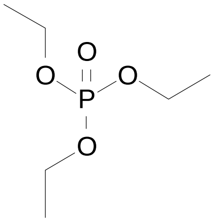
FOREWORD INTRODUCTION

TRIETHYLPHOSPHATE

CAS N°: 78-40-0

SIDS INITIAL ASSESSMENT PROFILE

CAS Nr.	78-40-0
Chemical Name	Triethylphosphate
Structural formula	

RECOMMENDATION OF THE SPONSOR COUNTRY

The chemical is of low current priority for further work in the SIDS context

SHORT SUMMARY WHICH SUPPORTS THE REASONS FOR THE RECOMMENDATIONS

The production volume of Triethylphosphate (TEP) is ca. 2000 t/a in Germany, less than 5000 t/a in the USA and import volumes to Japan are less than 600 t/a and less than 200 t/a to Canada. TEP is mostly used in ketene synthesis and as flame retardant and plasticiser in plastics industry. TEP is stable in neutral solution and is classified as "inherently biodegradable" (with industrial inoculum) with a "low bioaccumulation potential". The most sensitive environmental species to TEP is Daphnia magna (21d-NOEC = 31.6 mg/l). the derived PNEC is 632 µg/l.
For toxicological endpoints, the NOAEL is 1000 mg/kg bw for subacute toxicity, a NOEL of 625 mg/kg bw/day for teratogenicity and about 335 mg/kg bw for fertility effects. Due to missing data on carcinogenicity, a comprehensive description of the toxic effects of TEP is not possible. On the basis of all data on genotoxicity, a mutagenic effect of TEP is not assumed. The substance is harmful with a narcotic effect and, at high doses, shows certain neurotoxic properties (inhibition of cholinesterase) without indicating delayed neurotoxicity.

The highest worst case aquatic PEC was estimated to be 194 µg/l. The EHD for inhalational exposure is estimated at < 0.071 mg/kg bw.

In conclusion on the basis of the known facts and properties, a low concern for risk is to be expected to the human health or the environment.

IF FURTHER WORK IS RECOMMENDED, SUMMARISE ITS NATURE

SIDS PROFILE SUMMARY (part 1)

Triethylphosphate

CAS-NO.:			PROTOCOL	RESULTS
PHYSICAL CHEMICAL				
2.1	Melting Point		DIN 51583	-56 °C
2.2	Boiling Point		NA	215.6 °C (at101.3 kPa)
2.3	Density		DIN 51757	1060 kg/m^3
2.4	Vapour Pressure		NA	39 Pa at 20 °C
2.5	Partition Coefficient (Log Pow)		shake flask	1.11
2.6 A	Water solubility		NA	Miscible at 20 °C
B	pH		/	At °C
	pKa		/	
2.12	Oxidation : Reduction potential		/	mV
ENVIRONMENTAL FATE / BIODEGRADATION				
3.1.1	Photodegradation		calc. (Atkinson)	In air $T_{1/2}$ =8.8 hour
3.1.2	Stability in water		calc.	$T_{1/2}$ = 5.5 years
3.2	Monitoring data			In air = / mg/m^3 In surface water =<0.1 - 6.5 µg/l In soil / sediment = ND - 8.5 µg/kg In biota = / µg/g
3.3	Transport and Distribution		calculated (fugacity level 1 type)	In air / % In water / % In sediment / % In soil / % In biota / %
3.5	Biodegradation		OECD 301C OECD 302 B	0% after 28d 97% after 28d

SIDS PROFILE SUMMARY (part 2)

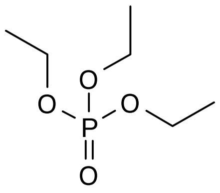
Triethylphosphate

CAS-NO.:		SPECIES	PROTOCOL	RESULTS
ECOTOXICOLOGY				
4.1	acute/prolonged toxicity to fish	Leuciscus idus	DIN 38412 L15	LC_{50} (48 hr) = 2140 mg/l
4.2	acute/prolonged toxicity to aquatic invertebrates (daphnia)	Daphnia magna	NA	EC_{50} (48 hr) = 350 mg/l
4.3	toxicity to aquatic plants e. g. algae	Scenedesmus subspicatus	DIN 38412 L9	EC_{50} (72 hr) = 900 mg/l EC_{10} (72 hr) = 80.3 mg/l
4.4	toxicity to microorganisms	Pseudomonas putida	NA (Robra)	EC_{10} (30 min) = 2985 mg/l
4.5.2	chronic toxicity to aquatic invertebrates (daphnia)	Daphnia magna	OECD 202	EC_{50}s (21 d) = 729 mg/l NOEC (21 d) = 31.6 mg/l
4.6.1	toxicity to soil dwelling organisms	Eisenia foetida	OECD 207	LC_{50} (14 d) = >1000 mg/kg NOEC (14 d) = 100 mg/kg
4.6.2	toxicity to terrestrial plants	several	NA (germination & early growth)	EC_0 (7 d) = > 100 mg/l
TOXICOLOGY				
5.1.1	acute oral toxicity	rat	NA	LD_{50} = 1131-1600 mg/kg
5.1.2	acute inhalation toxicity	rat	NA	LC_{50} = > 8817 mg/m^3/4h
5.1.3	acute dermal toxicity	guinea pig	NA	LD_{50} = >21400 mg/kg
5.4	repeated dose toxicity	rat (Wistar)	84/449/EEC, B.7.	NOEL = 100 mg/kg
5.5	genetic toxicity in vitro			
	bacterial test (gen mutation)	S. typhimurium his C117	Ames-test	+ and – (without metabolic activation)
	non-bacterial in vitro test (gen mutation)	V79 cellos	HPRT test	negative (with and without activation)
	non-bacterial in vitro test (chromosomal abberations)	rat hepatocytes	UDS-test	negative
5.6	genetic toxicity in vivo	mouse	- cytogenetic assay	negative
		mouse	- dominant lethal assay	negative
5.8	toxicity to reproduction	rat (Sprague Dawley)	NA	NOEL =100 mg/kg (litter size))
5.9	developmental toxicity / teratogenicity	/	/	NOEL = mg/kg (general toxicity) NOEL = mg/Kg (pregnancy/litter) NOEL = mg/Kg (foetal data)
5.11	experience with human exposure			

SIDS Initial Assessment Report

1.Identity

Name:	Triethylphosphate
CAS-Nr.:	78-40-0
Empirical Formula:	$C_6H_{15}O_4P$
Structural Formula:	



synonyms:	Phosphoric acid, triethylester TEP
purity of industrial product:	> 99.5 %

2. Exposure

2.1 General discussion

The production level of TEP in Germany was about 1000 - 1600 t/a in the years 1982 -1987 and about 2000 t in 1988. 20 - 30 % of this amount (400 - 600 t) was sold and handled in Germany. The rest was exported. There is no information about imported volumes of TEP.

About 40 -50 % of TEP used in Germany (ca. 250 t/a) goes into ketene synthesis where the compound is hydrolysed. About 40 % (ca. 240 t/a) are used in the plastics industry as a flame retardant, plasticiser and carrier, where it is available in the matrix. A further 10 to 20 % are used in other industrial branches as a solvent, plasticiser, flame retardant or intermediate for the production of pharmaceuticals, pesticides and laquers.

In the USA, TEP is produced by one company. The production rate is less than 5000 t/a. About three fourth of the annual production is company limited for use as a catalyst and the remainder is sold. Primary customer uses for triethyl phosphate in the USA are as an industrial catalyst (e.g., in the manufacture of ketene) and as a polymer resin modifier and plasticizer. Triethyl phosphate is also used in the USA in small amounts as a solvent, flame retarder, or industrial intermediate for the production of pesticides and other chemicals.

In Japan, less than 600 t/a are imported (no production). The use pattern is similar to that in Germany; most important uses are as polymerisation catalist for resins, additives for resins, intermediates for ketene synthesis, stabilizer for peroxides, solvent for acetylcellulose and plasticizer for unsaturated polyester.

In Finland, apart from being a laboratory chemical, TEP is also registered as a component of a car paint repairing product (12 - 18 % w/w) and as a flame retardant in PU-polymers (3% w/w).

Less than 200 t/a are imported in Canada (the exact use pattern is not available).

2.2 Environmental exposure

2.2.1 General

About 2.2 t/a pass into effluent after treatment in a waste water treatment plant and about 2 kg/a into air from industrial production in Germany. A certain amount passes diffusely into the environment through migration from plastics, the use of TEP as a solvent and the degradation of the pesticide parathion.

Atmospheric release of TEP during production and processing in the USA is minimal, because the manufacturing process is enclosed and the vapour pressure of TEP is low. TEP is present in one manufacturing waste stream, which is processed for removal prior to discharge. The concentration of TEP in the effluent is not known.

The following highest concentrations were recorded in the River Rhine and its tributaries (detection limit: 0.1 µg/l):

	Rhein	Sieg	Wupper	Erft	Ruhr	Emscher	Lippe
1987	0.1	<0.1	0.2	<0.1	<0.1	0.1	<0.1
1988	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1
1989	0.5	<0.1	2.4	0.1	0.2	6.5	<0.1
1990	0.3	<0.1	4.0	<0.1	0.2	3.7	<0.1
1991	0.52	<0.1	2.1	<0.1	<0.1	1.5	<0.1
1992	0.24	<0.1	0.27	<0.1	<0.1	3.9	<0.1

In a monitoring program in Japan in 1982, TEP was not detected in surface water or sediment in 42 samples. The detection limit was 0.005 - 0.1 ppb for surface water and 0.00025 - 0.005 ppm for sediment.

A danish study carried out in the vicinity of a pesticide factory recorded concentrations of TEP up to 8.5 µg/kg in 11 of 23 sediment samples.
Furthermore, 208 samples of sediment from the surroundings of Bremen in Germany in 1992 were analyzed for TEP. The maximum concentration was 29 µg/kg dw while both the minimum and the median were below the detection limit of 0.5 µg/kg dw.

Environmental fate

TEP is miscible with water and has a vapour pressure of 39 Pa at 20 °C. Its log Pow of 1.11 indicates that there is no considerable potential for geoaccumulation. TEP has a low tendency for bioaccumulation; its measured BCFs are <1.3.

Based on the miscibility with water, the low vapour pressure and the low log Pow, TEP does not tend to be transported from water to air or to be adsorbed on sediment/soil or accumulate in biota. It can therefore readily leach through the soil with potential subsequent contamination of ground water.

TEP is not readily biodegradable (OECD 301E: 0% after 28d). With industrial inoculum, TEP was found to be inherently biodegradable (OECD 302B: 98% after 28d).

Based on the above cited physical chemical properties ($\log H \le -1$; $\log Pow = 1.11$), as well as the biodegradation rate of 0.1 h^{-1} in a WWTP, which is assumed for inherently biodegradable substances, the elimination through biodegradation and distribution can be estimated with the model SIMPLETREAT (described in 1):

% to air	0
% to water	49
% to sludge	0
% degraded	51
% removal	51

Hydrolytic degradation is possible, but the half-life under environmental conditions is between five and ten years. Direct photodegradation is not possible because TEP in water doesn't absorb UV light.

The half-life due to photochemical-oxidative degradation in the atmosphere is between 7 and 8.8 hours.

2.2.2 Exposure assessment

a. local exposure

at production:
TEP is mostly used as such and not as an intermediate in chemical synthesis. In the Technical Guidance Documents (1), a generic (i.e. non site-specific) exposure scenario ("use category document",UCD) for the release into surface water of intermediates during production is proposed. This scenario reflects a realistic worst case situation. The following calculation can be performed:

Maximum production quantity:	5000 t/a
Release factor:	0.003
Degree of removal in a WWTP	0.51
Number of working days per year	300
Flow rate of receiving river:	60 m^3/s

PEC$_{local}$ = 4.7 µg/l

Specific data are available for the German production site. According to the German manufacturer, 2.2 t/a of TEP are released into the effluent. Considering, in a realistic worst case assumption, a production period of 180 days per year, this would lead to a concentration in the Rhine at mean flow rate (2060 m^3/s) of 0.07 g/l. At a low flow rate (10-percentile = 690 m^3/s), the concentration would amount to **PEC$_{local}$ = 0.2 µg/l**. In both cases a total dilution in in the river is assumed.

inclusion into polymeric matrix:
The use pattern of TEP suggests that releases to the environment may be possible during inclusion of TEP into polymeric products as flame retardant or plasticizer. Some experience is available from the inclusion of phtalates into PVC, as described in the "use category document: assessment of environmental exposure from additives in plastics" in (1). The highest release factor is observed during spread coating process, up to 1%. The following worst case scenario can be established:

Assumed maximum quantity used at one site for inclusion into polymeric products:	240 t/a (data from Germany)
Release factor:	0.01
Degree of removal in a WWTP	0.51
Number of working days per year	300
Flow rate of receiving WWTP:	2000 m^3/d
Dilution factor in the surface water:	10

PEC$_{local}$ = 196 µg/l

The above scenario assumes that the whole amount of TEP used as flame retarder or plasticizer in Germany is processed at one single site. This is probably not very realistic and the local concentration would be expected to be much lower. No specific data is available though allowing a refinement of the above scenario.

use as a solvent:
TEP is also used as an industrial solvent in certain production processes. According to the German producer, TEP is continously recycled in these processes and releases to the waste water are negligeable. there are no data available allowing an estimation of an environmenatl concentration.

b. diffuse release

An approach to a quantitative exposure assessment based on diffuse release sources can be achieved with the regional distribution model SIMPLEBOX (described in (1)). The following worst case assumptions are made concerning the release rate of TEP in Germany:

- a maximum of 240 t/a of TEP is included into plastic matrix as flame retardant, plasticiser and carrier. An emission of 10% (i.e. 24 t/a) through migration is assumed (default worst case assumption). It cannot realistically be estimated what part of these releases pass through WWTPs; in a first approach, it is assumed that these releases occur directly into the hydrosphere;

- a maximum of 120 t/a of TEP is used in a variety of industrial branches like intermediate and industrial solvants. As the exact distribution is not known, a total emission of 10% i.e. 12 t/a is assumed. For industrial uses, the passage of waste waters through a WWTP can be assumed. With an elimination rate of 51%, ca 6 t/a are released to the hydrosphere.

According to (1), for modeling purposes, 10% of the estimated European releases are to be emitted into a small area of 200x200 km. As the releases throughout Europe are not known, the whole of the estimated German releases are emitted into this region.

For other input parameters, the default values proposed in (1) were used (see Appendix 1).

The resulting concentrations (**PEC$_{\mathbf{regional}}$**) are:

water: 1.1 µg/l
soil: 0.075 ng/kg dry weight
sediment: 0.71 µg/kg dry weight
air: $4.3 \cdot 10^{-12}$ g/m^3

This calculation does not consider the introduction of TEP into the environment through degradation of the pesticide parathion. This contribution can not be quantified.

Although the exposure data used for the above calculation is specific for Germany, it is considered that the assumed emitted amounts reflect a "worst case" situation. The exposure situation in other countries is considered to be similar, especially as the production volumes and use patterns are comparable.

c. environmental concentration used in the risk characterisation

Comparing the measured to the calculated concentrations, it becomes clear that the measured data reflect probably mostly background concentrations. Only one value of 29 µg/kg dw in sediment suggests that high local concentrations may be possible.

In some tributaries of the river Rhine though, concentrations, up to 6.5 µg/l have been recorded. The 90-percentile of the listed highest concentrations recorded over the last years is 2.4 µg/l, which is very close to the calculated background concentration of 1.1 µg/l. As more confidence can be put upon the measured values in this case, a regional background concentration of **PECregional = 2.4 µg/l** is used in the risk characterisation.

2.3 Consumer exposure

While consumer contact with products containing TEP cannot be rules out, exposure concentrations are probably very low, due to the substance's low vapor pressure.

2.4 Exposure via the environment

The highest exposure to the general population via the environment would be expected through drinking water processed from surface water. Based on the physical chemical properties of TEP, a significant removal of during processing is not to be expected (1). Therefore, the concentration in drinking water is assumed to be **2.4 µg/l**.

2.5 Exposure at the workplace

Probable exposure route:
As TEP is produced in a closed system, exposure during synthesis may be excluded.
The only possiblity of a slight workplace exposure is when the product is filled into barrels, with inhalational uptake considered to be the main exposure rout. Skin contact plays a minor role.

Measured values at the workplace: < 0.5 mg/m^3

Estimated human dose (EHD): < 0.071 mg/kg bw, employing the following calculation model:

$$\frac{\text{respiratory volume (10m}^3\text{) x exposure (< 0.5 mg/m}^3\text{)}}{\text{body weight (70 kg)}}$$

3. Toxicity

3.1 Human Toxicity

a) Acute Toxicity

The substance has moderate acute toxicity (rat; LD 50 oral 1.1 - 1.6 g/kg bw; dermal guinea pig > 21.4 g/kg bw; rat LC 50 inhal. > 8817 mg/m^3/4h with NOAEL of 1400 mg/m^3).

b) Repeated Dose Toxicity

In a subchronic study (rat; oral, up to 6700 mg/kg bw) retarded weight gain, elevated liver and adrenals weight were observed (a validated NOEL or NOAEL cannot be given, the approx. NOEL based on the available data is about 670 mg/kg bw)[Gumbmann 1968]. A subacute 28-day study performed according actual guidelines after oral administration to rats determined a NOEL of 100 mg/kg bw (increased liver metabolism). An increase of liver metabolism is of no toxicological relevance, therefore a NOAEL of 1000 mg/kg bw was derived [Bayer 1992].

After high doses to rats a depressive effect on the central nervous system and slight inhibition of cholineesterases are described.

In mice, a NOAEL of 274 mg/kg bw was determined in an oral study (1/5 LD 50 = 274 mg/kg bw for 4 weeks) [Pyatlin 1968]. In rats a NOEL following inhalatory exposure (5h/d for 12 d) of 366 mg/m^3 was determined [Eastman Kodak 1984].

Conclusion: low toxicity, no serious damage in oral doses up to 6700 mg/kg bw. The NOAEL in the most relevant tests was 1000 mg/kg bw/day.

c) Reproductive Toxicity

In an early study using a small number of animals the litter size was reduced after repeated feeding to both sexes (rat) beginning at 670 mg/kg bw, although no symptoms of poisoning in the parent animals were described for the 670 mg/kg bw dose. The NOEL for effects on the litter size was 335 mg/kg bw/day. Neither testicular weights nor the histological investigation of the testes revealed remarkable findings in this study (max. dose 6700 mg/kg bw/day). A recent 28-day study with doses up to 1000 mg/kg bw also showed no effect on the testicular weight [Bayer 1992].

A teratogenicity study in rats showed no evidence of a teratogenic potential up to the highest dose of 625 mg/kg bw/day (NOEL developmental toxicity). In the highest dose there was reduction of body weight gain, food intake and feces excretion as a sign of maternal toxicity (NOEL 125 mg/kg bw/day).

d) Genetic Toxicity

Aside from several Ames tests with negative results, triethylphosphate induces gene mutations without metabolic activation in S. typhimurium his C117, some bacteria, viruses and a yeast strain. For clarification of the endpoint gene mutation a HPRT test in V79 cell cultures was done. This test revealed a negative result with and without metabolic activation (Bayer 1996)

In an in vitro UDS test on rat hepatocytes triethylphosphate showed no DNA-damaging effect (Bayer AG, 1992). The results for Drosophilia melanogaster in the limited documented recessive-lethal tests are contradictory, while in vivo studies on the mouse (cytogenetics in the bone marrow, dominant lethal test) were negative.

e) Carcinogenicity

Carcinogenicity studies are not available. An in vitro cell transformation test was negative.

f) Toxicokinetics and Metabolism

Triethylphosphate administered orally or i.p. to rodents is eliminated rapidly and comprehensively (90% within 16 hours). The very low acute dermal toxicity indicates a markedly lower adsorption than with oral administration.

g) other effects

The substance is not irritant to the skin. Studies on experimental animals showed no irritation properties. The most comprehensive documented, actual study (OECD Guideline 405, GLP) showed moderate irritation in 1 of 3 animals. According to the classification guideline this does not lead to a classification as irritant.

In the chicken, a sensitive species for delayed neurotoxicity, triethylphosphate gave no indication of neurotoxicity. After single administration of high doses (rat, mouse, i.p. ≥ 300 mg/kg; dog oral 250 mg/kg) TEP causes narcosis and a cholinesterase inhibition which is slight compared to other phosphoric esters. Cholineesterase inhibition is detectable in in vitro studies.

3.2 Ecotoxicity

3.2.1 Aquatic organisms

The following ecotoxicological effect concentrations, corresponding to the aquatic compartment, are available:

a) acute toxicity to fish

Leuciscus idus	48h-LC_{50}	2140 mg/l
Pimephales promephales	96h-LC_{50}	>100 mg/l
	96h-LC_{50}	>1000 mg/l
Oryzias latipes	48h-LC_{50}	>500 mg/l

b) toxicity to invertebrates

Results from tests on acute toxicity with *Daphnia magna* (EC_{50}) range from >100 mg/l up to 2705 mg/l. The lowest recorded concentration causing 50% mortality in 48 h was 330 µl = 350 mg/l.

Results from a 21d-reproduction test with *Daphnia magna* are available as well: the graphically determined EC_{50} (reproduction after 21 days) is 729 mg/l, the NOEC was determined to be 31.6 mg/l.

In tests on acute toxicity with other aquatic invertebrates (*Gammarus fasciatus*, *Dugesia tigrina*, *Helisoma trivolis*, *Lumbriculus variegatus*, *Asellus intermedius*), the 96h-LC_{50} values were all >100µl (i.e. > 106 mg/l).

c) toxicity to algae

Scenedesmus subspicatus	72h-EC_{50}	900 mg/l
Effect: growth inhibition (biomass)	72h-EC_{10}	80.3 mg/l
Selenastrum capricornutum	7d-EC_0	1000 mg/l
Effect: growth inhibition		

d) Toxicity to bacteria

Pseudomonas putida	30min-EC_{10}	3000 mg/l
Pseudomonas fluorescens	18h-EC_0	10000 mg/l
Activated sludge	5h-EC_{50}	>5000 mg/l
Effect: respiration inhibition		

3.2.2 Terrestrial organisms

a) toxicity to plants

A concentration of 1.5 - 2.5 % of TEP had no effect on the leaves of the bean species *Phaseolus vulgaris nanus*.

Furthermore, a concentration of 100 µl (=106.4 mg/l) had no adverse effects on germination of ryegrass (*Lolium perenne*), radish (*Raphanus sativus*) and lettuce (*Lactuca sativa*), or on the seedling stage of marigold (*Tagetes patula*), corn (*Zea mays*), lettuce (*Lactuca sativa*) and radish (*Raphanus sativus*).

b) toxicity to invertebrates

In an acute toxicity test to the earthworm *Eisenia fetida* according to OECD-Guideline No. 207 the following results have been obtained:

14d-LC_{50}	>1000 mg/kg (dry weight)
14d-LOEC	1000 mg/kg
14d-NOEC	100 mg/kg

At a concentration of 1000 mg/kg, the earthworms appeared to be slightly hardened at the end of the study.

4. Initial Assessment / Risk Characterisation

4.1 Human toxicity

4.1.1 Identification of Critical Toxic Effects

Due to the missing data (carcinogenicity) a comprehensive description of the toxic effects of triethylphosphate is not possible. Considering the conflicting results of genotoxic studies, a mutagenic effect of TEP cannot be totally excluded. In a HPRT test which was performed for clarification TEP was nonmutagenic. The substance is harmful with a narcotic effect and, at high doses, shows certain neurotoxic properties (inhibition of cholineesterase) without indicating delayed neurotoxicity.

4.1.2 Comparison of Exposure and Critical Effects

Workplace

The EHD for inhalational exposure is <0.071 mg/kg bw, far below the NOAEL described in animal experiments of 1000 mg/kg bw for subacute toxicity, about 335 mg/kg bw for fertility effects and a NOEL of 625 mg/kg bw/day for teratogenicity. The safety factor based on the lowest NOAEL is:

$$\frac{335 \text{ mg/kg bw}}{<0.071 \text{ mg/kg bw}} \quad = \; > 4718$$

and thus does not suggest a particular risk.

Isolated cases of exposure through skin contact cannot be rules out. The uptake of a chronically toxic amount of the substance (NOAEL in animal experiments 1000 or about 335 mg/kg bw) is not to be expected, also due to the low absorption. Thus the risk via this uptake route is negligible.

Consumer area

Data on consumer exposure are not available. However, it cannot be excluded that products containing triethylphosphate give off small amounts of the substance into the surrounding area. Considering the substance's low vapour pressure, its rapid degradation in the body, and its limited uptake through the skin, contamination of consumers is assumed to be very low. It is certainly more than 4 orders of magnitude below the dose which showed toxic effects with multiple administration in animal experiments. There is very little probability of acute poisoning, due to the low toxicity of TEP. A possible risk through long-term contamination by minuscule quantities of TEP cannot be be completely ruled out, due to inconsistent or missing information on mutagenic and carcinogenic effects.

Exposure through the Environment

Data are not available on exposure of the population. It would in any case be markedly lower than, or at most equal to, consumer exposure. Thus the comments regarding the consumer area apply here in a broader sense.

Exposure of the population via the hydrosphere is considered to be minimum, even assuming the concentration in drinking water to be equal to the concentration in surface water i.e. 2.4 µg/l. With 2 l drinking water/person/day, the daily dose would be 4.8 µg/person = 0.07 µg/kg bw. Compared to the exposure at the working place, the exposure through the environment is negligible.

4.2 Assessment of environmental risks

aquatic compartment

According to the EU-Technical Guidance Documents (1), the value of the safety factor is **F = 50**, as long-term NOECs are available for dapnids and algae.
With the lowest long-term NOEC of 31.6 mg/l and the PEC of 2.4µg/l:

$$\mathbf{PNEC} = \frac{31600}{50} = \mathbf{632\ \mu g/l}$$

In the following table the comparison between PEC and PNEC for all relevant exposure scenarios are presented:

scenario	**PEC$_{local}$ + PEC$_{regional}$**	**PEC/PNEC**
production at site:		
default seario	4.7 + 2.4	0.011
German producer	0.2 + 2.4	0.004
inclusion into polymeric matrix	196 + 2.4	0.3

As PEC/PNEC < 1 for all scenarios, TEP represents presently a low potential risk for the aquatic compartment.

terrestrial compartment

For the terrestrial compartment, there are no measured concentrations available. The highest calculated concentration amounts to 0.2 ng/kg dry weight soil. Furthermore, the highest concentration measured in sediment (27 µg/kg) and the low tendency of TEP to geoaccumulation suggest a low exposure of the terrestrial compartment.

On the other hand, the effect concentrations of TEP to terrestrial organisms (min. 100 mg/kg) leads to the conclusion that TEP represents presently no significant hazard for the terrestrial compartment.

5. Conclusions and Recommendations

Toxicity

On the basis of the known facts and properties, triethylphosphate does not represent a health risk for the consumer or the population. Since information is lacking on the substance's carcinogenicity, a residual carcinogenic risk cannot be ruled out entirely. However, the data on genotoxicity gave no evidence of a mutagenic potential.

Ecotoxicity

A comparison of measured environmental concentrations and the predicted no-effect concentration for aquatic ecosystems, based on a chronic test, indicates that only a low potential risk of damage to aquatic ecosystems is to be expected.

Based on the fact that the hydrosphere is the target compartment for introductions, and since the substance shows only low toxicity in plants and invertebrates, a risk of damage in the terrestrial area is not expected.

References

(1) Technical Guidance Documents in Support of the Commission Directive 93/67/EEC on Risk Assessment for New Notified Substances and the Commission Regulation (EC) 1488/94 on Risk Assessment for Existing Substances, 1996

EXTRACT FROM IRPTC LEGAL FILE

File: 17.01 LEGAL rn : 500588

```
systematic name:Phosphoric acid,triethyl ester
common name    :triethyl phosphate
reported name  :Phosphoric acid triethyl ester
cas no         :78-40-0             rtecs no       :TC7900000
area          : DEU                 type          : REC
 --------------------------------
|subject|specification|descriptor|
|-------+-------------+----------|
| AQ    |             |   CLASS  |
| USE   |    INDST    |   RQR    |
 --------------------------------
THIS SUBSTANCE IS CLASSIFIED AS SLIGHTLY HAZARDOUS TO WATER
(WATER-HAZARD CLASS: WGK 1). (THE DIFFERENT CLASSES ARE: WGK 3 = VERY
HAZARDOUS; WGK 2 = HAZARDOUS; WGK 1 = SLIGHTLY HAZARDOUS; WGK 0 = IN
GENERAL NOT HAZARDOUS.) THE CLASSIFICATION FORMS THE BASIS FOR
WATER-PROTECTION REQUIREMENTS FOR INDUSTRIAL PLANTS IN WHICH
WATER-HAZARDOUS SUBSTANCES ARE HANDLED.
entry date: JAN 1995

title: Administrative Rules concerning Substances Hazardous to Water
(Verwaltungsvorschrift wassergefaehrdende Stoffe)
original : GMSMA6, Gemeinsames Ministerialblatt, , 8 , 114 , 1990
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File: 17.01 LEGAL rn : 1142383

```
systematic name:Phosphoric acid,triethyl ester
common name    :triethyl phosphate
reported name  :TRIETHYL PHOSPHATE
cas no         :78-40-0             rtecs no       :TC7900000
area          : RUS                 type          : REG
 --------------------------------
|subject|specification|descriptor|
|-------+-------------+----------|
| AIR   |     OCC     |   MAC    |
|       |             |   CLASS  |
 --------------------------------
CLV: 2.0MG/M3 (VAPOUR, AEROSOL) HAZ. CLASS: III
entry date: MAY 1990                          effective date:   NOV1989

amendment: PDKAD*, PREDELNO DOPUSTIMYE KONTSENTRATSII VREDNYKH
           VESHCHESTV V VOZDUKHERABOCHEI ZONY (MAXIMUM ALLOWABLE
           CONCENTRATIONS OF HARMFUL SUBSTANCES IN OCCUPATIONAL AIR),
           5147-89 , , , 1989
```

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File: 17.01 LEGAL rn : 1143111

```
systematic name:Phosphoric acid,triethyl ester
common name    :triethyl phosphate
reported name  :TRIETHYL PHOSPHATE
cas no         :78-40-0             rtecs no       :TC7900000
area          : RUS                 type          : REG
 --------------------------------
|subject|specification|descriptor|
|-------+-------------+----------|
| AIR   |     OCC     |   PSL    |
 --------------------------------
```

```
     CLV: 3.0MG/M3 (VAPOUR)
     entry date: JUL 1990                          effective date:   APR1988

     amendment: OBUVR*, ORIENTIROVOCHNYE BEZOPASNYE UROVNI VOZDEISTVIYA
               (OBUV) VREDNYKHVESHCHESTV V VOZDUKHE RABOCHEI ZONY (TENTATIVE
                SAFE EXPOSURE LEVELS OF HARMFUL SUBSTANCES IN OCCUPATIONAL
                AIR), 4613-88 , , , 1988

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```

File: 17.01 LEGAL   rn : 1143495

```
     systematic name:Phosphoric acid,triethyl ester
     common name    :triethyl phosphate
     reported name  :TRIETHYL PHOSPHATE
     cas no         :78-40-0             rtecs no       :TC7900000
     area          : RUS                 type          : REG
      -------------------------------
     |subject|specification|descriptor|
     |-------+-------------+----------|
     | AQ    |    SURF     |   MAC    |
     |       |             |   CLASS  |
      -------------------------------
     0.3MG/L HAZARD CLASS: III
     entry date: JUL 1990                          effective date:  1JAN1989

     amendment: SPNPV*, SANITARNYE PRAVILA I NORMY OKHRANY POVERKHNOSTNYKH
                VOD OT ZAGRIAZNENIA (HEALTH REGULATION AND STANDARDS OF
                SURFACE WATER PROTECTION FROM CONTAMINATION), 4630-88 , , ,
                1988

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File: 17.01 LEGAL   rn : 1302843

```
     systematic name:Phosphoric acid,triethyl ester
     common name    :triethyl phosphate
     reported name  :TRIETHYLPHOSPHATE
     cas no         :78-40-0             rtecs no       :TC7900000
     area          : USA                 type          : REG
      -------------------------------
     |subject|specification|descriptor|
     |-------+-------------+----------|
     | FOOD  |    ADDIT    |   RSTR   |
     | TRANS |             |   RSTR   |
     | STORE |             |   RSTR   |
     | PACK  |             |   RSTR   |
      -------------------------------
     ; Summary - THIS SUBSTANCE IS INCLUDED ON A LIST OF SUBSTANCES USED TO
     PREPARE ADHESIVES WHICH MAY BE SAFELY USED AS COMPONENTS OF ARTICLES
     INTENDED FOR USE IN PACKAGING, TRANSPORTATION, OR HOLDING FOOD IN
     ACCORDANCE WITH THE FOLLOWING PRESCRIBED CONDITIONS: SUBSTA NCE MUST BE
     SEPARATED FROM THE FOOD BY A FUNCTIONAL BARRIER, MUST NOT EXCEED LIMITS
     OF GOOD MANUFACTURING PRACTICE USED WITH DRY FOODS, OR NOT EXCEED TRACE
     AMOUNTS AT SEAMS AND EDGE EXPOSURES WHEN USED WITH FATTY AND AQUEOUS
     FOODS. ALSO REGULATED BY SEA M INTEGRITY, LABELING STANDARDS, AND ANY
     PROVISION UNDER 21 CFR 175
     entry date: NOV 1991                          effective date:      1977

     title: SUBSTANCES FOR USE ONLY AS COMPONENTS OF ADHESIVES
     original : FEREAC, FEDERAL REGISTER, 42 , , 14534 , 1977
     amendment: CFRUS*, CODE OF FEDERAL REGULATIONS, 21 , 175 , 105 , 1988
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File: 17.01 LEGAL **rn : 1344001**

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systematic name:Phosphoric acid,triethyl ester
common name    :triethyl phosphate
reported name  :TRIETHYL PHOSPHATE
cas no         :78-40-0            rtecs no       :TC7900000
area          : USA                type          : REG
 --------------------------------
|subject|specification|descriptor|
|-------+-------------+----------|
| MONIT |    CONSM    |   RQR    |
| MONIT |    OCC      |   RQR    |
| MONIT |    AMBI     |   RQR    |
 --------------------------------
 Summary - ALL MANUFACTURERS OF CHEMICAL SUBSTANCES ARE SUBJECT TO THIS
 RULE. IF MANUFACTURE OCCURS AT ANY SITE OWNED OR CONTROLLED BY A FIRM,
 THEN THAT FIRM IS SUBJECT TO THE RULE. ADDITIONALLY, PERSONS WHO
 PROCESS CHEMICAL SUBSTANCES ARE SUBJECT TO THE RULE IF THEIR PROCESSOR
 ACTIVITIES ARE DESCRIBED IN STANDARD INDUSTRIAL CLASSIFICATION (SIC)
 MAJOR GROUP 28, CHEMICALS AND ALLIED PRODUCTS, OR SIC CODE 2911,
 PETROLEUM REFINING. RECORDS REQUIRED TO BE MAINTAINED INCLUDE RECORDS
 OF CONSUMER ALLEGATIONS OF PERSON AL INJURY OR HARM TO HEALTH, REPORTS
 OF OCCUPATIONAL DISEASE OR INJURY, AND REPORTS OF COMPLAINTS OF INJURY
 TO THE ENVIRONMENT.
entry date: OCT 1991                         effective date: 21NOV1983

title: RECORDS OF ALLEGATIONS OF SIGNIFICANT ADVERSE REACTIONS NOTICES
AND RULES
original : FEREAC, FEDERAL REGISTER, 48 , , 38178 , 1983
amendment: XCODE*, UNITED STATES CODE, 15 , , 2607C , 1991
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File: 17.01 LEGAL **rn : 1421652**

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systematic name:Phosphoric acid,triethyl ester
common name    :triethyl phosphate
reported name  :TRIETHYL PHOSPHATE
cas no         :78-40-0            rtecs no       :TC7900000
area          : EEC                type          : REG
 --------------------------------
|subject|specification|descriptor|
|-------+-------------+----------|
| CLASS |             |   CLASS  |
| LABEL |             |   RQR    |
| PACK  |             |   RQR    |
 --------------------------------
CLASS: XN - HARMFUL; HARMFUL IF SWALLOWED (R 22). LABEL: XN - HARMFUL;
HARMFUL IF SWALLOWED (R 22); (KEEP OUT OF THE REACH OF CHILDREN (S 2));
AVOID CONTACT WITH EYES (S 25).
entry date: AUG 1994                         effective date:   JAN1994

title: COUNCIL DIRECTIVE 67/548/EEC OF 27 JUNE 1967 ON THE APROXIMATION
OF THE LAWS, REGULATIONS AND ADMINISTRATIVE PROVISIONS RELATING TO THE
CLASSIFICATION, PACKAGING AND LABELLING OF DANGEROUS SUBSTANCES
 original : OJEC**, OFFICIAL JOURNAL OF THE EUROPEAN COMMUNITIES, 196 ,
 ,1 , 1967
amendment: OJEC**, OFFICIAL JOURNAL OF THE EUROPEAN COMMUNITIES, L 13 ,
, 1 , 1994
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