). Exposure information on other producing and/or processing sites in Germany is not available.

At the Bayer manufacturing site, workplaces where phosphorus trichloride is manufactured or processed in closed systems (Bayer Chemicals, 2004a), include

- Manufacturing processes: Conversion of P_4 with Cl_2 to phosphorus trichloride, distillation.
- Processing: on site in chemical synthesis, e.g. production of phosphorus oxichloride and phosphonates.

In the Bayer industrial park in Leverkusen most of the phosphorus trichloride is transported via pipeline. For transports to customers outside this industrial park, mostly railcars and ISO-containers (20 feet-containers) are used. A minor amount (less than 5 %) of phosphorus trichloride is transported in steel barrels (Bayer Chemicals, 2004a).

Precautionary measures at the workplace

Surveys of the Bayer workplaces have been performed according to German Technical Guidance TRGS 402 (1997). This includes regular checks in the working area for any possible exposure to phosphorus trichloride and appropriate control measures (Bayer Chemicals, 2004a).

To protect workers several precautionary and protective measures are taken. These measures include technical equipment like suction devices at filling and sampling stations as well as appropriate personal protection equipment as prescribed in detail for different work situations e.g. during sampling, maintenance, and repair work. During sampling, for instance, gas filter masks, goggles, and rubber gloves have to be worn. Depending on the work to be done during maintenance, gas filter masks (classification ABEK) or a respirator with independent air supply have to be used as well as protective clothing (Bayer Chemicals, 2004a).

Down stream users of phosphorus trichloride are informed by way of a material safety data sheet on the recommended safety measures (see above, Bayer Chemicals, 2004a).

Potential exposure at the workplace

The maximum admissible concentration of phosphorus trichloride in the workplace air (MAK) is 2.8 mg/m^3 (0.5 ppm) in Germany. Workplace air measurements of phosphorus trichloride were performed in the Bayer Chemicals manufacturing and processing units. In the manufacturing unit, 13 total shift measurements were done in the relevant areas between 1987 and 1993. 6 values of these (0.009 - 0.7 mg/m^3) were above the detection limit (0.004 - 0.09 mg/m^3 depending on sampling conditions). Phosphorus trichloride was not detected in the other 7 samples. Phosphorus trichloride was also measured in 2 phosphorus trichloride processing units. 8 total shift values were measured between 1986 and 1996. 2 of these values (0.08 and 0.36 mg/m^3) were above the limit of detection, the other 6 samples were below the limit of detection (0.04 - 0.6 mg/m^3 depending on sampling conditions). All results were below one third of the MAK value (Bayer Chemicals, 2004a).

Since there was no relevant exposure to phosphorus trichloride, the monitoring program was modified to include all compounds which release hydrochloric acid upon hydrolysis, e.g. phosphorus oxychloride. The MAK value of hydrochloric acid is 8 mg/m^3 (5 ppm). Between 1999 and 2003, eight hydrochloric acid measurements were performed in the manufacturing unit, and one in a processing unit. All results were below the limit of detection (0.8 mg/m^3) (Bayer Chemicals, 2004a).

In general, the exposure of workers to phosphorus trichloride and to the hydrolysis product hydrochloric acid is negligible.

Biological monitoring

In the framework of the Bayer occupational health surveillance program, the level of an immunoglobin E (IgE) specific for phosphorus trichloride (and phosphorus oxychloride) was determined in the last 5 years (1999 - 2003) in about 900 workers routinely handling these substances. This specific IgE would indicate a possible sensitising effect of phosphorus chloride (and phosphorus oxychloride). With a detection limit of 0.35 kU, in the previous five years no specific IgE against phosphorus trichloride (and phosphorus oxychloride) was seen neither in the occupational surveillance program nor in any case of product contact. Phosphorus trichloride (and phosphorus oxychloride) appears to have no sensitisation potential (Bayer Industry Services, 2004).

2.3.2 Consumer Exposure

Phosphorus trichloride is exclusively used as an intermediate for chemical synthesis (*cf* Chapter 2.1). No direct use is known (Bayer Chemicals, 2004a). Phosphorus trichloride is not listed in the Finnish, Norwegian, (SPIN, 2004), and Swiss product registers (Swiss Product Register, 2003). For the Danish Product Register the entry is confidential (SPIN, 2004). The Swedish product register lists 5 products (industrial intermediates use in closed systems) with a total quantity of 950 t in 2000 (SPIN, 2004; Swedish Product Register, 2003).

In several products of the Sponsor company no phosphorus trichloride could be detected. To cover all chlorine containing compounds in products manufactured from phosphorus chloride, two phosphonates were analysed for chloride with a determination limit of about 1 mg/kg. No chloride could be quantified (Bayer Chemicals, 2004a).

Phosphorus trichloride can be converted by multistage chemical synthesis to nerve gases. Therefore the production and export of phosphorus trichloride is stringently controlled under the International Chemical Weapons Convention (1993). The Chemical Weapons Convention lists phosphorus trichloride as precursor to chemical weapons.

Thus, an exposure of consumers to phosphorus trichloride is unlikely to occur.

3 HUMAN HEALTH HAZARDS

3.1 Effects on Human Health

3.1.1 Toxicokinetics, Metabolism and Distribution

Hydrolysis of phosphorus trichloride is mostly complete within 4-6 seconds in excess water. Products are hydrochloric acid (HCl) and phosphorous acid (H_3PO_3). The rate of pH-change upon dissolution of phosphorus trichloride in water is comparable to the addition of concentrated hydrochloric acid. The change of pH of water was recorded during addition of phosphorus trichloride at room temperature. (Bayer Chemicals, 2004b)

At low concentrations the free acids resulting from the hydrolysis of phosphorus trichloride will be neutralised quickly by body fluids. The resulting chloride ions are natural components of food and ubiquitously found in living tissues, and are therefore not expected to pose a hazard. At high concentrations, which exceed the buffer capacity of body fluids the acids will damage the tissue at the portal of entry dependent upon concentration and duration of exposure. An availability of phosphorus trichloride or free acids in tissues distant from the portal of entry is hence not expected.

Studies in Animals and Humans

No studies in animals or humans were available in the literature

Conclusion

Phosphorus trichloride is quickly hydrolysed at first contact with water. It is, therefore, very unlikely that phosphorus trichloride will reach tissues distant from the portal of entry and become systemically available. The products of hydrolysis, hydrochloric acid and phosphorous acid, are also acting at the portal of entry.

3.1.2 Acute Toxicity

Studies in Animals

Inhalation

Toxicity after inhalation was determined in rats and guinea pigs by Weeks et al. (1964).

In rats the LC_{50} of phosphorus trichloride was 104.3 ppm (592 mg/m³). Twenty female rats per group were exposed by whole body exposure. Animals were observed and deaths were recorded up to 14 days post exposure. Hydrolysis of phosphorus trichloride in the chamber atmosphere was about 40 percent. Animals showed signs of irritation (agitation, restlessness, irregular breathing, eyes closed, chromodakryorhea) during exposure to phosphorus trichloride. All deaths occurred within 10 days. Histopathology revealed necrosis in the epithelium and its supporting structures in the nostrils. Pulmonary damage was negligible. The kidney showed nephrosis of the tubules of the cortico-medullary region (Weeks et al., 1964).

In guinea pigs the LC_{50} of phosphorus trichloride was 50.1 ppm (285 mg/m³) under similar conditions. Animals showed the same signs of irritation during exposure to phosphorus trichloride as described for rats (Weeks et al., 1964).

Monsanto (1983) reported a mean lethal concentration of 118 ppm (measured concentration as inorganic phophorus corresponding to 673 mg/m³, corresponding to a nominal concentration of 453 ppm) after 4 hours “nose only” or “whole body” exposure in rats. Chamber analysis was based on inorganic phosphorus. Higher values were reported, if analysis was based on chloride or gravimetry. The mass median aerodynamic diameter was < 0.65 microns at the high doses and 1.75 microns at the lowest dose. Four groups of 5 male and 5 female Sprague-Dawley rats were exposed for 4 h to phosphorus trichloride by whole body as well as nose only exposure. Afterwards they were observed for 14 days. The LC_{50} (4 h) was above 453 ppm (nominal). Three males and two female animals died. Clinical signs of intoxication were reduction of body weight, wheezing, laboured respiration, localised sores, swollen nose, blocked nostrils, and red crusts around the eyes. (Randall and Robinson, 1990; Monsanto, 1983a). Similar findings were also reported by Hoechst AG (1977) in an inhalation hazard test in rats.

Molodkina gave an LC_{50} of 226 mg/m³ for rats with similar symptoms as described by other authors like reduction of body weight, wheezing, laboured respiration, localised sores, swollen nose, blocked nostrils, agitation, pawing of nose, sedation, coordination disturbances, lateral position, fibrilar twitching, convulsions. Additionally, lacrimation, and corneal opacity were reported (Molodkina, 1974; Roshchin and Molodkina, 1977).

In an early report Butjagin (1904) described the effects of phosphorus trichloride on rabbits and cats.

Two to three rabbits per concentration range were exposed to phosphorus trichloride at concentrations of 4 - 30, 40 - 330, or 370 - 3870 ppm and observed for clinical signs for 6, 6 - 10, or 3 - 4 hours, respectively (whole body exposure). Low concentrations caused sedation and reduced respiratory frequency. The medium concentrations produced agitation, nasal discharge, rhinitis, sedation, reduced respiratory frequency, irregular respiration, corneal corrosion, dyspnea, tremor, lacrimation, and salivation. After the high concentration animals exhibited sneezing, agitation, closed eyes, white secretion from eyes, corneal opacity (starting at 118 min), weight loss and death. At necropsy animals of the medium dose group showed hyperemia of the trachea, slight lung oedema, and partial infiltration of right lung. Rabbits treated with the high concentration had severe lung oedema, emphysema, severe catarrh, and corrosion of the tongue and the cornea.

Although cats proved to be more sensitive the type of effects was identical to the findings in rabbits. The concentration range was 4 - 1080 ppm (23 - 6145 mg/m³) and animals were exposed for 6 hours. Salivation, nasal discharge, reduced, irregular respiratory frequency, dyspnea, cough, breathing through open mouth, lacrimation, and sedation were recorded. At higher doses immediate agitation, sneezing, rhinitis, conjunctivitis, loss of weight, and death occurred. Necropsy revealed discoloration and corrosion, of nasal cavity, injection and foam in the trachea, lung oedema, ecchymosis, corneal opacity, conjunctivitis, oedema of epiglottis, and severe emphysema (Butjagin, 1904).

Dermal

Dermal toxicity of phosphorus trichloride was determined in New Zealand White rabbits. The dose range was 1000 to 2000 mg/kg bw. No mortality was seen at 1000 mg/kg. Due to the low animal number an LD_{50} could not be derived. The LDlow was 1260 mg/kg bw. Animals showed reduced appetite and activity (3 to 15 days in survivors), increasing weakness, collapse, and death. At necropsy the lungs were hyperaemic, the livers discoloured, and the gall bladder enlarged. Kidneys and spleen were darkened and the gastrointestinal tract was slightly inflamed (Monsanto, 1977; Randall and Robinson, 1990).

A second study in rabbits afforded corrosion in animals treated with 250 mg/kg bw and death (LD_{low}) in the one rabbit treated with 500 mg/kg bw (Mobil International 1977).

Oral

The oral LD_{50} was determined as 550 mg/kg in a study using 6 rats per dose group. Signs of intoxication were nausea, disturbance of movement coordination, fatigue, weakness, chromodakryorhea. The respiratory frequency was reduced to 50-80 per minute. Twenty to 40 minutes after application of the LD_{50} cyanosis, weakness, convulsions, and dyspnea were observed. At necropsy the lungs of deceased animals were intensely red discoloured. The livers were dark-grey, the stomachs were distended and haemorrhagic (Molodkina, 1974; Roshchin and Molodkina, 1977).

Monsanto found a LD_{50} of 18 mg/kg bw in Sprague Dawley rats. The dose range was 12.6 to 25.1 mg/kg bw. Doses of 12.6, 15.8, 20.0, or 25.1 mg/kg bw produced 0, 2, 3, 5 deaths, resp., in groups of 5 rats. Symptoms of toxicity were reduced appetite and activity (3 to 10 days in survivors), increasing weakness, collapse, and death. At necropsy the lungs were congested and the liver discoloured. Acute gastrointestinal inflammation with ulceration of the stomach was detected also in some survivors (Monsanto, 1977; Randall and Robinson, 1990).

A third study by Mobil employed male and female rats. Animals were fasted for 24 hours before administration of the test substance. The test material was administered orally, by intubation, as a 10 % solution in corn oil at doses of 100, 200, 300, 400, or 500 mg/kg bw. Animals were observed at 1, 3, 6, 24, 48, and 72 hours, then daily up to 14 days. The oral LD_{50} was calculated as 200 ± 29 mg/kg bw. Signs of toxicity were decreased locomotor activity, piloerection, ptosis, wet underside and death. Normal body activity returned within 9 days in all surviving animals. All surviving animals were killed and autopsied. Necropsy revealed rugation of the pyloric mucosa, enlarged and darkened spleen, irregular thickening of the pyloric mucosa, stomach fused to liver or liver and pancreas, chronic pulmonary disease (Mobil International 1977a).

Studies in Humans

No studies but a number of case reports are available describing the effects after phosphorus trichloride exposure in humans.

Inhalation

Workers employed in the production of phosphorous trichloride were exposed to concentrations of 10 - 20 mg/m^3 under normal condition and 80 - 150 mg/m³ at times when the plant was out of order. In acute poisoning after 2 - 6 hours burning sensation in eyes and throat, photophobia, feeling of chest oppression, dry cough, and irritation of mucous membranes were reported. In subacute poisoning the symptoms occurred after 1 - 8 weeks with signs of irritation and asthmatic bronchitis (Sassi, 1952).

Patients accidentally exposed to phosphorus trichloride after a railroad accident reported of burning eyes (85 %), shortness of breath (59 %), throat irritation (59 %) and lacrimation (59 %). Headache and nausea (48 %), burning skin (44 %), increased sputum production (41 %), generalised or pleuric chest pain (33 %) and rash/itch (33 %)were also observed. Additionally, wheezing (26 %), blurred vision (22 %), vomiting (15 %) and abdominal pain (15 %) occurred. Lactic dehydrogenase was increased in 22 % of patients and recovered within four weeks after exposure. Pulmonary function tests showed some abnormalities in some patients (Wason et al., 1982; Wason et al., 1984).

Phosphorus trichloride caused irritation of eyes and mucous membranes in workers. Symptoms appeared immediately or delayed for up to 1 day. One patient died after several days due to an asthmatic fit caused by the exposure to phosphorus trichloride in concentrations less than 1 mg/l air. Rhinitis and conjunctivitis were accompanied by pain in nose and throat. At higher concentrations dyspnea and death followed (Reinl, 1956).

Conclusion

The acute toxicity of phosphorus trichloride is high. It is characterised by immediate irritation/corrosion at the portal of entry in experimental animals and humans due to the irritant/corrosive properties of the products of hydrolysis. After inhalation (4h in some studies, unspecified in others) the LC_{50} was determined in rats as 226 to > 500 mg/m³. The oral LD_{50} presumably by gavage in corn oil or vegetable oil (data for mode of application and for vehicle sometimes not given) was 18 to 550 mg/kg bw. in rats showing a very steep dose/mortality-curve in individual studies. The dermal LDlow was 500 mg/kg bw. The most relevant route of exposure is inhalation. Therefore, the primary target tissues are the mucous membranes of mouth, eyes and respiratory tract. After oral exposure stomach ulceration is to be expected.

3.1.3 Irritation

Skin Irritation

Studies in Animals

To determine the skin irritation potential of phosphorus trichloride 100 µl of undiluted test substance were applied to the shaved skin of rabbits. The treated area was washed 60 seconds thereafter with water, Lutrol, or paraffin oil. Nevertheless, this exposure caused skin corrosion (Bayer, 1984).

Other authors similarly reported severely irritating or corrosive effects (Molodkina, 1974; Randall and Robinson, 1990; Radionova and Ivanov 1979).

Additionally signs of severe irritation at the site of first contact were reported in almost all studies aimed at systemic toxicity in animals.

Eye Irritation

Studies in Animals

Undiluted phosphorus trichloride was applied to the conjunctival sac of rabbits. The dose was 0.1 ml per eye. Phosphorus trichloride caused corrosion (Randall and Robinson, 1990). In an other study necrosis of the eye causing irreversible loss of vision is reported (Molodkina 1974).

Additionally signs of severe irritation at the site of first contact were reported in most studies aimed at systemic toxicity in animals.

Studies in Humans

Phosphorus trichloride caused irritation of eyes and mucous membranes in workers. Symptoms appeared immediately or delayed for up to 1 day (Reinl, 1956, Weichardt 1957, Sassi, 1952, Wason et al., 1982; Wason et al., 1984).

Respiratory Tract Irritation

Studies in Animals

Symptoms of respiratory tract irritation are reported in almost all studies. The findings are described in the respective chapters(see chapters 3.1.2, 3.1.5)

Studies in Humans

Phosphorus trichloride caused irritation of mucous membranes in workers. Symptoms appeared immediately or delayed for up to 1 day. Rhinitis and conjunctivitis were accompanied by pain in nose and throat. At higher concentrations dyspnea and death followed (Reinl 1956; Weichardt 1957; Zamakovhskaya 1940; Sassi 1952; Wason et al. 1982; Wason et al. 1984).

Conclusion

Phosphorus trichloride is corrosive to the skin and mucous membranes of the eyes and the respiratory tract.

3.1.4 Sensitisation

No data on sensitisation potential for phosphorus trichloride were identified in the available literature. The hydrolysis product hydrochloric acid was tested in a Guinea Pig Maximisation Test (concentration of 1 %) and also in a Mouse Ear Swelling Test (concentrations of up to 5 %). Both tests gave no indication for a sensitising potential (Gad et al., 1986).

Conclusion

Data on sensitisation potential for phosphorus trichloride were not identified. The hydrolysis product hydrochloric acid gave no indication for a sensitising potential in humans and experimental animals. Data on phosphorous acid, the second hydrolysis product, are not available, but no specific effects are expected due to its structure.

3.1.5 Repeated Dose Toxicity

Studies in Animals

No studies employing oral or dermal exposure were identified.

Inhalation

Fifteen male and 15 female Sprague-Dawley rats per group were exposed to phosphorus trichloride for 4 weeks (6h*5 days*4 weeks, whole body). The concentration range was 0 (air control), 0.5, 3.0, and 10.0 ppm (2,85 – 57 mg/m³). While the low concentrations did not produce any effects, the histopathological examination of the nasal cavity revealed squamous metaplasia of respiratory epithelium and focal suppurative inflammation of the anterior nasal region in the group exposed to 10 ppm. No other effects were recorded in clinical, clinical pathologic (haematology; clinical chemistry; urinalysis), and ophtalmoscopical examinations. Organ weights (absolute; relative to brain and body weight) and gross pathology findings were determined at necropsy. The NOAEC was 3 ppm (17 mg/m³) (Monsanto, 1983b).

A study conducted by CIIT employed F344/CrlBr and Sprague-Dawley rats at an age of 6 - 7 weeks. Thirtyone males and 21 females per group were expossed to hydrogen chloride whole body; (6h*5d/w; 0, 10; 20 or 50 ml/m^3) for 90 days. The parameters examined included: Clinical signs (daily), body weight (weekly), food consumption (weekly), urinalysis, hematology, clinical chemistry, necropsy, organ weights, histopathology [nasal turbinates, trachea, lung, brain , heart, kidney, liver, testis, adrenal, duodenum, eyes and optic nerve, mesenteric lymph nodes, aorta, sternum bone, ear canal, bone marrow, colon, epididymis, jejunum, mandibular lymph nodes, oviducts, ovaries, prostate, skin, pituitary glands, spinal cord, sciatic nerve, peripheral nerve, salivary gland, spleen, thyroid glands, urinary bladder, uterus, thymus, fore and glandular stomach, pancreas, parathyroid, skeletal muscle, seminal vesicle, tongue, femur bone, cecum, esophagus, ileum, lacrimal gland, mammary gland, larynx. NOAEC = 20 ppm (disregarding irritation). The treatment resulted in no mortality. Body weight (50 ppm) and food consumption (20 and 50 ppm) were reduced. Clinical pathology showed no effects in hematology, clin. chemistry, and urinalysis. At the histopathology examination rhinitis in the nasal cavity was detected in all treatment groups. The finding was accompanied with occasional hyperceratosis (CIIT 1984).

Studies in Humans

Inhalation

Workers employed in the production of phosphorus trichloride were exposed to concentrations of 10 - 20 mg/m^3 under normal condition and 80-150 mg/m3 in cases of technical failures. After 1 - 8 weeks with signs of irritation and asthmatic bronchitis were reported (Sassi, 1952).

Symptoms reported by exposed workers in Russia were respiratory tract and eye irritation, cough, asthma, loss of voice (Zamakovhskaya, 1940).

Phosphorus trichloride is mentioned as a cause of occupational asthma. Forty eight of 170 (28.2 %) workers exposed to phosphorus chlorides (PCl3, PCl5, POCl3) are reported to have developed asthma (Buess and Lerner, 1956).

Conclusion

After 4-weeks of whole-body inhalation exposure to 0.5, 3, or 10 ppm (2.8, 17.1 or 56.8 mg/m^3) phosphorus trichloride (6h/day, 5d/wk for 4 weeks), irritation of the eyes and the respiratory tract (suppurative inflammation, and inflammation and squamous metaplasia of respiratory epithelium) was observed in rats.. Symptoms not related to the irritant properties of phosphorus trichloride were not detected. The NOAEC in rats was 3 ppm (17 mg/m³). Studies employing other routes were not identified in the literature. Chronic bronchitis may develop in humans. Repeated dose toxicity studies employing other routes were not identified in the literature. Because phosphorus trichloride as well as its hydrolysis products are toxicants acting at the portal-of-entry, and because phosphorus

trichloride is unlikely to reach tissues distant from the portal of entry due to rapid hydrolysis, direct systemic toxicity is not likely to occur following exposure to phosphorus trichloride by any route.

The excess phosphate produced by hydrolysis of phosphorus trichloride may play a role in the development of effects on kidney, bone and calcium levels. Also by other routes (oral, dermal) phosphorous trichloride is expected to produce effects at the site of first contact (irritation, corrosion). The long term effects observed in humans (chronic bronchitis) are considered as sequelae of the irritation in the lungs which after prolonged periods may lead to an impairment of lung function (i.e. oxygen availability).

3.1.6 Mutagenicity

In vitro Studies

Only two studies in bacteria could be identified in the available literature.

In a modified Ames-Test using *S. typhimurium* (TA1535, TA100, TA1537, D3052, TA1538, TA98, C3076, G46) and *E. coli* tester strains (WP2, WP2uvrA-) phosphorus trichloride had no mutagenic effects with and without metabolic activation by rat-S-9 mix (McMahon et al., 1979). *In vitro* studies with mammalian cells are not available.

S. typhimurium (TA1535, TA100, TA1537, TA1538, TA98) and S. cerevisiae (D4) were treated in a second study by Mobil with 0.001 to 5.0 µl of phosphorus trichloride per plate in the presence and absence of a metabolic activation system. No mutagenic effects were observed (Mobil International 1977b).

In vivo Studies

Male mice were injected 5 times intraperitoneally with phosphorus trichloride at doses of 10.94, 21.88, or 43.75 mg/kg and killed on day 6. The bone marrow was prepared for the determination of chromosomal aberrations and micronuclei. For chromosomal aberrations 100 cells were scored and for micro-nuclei 1000 polychromatic erythrocytes were examined. Phosphorus trichloride did not induce chromosomal aberrations or increases of the rate of micronuclei in mouse bone marrow cells (He et al., 1989).

Study in humans

Twenty-four workers exposed to phosphorus trichloride and 10 non-exposed were examined for chromosomal aberrations in peripheral lymphocytes. Phosphorus trichloride did not increase the incidence of chromosome aberrations (He et al., 1989).

Conclusion

Phosphorus trichloride did not show mutagenic activity in a bacterial mutagenicity assay. Neither micronuclei nor chromosomal aberrations were induced in mouse bone marrow and human blood cells in vivo.

As phosphorus trichloride decomposes to acid within seconds in aqueous media the resulting acidity of the hydrolysis products may cause unspecific effects of low pH in in-vitro tests. The change in pH may induce chromosomal aberrations and other DNA damage.

In vivo, reduced pH levels could lead to chromosomal changes and DNA damage at the portal-of-entry of phosphorus trichloride. However, it is unlikely that systemic changes in pH would occur after exposure to phosphorus trichloride, that are sufficient in magnitude to induce this effect in distant tissues or organs. The excess phosphate produced by hydrolysis of phosphorus trichloride

may play a role in the development of effects on kidney, bone and calcium levels. Also by other routes (oral, dermal) phosphorous trichloride is expected to produce effects at the site of first contact (irritation, corrosion). The long term effects observed in humans (chronic bronchitis) are considered as sequelae of the irritation in the lungs which after prolonged periods may lead to an impairment of lung function (i.e. oxygen availability).

3.1.7 Carcinogenicity

No carcinogenicity studies with phosphorus trichloride in experimental animals were identified in the available literature. As phosphorus trichloride hydrolyses quickly to form hydrochloric and phosphorous acids, chronic effects are expected mostly from exposure to these degradation products. Data are available only regarding hydrochloric acid/hydrogen chloride.

Inhalation

Albert et al. (1982) reported data from a chronic whole body inhalation exposure study with HCl in rats, discussed in detail by Sellakumar et al. (1985). One hundred male Sprague-Dawley rats were exposed to 10 ppm hydrogen chloride (HCl) for 6 hours/day, 5 days/week (duration-adjusted concentration = 2.5 mg/m^3) for their lifetimes. All animals were observed daily, weighed monthly, and allowed to die naturally or killed when moribund. Complete necropsy was performed on all animals, with particular attention given to the respiratory tract. Histological sections were prepared from the nasal cavity (one lateral section from each side of the head), lung (one section from each lobe), trachea, larynx, liver, kidneys, testes, and other organs where gross pathological signs were present. However, Sellakumar et al. (1985) did not discuss histopathological events in organs other than the respiratory tract. HCl-exposed animals showed no differences in body weights or survival when compared with air controls. The data indicated 62/99 exposed animals with epithelial or squamous hyperplasia in the nasal mucosa (location not specified) vs. 51/99 in the concurrent control group. Incidence of squamous metaplasia was 9 and 5 in the exposed and control rats, respectively. There was increased hyperplasia of laryngeal-tracheal segments in HCl-exposed rats (larynx 22/99, trachea 26/99) vs. the controls (larynx 2/99, trachea 6/99). The authors did not make any comments concerning the severity of these changes. The tumour incidence in organs other than the respiratora tract was similar in the treated and control groups. The total incidences of tumours at various sites being 19/99, 25/99 and 24/99 in treated, air control and colony control animals, respectively.

Oral

The repeated oral application of hydrochloric acid in mice gave no indication for an increased tumour incidence and also did not promote the activity of a known carcinogen. However, possibly only the gastro-intestinal tract was examined (Dyer, Kelly and Dunn, 1946).

The product of hydrolysis and subsequent partial neutralisation of phosphorus trichloride, mono sodium phosphite, was studied in rats. The US EPA IRIS data base reported a study with dietary treatment of rats with for 27 months, which gave no indication of a carcinogenic potential even at doses of 32000 ppm in the diet (US EPA IRIS, 2003; US EPA, 1986).

Studies in Humans

No data regarding carcinogenicity in humans were identified in the available literature.

Conclusion

No carcinogenicity studies with phosphorus trichloride were identified. The hydrolysis product hydrochloric acid (rats and mice) gave no clear indications for an increased tumour incidence in

the respiratory tract after life-time exposure by inhalation. The other product of hydrolysis and subsequent partial neutralisation of phosphorus trichloride, mono sodium phosphite, gave also no indication of a carcinogenic potential after long-term oral exposure. At low concentrations the hydrolysis products, phosphoric and hydrochloric acid, will be neutralized immediately in the physiologic medium at the portal of entry. Nevertheless prolonged irritation could give rise to a constant stimulus to local cell proliferation.

3.1.8 Toxicity for Reproduction

Studies on Fertility

Studies in Animals

He et al. describe studies on the effects of phosphorus trichloride on sperm morphology in rats and mice. Male mice were treated by gavage with phosphorus trichloride in vegetable oil for 5 days at doses of 45 - 178 mg/kg bw/day and the morphology of sperm cells was evaluated 4 weeks later. Rats were treated for 45 or 60 days at concentrations of 2, 33.5, and 97.76 mg/m³. No abnormalities of sperm cells were seen in rats and mice treated with phosphorus trichloride. (He et al., 1989)

Studies on Developmental toxicity

Studies in Animals

He et al. also treated pregnant rats with oral doses of 6.44, 9.7 and 19.3 mg/kg bw/day phosphorus trichloride on days 6 - 15 of pregnancy. The study also included a positive control group (substance described as: Dikushuang, the chinese name of a pesticide.The dose was 7 mg/kg bw). Body weights and reproductive indices (number of fetuses; corpora lutea, corpora lutea per rat, number of pups/litter, dead fetuses, % dead fetuses, resorptions, % resorptions, litters with resorptions, % litters with resorptions) were determined. Regarding the offspring the number of pups, size, tail length, weight of placenta and the size of the frontal fontanella were determined.

There were no significant differences between treated and negative control animals. No malformations were detected. Skeletal development in treated fetuses was retarded but without a dose effect relation. The NOAEL was 19.3 mg/kg bw.(He et al., 1989).

There were no studies identified for the hydrolysis products hydrochloric acid and phosphorous acid.

Conclusion

The repeated treatment of male animals with phosphorus trichloride via gavage or by inhalation did not induce sperm morphology aberrations inrats and mice.

There were no significant effects on intra-uterine development in rats. No malformations were detected. Skeletal development in treated fetuses was retarded but without a dose effect relation. The NOAEL was 19.3 mg/kg bw.

Due to the rapid hydrolysis it is unlikely that PCl_3 could reach the reproductive organs or the embryo/fetus. At high concentrations major toxic effects (severe irritation and/or corrosion) on the parents are expected that could influence reproductive success. Specific toxicity to reproduction or developmental toxicity in mammals are not likely to occur following exposure to phosphorus trichloride by any route.

As, due to the corrosive nature of the substance, exposure is limited to the technically feasible extent in industrial settings, no consumer exposure is anticipated and it is unlikely that PCl_3 could reach the reproductive organs, reproductive toxicity studies in animals are not warranted.

3.2 Initial Assessment for Human Health

Phosphorus trichloride is quickly hydrolysed at first contact with water. It is, therefore, very unlikely that phosphorus trichloride will reach tissues distant from the portal of entry and become systemically available. The products of hydrolysis, hydrochloric acid and phosphorous acid, are also acting at the portal of entry.

The acute toxicity of phosphorus trichloride is high. It is characterised by immediate irritation/corrosion at the portal of entry in experimental animals and humans due to the irritant/corrosive properties of the products of hydrolysis. After 4h-inhalation the LC_{50} was determined in rats as 226 to > 500 mg/m³. The oral LD_{50} presumably by gavage in corn oil or vegetable oil (data for mode of application and for vehicle sometimes not given) was 18 to 550 mg/kg bw. in rats showing a very steep dose/mortality-curve in individual studies. The dermal LDlow was 1260 mg/kg bw. The most relevant route of exposure is inhalation. Therefore, the primary target tissues are the mucous membranes of mouth, eyes and respiratory tract. After oral exposure stomach ulceration is to be expected.

Phosphorus trichloride is corrosive to the skin and mucous membranes of the eyes and the respiratory tract.

Data on sensitisation potential for phosphorus trichloride were not identified. The hydrolysis product hydrochloric acid gave no indication for a sensitising potential in humans and experimental animals. Data on phosphorous acid, the second hydrolysis product, are not available, but no specific effects are expected due to its structure

After 4-weeks of whole-body inhalation exposure to 0.5, 3, or 10 ppm (2.8, 17.1 or 56.8 mg/m^3) phosphorus trichloride (6h/day, 5d/wk for 4 weeks), irritation of the eyes and the respiratory tract (suppurative inflammation, and inflammation and squamous metaplasia of respiratory epithelium) was observed in rats.. Symptoms not related to the irritant properties of phosphorus trichloride were not detected. The NOAEC in rats was 3 ppm (17 mg/m³). Chronic bronchitis can develop in humans.

Repeated dose toxicity studies employing other routes were not identified in the literature. Because phosphorus trichloride as well as its hydrolysis products are toxicants acting at the portal of entry, and because phosphorus trichloride is unlikely to reach tissues distant from the portal of entry due to hydrolysis, direct systemic toxicity is not likely to occur following exposure to phosphorus trichloride by any route.

The excess phosphate produced by hydrolysis of phosphorus trichloride may play a role in the development of effects on kidney, bone and calcium levels. Also by other routes (oral, dermal) phosphorous trichloride is expected to produce effects at the site of first contact (irritation, corrosion). The long term effects observed in humans (chronic bronchitis) are considered as sequelae of the irritation in the lungs which after prolonged periods may lead to an impairment of lung function (i.e. oxygen availability).

Phosphorus trichloride did not show mutagenic activity in a bacterial mutagenicity assay. Neither micronuclei nor chromosomal aberrations were induced in mouse bone marrow and human blood cells in vivo.

As phosphorus trichloride decomposes to acid within seconds in aqueous media the resulting acidity of the hydrolysis products may cause unspecific effects of low pH in in-vitro tests. The change in pH may induce chromosomal aberrations and other DNA damage.

In vivo, reduced pH-levels could lead to chromosomal changes and DNA damage at the portal-of-entry of phosphorus trichloride. However, it is unlikely that systemic changes in pH would occur

after exposure to phosphorus trichloride, that are sufficient in magnitude to induce this effect in distant tissues or organs.

No carcinogenicity studies with phosphorus trichloride were identified. The hydrolysis product hydrochloric acid (rats and mice) gave no clear indications for an increased tumour incidence after life-time exposure by inhalation. The other product of hydrolysis and subsequent partial neutralisation of phosphorus trichloride, mono sodium phosphite, gave also no indication of a carcinogenic potential after long term oral exposure.

At low concentrations the hydrolysis products, phosphoric and hydrochloric acid, will be neutralized immediately in the physiologic medium at the portal of entry. Nevertheless prolonged irritation could give rise to a constant stimulus to local cell proliferation.

The repeated treatment of male animals with phosphorus trichloride via gavage or by inhalation did not induce sperm morphology aberrations in rats and mice.

There were no significant effects on intra-uterine development in rats. No malformations were detected. Skeletal development in treated fetuses was retarded but without a dose effect relation. The NOAEL was 19.3 mg/kg bw

Phosphorus trichloride is a toxicant acting at the portal-of-entry. It is quickly hydrolysed in aqueous media (half-life < 10 seconds) and the resulting free acids will be neutralised immediately at low concentrations. At high concentrations the acids will damage the tissue at the site of first contact. Therefore it is unlikely that phosphorus trichloride could reach the reproductive organs or the embryo/fetus. At high concentrations major toxic effects (severe irritation and/or corrosion) on the parents are expected that could influence reproductive success. Specific toxicity to reproduction or developmental toxicity in mammals are not likely to occur following exposure to phosphorus trichloride by any route.

As, due to the corrosive nature of the substance, exposure is limited to the technically feasible extent in industrial settings, no consumer exposure is anticipated and it is unlikely that PCl_3 could reach the reproductive organs, reproductive toxicity studies in animals are not warranted.

4 HAZARDS TO THE ENVIRONMENT

4.1 Aquatic Effects

In water, phosphorus trichloride hydrolyzes to phosphonic acid and hydrogen chloride. The experimentally determined half-life is < 10 seconds (*cf.* Chapter 2.2.3). Right from the start of the test, ecotoxicological measurements as described in chapter 4.1 will cover the effects of the degradation products phosphonic acid and hydrogen chloride.

The hydrolysis product hydrochloric acid is tested with aquatic species (OECD, 2002). Hydrochloric acid causes a pH shift in water (Table 2). It is the resulting pH that determines the impact of hydrogen chloride on aquatic life as shown with buffered test substance solution. Thus toxic effects are not due to substance inherent properties but caused by the low pH (OECD, 2002).

Some experiments with phosphorus trichloride were performed in the presence of buffer to avoid the pH effects of the acids formed by hydrolysis of phosphorus trichloride. Comparison of experiments in the presence and absence of buffer (with and without neutralisation) confirmed the conclusions drawn from the OECD-SIDS Hydrochloric Acid (2002; see below). Regarding natural systems, the impact of dissociated acids depends on the buffer capacity of the system. Buffer

function is attributed to humic substances, alkaline earth carbonates, clay minerals, silicates, as well as amphoteric oxides.

Table 2 Theoretical pH-values of hydrochloric acid in non-buffered water

Hydrochloric acid concentration (mg/l)	Corresponding phosphorus trichloride concentration (mg/l)	pH
0.036	0.046	6
0.36	0.46	5
3.6	4.7	4
36	46	3

The tolerance of water organisms towards pH is diverse. pH-values recommended in OECD guidelines for testing issues are compiled in Table 3.

Table 3 pH values recommended in OECD guidelines for testing issues

Group (Trophic level)	Recommendation
Fish	pH 6.0 to pH 8.5 is preferable
Daphnia	within the range of pH 6 to pH 9
Algae	approximately pH 8

Acute Toxicity Test Results

Short term tests on aquatic toxicity are available for each trophic level (Table 4).

Acute toxicity to fish (*Danio rerio*) was tested in a static test system according to the method proposal of the German Environmental Protection Agency "Lethal effects on Brachydanio rerio". Phosphorus trichloride was not monitored because it hydrolyzes. A limit test was conducted with an adjusted pH (pH ca. 7.5) value at 1000 mg/l (nominal concentration). During 96 h no effects were observed at the tested concentration level, and a LC_0 of ≥ 1000 mg/l was determined for phosphorus trichloride, which equals a LC_0 of ≥ 597 mg/l of (neutralized) phosphonic acid as the hydrolysis product (Bayer AG, 1991).

In contrast, acute toxicity was found in a study without adjustment of pH. This test was not conducted according to any guideline (Gurova, Krasnov and Mazmanidi, 1970). In the test media (dechlorinated tap water and Wolga water) pH values are assumed to vary from 3.3 to 7 (information not given for the acute study but for the long-term study of the same authors performed with the same concentration range as described below.) (*cf.* Table 3). The 3 d-NOEC (= LC_0) was found to be about 60 mg/l (LC_{100}: 75 mg/l) for sturgeon eggs (*Acipenser stellatus*). The hatching success of the fish larvae was reduced by about 10 % at 60 and 70 mg/l. Growth of hatchlings was not tested at 70 mg/l, as all hatchlings showed abnormalities at this concentration. With regard to length of the hatchlings after 5 days, a NOEC of 20 mg/l was observed. A small reduction (5 %) of fish larvae weight was observed at the lowest concentration tested (20 mg/l). In an insufficiently described experiment, dace (*Leuciscus leuciscus*) were more sensitive to phosphorus trichloride and its degradation products, respectively, and a 10 d-LC_{100} of 25 mg/l was observed However, from this study, no EC_{50} can be derived (Gurova, Krasnov and Mazmanidi, 1970).A test on prolonged toxicity of phosphorus trichloride to 3 fish species was performed by

Gurova, Krasnov, and Mazmanidi (1970) with the same conditions as above. In 30 d tests with the 3 fish species *Carassius carassius, Perca fluviatilis*, and *Esox lucius*, NOEC values of 40-50 mg/l were found (Gurova, Krasnov and Mazmanidi, 1970) in non-buffered media.

With the invertebrate *Daphnia magna* one acute test according to the European guideline 92/69/EEC, method C.2, is available. In non-buffered test solution the pH decreased from pH 7.9 in the controls to about pH 6.7 at 12.5 mg/l, pH 6.1 at 25 mg/l, pH 3.6 at 50 mg/l, and pH 2.9 at 100 mg/l. For a test period of 24 h an EC_0 (immobilisation) of 25 mg/l, an EC_{50} of 35.4 mg/l, and an EC_{100} of 50 mg/l were obtained. The same effect concentrations were reported after a test period of 48 hours. In buffered test solution no effect was observed at the highest tested concentration of 100 mg/l of phosphorus trichloride, suggesting that the effects in the non-buffered solutions were solely due to the pH decrease (Bayer AG, 2003a).

Algal toxicity was determined by a test with *Desmodesmus subspicatus* in the presence of phosphorus trichloride and its hydrolysis products. In a growth inhibition test according the European guideline 92/69/EEC, method C.3, equivalent to OECD TG 201, in non-buffered solution, the pH depended on the nominal phosphorus trichloride concentration and was pH 8.2 in the controls and pH 2.9 at 100 mg/l (nominal concentration at the start of the incubation period). In non-buffered solution, a 72 h-E_rC_{50} of 33 mg/l was determined for growth rate (population density) and a 72 h-E_bC_{50} of 30 mg/l for growth (integral of biomass). The 72h-NOEC was 12.5 mg/l for both growth rate and biomass. In buffered solution no effect was observed at the highest phosphorus trichloride concentration tested (nominal 100 mg/l). Therefore, it can be concluded that the effects found in this study are caused by pH effects (Bayer AG, 2003b).

Chronic Toxicity Test Results

There are no results available on chronic toxicity.

Toxicity to Microorganisms

A test with activated sludge with a duration of 3 h was conducted according to the ISO 8192 (Test for the Inhibition of Oxygen Consumption by Activated Sludge). The inoculum contained 6 g of dry matter per litre (the pH was not reported). An EC_{50} of 9450 mg/l and an EC_0 of 3520 mg/l were determined (Bayer AG, 1991).

Table 4 Aquatic toxicity of phosphorus trichloride and its hydrolysis products

Species	Endpoint	Eposure regime	Duration	Effect concentration	Reference	IUCLID
Fish						
Danio rerio	Mortality	Static	96 h-LC_{50}	>= 1000 mg/l (n)*	Bayer AG, 1991	4.1
Acipenser stellatus, eggs	Mortality (hatching success)	Semistatic	3 d-NOEC (= LC_0) 3 d-LC_{10} 3 d-LC_{100}	60 mg/l (n) >60-70 mg/l (n) 75 mg/l (n)	Gurova, Krasnov and Mazmanidi 1970	4.1
Acipenser stellatus, hatchlings	Growth (weight, length)	Semistatic	EC_{10} NOEC	60 mg/l (n) 20 mg/l (n)	Gurova, Krasnov and Mazmanidi 1970	4.1
Leuciscus leuciscus	Mortality	Semistatic	10 d-LC_{100}	25 mg/l (n)	Gurova, Krasnov, and Mazmanidi 1970	4.1
Carassius carassius, Perca fluviatilis, and *Esox lucius*	Mortailty and Growth (weight)	Semistatic	30 d-NOEC	40-50 mg/l (n)	Gurova, Krasnov, and Mazmanidi 1970	4.5.1
Invertebrates						
Daphnia magna	Immobility	Static	48 h-EC_0 48 hEC_{50} 48 h-EC_{100} 48 h-EC_{50}	25 mg/l (n)35.4 mg/l (n) 50 mg/l (n) >= 100 mg/l (n)*	Bayer AG 2003a	4.2
Algae						
Desmodesmus subspicatus	Growth	Static	72 h-E_rC_{50} 72 h-E_bC_{50} 72 h-EC_{50} 72 h-NOEC (for both population growth and biomass) 72 h-NOEC	33 mg/l (n) 30 mg/l (n) >= 100 mg/l (n)* 12.5 mg/l (n) >= 100 mg/l (n)*	Bayer AG 2003b	4.3
Activated Sludge	Respiration inhibition	Static	3 h-EC_{50}	9450 mg/l (n)	Bayer AG 1991	4.4

(n) = nominal concentration; *buffered test medium

Determination of $PNEC_{aqua}$

For phosphorus trichloride and its hydrolysis products, the lowest acute effect concentration was found for the dace (*Leuciscus leuciscus)* with a 10 d-EC_{100} = 25 mg/l in a non-guideline study (Gurova, Krasnov and Mazmanidi, 1970). In this study, non-buffered media were used and the pH was presumably 3.3. As has been shown by several other studies (OECD,2002), this effect was due to the pH which was outside the pH range tolerated by fish (*cf.* Table 2 and 3). Other tests in non-buffered media showed similarly that effects depended on the pH (Bayer AG 1991, Bayer AG 2003a, b). However, there are acute test results available from test with buffered test media at three

trophic levels. In this series of experiments, the lowest acute effect concentration is a 48 h-EC_{50} of ≥ 100 mg/l (n) of *Daphnia magna*. Applying an assessment factor of 1000 according to the EU Technical Guidance Document results in a

$PNEC_{aqua}$ > 0.1 mg/l.

Due to the fast hydrolysis this $PNEC_{aqua}$ covers also the hydrolysis products hydrochloric acid and phosphonic acid.

4.2 Terrestrial Effects

No data available.

4.3 Other Environmental Effects

No data available.

4.4 Initial Assessment for the Environment

Phosphorus trichloride is a moisture/water sensitive fluid with a melting point of -93.6 °C, a boiling point of 76.1 °C, and a density of 1.575 g/cm³ at 20 °C. The vapour pressure of the substance is 129.7 hPa at 20 °C. The log K_{ow}, the water solubility and several other parameters cannot be determined due to hydrolysis. Phosphorus trichloride hydrolyzes completely in water with a $t_{1/2}$ of less than 10 seconds at 20 °C, forming phosphonic acid and hydrochloric acid. In the atmosphere, PCl_3 is oxidised by several photooxidants. Any emission into water, air, or the terrestrial compartment would be affected by humidity and also results in the formation of the hydrolysis products. Hydrochloric acid dissociates readily in water causing a pH shift which determines the impact of phosphoryl trichloride on aquatic life.. The tolerance of water organisms towards pH is diverse. Recommended pH values for test species listed in OECD guidelines are between 6 and 9. Phosphonic acid (pK_a = 2.0)/ phosphoric acid (pK_a = 2.1) is of medium acidity and partly dissociates in water causing a pH shift. Phosphoric acid and phosphates may affect aquatic life due to eutrophication.

Several aquatic toxicity tests have been undertaken in non-buffered solution. The observed toxicity effects in these studies can be attributed to the acidity of the degradation products and are not used for the hazard assessment. Acute toxicity of phosphorus trichloride (buffered) to fish (*Danio rerio*) tested according to the German guideline proposal “Lethal effects on Brachydanio rerio”, was ≥ 1000 mg/l (96 h-LC_0, nominal concentration), which equals an LC_0 of ≥ 597 mg/l of (buffered) phosphonic acid. With *Daphnia magna* an EC_{50} (48 h) of > 100 mg/l in buffered solution was determined (92/69/EEC, method C.2). Algal toxicity was determined in a growth inhibition test with *Desmodesmus subspicatus* (92/69/EEC, method C.3). In buffered solution no effect was observed at 100 mg/l (nominal). There are no results available on chronic toxicity. With activated sludge a 3 h-EC_{50} of 9450 mg/l (nominal) and an EC_0 of 3520 mg/l (nominal) were measured according to the ISO 8192 (pH not reported).

There are test results available for acute testing from three trophic levels (all in buffered media). Using the lowest acute test result, a 48 h-EC_{50} of ≥ 100 mg/l (*Daphnia magna*, nominal concentration of buffered solution), and an assessment factor of 1000, a $PNEC_{aqua}$ > 0.1 mg/l was obtained.

5 RECOMMENDATIONS

The chemical is currently of low priority for further work.

Human Health:

The chemical possesses properties indicating a hazard for human health (acute toxicity, corrosiveness). Based on data presented by the Sponsor country (relating to production by one producer which accounts for 1-6% of global production and relating to the use pattern in several OECD countries), exposure is limited to the technically feasible extent in occupational settings in the sponsor country. There is no exposure of consumers. No recommendation for further testing within the context of the SIDS program is therefore warranted. Although there are no valid data regarding reproductive effects, due to the fast hydrolysis it is unlikely that PCl3 could reach organs and tissues distant from the site of first contact, therefore, and due to the corrosive properties further studies in animals are not warranted. The chemical is currently of low priority for further work.

Environment:

The chemical is currently of low priority for further work due to its low hazard profile. One of the degradation products, hydrochloric acid, has already been assessed within the OECD SIDS-Program.

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I U C L I D

Data Set

Existing Chemical	:	ID: 7719-12-2
CAS No.	:	7719-12-2
EINECS Name	:	phosphorus trichloride
EC No.	:	231-749-3
TSCA Name	:	Phosphorous trichloride
Molecular Formula	:	Cl3P

Producer related part

Company	:	Bayer AG
Creation date	:	22.09.1992

Substance related part

Company	:	Bayer AG
Creation date	:	22.09.1992
Status	:	
Memo	:	X AKTUELL EG / ICCA
Printing date	:	15.02.2006
Revision date	:	02.06.1994
Date of last update	:	13.02.2006
Number of pages	:	79
Chapter (profile)	:	Chapter: 1, 2, 3, 4, 5, 6, 7, 8, 10
Reliability (profile)	:	Reliability: without reliability, 1, 2, 3, 4
Flags (profile)	:	Flags: without flag, non confidential, WGK (DE), TA-Luft (DE), Material Safety Dataset, Risk Assessment, Directive 67/548/EEC, SIDS

1.0.1 APPLICANT AND COMPANY INFORMATION

1.0.2 LOCATION OF PRODUCTION SITE, IMPORTER OR FORMULATOR

1.0.3 IDENTITY OF RECIPIENTS

1.0.4 DETAILS ON CATEGORY/TEMPLATE

1.1.0 SUBSTANCE IDENTIFICATION

IUPAC Name : Phosphorus trichloride
Smiles Code : ClP(Cl)Cl
Molecular formula : Cl3P
Molecular weight : 137.33
Petrol class :

Flag : Critical study for SIDS endpoint
17.10.2003 (1)

1.1.1 GENERAL SUBSTANCE INFORMATION

Purity type : typical for marketed substance
Substance type : inorganic
Physical status : liquid
Purity : > 99.7 % w/w
Colour :
Odour :

Flag : Critical study for SIDS endpoint
09.02.2004 (2)

Purity type : typical for marketed substance
Substance type : inorganic
Physical status : liquid
Purity : = 99.7 % w/w
Colour : colourless
Odour : pungent

Method : Purity: Method CH-P ELS 31.91 GC-WLD
Flag : Critical study for SIDS endpoint
27.01.2004 (3)

Purity type : typical for marketed substance
Substance type : inorganic
Physical status : liquid
Purity : ca. 99 % w/w
Colour : colourless
Odour : pungent

09.02.2004 (4) (5)

1.1.2 SPECTRA

1.2 SYNONYMS AND TRADENAMES

Chloride of phosphorus

17.10.2003 (6) (7)

Phosphorus chloride

24.09.2003 (6) (7)

Phosphorus trichloride

31.07.2003 (6) (1) (7)

Phosphorus(III)chloride

31.07.2003 (7)

Trichlorophosphine

24.09.2003 (6)

1.3 IMPURITIES

Purity : typical for marketed substance
CAS-No : 10025-87-3
EC-No : 233-046-7
EINECS-Name : phosphoryl trichloride
Molecular formula : POCl3
Value : < 1 % w/w

Flag : Critical study for SIDS endpoint
09.02.2004 (5)

Purity : typical for marketed substance
CAS-No : 10025-87-3
EC-No : 233-046-7
EINECS-Name : phosphoryl trichloride
Molecular formula : POCl3
Value : <= .3 % w/w

Flag : Critical study for SIDS endpoint
09.02.2004 (3)

Purity : typical for marketed substance
CAS-No :
EC-No :
EINECS-Name : Destillation residue
Molecular formula :
Value : <= .1 % w/w

Flag : Critical study for SIDS endpoint
09.02.2004 (3)

Purity : typical for marketed substance
CAS-No : 7439-89-6
EC-No : 231-096-4
EINECS-Name : iron
Molecular formula :
Value : <= .001 g/kg

Remark : Value given as <= 1 mg/kg
Flag : Critical study for SIDS endpoint
09.02.2004 (3)

Purity : typical for marketed substance
CAS-No : 7440-38-2
EC-No : 231-148-6
EINECS-Name : arsenic
Molecular formula : As
Value : = 0 % w/w

Remark : Value given as = 0.02 mg/kg
Flag : Critical study for SIDS endpoint
09.02.2004 (3)

1.4 ADDITIVES

1.5 TOTAL QUANTITY

Quantity : - tonnes in 1995

Remark : In 1995, the phosphorus trichloride manufacturing capacities were about 0.2 million tonnes in the USA, 0.2 million tonnes in Western Europe, and 0.02 million tonnes in Japan. The phosphorus trichloride consumption of the USA increased from 73,000 tonnes in 1983 to about 142,500 tonnes in 1994
Flag : Critical study for SIDS endpoint
14.07.2005 (2)

Quantity : - tonnes in 2001

Result : The US production capacity is reported to be about 315,000 tonnes and the US consumption to be about 277,000 tonnes in 2001
Flag : Critical study for SIDS endpoint
14.07.2005 (8)

Quantity : - tonnes in 2002

Result : The global production capacity was estimated to be 0.8 million tonnes for about 20 producers in 2002. Approximately 0.5 million tonnes/a of the manufacturing capacity are in OECD countries and 0.3 million tonnes/a in non-member countries. In Western Europe there are 5 producers of phosphorus trichloride. Three of them have production plants in Germany in 2002
Flag : Critical study for SIDS endpoint
14.07.2005 (9)

1.6.1 LABELLING

Labelling	:	as in Directive 67/548/EEC
Specific limits	:	no
Symbols	:	T+, C, ,
Nota	:	, ,
R-Phrases	:	(14) Reacts violently with water (26/28) Very toxic by inhalation and if swallowed (35) Causes severe burns (48/20) Harmful: danger of serious damage to health by prolonged exposure through inhalation
S-Phrases	:	(1/2) Keep locked up and out of reach of children (7/8) Keep container tightly closed and dry (26) In case of contact with eyes, rinse immediately with plenty of water and seek medical advice (36/37/39) Wear suitable protective clothing, gloves and eye/face protection (45) In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible)
Remark	:	Index-No. 015-007-00-4 EG-No. 231-749-3 Substance is dealt with in the 25th ATP. As an editorial mistake R29 is missing in the labelling. Will be corrected in the 29th ATP which is not yet published.

25.03.2004 (10)

1.6.2 CLASSIFICATION

Classified	:	as in Directive 67/548/EEC
Class of danger	:	
R-Phrases	:	(14) Reacts violently with water
Specific limits	:	

17.08.2004 (10)

Classified	:	as in Directive 67/548/EEC
Class of danger	:	
R-Phrases	:	(29) Contact with water liberates toxic gas
Specific limits	:	

18.12.2003 (10)

Classified	:	as in Directive 67/548/EEC
Class of danger	:	very toxic
R-Phrases	:	(26/28) Very toxic by inhalation and if swallowed
Specific limits	:	

18.12.2003 (10)

Classified	:	as in Directive 67/548/EEC
Class of danger	:	harmful

R-Phrases : (48/20) Harmful: danger of serious damage to health by prolonged exposure through inhalation
Specific limits :

18.12.2003 (10)

Classified : as in Directive 67/548/EEC
Class of danger : corrosive
R-Phrases : (35) Causes severe burns
Specific limits :

18.12.2003 (10)

1.6.3 PACKAGING

1.7 USE PATTERN

Type of use : type
Category : Use in closed system

09.02.2004 (5)

Type of use : industrial
Category : Chemical industry: used in synthesis

17.12.2003 (5)

Type of use : use
Category : Intermediates

17.12.2003 (5)

1.7.1 DETAILED USE PATTERN

1.7.2 METHODS OF MANUFACTURE

1.8 REGULATORY MEASURES

1.8.1 OCCUPATIONAL EXPOSURE LIMIT VALUES

Type of limit : MAK (DE)
Limit value : 2.8 mg/m3

Remark : 1 mg/m³ = 0.175 ml/m³ (ppm)
Ceiling limit: Category I (should not be exceeded)
MAK: 0.5 ppm

25.03.2004 (11)

Type of limit : TLV (US)
Limit value : .2 other: ppm
Short term exposure limit value
Limit value : .5 other: ppm
Time schedule : 15 minute(s)
Frequency : times

25.03.2004 (12)

1.8.2 ACCEPTABLE RESIDUES LEVELS

1.8.3 WATER POLLUTION

Classified by : other: VwVwS
Labelled by :
Class of danger : 1 (weakly water polluting)

Remark : Official German Classification with identification number (Kenn-Nr.) 1245
26.03.2004

1.8.4 MAJOR ACCIDENT HAZARDS

Legislation : Stoerfallverordnung (DE)
Substance listed : yes
No. in Seveso directive :

Remark : Major accidents regulations: no. 1 (highly toxic)
25.03.2004 (13)

1.8.5 AIR POLLUTION

1.8.6 LISTINGS E.G. CHEMICAL INVENTORIES

1.9.1 DEGRADATION/TRANSFORMATION PRODUCTS

1.9.2 COMPONENTS

1.10 SOURCE OF EXPOSURE

1.11 ADDITIONAL REMARKS

1.12 LAST LITERATURE SEARCH

Type of search : Internal and External
Chapters covered : 1
Date of search : 26.07.2002

10.02.2004

Type of search : Internal and External
Chapters covered : 2
Date of search : 26.07.2002

10.02.2004

Type of search : Internal and External
Chapters covered : 3, 4
Date of search : 26.07.2002

10.02.2004

Type of search : Internal and External
Chapters covered : 5
Date of search : 01.05.2003

10.02.2004

1.13 REVIEWS

2.1 MELTING POINT

Value : -93.6 °C
Sublimation :
Method : other: no data
Year : 2003
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Remark : Data selected as critical data because carefully peer-reviewed. MAK commission gave similar data. The melting point of -111.85 °C, found by mistake from S. v. Wroblewski, K. Olzewski (Ann. Phys. 3, 20 81983) 243-257) was cited by Landolt-Börnstein (1905) and International Critical Tables 1 (1926) p. 106.
Reliability : (2) valid with restrictions
Data from handbook or collection of data
Flag : Critical study for SIDS endpoint
22.09.2004 (5)

Value : -93.6 °C
Sublimation :
Method : other: no data
Year : 2003
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (2) valid with restrictions
Data from handbook or collection of data
22.09.2004 (14)

Value : -93.6 °C
Sublimation :
Method : other: no data
Year : 1988
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (4) not assignable
Data from handbook or collection of data, not peer-reviewed
22.09.2004 (15)

Value : -92 °C
Sublimation :
Method : other: no data
Year : 1984
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (2) valid with restrictions
Data from handbook or collection of data
22.09.2004 (16)

Value : -111.8 °C
Sublimation :
Method : other: no data
Year : 1979
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Remark : The melting point of -111.85 °C, found by mistake from S. v. Wroblewski, K. Olzewski (Ann. Phys. 3, 20 81983) 243-257) was cited by Landolt-Börnstein (1905) and International Critical Tables 1 (1926) p. 106.
Reliability : (2) valid with restrictions
Data from handbook or collection of data
22.09.2004 (17)

Value : -112 °C
Sublimation :
Method : other: no data
Year : 2003
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Remark : The melting point of -111.85 °C, found by mistake from S. v. Wroblewski, K. Olzewski (Ann. Phys. 3, 20 81983) 243-257) was cited by Landolt-Börnstein (1905) and International Critical Tables 1 (1926) p. 106.
Reliability : (2) valid with restrictions
Data from handbook or collection of data
22.09.2004 (18)

Value : -112 °C
Sublimation :
Method : other: no data
Year : 1991
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Remark : The melting point of -111.85 °C, found by mistake from S. v. Wroblewski, K. Olzewski (Ann. Phys. 3, 20 81983) 243-257) was cited by Landolt-Börnstein (1905) and International Critical Tables 1 (1926) p. 106.
Reliability : (2) valid with restrictions
Data from handbook or collection of data
22.09.2004 (19)

Value : -112 °C
Sublimation :
Method : other: no data
Year : 2001
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Remark : The melting point of -111.85 °C, found by mistake from S. v. Wroblewski, K. Olzewski (Ann. Phys. 3, 20 81983) 243-257) was cited by Landolt-Börnstein (1905) and International Critical Tables 1 (1926) p. 106.
Reliability : (2) valid with restrictions
Data from handbook or collection of data
22.09.2004 (20)

2.2 BOILING POINT

Value : 76.1 °C at 1013 hPa
Decomposition :
Method : other: no data
Year : 2003
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (2) valid with restrictions
Data from handbook or collection of data
Flag : Critical study for SIDS endpoint
22.09.2004 (5)

Value : 76.1 °C at 1013 hPa
Decomposition :
Method : other: no data
Year : 2003
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (2) valid with restrictions
Data from handbook or collection of data
22.09.2004 (14)

Value : 76.1 °C at 1013 hPa
Decomposition :
Method : other: no data
Year : 1988
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (4) not assignable
Data from handbook or collection of data, not peer-reviewed
22.09.2004 (15)

Value : 76 °C at 1013 hPa
Decomposition :
Method : other: no data
Year : 2003
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (2) valid with restrictions
Data from handbook or collection of data
22.09.2004 (18)

Value : 76 °C at 1013 hPa
Decomposition :
Method : other: no data
Year : 2001
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (2) valid with restrictions
Data from handbook or collection of data
22.09.2004 (20)

Value : 75.5 °C at 998.6 hPa
Decomposition :
Method : other: no data
Year : 1991
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (2) valid with restrictions
Data from handbook or collection of data

22.09.2004 (19)

Value : 74.2 °C at
Decomposition :
Method : other: no data
Year : 1979
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (2) valid with restrictions
Data from handbook or collection of data
22.09.2004 (17)

Value : 75 - 76 °C at 1020 hPa
Decomposition :
Method : other: not specified
Year : 1896
GLP : no
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (4) not assignable
Documentation insufficient for assessment
22.09.2004 (21)

Value : 74 °C at
Decomposition :
Method : other: no data
Year : 1984
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (2) valid with restrictions
Data from handbook or collection of data
22.09.2004 (16)

2.3 DENSITY

Type : density
Value : 1.575 g/cm³ at 20 °C
Method : other: no data
Year : 2003
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (2) valid with restrictions
Data from handbook or collection of data
Flag : Critical study for SIDS endpoint
22.09.2004 (5)

Type : relative density
Value : 1.574 at 21 °C
Method : other: no data
Year : 2001
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Result : Value relative to the density of water at 4°C.
Reliability : (2) valid with restrictions

Data from handbook or collection of data
22.09.2004 (20)

Type : density
Value : 1.574 g/cm³ at 21 °C
Method : other: no data
Year : 1979
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (2) valid with restrictions
Data from handbook or collection of data
22.09.2004 (17)

Type : relative density
Value : 1.6 at °C
Method : other: no data
Year : 2003
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Result : Value relative to the density of water at ambient temperature.
Reliability : (2) valid with restrictions
Data from handbook or collection of data
22.09.2004 (18)

Type : relative density
Value : 1.575 at 20 °C
Method : other: no data
Year : 2003
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Result : Value relative to the density of water at 4°C.
Reliability : (2) valid with restrictions
Data from handbook or collection of data
22.09.2004 (14)

Type : relative density
Value : 1.573 at 20 °C
Method : other: no data
Year : 1988
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Result : Value relative to the density of water at 4°C.
Reliability : (4) not assignable
Data from handbook or collection of data, not peer-reviewed
22.09.2004 (15)

Type : density
Value : 1.57 g/cm³ at 20 °C
Method : other: no data
Year : 2003
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (4) not assignable
Manufacturer data without proof

22.09.2004 (22)

Type : relative density
Value : 1.5941 at 11 °C
Method : other: not specified
Year : 1896
GLP : no
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (4) not assignable
Documentation insufficient for assessment

22.09.2004 (21)

Type : relative density
Value : 1.574 at 21 °C
Method : other: no data
Year : 1991
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Result : Value relative to the density of water at 4°C.
Reliability : (2) valid with restrictions
Data from handbook or collection of data

22.09.2004 (19)

Type : density
Value : 1.858 at -95.1 °C
Method : other: not specified
Year : 1965
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (2) valid with restrictions
Data from handbook or collection of data

22.09.2004 (23)

Type : density
Value : 2.015 at -183 °C
Method : other: not specified
Year : 1965
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (2) valid with restrictions
Data from handbook or collection of data

22.09.2004 (23)

Type : density
Value : at °C
Method : other: not specified
Year : 1965
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Result :

t*	-70	-20.5	0	20.8	35.2
d**	1.744	1.653	1.613	1.574	1.547

t*	50.3	64.8	75.1
d**	1.518	1.492	1.475

* t=temperature
** d=density

t*	0	15	25	35	50
d**	1.6114	1.5844	1.5659	1.5470	1.5181

t*	d**	t*	d**
0	1.609	20.8	1.574
0	1.6094	21	1.5696
0	1.612	25	1.5659
0	1.61275	30	1.5567
10	1.597	33.2	1.5505
16.4	1.582	43.5	1.5332
17.9	1.5792	46.2	1.527
18	1.579	59.7	1.5000
18	1.585	61.5	1.5008
18	1.576	76	1.471
20	1.5778		
20	1.5761		

Reliability : (2) valid with restrictions
Data from handbook or collection of data

22.09.2004 (23)

2.3.1 GRANULOMETRY

2.4 VAPOUR PRESSURE

Value : 129.7 hPa at 20 °C
Decomposition :
Method : other (measured): description of the method is not given
Year : 2003
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Result : Vapour pressure at 70°C: 857.5 hPa
Reliability : (2) valid with restrictions
Data from handbook or collection of data
Flag : Critical study for SIDS endpoint
22.09.2004 (5)

Value : 133 hPa at 21 °C
Decomposition :
Method : other (measured): description of the method is not given
Year : 2001
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (2) valid with restrictions
Data from handbook or collection of data
22.09.2004 (20)

Value : 133 hPa at 21 °C
Decomposition :
Method :
Year : 1979
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (2) valid with restrictions
Data from handbook or collection of data
22.09.2004 (18) (17)
Value : 127 hPa at 20 °C
Decomposition :
Method : other (measured): description of the method is not given
Year : 1988
GLP : no data
Test substance : other TS: Phosphorus trichloride

Result : Further, following values are reported:
vapour pressure at 30°C 194 hPa
vapour pressure at 50°C 415 hPa
Reliability : (4) not assignable
Data from handbook or collection of data, not peer-reviewed
22.09.2004 (15)

2.5 PARTITION COEFFICIENT

Partition coefficient : octanol-water
Log pow : at °C
pH value :
Method : other (calculated): Expert judgement
Year : 2003
GLP : no
Test substance : other TS: Phosphorus trichloride

Result : "Endpoint Partition Coefficient" is not applicable because the substance is not stable in water due to hydrolysis
Reliability : (2) valid with restrictions
Basic data given
Flag : Critical study for SIDS endpoint
22.09.2004 (24)

2.6.1 SOLUBILITY IN DIFFERENT MEDIA

Solubility in : Water
Value : at °C
pH value :
concentration : at °C
Temperature effects :
Examine different pol. :
pKa : at 25 °C
Description :
Stable :
Deg. product :
Method : other: Expert judgement
Year : 1990
GLP : no
Test substance : other TS: Phosphorus trichloride

Remark : Not stable in water due to hydrolysis, see chapter 3.1.2
Reliability : (2) valid with restrictions
Data from handbook or collection of data
Flag : Critical study for SIDS endpoint

22.09.2004 (25)

Solubility in	:	Organic Solvents
Value	:	at °C
pH value	:	
concentration	:	at °C
Temperature effects	:	
Examine different pol.	:	
pKa	:	at 25 °C
Description	:	
Stable	:	
Deg. product	:	
Method	:	other: no data
Year	:	1991
GLP	:	no data
Test substance	:	other TS: Phosphorus trichloride, purity not given
Result	:	Soluble in ether, benzene, chloroform, carbon disulfide and carbon tetrachloride.
Reliability	:	(2) valid with restrictions Data from handbook or collection of data
Flag	:	Critical study for SIDS endpoint

22.09.2004 (19)

Solubility in	:	Organic Solvents
Value	:	at °C
pH value	:	
concentration	:	at °C
Temperature effects	:	
Examine different pol.	:	
pKa	:	at 25 °C
Description	:	
Stable	:	
Deg. product	:	
Method	:	other: no data
Year	:	2003
GLP	:	no data
Test substance	:	other TS: Phosphorus trichloride, purity not given
Result	:	Soluble in benzene, chloroform, carbon tetrachloride, and diethyl ether. Miscible with phosphoryl chloride.
Reliability	:	(2) valid with restrictions Data from handbook or collection of data
Flag	:	Critical study for SIDS endpoint

22.09.2004 (5)

Solubility in	:	Organic Solvents
Value	:	at °C
pH value	:	
concentration	:	at °C
Temperature effects	:	
Examine different pol.	:	
pKa	:	at 25 °C
Description	:	
Stable	:	
Deg. product	:	
Method	:	other: no data
Year	:	2001
GLP	:	no data
Test substance	:	other TS: Phosphorus trichloride, purity not given

Result : Soluble in benzene, chloroform, ether, and carbon disulfide.
Reliability : (2) valid with restrictions
Data from handbook or collection of data
22.09.2004 (20)

2.6.2 SURFACE TENSION

2.7 FLASH POINT

Method :
Year :
GLP :
Test substance : other TS: Phosphorus trichloride, purity not given

Remark : not applicable
Flag : Critical study for SIDS endpoint
22.09.2004

2.8 AUTO FLAMMABILITY

2.9 FLAMMABILITY

2.10 EXPLOSIVE PROPERTIES

2.11 OXIDIZING PROPERTIES

2.12 DISSOCIATION CONSTANT

2.13 VISCOSITY

Value : .65 - mPa s (dynamic) at 0 °C
Result :
Method : other: no data
Year : 2003
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Result : Further, a viscosity of 0.438 mPa*s at 50°C is reported.
Reliability : (2) valid with restrictions
Data from handbook or collection of data
22.09.2004 (5)

Test type : other: no data
Test procedure :
Method : other: no data
Year : 1965
GLP : no data

Test substance : other TS: Phosphorus trichloride, purity not given

Result :

t*	-15	0	10	20	30
h**	0.874	0.755	0.690	0.636	0.600

t*	40	50	60	70
h**	0.571	0.548	0.526	0.508

New measurements reveal lower values:

t*	0	15	25	35	50
h**	0.656	0.560	0.501	0.479	0.453

* t=temperature
** h=viscosity

Reliability : (2) valid with restrictions
Data from handbook or collection of data
22.09.2004 (23)

Value : .438 - mPa s (dynamic) at 50 °C
Result :
Method : other: no data
Year : 1999
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (4) not assignable
Manufacturer data without proof
22.09.2004 (26)

Value : .536 - mPa s (dynamic) at 20 °C
Result :
Method : other: DIN 53 015
Year : 2002
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Reliability : (4) not assignable
Manufacturer data without proof
22.09.2004 (3)

2.14 ADDITIONAL REMARKS

Memo : Conversion factors

Result : 1 ml/m³ (ppm) = 5.69 mg/m³
1 mg/m³ = 0.175 ml/m³ (ppm)
Flag : Critical study for SIDS endpoint
03.02.2004 (16)

Memo : Conversion factors at 20°C and 1.013 bar

Result : 1 ppm = 5.71 mg/m³
1 mg/m³ = 0.175 ppm
Reliability : (4) not assignable
Data from handbook or collection of data, not peer-reviewed
02.02.2004 (15)

Memo : Hazards identification and decomposition products

Result : The substance decomposes on heating producing toxic and corrosive fumes including hydrogen chloride and phosphorus oxides. Reacts violently with water producing heat and decomposition products including hydrochloric acid and phosphorus acid, causing fire and explosion hazard. [Note: Hydrolysis in water to form hydrochloric acid and phosphoric acid.]
Reliability : (2) valid with restrictions
Data from handbook or collection of data
18.11.2003 (18)

Memo : Refraction index

Result :

l*	263	274	288	298	325	340
n**	1.666	1.634	1.610	1.597	1.573	1.564

l*	346	361	467	480	508	537
n**	1.561	1.555	1.529	1.525	1.524	1.520

* l=wavelength in mμ
** n=refraction index
Reliability : (2) valid with restrictions
02.02.2004 (23)

Memo : Relative vapour density

Result : 4.74 (air = 1)
Reliability : (4) not assignable
Data from handbook or collection of data, not peer-reviewed
02.02.2004 (15)

Memo : Relative vapour density

Result : 4.75 (air = 1)
Reliability : (2) valid with restrictions
Data from handbook or collection of data
Flag : Critical study for SIDS endpoint
18.11.2003 (18) (17)

Memo : pH value

Result : ca. pH 1 at 5 g/l water
Reliability : (4) not assignable
Manufacturer data without proof
Flag : Critical study for SIDS endpoint
17.11.2003 (22) (26)

3.1.1 PHOTODEGRADATION

Deg. product	:	
Method	:	other (calculated): expert judgemant
Year	:	2004
GLP	:	
Test substance	:	other TS: Phosphorus trichloride
Result	:	Photodegradation due to OH radicals in the atmosphere is not calculable with AOPWIN v. 1.90 (2000) (expert judgement). Direct photolysis of gaseous phosphorus trichloride is not expected due to the lack of adsorption of light with a wavelength above 225 nm (Jan-Khan and Samuel 1936). Photodegradation in water cannot be calculated because the substance is not stable in water due to hydrolysis (Bayer Chemicals 2004).
Reliability	:	(2) valid with restrictions Accepted calculation method
Flag	:	Critical study for SIDS endpoint

22.09.2004 (24) (27)

3.1.2 STABILITY IN WATER

Type	:	abiotic
t1/2 pH4	:	at °C
t1/2 pH7	:	at °C
t1/2 pH9	:	at °C
Deg. product	:	yes
Method	:	other: pH monitoring
Year	:	2003
GLP	:	no
Test substance	:	other TS: Phosphorus trichloride, purity not given
Deg. products	:	7647-01-0 231-595-7 hydrogen chloride
Method	:	The reaction of phosphorus trichloride and water was studied by bringing a small amount of neat phosphorus trichloride into contact with an excess of well stirred water and following the generation of acidic reaction products using a pH electrode. Quantitative analysis (redox titration with AgNO3 and pH titration) after completion of reaction confirmed that all reaction products have been captured by this method.
Result	:	The experimental set up could not distinguish the apparent reaction rate from, e.g., the mixing delay or the inertia of the measuring system. However, the half-life of phosphorus trichloride in water was estimated to be less than 10 seconds at 23 °C. Quantitative analysis (redox titration with AgNO3 and pH titration) after completion of reaction confirmed that all reaction products were captured by this method. In the chloride titrations with AgNO3 99 % of the chloride expected to be generated by hydrolysis of the phosphorus trichloride were recovered. In the pH titrations, 94 % of the expected total acidity were recovered.
Reliability	:	(2) valid with restrictions Basic data given
Flag	:	Critical study for SIDS endpoint

22.09.2004 (24)

Type	:	abiotic
t1/2 pH4	:	at °C
t1/2 pH7	:	at °C

t1/2 pH9	:	at °C
Deg. product	:	
Method	:	other: see test conditions
Year	:	1925
GLP	:	no
Test substance	:	other TS: Phosphorus trichloride, purity not given
Remark	:	Study is reliable in regard to time course of acidity release. In regard to postulated intermediates up to date by the time the study was performed but outdated in regard to analytical methods of the 21st century
Result	:	The kinetics and the intermediates of the hydrolysis of phosphorus trichloride were examined. A fast release of acidity (98 %) was observed within 1 min, but this acidity still increased within about half an hour. An "abnormally pronounced reducing property" was observed that became normal after some hours. The author postulated that P(OH)2Cl occured as an intermediate which would account for increased acidity for 1/2-hour. The increased reducing power for hours is due to the second form of phosphorus acid, P(OH)3 which does not immediately (after nascency from PCl3) change to the ordinary form HPO(OH)2. It also reacted as a reductant for iodine. However: - The speed of the iodine reaction might vary depending on the specific reaction conditions - The structural formula of the suggested intermediate is not consistant with the observation, that 98 % of the acidity was released within one minute (which means that most of this intermediate - if it was formed as a stochiometric intermediate of hydrolysis - would have hydrolised also during about 1 min but was virtually stable afterwards) -It is observed that when phosphorus trichloride reacts with water, the solution initially produced had much stronger reducing properties than after several hours. -The duration of increased reducing power is far longer than can be attributed to the intermediate oxychloride. It is suggested by the author that this may be due to the second form of phosphorus acid, P(OH)3, which does not immediately change to the ordinary form, HPO(OH)2. -The hydrolysis was always accompanied by a slight smell of phosphine which became more pronounced at much higher temperatures.
Test condition	:	The presence of reducing intermediates (postulated to be phosphorus (III) oxychloride [P(OH)2Cl] and P(OH)3]) was examined by titration with iodine: - Up to 3.2 g of phosphorus trichloride were put in glass bulbs, which were submersed in 200 ml water -After breaking the bulbs and mixing the phosphorus trichloride with water (= start of the experiments), a iodine solution was added after a defined hydrolysis time (e.g. 15 s, 24 h) - Definite volumes of the solutions were titrated by a sodium thiosulphate solution at different times To examine the time course of acidity formation the solution containing phosphorus trichloride and water was titrated by sodium hydroxide
Reliability	:	(2) valid with restrictions Basic data given
Flag	:	Critical study for SIDS endpoint
22.09.2004		(28)

Type	:	abiotic
t1/2 pH4	:	at °C
t1/2 pH7	:	at °C
t1/2 pH9	:	at °C
Deg. product	:	
Method	:	other: Calorimetry
Year	:	1989

GLP :
Test substance : other TS: Phosphorus trichloride, purity not given

Method : The rate of hydrolysis measured in dilute aqueous-organic solvent (dioxan) using calorimetric techniques.
- Precision kalorimeter LKV-8700 (Sweden). The response time of the instrument was about 0.5 s, suited to determine half-lives of about 2 s
- Heat released (value taken from literature): 68,5 kcal/Mol for PCl3 + 3 H2O > H3PO3 + 3 HCl
- After thermic equilibrium at 18 °C, an ampulla containing PCl3 in dioxan was broken in dioxan/water (= start of experiment) and the heat released was measured for 1 h

Result : The reaction is of second order. The half-life of phosphorus trichloride was found to be 1-13 seconds, depending on reaction conditions for PCl3-concentration in the range 6.1-18x10exp-4 mol/l and water concentrations in the range 4-350x10exp-3

Reliability : (2) valid with restrictions
Basic data given

Flag : Critical study for SIDS endpoint
22.09.2004 (29)

Type : abiotic
t1/2 pH4 : at °C
t1/2 pH7 : at °C
t1/2 pH9 : at °C
Deg. product :
Method :
Year : 1872
GLP :
Test substance : other TS: Phosphorus trichloride, purity not given

Result : Reaction products of phosphorus trichloride in water were examined. In hot water hydrolysis let to hydrochloric acid, phosphorus acid and a small amount of red phosphorus (with the unproven postulation of the formation of phosphine as an intermediate).

Reliability : (4) not assignable
Unsuitable test system

Flag : Critical study for SIDS endpoint
22.09.2004 (30)

Type : abiotic
t1/2 pH4 : at °C
t1/2 pH7 : at °C
t1/2 pH9 : at °C
Deg. product :
Method : other: Computer modeling
Year : 2001
GLP :
Test substance : other TS: Phosphorus trichloride, purity not given

Method : The dangers caused by accidental releases of phosphorus trichloride (including spill behaviour) were examined using a computer model (REACTPOOL).

Remark : Not relevant for assessment

Result : The model suggests possible effects depending on the way phosphorus trichloride reacts with water, the amount of water available, surface roughness and wind speed.
Under stoichiometric or excess water conditions the reaction products between phosphorus trichloride and water are hydrochloric acid and

phosphorus acid with 3 mol of hydrochloric acid forming for every mole of phosphorus trichloride.
The hydrolysis is highly exothermic, raising both the temperature and the vapour evolution rates. Hydrochloric acid vapour will be evolved due to its high volatility. The amount of phosphorous acid evolved is negligible due to its extremely low volatility.
When phosphorus trichloride is in excess of the stoichiometic amount of water essential for complete hydrolysis, liquid phosphoric acid, solid red phosphorus and hydrochloric acid were formed. The hydrolysis reaction may produce solid particles of red phosphorus.
Increasing roughness and wind speed results in increasing vapour evolution rates.

Reliability : (2) valid with restrictions
Basic data given

14.07.2005 (31)

Type : abiotic
t1/2 pH4 : at °C
t1/2 pH7 : at °C
t1/2 pH9 : at °C
Deg. product :
Method : other: Calorimetry
Year : 1998
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given
Deg. products : 13598-36-2 237-066-7 phosphonic acid
7647-01-0 231-595-7 hydrogen chloride
7664-38-2 231-633-2 orthophosphoric acid
7723-14-0 231-768-7 phosphorus

Method : Small scale experiments on the reaction characteristics of phosphorus trichloride and water, including both closed and open test cells. The impact of variables on reaction rates including the interface surface area, layer depth, and stirring, were investigated experimentally.

Result : -Phosphorus trichloride hydrolyzes according to: PCl3 + 3 H2O > H3PO3 + 3 HCl.
-The reaction between water and phosphorus trichloride begins immediately.
-When hydrochloric acid is added rather than water, the maximum temperature achieved is less (maximum approximately 75°C compared to 100°C) and the reaction appears to proceed more slowly.
-From the stoichiometric case, three stages were apparent following the addition of water. Firstly, a rapid temperature rise and little loss of water is observed as the reaction proceeds and all hydrochloric acid enters into solution. Then the temperature falls due to further dilution with water and phosphorus trichloride vapour is evolved. Finally the temperature rises again and only hydrochloric acid is liberated.
-No phosphine odour is detected.

Test condition : Experiments were carried out using ARC (Accelerating Rating Calorimeter), RSST (Reactive System Screening Tool -pseudo-adiabatic calorimeter) and VST (Vent Sizing Package).
Four different reactor vessels were used during the experiments: a Dewar flask, a 50 ml beaker, a 100 ml and a 25 ml graduated cylinder. An electrically driven glass rod with a right angle bend was used as a stirrer in four of the cases to investigate the effect of mechanical mixing on the reaction. Only one stirring speed, estimated to be around 300 rpm, was used. The desired volume of phosphorus trichloride was measured, heated to about 50°C and then added to the reactor vessel. The reactor was then placed on an electronic mass balance and a thermocouple was inserted, so that it penetrated the phosphorus trichloride layer prior to water addition.

The stirrer was started and a measured volume of distilled water or HCL (aqueous) at ambient temperature was added. The temperature and mass of the reactor was recorded throughout the water addition and reaction stages using a computer data logging system.

Reliability : (2) valid with restrictions
Study meets generally accepted scientific principles

22.09.2004 (32)

Type : abiotic
t1/2 pH4 : at °C
t1/2 pH7 : at °C
t1/2 pH9 : at °C
Deg. product : not measured
Method : other: see test conditions
Year : 1942
GLP : no
Test substance : other TS: Phosphorus trichloride, purity not given

Remark : Stock solution contains toluene
Result : At 20 °C the constant for the reaction rate was found to be k = 0.093 corresponding to a half life of t1/2 = 7 s.

At 35 °C the constant for the reaction rate was found to be k = 0.13 corresponding to a half life of t1/2 = 5 s.

Test condition : Stock solution was prepared with 137.4 g of phosphorus trichloride dissolved in 1000 cm3 toluene.
An aliquot of 10 cm3 was added in 10 cm3 bidistilled, not buffered water and introduced in a reactor provided with a termostat.
Two tests were performed with different temperatures: 20 °C and 35 °C.
For each temperature 3 replicates were conducted (with slight different surface of reaction).
Solution was analysed in an interval of approx. 7 min till 47 min (20 °C) and 34 min (25 °C).
Analytical method: The sample was titrated with NaOH N/10.
Phenolphthalein was used as an indicator.

Reliability : (2) valid with restrictions
Basic data given

22.09.2004 (33)

Type : abiotic
t1/2 pH4 : at °C
t1/2 pH7 : at °C
t1/2 pH9 : at °C
Deg. product :
Method : other: see below
Year : 1987
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Method : Vapor phase hydrolysis of phosphorus trichloride in argon was examined at about 1.000 K.
Remark : High temperature hydrolysis not relevant for environmental assessment.
Result : In the equilibrium gas mixture, co-condensed with an excess of argon, OPCl is detected. After addition of water in excess molecular phosphoric acid (HOPO) is found.

Reliability : (2) valid with restrictions
Study meets generally accepted scientific principles

22.09.2004 (34) (35)

Type : abiotic

t1/2 pH4 : at °C
t1/2 pH7 : at °C
t1/2 pH9 : at °C
Degradation : .2 % after 39 minute(s) at pH and 5 °C
Deg. product : yes
Method : other: non-homogeneous system according to Carrara and Zoppellari (1894)
Year : 1896
GLP : no
Test substance : other TS: Phosphorus trichloride, purity not given
Deg. products : 7647-01-0 231-595-7 hydrogen chloride

Result : Authors report that within about 39 min at 5 °C only 0.2 % (= 1/500 molecular weight) of phosphorus chloride was completely degraded (K = 0.0071).). Only 2-3 °C above the temperature the observation took place (5 °C), the reaction was too vigorous to make measurements.
Test condition : Examination of the reaction of phosphorus trichloride with water in non-homogeneous system according to Carrara and Zoppellari (1894).
Phosphorus trichloride hydrolyses according to
PCl3 + 3 H2O > PO3H3 + 3HCl.
- Cylindrical recipient with a termostate
- Constant temperature (5 °C)
- The amount of acid released was analyzed with alkali
- Test period: 70 min
Reliability : (4) not assignable
Documentation insufficient for assessment

22.09.2004 (36) (21)

Type : abiotic
t1/2 pH4 : at °C
t1/2 pH7 : at °C
t1/2 pH9 : at °C
Deg. product :
Method : other: Description of the method is not given
Year : 1924
GLP : no
Test substance : other TS: Phosphorus trichloride, purity not given

Remark : The nature of the water - phosphorus trichloride reaction is described. It is suggested that the oxygen atom in a water molecule would attach itself to the lone pair of electrons on the phosphorus atom and a hydrogen and chlorine atom would then react to form hydrochloric acid. This would be repeated until all chlorine atoms were displaced from the phoshorus.
Reliability : (4) not assignable
Documentation insufficient for assessment

22.09.2004 (37)

Type : abiotic
t1/2 pH4 : at °C
t1/2 pH7 : at °C
t1/2 pH9 : at °C
Deg. product :
Method :
Year : 1947
GLP :
Test substance : other TS: Phosphorus trichloride, purity not given

Remark : It is not clearly stated, how the humidity of the gas phase was controlled
Result : Hydrolysis of phosphorus trichloride in vapour phase was investigated. No

reaction between phosphorus trichloride and water vapour in the vapour phase was detected. At 25 °C the reaction was shown to be heterogeneous by comparing rates in waxed and unwaxed vessels. Authors speculate that the rate of hydrolysis is governed by the rate of absorption of the gases on the phosphoric acid deposited on the reaction vessel surface. At higher temperatures no hydrolysis could be detected.
Description and experimental details are not sufficient.

Reliability : (4) not assignable
Documentation insufficient for assessment

22.09.2004 (38)

Type : abiotic
t1/2 pH4 : at °C
t1/2 pH7 : at °C
t1/2 pH9 : at °C
Deg. product :
Method : other: description of the method is not given
Year : 1897
GLP : no
Test substance : other TS: Phosphorus trichloride, purity not given

Remark : Not relevant for environmental assessment
Result : The reaction products of phosphorus trichloride and water were hydrochloric acid and phosphorous acid. When phosphorus trichloride was in excess of water the author postulates the formation of some phosphoryl monochloride as well as P2O5, P2O3 and P2O.
Reliability : (4) not assignable
Documentation insufficient for assessment

22.09.2004 (39) (40)

Type : abiotic
t1/2 pH4 : at °C
t1/2 pH7 : at °C
t1/2 pH9 : at °C
Deg. product :
Method :
Year : 1871
GLP :
Test substance : other TS: Phosphorus trichloride, purity not given

Remark : For excess phosphorus trichloride the formation of some red phosphorus, hydrochloric acid and phosphoric acid was observed. It is suggested that initially phosphorus acid was formed which then reacted with phosphorus trichloride. Overall, 12 mol of water were required per 5 mol of phosphorus trichloride as indicated by the suggested total reaction.
Reliability : (4) not assignable
Original reference not available

22.09.2004 (41)

Type : abiotic
t1/2 pH4 : at °C
t1/2 pH7 : at °C
t1/2 pH9 : at °C
Deg. product :
Method :
Year : 1811
GLP :
Test substance : other TS: Phosphorus trichloride, purity not given

Remark	:	It is noted that a rise in temperature and the gradual formation of hydrochloric acid and phosphorus acid occured, when water reacted with phosphorus trichloride. It is suggested that three moles of water are required per mole of phosphorus trichloride for hydrolysis.
Reliability	:	(4) not assignable Original reference not available

22.09.2004 (42)

Type	:	abiotic
t1/2 pH4	:	at °C
t1/2 pH7	:	at °C
t1/2 pH9	:	at °C
Deg. product	:	
Method	:	other: modeling
Year	:	2001
GLP	:	
Test substance	:	other TS: Phosphorus trichloride, purity not given
Method	:	A case study modeling the indoor release of phosphorus trichloride in a major accident. It is assumed that when phosphorus tricloride reacts with the moisture in air hydrochloric acid and phosphorous acid are formed. For modeling purposes the duration of exposure, the mass of water for reaction, the pool growth, the mass flow rate of hydrochloric acid produced and the mass release rate of hydrochloric acid at different circumstances of accident were determined.
Remark	:	Not relevant for environmental assessment
Result	:	The hydrochloric acid release rate is the same for releases from storage, no matter the size of the leak from the storage tank. This is because it is assumed that the bunded area is immediately filled and thus the surface area over which the reaction with moisture in air takes place is always constant. In reality the liquid pool would grow to its limiting size and there would also be the surface area of the liquid as it is released from the hole.
Reliability	:	(2) valid with restrictions Study meets generally accepted scientific principles

22.09.2004 (43)

Type	:	abiotic
t1/2 pH4	:	at °C
t1/2 pH7	:	at °C
t1/2 pH9	:	at °C
Deg. product	:	
Method	:	
Year	:	1996
GLP	:	
Test substance	:	other TS: Phosphorus trichloride, purity not given
Remark	:	In general, adding small amounts of phosphorus trichloride to water (molar ratio of water to phosphorus trichloride > 3), the hydrolysis products of phosphorus trichloride are phosphonic acid and hydrochloric acid. Is the molar ratio of water to phosphorus trichloride between 2.5 and 3, a mixture of phosphorus and pyrophosphonic acid is formed. A molar ratio below 2.5 results in a product of indefinite composition, called lower oxides of phosphorus. When the molar ratio of water to phosphorus trichloride is low, traces of phosphine may be formed in hot water.
Reliability	:	(2) valid with restrictions Data from handbook or collection of data
Flag	:	Critical study for SIDS endpoint

22.09.2004 (4)

3.1.3 STABILITY IN SOIL

Deg. product	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: Phosphorus trichloride, purity not given
Remark	:	not stable, hydrolysis with moisture in soil

22.09.2004 (25)

3.2.1 MONITORING DATA

3.2.2 FIELD STUDIES

3.3.1 TRANSPORT BETWEEN ENVIRONMENTAL COMPARTMENTS

Type	:	adsorption
Media	:	
Air	:	% (Fugacity Model Level I)
Water	:	% (Fugacity Model Level I)
Soil	:	% (Fugacity Model Level I)
Biota	:	% (Fugacity Model Level II/III)
Soil	:	% (Fugacity Model Level II/III)
Method	:	other: Expert judgement
Year	:	2003
Result	:	Models of fate and behaviour in the environment require values for Kow, water solubility and vapour pressure. Since the substance is highly unstable in water, environmental distribution modelling of either the substance itself or its hydrolysis products (mineral acids, the anions of which are ubiquitous in the environment) is not relevant in this case.
Test substance	:	Phosphorus trichloride, purity not given
Reliability	:	(2) valid with restrictions Basic data given
Flag	:	Critical study for SIDS endpoint

14.07.2005 (24)

3.3.2 DISTRIBUTION

Media	:	air - biota - sediment(s) - soil - water
Method	:	other (calculation): Expert judgement
Year	:	2003
Result	:	Models of fate and behaviour in the environment require values for Kow, water solubility and vapour pressure. Since the substance is highly unstable in water, environmental distribution modelling of either the substance itself or its hydrolysis products (mineral acids, the anions of which are ubiquitous in the environment) is not relevant in this case.
Test substance	:	Phosphorus trichloride, purity not given
Reliability	:	(2) valid with restrictions Basic data given

Flag : Critical study for SIDS endpoint
14.07.2005 (24)

3.4 MODE OF DEGRADATION IN ACTUAL USE

3.5 BIODEGRADATION

Type : aerobic
Inoculum :
Deg. product :
Method : other: expert judgement
Year : 2004
GLP : no
Test substance : other TS: Phosphorus trichloride, purity not given

Remark : "Endpoint Biodegradation" not applicable to inorganics.
Since phosphorus trichloride hydrolyzes rapidly in water (Bayer Chemicals 2004), no biodegradation can be measured. The hydrolysis products chloride, phosphonate and hydrogen ions, are inorganic end products of biodegradation.
Reliability : (2) valid with restrictions
Basic data given
Flag : Critical study for SIDS endpoint
22.09.2004 (24)

3.6 BOD5, COD OR BOD5/COD RATIO

3.7 BIOACCUMULATION

3.8 ADDITIONAL REMARKS

4.1 ACUTE/PROLONGED TOXICITY TO FISH

Type	:	static
Species	:	Brachydanio rerio (Fish, fresh water)
Exposure period	:	96 hour(s)
Unit	:	mg/l
LC0	:	>= 1000
Limit test	:	
Analytical monitoring	:	no
Method	:	other: UBA-Verfahrensvorschlag "Letale Wirkung beim Zebrabaerbling Brachydanio rerio" (LC 0, LC 50, LC 100; 48-96 Stunden) (Mai 1984)
Year	:	1991
GLP	:	yes
Test substance	:	other TS: Phosphorus trichloride, purity not given
Remark	:	Although not explicitly mentioned in the original report, the test was conducted with pH-neutralised medium. LC0 >= 1000 mg/l PCl3 corresponds to a LC0 of >= 597 mg/l of (neutralised) phosphonic acid as hydrolysis product. The accepted scientific name for Brachydanio rerio is Danio rerio.
Test condition	:	- Brachydanio rerio from West-Aquarium (Bad Lauterberg) - pH: 7.3-7.7 adjusted - Temperature: 22 °C - Oxygen: 7.8-8.6 mg/l - Test concentration: 1000 mg/l (nominal concentration), 1000 mg/l PCl3 correspond to 597 mg/l HP(O)(OH)2 - 5 l test medium, 10 fishes/tank - No carrier - Control: synthetic tap water, hardness 14.8 °dH - No analytical monitoring because test substance hydrolyses rapidly into hydrochloric acid and phosphonic acid
Reliability	:	(1) valid without restriction Test procedure in accordance with national standard methods
Flag	:	Critical study for SIDS endpoint

14.07.2005 (44)

Type	:	semistatic
Species	:	Leuciscus sp. (Fish, fresh water)
Exposure period	:	10 day(s)
Unit	:	mg/l
LC100	:	25
Limit test	:	
Analytical monitoring	:	no data
Method	:	other
Year	:	1970
GLP	:	no
Test substance	:	other TS: Phosphorus trichloride, purity not given
Remark	:	Original reference in Russian, cited according to German translation The pH was presumably pH 3-4, which is not tolerated by several fish species (compare OECD-SIDS Hydrochloric Acid (2002)). The recommended for fish tests is pH 6.0 to pH 8.5 according to OECD Guidelines
Result	:	5d-LC100 = 30 mg/l 10d-LC100 = 25 mg/l
Test condition	:	Tests were performed under the following conditions: -Test species: Leuciscus leuciscus -Dilution water: dechlorinated tap water

-Test temperature: 22 - 24 °C
-Oxygen concentration: 5.8 - 7.8 mg/l
-Concentration of test substance: 10, 20, 30, 40 mg/l, pH not adjusted
-Test duration: 5-10 days

Reliability : (2) valid with restrictions
Study acceptable for assessment
Flag : Critical study for SIDS endpoint
22.07.2004 (45)

Type : semistatic
Species : other: species name not stated, it is assumed to be Acipenser stellatus
Exposure period : 5 day(s)
Unit : mg/l
NOEC : ca. 20
LC100 : ca. 70
EC1 (length) : ca. 20
EC5 (body weight) : ca. 20
Limit test :
Analytical monitoring : no data
Method : other
Year : 1970
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Remark : Original reference in Russian, cited according to German translation
Result : 70 mg/l (highest concentration tested): 100 % malformation of larvae, death after 3d (LC100)
60 mg/l: 15 % reduction of length, 30 % reduction of body weight, slight pigmentation
20 mg/l (lowest concentration tested): 1.2 % reduction of length (EC1), 5.4 % reduction of body weight (EC5). EC1 and EC5 were used as NOEC (20 mg/l).
Test condition : Test was performed under the following conditions:
-Test species: larvae of Acipenser stellatus
-Test vessels: enamelled basins of 1 l or aquaria of 10 l
-Dilution water: water from the river Wolga
-Test temperature: 20.2 - 24.2 °C
-Oxygen concentration: 5.9 - 8.14 mg/l
-Concentration of test substance: 20, 60, 70 mg/l, pH not adjusted
-Test duration: 5 days

Reliability : (2) valid with restrictions
Study acceptable for assessment
Flag : Critical study for SIDS endpoint
22.09.2004 (45)

Type : semistatic
Species : other: species name not stated, it is assumed to be Acipenser stellatus (eggs)
Exposure period : 3 day(s)
Unit : mg/l
NOEC : ca. 60
LC100 : ca. 75
LC30 : ca. 70
Limit test :
Analytical monitoring : no data
Method : other
Year : 1970
GLP : no data
Test substance : other TS: Phosphorus trichloride, purity not given

Remark	:	Original reference in Russian, cited according to German translation
Result	:	LC0 ca. 60 mg/l LC100 ca. 75 mg/l
Test condition	:	Test was performed under the following conditions: -Test species: eggs of Acipenser stellatus -Test vessels: enamelled basins of 1 l -Dilution water: water from the river Wolga -Test temperature: 20.2 - 24.2°C -Oxygen concentration: 5.9 - 8.14 mg/l -Concentration of test substance: 20, 60, 70, 74, 80, 100, 150 mg/l, pH not adjusted -Test duration: 3 days
Reliability	:	(2) valid with restrictions Study acceptable for assessment
Flag	:	Critical study for SIDS endpoint

22.09.2004 (45)

Type	:	semistatic
Species	:	other: species name not stated, it is assumed to be Esox lucius and Perca fluviatilis
Exposure period	:	30 day(s)
Unit	:	mg/l
LC0	:	> 40
Limit test	:	
Analytical monitoring	:	no data
Method	:	other
Year	:	1970
GLP	:	no data
Test substance	:	other TS: Phosphorus trichloride, purity not given

Remark	:	Original reference in Russian, cited according to German translation
Result	:	No mortality and no deviations from normal appearence of fish observed at 40-50 mg/l
Reliability	:	(4) not assignable Documentation insufficient for assessment
Flag	:	Critical study for SIDS endpoint

22.09.2004 (45)

Type	:	semistatic
Species	:	Carassius carassius (Fish, fresh water)
Exposure period	:	30 day(s)
Unit	:	mg/l
NOEC	:	ca. 40
Limit test	:	
Analytical monitoring	:	no data
Method	:	other
Year	:	1970
GLP	:	no data
Test substance	:	other TS: Phosphorus trichloride, purity not given

Remark	:	A NOEC of ca. 40 mg/l was derived from EC0 Original reference in Russian, cited according to German translation Test cannot be used to derive a PNECaqua, because it is not clear, whether early life stages have been covered
Result	:	10-40 mg/l: Continuous increase of body weight during whole test period, no difference in comparison to control 50-58 mg/l: Decrease in body weight up to day 15, than increase of body weight 60 mg/l: No increase of body weight up to day 30, than decrease to 0.35 mg body weight

65 mg/l: 100 % death after 2 days
data of body weight development of control are not given

Test condition : Tests were performed under the following conditions:
-Test vessel 10 l aquarium
-Semistatic incubation with change of incubation solution every 24 h
-Dilution water: dechlorinated tap water
-Test temperature: 22 - 24 °C
-Oxygen concentration: 5.8 - 7.8 mg/l
-pH 3.3- 7.0
-Concentration of test substance and corresponding values for HCl and HP(O)(OH)2:

PCl3 (mg/l)	HCl (mg/l) cal	HP(O)(OH)2
10	2.7	6.0
20	5.3	11.9
30	8.0	18.0
40	10.6	23.9
50	13.3	29.9
55	14.3	32.8
58	15.4	34.6
60	16.0	35.8
65	17.3	38.8

-Fish were weighthed every five days
-Fish were fed with earthworms and gammarids
-Prior to incubation, fish were acclimated to test conditions for 10-15 days in dechlorinated tap water

Reliability : (2) valid with restrictions
Study acceptable for assessment

Flag : Critical study for SIDS endpoint

22.07.2004 (45)

4.2 ACUTE TOXICITY TO AQUATIC INVERTEBRATES

Type : static
Species : Daphnia magna (Crustacea)
Exposure period : 48 hour(s)
Unit : mg/l
EC0 : 25
EC50 : 35.4
EC100 : 50
Analytical monitoring : no
Method : Directive 92/69/EEC, C.2
Year : 2003
GLP : yes
Test substance : other TS: Phosphorus trichloride, purity not given

Method : Method is in most parts equivalent to the OECD TG 202 Daphnia sp., Acute immobilisation test and reproduction test, Part I -The 24h EC50 Acute immobilisation test.

Result : The following values were determined:
24h-EC0 = 25 mg/l
24h-EC100 = 50 mg/l
48h-EC0 = 25 mg/l
48h-EC100 = 50 mg/l
Under pH-adjusted conditions no immobilisation of the daphnids has been observed at a nominal concentration up to 100 mg/l.
Geometric mean (EC0/EC100) = 35.4 mg/l
Measured pH-values:

concentration	0h	48h

	control	7.9	7.8
	12.5 mg/l	6.7	7.7
	25 mg/l	6.1	7.2
	50 mg/l	3.6	3.7*
	100 mg/l	2.9	2.9*
	50 mg/l	7.9	7.9 (with adjusted pH)
	100 mg/l	8.0	7.8 (with adjusted pH)

The results of the respective replicates clearly demonstrate that the immobilisation observed was caused by pH-effects.

Test condition : -50 ml glass beakers holding 10 neonates in 20 ml of test medium
-dilution water: reconstituted water, total hardness, measured at test start: 14.8°dH
-10 neonates per vessel, 2 replicates per concentration/control
-temperature during the test: 18-22 °C
-pH and oxygen values measured at the end of the test
-experimental design: 6 test concentrations plus 1 control
-no feeding during the exposure period
-lighting: 16 h light/8 h dark
-nominal test concentrations: 12.5, 25, 50 and 100 mg/l without adjustment of pH-value, additionally 50 and 100 mg/l with adjustment of the pH-value, since extreme pH decreases were observed due to hydrolysis of the test substance
-criteria of effects: item-induced alteration of the normal mobility behaviour and loss of locomotory actions of the neonates, observed at 24 h and 48 h
-no chemical analysis has been performed, as the test substance phosphorus trichloride hydrolyses rapidly in aqueous medium.

Reliability : (1) valid without restriction
Comparable to guideline study

Flag : Critical study for SIDS endpoint

14.07.2005 (46)

4.3 TOXICITY TO AQUATIC PLANTS E.G. ALGAE

Species : Scenedesmus subspicatus (Algae)
Endpoint : growth rate
Exposure period : 72 hour(s)
Unit : mg/l
NOEC : 12.5 measured/nominal
LOEC : 25
EC50 : 33.41
Limit test : yes
Analytical monitoring : no
Method : Directive 92/69/EEC, C.3
Year : 2003
GLP : yes
Test substance : other TS: Phosphorus trichloride, purity not given

Method : Method is in most parts equivalent to the OECD TG 201 Alga, Growth inhibition test

Remark : Accepted new scientific name for Scenedesmus subspicatus: Desmodesmus subspicatus.

Result : The following results were observed:
-Effect concentrations based on biomass growth (b):
EC 10 = 21.30 mg/l
EC 50 = 30.24 mg/l
Determined NOEC and LOEC-values based on biomass growth (b):
NOEC = 12.5 mg/l
LOEC = 25 mg/l

Under pH-adjusted conditions no inhibition of the algae growth has been observed at a nominal concentration of 100 mg/l.
-Effect concentrations based on population density growth rate (r):
EC 10 = 24.89 mg/l
EC 50 = 33.41 mg/l
Determined NOEC and LOEC values based on population density growth rate (r):
NOEC = 12.5 mg/l
LOEC = 25 mg/l
Under pH-adjusted conditions no inhibition of the algae growth has been observed at a nominal concentration of 100 mg/l.
Measured pH-values:

concentration	0h	72h	av.growth rate
control	8.2	10.5	1.12
3.13 mg/l	7.8	10.4	1.17
6.25 mg/l	7.6	10.3	1.16
12.5 mg/l	7.3	10.0	1.17
25 mg/l	6.9	9.2	1.02
50 mg/l	3.5	3.5	0.0
100 mg/l	2.9	2.9	0.0
100 mg/l	8.0	10.7	1.31 (with adjusted pH)

The results of the respective replicates clearly demonstrate that the inhibitory effects observed were caused by pH-effects.

Test condition : -Static conditions
-Algal inoculum about 10E+04 cells/ml initial cell density
-300 ml Erlenmeyer flasks with stoppers as test vessels
-Temperature during the test: 21-25 °C
-Lighting 60-120 µE/m²/s
-pH is measured at the beginning of the test and at 72 h
-Experimental design: 6 test concentrations plus 1 control, 3 replicates per concentration, 6 replicates per control, highest test concentration without algae
-Nominal test concentrations: 3.13, 6.25, 12.5, 25, 50 and 100 mg/l without adjustment of pH-value, 100 mg/l PCl3 correspond to 59.7 mg/l HP(O)(OH)2
-As extreme pH-decreases were observed due to hydrolysis of the test substance additional replicates of the highest test concentration (100 mg/l) were investigated after pH-adjustment
-Cell densities measured at 24 h intervals using a microcell counter
- Inhibition of algal population measured as reduction in biomass growth (index b) and population density growth rate (index r), relative to control cultures under identical conditions
- The 72 h-EC50 values are calculated or read from the concentration/percentage response curve.
-No chemical analysis has been performed, as the test substance phosphorus trichloride hydrolyses rapidly in aqueous medium.

Reliability : (1) valid without restriction
Comparable to guideline study

Flag : Critical study for SIDS endpoint

14.07.2005 (47)

4.4 TOXICITY TO MICROORGANISMS E.G. BACTERIA

Type : aquatic
Species : activated sludge
Exposure period : 3 hour(s)
Unit : mg/l
EC50 : 9450
EC05 : 3520

Analytical monitoring : no
Method : ISO 8192 "Test for inhibition of oxygen consumption by activated sludge"
Year : 1991
GLP : yes
Test substance : other TS: Phosphorus trichloride, purity 99.7 %

Test condition : Inoculum: Activated sludge from laboratory waste water treatment plant, inoculum contained 6 g/l TS
Test concentrations of Phosphorus trichloride: 1000, 1800, 3200, 5600, and 10000 mg/l,
Reference substance: 3,5-dichlorophenol
No analytical monitoring because test substance hydrolyses into hydrochloric acid and phosphonic acid
Reliability : (1) valid without restriction
Test procedure in accordance with national standard methods
Flag : Critical study for SIDS endpoint
09.02.2004 (44)

4.5.1 CHRONIC TOXICITY TO FISH

4.5.2 CHRONIC TOXICITY TO AQUATIC INVERTEBRATES

4.6.1 TOXICITY TO SEDIMENT DWELLING ORGANISMS

4.6.2 TOXICITY TO TERRESTRIAL PLANTS

4.6.3 TOXICITY TO SOIL DWELLING ORGANISMS

4.6.4 TOX. TO OTHER NON MAMM. TERR. SPECIES

4.7 BIOLOGICAL EFFECTS MONITORING

4.8 BIOTRANSFORMATION AND KINETICS

4.9 ADDITIONAL REMARKS

Memo : Aquatic toxicity
Remark : Aquatic toxicity range 10-100 mg/l
Test substance : Phosphorus trichloride, purity not given
Reliability : (4) not assignable
Original reference not available
09.02.2004 (48)
Memo : Harmful effects
Remark : harmful effects through shift of pH in water
Test substance : Phosphorus trichloride
Reliability : (4) not assignable
Manufacturer data without proof
09.02.2004 (22)

5.0 TOXICOKINETICS, METABOLISM AND DISTRIBUTION

In Vitro/in vivo	:	In vitro
Type	:	
Species	:	
Number of animals		
Males	:	
Females	:	
Doses		
Males	:	
Females	:	
Vehicle	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: phosphorus trichloride
Result	:	detailed investigations on the reaction between water and PCl3 were performed. PCl3 hydrolyses quickly and exothermally to give hydrochloric and phosphorous acid. Reaction is complete within few seconds when stirred.
Reliability	:	(4) not assignable

21.09.2004 (49)

In Vitro/in vivo	:	In vitro
Type	:	
Species	:	
Number of animals		
Males	:	
Females	:	
Doses		
Males	:	
Females	:	
Vehicle	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: phosphorus trichloride
Remark	:	Hydrolysis of PCl3 is reported under 5.11 Metabolism

21.09.2004

5.1.1 ACUTE ORAL TOXICITY

Type	:	LD50
Value	:	= 550 mg/kg bw
Species	:	rat
Strain	:	
Sex	:	no data
Number of animals	:	
Vehicle	:	other: vegetable oil
Doses	:	
Method	:	
Year	:	
GLP	:	no data
Test substance	:	other TS: phosphorus trichloride

Result	:	LD50: 550 mg/kg (470-643) LD16: 430 mg/kg LD84: 675 mg/kg Signs of intoxication: depresssionn, ausea, disturbance of movement co-ordination, fatigue, weakness, dakryorhea,appearance of an ichorous discharge from the eyes ,respiratory frequency: 50-80 per minute. 20 to 40 minutes after application of the LD50: cyanosis, weakness,sweat, convulsions, short-windedness. Necropsy: lungs of deceased animals were intensly red discolored. The livers were dark-gray-brown and full of blood when sectioned, the stomach was distended and hemorhagic
Test condition	:	6 Animals per dose group;
Reliability	:	(2) valid with restrictions short report, detailed description of toxicity
Flag	:	Critical study for SIDS endpoint
21.09.2004		(50) (51)

Type	:	LD50
Value	:	= 18 mg/kg bw
Species	:	rat
Strain	:	Sprague-Dawley
Sex	:	male/female
Number of animals	:	20
Vehicle	:	other: undiluted
Doses	:	12.6 - 15.8 - 20.0 - 25.1 m/{kg
Method	:	
Year	:	
GLP	:	no
Test substance	:	other TS: phosphorus trichloride >99%

Result	:	Dose / Mortality 12,6 / 0/5 15,8 / 2/5 20,0 / 3/5 25,1 / 5/5 LD50: 18 (15.6 - 20.7) mg/kg Symptoms: Reduced appetite and activity (3 to 10 days in survivors), increasing weakness, collpse, death Necropsy: lung congestion, liver discoloration, acute gastrointestinal inflammation (stomach ulceration, also in some survivors)
Reliability	:	(2) valid with restrictions short, tabular report;
Flag	:	Critical study for SIDS endpoint
21.09.2004		(52) (53)

Type	:	LD50
Value	:	= 200 mg/kg bw
Species	:	rat
Strain	:	Sprague-Dawley
Sex	:	male/female

Number of animals : 50
Vehicle : other: corn oil
Doses : 100-200-300-400-500 mg/kg
Method : other: no data
Year : 1977
GLP : no data
Test substance : other TS: PCl3

Remark : Male and female rats were fasted for 24 hours before administration of the test substance. The test material was administered orally, by intubation, as a 10% solution in corn oil. Animals were observed at 1, 3, 6, 24, 48, 72 hours then daily up to 14 days. The oral LD50 was calculated. All surviving animals were killed, autopsied and observed for gross pathological organ changes.

Result : Mortality

100	3/10
200	5/10
300	8/10
400	9/10
500	10/10

LD50: 200 ± 29 mg/kg bw
LD16: 110 mg/kg
LD84: 365 mg/kg

Signs of toxicity:
Decreased locomotor activity, piloerection, ptosis, wet underside and death. Normal body activity returned within 9 days in all surviving animals.

Necropsy:
Rugation of the pyloric mucosa, enlarged and darkened spleen, irregular thickening of the pyloric mucosa, stomach fused to liver or liver and pancreas, chronic pulmonary disease.

Reliability : (2) valid with restrictions
Summary report, detailed description
Flag : Critical study for SIDS endpoint
16.01.2006 (54)

Type : other
Value :
Species : other: mice and rats
Strain :
Sex :
Number of animals :
Vehicle :
Doses :
Method :
Year :
GLP :
Test substance : other TS: phosphorus trichloride

Result : by intragastric intubation to rats and mice PCl3 showed a median degree of toxicity, through the respiratory tract to mice, it was highly toxic. Threshold for acute toxicity to rat pulmonary macrophages was 686.8 mg/m3. PCl3 was a strong irritant to guinea pigs (no further data).

Reliability : (4) not assignable
Abstract only, no further data
21.09.2004 (55)

5.1.2 ACUTE INHALATION TOXICITY

Type	:	LC50
Value	:	= 226 mg/m³
Species	:	rat
Strain	:	
Sex	:	
Number of animals	:	
Vehicle	:	
Doses	:	
Exposure time	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: phosphorus trichloride
Remark	:	exposure period not known
Result	:	Symptoms: agitation, pawing of nose, sedation, coordination disturbances, lateral position, fibrilar twitching, convulsions, reduced and strenuous respiration Additionally: corrosion of lips, lacrimation, and corneal opacity. Loss of appetite and weight and weakness were recorded in survivors
Reliability	:	(2) valid with restrictions limited documentation; very few details given
Flag	:	Critical study for SIDS endpoint

21.09.2004 (50) (51)

Type	:	LC50
Value	:	= 592 mg/m³
Species	:	rat
Strain	:	
Sex	:	
Number of animals	:	
Vehicle	:	
Doses	:	
Exposure time	:	4 hour(s)
Method	:	
Year	:	
GLP	:	no data
Test substance	:	other TS: phosphorus trichloride
Remark	:	No further data given
Result	:	LC50s of PCl3 was 104.3 ppm (592 mg/m³) for rats. The slope of the dose response curve was 4.3 +- 0.7. Hydrolysis of PCl3 was about 40 percent. Animals showed signs of irritation (agitated, restless, irregular breathing, eyes closed, chromodakryorhea) during exposure to PCl3. All deaths occurred within 10 days. Histopathology revealed necrosis in the epithelium and its supporting structures in the nostrils. Pulmonary damage was negligible. The main site of pathologic action ws the kidney with nephrosis of the tubules of the cortico-medullary region.
Test condition	:	20 female rats per group; whole body Animals were observed and deaths were recorded up to 14 days post exposure. Median lethal concentrations (LC50) were computed. Hydrolysis of the test substance in the atmosphere: ca. 40%
Reliability	:	(2) valid with restrictions few details reported, number of groups and dose regimen missing
Flag	:	Critical study for SIDS endpoint

21.09.2004 (56)

Type	:	LC50
Value	:	> 118 ppm
Species	:	rat
Strain	:	Sprague-Dawley
Sex	:	male/female
Number of animals	:	
Vehicle	:	
Doses	:	
Exposure time	:	4 hour(s)
Method	:	other: EPA TSCA
Year	:	1982
GLP	:	yes
Test substance	:	other TS: phosphorus trichloride:>99.9%
Remark	:	There is a large discrepancy between nominal and measured concentrations e.g. high dose nominal concentration: 452.9 ppm = 2540 µg/l gravimetric measured conc.: (80 ppm) = 449 µg/l chloride measured: 159 ppm = (893 µg/l) inorganic phosphorus conc.: 118 ppm = (627 µg/l) Values in brackets are calculated. Other figures are stated in the report. The correct value cannot be drawn from the report. Possibly the unit (µg/l) for the gravimetric measured concentrations is wrong and should be read as "ppm " analogous to the other tables. This would give a gravimetric value near the nominal concentration. It is unclear how the nominal concentration was determined. If one accepts the measured values inspite of the large deviations, then the LC50 should be stated with regard to some measured value, not as a nominal value
Result	:	Mortality: 453 ppm: nose only: 1m+1f (day 7) whole body: 2m+1f (day 7+8) LC50 > 453 ppm (nominal)(2582 mg/m³) gravimetric: 449 mg/m³; analytic: 159,2 ppm (based on chloride); 118,2 ppm (based on inorg. P) Body weight: transient decrease at concentrations >= 278 ppm (1585 mg/m³) Clincal observation: dose dependent incidence and severity in all treated groups: wheezing, labored respiration, localized sores at nose, mouth and paws, swollen nose, blocked nostrils, red crusts arround the eyes. Necropsy: sores at nares,
Source	:	Astaris
Test condition	:	Chamber analysis : Group: C- low1- mid - high - low2 Nominal Concentrations: 0-103.4-278.1- 452.9 -28.5 ppm 0- 580 - 1560- 2540 - 160 µg/l gravimetric concentration: 0-281.8-354.3- 449.5 -57.9 µg/l

Analysis
Chloride: 0-101.7-219.6- 159.2 -16.2 ppm
inorg. phosphorus: 0- 81.8-149.6- 118.2 -14.3 ppm

mass median aerodynamic diameter:
< 0.65 µm in groups 2-4;
= 1.75 µm in group 5

Animals: 5m+5f per group per exposure type
Nose only as well as whole body exposure were employed
Duration: 4h

Reliability : (2) valid with restrictions
Guideline study, full report available, GLP
Analysis of atmosphere gives variable results, depending on method
Flag : Critical study for SIDS endpoint
22.09.2004 (57)

Type : LC50
Value : > 453 ppm
Species : rat
Strain : Sprague-Dawley
Sex : male/female
Number of animals : 40
Vehicle :
Doses :
Exposure time : 4 hour(s)
Method :
Year :
GLP :
Test substance : other TS: phosphorus trichloride

Remark : 453 ppm = 2582 mg/m³
Result : LC50 (4h): >453 ppm (nominal)
3 male and 2 female animals died.
Clinical signs: reduction of body weight, wheezing, labored respiration, localized sores, swollen nose, blocked nostrils, red crusts around the eyes.
Test condition : 4 Groups of 5m+5f Sprague-Dawley rats were exposed for 4 h to PCl3. Afterwards they were observed for 14 days
Reliability : (2) valid with restrictions
Summary, no further data
Flag : Critical study for SIDS endpoint
21.09.2004 (53)

Type : LC50
Value : 132 mg/m³
Species : rat
Strain :
Sex :
Number of animals :
Vehicle :
Doses :
Exposure time :
Method :
Year :
GLP :
Test substance : other TS: phosphorus trichloride

Reliability : (4) not assignable
RTECS data; Report not available

21.09.2004 (58) (59)

Type	:	LC50
Value	:	> 20.29 mg/l
Species	:	rat
Strain	:	
Sex	:	
Number of animals	:	10
Vehicle	:	
Doses	:	20.29 mg/l
Exposure time	:	1 hour(s)
Method	:	
Year	:	1977
GLP	:	
Test substance	:	other TS: PCl3
Remark	:	10 rats were exposed to an aerosol of the test material. Observation period not given.
Result	:	Mortality 20.29 0/10 Signs of toxicity: Face pawig, shovel nosing, salivation, nasal discharge, escape motions, decreased locomotor activity, redness on eye membrane and ears, lacrimation
Reliability	:	(2) valid with restrictions Short report, limited description
Flag	:	Critical study for SIDS endpoint

16.01.2006 (60)

Type	:	other
Value	:	
Species	:	rat
Strain	:	
Sex	:	
Number of animals	:	
Vehicle	:	
Doses	:	
Exposure time	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: phosphorus trichloride
Result	:	The threshold of acute toxicity of PCl3 was 686.8 mg/m³ in rat lung macrophages
Reliability	:	(4) not assignable Abstract only, no further data

21.09.2004 (55)

Type	:	other: Inhalation hazard test
Value	:	
Species	:	rat
Strain	:	Wistar
Sex	:	male/female
Number of animals	:	60
Vehicle	:	
Doses	:	
Exposure time	:	
Method	:	
Year	:	1977

GLP	:	no
Test substance	:	other TS: phosphorus trichloride
Result	:	Mortality: none after 0.5 and 1 minute; 100% after 2, 5, and 10 minutes exposure within 5 to 60 minutes Symptoms: agitation, lethargy, irregular gasping, wheezing, sneezing, prostration, ptosis Necropsy: discoloration of lungs, after 2 and more minutes: corneal opacity and swelling of nose.
Test condition	:	Animals: 6 male and 6 female Wistar rats per group Exposure time: 0.5, 1, 2, 5, 14 minutes Observation time: up to 14 days after exposure Observation: clinical findings, necropsy
Test substance	:	chemically pure substance
Reliability	:	(2) valid with restrictions Detailed report available; non-standard test,
Flag	:	Critical study for SIDS endpoint

21.09.2004 (61)

Type	:	other
Value	:	
Species	:	mouse
Strain	:	
Sex	:	
Number of animals	:	
Vehicle	:	
Doses	:	
Exposure time	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: phosphorus trichloride
Result	:	PCl3 was "highly toxic"
Reliability	:	(4) not assignable Abstract only, no further data

21.09.2004 (55)

Type	:	other: LClo
Value	:	= 600 ppm
Species	:	mouse
Strain	:	
Sex	:	
Number of animals	:	
Vehicle	:	
Doses	:	
Exposure time	:	10 minute(s)
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: phosphorus trichloride
Remark	:	600 ppm = 3420 mg/m³
Reliability	:	(4) not assignable Report not available

21.09.2004 (62)

Type	:	LCLo
Value	:	3500 mg/m³
Species	:	rabbit
Strain	:	
Sex	:	
Number of animals	:	
Vehicle	:	
Doses	:	
Exposure time	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: phosphorus trichloride
Reliability	:	(4) not assignable RTECS data; Report not available

21.09.2004 (58) (59)

Type	:	
Value	:	
Species	:	rabbit
Strain	:	
Sex	:	
Number of animals	:	7
Vehicle	:	
Doses	:	4-30, 40-330, 930-3870 ppm (22.8-171, 228-1881, 2109- 22059 mg/m³)
Exposure time	:	
Method	:	
Year	:	1904
GLP	:	no
Test substance	:	other TS: phosphorus trichloride
Result	:	Symptoms: low dose: Sedation, reduced respiratory frequency medium dose: agitation, nasal discharge, rhinitis, sedation, reduced respiratory frequency, irregular respiration, corneal corrosion, dyspnea, tremor, lacrimation, salivation, high dose: sneezing, agitation, closed eyes, white secretion from eyes, corneal opacity (at 118 min), death, weight loss Necropsy: medium dose: hyperemia of trachea, slight lung edema, partial infiltration of right lung high dose: severe lung edema, emphysema, severe catarrh, corrosion of tongue and cornea
Test condition	:	2-3 rabbits per concentration range were exposed to PCl3 at concentrations of 4-30, 40-330, or 370-3870 ppm and observed for clinical signs for 6, 6-10, or 3-4 hours respectively
Reliability	:	(2) valid with restrictions Early study, detailed description of findings, non-standard test animal
Flag	:	Critical study for SIDS endpoint

21.09.2004 (63)

Type	:	LCLo
Value	:	500 mg/m³
Species	:	cat
Strain	:	
Sex	:	
Number of animals	:	
Vehicle	:	

Doses	:	
Exposure time	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: phosphorus trichloride
Reliability	:	(4) not assignable RTECS data; Report not available
21.09.2004		(58) (59)
Type	:	other: TCLo
Value	:	10 - 40 mg/m³
Species	:	cat
Strain	:	
Sex	:	
Number of animals	:	
Vehicle	:	
Doses	:	
Exposure time	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: phosphorus trichloride
Remark	:	40 mg/m³ for 6h 10 mg/m³ for 1h
Reliability	:	(4) not assignable RTECS data; Report not available
21.09.2004		(58) (59)
Type	:	
Value	:	
Species	:	cat
Strain	:	
Sex	:	no data
Number of animals	:	13
Vehicle	:	
Doses	:	4-30, 40-330, 370-3870 ppm (22.8-171, 228-1881, 2109- 22059 mg/m³)
Exposure time	:	
Method	:	
Year	:	1904
GLP	:	no
Test substance	:	other TS: phosphorus trichloride
Remark	:	According to the author the findings were almost identical to findings produced by HCl vapors in earlier studies. PCl3 was more effective at low doses
Result	:	Symptoms: low dose: salivation, irregular respiration, dyspnea, cough, lacrimation, sedation medium dose: immediate agitation, reduced irregular respiratory frequency, cough, sneezing, breathing through open mouth, foamy salivation, nasal discharge, rhinitis, conjunctivitis, dyspnea, loss of weight high dose: as above but earlier onset and more severe; death Necropsy: low dose: discoloration of nasal cavity, injection of trachea, lung edema, ecchymosis,

medium dose: corneal opacity, conjunctivitis, nasal corrosion, trachea contain foamy red liquid, edema of epiglottis, severe emphysema
high dose: as medium dose

Test condition : 1-5 cats per concentration range were exposed to PCl3 at concentrations of 4-30, 40-330, or 370-3870 ppm and observed for clinical signs for 3-6, 6-10, or 3-6.5 hours respectively
additionally a gross necropsy was performed

Reliability : (2) valid with restrictions
Early study, detailed description of findings, non-standard test animal

Flag : Critical study for SIDS endpoint

21.09.2004 (63)

Type : LC50
Value : = 285 mg/m³
Species : guinea pig
Strain :
Sex :
Number of animals :
Vehicle :
Doses :
Exposure time : 4 hour(s)
Method :
Year :
GLP :
Test substance : other TS: phosphorus trichloride

Remark : no further data given

Result : LC50s of PCl3 was 50.1 ppm (285 mg/m³) for guinea pigs. The slope of the dose response curve was 5.7 +- 0.9.
Hydrolysis of PCl3 was about 40 percent.
Animals showed signs of irritation (agitated, restless, irregular breathing, eyes closed, chromodakryorhea) during exposure to PCl3.
All deaths occurred within 10 days.
Histopathology revealed necrosis in the epithelium and its supporting structures in the nostrils. Pulmonary damage was negligible. The main site of pathologic action was the kidney with nephrosis of the tubules of the cortico-medullary region.

Test condition : 10 male guinea pigs per group; whole body
Animals were observed and deaths were recorded up to 14 days post exposure. Median lethal concentrations (LC50) were computed.

Reliability : (2) valid with restrictions
the differentiation between the study in rats and the guinea pig study regarding the observed symptoms is not possible

Flag : Critical study for SIDS endpoint

21.09.2004 (56)

Type : LC50
Value : 63.5 mg/m³
Species : guinea pig
Strain :
Sex :
Number of animals :
Vehicle :
Doses :
Exposure time :
Method :
Year :
GLP :
Test substance : other TS: phosphorus trichloride

Reliability : (4) not assignable
RTECS data; Report not available

21.09.2004 (58) (59)

5.1.3 ACUTE DERMAL TOXICITY

Type	:	LD50
Value	:	> 1000 mg/kg bw
Species	:	rabbit
Strain	:	New Zealand white
Sex	:	male/female
Number of animals	:	5
Vehicle	:	other: undiluted
Doses	:	1000 - 1260 - 2000 mg/kg
Method	:	
Year	:	
GLP	:	no
Test substance	:	other TS: phosphorus trichloride: >99%

Result :
Dose / Mortality
1000 / 0/2
1260 / 1/2
2000 / 1/1

LDlo = 1260 mg/kg

Symptoms:
Reduced appetite and activity (3 to 15 days in survivors), increasing weakness, collapse, death

Necropsy:
dead animals: lung hyperemia, liver discoloration,kidney and spleen darkened, enlarged gall bladder, slight gastrointestinal inflammation
survivors: kidney and spleen discolored,slight gastrointestinal inflammation

Test condition : semi-occlusive; 24 h exposure
Reliability : (2) valid with restrictions
short report; few details given
Flag : Critical study for SIDS endpoint

21.09.2004 (52) (53)

Type	:	LD50
Value	:	> 250 mg/kg bw
Species	:	rabbit
Strain	:	New Zealand white
Sex	:	male
Number of animals	:	12
Vehicle	:	other: none
Doses	:	250 mg/kg
Method	:	
Year	:	1977
GLP	:	
Test substance	:	other TS: PCl3

Remark :
Range finder:
Two animals were used, one at each of 250 and 500 mg/kg bw.

Main study:
The test material was administered undiluted to intact skin for 6 animals

and to abraded skin for the other 6 animals. Animals were observed at 1, 3, 6, 24, 48, 72 hours then daily up to 14 days.

Result : Mortality (range finder)
250 0/1
500 1/1
Based on the corrosive effects at these doses, 250 mg/kg was used in the main study.

Main Study
250 0/12

LD50: > 250 mg/kg bw

Signs of toxicity:
In the range finding study the test substance produced oedema, erythema, necrosis, eschar, and death at 500 mg/kg.
In the range finder and main study, the animals exposed to 250 mg/kg showed oedema, erythema, necrosis and eschar but no mortality.

Reliability : (2) valid with restrictions
Short report, detailed description

16.01.2006 (64)

5.1.4 ACUTE TOXICITY, OTHER ROUTES

5.2.1 SKIN IRRITATION

Species	:	rabbit
Concentration	:	
Exposure	:	
Exposure time	:	
Number of animals	:	
Vehicle	:	
PDII	:	
Result	:	highly corrosive
Classification	:	
Method	:	
Year	:	1984
GLP	:	
Test substance	:	other TS: phosphorus trichloride
Result	:	PCl3 caused skin corrosion after 60 seconds of contact to skin even when the skin was cleaned using water, lutrol, or paraffin oil
Test condition	:	100 µl of PCl3 were applied to the shaved skin of rabbits (number not stated). The treated area was washed 60 seconds thereafter with water, lutrol, or paraffin oil. Changes were recorded
Reliability	:	(2) valid with restrictions
Flag	:	Critical study for SIDS endpoint

21.09.2004 (65)

Species	:	rabbit
Concentration	:	
Exposure	:	
Exposure time	:	
Number of animals	:	
Vehicle	:	

PDII	:	
Result	:	
Classification	:	
Method	:	other: no data
Year	:	
GLP	:	
Test substance	:	other TS: phosphorus trichloride
Remark	:	thickening in skin folds, bleeding
Test condition	:	4 drops were applied to the shaved skin
Reliability	:	(4) not assignable Short notice; no details given

21.09.2004 (50)

Species	:	rabbit
Concentration	:	
Exposure	:	
Exposure time	:	
Number of animals	:	
Vehicle	:	
PDII	:	
Result	:	
Classification	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: phosphorus trichloride
Result	:	A correlation between the inhalation irritation threshold for humans and rats on one hand, and skin irritation for rabbits on the other, was assessed for PCl3 and other chemicals. The degree of hyperemia following the dermal application to rabbits was correlated with an increase in the thickness of the skin fold. The skin irritation was concn.-dependent. The inhalation toxicity may be approx. assessed from skin irritation tests.
Test condition	:	Literature review; no experimental details
Reliability	:	(4) not assignable non standard evaluation and comparison scheme; no experimental data

21.09.2004 (66)

Species	:	rabbit
Concentration	:	undiluted
Exposure	:	Semiocclusive
Exposure time	:	24 hour(s)
Number of animals	:	
Vehicle	:	
PDII	:	
Result	:	corrosive
Classification	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: phosphorus trichloride: >99%
Result	:	Loosening about edge of scab in ten to fourteen days showing injury in depth
Test condition	:	New Zealand White rabbits were treated on the shaved skin
Reliability	:	(2) valid with restrictions

Abstract only, no further data
Flag : Critical study for SIDS endpoint
21.09.2004 (52) (53)

Species : rabbit
Concentration : undiluted
Exposure :
Exposure time : 24 hour(s)
Number of animals : 6
Vehicle : other: none
PDII :
Result : corrosive
Classification :
Method :
Year : 1977
GLP :
Test substance : other TS: PCl3

Remark : 0.5 ml of the test material was administered undiluted to abraded skin. Animals were observed for signs of dermal irritation on removal of dressing and at 72 hours.
Result : Application of the test material caused immediate tissue destruction. Due to the severity of tissue destruction, a primary irritation index could not be calculated.
Reliability : (2) valid with restrictions
Short report, detailed description
Flag : Critical study for SIDS endpoint
16.01.2006 (67)

Species : rat
Concentration :
Exposure : no data
Exposure time :
Number of animals :
Vehicle :
PDII :
Result :
Classification :
Method :
Year :
GLP : no data
Test substance : other TS: phosphorus trichloride

Remark : observation in acute inhalation study
Result : The irritant effect of PCl3 is more pronounced, which is demonstrated by turbidity of the cornea, appearance of skin ulcers around the mouth and nose of the experimental animals and by a well developed pathomorphological picture of irritation of the respiratory passages.
Reliability : (2) valid with restrictions
short report, few detail, no data on study design
Flag : Critical study for SIDS endpoint
21.09.2004 (51)

5.2.2 EYE IRRITATION

Species : rabbit
Concentration :

Dose	:	
Exposure time	:	
Comment	:	
Number of animals	:	
Vehicle	:	
Result	:	
Classification	:	
Method	:	other: no data
Year	:	
GLP	:	
Test substance	:	other TS: phosphorus trichloride
Remark	:	irreversible necrosis in the eye causing loss of vision.
Reliability	:	(4) not assignable limited documentation; no experimental details given
Flag	:	Critical study for SIDS endpoint

21.09.2004 (50)

Species	:	rabbit
Concentration	:	undiluted
Dose	:	.1 ml
Exposure time	:	
Comment	:	
Number of animals	:	
Vehicle	:	
Result	:	corrosive
Classification	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: phosphorus trichloride:>99%
Result	:	corrosive in 5 seconds immediate discomfort with severe pawing, squealing, trashing about the stocks, eyes tightly closed
Test condition	:	PCl3 was applied to the conjunctival sac. Effects were scored according to Draize
Reliability	:	(2) valid with restrictions Abstract only, few details given
Flag	:	Critical study for SIDS endpoint

21.09.2004 (52) (53)

Species	:	rabbit
Concentration	:	undiluted
Dose	:	.1 ml
Exposure time	:	
Comment	:	
Number of animals	:	6
Vehicle	:	none
Result	:	corrosive
Classification	:	
Method	:	
Year	:	1977
GLP	:	
Test substance	:	other TS: PCl3
Remark	:	The test material was instilled undiluted into the conjunctival sac of one eye of each rabbit. Ocular reactions were graded at 1, 24, 48, 72 hours, 4 and 7 days.

Result	:	Scoring could not be done due to irreversible damage to eye tissue on contact.
Reliability	:	(2) valid with restrictions Short report, detailed description
Flag	:	Critical study for SIDS endpoint

16.01.2006 (67)

5.3 SENSITIZATION

Type	:	Guinea pig maximization test
Species	:	guinea pig
Number of animals	:	
Vehicle	:	
Result	:	not sensitizing
Classification	:	
Method	:	other
Year	:	
GLP	:	
Test substance	:	other TS: 1% hydrochloric acid in 70% ethanol.
Remark	:	Sensitization was not induced in 15 guinea pigs that were given two intradermal injections and a covered application (48-hr) of 1% HCl (in ethanol of undefined concentration) and challenged 2 weeks later by a similar 24-hr covered. No. of animals with skin reaction at challenge: Treated: 0/15 Control group: 0/6

22.07.2004 (68)

Type	:	Mouse ear swelling test
Species	:	mouse
Number of animals	:	
Vehicle	:	
Result	:	not sensitizing
Classification	:	
Method	:	other
Year	:	
GLP	:	no
Test substance	:	other TS: 1% hydrochloric acid in 70% ethanol.
Remark	:	Four consecutive daily uncovered applications of 1% HCl solution in 70% ehtanol to the abdominal skin were followed 7 days later by a challenge with a 5% uncovered application to the ear. No evidence of sensitization was seen. No. of animals: Not stated Control group: Not stated

22.07.2004 (68)

5.4 REPEATED DOSE TOXICITY

Type	:	Sub-acute
Species	:	rat
Sex	:	male/female
Strain	:	Sprague-Dawley
Route of admin.	:	inhalation
Exposure period	:	4 weeks
Frequency of treatm.	:	5 days/week
Post exposure period	:	none
Doses	:	0.5, 3.0, and 10 ppm

Control group	:	yes
NOAEL	:	= 3 ppm
Method	:	other: EPA/TSCA
Year	:	1982
GLP	:	yes
Test substance	:	other TS: phosphorus trichloride: >99.9 %
Remark	:	histopath: squamous metaplasia of respiratory epithelium; focal suppurative inflamation of the anterior nasal region.
Result	:	1) 0.5 ppm: no effects 2) 3 ppm: no effects 3) 10 ppm: nasal cavity and turbinates, histopathology:proteinaceous fluid with suppurative inflammation; inflammation and squamous metaplasia of respiratory epithelium
Test condition	:	Animals: 15 per sex per group Exposure: 6h*5d*4W; whole body Parameters: mortality, ophthalmoscopy, clinical findings, body weights, clinical pathology (hematology; clinical chemistry; urinalysis), organ weights (absolute; relative to brain and body weight), gross pathology, histopathology
Reliability	:	(1) valid without restriction Guideline study, full report available
Flag	:	Critical study for SIDS endpoint

08.07.2005 (69)

Type	:	Sub-chronic
Species	:	rat
Sex	:	male/female
Strain	:	other: F344/CrlBr and Sprague-Dawley
Route of admin.	:	inhalation: aerosol
Exposure period	:	90 days
Frequency of treatm.	:	6h/d x 5d/w
Post exposure period	:	
Doses	:	0-10-20-50ppm (nominal)
Control group	:	yes, concurrent vehicle
Method	:	
Year	:	1983
GLP	:	yes
Test substance	:	other TS: HCl
Result	:	NOAEC = 20 ppm (disregarding irritation) Mortality: none Body weight (50 ppm) and food consumption (20 and 50 ppm) were reduced. clinical pathology: no effects in hematology, clin. chemistry, urinalysis Histopathology: Rhinitis in the nasal cavity, detected in all treatment groups, accompanied with occasional hyperceratosis, was the only finding. No treatment related findings were present in other tissues , e.g. the reproductive organs testes, ovaries, etc. (tissues investigated: see TC).
Test condition	:	Age of animals at start: 6 -7 weeks Number of animals: 31 m +21 f per group Exposure: whole body; (6h*5d/w)*90d Vehicle : air Parameter examined: Clinical signs (daily), body weight (weekly), food consumption (weekly),

urinalysis, hematology, clinical chemistry, necropsy, organ weights, histopathology [nasal turbinates, trachea, lung, brain , heart, kidney, liver, testis, adrenal, duodenum, eyes and optic nerve, mesenteric lymph nodes, aorta, sternum bone, ear canal, bone marrow, colon, epididymis, jejunum, mandibular lymph nodes, oviducts, ovaries, prostate, skin, pituitary glands, spinal cord, sciatic nerve, peripheral nerve, salivary gland, spleen, thyroid glands, urinary bladder, uterus, thymus, fore and glandular stomach, pancreas, parathyroid, skeletal muscle, seminal vesicle, tongue, femur bone, cecum, esophagus, ileum, lacrimal gland, mammary gland, larynx]

Statistics:
ANOVA for parametric data; significant values were studied with Tukey's or Scheffe's test of multiple comparison
Non parametric data were evaluated according to Kruskal- Wallis ANOVA discontinuous data were compared using Fisher' Exact or Chi-square Probability Test

Reliability : (2) valid with restrictions
Flag : Critical study for SIDS endpoint
13.02.2006 (70)

Type : Sub-chronic
Species : mouse
Sex : male/female
Strain : B6C3F1
Route of admin. : inhalation
Exposure period : 90 days
Frequency of treatm. : 6h*5d/w*90d
Post exposure period : none
Doses : 0-10-20-50 ppm
Control group : yes
Method :
Year :
GLP : yes
Test substance : other TS: HCl

Result : Moratlity: 4/52 (low dose)
0/52 (mid dose)
2/52 (high dose)
According to authors death was not related to exposure

Body weight gain: all exposed high dose animals affected
clinical pathology: no effects in hematology, clin. chemistry, urinalysis

Organ weights: decreased liver weight (high dose)

Pathology: gross lesions in perioral tissue and toes (swelling, ulcerative dermatitis); cheilitis with accumulating hemosiderin-laden macropahges and eosinophilic globules in the epthelium of nasal turbinates were observed in exposed mice

Test condition : Animals: 31 m +m 21 f per group
Exposure: whole body; (6h*5d/w)*90d
Reliability : (2) valid with restrictions
Flag : Critical study for SIDS endpoint
27.09.2004 (70)

5.5 GENETIC TOXICITY 'IN VITRO'

Type	:	Ames test
System of testing	:	S. typhimurium TA1535, TA100, TA1537, D3052, TA1538, TA98, C3076, G46
Test concentration	:	0.1-1000µg/mL
Cycotoxic concentr.	:	
Metabolic activation	:	with and without
Result	:	negative
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: phosphorus trichloride
Test condition	:	positive and negative controls used in both activated and non-activated tests
Reliability	:	(2) valid with restrictions Non-standard test: gradient test
Flag	:	Critical study for SIDS endpoint

21.09.2004 (71)

Type	:	Bacterial gene mutation assay
System of testing	:	E. coli WP2, WP2uvrA-
Test concentration	:	0.1 - 1000 µg/mL
Cycotoxic concentr.	:	
Metabolic activation	:	with and without
Result	:	negative
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: phosphorus trichloride
Test condition	:	positive and negative controls used in both activated and non-activated tests
Reliability	:	(2) valid with restrictions Non-standard test: gradient test
Flag	:	Critical study for SIDS endpoint

21.09.2004 (71)

Type	:	Ames test
System of testing	:	S. typhimurium TA1535, TA100, TA1537, TA1538, TA98 S. cerevisiae D4
Test concentration	:	0.001 to 5.0 µl per plate
Cycotoxic concentr.	:	5.0 µl per plate
Metabolic activation	:	with and without
Result	:	negative
Method	:	
Year	:	1977
GLP	:	
Test substance	:	other TS: PCl3
Reliability	:	(2) valid with restrictions short report; limited description
Flag	:	Critical study for SIDS endpoint

16.01.2006 (72)

5.6 GENETIC TOXICITY 'IN VIVO'

Type	:	Cytogenetic assay

Species	:	human
Sex	:	no data
Strain	:	
Route of admin.	:	
Exposure period	:	
Doses	:	
Result	:	negative
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: phosphorus trichloride
Result	:	The incidence of chromosomal aberrations in workers with contact to PCl3 was 1.58 % The incidence of chromosomal aberrations in workers without contact to PCl3 was 1.4 % There was no significant difference
Test condition	:	Human peripheral lymphocytes were investigated 24 Worker with contact to PCl3 and 10 workers without contact to PCl3 were examined; there were smokers in both groups; 0.45 ml blood were collected, heparinized and cultured at 37 C for 72 hours. 4 hours before end of culture colchicine was added. Slides were prepared and exyamined microscopically
Reliability	:	(2) valid with restrictions short report
Flag	:	Critical study for SIDS endpoint

21.09.2004 (73)

Type	:	Micronucleus assay
Species	:	mouse
Sex	:	male
Strain	:	other: Kunming
Route of admin.	:	i.p.
Exposure period	:	5 days
Doses	:	10,94-21,88-43,75 mg/kg
Result	:	negative
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: phosphorus trichloride
Result	:	PCl3 did not induce chromosome aberration or micronucleus rate increases in bone marrow cells or abnormalities in sperm of mice. Chromosomal aberrations: 0,8%, 0,6% or 0,6% in treated animals (P >0,05; X2 = 1,7362) = non significant negative control: 0,2% positive control: 11,7%. P <0,01 (X2 = 33,31) =significant.
Test condition	:	Animals were injected 5 times and killed on day 6. 3-4 h before death animals were treated with colchicine (ip) both femora were prepared and the bone marrow collected for the determination of chromosomal aberrations and micro-nuclei Vehicle: cod liver oil pos. control: cyclophosphamide For chromosomal aberrations 100 cells were scored and for micro-nuclei 1000 polychromatic erythrocytes were examined. Statistics: Chi square test

Reliability : (2) valid with restrictions
Detailed publication
Flag : Critical study for SIDS endpoint
27.09.2004 (73)

5.7 CARCINOGENICITY

Species : rat
Sex : male
Strain : Sprague-Dawley
Route of admin. : inhalation
Exposure period : Maximum, 128 weeks (for life)
Frequency of treatm. : 6 hours/day, 5 days/week
Post exposure period : No
Doses : 10.0 ppm (14.9 mg/m³)
Result :
Control group : yes, concurrent vehicle
Method : other
Year :
GLP : no data
Test substance : other TS: Hydrogen chloride, purity 99.0% grade, Matheson Gas Products

Remark : Method: Three groups of 100 male rats, nine weeks old, were unexposed (colony controls), exposed by inhalation to air (air control) or exposed to 10 ppm of hydrogen chloride. Complete necropsy was performed on each animal and particular attention was give to the respiratory tract.
Result : Mortality did not significantly differ from air control group. No preneoplastic or neoplastic nasal lesion was observed in any group, but hyperplasia of the larynx and trachea was observed in treated animals (22/99 and 26/99, respecively). Tumor responses were similar in the treated and control groups, the total incidences of tumours at various sites being 19/99, 25/99 and 24/99 in treated, air control and colony control animals, respectively.

Observation		HCl	Air	Colony
No. examined		99	99	99
Larynx	Hyperplasis	22	2	2
	Squamous metaplasis	0	0	0
Trachea	Hyperplasis	26	6	2
	Squamous metaplasis	0	0	0
Nasal	Rhinitis	81	72	70
mucosa	Epithelial or squamous hyperplasia	62	51	45
	Squamous metaplasis	9	5	6
Total no. of tumors		19	25	24

Reliability : (2) valid with restrictions
main study details reported
Flag : Critical study for SIDS endpoint
21.09.2004 (74)

Species : rat
Sex : male/female
Strain : Sprague-Dawley
Route of admin. : inhalation
Exposure period : 588 days (19.4 months)
Frequency of treatm. : 6 hours/day, 4.7 days/week or two-thirds of each week
Post exposure period : No
Doses : Average concentration; 10.2 ppm
Result :

Control group	:	yes, concurrent vehicle
Method	:	other
Year	:	
GLP	:	no data
Test substance	:	other TS: Hydrogen chloride, purity; 99.0% grade, Matheson Gas Product
Remark	:	Method: 20 rats were treated with Hydrogen chloride gas or air shamexposed as control. Complete necropsy was performed on each animals and particular attention was given to the respiratory tract.
Result	:	No carcinogenic response was observed. Mortality after 588 days (19.4 months) was 29% in treated rats and 28% in airsham-exposed rats; at necropsy no nasal cancers were observed. There was no significant weight loss in treated group.
Test condition	:	Animals: 20 rats per group Treatment: whole body hydrogen chloride gas or air sham-exposed as control. Duration: 6h*5d/w for lifetime Observation: All animals were observed daily and weighed monthly Complete necropsy was performed on each animal and particular attention was given to the respiratory tract
Reliability	:	(2) valid with restrictions publication, main features of study reported
Flag	:	Critical study for SIDS endpoint

13.02.2006 (75)

Species	:	rat
Sex	:	male/female
Strain	:	other: Charles River CD
Route of admin.	:	oral feed
Exposure period	:	27 months
Frequency of treatm.	:	
Post exposure period	:	
Doses	:	0 - 2000 - 8000 - 32000 ppm
Result	:	negative
Control group	:	yes
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: mono sodium phosphite
Remark	:	Due to its corrosive properties and high reactivity PCl3 will be bio-available exclusively at the portal of entry. Products of hydrolysis (HCl and phosphorous acid) will form at a high rate and be neutralised immediately. Therefore, at longer term exposure at low doses only the salts (anions) will be systemically available and daqta on these salts can be used as a surrogate for PCl3 in this context.
Result	:	There was no evidence of oncogenic response in the urinary bladder, adrenal medulla or at any other site The following symptoms were detected: reduction of body weight: 32000 ppm (m: -13,8%; f:-9,4%) 8000 ppm (m: -15,4%) 2000 ppm (m: - 9,5%) reduced utilization of food: 32000 + 8000 ppm, males only soft stool: 32000 ppm, males silght reduction of urinary pH: 32000 ppm, males

		increase in relative weight: liver: males kidney: males + females heart: males + females
Test condition	:	Animals: 60 per sex/group
Test substance	:	mono sodium phosphite
Reliability	:	(2) valid with restrictions
Flag	:	Critical study for SIDS endpoint

28.11.2005 (76) (77)

Species	:	mouse
Sex	:	male/female
Strain	:	C3H
Route of admin.	:	oral unspecified
Exposure period	:	11 months
Frequency of treatm.	:	First 5 months of the experiment injections were made 5 days/week. Because of great mortality among the treated mice, the number of injections was decreased to 3 days/week on alternate days.
Post exposure period	:	No
Doses	:	90-360 mg/kg b.w.
Result	:	
Control group	:	yes, concurrent vehicle
Method	:	other
Year	:	
GLP	:	no
Test substance	:	other TS: Hydrochloric acid
Remark	:	Method: Hydrochloric acid was orally given to mice with (40 mice) or without (58 mice) 1,2,5,6-dibenzanthracene, which was administered once a week during a later period. Probably, only the gastrointestinal tractr was examined.
Result	:	The treatment did not apparently increase the incidence of tumors. The treatment lead to stomach damage. Probably no other tissue examined.
Reliability	:	(2) valid with restrictions short notice, few details

21.09.2004 (78)

5.8.1 TOXICITY TO FERTILITY

5.8.2 DEVELOPMENTAL TOXICITY/TERATOGENICITY

Species	:	rat
Sex	:	female
Strain	:	other: no data
Route of admin.	:	gavage
Exposure period	:	day 6-15
Frequency of treatm.	:	
Duration of test	:	
Doses	:	0 - 0 - 6.44 - 9.7 - 19.3 mg/kg bw
Control group	:	other: positive + vehicle control groups
NOAEL teratogen.	:	= 19.3 mg/kg bw
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: phosphorus trichloride
Remark	:	positive control substance described as: Dikushuang, the chinese name of

some pesticide
The dose was 7 mg/kg bw

The stated number of resorptions 67 is 47.5% of 141; i.e. The number of resorptions is included in the number of fetuses. It is possible that the heading "Number of fetuses" should have been translated as "number of implantations" and is a translation mistake

Result : Body weight gain of dams:
no effect in treated animals; reduction in pos. controls

Effects on fertility:	neg	low	med	hig	pos
Number of pregnant rats:	16	15	15	14	15
number of fetuses:	136	126	132	124	141
Corpora lutea:	218	205	217	206	150
corpora lutea per rat:	13.6	13.7	14.5	14.7	10
number of pups/litter:	8.13	7.73	8.47	8.06	8.2
dead fetuses:	3	1	3	10	0
% dead fetuses:	2.3	0.79	2.27	8.06	0
resorptions:	3	9	2	1	67
% resorptions:	2.2	7.1	1.52	0.81	47.5*
litters with resorptions:	3	3	1	1	11
% Litter w. resorptions:	12.3	20	6.67	7.14	73.3*

* = significant

	neg	low	med	hig	pos
pups examined:	130	116	127	113	74
size (cm):	3,84	3.89	3.84	3.79	3,64
tail (cm):	1,29	1,29	1,25	1,25	1,13
weight of placenta (g):	0,43	0,49	0,46	0,47	0,51
frontal fontanella (mm):	3,14	2,95	3,06	2,97	2,93

There were no significant differences between treated and negative control animals. No malformations were detected.
Skeletal development in treated fetuses was retarded but without a dose effect relation.
Pos. control showed clear effects on fertility indices but no malformations.

Test condition : Animals were killed on day 20 of pregnancy and fetuses collected by cecsarean section.
the positive control group was exposed on days 9 - 11

Reliability : (2) valid with restrictions
Detailed publication

Flag : Critical study for SIDS endpoint

13.02.2006 (73)

5.8.3 TOXICITY TO REPRODUCTION, OTHER STUDIES

Type : other:structural aberrations in sperm cells
In vitro/in vivo : In vivo
Species : rat
Sex : male
Strain :
Route of admin. : inhalation
Exposure period : 4 h
Frequency of treatm. : daily

Duration of test : 45 or 60 days
Doses : 2 - 33,5 - 97,76 mg/m³
Control group :
Result : negative
Method :
Year : 1989
GLP :
Test substance : other TS: phosphorus trichloride

Remark : The authors regard the result as "not significant"
Result : 45 days exposure:

group:	97,25 mg/m3 (97,76)	2 mg/m3	Control
findings(%):	1,44*	0,56	0,4
hooks (%):	16 (44,4)	5 (35,7)	4 (40,0)
banana (%):	16 (44,4)	7 (50)	5 (50)
amorphous (%):	4(11,1)	2 (14,3)	1 (10)

60 days exposure:

group:	33,5 mg/m3	2 mg/m3	Control
findings(%):	1,1	1,3	0,86
hooks (%):	42 (45,2)	26 (46,4)	27 62,8)
banana (%):	42 (45,2)	28 (50)	14 (32,6)
amorphous (%):	8 (8)	2 (3,6)	2 (4,7)
folding (%):	1 (1,0)		

Total structural aberrations were increased significantly only at 97.25 mg/m³ after 45 days. No change was seen after 60 days.

Comment: The original paper contains both figures (97,25 and 97,76mg/m³). It is not clear which of these is correct.
Test condition : 48 male rats were randomly allocated to 4 groups:
neg. control;
PCl3 (2 mg/m³)
PCl3 (33,5 mg/m³)
PCl3 (97, 25 - 97,76 mg/m³) *)

Body weight: 154-180 g

Animals were treated for 45 or 60 days

Sperm cells were collected from epididymides and slides prepared 500 cells per animal, a total of 2500 cells per group, were evaluated

*) Comment: The original paper contains both figures (97,25 and 97,76mg/m³). It is not clear which of these is correct.
No information regarding a positive control is given.
Reliability : (2) valid with restrictions
Detailed publication
Flag : Critical study for SIDS endpoint
28.11.2005 (73)

Type : other:structural aberrations in sperm cells
In vitro/in vivo : In vivo
Species : mouse
Sex : male
Strain :
Route of admin. : gavage
Exposure period : 5 days
Frequency of treatm. : daily

Duration of test :
Doses :
Control group :
Method :
Year :
GLP :
Test substance : other TS: phosphorus trichloride

Result :

	control			TREATED		
group:	water	oil	pos	45 mg/kg	90 mg/kg	178 mg/kg
total:	1,24	1,16	2,64	3,56	2,60	3,40
hooks:	4	3	1	1	10	11
(%):	12,9	10,4	1,5	10,1	11	21,6
banana:	7	5	37	23	5	6
(%):	22,4	17,2	56	25,8	5,5	11,8
amorph:	15	15	25	49	60	21
(%):	48,4	51,7	37,9	55,1	65,9	41,2
folds:	5	6	3	8	16	13
(%):	16,1	20,7	4,6	9	17,6	24,5

There were no significant findings

Test condition : 60 male mice were randomly allocated to 6 groups:
neg Control-water;
neg. control- vegetable oil;
pos. control-cyclophosphamide (30 mg/kg);
PCl3 (45 mg/kg)
PCl3 (90 mg/kg)
PCl3 (178 mg/kg)

Body weight: 20-25 g

Animals were treated for 5 days and killed after 4 weeks

Sperm cells were collected from epididymides and slides prepared
500 cells per animal, a total of 2500 cells per group, were evaluated

Reliability : (2) valid with restrictions
Detailed publication
Flag : Critical study for SIDS endpoint
23.09.2004 (73)

5.9 SPECIFIC INVESTIGATIONS

5.10 EXPOSURE EXPERIENCE

Type of experience : Human - Medical Data

Remark : workers exposed to phosphorus-chloride compounds: increased incidence of asthmatics
Test substance : phosphorus trichloride
Reliability : (4) not assignable
PCl3 mentioned without detailed evidence
14.09.2005 (79)

Type of experience : Human

Remark : threshold of the irritant effects similar in man and animals. Lim ir. 0.004 or 0.005 mg/l in man or animal.
Test substance : phosphorus trichloride
Reliability : (2) valid with restrictions
limited documentation, non standard evaluation scheme
Flag : Critical study for SIDS endpoint
12.05.2004 (51)

Type of experience : Human

Remark : workers employed in the production of phosphorus trichloride: concentration was 10-20 mg/m3 under normal condition and 80-150 mg/m3 at times when the plant was out of order. In acute poisoning after 2-6 hours burning sensation in eyes and throat, photophobia, feeling of chestoppression, dry cough, irritation of mucous membranes. In subacute poisoning the symptoms occur after 1-8 weeks with signs of irritation and asthmatic bronchitis.
Test substance : phosphorus trichloride
Reliability : (2) valid with restrictions
limited documentation; case report
Flag : Critical study for SIDS endpoint
12.05.2004 (80)

Type of experience : Human

Remark : patients accidentally exposed to PCl3 and its degradation products after a railroad accident:
symptoms: burning eyes (85%; mild conjunctivitis in 36%), shortness of breath (59%), throat irritation (59%) and lacrimation (59%), headache and nausea (48%), burning skin (44%), sputum production (41%), generalized or pleuric chest pain (33%) and rash/itch (33%), wheezing (26%), blurred vision (22%), vomiting (15%) and abdominal pain (15%).
Lactic dehydrogenase was increased in 22% of patients and recovered within four weeks after exposure.
Pulmonary function tests showed a decrease of vital capacity in patients within 1/8 mile of the event.
Hypoxemia was recorded in these patients after two months.
Test substance : phosphorus trichloride
Reliability : (2) valid with restrictions
limited documentation; case report
Flag : Critical study for SIDS endpoint
19.02.2004 (81) (82)

Type of experience : Human - Medical Data

Remark : accident: conjunctivitis, pain in nose and throat, difficulty in swallowing, sore throat, feeling of chest oppression.
Test substance : no data
Reliability : (4) not assignable
Report not available
13.05.2004 (83)

Type of experience : Human

Result : PCl3 after inhalation (1 single breath) caused painful irritaion of eyes, nose and throat, strained respiration, difficulty to swallow lasting pain in the trhoat and severe catarrh. Recovery was achieved wihtin 8 days.

Test substance : no data
Reliability : (4) not assignable
report not available
19.02.2004 (84)

Type of experience : Human - Medical Data

Result : PCl3 caused irritation of eyes and mucous membranes in workers.
Symptoms appeared immediately or delayed for up to 1 day.
One patient died after several days due to an asthmatic fit caused by the exposure to PCl3

in concentrations less than 1 mg/l air rhinitis, conjunctivitis, pain in nose and throat: in higher concentrations dyspnea and death.
Test substance : phosphorus trichloride
Reliability : (2) valid with restrictions
Case report; limited documentation
Flag : Critical study for SIDS endpoint
19.02.2004 (85)

Type of experience : Human - Medical Data

Result : PCl3 is quickly hydrolysed in water.
It causes immediate irritation to mucous membranes. In patients PCl3 therefore causes immediate defence and effects are mainly found in the upper respiratory tract
Test substance : phosphorus trichloride
Reliability : (4) not assignable
secondary literature
19.02.2004 (86)

Type of experience : Human

Result : Symptoms reported by exposed workers were: respiratory tract and eye irritation, cough, asthma, loss of voice
Test substance : phosphorus trichloride
Reliability : (2) valid with restrictions
limited documentation; few details given
Flag : Critical study for SIDS endpoint
26.02.2004 (87)

Type of experience : Human

Result : PCl3 is mentioned as a cause of occupational asthma:
48/170 (28,2%) exposed to phosphorus chlorides (PCl3, PCl5, POCl3) are reported to have asthma
Test substance : phosphorus trichloride
Reliability : (4) not assignable
Short remark within a review
Flag : Critical study for SIDS endpoint
23.03.2004 (88)

Type of experience : Human - Epidemiology

Result : 37 exposed and 22 unexposed workers were investigated regarding their pulmonary function. Exposed employees had a significantly higher prevalence (65%) of occasional respiratory discomfort than unexposed employees (5%). No consistent association between pulmonary function parameters and exposure could be documented.

Test substance : phosphorus trichloride
Reliability : (2) valid with restrictions
19.05.2004 (89) (90)

Type of experience : Human - Epidemiology

Result : Follow up of NTIS PB 81-170920
26 exposed and 11 non-exposed
13 of the xposed worker reported intermittent respiratory distress (wheezing, breathlessness, chest thightness).
Although a significantly larger group of exposed workers exhibited symptoms, a decrement of pulmonary function due to exposure could not be demonstrated.
Test substance : phosphorus trichloride
14.09.2005 (91) (92)
Result : IgE specific for phosphorus trichloride was determined in an occupational surveillance program for 5 years
No specific IgE against phosphorus trichloride was seen, neither in the surveillance program nor in any case of product contact
Test substance : phosphorus trichloride
14.09.2005 (93)

5.11 ADDITIONAL REMARKS

Type : Metabolism

Result : Hydrolysis of PCl3 is mostly complete within 4-6 seconds in excess water.
Products are hydrochloric acid (HCl) and phosphorous acid (H3PO3)
The rate of pH-change is comparable to the addition of concentrated hydrochloric acid
Test condition : The change of pH of water was recorded during addition of PCl3 at room temperature
Test substance : phosphorus trichloride
Reliability : (1) valid without restriction
Full report available
Flag : Critical study for SIDS endpoint
16.06.2004 (24)

Type : Neurotoxicity

Result : Serum BChE but not brain AChE was inhibited in vivo 1 h after exposure
ED50 : 14 mg/kg
Mortality: >100 mg/kg
Symptoms: tremors and muscle fasciculation
Test condition : Animals: male Swiss Webster mice
Dose: 0-10-30-100 mg/kg ip in corn oil

Tissue samples were removed for AChE determination 1 or 24 hours after treatment or at death. Blood, skeletal muscle, diaphragm, and brain were examined.

The in vivo experiments were supplemented by in vitro studies using different sources of AChE
Test substance : phosphorus trichloride
Reliability : (4) not assignable
irrelevant route of exposure (i.p.); only few experimental details;
13.02.2004 (94)

Type : Neurotoxicity

Remark : Species not relevant for mammalian toxicity determination; insufficient documentation
Result : ED 50 : 6-20 mg/L
IC 50 : 6 mg/L (brain)
Mortality was associated with > 90% inhibition
Test condition : adult house flies were exposed to vapours of POCl3 in a 120 ml glas chamber. The inability to walk or fly was recorded and at 15 minutes mortality was determined. Animals were frozen on dry ice, heads removed and AChE activity assayed.
Test substance : phosphorus trichloride
Reliability : (4) not assignable
13.02.2004 (94)

Type : other: Acute toxicity of phosphous acid
Result : LD50 :
Male rats: 2844,4 (2261,7 - 3427,1) mg/kg
Female rats: 1895,3 (1521,3 - 2269,3) mg/kg
Mice: 2172,3 (1548,5 - 2796,1) mg/kg

Death occured within few days after treatment (mean time to death 14,3 h for rats)
Test substance : phosphorous acid; degradation product of PCl3
Reliability : (2) valid with restrictions
limited documentation
Flag : Critical study for SIDS endpoint
01.08.2005 (95)

Type : other: Corrosion

Remark : corrosive changes in animals exposed to PCl3 vapours.
Test condition : 1
Test substance : phosphorus trichloride
Reliability : (2) valid with restrictions
no experimental details given
19.02.2004 (56)

Type : other: Exposure limit

Result : Recommended Exposure Limit (REL, NIOSH) = 0.2 ppm
Permissible Exposure Limit (PEL, OSHA) = 0.5 ppm
Immediately dangerous for Life or Health (IDLH) = 25 ppm
Test substance : phosphorus trichloride
Reliability : (4) not assignable
secondary literature
19.02.2004 (96)

Type : other: MAK value

Result : MAK = 0.5 ppm = 3 mg/m³
(MAK= maximum concentration in air at the workplace (8h/d; 5d/w))
Test substance : phosphorus trichloride
Reliability : (4) not assignable
secondary literature
19.02.2004 (97)

Type : other: Maximum allowable concentration in the workplace air

Result : The maximum allowable concentration are mentioned as:
2 ppp (12 mg/m³) for 1 minute
1 ppm for "short exposure"
0.5 ppm for "satisfactory conditions"
Test substance : phosphorus trichloride
Reliability : (4) not assignable
secondary literature

19.02.2004 (98)

Type : other: Repeated dose toxicity of phosphorous acid

Remark : limited documentation
Result : In the subacute study all doses created toxic effects. The largest changes occurred in the levels of choline esterase in blood and liver as well as the activity of monoamine oxidase in liver.
Statistically significant reductions were seen in liver (day 20: high dose; day 30: mid+high dose), kidney (day 10: high dose; day 20 mid+high dose; day 30: all doses) and blood (day 20+30: all doses). Reductions reached a level of up to 48% in the high dose group after 30 days.
Monoamine oxidase showed an increase on days 10 and 20 (up to 75%) and a decrease (up to 25%) on day 30 in mid and high dose groups.
In the mid and high doses a reduction of alkaline phosphatase in blood and of sulfhydryl groups in liver and kidneys were recorded. Motoractivity and body weight were also reduced. Increases were observed in the activity of ALAT in blood.
Microscopic examination of the liver revealed dilation of sinuses, infiltration of connective tissue and necrotic foci. In kidneys destruction of tubular and glomuerular cell occurred, accompanied by lymphocytic infiltration.
The LOEL was 2,45 mg/kg based on the effect on choline esterase in kidney tissue.

The chronic treatment of animals with 1/250 LD50 (11.4 mg/kg) caused increases in motroactivity and choline esterase activity.
At the histopathologic examination after 90 and 180 days of treatment livers showed dilation and lymphocytic infiltration, focal destruction of liver trabecula.

A dose of 1/2000 LD50 (1.4 mg/kg) was without any effect.

In both studies no functional effects on spermatogenesis were detected. Only a dose of 1/10 LD50 caused necrosis of testicular epithelium.
Test condition : Animals: male rats

Dose ranges:
subacute test: 0.1 - 0.02 - 0.004*LD50 (284-11.4 mg/kg)
chronic test: 0.004 - 0.0005*LD50 (11.4-1.4 mg/kg)

Animals were examined after 10, 20 and 30 days in the subacute test and after 60, 90, 120, 150, and 180 days in the chronic test

Parameters:
Body weight; haematology; choline esterase activity in brain, liver, kidneys and blood; monoamineoxidase in liver and brain; clinical chemistry in blood and tissue;
open field test; behavior;
histopathology of liver, kidney and testes.
Test substance : phosphoric acid
Reliability : (2) valid with restrictions
23.03.2004 (95)

Type : other: Review

Test substance : phosphorus trichloride
Reliability : (4) not assignable
secondary literature
19.05.2004 (99)

Type : other: Review

Test substance : phosphorus trichloride
Reliability : (4) not assignable
secondary literature
01.08.2005 (100)

Type : other: Review

Test substance : phosphorus trichloride
Reliability : (4) not assignable
secondary literature
14.09.2005 (101)

Result : In subacute and chronic studies no functional effects on spermatogenesis were detected. Only a dose of 1/10 LD50 caused necrosis of testicular epithelium.

Embryotoxicity test:
The number as well as the weight of pups was reduced. No effects on fertility index, pre- and post-implantation loss. No malformations.

Test condition : Dose ranges: (male rats)
subacute test: 0.1 - 0.02 - 0.004 LD50 (284-11.4 mg/kg)
chronic test: 0.004 - 0.0005 LD50 (11.4-1.4 mg/kg)

Animals were examined after 10, 20 and 30 days in the subacute test and after 60, 90, 120, 150, and 180 days in the chronic test

Embryotoxicity Test: (female rats)
Dose: 284 mg/kg
Parameters:
Fertility index; maternal, pre- and post implantation mortality; fetal survival;

Test substance : phosphorus trichloride
Reliability : (2) valid with restrictions
limited documentation
14.09.2005 (102)

Result : negative
Test condition : Guinea pigs were treated by subcutaneous implantation at doses of 28 and 57 mg/kg
Test substance : phosphorus trichloride
14.09.2005 (102)

Result : Comprhensive review on properties, uses, exposure and effects of PCl3
Test substance : phosphorus trichloride
14.09.2005 (103)

Result : TLV-TWA = 0,2 ppm (1,1 mg/m³)

TLV-STEL = 0,5 ppm (2,8 mg/m³)

Test substance : phosphorus trichloride

14.09.2005 (12)

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