FOREWORD INTRODUCTION

Cyanuric chloride

CAS N°: 108-77-0

SIDS Initial Assessment Report

For

SIAM 13

Bern, Switzerland, 6-9 November 2001

1. Chemical Name:	Cyanuric chloride
2. CAS Number:	108-77-0
3. Sponsor Country:	Switzerland National SIDS Contact Point in Sponsor Country: Dr Georg Karlaganis Swiss Agency for the Environment, Forests and Landscape CH – 3003 Bern Tel : +41 31 322 69 55 Fax : +41 31 324 79 78 E-mail : georg.karlaganis@buwal.admin.ch
4. Shared Partnership with:	ICCA (Syngenta Crop Protection Ltd)
5. Roles/Responsibilities of the Partners:	
• Name of industry sponsor /consortium	
• Process used	
6. Sponsorship History	
• How was the chemical or category brought into the OECD HPV Chemicals Programme ?	
7. Review Process Prior to the SIAM:	
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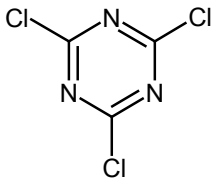
9. Date of Submission:	25 September 2001
10. Date of last Update:	
11. Comments:	No testing ☑ Testing

SIDS INITIAL ASSESSMENT PROFILE

CAS No.	108-77-0
Chemical Name	Cyanuric chloride
Structural Formula	

RECOMMENDATIONS

The chemical is currently of low priority for further work.

SUMMARY CONCLUSIONS OF THE SIAR

Human Health

Acute toxicity of cyanuric chloride showed an oral LD50 of ~320 mg/kg bw and a dermal LD50 of >2000 mg/kg bw. The high acute inhalation toxicity of cyanuric chloride (LC50 170 mg/m^3) is likely to be secondary to its highly irritating/caustic properties. The compound is highly irritating to the skin, the eyes and the respiratory tract (RD50 5.9 mg/m^3). In humans exposure to cyanuric chloride causes irritation and caustic effects to the skin, eyes and respiratory tract. Cyanuric chloride is sensitizing. Asthma and contact dermatitis are also reported in humans.

In oral repeated dose studies cyanuric chloride induced body weight loss and stomach erosion and ulceration. In a 21-day dermal study decreased body weight was reported at 150 and 500 mg/kg bw. Severe dermal irritation was seen at all dose levels tested. Since it can not be excluded that the effects on body weight were secondary to stress by the treatment, no systemic NOAEL was derived. The LOAEL for local effects is 50 mg/kg bw. From a 90-day inhalation study a NOAEC of 0.25 mg/m^3 (the highest concentration tested) for systemic toxicity was derived. The NOAEC for local effects in the respiratory tract of rats displaying intercurrent respiratory infection was found to be 0.05 mg/m^3. The effects included inflammation in the nose and lungs.

For developmental toxicity an oral teratogenicity study is available. The NOAEL for maternal toxicity is 25 mg/kg bw, based on a decreased body weight gain. For developmental effects a NOAEL of 25 mg/kg bw was derived, based on increased post-implantation loss and a decreased number of fetuses at 50 mg/kg bw. In the 90-day inhalation toxicity study no effects on the gonads were found and therefore no studies of any effects of cyanuric chloride on fertility are required under SIDS.

Cyanuric chloride is found to be not mutagenic in the Ames test and the mouse micronucleus test.

Environment

Released cyanuric chloride will end up in surface water for ~99% (EQC-model). In water cyanuric chloride hydrolyses quickly to cyanuric acid via the intermediates 2,4-dichloro-6-hydroxy-s-triazine and 2-chloro-4,6-dihydroxy-s-triazine (DT_{50} < 5 hours). The DT_{50} for the disappearance of cyanuric chloride in aqueous medium is < 5 minutes.

Cyanuric chloride has a low vapour pressure and logKow of 1.7. Due to its low solubility (440 mg/L) and its hydrolysis properties, the actual concentration of cyanuric chloride in water is very low. For the biodegradation process of cyanuric chloride the hydrolysis products are much more relevant than cyanuric chloride itself. Studies on these hydrolysis products showed very limited biodegradability of these compounds under standard test

conditions.

The toxicity of cyanuric chloride to aquatic organisms can not be determined in view of the hydrolytic properties of the substance. For the hydrolysis product 2-chloro-4,6-dihydroxy-s-triazine the LC50 in fish and the EC50 in daphnia were >2000 mg/L. For cyanuric acid the fish LC50 was >1000 mg/L and the daphnia EC50 was >1800 mg/L. No effects of cyanuric acid on algae were found in saturated medium. Algal toxicity was investigated for isocyanuric acid (72-h LC50 620 mg/L, NOEC 62.5 mg/L). No bioaccumulation in carps was found in a test with cyanuric acid.

Exposure

Yearly more than 100,000 tonnes of cyanuric chloride are produced. The compound is used exclusively as an intermediate in the production of pesticides (herbicides), optical brighteners, dyes and plastic additives.

Due to the fact that cyanuric chloride is almost exclusively used in closed systems, worker exposure is expected to be low or negligible. During production cyanuric chloride may be released to the environment via the waste water. The annual release into the atmosphere was 268 kg/year (1990/1991), Consumer exposure is considered not relevant in view of the use as an intermediate.

NATURE OF FURTHER WORK RECOMMENDED

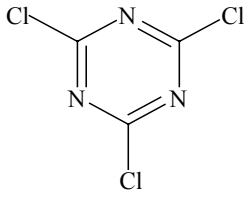
No further work recommended.

SIDS Initial Assessment Report

1 IDENTITY

1.1 Identification of the Substance

CAS Number: 108-77-0
IUPAC Name: 2,4,6-trichloro-1,3,5-triazine
Molecular Formula: $C_3Cl_3N_3$
Structural Formula:



Molecular Weight: 184.41
Synonyms: Cyanuric chloride, Chlorotriazine, cyanuric acid chloride, s-triazine trichloride, 2,4,6-trichlorotriazine

1.2 Purity/Impurities/Additives

Purity: 99-99.5% w/w

1.3 Physico-Chemical properties

Table 1 Summary of physico-chemical properties

Property	Value	Reference
Physical state	Solid	
Melting point	145-146°C	1, 22
Boiling point	190-198°C (at 760 mm Hg)	3, 21, 83
Relative density	1.32 (20°C)	
Vapour pressure	1.2 Pa 2.5 Pa (20°C) 267 Pa (70°C)	 17 45
Water solubility	440 mg/L (20°C)	7, 17
Partition coefficient n-octanol/water (log value)	0.51 >1.7 1.73	6 50 Epiwin
Henry's law constant	0.04 $Pa.m^3/mol$	17
Flash point	> 190°C	106
Ignition temp.	> 650 °C	106

The data presented in this section came from ref. 71, 72 unless indicated to be from other sources.

For the logKow three values are available. The lowest value comes from a publication using the CLOGP-program (ref. 6). For cyanuric chloride, however, the way of derivation of the logKow value was not clear. In a study using HPLC retention time as a measurement for logKow, the value for cyanuric chloride was above the logKow for acetophenone (i.e. 1.7). No exact value for cyanuric chloride could be derived from this study, since only extrapolation would have been possible (ref. 50).

Based on the above mentioned the value calculated with the Epiwin model , i.e. 1.73 was considered to be most reliable (Appendix A).

Calculations with the Epiwin model on the hydrolysis products of cyanuric chloride (see section on environmental fate) 2-chloro-4,6-dihydroxy-1,3,5-s-triazine and cyanuric acid gave the following values for water solubility and log Kow (values not included in the summaries):

	Log Kow	**Water solubility (g/L)**
2-chloro-4,6-dihydroxy-1,3,5-s-triazine	0.98	11.2
cyanuric acid	0.61	288

2 GENERAL INFORMATION ON EXPOSURE

Yearly more than 100000 tonnes of cyanuric chloride are produced. The compound is used exclusively as an intermediate in the production of pesticides (herbicides), optical brighteners, dyes and plastic additives (ref.100).

From old Russian reports it was deduced that cyanuric chloride was present in the air of chemical premises at a maximum measured concentration of 0.1 mg/m^3. The substance could be released during loading and sampling (ref. 42, 43, 45 and 70). In a more recent publication (ref. 79) measured concentrations were 7.09 ± 9.22 $\mu g/m^3$ during filling , 4.43 ± 2.72 $\mu g/m^3$ (exhaust air concentration) and 92.76 ± 147.52 $\mu g/m^3$ (concentration measured on workers).

In an unpublished letter from a producer it is reported that a peak concentration of 3.2 mg/m^3 was measured in exhaust air released from a production site (ref. 16). This value corresponds to total dust concentration. However, the amount of cyanuric chloride was not determined.

Although at present cyanuric chloride will be used mostly in closed (automated) systems, it can not be excluded that worker exposure (also non-accidental) may occur in less developed countries.

Consumer exposure is considered to be not relevant for cyanuric chloride.

It can not be excluded that during production and use of cyanuric chloride some environmental release will take place. During chemical production the distribution can be assessed with several models, i.e. the USES 3.0 model (distribution in waste water treatment plant) and the EQC-model (Equilibrium Criterion model). Both models indicate that the substance will predominantly end up in the aquatic compartment either directly or via passage of a biological waste water treatment plant and hydrolyse rapidly (ref. 106)(see appendix B1 and C1), using a DT_{50} of 5 minutes (ref. 12)

From the EQC model it is deducted that 98.9% will up in surface water (appendix C1). Since the substance will hydrolyse rapidly, the final product will be cyanuric acid. The overall hydrolysis rate will depend on the third hydrolysis step (see below). The concentration calculated with this model in surface water is (7 ng/L) lower than calculated with USES 3.0 (0.04 mg/L). This is related to the use of other default input parameters (see appendices B1 and C1).

From the USES 3.0 it can be deduced that 98% of cyanuric chloride will be hydrolysed/degraded in the waste water treatment plant and only 1.7% will be emitted. The detectable hydrolyse products, that will end up in surface water, will be 2-chloro-4,6-dihydroxy-s-triazine or cyanuric acid. With the data available it is considered that only 4.7% of 2-chloro-4,6-dihydroxy-s-triazine (using cyanuric chloride data) will be degraded due to abiotic degradation in the waste water treatment plant, which is due to the fact that the DT_{50} = 4 days (ref. 11), as the first and second hydrolysis step will take place more rapidly. When another DT_{50} is chosen i.e. DT_{50} is 5 hours (ref. 12.) the degradation in the waste water treatment plant is ~50%. Hence, since the time in the waste water treatment plant is default 24 hours, the hydrolysis of the hydrolysis product(s) is/are of importance. It can be concluded that the annual average concentration between 1.0 and 2.0 mg/l (appendix C2) in surface water for 2-chloro-4,6-dihydroxy-s-triazine and below the 0.0424 mg/l for cyanuric acid. This fact is confirmed by the BUA report which indicates that appearance of cyanuric chloride in the hydrosphere is not expected (ref. 70). The difference between the actual values in the BUA report and the values presented here can be explained by the high amount of cyanuric acid used as default data by USES3.0 (50 kg/day for 300 days/year)

Release to atmosphere was reported to be 268 kg/year in 1990/91 (German data).

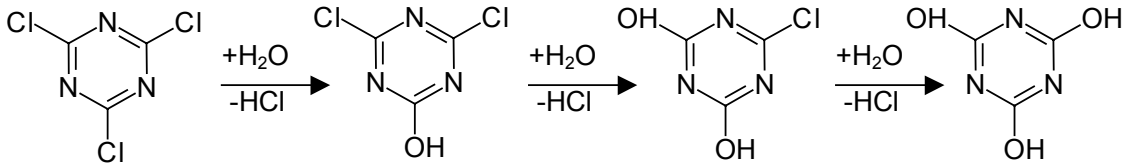
2.1 Environmental Exposure and Fate

The atmospheric oxidation potential (AOP) predicted from the Epiwin program indicates that cyanuric chloride is not photolytically reactive (degradation half-life of > 15 year). A summary of the Epiwin calculations is attached as Appendix A.

Cyanuric chloride reacts readily with nucleophilic substances like ammonia, diethylamine, aniline, methanol and water (ref. 1).

Cyanuric chloride hydrolyses quickly to cyanuric acid in water via formation of 2,4-dichloro-6-hydroxy-s-triazine and 2-chloro-4,6-dihydroxy-s-triazine (ref. 12, 15, 16, see fig. 1).

Fig. 1 Hydrolysis of cyanuric chloride



Cyanuric chloride 2,4-dichloro-6-hydroxy-s-triazine 2-chloro-4,6-dihydroxy-s-triazine cyanuric acid

The reactivity of cyanuric chloride is comparable to that of an acid chloride. The hydrolysis of cyanuric chloride takes place by a step-wise substitution of all three chlorine atoms by hydroxyl groups. In the 3-step reaction, the first intermediate formed is 2,4-dichloro-6-hydroxy-1,3,5-triazine which further reacts to 2-chloro-4,6-dihydroxy-1,3,5-triazine. The final product of the subsequent reaction is cyanuric acid, which is stabilised by tautomerism (tautomer: isocyanuric acid). Compared with its hydrolytic products, cyanuric chloride is relatively poorly soluble in water. Therefore, precise and dependable statements on the hydrolytic degradation are difficult to make.

The nucleophilic reaction in all partial steps can be described by a first-order reaction rate equation. Reaction rate constants of the single partial reactions differed by one to two orders of magnitude, i.e. at the time of the concentration maximum of the respective hydrolytic product, its predecessor was already extensively degraded. The half-lives of cyanuric chloride and its hydrolysis products depend on pH value, the temperature and partially also on the type of buffer system used. The lowest reaction rate was calculated for a pH value of about 5.5. The reaction rate constant rises

sharply towards higher as well as lower pH values, whereby the reaction of cyanuric chloride to cyanuric acid is faster in acidic solution than in alkaline solution. The relative decrease of the rate of hydrolysis with increasing basicity compared to increasing acidity is caused by the fact that although k1 (cyanuric chloride to 2,4-dichloro-6-hydroxy-1,3,5-triazine) increases, k2 (2,4-dichloro-6-hydroxy-1,3,5-triazine to 2-chloro-4,6-dihydroxy-1,3,5-triazine) and k3 (2-chloro-4,6-dihydroxy-1,3,5-triazine to cyanuric acid) are nonetheless lower than the corresponding values in the acidic range.

The reason for the slower reaction rate in neutral or alkaline media than in an acidic medium lies in the dissociation of the hydroxyl groups and formation of mono- or di-sodium salts of the hydroxychlorotriazines. The reactivity of the remaining chlorine atom(s) on the triazine ring is reduced upon formation of these salts, which leads to a stabilization of the hydrolytic intermediate products in form of its anions under neutral or alkaline conditions. In fact, under alkaline conditions, the hydrolysis can almost come to a standstill at the step of 2-chloro-4,6-dihydroxy-1,3,5-triazine (see below).

Measured DT_{50}-values for cyanuric chloride (based on hydrolysis to cyanuric acid) range from 1 hour (ref. 13) to 1-2 days (ref. 11) in different studies without specification of the pH.

In a particular hydrolysis study cyanuric chloride was incubated at different pH values and at different temperatures. The DT_{50} for the disappearance of cyanuric chloride was calculated to be <5 minutes at pH 2-12 and temperature 25-40 °C. The calculation of the DT_{50} for the transformation to the acid were based on the rate limiting step (conversion of 2-chloro-4,6-dihydroxy-s-triazine to cyanuric acid). The DT_{50} is <5 hours at pH 2-7 and temperature 25-40°C (at pH 12 at 40°C a DT_{50} of 2.5 days was found)(ref. 12). In this study little information on the analytical method was available.

The same trend was reported in another study. The DT_{50} for hydrolysis of cyanuric chloride decreased with increasing temperature (at pH 1 and 3) from 50 minutes (at 0°C) to 4.5 minutes (at 25°C). At increasing pH values decreasing DT_{50} values were found (at pH 3: DT_{50} 30 min.; at pH 9: DT_{50} 3.7 min.) for cyanuric chloride. These results confirm the abovementioned finding that under alkaline conditions k1 increases in comparison with acidic conditions.

The values reported were not determined under sterile conditions and therefore it is thought that other processes apart from hydrolysis may have been involved in the degradation of cyanuric chloride (ref.7).

The DT_{50} for the disappearance of 2,4-dichloro-6-hydroxy-s-triazine was assessed in a study at pH 10 and 50°C in toluene/water (50/50) for approximately 3 hours. The test solution, however, was not buffered. The DT_{50} calculated by the reviewer was 1.5 days (extrapolation from first order regression). The result is considered to be less reliable (ref. 10).

As expected, increasing the temperature will lead to a faster hydrolysis (ref. 7, 12, 13, 14)

Adsorption of cyanuric chloride to soil is expected to be very low based on the log Pow (ref. 18).

Furthermore the substance may be hydrolysed in the aqueous phase of the soil. Information on the K_{oc} (solid/liquid partition coefficient) is not available. The Epiwin model predicts a K_{oc} of 124.4 , but this value is considered to be less reliable since it will be highly pH dependent.

In soil (clay loam) cyanuric acid persisted with a DT_{50} of 183 days (at 20°C). This DT_{50} value was based on nitrate measurements only (ref. 55).

In a test with radio-labelled cyanuric chloride a DT_{50} of 8.3 days was found in a sandy loam. This value was only based on the amount of $^{14}CO_2$ recovered (ref. 54). In both tests transformation to

other degradation products was not taken into consideration. Therefore the DT_{50} calculated is considered a worst case value. Although both studies were poorly reported, measurement of nitrate is considered a less reliable method in the determination of disappearance of cyanuric chloride from soil.

The biodegradation of cyanuric chloride as such cannot directly be determined, because its water solubility is low (0.44 g/L at 20°C) and the compound hydrolyses very quickly to various degradation products. Therefore, the parent compound can only be measured together with its degradation products, or degradation products as such can be tested.

2-Chloro-4,6-dihydroxy-s-triazine was found to be not readily biodegradable in a modified OECD screening test, most probably under aerobic conditions (ref. 48). In this test, however, no toxicity controls were included and therefore the lack of biodegradability may have been caused by toxicity towards the micro-organisms of the inoculum. In a Zahn Wellens test cyanuric acid was found to be not inherently biodegradable (ref. 67). Only a summary of the test was available.

Tests were performed with domestic sewage sludge both under anaerobic and (partially) aerobic conditions to establish the biodegradation of cyanuric acid. The compound (radio-labelled) was found to degrade completely within 96 hours under anaerobic conditions. When incubated aerobically for 48 hours at 23°C 95-98% of the added ^{14}C evolved as CO_2. In a separate test the biodegradability of cyanuric acid appeared to increase under anaerobic conditions (ref. 52). Cyanuric acid (1600 mg/L) was degraded completely (100%) by pre-adapted micro-organisms within 1 week after 11 weeks. In the effluent the main degradation product was ammonium (ref. 107). Except for the first two tests (ref. 48 and 67), none of the tests was performed in accordance with current OECD-guidelines.

Conclusion:

Cyanuric chloride is considered to be photolytically stable. The DT_{50} for hydrolysis (transformation to the acid) is established to be <5 hours, while the DT_{50} for disappearance of cyanuric chloride is <5 minutes (ref. 12). From the EQC model it can be deduced that >98 % of cyanuric chloride will end up in the water phase.

No studies on biodegradability of cyanuric chloride were available. Due to the low solubility and its hydrolysis properties, the actual concentration of cyanuric chloride in water is very low. For the biodegradation process of cyanuric chloride the hydrolysis products are much more relevant than cyanuric chloride itself. Studies on hydrolysis products showed very limited biodegradability of these compounds under standard test conditions (ref. 48 and 67).

3 HUMAN HEALTH HAZARDS

3.1 Effects on Human Health

3.1.1 Acute Toxicity

Oral

Cyanuric chloride was tested in an acute oral test in rats in peanut oil. At and above 1000 mg/kg piloerection, diarrhoea and ataxia were noted together with decreased muscle tone and loss of rightening reflex in females only. Macroscopically dark areas in the stomach and erosion of the stomach were found. The oral LD_{50} is 1143 mg/kg bw (ref. 23). In a separate test (vehicle polyethylene glycol) an LD_{50} of 315 mg/kg bw was reported for males and 327 mg/kg bw for females (ref. 24). Dose related findings included hypokinesia, somnolency, decreased muscle tone,

loss of reflexes, piloerection, accelerated respiration and decreased body temperature. Macroscopic findings were mainly related to stomach lesions (increasing in severity with higher doses).

In other studies LD_{50}-values between 208 and 1170 mg/kg bw were reported for rats (ref. 92, 94, 96). In one study (ref. 5) an LD_{50} of 166 mg/kg bw was reported for rats. This value is considered not reliable, since the method for calculation (logit) is not appropriate for response values of 0% mortality and 100% mortality. Recalculation of the LD_{50} by the reviewer gave values of 200 mg/kg and above (ref. 5). For mice a range of 350-1000 mg/kg bw was presented. Ranges for the lowest lethal dose in rabbits and dogs were 340-380 and 500-1000 mg/kg bw, respectively (ref.81).

Dermal

Two dermal tests (ref. 28 and 29) were available with cyanuric chloride. In rabbits a LD_{50} of >2000 mg/kg bw was found. The test was performed under the corresponding OECD guideline (without indication of the size of the application area)). In rats only males were tested. The effects were limited to the skin. At 5000 mg/kg bw 2 of 5 animals died (ref. 28).

Inhalation

In a well documented inhalation study (ref. 78), it was demonstrated that particulate cyanuric chloride at concentrations of up to about 300 mg/m3 air (sum of gaseous and particulate cyanuric chloride) is to be considered thermodynamically unstable; i.e. smaller particles evaporate until the vapour saturation is attained. Air enriched with cyanuric chloride dust thus always contains solid and gaseous fractions. On the other hand, one must expect solid particulate fractions in the exposure atmosphere for gaseous cyanuric chloride above the saturation vapour pressure because of the pronounced tendency of cyanuric chloride to desublimate. In this study, a LD_{50} of 170 mg/m^3 (vapour and respirable dust) was established (201 mg/m^3 for males and 150 mg/m^3 for females) (ref. 78). Animals a concentration related increase of showed heavy and slow breathing, shortness of breath, nasal discharge, reduced motility, poor coat condition, piloerection, gasping, bloody and crusted nose, periorbital crusts, cyanosis and cachexia, abnormal gait and diminished reflexes. Macroscopically bloated, oedematous and discoloured lungs with bronchia filled with slime, hydrothorax, red staining of the nose, pale liver and kidneys, liver lobulated, bloody-slimy contents of gastrointestinal tract and red staining of mucosa of small intestine were reported. The high acute inhalation toxicity of cyanuric chloride may be secondary to its highly irritating/caustic properties.

The LC_{50} after inhalation exposure during 2 hours for mice was 10 mg/m^3 (ref. 68). In other studies LC_{50} values between 18.5 and 180 mg/m^3 were reported for exposure of rats during 4-hours to the vapour or to aerosols of cyanuric chloride (ref.85, 86, 87, 88, 89, 90, 91).

Conclusion

The great variance in the acute oral LD_{50} values may be explained by the dependency of the used vehicles. The oral LD_{50} for cyanuric chloride is 315 mg/kg bw for males and 327 mg/kg bw for females (ref.24).

The dermal LD_{50} for cyanuric chloride is > 2000 mg/kg bw (ref. 28 and 29).

The inhalatory LC_{50} for cyanuric chloride is 170 mg/m^3 (ref. 78).

3.1.2 Irritation and sensitisation

In two tests performed with two different strains of rabbits, cyanuric chloride proved to be irritating to the skin (ref. 30, 32)

Application of 0.1 g cyanuric chloride to the conjunctival sac of the rabbit eye, led to effects on the cornea, iris and conjunctivae. Cyanuric chloride was extremely irritating to the rabbit's eye (ref. 33, 34).

Mice (Balb/C) were exposed to an aerosol of cyanuric chloride (2.1 – 14.6 mg/m^3) for 15 minutes. No details were provided on particle size or stability of the aerosol. The respiratory rate of the animals was found to be reduced in a dose dependant manner. A 50% reduction of the respiratory frequency (RD_{50}) was found at 5.9 mg/m^3 (ref. 41).

Cyanuric chloride exhibited sensitising properties in a maximisation test in the guinea-pig (ref. 35). Local lymph node assays in mice and guinea-pigs confirmed the findings of the maximisation test and showed that the effects on the immune system increased with dose both in presence and absence of interleukin-2 (ref. 75, 76).

Conclusion

Cyanuric chloride is irritating to the skin (ref. 30, 32) and extremely irritating to eyes (ref. 33, 34). Based on the RD_{50} value and the results found in repeated dose inhalation studies (see next section), cyanuric chloride is highly irritating to the respiratory tract. The substance is sensitising in the maximisation test (ref. 35).

3.1.3 Repeated Dose Toxicity

Oral

Five days oral (gavage) exposure of mice (5/sex/dose level) to 10 to 320 mg/kg bw led to a decreased body weight and a reduced food consumption at 20 mg/kg bw and above. At 40, 80, 160 and 320 mg/kg bw 1, 6, 8 and 10 of 10 animals died, respectively. Clinical symptoms seen at 20 mg/kg bw and at the higher dose levels consisted of rales, excessive salivation, laboured breathing, gasping, cool to touch, decreased motor activity, brown material around mouth/nose, moist areas of yellow material on several body regions, dry and/or red material around eye(s) and/or mouth and black material around anal opening. Macroscopic findings found at 20 mg/kg bw and above consisted of dark discoloration (with foci), haemorrhage and erosions or ulcerations in the glandular stomach and/or nonglandular stomach. Only limited endpoints were investigated in this ‘range finding’ study (ref. 36).

In a 4-5-week dietary study no toxic effects were seen at 37 mg/kg diet in rabbits (ref. 45, 99). No further information was available. In another study administration of 0.1 and 0.5% cyanuric chloride in the diet of rats led to decreased body weight gain. No effects were seen at the lowest tested dose (0.02%, corresponds to 20 mg/kg bw according to ref. 99). Only an abstract was available (ref. 99).

In a 28-day study rats (Wistar, 8 animals/sex) were given daily oral doses of 0, 4, 20 and 100 mg/kg bw. At 4 mg/kg bw 1 female, at 20 mg/kg bw 1 male and 2 females and at 100 mg/kg bw 6 males and 3 females died. Animals that died showed atrophic spleen lymphatic nodules and gastritis. In survivors dose related effects included erosion and ulceration of the stomach mucosa and focal papillomatous proliferation and hyperkeratosis of the forestomach epithelium. Active germinal centers of lymphatic nodules in the small intestine were seen at the two highest dose groups. At 100 mg/kg bw vacuolisation of hepatocytes and polymorphism of hepatocyte nuclei was reported. Food consumption and body weight were decreased in the highest dose group. Liver and adrenal weights were increased and red blood cell count, haemoglobin concentration and haematocrit were lowered in the same group. An increase in alkaline phosphatase activity was seen at 100 mg/kg bw. The report was available as an abstract (ref. 73).

Dermal

In a 21-day dermal test, rabbits received 50, 150 or 500 mg cyanuric chloride/kg bw in mineral oil (occlusive). Local effects (dermal irritation and inflammation) were seen in rabbits of all treatment groups and vehicle treated controls. Body weights were decreased in males at 150 and 500 mg/kg bw and (significantly) in females at the highest dose group. This effect may be at least partly related to stress due to the repeated use of bandages and the skin damage. A significant increase in number of neutrophils in males at all treatment groups and a concomitant increase in leukocytes at the two highest dose levels may be related to the skin damage. The exposed area was about 30% of the body surface, therefore the study represents a worst case situation. Since it cannot be excluded that the effcts on body weight were related to stress by the treatment, no NOAEL for systemic effects was derived. For local effects 50 mg/kg is a LOAEL. (ref. 37).

Inhalation

Rats (10/group) were exposed to 0 or 1.88 mg/m^3 during 75 days. Cyanuric chloride exposed animals showed irritation of the mucous of the eyes and the upper respiratory tract, lethargy, reduced red blood cell counts, decreased haemoglobin level and reduced body weight gain. Three out of ten animals died. Pathological findings included mild granular dystrophy in the liver, kidneys and myocardium.(ref. 68, 70). In a parallel 5 months study, a NOEC of 0.3 mg/m^3 was reported (ref. 68, 70). No further information is available.

Inhalation exposure of Wistar rats to cyanuric chloride (6 hours/day, 5 days/week) at 0, 0.04, 0.2, 0.4, 1.0 and 1.5 mg/m^3 during 4 weeks gave at the higher dose groups (not indicated) increased mortality, decreased body weight gain and food consumption. Other effects seen in treated animals included increase of bronchoalveolar lymphatic tissue, atrophy of the thymus cortex, enlargement of the mesenteric lymph nodes and increase of lymph node weights and cell numbers. The study was available as a short abstract, a full evaluation was not possible based on insufficient description (ref. 77).

In a 90-day inhalation study Wistar rats (10/sex/treatment, exposure 6 hours/day, 5 days/week) were exposed to vapour concentrations of 0.01, 0.05 and 0.25 mg/m^3. No effects on mortality, clinical observations, body weight and food consumption were found. There were no effects on the gonads at any concentration tested. At the highest concentration, an increased incidence of inflammation of the repiratory tract was observed. Yellow exudate with a concomittant increase of the number of neutrophils was present in the nasal cavities of 6 of 10 males. In controls and other exposed animals yellowish exudate was seen with 0-2 of 10 animals/sex/treatment. Presence of PMN in the lumen (6/10 males) and tracheitis (5/10 males) were found at the top dose level. Congestion of the lungs with foamy macrophages (5/10) and lymphocyte infiltrations (7/10) were observed in high dose males, but in all other exposed animals low levels of interstitial lymphocyte infiltration(1-5/10) in alveolar septa of the lungs and foamy macrophages (0-3/10) were reported. The pathogenesis was considered by the author to be of infectious origin rather than due to local irritation. The increased background levels of lung pathology can be related to the use of non-SPF rats in this study. Since the changes in nose and lung are most severe at the highest concentration, an exacerbation of the intercurrent infection by the treatment cannot be excluded. The NOAEC for systemic toxicity was 0.25 mg/m^3. The NOAEC for local effects in the respiratory tract of rats displaying intercurrent respiratory infection was found to be 0.05 mg/m^3 (ref. 74).

Conclusion

Main effects seen in the repeated dose studies were considered to be related to the irritating properties of cyanuric chloride.

From the 90-day inhalation study (ref. 74) a NOAEC for systemic toxicity of 0.25 mg/m^3 was derived. The NOAEC for local effects in the respiratory tract of rats displaying intercurrent respiratory infection was found to be 0.05 mg/m^3.

In the dermal study (ref. 37) the LOAEL for local effects was 50 mg/kg bw based on dermal irritation.

The oral studies were either of very short duration (ref. 36) or only available as an abstract (ref. 73). Findings included corrosion and ulcerations in the stomach.

3.1.4 Mutagenicity

In vitro Studies

Cyanuric chloride was not mutagenic in the Ames test with strain TA97a, TA98, TA100 and TA102 (ref. 38)

In vivo Studies

In a micronucleus test mice (NMRI) received cyanuric chloride at a dose level of 619 mg/kg bw (gavage). At this level toxicity in the animals was observed (4 of 42 mice died and salivation, forced respiration, ruffled fur, hypokinesia, tremor and disturbance of the general condition was reported). No increase in the number of micronucleated erythrocytes was seen (ref. 39).

Other

25 male and 25 female rats received weekly subcutaneous injections with cyanuric chloride (purity 96.5%) in sunflower oil. After 3.5 months the subcutaneous administration was discontinued due to severe necrotic effects seen at the injection sites and the animals received 10 mg/0.5 ml oil for the additional 20.5 months (6 days/week) of the study. Nine rats were found with sarcomas at the necrotic application sites. These tumours were connected with the irritating/caustic effect of cyanuric chloride. Additional tumours found were considered to be without relationship to the treatment (ref. 45, 97).

In another study male and female rats (n= 27 and 23, respectively) received 10 mg/0.5 ml oil with the food during 24 months. The tumours (5 fibrosarcoma of the mammary gland, 1 leiomyosarcoma of the uterus, 1 lymphosarcoma of the intestinal tissue, 1 subcutaneous tissue fibroma and 1 prostate carcinoma) observed were considered spontaneous pathological findings based on their type and incidence and were considered unrelated to treatment (ref. 97).

These studies do not correspond to international guidelines regarding test performance and are considered not suitable for determining carcinogenic potential. In both studies no control groups were included.

3.1.5 Toxicity for Reproduction

Effects on Fertility

In the 90-day repeated dose inhalation study no macroscopic or microscopic findings on male and female gonads were reported (ref. 74).

Developmental Toxicity

In a range-finding study pregnant rats (5/group) received 0, 5, 10, 20, 30 and 40 mg cyanuric chloride/kg bw during day 6 to 19 of gestation. No effects on the offspring were found (ref. 93).

In the following main study no teratogenic effects were found at 5, 25 or 50 mg cyanuric chloride/kg bw in the offspring of mated female rats. At the highest dose tested maternal toxicity became apparent (decreased body weight gain and clinical signs). Increased post-implantation loss and a decreased number of live foetuses were reported at maternally toxic doses. The NOAEL for maternal toxicity developmental effects was 25 mg/kg bw (ref. 40).

3.1.6 Effects on Humans

Although large amounts of cyanuric chloride have been handled in the industry for more than 40 years, mainly cases of irritation and caustic effects to the skin and mucosa of the eyes and respiratory tract were observed from acute exposure (ref. 102, 103, 104). These effects disappeared completely after a short time and no persisting problems were reported.

Effects of cyanuric chloride on the viscosity of arterial vessels were reported in exposed workers (n=38). No effects were seen in an unexposed control group (n=30) (ref. 46).

In studies with workers, who were exposed to cyanuric chloride for a period between 1 and 22 years, physical examinations did not reveal effects on lungs, eyes and skin. Lung function appeared to be normal and no other adverse effects of cyanuric chloride were reported (ref. 79).

An, in general, healthy male (age 54) was exposed to cyanuric chloride during an inspection in a factory where herbicides were produced. Cyanuric chloride (one of the basic materials) was accidentally released, because a vessel broke down. The man was heavily exposed to the powder.

Signs of intoxication consisted of irritation of the skin, eyes and pharynx, followed by serious obstructive pulmonary syndrome with impairment of alveolar capillary exchanges. No effects on the heart function were seen (although a slightly abnormal ECG was reported from a pre-exposure investigation). The man recovered within 20 days (ref. 45).

The effects associated with acute exposure to cyanuric chloride are irritation of the skin and of the mucosa of the eyes, naso-pharyncheal cavities and the respiratory tract. Inhalation of the dust or vapour causes respiratory irritation, which reaches with a certain delay also the lower respiratory tract (ref. 102, 103, 104).

Allergic contact dermatitis and asthmatic reactions are reported (ref. 103, 104).

After one minute exposure a concentration of 0.13 mg cyanuric chloride vapour/m^3 did not yield symptoms in volunteers. The effect level was 0.3 mg/m^3 (stated in ref. 68).

Several reports on chronic intoxication after occupational exposure to cyanuric chloride are (ref. 82, 84, 102, 103, 104, 105). Concentrations in air were > 0.1 mg/m^3 and during certain procedures exposure to 3 mg/m^3 with peaks up to 9 mg/m^3 were reported. During the high exposure workers worn gas masks. Effects seen included irritation of the eyes, burning and itching of the skin, nervous disturbances, headache, irritability, increased tiredness, poor memory, bad sleep and pain in the heart region. The CNS effects reported (ref. 84) were not confirmed by the results of any other studies and are therefore considered isolated findings.

All publications on human exposure and effects provided limited details. Only general information was available.

3.1.7 Existing guidelines

No exposure or emission limits for cyanuric chloride are known.

3.2 Initial Assessment for Human Health

For the acute effects tests are available. Cyanuric chloride is considered to be harmful after oral administration and not toxic after dermal application. The high acute inhalation toxicity of cyanuric chloride is likely to be secondary to its highly irritating/caustic properties.

The compound is highly irritating to the skin and the eyes.

The compound is sensitising.

The data on repeated dose are considered to be sufficient. From the available oral studies showing effects on body weight and erosion and ulceration of the stomach no NOAEL could be derived, due to limited reporting. Since the dermal and inhalatory route are expected to be the main route of worker exposure, no additional data are considered necessary. The LOAEL derived is 50 mg/kg bw for dermal exposure based on severe skin irritation. From a 90-day inhalation study a NOAEC of 0.25 mg/m^3 for systemic toxicity was derived. The NOAEC for local effects in the respiratory tract of rats displaying intercurrent respiratory infection was found to be 0.05 mg/m^3.

For teratogenic effects an oral study is available. The NOAEL for maternal toxicity is 25 mg/kg bw. For developmental effects a NOAEL of 25 mg/kg bw was derived. In the 90-day repeated dose study no effects on the gonads were reported. Since human exposure to cyanuric chloride is expected to be very low, this is for the time being considered sufficient to meet the requirements for effects on fertility.

Cyanuric chloride is found to be not mutagenic in the Ames test and the mouse micronucleus test.

The results of carcinogenicity testing are not adequate for evaluation.

In humans irritation was the main effect after acute exposure. No persisting effects were seen. In a Russian article effects on the arterial walls (viscosity) are reported.

4 HAZARDS TO THE ENVIRONMENT

4.1 Aquatic Effects

The aquatic toxicity of cyanuric chloride is not directly determinable due to its poor solubility and its hydrolytic properties. Only difficult to define hydrolytic mixtures, which are affected by pH value, the temperature, the amount added and the time period between production and the test run, can be studied. In order to transverse this boundary which applies for all studies of cyanuric chloride in aqueous systems, results of tests with hydrolytic products capable of isolation, such as 2-chloro-4,6-dihydroxy-1,3,5-triazine and cyanuric acid, were included here. Additionally QSAR calculations on acute toxicity towards fish, daphnia and algae were performed (see Table 2).

In view of the rapid hydrolysis of this compound it is expected that these organisms will be exposed to the reaction products found after hydrolysis, particularly 2-chloro-4,6-dihydroxy-s-triazine and cyanuric acid, rather than to the parent compound.

No toxicity was observed up to concentrations of 525 mg/L cyanuric chloride in a test with the golden orfe (*Leuciscus idus melanotus*) (ref. 21).

In a 96-hour test with guppies exposed to 2-chloro-4,6-dihydroxy-s-triazine no deaths or effects were reported at a concentration of 1000 mg/L (96-h LC_{50} >1000 mg/L). In this test no analyses were performed, but in a range-finding test at the same concentration samples taken were between 94 and 97% of nominal values over a 96-hour period (ref. 49).

For cyanuric acid the 48-h LC_{50} in a test with the orange-red killifish (*Oryzias latipes*) was > 1000 mg/L. The report was available as an abstract without specification of test concentrations, loading rate, oxygen concentration and pH (ref. 20).

The 24-h EC_{50} value of 2-chloro-4,6-dihydroxy-s-triazine for *Daphnia magna* was >1000 mg/L (ref. 47). The test was performed according to OECD 202. No analyses were done, but in other tests (see above) it was confirmed that the initial concentration was maintained. For cyanuric acid the 24-h EC_{50} for *Daphnia magna* (age <72 h) was reported to be >1800 mg/L (ref. 69). For reproductive parameters no effects were seen at concentrations of 125, 250 and 500 mg/L cyanuric acid (ref. 69). The tests performed with the acid were not in accordance with OECD requirements and were poorly reported.

No direct information on the toxicity to algae is reported. An algae study with isocyanuric acid a NOEC of 62.5 mg/L was found (LC50 620 mg/L) (ref. 80) In a microcosm study, which was available in the public literature, no effects on algae were seen when exposed to a saturated cyanuric acid solution (ref. 69).

Table 2 QSAR calculations

	Fish (LC50 mg/L)	**Daphnia (EC50 mg/L)**	**Algae (EC50 mg/L)**
Method	ECOSAR	ECOSAR	Log EC50 = -1.00 logKow -1.23 (ref. Van Leeuwen)
Cyanuric chloride	245	258	202
2-chloro-4,6-dihydroxy-1,3,5-s-triazine	994	993	909
cyanuric acid	1940	1890	1866

No effect of cyanuric chloride or its hydrolytic products on bacteria in sludge (dehydrogenase activity) was reported (tested concentrations 0.72-576 mg/L) (ref. 21).

Cyanuric acid was found to affect the viability of molluscs at concentrations of 250 mg/L and above, when tested over a 96-97 days period (ref. 25). Exposure of molluscs to 500 mg/L without aeration lead to survival up to 14 days. In a test with exposure to 1000 mg/L for 20 days under condition of aeration a longer survival time was seen (not quantified) (ref. 69).

Based on the chemical properties (very fast hydrolysis to cyanuric acid), it is not expected, that cyanuric chloride will be bioaccumulated. In a test with carps exposed to cyanuric acid, rather large fishes were used at a temperature of 25°C. The bioaccumulation factor was found to be <0.1 (at 10 mg/L) and <0.5 (at 1 mg/L).The information on the study design is limited (ref. 20).

Conclusion:

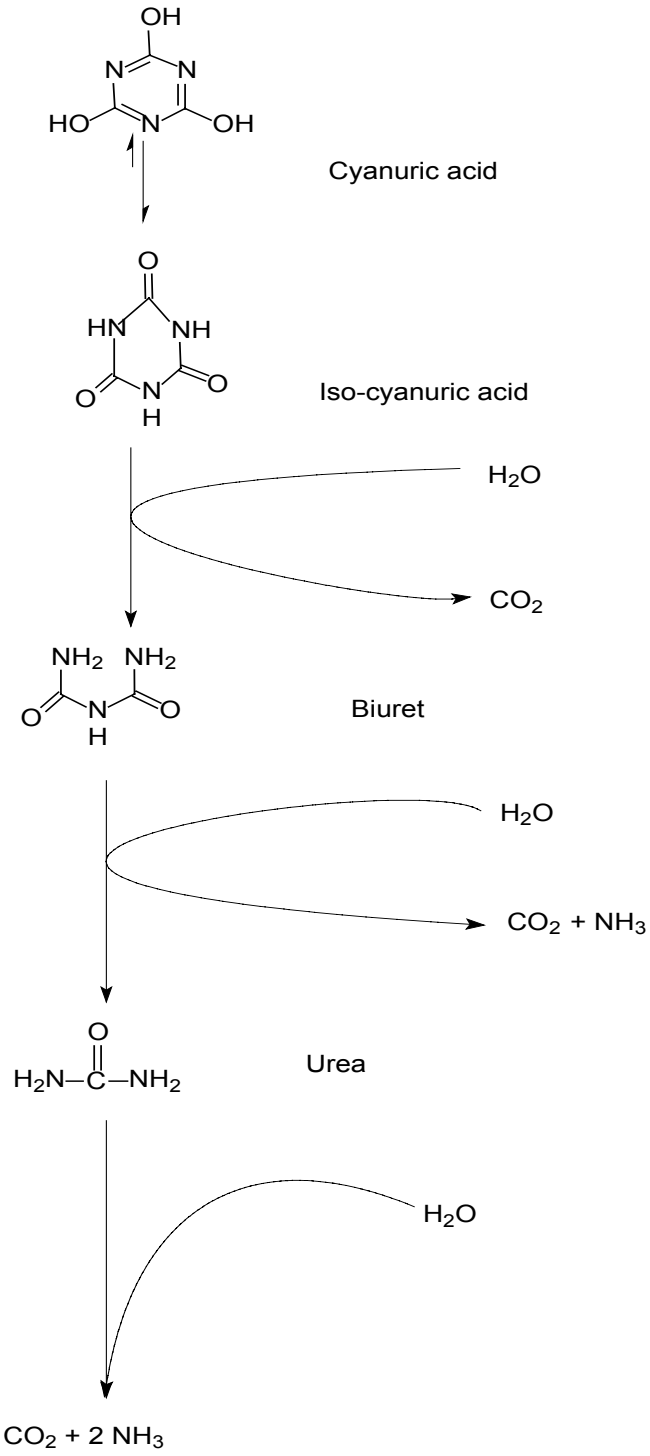
Due to low solubility and quick hydrolysis, the aquatic toxicity of cyanuric chloride cannot be determined directly. For some hydrolysis products tests are available.

The LC_{50} for fish and daphnia was >1000 mg/L (ref. 20, 47 and 49) in tests with one of the hydrolysis products. No data on algal toxicity were available for cyanuric chloride. However, cyanuric acid was not toxic to algae at maximum saturable concentrations. Isocyanuric acid was found to have an EC50 for algae of 620 mg/L. Model calculations or acute effects on aquatic organisms were in general in good agreement with the measured values.

4.2 Terrestrial Effects

Cyanuric acid was reported not to affect nitrifying micro-organisms at 25°C over a 90 day period. However, at 20°C a transient effect was observed and at 10°C nitrification was inhibited during the whole observation period up to levels of 25% (ref. 55). In a poorly reported nitrification test cyanuric acid did not affect the CO_2 production by micro-organism (ref. 54). In fact several bacteria and fungi can use cyanuric acid as nitrogen source (ref. 56, 57, 58, 60, 61, 62, 63, 65, 66, 67).

Fig. 2 degradation pathway of cyanuric acid (bacteria)



The course of the degradation pathway (in bacteria) is via cleavage of the triazine-ring (ref. 60, 61, 63). For two strains of pseudomonas and one strain of Klebsiella pneumonia the degradation pathway of cyanuric acid was analysed. An enzymatic transformation to urea was identified. However, the report was limited and the analytical methods used were insufficiently specified (ref. 63, see fig. 2)

4.3 Other Environmental Effects

Birds

In an acute toxicity test an oral LD_{50} value of 192 mg/kg bw was found for the Japanese quail (ref. 64).

In Peking ducklings tested in an 8-day dietary test curved body position and sedative effects were observed at all tested concentrations (10-1000 mg/kg diet). No deaths were reported. Food intake was reduced in animals fed at concentrations of 200 and 1000 mg/kg diet (ref. 27).

4.4 Initial Assessment for the Environment

The manufacture of cyanuric chloride takes place in a continuous closed process. Worker exposure is therefore expected to be low. Calculations with the USES-model show very low PEC values (appendix B). Due to fast hydrolysis no residual cyanuric chloride is expected in the environment (see section on ecotoxicity).

All physico-chemical endpoints are sufficiently investigated.

Cyanuric chloride is considered to be photolytically stable based on the results of Epiwin-modelling.

The compound hydrolyses quickly to cyanuric acid in water via formation of 2,4-dichloro-6-hydroxy-s-triazine and 2-chloro-4,6-hydroxy-s-triazine.

The tests found on biodegradation of 2-chloro-4,6-hydroxy-s-triazine and cyanuric acid are considered to be less reliable. In view of the limited toxicity to aquatic organisms of both substances and the low bioaccumulating potential of cyanuric acid, it is not necessary to perform a biodegradation study.

From the EQC model and the USES model (version 2.0) it can be deduced that 97-98% of cyanuric chloride will end up in the surface water. Therefore it is considered not necessary to conduct an adsorption-desorption study in soil. Some micro-organisms are able to degrade cyanuric chloride. It is not clear whether or not “normal” soil micro-organisms are able to degrade cyanuric chloride. However in view of the low exposure that is expected for soil-micro-organisms, it is not necessary to conduct further testing.

Cyanuric chloride and its hydrolysis products are of low toxicity towards fishes. For Daphnia and fish no toxic effects were reported at concentrations of 500 mg 2-chloro-4,6-hydroxy-s-triazine/L.

Cyanuric acid was not toxic to algae at maximum saturable concentrations.

5 RECOMMENDATIONS

The chemical is currently of low priority for further work.

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81	American Cyanamid Company	1952	The chemistry of cyanuric chloride	New Products Bulletin Collective, Vol. 1, RE-ISED Ed. 1, Band 1
82	Goldblatt, M.	1945	Vesication and some vesicants	Brit. J. Ind. Med. 2, 183-201
83	Von Herlinger, H.	1964	Synthese von Halogenalkyl-dichlor- und bis-(halogenalkyl)-chlor-s-triazinen	Angew. Chem. 76(10), 437
84	Kaskevich, L. et al.	1984	Einwirkungen von Cyanurchlorid auf den menschlichen Organismus	Vrachebn. Delo 8, 109-112
85	Wallace, J.	1975	Acute oral toxicity study.	Bio-Toxicology Laboratories, Inc.
86	Ullmann, L.	1985	4-hour acute aerosol inhalation toxicity (LC50) study with cyanurchlorid in rats	RCC AG, Switzerland
87	Ullmann, L.	1986	4-hour vapour inhalation toxicity study with cyanurchloride in rats.	RCC AG, Switzerland
88	Duchosal, F.	1991	4-hour acute inhalation toxicity study with cyanuric chloride – non-micronized - aerosol in rats. Project 291172.	RCC AG, Switzerland
89	Duchosal, F.	1991	4-hour acute inhalation toxicity study with cyanuric chloride vapor in rats.	RCC AG, Switzerland
90	Duchosal, F.	1991	4-hour acute inhalation toxicity study with cyanuric chloride micronized aerosol in rats. Project 291161.	RCC AG, Switzerland
91	Stevens, J.	1981	Report on acute vapor inhalation toxicity in the rat of cyanuric chloride (GS-41711).	Ciba-Geigy Ltd. Switzerland

Ref	Author	Year	Title	Source/performing laboratory
92	Sarasin, G.	1981	Acute oral LD50 n the rat of technical GS 41'711	Ciba-Geigy Ltd. Switzerland
93	Cuddeback, B.	1983	Exploratory range-finding teratology study in rats with technical cyanuric chloride	Int. R&D Corp. Michigan USA
94	Paa, H.	1974	Acute oral toxicity study – female albino rats	Industrial Bio-Test Laboratories, Inc.
95	Boehm and Mertschenk	1992	BUA-Bericht "Cyanurchlorid" – Eintrag in die Umwelt.	SKW Trostberg Aktiengesellschaft
96	Marhold, J.	1972	Sbornik Vysledku Toxikologickeno Vysetreni Latek a Pripravku, Prag	p. 152
97	Pliss, G.	1966	Blastomogene Effekte von Cyanurchlorid (translation from Russian)	Vopr. Onkol. 12 (4), 78-82
98	Kriebitzsch, N.	1987	Cyanuric Acid and Cyanuric Chloride	In Ullmann's Encyclopedia of Industrial Chemistry, VCH Verlagsgesellschaft, Weinheim, S. 191-200.
99		1981	Cyanuric Chloride	Patty's Industrial Hygiene and Toxicology, 3e ed., vol 2A, 2763-2765 (via personal communication with E. Flint)
100	Kegel, A.	1992	BUA-Bericht "cynurchlorid" – Producktionsmengen, Verarbeitung, Anwendung, Verbrauchsmengen.	Degussa AG, Internal letter 16-10-92
101	Haubrich	1992	BUA-Bericht "Cyanurchlorid" – Beschreibung des Herstellungsverfahrens und des Umwelteintrages	Degussa AG, Internal letter 28-09-92
102	Kulzer, R.	1991	Langzeitfolgen einer einmaligen (unfallmäβigen) Einwirkung von Cyanurchlorid auf Mitarbeiter des Betriebes	Degussa AG, Internal letter 29-07-91
103	Jacobs, K.	1982	Cyanurchlorid	Degussa AG, Internal letter 17-03-82, Wesseling
104	Mohr	1980	Eventuelle Gesundheitsschäden durch Umgang mit Cyol und MMA..	Degussa AG, Internal letter 11-12-80
105		1979	Cyanurchlorid - MDT.	Degussa AG, Internal letter 11-05-79
106		1987	Cyanurchlorid (Degussa brochure).	Degussa AG
107	Häusler, A.	1989	Anaerober Abbau von Cyanursäure in diskontinuierlichen Suspensionsreaktoren und kontinuierlich betriebenen Festbett-Umlaufreaktoren	Diplomarbeit, Technischen Hochschule Darmstadt

* Not used because it was written in a language that we could not read.

+ The data from this reference were only used to complete the assessment if necessary.

ANNEX: SEARCH CRITERIA

The following data bases were searched under the CAS number 6386-38-5 and Metilox in September 2001: HSDB, Medline, Toxline, Healthstar, Kluwer-Verlagsdatenbank für Volltexte, Springer-Verlagsdatenbank für Volltexte and ZEBET.

No additional references were identified.

For environmental fate and ecotoxicology endpoints in addition the following databases were investigated: Embase, Biosis and Enviroline, . The search profile included the following search criteria: Environm? or ecotox? or fate; air or soil or water or aquatic? or sedim?; photo? or stab? or distribut? or degrad? or transp? or monitor? or BOD or COD or accumul?; solub? or partition? or Kow or Pow or Koc or hydrol?; fish? or invert? or daphn? or alg? or plant? or kinet? or acute or chronic?; vertebrat? or microorg? or micro-org? or bacter? or ?dwelling? or tranform? or terrestr?

APPENDIX A

```
SMILES : n(c(nc(n1)CL)CL)c1CL
CHEM   : 1,3,5-Triazine, 2,4,6-trichloro-
CAS NUM: 000108-77-0
MOL FOR: C3 CL3 N3
MOL WT : 184.41
------------------------------ EPI SUMMARY (v3.10) --------------------------
 Physical Property Inputs:
    Water Solubility (mg/L):   ------
    Vapor Pressure (mm Hg) :   ------
    Henry LC (atm-m3/mole) :   ------
    Log Kow (octanol-water):   ------
    Boiling Point (deg C)  :   ------
    Melting Point (deg C)  :   ------

KOWWIN Program (v1.66) Results:
================================

                  Log Kow(version 1.66 estimate): 1.73

SMILES : n(c(nc(n1)CL)CL)c1CL
CHEM   : 1,3,5-Triazine, 2,4,6-trichloro-
MOL FOR: C3 CL3 N3
MOL WT : 184.41
-------+-----+-------------------------------------------+---------+--------
 TYPE  | NUM |        LOGKOW FRAGMENT DESCRIPTION        |  COEFF  |  VALUE
-------+-----+-------------------------------------------+---------+--------
 Frag  |  3  |  Aromatic Carbon                          | 0.2940  |  0.8820
 Frag  |  3  |  Aromatic Nitrogen                        |-0.7324  | -2.1972
 Frag  |  3  |  -CL     [chlorine, aromatic attach]      | 0.6445  |  1.9335
 Factor|  1  |  sym-Triazine ring correction             | 0.8856  |  0.8856
 Const |     |  Equation Constant                        |         |  0.2290
-------+-----+-------------------------------------------+---------+--------
                                                       Log Kow   =   1.7329



MPBPWIN (v1.40) Program Results:
================================
Experimental Database Structure Match:
  Name     :  CYANURIC CHLORIDE
  CAS Num  :  000108-77-0
  Exp MP (deg C):  154
  Exp BP (deg C):  192
  Exp VP (mm Hg):  ---

SMILES : n(c(nc(n1)CL)CL)c1CL
CHEM   : 1,3,5-Triazine, 2,4,6-trichloro-
MOL FOR: C3 CL3 N3
MOL WT : 184.41
----------------------- SUMMARY MPBPWIN v1.40 --------------------


Boiling Point:  234.02 deg C (Adapted Stein and Brown Method)

Melting Point:  206.25 deg C (Adapted Joback Method)
Melting Point:   22.98 deg C (Gold and Ogle Method)
Mean Melt Pt :  114.62 deg C (Joback; Gold,Ogle Methods)
  Selected MP:   68.80 deg C (Weighted Value)

Vapor Pressure Estimations (25 deg C):
```

```
  (Using BP: 192.00 deg C (exp database))
  (Using MP: 154.00 deg C (exp database))
    VP:  0.0282 mm Hg (Antoine Method)
    VP:  0.0236 mm Hg (Modified Grain Method)
    VP:  0.0412 mm Hg (Mackay Method)
  Selected VP:  0.0236 mm Hg (Modified Grain Method)


-------+-----+--------------------+----------+---------
 TYPE  | NUM |  BOIL DESCRIPTION  |  COEFF   |  VALUE
-------+-----+--------------------+----------+---------
 Group |  3  |  -C (aromatic)     |   30.76  |   92.28
 Group |  3  |  N (aromatic)      |   39.88  |  119.64
 Group |  3  |  -Cl (to aromat)   |   36.79  |  110.37
   *   |     |  Equation Constant |          |  198.18
=============+====================+==========+=========
RESULT-uncorr|  BOILING POINT in deg Kelvin  |  520.47
RESULT- corr |  BOILING POINT in deg Kelvin  |  507.18
             |  BOILING POINT in deg C       |  234.02
-------------------------------------------------------

-------+-----+--------------------+----------+---------
 TYPE  | NUM |  MELT DESCRIPTION  |  COEFF   |  VALUE
-------+-----+--------------------+----------+---------
 Group |  3  |  -C (aromatic)     |   37.02  |  111.06
 Group |  3  |  N (aromatic)      |   68.40  |  205.20
 Group |  3  |  -Cl (to aromat)   |   13.55  |   40.65
   *   |     |  Equation Constant |          |  122.50
=============+====================+==========+=========
   RESULT    |  MELTING POINT in deg Kelvin  |  479.41
             |  MELTING POINT in deg C       |  206.25
-------------------------------------------------------



Water Sol from Kow (WSKOW v1.40) Results:
=========================================

          Water Sol: 1735 mg/L

SMILES : n(c(nc(n1)CL)CL)c1CL
CHEM   : 1,3,5-Triazine, 2,4,6-trichloro-
MOL FOR: C3 CL3 N3
MOL WT : 184.41
---------------------------------- WSKOW v1.40 Results -----------------------
Log Kow  (estimated)  :  1.73
Log Kow (experimental):  not available from database
Log Kow used by Water solubility estimates:  1.73

Equation Used to Make Water Sol estimate:
   Log S (mol/L) = 0.796 - 0.854 log Kow - 0.00728 MW + Correction
       (used when Melting Point NOT available)

      Correction(s):         Value
      -------------------    -----
       No Applicable Correction Factors

   Log Water Solubility  (in moles/L) :  -2.026
   Water Solubility at 25 deg C (mg/L):  1735



ECOSAR Program (v0.99g) Results:
```

```
================================
SMILES : n(c(nc(n1)CL)CL)c1CL
CHEM   : 1,3,5-Triazine, 2,4,6-trichloro-
CAS Num:
ChemID1:
ChemID2:
ChemID3:
MOL FOR: C3 CL3 N3
MOL WT : 184.41
Log Kow: 1.73  (KowWin estimate)
Melt Pt:
Wat Sol: 1546 mg/L  (calculated)

ECOSAR v0.99g Class(es) Found
-----------------------------
Triazines


                                                                  Predicted
ECOSAR Class                    Organism            Duration  End Pt   mg/L (ppm)
============================  ==================  ========  ======   ==========
Neutral Organic SAR         : Fish                14-day    LC50      425.559
(Baseline Toxicity)

Triazines                   : Fish                96-hr     LC50      245.239
Triazines                   : Fish                14-day    LC50      425.559
Triazines                   : Daphnid             48-hr     LC50      257.923
Triazines                   : Daphnid             16-day    EC50       11.754
Triazines                   : Fish                          ChV        30.248
Triazines                   : Fish  (SW)          96-hr     LC50       49.305

 Note:  * = asterick designates: Chemical may not be soluble
        enough to measure this predicted effect.
         Fish and daphnid acute toxicity log Kow cutoff: 5.0
         Green algal EC50 toxicity log Kow cutoff: 6.4
         Chronic toxicity log Kow cutoff: 8.0
         MW cutoff: 1000



HENRY (v3.10) Program Results:
==============================

       Bond Est :  4.91E-007 atm-m3/mole
       Group Est:  Incomplete

SMILES : n(c(nc(n1)CL)CL)c1CL
CHEM   : 1,3,5-Triazine, 2,4,6-trichloro-
MOL FOR: C3 CL3 N3
MOL WT : 184.41
--------------------------- HENRYWIN v3.10 Results --------------------------
----------+-----------------------------------------+---------+----------
   CLASS  |     BOND CONTRIBUTION DESCRIPTION       | COMMENT |  VALUE
----------+-----------------------------------------+---------+----------
 FRAGMENT |   3  Car-CL                             |         | -0.0723
 FRAGMENT |   6  Car-Nar                            |         |  9.7693
 FACTOR   |   2  Additional aromatic nitrogen(s)    |         | -5.0000
----------+-----------------------------------------+---------+----------
 RESULT   |    BOND ESTIMATION METHOD for LWAPC VALUE   |  TOTAL  |  4.697
----------+-----------------------------------------+---------+----------
HENRYs LAW CONSTANT at 25 deg C = 4.91E-007 atm-m3/mole
                                = 2.01E-005 unitless
```

	GROUP CONTRIBUTION DESCRIPTION	COMMENT	VALUE
	3 Nar (Car)(Car)		9.18
	MISSING Value for: Car (Nar)(CL)(Nar)		
	MISSING Value for: Car (Nar)(CL)(Nar)		
	MISSING Value for: Car (Nar)(CL)(Nar)		
RESULT	GROUP ESTIMATION METHOD for LOG GAMMA VALUE	INCOMPLETE	9.18

Henrys LC [VP/WSol estimate using EPI values]:
HLC: 3.301E-006 atm-m3/mole
VP: 0.0236 mm Hg
WS: 1.74E+003 mg/L

BIOWIN (v4.00) Program Results:
==========
SMILES : n(c(nc(n1)CL)CL)c1CL
CHEM : 1,3,5-Triazine, 2,4,6-trichloro-
MOL FOR: C3 CL3 N3
MOL WT : 184.41
---------- BIOWIN v4.00 Results ----------

Linear Model Prediction : Does Not Biodegrade Fast
Non-Linear Model Prediction: Does Not Biodegrade Fast
Ultimate Biodegradation Timeframe: Months
Primary Biodegradation Timeframe: Weeks
MITI Linear Model Prediction : Does Not Biodegrade Fast
MITI Non-Linear Model Prediction: Does Not Biodegrade Fast

TYPE	NUM	BIOWIN FRAGMENT DESCRIPTION	COEFF	VALUE
Frag	1	Triazine ring (symmetric)	0.0095	0.0095
Frag	3	Aromatic chloride [-CL]	-0.1824	-0.5473
MolWt	*	Molecular Weight Parameter		-0.0878
Const	*	Equation Constant		0.7475
RESULT		LINEAR BIODEGRADATION PROBABILITY		0.1220

TYPE	NUM	BIOWIN FRAGMENT DESCRIPTION	COEFF	VALUE
Frag	1	Triazine ring (symmetric)	-5.7252	-5.7252
Frag	3	Aromatic chloride [-CL]	-2.0155	-6.0465
MolWt	*	Molecular Weight Parameter		-2.6187
RESULT		NON-LINEAR BIODEGRADATION PROBABILITY		0.0000

A Probability Greater Than or Equal to 0.5 indicates --> Biodegrades Fast
A Probability Less Than 0.5 indicates --> Does NOT Biodegrade Fast

TYPE	NUM	BIOWIN FRAGMENT DESCRIPTION	COEFF	VALUE
Frag	1	Triazine ring (symmetric)	-0.2459	-0.2459

```
 Frag |  3  |  Aromatic chloride   [-CL]                | -0.2066 | -0.6198
 MolWt|  *  |  Molecular Weight Parameter               |         | -0.4075
 Const|  *  |  Equation Constant                        |         |  3.1992
============+===========================================+=========+=========
   RESULT   |   SURVEY MODEL - ULTIMATE BIODEGRADATION  |         |  1.9260
============+===========================================+=========+=========

------+-----+-------------------------------------------+---------+---------
 TYPE | NUM |        BIOWIN FRAGMENT DESCRIPTION        |  COEFF  |  VALUE
------+-----+-------------------------------------------+---------+---------
 Frag |  1  |  Triazine ring (symmetric)                | -0.0575 | -0.0575
 Frag |  3  |  Aromatic chloride   [-CL]                | -0.1653 | -0.4960
 MolWt|  *  |  Molecular Weight Parameter               |         | -0.2661
 Const|  *  |  Equation Constant                        |         |  3.8477
============+===========================================+=========+=========
   RESULT   |   SURVEY MODEL - PRIMARY BIODEGRADATION   |         |  3.0281
============+===========================================+=========+=========

 Result Classification:   5.00 -> hours     4.00 -> days    3.00 -> weeks
  (Primary & Ultimate)    2.00 -> months    1.00 -> longer

------+-----+-------------------------------------------+---------+---------
 TYPE | NUM |        BIOWIN FRAGMENT DESCRIPTION        |  COEFF  |  VALUE
------+-----+-------------------------------------------+---------+---------
 Frag |  1  |  Triazine ring (symmetric)                |  0.1168 |  0.1168
 Frag |  3  |  Aromatic chloride   [-CL]                |  0.0062 |  0.0185
 MolWt|  *  |  Molecular Weight Parameter               |         | -0.5486
 Const|  *  |  Equation Constant                        |         |  0.7121
============+===========================================+=========+=========
   RESULT   |  MITI LINEAR BIODEGRADATION PROBABILITY   |         |  0.2988
============+===========================================+=========+=========

------+-----+-------------------------------------------+---------+---------
 TYPE | NUM |        BIOWIN FRAGMENT DESCRIPTION        |  COEFF  |  VALUE
------+-----+-------------------------------------------+---------+---------
 Frag |  1  |  Triazine ring (symmetric)                | -9.3006 | -9.3006
 Frag |  3  |  Aromatic chloride   [-CL]                | -0.2191 | -0.6574
 MolWt|  *  |  Molecular Weight Parameter               |         | -5.3238
============+===========================================+=========+=========
   RESULT   | MITI NON-LINEAR BIODEGRADATION PROBABILITY |         |  0.0000
============+===========================================+=========+=========

 A Probability Greater Than or Equal to 0.5 indicates --> Readily Degradable
 A Probability Less Than 0.5 indicates --> NOT Readily Degradable



AOP Program (v1.90) Results:
============================
SMILES : n(c(nc(n1)CL)CL)c1CL
CHEM   : 1,3,5-Triazine, 2,4,6-trichloro-
MOL FOR: C3 CL3 N3
MOL WT : 184.41
------------------- SUMMARY (AOP v1.90): HYDROXYL RADICALS -------------------
Hydrogen Abstraction       =   0.0000 E-12 cm3/molecule-sec
Reaction with N, S and -OH =   0.0000 E-12 cm3/molecule-sec
Addition to Triple Bonds   =   0.0000 E-12 cm3/molecule-sec
Addition to Olefinic Bonds =   0.0000 E-12 cm3/molecule-sec
Addition to Aromatic Rings =   0.0037 E-12 cm3/molecule-sec
Addition to Fused Rings    =   0.0000 E-12 cm3/molecule-sec

   OVERALL OH Rate Constant = 0.003733 E-12 cm3/molecule-sec
```

```
   HALF-LIFE =  2864.910 Days (12-hr day; 1.5E6 OH/cm3)
------------------- SUMMARY (AOP v1.90): OZONE REACTION ----------------------

               ******  NO OZONE REACTION ESTIMATION ******
               (ONLY Olefins and Acetylenes are Estimated)

Experimental Database:  NO Structure Matches



PCKOC Program (v1.66) Results:
==============================

                  Koc (estimated): 124

                Koc may be sensitive to pH!
SMILES : n(c(nc(n1)CL)CL)c1CL
CHEM   : 1,3,5-Triazine, 2,4,6-trichloro-
MOL FOR: C3 CL3 N3
MOL WT : 184.41
--------------------------- PCKOCWIN v1.66 Results ---------------------------

         First Order Molecular Connectivity Index  ..... :  4.182
         Non-Corrected Log Koc  ........................... :  2.8469
         Fragment Correction(s):
                  1   Triazine  ring  ....................  : -0.7521
         Corrected Log Koc  ............................... :  2.0948

                        Estimated Koc:  124.4

                                   NOTE:
     The Koc of this structure may be sensitive to pH!  The estimated
     Koc represents a best-fit to the majority of experimental values;
     however, the Koc may vary significantly with pH.



HYDROWIN Program (v1.67) Results:
=================================
SMILES : n(c(nc(n1)CL)CL)c1CL
CHEM   : 1,3,5-Triazine, 2,4,6-trichloro-
MOL FOR: C3 CL3 N3
MOL WT : 184.41
-------------------------- HYDROWIN v1.67 Results --------------------------

 Currently, this program can NOT estimate a hydrolysis rate constant for
               the type of chemical structure entered!!

 ONLY Esters, Carbamates, Epoxides, Halomethanes (containing 1-3 halogens)
   and Specific Alkyl Halides can be estimated!!  For more information,
    (Click OVERVIEW in Help  or  see the User's Guide)

             *****   CALCULATION NOT PERFORMED   *****



BCF Program (v2.14) Results:
============================
SMILES : n(c(nc(n1)CL)CL)c1CL
CHEM   : 1,3,5-Triazine, 2,4,6-trichloro-
MOL FOR: C3 CL3 N3
MOL WT : 184.41
```

```
---------------------------------- Bcfwin v2.14 ----------------------------------
Log Kow  (estimated)  :  1.73
Log Kow (experimental):  not available from database
Log Kow used by BCF estimates:  1.73

Equation Used to Make BCF estimate:
   Log BCF = 0.77 log Kow - 0.70 + Correction

      Correction(s):                    Value
       Aromatic sym-triazine ring      -0.320

   Estimated Log BCF =  0.314  (BCF = 2.062)



                           Volatization From Water
                           =======================

Chemical Name: 1,3,5-Triazine, 2,4,6-trichloro-

Molecular Weight    :  184.41 g/mole
Water Solubility    :  -----
Vapor Pressure      :  -----
Henry's Law Constant:  4.91E-007 atm-m3/mole  (estimated by Bond SAR Method)

                             RIVER            LAKE
                           ---------        ---------
Water Depth     (meters):   1                1
Wind Velocity    (m/sec):   5                0.5
Current Velocity (m/sec):   1                0.05

      HALF-LIFE (hours) :   1621             1.779E+004
      HALF-LIFE (days ) :   67.53            741.4
      HALF-LIFE (years) :   0.1849           2.03


STP Fugacity Model:  Predicted Fate in a Wastewater Treatment Facility
=======================================================================
PROPERTIES OF: 1,3,5-Triazine, 2,4,6-trichloro-
-------------
Molecular weight (g/mol)                                  184.41
Aqueous solubility (mg/l)                                 0
Vapour pressure (Pa)                                      0
                (atm)                                     0
                (mm Hg)                                   0
Henry 's law constant (Atm-m3/mol)                        4.91E-007
Air-water partition coefficient                           2.00804E-005
Octanol-water partition coefficient (Kow)                 53.7032
Log Kow                                                   1.73
Biomass to water partition coefficient                    11.5406
Temperature [deg C]                                       25
Biodeg rate constants (h^-1),half life in biomass (h) and in 2000 mg/L MLSS (h):
          -Primary tank        0.00       225.61       10000.00
          -Aeration tank       0.00       225.61       10000.00
          -Settling tank       0.00       225.61       10000.00

 STP Overall Chemical Mass Balance:
 ----------------------------------
                              g/h              mol/h          percent

Influent                    1.00E+001         5.4E-002        100.00
```

Primary sludge	3.78E-002	2.0E-004	0.38
Waste sludge	1.59E-001	8.6E-004	1.59
Primary volatilization	2.67E-004	1.4E-006	0.00
Settling volatilization	7.26E-004	3.9E-006	0.01
Aeration off gas	1.79E-003	9.7E-006	0.02
Primary biodegradation	1.79E-003	9.7E-006	0.02
Settling biodegradation	5.36E-004	2.9E-006	0.01
Aeration biodegradation	7.06E-003	3.8E-005	0.07
Final water effluent	9.79E+000	5.3E-002	97.91
Total removal	2.09E-001	1.1E-003	2.09
Total biodegradation	9.39E-003	5.1E-005	0.09

Level III Fugacity Model (Full-Output):

Chem Name : 1,3,5-Triazine, 2,4,6-trichloro-
Molecular Wt: 184.41
Henry's LC : 4.91e-007 atm-m3/mole (Henrywin program)
Vapor Press : 0.0236 mm Hg (Mpbpwin program)
Liquid VP : 0.064 mm Hg (super-cooled)
Melting Pt : 68.8 deg C (Mpbpwin program)
Log Kow : 1.73 (Kowwin program)
Soil Koc : 22 (calc by model)

	Mass Amount (percent)	Half-Life (hr)	Emissions (kg/hr)
Air	0.032	6.88e+004	0
Water	99.5	1.44e+003	1000
Soil	0.187	1.44e+003	0
Sediment	0.288	5.76e+003	0

	Fugacity (atm)	Reaction (kg/hr)	Advection (kg/hr)	Reaction (percent)	Advection (percent)
Air	2.87e-013	0.00218	2.17	0.000218	0.217
Water	8.96e-012	324	673	32.4	67.3
Soil	2.26e-013	0.608	0	0.0608	0
Sediment	8.49e-012	0.235	0.039	0.0235	0.0039

Persistence Time: 676 hr
Reaction Time: 2.08e+003 hr
Advection Time: 1e+003 hr
Percent Reacted: 32.5
Percent Advected: 67.5

Half-Lives (hr), (based upon Biowin (Ultimate) and Aopwin):
Air: 6.876e+004
Water: 1440
Soil: 1440
Sediment: 5760
Biowin estimate: 1.926 (months)

Advection Times (hr):
Air: 100
Water: 1000
Sediment: 5e+004

APPENDIX B1 'CYANURIC ACID'

USES 3.0

Input parameters/assumptions

Fysico-chemical data taken from section in this report
Changes in default: Hydrolysis set to 5 minutes (for abiotic degradation in waste water treatment plants)

High Production Volume:	Yes, production > 1000 tonnes/year
Tonnage used for assessment:	50.000 tonnes/year
Regional production of substance:	10% of total amount i.e. 5000 tonnes/year
Industry category:	1. Agricultural Chemicals
Use category:	33. Intermediates
Life-cycle steps chosen:	1. Production (III Multi purpose equipment)
	3. Processing (III Non-dispersive use)

According to USES3.0 the following emissions will occur:

Production (fraction of tonnage)	
Fraction released to air	1E-04
Fraction released to waste water	3E-03
Fraction released to surface water	0
Fraction released to industrial soil	1E-04
Fraction of main local source	1
Number of emission days	300/year

Which gives a release during production of 50 kg/day (USES 3.0 prediction)

Processing (fraction of tonnage)	
Fraction released to air	0.1
Fraction released to waste water	0
Fraction released to surface water	0.1
Fraction released to industrial soil	0
Fraction of main local source	0
Number of emission days	1/year

Since the fraction of local source is 0, the release during processing is 0 kg/day (USES 3.0 prediction)

Additional parameter
A rate constant for hydrolysis in water has been added:DT_{50} is 5 minutes (ref. 7)

Outcome (production only)	**DT_{50} 5 minutes**
Concentration in waste water treatment plant during production:	25 mg/L
Emission to waste water from waste water treatment plant:	1.72%
Concentration in effluent:	0.42 mg/L
Dilution factor to surface water:	about 10
Concentration surface water during emissions:	0.042 mg/L
Annual average:	0.035 mg/L
Concentration in waste water treatment plant during production:	25 mg/L
Emission to sludge from waste water treatment plant:	0.03%
Concentration in sludge:	18.8 mg/kg
Concentration agricultural soil 30 days:	0.023 mg/kg_{wwt}
Concentration agricultural soil 180 days:	0.011 mg/kg_{wwt}

USES Compact report	Single substance
Printed on	9/17/01 11:29:47 AM
Study	new
Substance	Cyanuric Chloride
Defaults	Standard
Assessment types	1A, 1B, 2, 3A, 3B, 5
Base set complete	No
Explanation status column	'O' = Output; 'D' = Default; 'S' = Set; 'I' = Imported

Name	Reference	Value	Units	Status
STUDY				
STUDY IDENTIFICATION				
Study name	new	new		D
Study description				D
Author				D
Institute				D
Address				D
Zip code				D
City				D
Country				D
Telephone				D
Telefax				D
Email				D
Calculations checksum	DC580245	DC580245		S

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Base set complete	No

Name	Reference	Value	Units	Status
DEFAULTS				
DEGRADATION AND TRANSFORMATION RATES				
Rate constant for abiotic degradation in STP	0.083333	0.083333	[hr] (DT50)	S

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Base set complete	No

Name	Reference	Value	Units	Status
SUBSTANCE				
SUBSTANCE IDENTIFICATION				
General name	Cyanuric Chloride	Cyanuric Chloride		S
Description	unknown	unknown		S
CAS-No	108-77-0	108-77-0		S
EC-notification no.	n.a.	n.a.		S
EINECS no.	203-614-9	203-614-9		S
PHYSICO-CHEMICAL PROPERTIES				
Molecular weight	184.41	184.41	[g.mol-1]	S
Melting point	154	154	[oC]	S
Boiling point	190	190	[oC]	S
Vapour pressure at 25 [oC]	2.5	2.5	[Pa]	S
Octanol-water partition coefficient	0.512	0.512	[log10]	S
Water solubility	440	440	[mg.l-1]	S

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Base set complete	No

Name	Reference	Value	Units	Status
RELEASE ESTIMATION				
CHARACTERIZATION AND TONNAGE				
High Production Volume Chemical	Yes	Yes		S
Production volume of chemical in EU	5E+04	5E+04	[tonnes.yr-1]	S
Volume of chemical imported to EU	0	0	[tonnes.yr-1]	D
Volume of chemical exported from EU	0	0	[tonnes.yr-1]	D
Intermittent release	No	No		D
USE PATTERNS				
EMISSION INPUT DATA				
Industry category	1 Agricultural chemicals	1 Agricultural chemicals		S
Use category	33 Intermediates	33 Intermediates		S
Emission scenario document available	No	No		O
Extra details on use category	No extra details necessary	No extra details necessary		D
Extra details on use category	No extra details necessary	No extra details necessary		D
Fraction of tonnage for application	1	1	[-]	O
Fraction of chemical in formulation	1	1	[-]	D
Production	Yes	Yes		D
Formulation	No	No		S
Processing	Yes	Yes		S
Private use	No	No		S
Recovery	No	No		S
Main category production	III Multi-purpose equipment	III Multi-purpose equipment		D
Main category formulation	III Multi-purpose equipment	III Multi-purpose equipment		D
Main category processing	III Non-dispersive use	III Non-dispersive use		S

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Defaults	Standard
Assessment types	1A, 1B, 2, 3A, 3B, 5
Base set complete	No

Name	Reference	Value	Units	Status
RELEASE ESTIMATION				
CHARACTERIZATION AND TONNAGE				
High Production Volume Chemical	Yes	Yes		S
Production volume of chemical in EU	5E+04	5E+04	[tonnes.yr-1]	S
Volume of chemical imported to EU	0	0	[tonnes.yr-1]	D
Volume of chemical exported from EU	0	0	[tonnes.yr-1]	D
Intermittent release	No	No		D
USE PATTERNS				
EMISSION INPUT DATA				
Industry category	1 Agricultural chemicals	1 Agricultural chemicals		S
Use category	33 Intermediates	33 Intermediates		S
Emission scenario document available	No	No		O
Extra details on use category	No extra details necessary	No extra details necessary		D
Extra details on use category	No extra details necessary	No extra details necessary		D
Fraction of tonnage for application	1	1	[-]	O
Fraction of chemical in formulation	1	1	[-]	D
Production	Yes	Yes		D
Formulation	No	No		S
Processing	Yes	Yes		S
Private use	No	No		S
Recovery	No	No		S
Main category production	III Multi-purpose equipment	III Multi-purpose equipment		D
Main category formulation	III Multi-purpose equipment	III Multi-purpose equipment		D
Main category processing	III Non-dispersive use	III Non-dispersive use		S

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Defaults	Standard
Assessment types	1A, 1B, 2, 3A, 3B, 5
Base set complete	No

Name	Reference	Value	Units	Status
RELEASE ESTIMATION				
CHARACTERIZATION AND TONNAGE				
High Production Volume Chemical	Yes	Yes		S
Production volume of chemical in EU	5E+04	5E+04	[tonnes.yr-1]	S
Volume of chemical imported to EU	0	0	[tonnes.yr-1]	D
Volume of chemical exported from EU	0	0	[tonnes.yr-1]	D
Intermittent release	No	No		D
USE PATTERNS				
EMISSION INPUT DATA				
Industry category	1 Agricultural chemicals	1 Agricultural chemicals		S
Use category	33 Intermediates	33 Intermediates		S
Emission scenario document available	No	No		O
Extra details on use category	No extra details necessary	No extra details necessary		D
Extra details on use category	No extra details necessary	No extra details necessary		D
Fraction of tonnage for application	1	1	[-]	O
Fraction of chemical in formulation	1	1	[-]	D
Production	Yes	Yes		D
Formulation	No	No		S
Processing	Yes	Yes		S
Private use	No	No		S
Recovery	No	No		S
Main category production	III Multi-purpose equipment	III Multi-purpose equipment		D
Main category formulation	III Multi-purpose equipment	III Multi-purpose equipment		D
Main category processing	III Non-dispersive use	III Non-dispersive use		S

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Base set complete	No

Name	Reference	Value	Units	Status
DISTRIBUTION				
DEGRADATION AND TRANSFORMATION RATES				
AIR/WATER				
Rate constant for hydrolysis in surface water	5.27292E+05	0.208	[d] (DT50,20[oC])	S
SEWAGE TREATMENT				
LOCAL				
[PRODUCTION]				
INPUT AND CONFIGURATION [PRODUCTION]				
Type of local STP	With primary settler (9-box)	With primary settler (9-box)		S
CONTINENTAL AND REGIONAL				
CONTINENTAL				
Continental PEC in surface water (total)	1.82E-03	2.29E-05	[mg.l-1]	O
Continental PEC in sea water (total)	??	??	[mg.l-1]	D
Continental PEC in surface water (dissolved)	1.82E-03	2.29E-05	[mg.l-1]	O
Continental PEC in sea water (dissolved)	??	??	[mg.l-1]	D
Continental PEC in air (total)	4.19E-05	2.41E-05	[mg.m-3]	O
Continental PEC in agricultural soil (total)	2.97E-05	1.71E-05	[mg.kgwwt-1]	O
Continental PEC in pore water of agricultural soils	1.69E-04	9.74E-05	[mg.l-1]	O
Continental PEC in natural soil (total)	2.97E-05	1.71E-05	[mg.kgwwt-1]	O
Continental PEC in industrial soil (total)	3.48E-05	2.21E-05	[mg.kgwwt-1]	O
Continental PEC in sediment (total)	1.19E-03	1.5E-05	[mg.kgwwt-1]	O
Continental PEC in sea water sediment (total)	??	??	[mg.kgwwt-1]	D
REGIONAL				
Regional PEC in surface water (total)	0.0101	2.15E-04	[mg.l-1]	O
Regional PEC in sea water (total)	??	??	[mg.l-1]	D
Regional PEC in surface water (dissolved)	0.0101	2.15E-04	[mg.l-1]	O
Regional PEC in sea water (dissolved)	??	??	[mg.l-1]	D
Regional PEC in air (total)	7.55E-05	4.75E-05	[mg.m-3]	O
Regional PEC in agricultural soil (total)	5.36E-05	3.38E-05	[mg.kgwwt-1]	O
Regional PEC in pore water of agricultural soils	3.06E-04	1.93E-04	[mg.l-1]	O
Regional PEC in natural soil (total)	5.35E-05	3.37E-05	[mg.kgwwt-1]	O
Regional PEC in industrial soil (total)	1.03E-04	8.3E-05	[mg.kgwwt-1]	O
Regional PEC in sediment (total)	6.67E-03	1.43E-04	[mg.kgwwt-1]	O
Regional PEC in sea water sediment (total)	??	??	[mg.kgwwt-1]	D
LOCAL PECS [PRODUCTION]				
Annual average local PEC in air (total)	4.56E-04	4.28E-04	[mg.m-3]	O
Local PEC in surface water during emission episode	0.0524	0.0426	[mg.l-1]	O
Annual average local PEC in surface water (dissolved)	0.0449	0.035	[mg.l-1]	O
Local PEC in sediment during emission episode	0.0448	0.0363	[mg.kgwwt-1]	O
Local PEC in agric. soil (total) averaged over 30 days	0.0235	0.0235	[mg.kgwwt-1]	O

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Defaults	Standard
Assessment types	1A, 1B, 2, 3A, 3B, 5
Base set complete	No

Name	Reference	Value	Units	Status
LOCAL PECS [PRODUCTION] (Continued)				
Local PEC in agric. soil (total) averaged over 180 days	0.0114	0.0113	[mg.kgwwt-1]	O
Local PEC in grassland (total) averaged over 180 days	2.64E-03	2.62E-03	[mg.kgwwt-1]	O
Local PEC in pore water of agricultural soil	0.0647	0.0646	[mg.l-1]	O
Local PEC in pore water of grassland	0.015	0.0149	[mg.l-1]	O
Local PEC in groundwater under agricultural soil	64.7	64.6	[ug.l-1]	O

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Base set complete	No

Name	Reference	Value	Units	Status
EXPOSURE				
HUMAN EXPOSURE AT THE WORKPLACE				
SUBSTANCE DATA AND PATTERN OF USE				
SUBSTANCE PROPERTIES				
Physical state of a substance	Solid	Solid		O
Process temperature	25	25	[oC]	S
Determination of Vapour Pressure	Measured at process temperature	Measured at process temperature		D
Vapour pressure at the process temperature	2.5	2.5	[Pa]	O
Aerosol formed	No	No		D
Inhalation exposure to dust particles	Yes	Yes		S
Particle size of the substance	Respirable	Respirable		S
Type of dust	Non-Fibrous	Non-Fibrous		S
Ability of fibrous dust to become airborne	Low	Low		S
Dust particles aggregates readily	No	No		D
PATTERN OF USE				
Pattern of use	Closed system	Closed system		S
Is closed system (considered to be) breached	No	No		S
Pattern of control applied to the process	Local Exhaust Ventilation (LEV)	Local Exhaust Ventilation (LEV)		S
Type of process operations	Low dust techniques	Low dust techniques		S
Local Exhaust Ventilation (LEV) present	Yes	Yes		S
DERMAL DATA				
Amount of dermal contact between worker and substance	Incidental	Incidental		S
Area of contact between substance and skin	0.114	0.114	[m2]	O
Thickness of layer of product on skin	0.01	0.01	[cm]	D
Mean number of events	2	2	[d-1]	S
Pattern of control applied to the process	Not direct handling	Not direct handling		O
INTERMEDIATE RESULTS				
INHALATION				
Vapour concentration in air for workers	0 - 0.1	0 - 0.1	[ppm]	O
Vapour concentration in air for workers	0 - 0.767	0 - 0.767	[mg.m-3]	O
Fibre concentration in air for workers	0 - 0	0 - 0	[fibres.m-3]	O
Dust concentration in air for workers	0 - 1	0 - 1	[mg.m-3]	O
DERMAL				
Dermal weight of substance on the skin of workers	0 - 0	0 - 0	[mg.cm-2.d-1]	O
Potential dermal uptake for workers	0 - 0	0 - 0		O

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Study	new			
Substance	Cyanuric Chloride			
Defaults	Standard			
Assessment types	1A, 1B, 2, 3A, 3B, 5			
Base set complete	No			
Name	Reference	Value	Units	Status
EFFECTS				
INPUT OF EFFECTS DATA				
MICRO-ORGANISMS				
EC50 for micro-organisms in a STP	??	??	[mg.l-1]	D
Specific bacterial population?	No	No		D
EC10 for micro-organisms in a STP	??	??	[mg.l-1]	D
Specific bacterial population?	No	No		D
NOEC for micro-organisms in a STP	??	??	[mg.l-1]	D
Specific bacterial population?	No	No		D
AQUATIC ORGANISMS				
LC50 for fish	??	??	[mg.l-1]	D
L(E)C50 for Daphnia	??	??	[mg.l-1]	D
EC50 for algae	??	??	[mg.l-1]	D
LC50 for other aquatic species	??	??	[mg.l-1]	D
Species	other	other		D
NOEC for fish	??	??	[mg.l-1]	D
NOEC for Daphnia	??	??	[mg.l-1]	D
NOEC for algae	??	??	[mg.l-1]	D
NOEC for other aquatic species	??	??	[mg.l-1]	D
Additional aquatic NOEC	??	??	[mg.l-1]	D
Additional aquatic NOEC	??	??	[mg.l-1]	D
Additional aquatic NOEC	??	??	[mg.l-1]	D
Additional aquatic NOEC	??	??	[mg.l-1]	D
Additional aquatic NOEC	??	??	[mg.l-1]	D
Additional aquatic NOEC	??	??	[mg.l-1]	D
TERRESTRIAL ORGANISMS				
LC50 for plants	??	??	[mg.kgdwt-1]	D
LC50 for earthworms	??	??	[mg.kgdwt-1]	D
EC50 for microorganisms	??	??	[mg.kgdwt-1]	D
LC50 for other terrestrial species	??	??	[mg.kgdwt-1]	D
Species	other	other		D
NOEC for plants	??	??	[mg.kgdwt-1]	D
NOEC for earthworms	??	??	[mg.kgdwt-1]	D
NOEC for microorganisms	??	??	[mg.kgdwt-1]	D
NOEC for other terrestrial species	??	??	[mg.kgdwt-1]	D
Additional terrestrial NOEC	??	??	[mg.kgdwt-1]	D
Additional terrestrial NOEC	??	??	[mg.kgdwt-1]	D
Additional terrestrial NOEC	??	??	[mg.kgdwt-1]	D
Additional terrestrial NOEC	??	??	[mg.kgdwt-1]	D
Additional terrestrial NOEC	??	??	[mg.kgdwt-1]	D
Additional terrestrial NOEC	??	??	[mg.kgdwt-1]	D
BIRDS				
LC50 in avian dietary study (5 days)	??	??	[mg.kgfd-1]	D
LD50 for birds	??	??	[mg.kgbw-1]	D
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Defaults	Standard
Assessment types	1A, 1B, 2, 3A, 3B, 5
Base set complete	No

Name	Reference	Value	Units	Status
BIRDS (Continued)				
NOAEL for birds	??	??	[mg.kgbw-1.d-1]	D
NOEC via food	??	??	[mg.kgfd-1]	O
Duration of (sub-)chronic oral test	Chronic	Chronic		D
Conversion factor NOAEL to NOEC	8	8	[kg.d.kg-1]	D
MAMMALS				
ACUTE				
Oral LD50	??	??	[mg.kgbw-1]	D
Oral Discriminatory Dose	??	??	[mg.kg-1]	D
Dermal LD50	??	??	[mg.kgbw-1]	O
Inhalatory LC50	??	??	[mg.m-3]	O
(SUB)CHRONIC				
Oral NOAEL	??	??	[mg.kgbw-1.d-1]	D
Oral LOAEL	??	??	[mg.kgbw-1.d-1]	O
Inhalatory NOAEL	??	??	[mg.m-3]	O
Inhalatory LOAEL	??	??	[mg.m-3]	O
Dermal NOAEL	??	??	[mg.kgbw-1.d-1]	O
Dermal LOAEL	??	??	[mg.kgbw-1.d-1]	O
Inhalatory (fibre) NOAEL	??	??	[fibres.m-3]	D
Inhalatory (fibre) LOAEL	??	??	[fibres.m-3]	D
FOOD				
NOEC via food	??	??	[mg.kg-1]	O
LOEC via food	??	??	[mg.kg-1]	D
Duration of (sub-)chronic oral test	28 days	28 days		D
Species for conversion of NOAEL to NOEC	Rattus norvegicus (<6 weeks)	Rattus norvegicus (<6 weeks)		D
Conversion factor NOAEL to NOEC	10	10	[kg.d.kg-1]	O
Test duration for mammalian toxicity test	28	28	[d]	D
Mammalian species of concern	Dutch standard mammal	Dutch standard mammal		D
Mean bodyweight of mammalian species of concern	??	??	[g]	D
Daily food intake for mammalian species of concern	??	??	[gdwt.d-1]	D
Daily water intake of mammalian species of choice	??	??	[ml.d-1]	D
HUMANS				
(SUB)CHRONIC				
Oral NOAEL	??	??	[mg.kgbw-1.d-1]	D
Oral LOAEL	??	??	[mg.kgbw-1.d-1]	D
Dermal NOEC in a medium	??	??	[mg.cm-3]	D
Dermal LOEC in a medium	??	??	[mg.cm-3]	D
Dermal LOAEL	??	??	[mg.kgbw-1.d-1]	O
Dermal NOAEL	??	??	[mg.kgbw-1.d-1]	O
Inhalatory LOAEL	??	??	[mg.m-3]	O
Inhalatory NOAEL	??	??	[mg.m-3]	O

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Base set complete	No

Name	Reference	Value	Units	Status
HUMANS (Continued)				
(SUB)CHRONIC				
Inhalatory (fibre) NOAEL	??	??	[fibres.m-3]	D
Inhalatory (fibre) LOAEL	??	??	[fibres.m-3]	D
CURRENT CLASSIFICATION				
Corrosive (C, R34 or R35)	No	No		D
Irritating to skin (Xi, R38)	No	No		D
Irritating to eyes (Xi, R36)	No	No		D
Risk of serious damage to eyes (Xi, R41)	No	No		D
Irritating to respiratory system (Xi, R37)	No	No		D
May cause sensitisation by inhalation (Xn, R42)	No	No		D
May cause sensitisation by skin contact (Xi, R43)	No	No		D
May cause cancer (T, R45)	No	No		D
May cause cancer by inhalation (T, R49)	No	No		D
Possible risk of irreversible effects (Xn, R40)	No	No		D
ENVIRONMENTAL EFFECTS ASSESSMENT				
INTERMEDIATE RESULTS AQUATIC ORGANISMS, MICRO-ORGANISMS AND PREDATORS				
Toxicological data used for extrapolation to PNEC Aqua	??	??	[mg.l-1]	O
Assessment factor applied in extrapolation to PNEC Aqua	??	??	[-]	O
Toxicological data used for extrapolation to PNEC Aqua	??	??	[mg.l-1]	O
Assessment factor applied in extrapolation to PNEC Aqua	??	??	[-]	O
Toxicological data used for extrapolation to PNEC micro	??	??	[mg.l-1]	O
Assessment factor applied in extrapolation to PNEC micro	??	??	[-]	O
Toxicological data used for extrapolation to PNEC oral	??	??	[mg.kg-1]	O
Assessment factor applied in extrapolation to PNEC oral	??	??	[-]	O
INTERMEDIATE RESULTS TERRESTRIAL AND SEDIMENT ORGANISMS				
Toxicological data used for extrapolation to PNEC Terr	??	??	[mg.kgdwt-1]	O
Assessment factor applied in extrapolation to PNEC Terr	??	??	[-]	O
Equilibrium partitioning used for PNEC in soil?	Yes	Yes		O
Equilibrium partitioning used for PNEC in sediment?	Yes	Yes		O
PNECS FOR AQUATIC ORGANISMS, MICRO-ORGANISMS AND PREDATORS				
PNEC for aquatic organisms	??	??	[mg.l-1]	O
PNEC for aquatic organisms, intermittent releases	??	??	[mg.l-1]	O

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Base set complete	No

Name	Reference	Value	Units	Status
PNECS FOR AQUATIC ORGANISMS, MICRO-ORGANISMS AND PREDATORS (Continued)				
PNEC for micro-organisms in a STP	??	??	[mg.l-1]	O
PNEC for secondary poisoning of birds and mammals	??	??	[mg.kg-1]	O
PNEC for aquatic organisms with statistical method	??	??	[mg.l-1]	O
PNECS FOR TERRESTRIAL AND SEDIMENT ORGANISMS				
PNEC for terrestrial organisms	??	??	[mg.kgdwt-1]	O
PNEC for terrestrial organisms with statistical method	??	??	[mg.kgdwt-1]	O
PNEC for sediment-dwelling organisms	??	??	[mg.kgdwt-1]	O

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Base set complete	No

Name	Reference	Value	Units	Status
RISK CHARACTERIZATION				
ENVIRONMENTAL EXPOSURE				
LOCAL				
RISK CHARACTERIZATION OF [PRODUCTION]				
ENVIRONMENTAL				
RCR for the local water compartment	??	??	[-]	O
Intermittent release	No	No		D
RCR for the local soil compartment	??	??	[-]	O
Extra factor 10 applied to PEC	No	No		O
RCR for the local sediment compartment	??	??	[-]	O
Extra factor 10 applied to PEC	No	No		O
RCR for the sewage treatment plant	??	??	[-]	O
PREDATORS				
RCR for fish-eating birds and mammals	??	??	[-]	O
RCR for worm-eating birds and mammals	??	??	[-]	O
HUMANS				
MOS local, total exposure via all media	??	??	[-]	O
MOS local, exposure via air	??	??	[-]	O
REGIONAL				
ENVIRONMENT				
RCR for the regional water compartment	??	??	[-]	O
RCR for the regional soil compartment	??	??	[-]	O
Extra factor 10 applied to PEC	No	No		O
RCR for the regional sediment compartment	??	??	[-]	O
Extra factor 10 applied to PEC	No	No		O
HUMANS				
MOS regional, total exposure via all media	??	??	[-]	O
MOS regional, exposure via air	??	??	[-]	O
EXPOSURE AT THE WORKPLACE				
MOS for worker, vapour inhalation	?? - ??	?? - ??	[-]	O
MOS for worker, fibres inhalation	?? - ??	?? - ??	[-]	O
MOS for worker, dust inhalation	?? - ??	?? - ??	[-]	O
MOS for worker, dermal (Uptake / N(L)OAEL)	?? - ??	?? - ??	[-]	O
MOS for worker, dermal (Conc / N(L)OEC)	?? - ??	?? - ??	[-]	O

APPENDIX B2 '2-CHLORO-4,6-DIHYDROXY-S-TRIAZINE'

USES 3.0

Input parameters/assumptions

Fysico-chemical data taken from section in this report
Changes in default: Hydrolysis set to 5 hours (for abiotic degradation in waste water treatment plants)

High Production Volume:	Yes, production > 1000 tonnes/year
Tonnage used for assessment:	50.000 tonnes/year
Regional production of substance:	10% of total amount i.e. 5000 tonnes/year
Industry category:	1. Agricultural Chemicals
Use category:	33. Intermediates
Life-cycle steps chosen:	1. Production (III Multi purpose equipment) 3. Processing (III Non-dispersive use)

According to USES3.0 the following emissions will occur:

Production (fraction of tonnage)	
Fraction released to air	1E-04
Fraction released to waste water	3E-03
Fraction released to surface water	0
Fraction released to industrial soil	1E-04
Fraction of main local source	1
Number of emission days	300/year

Which gives a release during production of 50 kg/day (USES 3.0 prediction)

Processing (fraction of tonnage)	
Fraction released to air	0.1
Fraction released to waste water	0
Fraction released to surface water	0.1
Fraction released to industrial soil	0
Fraction of main local source	0
Number of emission days	1/year

Since the fraction of local source is 0, the release during processing is 0 kg/day (USES 3.0 prediction)

Additional parameter
A rate constant for hydrolysis in water has been added:DT_{50} is 5 hours (ref. 12) (additionally a worst case estimate was calculated based on based on ref. 11 (DT_{50} 4 days)) for the hydrolysis of 2-chloro-4,6-dihydroxy-s-triazine to cyanuric acid. The substance itself will be totally hydrolysed within 1 hour (DT_{50} 5 min).

Outcome (production only)	**DT_{50} 4 days**	**DT_{50} 5 hrs**
Concentration in waste water treatment plant during production:	25 mg/L	25 mg/L
Emission to waste water from waste water treatment plant:	**93.3%**	**50.3%**
Concentration in effluent:	23.3 mg/L	12.6 mg/L
Dilution factor to surface water:	about 10	about 10
Concentration surface water during emissions:	2.33 mg/L	1.26 mg/L
Annual average:	1.92 mg/L	1.03 mg/L
Concentration in waste water treatment plant during production:	25 mg/L	25 mg/L
Emission to sludge from waste water treatment plant:	0.04%	0.04%
Concentration in sludge:	25.5 mg/kg	22.3 mg/kg
Concentration agricultural soil 30 days:	0.0318 mg/kg_{wwt}	0.028 mg/kg_{wwt}
Concentration agricultural soil 180 days:	0.015 mg/kg_{wwt}	0.014 mg/kg_{wwt}

USES Compact report	Single substance
Printed on	8/23/01 3:09:22 PM
Study	new
Substance	Cyanuric Chloride
Defaults	Standard
Assessment types	1A, 1B, 2, 3A, 3B, 5
Base set complete	No
Explanation status column	'O' = Output; 'D' = Default; 'S' = Set; 'I' = Imported

Name	Reference	Value	Units	Status
STUDY				
STUDY IDENTIFICATION				
Study name	new	new		D
Study description				D
Author				D
Institute				D
Address				D
Zip code				D
City				D
Country				D
Telephone				D
Telefax				D
Email				D
Calculations checksum	767E20EA	767E20EA		S

USES Compact report	Single substance
Printed on	8/23/01 3:09:22 PM
Study	new
Substance	Cyanuric Chloride
Defaults	Standard
Assessment types	1A, 1B, 2, 3A, 3B, 5
Base set complete	No

Name	Reference	Value	Units	Status
DEFAULTS				
DEGRADATION AND TRANSFORMATION RATES				
Rate constant for abiotic degradation in STP	5	5	[hr] (DT50)	S

USES Compact report	Single substance
Printed on	8/23/01 3:09:22 PM
Study	new
Substance	Cyanuric Chloride
Defaults	Standard
Assessment types	1A, 1B, 2, 3A, 3B, 5
Base set complete	No

Name	Reference	Value	Units	Status
SUBSTANCE				
SUBSTANCE IDENTIFICATION				
General name	Cyanuric Chloride	Cyanuric Chloride		S
Description	unknown	unknown		S
CAS-No	108-77-0	108-77-0		S
EC-notification no.	n.a.	n.a.		S
EINECS no.	203-614-9	203-614-9		S
PHYSICO-CHEMICAL PROPERTIES				
Molecular weight	184.41	184.41	[g.mol-1]	S
Melting point	154	154	[oC]	S
Boiling point	190	190	[oC]	S
Vapour pressure at 25 [oC]	2.5	2.5	[Pa]	S
Octanol-water partition coefficient.	0.512	0.512	[log10]	S
Water solubility	440	440	[mg.l-1]	S

USES Compact report	Single substance
Printed on	8/23/01 3:09:22 PM
Study	new
Substance	Cyanuric Chloride
Defaults	Standard
Assessment types	1A, 1B, 2, 3A, 3B, 5
Base set complete	No

Name	Reference	Value	Units	Status
RELEASE ESTIMATION				
CHARACTERIZATION AND TONNAGE				
High Production Volume Chemical	Yes	Yes		S
Production volume of chemical in EU	5E+04	5E+04	[tonnes.yr-1]	S
Volume of chemical imported to EU	0	0	[tonnes.yr-1]	D
Volume of chemical exported from EU	0	0	[tonnes.yr-1]	D
Intermittent release	No	No		D
USE PATTERNS				
EMISSION INPUT DATA				
Industry category	1 Agricultural chemicals	1 Agricultural chemicals		S
Use category	33 Intermediates	33 Intermediates		S
Emission scenario document available	No	No		O
Extra details on use category	No extra details necessary	No extra details necessary		D
Extra details on use category	No extra details necessary	No extra details necessary		D
Fraction of tonnage for application	1	1	[-]	O
Fraction of chemical in formulation	1	1	[-]	D
Production	Yes	Yes		D
Formulation	No	No		S
Processing	Yes	Yes		S
Private use	No	No		S
Recovery	No	No		S
Main category production	III Multi-purpose equipment	III Multi-purpose equipment		D
Main category formulation	III Multi-purpose equipment	III Multi-purpose equipment		D
Main category processing	III Non-dispersive use	III Non-dispersive use		S

USES Compact report	Single substance
Printed on	8/23/01 3:09:22 PM
Study	new
Substance	Cyanuric Chloride
Defaults	Standard
Assessment types	1A, 1B, 2, 3A, 3B, 5
Base set complete	No

Name	Reference	Value	Units	Status
DISTRIBUTION				
DEGRADATION AND TRANSFORMATION RATES				
AIR/WATER				
Rate constant for hydrolysis in surface water	5.27292E+05	0.208	[d] (DT50,20[oC])	S
SEWAGE TREATMENT				
LOCAL				
[PRODUCTION]				
INPUT AND CONFIGURATION [PRODUCTION]				
Type of local STP	With primary settler (9-box)	With primary settler (9-box)		S
CONTINENTAL AND REGIONAL				
CONTINENTAL				
Continental PEC in surface water (total)	1.84E-03	2.31E-05	[mg.l-1]	O
Continental PEC in sea water (total)	??	??	[mg.l-1]	D
Continental PEC in surface water (dissolved)	1.84E-03	2.31E-05	[mg.l-1]	O
Continental PEC in sea water (dissolved)	??	??	[mg.l-1]	D
Continental PEC in air (total)	4.21E-05	2.41E-05	[mg.m-3]	O
Continental PEC in agricultural soil (total)	2.99E-05	1.71E-05	[mg.kgwwt-1]	O
Continental PEC in pore water of agricultural soils	1.7E-04	9.74E-05	[mg.l-1]	O
Continental PEC in natural soil (total)	2.99E-05	1.71E-05	[mg.kgwwt-1]	O
Continental PEC in industrial soil (total)	3.49E-05	2.21E-05	[mg.kgwwt-1]	O
Continental PEC in sediment (total)	1.2E-03	1.51E-05	[mg.kgwwt-1]	O
Continental PEC in sea water sediment (total)	??	??	[mg.kgwwt-1]	D
REGIONAL				
Regional PEC in surface water (total)	0.0102	2.18E-04	[mg.l-1]	O
Regional PEC in sea water (total)	??	??	[mg.l-1]	D
Regional PEC in surface water (dissolved)	0.0102	2.18E-04	[mg.l-1]	O
Regional PEC in sea water (dissolved)	??	??	[mg.l-1]	D
Regional PEC in air (total)	7.58E-05	4.75E-05	[mg.m-3]	O
Regional PEC in agricultural soil (total)	5.39E-05	3.38E-05	[mg.kgwwt-1]	O
Regional PEC in pore water of agricultural soils	3.07E-04	1.93E-04	[mg.l-1]	O
Regional PEC in natural soil (total)	5.37E-05	3.37E-05	[mg.kgwwt-1]	O
Regional PEC in industrial soil (total)	1.03E-04	8.3E-05	[mg.kgwwt-1]	O
Regional PEC in sediment (total)	6.74E-03	1.44E-04	[mg.kgwwt-1]	O
Regional PEC in sea water sediment (total)	??	??	[mg.kgwwt-1]	D
LOCAL PECS [PRODUCTION]				
Annual average local PEC in air (total)	4.57E-04	4.28E-04	[mg.m-3]	O
Local PEC in surface water during emission episode	1.27	1.26	[mg.l-1]	O
Annual average local PEC in surface water (dissolved)	1.04	1.03	[mg.l-1]	O
Local PEC in sediment during emission episode	1.08	1.07	[mg.kgwwt-1]	O
Local PEC in agric. soil (total) averaged over 30 days	0.028	0.0279	[mg.kgwwt-1]	O
Local PEC in agric. soil (total) averaged over 180 days	0.0135	0.0135	[mg.kgwwt-1]	O
Local PEC in grassland (total) averaged over 180 days	3.14E-03	3.12E-03	[mg.kgwwt-1]	O
Local PEC in pore water of agricultural soil	0.077	0.0769	[mg.l-1]	O

USES Compact report	Single substance
Printed on	8/23/01 3:09:22 PM
Study	new
Substance	Cyanuric Chloride
Defaults	Standard
Assessment types	1A, 1B, 2, 3A, 3B, 5
Base set complete	No

Name	Reference	Value	Units	Status
LOCAL PECS [PRODUCTION] (Continued)				
Local PEC in pore water of grassland	0.0179	0.0178	[mg.l-1]	O
Local PEC in groundwater under agricultural soil	77	76.9	[ug.l-1]	O

USES Compact report	Single substance
Printed on	8/23/01 3:09:22 PM
Study	new
Substance	Cyanuric Chloride
Defaults	Standard
Assessment types	1A, 1B, 2, 3A, 3B, 5
Base set complete	No

Name	Reference	Value	Units	Status
EXPOSURE				
HUMAN EXPOSURE AT THE WORKPLACE				
SUBSTANCE DATA AND PATTERN OF USE				
SUBSTANCE PROPERTIES				
Physical state of a substance	Solid	Solid		O
Process temperature	25	25	[oC]	S
Determination of Vapour Pressure	Measured at process temperature	Measured at process temperature		D
Vapour pressure at the process temperature	2.5	2.5	[Pa]	O
Aerosol formed	No	No		D
Inhalation exposure to dust particles	Yes	Yes		S
Particle size of the substance	Respirable	Respirable		S
Type of dust	Non-Fibrous	Non-Fibrous		S
Ability of fibrous dust to become airborne	Low	Low		S
Dust particles aggregates readily	No	No		D
PATTERN OF USE				
Pattern of use	Closed system	Closed system		S
Is closed system (considered to be) breached	No	No		S
Pattern of control applied to the process	Local Exhaust Ventilation (LEV)	Local Exhaust Ventilation (LEV)		S
Type of process operations	Low dust techniques	Low dust techniques		S
Local Exhaust Ventilation (LEV) present	Yes	Yes		S
DERMAL DATA				
Amount of dermal contact between worker and substance	Incidental	Incidental		S
Area of contact between substance and skin	0.114	0.114	[m2]	O
Thickness of layer of product on skin	0.01	0.01	[cm]	D
Mean number of events	2	2	[d-1]	S
Pattern of control applied to the process	Not direct handling	Not direct handling		O
INTERMEDIATE RESULTS				
INHALATION				
Vapour concentration in air for workers	0 - 0.1	0 - 0.1	[ppm]	O
Vapour concentration in air for workers	0 - 0.767	0 - 0.767	[mg.m-3]	O
Fibre concentration in air for workers	0 - 0	0 - 0	[fibres.m-3]	O
Dust concentration in air for workers	0 - 1	0 - 1	[mg.m-3]	O
DERMAL				
Dermal weight of substance on the skin of workers	0 - 0	0 - 0	[mg.cm-2.d-1]	O
Potential dermal uptake for workers	0 - 0	0 - 0		O

USES Compact report	Single substance
Printed on	8/23/01 3:09:22 PM
Study	new
Substance	Cyanuric Chloride
Defaults	Standard
Assessment types	1A, 1B, 2, 3A, 3B, 5
Base set complete	No

Name	Reference	Value	Units	Status
EFFECTS				
INPUT OF EFFECTS DATA				
MICRO-ORGANISMS				
EC50 for micro-organisms in a STP	??	??	[mg.l-1]	D
Specific bacterial population?	No	No		D
EC10 for micro-organisms in a STP	??	??	[mg.l-1]	D
Specific bacterial population?	No	No		D
NOEC for micro-organisms in a STP	??	??	[mg.l-1]	D
Specific bacterial population?	No	No		D
AQUATIC ORGANISMS				
LC50 for fish	??	??	[mg.l-1]	D
L(E)C50 for Daphnia	??	??	[mg.l-1]	D
EC50 for algae	??	??	[mg.l-1]	D
LC50 for other aquatic species	??	??	[mg.l-1]	D
Species	other	other		D
NOEC for fish	??	??	[mg.l-1]	D
NOEC for Daphnia	??	??	[mg.l-1]	D
NOEC for algae	??	??	[mg.l-1]	D
NOEC for other aquatic species	??	??	[mg.l-1]	D
Additional aquatic NOEC	??	??	[mg.l-1]	D
Additional aquatic NOEC	??	??	[mg.l-1]	D
Additional aquatic NOEC	??	??	[mg.l-1]	D
Additional aquatic NOEC	??	??	[mg.l-1]	D
Additional aquatic NOEC	??	??	[mg.l-1]	D
Additional aquatic NOEC	??	??	[mg.l-1]	D
TERRESTRIAL ORGANISMS				
LC50 for plants	??	??	[mg.kgdwt-1]	D
LC50 for earthworms	??	??	[mg.kgdwt-1]	D
EC50 for microorganisms	??	??	[mg.kgdwt-1]	D
LC50 for other terrestrial species	??	??	[mg.kgdwt-1]	D
Species	other	other		D
NOEC for plants	??	??	[mg.kgdwt-1]	D
NOEC for earthworms	??	??	[mg.kgdwt-1]	D
NOEC for microorganisms	??	??	[mg.kgdwt-1]	D
NOEC for other terrestrial species	??	??	[mg.kgdwt-1]	D
Additional terrestrial NOEC	??	??	[mg.kgdwt-1]	D
Additional terrestrial NOEC	??	??	[mg.kgdwt-1]	D
Additional terrestrial NOEC	??	??	[mg.kgdwt-1]	D
Additional terrestrial NOEC	??	??	[mg.kgdwt-1]	D
Additional terrestrial NOEC	??	??	[mg.kgdwt-1]	D
Additional terrestrial NOEC	??	??	[mg.kgdwt-1]	D
BIRDS				
LC50 in avian dietary study (5 days)	??	??	[mg.kgfd-1]	D
LD50 for birds	??	??	[mg.kgbw-1]	D
NOAEL for birds	??	??	[mg.kgbw-1.d-1]	D
NOEC via food	??	??	[mg.kgfd-1]	O
Duration of (sub-)chronic oral test	Chronic	Chronic		D
Conversion factor NOAEL to NOEC	8	8	[kg.d.kg-1]	D

USES Compact report	Single substance
Printed on	8/23/01 3:09:22 PM
Study	new
Substance	Cyanuric Chloride
Defaults	Standard
Assessment types	1A, 1B, 2, 3A, 3B, 5
Base set complete	No

Name	Reference	Value	Units	Status
MAMMALS				
ACUTE				
Oral LD50	??	??	[mg.kgbw-1]	D
Oral Discriminatory Dose	??	??	[mg.kg-1]	D
Dermal LD50	??	??	[mg.kgbw-1]	O
Inhalatory LC50	??	??	[mg.m-3]	O
(SUB)CHRONIC				
Oral NOAEL	??	??	[mg.kgbw-1.d-1]	D
Oral LOAEL	??	??	[mg.kgbw-1.d-1]	O
Inhalatory NOAEL	??	??	[mg.m-3]	O
Inhalatory LOAEL	??	??	[mg.m-3]	O
Dermal NOAEL	??	??	[mg.kgbw-1.d-1]	O
Dermal LOAEL	??	??	[mg.kgbw-1.d-1]	O
Inhalatory (fibre) NOAEL	??	??	[fibres.m-3]	D
Inhalatory (fibre) LOAEL	??	??	[fibres.m-3]	D
FOOD				
NOEC via food	??	??	[mg.kg-1]	O
LOEC via food	??	??	[mg.kg-1]	D
Duration of (sub-)chronic oral test	28 days	28 days		D
Species for conversion of NOAEL to NOEC	Rattus norvegicus (<6 weeks)	Rattus norvegicus (<6 weeks)		D
Conversion factor NOAEL to NOEC	10	10	[kg.d.kg-1]	O
Test duration for mammalian toxicity test	28	28	[d]	D
Mammalian species of concern	Dutch standard mammal	Dutch standard mammal		D
Mean bodyweight of mammalian species of concern	??	??	[g]	D
Daily food intake for mammalian species of concern	??	??	[gdwt.d-1]	D
Daily water intake of mammalian species of choice	??	??	[ml.d-1]	D
HUMANS				
(SUB)CHRONIC				
Oral NOAEL	??	??	[mg.kgbw-1.d-1]	D
Oral LOAEL	??	??	[mg.kgbw-1.d-1]	D
Dermal NOEC in a medium	??	??	[mg.cm-3]	D
Dermal LOEC in a medium	??	??	[mg.cm-3]	D
Dermal LOAEL	??	??	[mg.kgbw-1.d-1]	O
Dermal NOAEL	??	??	[mg.kgbw-1.d-1]	O
Inhalatory LOAEL	??	??	[mg.m-3]	O
Inhalatory NOAEL	??	??	[mg.m-3]	O
Inhalatory (fibre) NOAEL	??	??	[fibres.m-3]	D
Inhalatory (fibre) LOAEL	??	??	[fibres.m-3]	D
CURRENT CLASSIFICATION				
Corrosive (C, R34 or R35)	No	No		D
Irritating to skin (Xi, R38)	No	No		D
Irritating to eyes (Xi, R36)	No	No		D
Risk of serious damage to eyes (Xi, R41)	No	No		D
Irritating to respiratory system (Xi, R37)	No	No		D
May cause sensitisation by inhalation (Xn, R42)	No	No		D

USES Compact report	Single substance
Printed on	8/23/01 3:09:22 PM
Study	new
Substance	Cyanuric Chloride
Defaults	Standard
Assessment types	1A, 1B, 2, 3A, 3B, 5
Base set complete	No

Name	Reference	Value	Units	Status
CURRENT CLASSIFICATION (Continued)				
May cause sensitisation by skin contact (Xi, R43)	No	No		D
May cause cancer (T, R45)	No	No		D
May cause cancer by inhalation (T, R49)	No	No		D
Possible risk of irreversible effects (Xn, R40)	No	No		D
ENVIRONMENTAL EFFECTS ASSESSMENT				
INTERMEDIATE RESULTS AQUATIC ORGANISMS, MICRO-ORGANISMS AND PREDATORS				
Toxicological data used for extrapolation to PNEC Aqua	??	??	[mg.l-1]	O
Assessment factor applied in extrapolation to PNEC Aqua	??	??	[-]	O
Toxicological data used for extrapolation to PNEC Aqua	??	??	[mg.l-1]	O
Assessment factor applied in extrapolation to PNEC Aqua	??	??	[-]	O
Toxicological data used for extrapolation to PNEC micro	??	??	[mg.l-1]	O
Assessment factor applied in extrapolation to PNEC micro	??	??	[-]	O
Toxicological data used for extrapolation to PNEC oral	??	??	[mg.kg-1]	O
Assessment factor applied in extrapolation to PNEC oral	??	??	[-]	O
INTERMEDIATE RESULTS TERRESTRIAL AND SEDIMENT ORGANISMS				
Toxicological data used for extrapolation to PNEC Terr	??	??	[mg.kgdwt-1]	O
Assessment factor applied in extrapolation to PNEC Terr	??	??	[-]	O
Equilibrium partitioning used for PNEC in soil?	Yes	Yes		O
Equilibrium partitioning used for PNEC in sediment?	Yes	Yes		O
PNECS FOR AQUATIC ORGANISMS, MICRO-ORGANISMS AND PREDATORS				
PNEC for aquatic organisms	??	??	[mg.l-1]	O
PNEC for aquatic organisms, intermittent releases	??	??	[mg.l-1]	O
PNEC for micro-organisms in a STP	??	??	[mg.l-1]	O
PNEC for secondary poisoning of birds and mammals	??	??	[mg.kg-1]	O
PNEC for aquatic organisms with statistical method	??	??	[mg.l-1]	O
PNECS FOR TERRESTRIAL AND SEDIMENT ORGANISMS				
PNEC for terrestrial organisms	??	??	[mg.kgdwt-1]	O
PNEC for terrestrial organisms with statistical method	??	??	[mg.kgdwt-1]	O
PNEC for sediment-dwelling organisms	??	??	[mg.kgdwt-1]	O

USES Compact report	Single substance
Printed on	8/23/01 3:09:22 PM
Study	new
Substance	Cyanuric Chloride
Defaults	Standard
Assessment types	1A, 1B, 2, 3A, 3B, 5
Base set complete	No

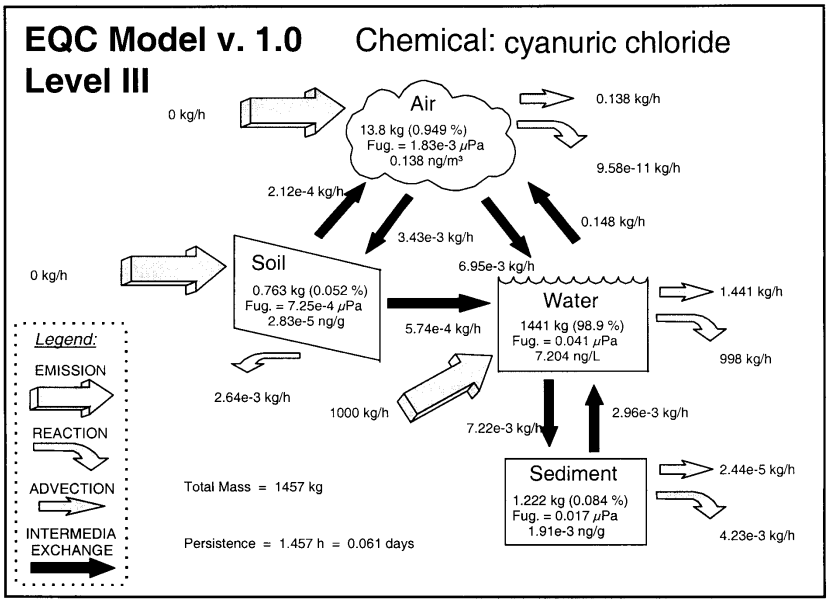
Name	Reference	Value	Units	Status
RISK CHARACTERIZATION				
ENVIRONMENTAL EXPOSURE				
LOCAL				
RISK CHARACTERIZATION OF [PRODUCTION]				
ENVIRONMENTAL				
RCR for the local water compartment	??	??	[-]	O
Intermittent release	No	No		D
RCR for the local soil compartment	??	??	[-]	O
Extra factor 10 applied to PEC	No	No		O
RCR for the local sediment compartment	??	??	[-]	O
Extra factor 10 applied to PEC	No	No		O
RCR for the sewage treatment plant	??	??	[-]	O
PREDATORS				
RCR for fish-eating birds and mammals	??	??	[-]	O
RCR for worm-eating birds and mammals	??	??	[-]	O
HUMANS				
MOS local, total exposure via all media	??	??	[-]	O
MOS local, exposure via air	??	??	[-]	O
REGIONAL				
ENVIRONMENT				
RCR for the regional water compartment	??	??	[-]	O
RCR for the regional soil compartment	??	??	[-]	O
Extra factor 10 applied to PEC	No	No		O
RCR for the regional sediment compartment	??	??	[-]	O
Extra factor 10 applied to PEC	No	No		O
HUMANS				
MOS regional, total exposure via all media	??	??	[-]	O
MOS regional, exposure via air	??	??	[-]	O
EXPOSURE AT THE WORKPLACE				
MOS for worker, vapour inhalation	?? - ??	?? - ??	[-]	O
MOS for worker, fibres inhalation	?? - ??	?? - ??	[-]	O
MOS for worker, dust inhalation	?? - ??	?? - ??	[-]	O
MOS for worker, dermal (Uptake / N(L)OAEL)	?? - ??	?? - ??	[-]	O
MOS for worker, dermal (Conc / N(L)OEC)	?? - ??	?? - ??	[-]	O

APPENDIX C1

EQC-model

Input parameters

Molecular weight	184.41
Temperature	20ºC
Water solubility	440 mg/L
Vapour pessure	2.5 Pa
Log Kow	0.51
Melting point	146ºC
Half-life air	1E11 hours
Half-life water	0.1 hours
Half-life soil/sediment	200 hours


EQC Model v. 1.0
Level III
Chemical: cyanuric chloride
Air
13.8 kg (0.949 %)
Fug. = 1.83e-3 μPa
0.138 ng/m³
0 kg/h
0.138 kg/h
9.58e-11 kg/h
2.12e-4 kg/h
3.43e-3 kg/h
0.148 kg/h
6.95e-3 kg/h
Soil
0.763 kg (0.052 %)
Fug. = 7.25e-4 μPa
2.83e-5 ng/g
0 kg/h
Water
1441 kg (98.9 %)
Fug. = 0.041 μPa
7.204 ng/L
1.441 kg/h
998 kg/h
5.74e-4 kg/h
2.64e-3 kg/h
1000 kg/h
7.22e-3 kg/h
2.96e-3 kg/h
Sediment
1.222 kg (0.084 %)
Fug. = 0.017 μPa
1.91e-3 ng/g
2.44e-5 kg/h
4.23e-3 kg/h
Legend:
EMISSION
REACTION
ADVECTION
INTERMEDIA EXCHANGE
Total Mass = 1457 kg
Persistence = 1.457 h = 0.061 days

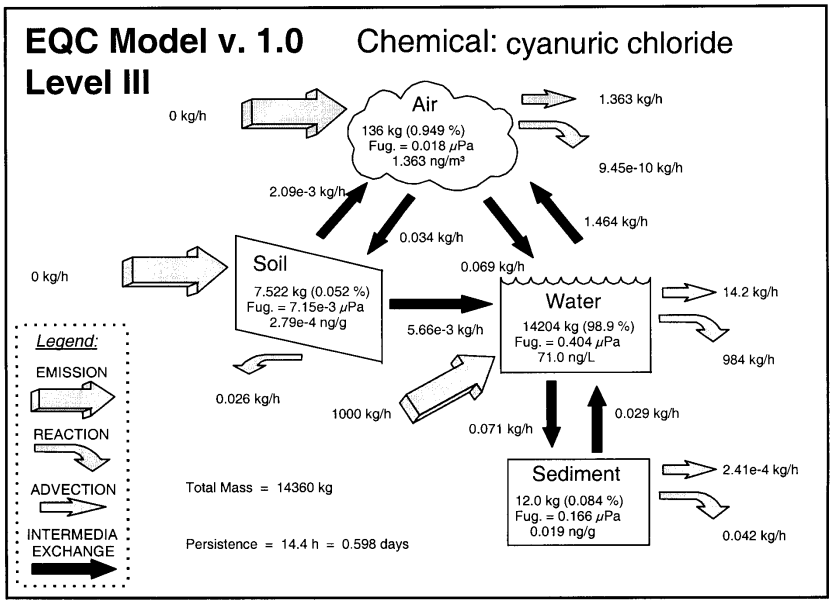
\M

APPENDIX C2

EQC-model

Input parameters

Molecular weight	184.41
Temperature	20ºC
Water solubility	440 mg/L
Vapour pessure	2.5 Pa
Log Kow	0.51
Melting point	146ºC
Half-life air	1E11 hours
Half-life water	10 hours
Half-life soil/sediment	200 hours


EQC Model v. 1.0
Level III
Chemical: cyanuric chloride
0 kg/h
Air
136 kg (0.949 %)
Fug. = 0.018 μPa
1.363 ng/m³
1.363 kg/h
9.45e-10 kg/h
2.09e-3 kg/h
0.034 kg/h
1.464 kg/h
0.069 kg/h
0 kg/h
Soil
7.522 kg (0.052 %)
Fug. = 7.15e-3 μPa
2.79e-4 ng/g
Water
14204 kg (98.9 %)
Fug. = 0.404 μPa
71.0 ng/L
14.2 kg/h
984 kg/h
5.66e-3 kg/h
0.026 kg/h
1000 kg/h
0.071 kg/h
0.029 kg/h
Sediment
12.0 kg (0.084 %)
Fug. = 0.166 μPa
0.019 ng/g
2.41e-4 kg/h
0.042 kg/h
Legend:
EMISSION
REACTION
ADVECTION
INTERMEDIA EXCHANGE
Total Mass = 14360 kg
Persistence = 14.4 h = 0.598 days

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SIDS Dossier on the HPV Chemical
Cyanuric Chloride

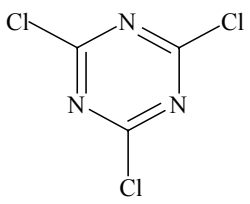
CAS No. 108-77-0

Sponsor Country: Switzerland

List of Abbreviations

[a]	Absolute to body weight
-	Absent
+	Present
a.i.	Active ingredient
ALP	Alkaline phosphatase
BCF	Bioconcentration factor
CFU	Colony forming units
d	Decrease
dc	Decrease (significant)
DOC	Dissolved organic carbon
DR	Dose related
F	Female
FID	Flame ionisation detection
GC	Gas chromatography
i	Increase
ic	Increase (significant)
LC	Liquid chromatopraphy
LOD	Limit of detection
M	Male
MCV	Mean corpuscular volume
MS	Massa spectronomy
N/A	Not applicable
QC	Quality control
[r]	Relative to body weight
TLC	Thin layer chromatography
UV	Ultra violet
WHC	Water holding capacity

1.01. Chemical identity

CAS No.	:	108-77-0
OECD name	:	Cyanuric chloride
Chemical/IUPAC name	:	2,4,6-trichloro-1,3,5-triazine
EINECS number	:	203-614-9
Molecular formula	:	$C_3Cl_3N_3$
Molecular weight	:	184.41
Structural formula	:	

1.02. OECD information

Sponsor country	:	Switzerland
Lead organisation	:	Dr Urs Staempfli, Swiss Agency for the Environment, Forests and Landscape
Name of responder (leader of consortium)	:	Dr Werner Bourgeois, Syngenta Crop Protection Ltd, Basel

1.1. General substance information

Type of substance	:	Organic
Physical state	:	Solid

1.2. Impurities

1.3. Additives

1.4. Synonyms

Chlorotriazine, cyanuric acid chloride, s-triazine trichloride, 2,4,6-trichlorotriazine

1.5. Quantity

Yearly more than 100000 tonnes of cyanuric chloride are produced.

1.6. Use pattern

The compound is used exclusively as an intermediate in the production of pesticides (herbicides), optical brighteners, dyes and plastic additives.

1.7. Sources of exposure

Occupational exposure during loading and sampling.

1.8. Additional information

2.1. Melting point

Title	Bericht über die Überprüfung von 2,4,6-trichlor-1,3,5-triazin auf toxikologisches Verhalten gegenüber Fischen und Bakterien und Bestimmung der Parameter zur Kennzeichnung des "Abwasserverhaltens"
Date of report	January 16, 1979.
GLP	No.
Reference	21.
Test substance	Cyanuric chloride, purity not indicated.
Melting point	146-7°C.
Reliability	4 Secondary literature (MSDS).

Title	Synthese von Halogenalkyl-dichlor- und bis-(halogenalkyl)-chlor-s-triazinen.
Date of report	1964.
GLP	No.
Reference	83.
Test substance	Cyanuric chloride, purity not indicated.
Test method	Not applicable.
Melting point	146 ^{o}C
Rev. note	The article consisted of a prescription for the synthesis of a.o. cyanuric chloride.
Reliability	4

Title	The chemistry of cyanuric chloride, In New Products Bulletin Collective, Vol. 1
Date of report	1952.
GLP	No.
Reference	81.
Test substance	Cyanuric chloride, purity not indicated.
Test method	Not indicated.
Stat. method	Not applicable.
Melting point	145.75 ± 0.05 ^{o}C
Reliability	4

Title	Reactions of nucleophilic reagents with cyanuric fluoride and cyanuric chloride.
Date of report	1958.
GLP	No.
Reference	1.
Test substance	Cyanuric chloride, purity not indicated.
Test method	Not applicable.
Melting point	145-146 ^{o}C
Rev. note	The article consisted of a prescription for the reaction of nucleophilic agents with cyanuric chloride.
Reliability	4

Title	Hydroxy-s-triazines (Japanese)
Date of report	1970.
GLP	No.
Reference	22.
Test substance	Cyanuric chloride, purity not clear from the report.
Test method	Not clear from the report.
Melting point	145-146°C.
Rev. note	Japanese article without English abstract.

Reliability 4 Japanese article.

2.2. Boiling point

Title Unpublished letter.
Date of report September 3, 1992.
GLP No.
Reference 3.
Test substance Cyanuric chloride, purity not indicated.
Boiling point 193°C.
Reliability 4

Title Bericht über die Überprüfung von 2,4,6-trichlor-1,3,5-triazin auf toxikologisches Verhalten gegenüber Fischen und Bakterien und Bestimmung der Parameter zur Kennzeichnung des "Abwasserverhaltens"
Date of report January 16, 1979.
GLP No.
Reference 21.
Test substance Cyanuric chloride, purity not indicated.
Boiling point 190°C.
Reliability 4 Secondary literature (MSDS).

Title Synthese von Halogenalkyl-dichlor- und bis-(halogenalkyl)-chlor-s-triazinen.
Date of report 1964.
GLP No.
Reference 83.
Test substance Cyanuric chloride, purity not indicated.
Test method Not applicable.
Boiling point 198 °C.
Rev. note The article consisted of a prescription for the synthesis of a.o. cyanuric chloride.
Reliability 4

Title Synthese von Halogenalkyl-dichlor- und bis-(halogenalkyl)-chlor-s-triazinen.
Date of report 1964.
GLP No.
Reference 83.
Test substance Cyanuric chloride, purity not indicated.
Test method Not applicable.
Boiling point 198 °C.
Rev. note The article consisted of a prescription for the synthesis of a.o. cyanuric chloride.
Reliability 4

2.3. Relative density

Title 2,4,6-Trichlorotriazine in Sax's Dangerous properties of industrial materials.
Date of report 1996.
GLP No.
Reference 71.
Test substance Cyanuric chloride, purity not indicated.
Specific gravity 1.32 at 20°C
Reliability 4

Title The chemistry of cyanuric chloride, In New Products Bulletin Collective, Vol. 1
Date of report 1952.
GLP No.
Reference 81.

Test substance Cyanuric chloride, purity not indicated.
Test method Not applicable.
Stat. method Not applicable.
Specific gravity 1.32
Reliability 4

2.4. Vapour pressure

Title Berechnung der Henrykonstante von Cyanurchlorid
Date of report 1993.
GLP No.
Reference 17.
Test substance Cyanuric chloride, purity not indicated.
Vapour pressure 1.2 Pa.
Reliability 4

Title Su di un caso di intossicazione acuta professionale da 2,4,6- trichloro-1-triazine (cloruro di cianurile)
Date of report 1987.
GLP No.
Reference 45.
Test substance Cyanuric chloride, purity not indicated.
Vapour pressure 2.5 Pa at 20 °C; 267 Pa at 70 °C..
Reliability 4

Title Bericht über die Überprüfung von 2,4,6-trichlor-1,3,5-triazin auf toxikologisches Verhalten gegenüber Fischen und Bakterien und Bestimmung der Parameter zur Kennzeichnung des “Abwasserverhaltens”
Date of report January 16, 1979.
GLP No.
Reference 21.
Test substance Cyanuric chloride, purity not indicated.
Vapour pressure 270 Pa at 70°C; 2000 Pa at 100°C.
Reliability 4 Secondary literature (MSDS).

Title The chemistry of cyanuric chloride, In New Products Bulletin Collective, Vol. 1
Date of report 1952.
GLP No.
Reference 81.
Test substance Cyanuric chloride, purity not indicated.
Test method Not applicable.
Stat. method Not applicable.
Vapour pressure 2 mm Hg at 70 °C.
Reliability 4

2.5. Partition coefficient

Title Zum Bioakkumulationspotential von Chlororganika

Date of report 1993.
GLP No.
Reference 6.
Test substance Cyanuric chloride.
Test method Not indicated.

Procedure	Overview of influence on lipophilic character of organic chloro compounds by substitution of chloro-atoms by other groups. For 2,4,6-trichlortriazin information was available of the following substitutes: methyl-, tert.-butyl-, methoxy-, methylthio-, acetoxy, acetyl, nitro-, hydroxy-, and amino-group. P_{ow} values were calculated by the CLOGP-program (Leo and Hansch, 1991).
Findings	Through substitution of chlor-atom with methyl-, acetoxy-, acetyl-, nitro-, hydroxy- (hydrolysis pathway) or amino-group the log Pow is decreased.
Conclusion	log P_{ow} cyanuric chloride: 0.51
Rev. note	Information is limited to what is included in the above summary. It is not clear from which source the log(P_{ow}) for cyanuric chloride was derived.
Reliability	4

Title	Substituent constants for correlation analysis in chemistry and biology; Chapter IV: The FRAGMENT method of calculating partition coefficients
Date of report	1979.
GLP	No.
Reference	19.
Procedure	A description of the FRAGMENT method of calculating partition coefficients is included in the report. Partition coefficients (observed and calculated) of some substances are included.
Conclusion	No data on cyanuric chloride.
Rev. note	Report contains no data on (degradates of) cyanuric chloride and subsequently is not relevant in this case.
Reliability	4 Not relevant.

Title	Bestimmung des Verteilungsgleichgewichts von Cyol nach der OECD-Richtlinie Testing of Chemicals Nr. 117 vom 03.03.1989 und 107 vom 12-05-1981
Date of report	December 15, 1992.
GLP	No.
Reference	50.
Test substance	Cyanuric acid
Test method	OECD 117, OECD 107.
Procedure	A HPLC/UV method [mobile phase (water/acetonitrile, 53/47)] was used to correlate log P_{ow} and retention time on two different columns. Seven substances were used in this test of which three were recommended reference compounds of OECD 117 with known log P_{ow}. The dead time (T_0) of the system was determined; chromatography was performed at 25°C. All compounds, except cyanuric acid, were dissolved in acetonitrile. The corrected retention time (T_c) for each reference substance and the test substance was calculated as $T_c = (T_r - T_0)$. There T_r was the measured retention time.
Conclusion	Probably log P_{ow} of cyanuricacid < 1.1. Log P_{ow} cyanuric chloride >1.7.
Rev. note	1. No reliable conclusion about the exact log P_{ow} of cyanuric acid and cyanuric chloride can be drawn from this test, because extrapolation is necessary. For cyanuric acid also another liquid was used for the preparation of the solution. Cyanuric acid was reported to be soluted in “LM”, which probably stands “Lösungsmittel“ (mobile phase; water/acetonitrile). 2. No calibration curve for the method used was presented.
Reliability	3 Different solvents (note 1), no calibration curve (note 2).

2.6. Water solubility and dissociation constant

Title	The hydrolysis of some chloro-1,3,5-triazines: Mechanism: Structure and reactivity.
Date of report	1963.
GLP	No.
Reference	7.
Test substance	Cyanuric chloride, purity not indicated.
Water solubility	440 mg/L at 20 °C.
Reliability	4

Title	Berechnung der Henrykonstante von Cyanurchlorid.
Date of report	1993.
GLP	No.
Reference	17.
Test substance	Cyanuric chloride, purity not indicated.
Water solubility	440 mg/L at 20 °C.
Reliability	4

Title	Bericht über die Überprüfung von 2,4,6-trichlor-1,3,5-triazin auf toxikologisches Verhalten gegenüber Fischen und Bakterien und Bestimmung der Parameter zur Kennzeichnung des “Abwasserverhaltens”
Date of report	January 16, 1979.
GLP	No.
Reference	21.
Test substance	Cyanuric chloride, purity not indicated.
Water solubility	Insoluble at 20°C; hydrolysis to water-soluble cyanuric acid from 10°C.
Reliability	4 Secondary literature (MSDS).

Title	The chemistry of cyanuric chloride, In New Products Bulletin Collective, Vol. 1
Date of report	1952.
GLP	No.
Reference	81.
Test substance	Cyanuric chloride, purity not indicated.
Test method	Not applicable.
Stat. method	Not applicable.
Water solubility	practically insoluble
Reliability	4

2.7. Flash point

Title	Cyanurchlorid (Degussa brochure).
Date of report	1987.
GLP	No.
Reference	106.
Test substance	Cyanuric chloride, purity not indicated.
Flash point	> 190 °C.
Reliability	4

2.8. Auto flammability

Title	Cyanurchlorid (Degussa brochure).
Date of report	1987.
GLP	No.
Reference	106.
Test substance	Cyanuric chloride, purity not indicated.

Ignition temp. > 650 °C.
Reliability 4

2.9. Flammability

2.10. Explosive properties

2.11. Oxidising properties

2.12. Oxidation/reduction potential

Not applicable.

2.13. Adsorption/desorption to soil

2.14. Additional information

Title The chemistry of cyanuric chloride, In New Products Bulletin Collective, Vol. 1
Date of report 1952.
GLP No.
Reference 81.
Test substance Cyanuric chloride, purity not indicated.
Test method Not applicable.
Stat. method Not applicable.
Stability on heating No depolymerisation occurs when cyanuric chloride is heated to 190 °C. Cyanuric chloride has been refluxed without decomposition.
Reliability 4

Title Reactions of nucleophilic reagents with cyanuric fluoride and cyanuric chloride

Date of report 1958.
GLP No.
Reference 1.
Test substance Cyanuric chloride.
Procedure Nucleophilic substances were passed into a solution of 10-20 mmol cyanuric chloride. After the reaction the products were evaporated to dryness and dried (vacuum).

Nucleophilic agent	Cynanuric chloride (mmol)	Solvent	Reaction time (h)	Product	Product (mmol)
Ammonia	20	Ether	1	2,4-dichloro-6-amino-*s*-triazine	15
Diethylamine	10	Chloroform	~1.5	2,4-bis(diethyl-amino)-6-chloro-*s*-triazine	10
Aniline	10	Tetrahydrofuran	~2	2,4-bis(phenylamino)-6-chloro-*s*-triazine	10
Water	20	Tetrahydrofuran	0.17	Cyanuric chlorid/cyanuric acid	-
Methanol	20	Tetrahydrofuran/ potassium carbonate/ methanol	~2	2,4,6-tris(methoxy)-*s*-triazine	12

Conclusion Cyanuric chloride reacts readily with nucleophilic agents.
Reliability 4

Title	Strukturbestimmung von Cyanursäuretrichlorid $C_3N_3Cl_3$ mit Verwendung der diffusen Röntgenstreustrahlung zur Bestimmung der Molekülorientierungen
Date of report	1957.
GLP	No.
Reference	4.
Test substance	Cyanuric chloride.
Procedure	Determination of crystal structure of cyanuric chloride by Röntgen-diffraction.
Rev. note	Information on structure of test substance.
Reliability	4 Structure information

Title	Abschätzung des umweltchemischen und ökotoxikologischen Verhaltens von Stoffen durch computergestützte Analyse von Struktur und Verhalten sowie von Struktur und Wirkung
Date of report	1993.
GLP	No.
Reference	8.
Procedure	Information about a software system for the determination of ecotoxicological and physico-chemical data based on quantitative structure-activity relationships.
Rev. note	No information on cyanuric chloride available in the report.
Reliability	4 No test substance related information

3.1.1. Photodegradation

Title Epiwin vs 3.10.

Date of report 2002.
Test substance Cyanuric chloride.
Test method Calculation with AOPWIN vs1.9, based on:
SMILES : n(c(nc(n1)CL)CL)c1CL
CHEM : 1,3,5-Triazine, 2,4,6-trichloro-
CAS NUM: 000108-77-0
MOL FOR: C3 CL3 N3
MOL WT : 184.41
Result AOP Program (v1.90) Results:
==========
SMILES : n(c(nc(n1)CL)CL)c1CL
CHEM : 1,3,5-Triazine, 2,4,6-trichloro-
MOL FOR: C3 CL3 N3
MOL WT : 184.41
---------- SUMMARY (AOP v1.90): HYDROXYL RADICALS ----------
Hydrogen Abstraction = 0.0000 E-12 cm3/molecule-sec
Reaction with N, S and -OH = 0.0000 E-12 cm3/molecule-sec
Addition to Triple Bonds = 0.0000 E-12 cm3/molecule-sec
Addition to Olefinic Bonds = 0.0000 E-12 cm3/molecule-sec
Addition to Aromatic Rings = 0.0037 E-12 cm3/molecule-sec
Addition to Fused Rings = 0.0000 E-12 cm3/molecule-sec

OVERALL OH Rate Constant = 0.003733 E-12 cm3/molecule-sec
HALF-LIFE = 2864.910 Days (12-hr day; 1.5E6 OH/cm3)
Reliability 4

3.1.2. Stability in water

Title On the hydrolysis of cyanuric chloride

Date of report 1960.
GLP No.
Reference 2.
Test substance Cyanuric chloride.
Test method Not clear from the report.
Procedure Hydrolysis was tested in $NaHCO_3$, Na_2CO_3 or NaOH.
Findings Hydrolysis of cyanuric chloride gives the sodium salt of 2,4 dichloro-6-hydroxy-s-triazine in NaOH (at low temperature), $NaHCO_3$ and Na_2CO_3 or the sodium salt of 2-chloro-4,6-dihydroxy-s-triazine with an excess NaOH at room temperature. Both products are stable under alkaline conditions, but under acidic conditions they were decomposed to cyanuric acid.

Conclusion Hydrolysis of cyanuric chloride gives 2,4 dichloro-6-hydroxy-s-triazine, 2-chloro-4,6-dihydroxy-s-triazine and/or cyanuric acid.
Rev. note Japanese article with English abstract, readable information limited.
Reliability 4 Japanese article

Title The hydrolysis of some chloro-1,3,5-triazines: mechanism: structure and reactivity
Date of report November 9, 1962.
GLP No.
Reference 7.

Test substance Cyanuric chloride.
Test method Not specified.

Procedure
A. 1.85 g cyanuric chloride in 12 mL acetone was added to 100 mL 0.1 N nitric acid. This mixture was stirred and titrated continuously with silver nitrate at 0.5, 10 and 20°C.
B. 3-5 g cyanuric chlorid was dissolved in 14-140 mL acetone and added to 700 mL water or nitric acid (0.001 N or 0.1 N) at 0-25°C. This mixture was vigorously stirred and 50 mL samples (≥4) were taken at 2 min. intervals, acidified and hydrolysed for 2 h at 100°C and titrated with silver nitrate.
Titration curves were made, from which solubility and hydrolysis constants were deduced.

Findings
Water solubility and hydrolysis were comparable between water, 0.001 and 0.1 M nitric acid (not buffered).

- DT_{50} was calculated for the transformation of cyanuric chloride to dichlorohydroxytriazine (see table below, formula used: DT50=ln2/k).
- DT_{50} for hydrolysis of dichlorohydroxytriazine to chlorodihydroxytriazine at 25°C in alkaline solution (pH 9.2-11.2) was 1.6-90 days; in acid solutions (pH 1.1-1.6) DT_{50} was 5-15 min.
- DT_{50} for hydrolysis of chlorodihydroxytriazine to cyanuric acid at 25°C in alkaline solution (pH 11-13) was 29-76 days; in acid solutions (pH 1-2) DT_{50} was 10 min.-5h. At pH 7 no degradation was seen after one month.

	Water solubility of cyanuric chloride at temperature					
Temperature (°C)	**0**	**5**	**10**	**15**	**20**	**25**
Concentration (g/L)	0.32	0.35	0.38	0.41	0.44	0.49

	DT_{50} [min] hydrolysis of cyanuric chloride at temperature [°C]:						
pH	**0**	**5**	**7**	**10**	**15**	**20**	**25**
Water, nitric acid (pH 3 and pH 1)	50	30		18	11	7.0	4.5
4			2.5-9.2				
6		17					
7		11					
9		3.7					

Conclusion
Rate of hydrolysis increased with higher temperature and in alkaline/acid solution. Cyanurchlorid hydrolyses fast (in the order of minutes-hours). Solubility in water is 0.49 g/L (25°C).

Rev. note
1. Water solubility may be overestimated due to supersaturation.
2. DT50 was not determined under sterile conditions and was not reported to be tested in the dark. Degradation is probably not completely attributable to hydrolysis, but also to other degradation pathways. DT50 values for hydrolysis may be underestimated.
3. In the report only the reaction constant (=k) was available. The reviewer calculated the DT50 with the following formula: DT50: ln2/k.

Reliability
2 Water solubility overestimated (note 1); DT50 underestimated (note 2)

Title
Nucleophile Substitutionen in der 1,3,5-Triazinreihe. VIII. Zur Hydrolyse des Cyanurchlorids in Dioxan-Wasser

Date of report
1983.

GLP
No.

Reference
9.

Test substance
Cyanuric chloride, purity 99%.

Test method
Not specified.

Procedure
Measurement of the reaction rate for the hydrolysis of cyanuric chloride (0.6-1.3 mM) in water with 1-70% dioxan at 19, 35 and 44°C.

Findings
- Reaction constant (k) for complete hydrolysis decreased with increasing conversion of Cl-atoms, due to nucleophilic substitution of three different Cl-atoms in the molecule.
- Reaction constant (k) increased with decreasing concentrations of dioxan.
- At dioxan concentrations >30-40%: constant k at 35 and 44°C, decrease in k at 19°C.
- At 44°C: $k=9x10^{-3}$ s^{-1} (water/dioxan: 90/10) for hydrolysis to 2,4-dichloro-6-hydroxy-s-triazin

Conclusion
DT_{50} (44°C): 1.3 min.

Rev. note
1. Report concerning the reaction mechanism involved in the hydrolysis of cyanuric

chlorid. Information about test conditions was essentially confined to what is included in the above summary.
2. In the report only the reaction constant (=k) was available. The reviewer calculated the DT50 with the following formula: DT50: ln2/k.

Reliability 4 Reaction mechanism study.

Title Chlorherbizide 2,4-dichlor-6-isopropylamino-s-triazin, kinetische Untersuchung der Hydrolyse und Aminolyse mit Aethlyamin in Abhängigkeit der wichtigsten Reaktionsparameter

Date of report June 30, 1978.

GLP No.

Reference 10.

Test substance 2,4-dichloride-6-isopropylamino-s-triazin (purity 97.8%).

Test method Not indicated.

Procedure *Only the separate hydrolysis study is included in this summary (note 1).*
Design: testing in toluene/water (50/50) at pH 10 and 50°C.
Test solutions of 2,4-dichloride-6-isopropylamino-s-triazin were prepared in toluene (0.5 M) and diluted with water (end volume 1 L). The pH was kept at pH 10 with the addition of 9.4 M NaOH. Aliquots of 25 mL were taken from the water phase. The amount of HCl formed during the study was measured by the NaOH added during the test. Additionally the water phase was titrated with $AgNO_3$. The hydrolysis-products were analysed by LC/UV.

Findings Hydrolysis products of 2,4-dichloride-6-isopropylamino-s-triazin (A) were 2-chloride-4-hydroxy-6-isopropylamino-s-triazin (B) and 2,4 dihydroxy-6-isopropylamino-s-triazin (C). See table below.

Time [min]	A_t [mMol]	B_t [mMol]	C_t [mMol]
0	250.00	0	0
3	250.00	0	0
10	249.48	0.52	0
24	248.23	1.48	0.29
45	246.26	3.16	0.58
60	244.80	4.64	0.56
75	242.90	6.11	0.99
90	242.41	6.43	1.16
116	239.80	8.72	1.48
140	237.18	11.59	1.23
167	238.92	9.72	1.36

Conclusion After 167 minutes 4.4% of 2,4-dichloride-6-isopropylamino-s-triazin was hydrolysed. The DT_{50} calculated by the reviewer was 1.5 days.

Rev. note
1. The tested substance is not a hydrolysis product of cyanuric chloride.
2. The reported test consists of a hydrolysis and an aminolysis part, sometimes combined in one system. Only the separate hydrolysis study is included in the summary, since this can be a relevant endpoint.
3. No buffer solution was used, but the pH was adjusted using 9.4 M NaOH. The deviation of the stated pH-level is not reported, neither is the temperature deviation during the study. Variations in pH are very important for the hydrolysis rate of a substance.
4. The DT_{50} was calculated assuming that the only products formed were 2-chloride-4-hydroxy-6-isopropylamino-s-triazin and 2,4 dihydroxy-6-isopropylamino-s-triazin. This is acceptable in a worst case approach.
5. A first order regression line was drawn by the reviewer for the following function: $\ln(A_t) = \ln(A_0) - kt$. Since only data were available of the first 167 minutes and not more than 4.4% of the test substance was hydrolysed by then, extrapolation was necessary to estimate the DT_{50}. Extrapolation makes the result less reliable.

Reliability 3 Extrapolated value (note 4)

Title Hydrolytische Zersetzung von Cyanurchlorid und MDT

Date of report February 22, 1978.

GLP No.
Reference 11.
Test substance Cyanuric chloride.
Test method Not specified.
Procedure In 300 mL flasks a suspense of 5 g cyanurchlorid in 200 mL water was prepared. The flasks were sealed and incubated at 22°C. Once a day the flasks were shaken. Samples were removed for analysis after 1, 2, 3, 4, 5, 8, 15 and 25 days. Samples were filtrated and analysed on hydrochlorid acid.
Findings The table below shows the hydrolysis of cyanurchlorid. Maximum hydrolysis of cyanurchloride after 25 days. Italic values are theoretical; actually they cannot be >100%.

Day	Formation HCl [%] based on		
	1 free Cl	2 free Cl	3 free Cl
1	3.3	1.7	1.1
2	66	33	22
3	90	45	30
4	*136*	68	46
5	*189*	96	63
8	*252*	*126*	84
15	*297*	*199*	99
25	*300*	*200*	100

Conclusion At 22°C: DT_{50} for total hydrolysis 4 days.
Rev. note
1. The method of analysis was specified only to a limited extent. No recovery or specificity was available for the analytical method.
2. The DT50 should be measured at two different temperatures and at minimal 3 different pH values. The acidity of the solution was not given in this report. pH is an important factor in the degradation of cyanuric chloride. Further it is not clear whether the temperature was kept constant. There were also no reference substances (aspirin or diazinon) included to provide the calibration of the used method.
3. The reviewer determined the DT50 value graphically (graph was available in the report.

Reliability 3 Incomplete description and limited test (note 1 and 2)

Title Kinetische Untersuchungen zur Hydrolyse von Cyanurchlorid
Date of report September 26, 1985.
GLP No.
Reference 12.
Test substance Cyanuric chloride.
Test method Not indicated.
Procedure Design: testing at pH 2, 3, 4, 7 and 12 (NaH_2PO_4-buffer, for pH 2 additional 0.1 M NaOH; temperature 25, 30 and 40°C (pH 2), 40°C (pH 3, 4 and 12), 20, 25, 30, 35 and 40°C (pH 7).
A solution of 461 mg cyanurchlorid in 5 mL acetonitrile was blended in 400 mL water and continuously stirred during the study.
Samples were analysed by HPLC at several time-intervals.
Findings *Metabolites*: 2,4-dichlor-6-hydroxy-1,3,5-triazin (first product, M1); 2-chlor-4,6-dihydroxy-1,3,5-triazin (second product, M2), cyanuric acid (endproduct, E).

k and DT_{50} values: see table below; DT50 values for the disappearance of cyanuric chlorid to M1 do not exceed 5 minutes. DT50 values for transformation of the test substance to the endproduct cyanuric acid do not exceed 5 hours except the DT50 at pH 12 and T 40 °C (~2.5 dag). Reaction rates are shown for all three transformations: reaction 1 from cyanuric chlorid to M1, reaction 2 from M1 to M2 and reaction 3 from M2 to E.

pH	T [°C]	Reaction rate k_x {1/min)			DT50 [min] for transformation of	
		k_1	k_2	k_3	Cyanuric chlorid to M1	M2 to E
2	25	5.8 E-1	4 E-2	6.2 E-3	1.2	112
	30	9.5 E-1	6.7 E-2	9.3 E-3	0.73	75
	40	2.5	1.5 E-1	2.2 E-2	0.28	32
3	40	9.8 E-1	2.1 E-2	3.7 E-3	0.71	187
4	40	4.2 E-1	2.1 E-3	-	1.7	-
7	20	1.5 E-1	1.2 E-2	-	4.6	-
	25	2 E-1	2.2 E-2	2.9 E-3	3.5	239
	30	3.4 E-1	3.2 E-2	5.1 E-3	2.0	136
	35	5.7 E-1	6.3 E-2	6.5 E-3	1.2	107
	40	8.9 E-1	7.8 E-2	1.1 E-2	0.78	63
12	40	>1.5	1.4 E-2	~ 2 E-4	<0.46	~3466

Conclusion DT_{50} (disappearance of cyanuric chlorid) <5 min (all tests)
DT_{50} (transformation to acid) <5 h (all tests except at 40°C and pH 12, DT_{50} ~2.5 d).

Rev. note
1. The method of analysis was specified only to a limited extent. No recovery or specificity were available for the analytical method.
2. The overall DT50 (cyanuric chlorid to cyanuric acid) is based on the rate limiting reaction which turned out to be the transformation of M2 to E (= cyanuric acid).
3. DT50 values were calculated by the reviewer (ln2/k) or extracted from the report (formula used also ln2/k).

Reliability 2 Analytical method not specified (note 1).

Title Communication. Azo and Anthraquinoid dyes containing the cyanuric ring

Date of report November 1937.
GLP No.
Reference 13.
Test substance Cyanuric chloride.
Test method Not indicated.
Procedure In a four-necked flask was placed in a water bath and fitted with a stirrer, thermometer and a gas delivery and gas exit tube. At 10°C 5.1 g cyanuric chloride, 7 g CaCO3 and 190 mL water, at 21°C 4.2 g cyanuric chloride, 12 g CaCO3 and 175 mL water and at 36°C 2.7 g cyanuric chloride, 10 g CaCO3 and 220 mL water were placed in the flask. The flasks was aerated with nitrogen gas and the outcoming gas was dried on sulphuric acid and calciumchloride and then absorbed in soda lime. The change in weight of the soda lime was measured.

Findings At 0°C after 12 h no hydrolysis occurred. The progress of hydrolysis at 10, 21 and 36°C is illustrated in the table below. 100% hydrolysis equals to the replacement of 1 Cl-atom by an hydroxide-group.

T (°C)	Time (min)	% Hydrolysis
10	20	2.3
10	40	4.9
10	60	7.4
10	90	11
10	134	17
10	160	20
10	196	25
10	232	40
21	11	2.5
21	20	6.5
21	33	13
21	60	26
21	90	40
21	113	51
21	132	60
36	16	12

36	24	19
36	30	25
36	35	30
36	50	45
36	60	55
36	70	65

Conclusion DT50 hydrolyses of cyanuric chloride at 10, 21 and 36°C is >3.9 h, ~2 h and ~1 h. At 0°C no hydrolytic degradation.

Rev. note
1. The pH of test solutions is not determined during the test. DT50 hydrolysis should be determined at pH 4, 7 and 9 (OECD 111).
2. Since the test was not performed in the dark under sterile conditions, the degradation of the test substance may be (partly) related to bacterial and/or photodegradation.
3. The reviewer deduced the DT50 values from the table included in the "Findings" section of this summary.

Reliability 3 pH (note 1) and hydrolysis not only pathway for degradation (note 2).

Title Determination of Dyrene and Cyanuric chloride in technical materials
Date of report January-February 1960.
GLP No.
Reference 14.
Test substance Cyanuric chloride.
Test method Not specified.
Procedure The rate of (complete) hydrolysis of cyanuric chloride was investigated in 1M Sodium hydroxide (pH 14), 1 M hydrochloric acid (pH 0) and water by determining the chloride. The test concentration was 6 g/L and 50 ml of test solution were incubated at 15, 25 and 50°C and at reflux.
Findings See table below.

pH	Temperature [°C]	Time [h]	% TS completely hydrolysed	DT50 [min]
0	15	1	10	-
0	25	1	15	-
0	50	1	70	50
0	reflux	1	100	<1
water	15	1	4	-
water	25	1	5	-
water	50	1	30	-
water	reflux	1	100	<5
14	15	1	85	<10
14	25, 50, reflux	1	100	<5

Conclusion Rate of hydrolysis increased with higher temperature and in alkaline or acid solution.

Rev. note
1. Information available in the report is limited to what is included above. DT50 was not determined under sterile conditions and was not reported to be tested in the dark. Degradation is probably not completely attributable to hydrolysis, but also to bacterial and photodegradation. DT50 values for hydrolysis may be underestimated. Further the pH values used in the test were very extreme or not specified (water).
2. The DT50 was estimated by the reviewer from graphs showing the percentage cyanuric chloride in the solution at different time points (0-60 minutes).

Reliability 4 Extreme or unspecified pH.

Title Der Mechanismus der Hydrolyse von Chlortriazinen in protischen Lösungsmitteln
Date of report 1971.
GLP No.
Reference 15.
Test substance Cyanuric chloride, purity not indicated.
Test method Not indicated.

Procedure	Design: testing at pH 8.0, 9.0, 9.3, 9.7 and 10 in an aquatic solution of 0-1x10^{-2} M $NaCH_3COO$ and 0.1 M $NaNO_3$ at 10.0±0.1°C. 2 mL of a cyanuric chloride solution (3.7 mg/mL acetone) was added to 20 mL of the aquatic solution mentioned above. The pH was kept constant by the addition of 0.1 M NaOH. The reaction was followed by the measurement of the NaOH added during the test. The reaction products were analysed by NMR and UV-measurements.
Conclusion	Cyanuric chloride degrades eventually to cyanuric acid under influence of water. The reaction constants are also dependent on the CH_3COO^--concentration in the test solution and so the test cannot be used to determine the DT_{50} hydrolysis.
Rev. note	The test was set up to determine the reaction mechanism of cyanuric chlorid in a solution of water at different pH-levels. The water was set at pH 8-10 using the acetate-ion. During the test it became clear that the acetate ion was involved in the hydrolysis-reaction. Because of this the test cannot be used to determine a reliable DT_{50} hydrolysis.
Reliability	3 Acetate-ion influences reaction rate.

Title	Brief, Hydrolyse von Cyanurchlorid, SKW Trostberg
Date of report	August 8, 1990.
GLP	No.
Reference	16.
Test substance	Cyanuric chloride.
Results	1. 100% hydrolysis at 40°C in aqueous solution (unbuffered) within 6 h; endproduct cyanuric acid. 2. At pH >8.5 the dihydroxychlorotriazine will persist some time.
Conclusion	It is considered unlikely that cyanuric chloride will persist in aqueous solutions at room temperature, even at slightly basic pH.
Rev. note	No report on the effects of pH and temperature on hydrolysis and reaction products.
Reliability	4

Title	Bericht über die Überprüfung von 2,4,6-trichlor-1,3,5-triazin auf toxikologisches Verhalten gegenüber Fischen und Bakterien und Bestimmung der Parameter zur Kennzeichnung des “Abwasserverhaltens”
Date of report	January 16, 1979.
GLP	No.
Reference	21.
Test substance	Cyanuric chloride, purity not indicated.
Hydrolysis	Completely hydrolysed (1 g/L at 20±2°C) within 2 hours.
Reliability	4 Secondary literature (MSDS).

3.1.3. Stability in soil

Title	Brief, Geographisches Institut, Kiel
Date of report	August 23, 1993.
GLP	No.
Reference	18.
Test substance	Cyanuric chloride and hydrolysis products.
Conclusion	Statement that based on the log Pow calculated by Hansch & Leo sorption to soil is expected to be low.
Rev. note	It is expected that the DT50 is very low and that almost all cyanuric chloride and its products will be mainly found in the watery phase of the soil. No adsorption-desorption study is available to support this hypothesis.
Reliability	4

3.2. Monitoring data

3.3. Transport and distribution between environmental compartments

Title	Notiz, Berechnung der Henrykonstante von Cyanurchlorid
Date of report	June 17, 1993.
GLP	No.
Reference	17.
Test substance	Cyanuric chloride.
Procedure	Recalculation of the Henry constant with a correction for the vapour pressure of water:

$p_{cyanuric\ chloride} = p_{total} - p_{water}$

Assuming that above the solubility limit of cyanuric chloride the total vapour pressure is almost equal to the vapour pressure of water the following formula was derived:

$$H = \frac{P_{(0)water} - P_{(0)water}\ (1-x)}{s}$$

x = solubility limit (mol/mol)
s = solubility in water (mol/m^3)

Conclusion	0.04 Pa.m^3/mol.
Rev. note	The method of calculation is acceptable.
Reliability	1

Title	Epiwin vs 3.10.
Date of report	2002.
Test substance	Cyanuric chloride.
Test method	Calculation with Epiwin vs 3.10, based on: Chem Name : 1,3,5-Triazine, 2,4,6-trichloro- Molecular Wt: 184.41 Henry's LC : 4.91e-007 atm-m3/mole (Henrywin program) Vapor Press : 0.0236 mm Hg (Mpbpwin program) Liquid VP : 0.064 mm Hg (super-cooled) Melting Pt : 68.8 deg C (Mpbpwin program) Log Kow : 1.73 (Kowwin program) Soil Koc : 22 (calc by model) Emission to water only.

Result Level III Fugacity Model (Full-Output):
==========

	Mass Amount (percent)	Half-Life (hr)	Emissions (kg/hr)
Air	0.032	6.88e+004	0
Water	99.5	1.44e+003	1000
Soil	0.187	1.44e+003	0
Sediment	0.288	5.76e+003	0

	Fugacity (atm)	Reaction (kg/hr)	Advection (kg/hr)	Reaction (percent)	Advection (percent)
Air	2.87e-013	0.00218	2.17	0.000218	0.217
Water	8.96e-012	324	673	32.4	67.3
Soil	2.26e-013	0.608	0	0.0608	0
Sediment	8.49e-012	0.235	0.039	0.0235	0.0039

Persistence Time: 676 hr
Reaction Time: 2.08e+003 hr
Advection Time: 1e+003 hr
Percent Reacted: 32.5
Percent Advected: 67.5

Half-Lives (hr), (based upon Biowin (Ultimate) and Aopwin):
Air: 6.876e+004
Water: 1440
Soil: 1440
Sediment: 5760
Biowin estimate: 1.926 (months)

Advection Times (hr):
Air: 100
Water: 1000
Sediment: 5e+004

Reliability 4

3.4. Biodegradation

3.5. BOD-5, COD or ration BOD-5/COD

3.6. Bioaccumulation

Title Bio-accumulation de l'acide cyanurique chez les mollusques bivalves et conséquences histologiques de sa toxicité chez *Anodonta cygnea*
Date of report 1988.
GLP No.
Reference 25.
Test substance Cyanuric acid, (pure and crude without further specification).
Guideline Not applicable.
Test system
Species *Anodonta cygnea* (bivalve mollusc).
No. of animals Not indicated.
Concentrations 250 and 500 mg/L (crude), 500 and 2000 mg/L (pure)
Test conditions Exposure for maximum 96-97 days in 5-10 L aquaria (aerated) at 20°C with renewal frequency not indicated); substances were stirred vigourously.
Observations Mortality several times during exposure time.
Histology of digestive glands and kidneys (organs of Bojanus).
Results Accumulation of cyanuric acid mainly in the kidney (test performed at a concentration of 1000 mg/L).

Concentration [mg/L] \ effect	250	500 (crude)	500 (pure)	2000
50% mortality on day			70	39
Symptoms (A)	+	+	+	+
Histopathology (B)		+	+	+

(A) Loss of closure strength and fragile valves.

(B) Effects on membranes and increased density of granules in the digestive gland; yellow granules (accumulating) in the kidney.

Conclusions Both crude and pure cyanuric acid have effects on molluscs.
Rev. note The reduced toxicity observed at 2000 mg/L is caused by closure of the valves during a strong attack by the toxicant.
Reliability 4 .

3.7. Additional information

Title Microbial decomposition of ring-^{14}C atrazine, cyanuric acid, and 2-chloro-4,6-diamino-*s*-triazine
Date of report 1975.
GLP No.
Reference 54.
Test substance ^{14}C-cyanuric acid, purity >98%.
Test method Not specified.
Test system **Procedure** Batches of the sieved (2 mm) soil (Greenfield sandy loam, 65/29/6% sand/silt/clay, pH 7.1, 1.1% om) were collected from the field, air-dried and adjusted to 60% WHC or 120% WHC. Aliquots of 500 g (d.w.) were then dispensed into 4x1 L Erlenmeyer flasks and treated with 1.25 mg ^{14}C-cyanuric acid (rate 2.5 mg/kg). Two flasks were amended with lima bean straw (0.5% d.w.⇔ 55 mg N/kg soil). The soil was aerated with CO_2-free air and the outcoming air was passed through a CO_2-trap containing 25 mL 3 N KOH. The traps were sampled after 16, 32, 66, 192 days for 60% WHC-soil and after 32, 66, 192, 264 and 375 days for 120% WHC-soil. The total amount of CO_2 in the traps was determined by backtitration with HCl, the $^{14}CO_2$ was determined by LSC. The amount of ^{14}C in solids was determined by combustion/LSC.
Findings Recovery ^{14}C in CO_2 and soil was 91-103%. No treatment related effects on total amount of CO_2 evolved during the test.

	soil 60% WHC [% of applied]	***soil 60% WHC [% of applied] + bean straw***	***soil 120% WHC [% of applied]***	***soil 120% WHC [% of applied] + bean straw***
day	***$^{14}CO_2$***	***$^{14}CO_2$***	***$^{14}CO_2$***	***$^{14}CO_2$***
16	87	96	nd	nd
32	96	98	57	76
66	98	99	83	87
192	99	99	97	93
264	nd	nd	98	93
375	nd	nd	99	94
	DT_{50} a.i.: 8.3 d	**DT_{50} a.i.: 7.5 d**	**DT_{50} a.i.: 27 d**	**DT_{50} a.i.: 19 d**

nd: not detected.

Conclusion DT_{50}-soil (aerobe): 8.3 d (note 3).
Cyanuric acid had no effect on the activity of micro-organisms in the soil.
Rev. note
1. The report gives no information about light regime, temperature, maximum water holding capacity of the soil. All of these are important factors in the determination of the degradation rate of a test substance in soil. Further only one soil is tested in this study (OECD guidelines require 3 soils). Since the degradation rate can be sensitive for type of soil, light regime, temperature and water amount, the study reliability is lowered.
2. There is only limited information about the microbial biomass. Since microbial degradation is tested in this type of studies, the amount of biomass is a very important factor to know. What has been reported in this study is that the amount of fungi, bacteria and actinomycetes increases with elevating levels of bean straw.
3. The DT_{50} values were graphically determined by the reviewer, assuming all ^{14}C not

recovered as $^{14}CO_2$ to be present as cyanuric acid in the soil. Actually an intermediate is involved in the transformation from cyanuric acid to CO_2, so the actual DT_{50} can be even lower. DT_{50}-values are considered acceptable in a worst case approach.

4. Also a test with fungal incubation (*S. chartarum & H. toruloidea*) was included in the report. Cyanuric acid degraded almost completely to CO_2 after 28 days by *S. chartarum. H. toruloidea* degraded only 15% of cyanuric acid to CO_2 after 8 weeks of incubation. This test was not included in the above summary, because it gives no additional useful information.

Reliability 4

Title Nitrification of triazine nitrogen
Date of report March-April, 1964.
GLP No.
Reference 55.
Test substance Cyanuric acid.
Test method Not specified.
Test system
Test soils Webster silty clay loam (Iowa), pH 8.2.
Hartsells fine sandy loam (Alabama), pH 5.2.

Procedure The soils adjusted to 60% FC and used in three separate tests.
Test 1: batches of 100 g Webster soil were mixed with 200 mg cyanuric acid in 500 mL Erlenmeyer flasks (2 g a.i./kg soil). Following treatment the soil batches (2/treatment) were incubated aerobically at 32°C. Analyses were performed after 10 and 28 weeks. A control was included.
Test 2: batches of 30 g Webster and Harttsells soil were mixed with 70 mg cyanuric acid (for Webster soil in duplo, one as solution and one as powder) in 125 mL square milk-dilution bottles (2.3 g a.i./kg soil). Following treatment the soil batches (2/treatment) were incubated aerobically at 32°C. Analyses were performed after 6, 12, 18 and 24 weeks.
Test 3: batches of 200 g Harttsells soil were put into 500 mL waxed cartons and 14.4 mg cyanuric acid and 20.0 mg ammonium sulfate ($(NH_4)_2SO_4$) were applied in a single spot 1.3 cm below the surface and incubated at either 10°, 20° and 30°C up to 90 days. Analyses were performed after 15, 30, 60 and 90 days.
Test 4: A perfusion experiment was included in which a dilute solution of cyanuric acid (rate 1.0 mg a.i./kg) with or without 10 mg NH_4-N was continuously circulated in an aerated closed system containing 30 g "Krilium"-treated Webster soil. After 60, 116 and 144 days additional 2-4 mg NH_4-N was added to the ammonium-treated systems. Incubation was performed at 25°C up to 165 days.

Findings
Test 1 N found as NO_3^- in week 10 and 28 was respectively 35 and 73%.
Test 2

test substance - form	% cyanuric acid-N nitrified in weeks: 6	12	18	24
Webster silty clay loam				
cyanuric acid - solution	6.9	69	84	86
cyanuric acid - powder	6.9	66	89	92
Hartsells fine sandy loam				
cyanuric acid – powder[1]	15	64	55	70

[1] duplicate samples were not reproducible

Test 3 Nitrification was inhibited for 90 days at 10°C (max. ~25%) and for ~50 days (max 30%) at 20°C. At 30°C no inhibition occurred. After 90 days at 20° and 30°C, respectively 12.5 and 15.3% of cyanuric acid was recovered as nitrate, assuming 100% oxidation of added ammonium.

Test 4 Slow degradation for about 4 weeks. No effect on nitrifying microorganisms; 2-day lag phase for degradation of ammonium to nitrate (and nitrite).

Conclusion **Degradation**

test 1: DT_{50} 117 d (2 g a.i./kg, 32°C); DT_{50} 306 d at 20°C.
test 2: DT_{50} 70 d in Webster soil (2.3 g a.i./kg, 32°C); DT_{50} 183 d at 20°C. maximum degradation after 18 weeks.

Nitrification

test 3: at 30°C no effects, at 20°C only transient effect ≥25% till day 30, at 10°C effects during whole period (90 days) with maximum inhibition at the end (~25%).
test 4: No effects on nitrifying micro-organisms at 25 °C.

1. The report gives no information about light regime, maximum water holding capacity, microbial biomass and history of the soil. All of these are important factors in the determination of the degradation and nitrification rate of the soil. The study reliability is lowered.
2. There is only limited information about the soil characteristics: only pH and soil classes are given in the report.
3. The reviewer graphically determined DT_{50} values. No DT_{50} values were calculated for the Harttsells soil from test 2 because of the large differences between replicates and so the unreliability of this value. It should be kept in mind that the only route of transformation included in this report was nitrification of cyanuric acid. It was assumed that all nitrogen not recovered, was present as the original substance cyanuric acid. It cannot be excluded that cyanuric acid is transformed to intermediates in the soil. DT_{50} values could have been overestimated, because of this. DT_{50}-values are considered acceptable in a worst case approach.

Reliability 3

Title Ready biodegradability: “modified OECD screening test” for 2-chloro-4,6-dihydroxy-1,3,5-triazin, monosodiumsalt
Date of report May 10, 1990.
GLP Yes.
Reference 48.
Test substance 2-chloro-4,6-dihydroxy-1,3,5-triazin (Na-salt); purity 97.5%.
Test method 84/449/EEC, C.3 (1985); OECD 301 E (1981).
Procedure Aliquots of a stock solution of the test substance (tested conc. 2.9 g/L ⇔ 31 mg DOC/L), inoculum from a domestic sewage plant (final conc. 0.5 mL/L) and nutrient solution were mixed. Water was added to give a total volume of 1 L. Duplicate test mixtures, 30 mL each, were incubated (shaken) at 20-21°C in the dark for 28 days. The following controls were included:
Control without test substance but with inoculum (1flask).
Positive control, aniline (19-20 mg DOC/L) with inoculum (2 flasks).

Aliquots were removed from each flask on day 0, 7, 14, 21, 27 and 28, centrifuged and analysed for DOC using a carbon analyser.

Findings

	% degradation [% of day 0 values]	
day	***test substance with inoculum***	***aniline with inoculum***
0	0	0
7	-19	95
14	19	100
21	8	101
27	5	100
28	8	101

Conclusion Not readily biodegradable.
Rev. note

1. The circumstances during the test should be aerobic. During the test the flasks were shaken, which stimulates the uptake of oxygen. It is not clear from the report if the shaking was adequate to maintain the aerobic conditions. The dissolved oxygen during the study was also not measured. Since the reference substance gave an adequate response, there was no effect on the test validity.

2. No adsorption and toxicity controls are included in the test. According to the log Pow adsorption is believed to be minimal (ref. 18), but the observed lack of biodegradation of the test substance may be attributable to toxicity towards micro organisms.

Reliability 2 No controls (note 2).

Title Biodegradation of Cyanuric Acid
Date of report December 1974.
GLP No.
Reference 52.
Test substance ^{14}C-cyanuric acid, radio chemical purity ≥99%

Test system

Design Tests 1 and 2 were performed in 1.5 L activated sludge unit (sludge from domestic sewage) which was refilled (two-third) with new sludge every hour; temperature 23 °C; CO_2 was trapped in 0.5 N NaOH and precipitated with $BaCO_3$.; radioactivity determined with LSC; nitrogen with method of Kjeldal or conversion to ammonium.

Procedure ***Test 1*** 10 μL/mL test substance was added to raw sewage feed with periodes of aeration followed by periods of Nitrogen air.
Test 2 10 μg/mL test substance was added to settled domestic sewage feed (anaerobe) for 96 h; nitrogen balance control with primary effluent from local sewage (3 weeks at 20 °C).
Test 3 1 mL test substance was added to 1 L of mixed liquor containing 2 g activated sludge (starved overnight and subsequently made anaerobic); $^{14}CO_2$ evolved was determined at several time points.
Test 4 0.44 ng/ml and 40 μg/mL test substance was added to 250 ml nutrient broth with an inoculum of a sewage plant effluent (incubated aerobically for 48 h at 23 °C) in a 500 mL flask (dissolved oxygen < 0.5 μg/ml ; evolved CO_2 was determined after 1.5, 3, 24 and 72 h.
Test 5 Soil or mud was treated with 18 μg test substance/20 g at 23 °C in 250 ml open flasks during 8-23 d.

Results ***Test 1*** (two replicates with different sludge badges)

Duration	**Aeration**	**Cyanuric acid (μg/ml)**	
		Within system	In effluent
A			
Days*	+	9.6	8.3
16 h	- (N_2)	7.7	<1.0
B			
24 h	+	10.5	7.4
16 h	- (N_2)	9.4	<1
3 d	+	6.8	6.7

* not specified

Test 2
After 48 h 25-50% reduction of cyanuric acid concentration; after 72-96 h complete disappearance.

Test 3
$^{14}CO_2$ evolved at 7 and 24 h and after 17 days was 4%, 11% and 82% (total), resp..
Results in independent repeats varied considerably from the reported values.

Test 4

Concentration/	**Evolved $^{14}CO_2$ (% of ^{14}C added)**			
Time (h)	1.5	3	24	48
0.44 ng/ml	0.49	1.20	25.0	95.0
40 μg/ml	0.11	0.47	4.1	98.0

Test 5
Evolved $^{14}CO_2$ ranged from 1-100% of ^{14}C added.

Conclusion Biodegradability of cyanuric acid increases under anaerobic circumstances.
Rev. note 1. Limited information available about the performed tests.
2. Tests are not in accordance with OECD-guidelines.
Reliability 4 .

Title	Zahn-Wellens-Test zum biologischen Abbau von Cyanursäure
Date of report	1989.
GLP	No.
Reference	67.
Test substance	Cyanuric acid, purity >98%.
Test method	Zahn-Wellens test (1974).
Test system	14-day Zahn-Wellens test with 1 g cyanuric acid and sludge of a sewage treatment plant as inoculum.
Findings	No degradation after 14 days.
Conclusion	Not inherently biodegradable.
Rev. note	Only a summary of the test is available confined to the above mentioned information. There is no information about the validity of the test; there is no information about a reference compound tested, or about the probable inhibition of bacteria by the test substance. No information about the possible adaptation phase of the system.
Reliability	4 Only summary available.

Title	Anaerober Abbau von Cyanursäure in diskontinuierlichen Suspensionsreaktoren und kontinuierlich betriebenen Festbett-Umlaufreaktoren.	
Date of report	1989.	
GLP	No.	
Reference	107.	
Test substance	Cyanuric acid, purity not indicated.	
Test system	**Design**	In two similar continuous reactors (3.5 L solid-bed circulating reactor with 2.9 L liquid volume) with inoculum from two domestic waste plants (6 L from Hanau-Stadt and Hanau-Erlensee (1:1) + 2 L pre-adapted sludge; organic dry weight 4.5 g/kg = 1.6 g/L) and ca. 100 mL mineral medium, 2.8 g/L cyanuric acid and 0.4 g/L ammonium chloride under anaerobic conditions and at a static pH; temperature 38 °C. Cyanuric acid and ammonium concentration and COD were determined once a week and from week 12 onwards twice a week.
	Analysis	Cyanuric acid: ion-exchange liquid chromatography with UV-detection (205 nm). Nitrogen: Kjeldahl-method. Ammonium: Kjeldahl-method or photometrically (Berthelot's Reaction). COD: photometrically according to DIN 38409 (H4). TOC: week 14-19 once a week.
Result	In week 9 in reactor 1 for the first time a 100% degradation of cyanuric acid was observed and from week 11 onwards the degradation rate in both reactors was constantly 100%.	
Rev. note	3. The aim of the study was to develop an anaerobic treatment of industrial wastewater. 4. Non-GLP study.	
Reliability	4	

4.1. Acute toxicity to fish

Title	Biodegradation and bioaccumulation data of existing chemicals based on the CSCL Japan	
Date of report	October, 1992.	
GLP	No.	
Reference	20.	
Test substance	Cyanuric acid, purity not indicated.	
Test method	Not indicated (only according to Japanese guideline JIS K 0102-1986-71).	
Stat. method	Doudoroff method or Probit method.	
Test system	**Species**	Orange-red killifish (*Oryzias latipes*).
	No. of fish	10/vessel.
	Test conditions	48-h static test or semi-static test with renewals every 8-16 hours at 25±2°C in glass vessels containing 4 L test water.
Conclusion	48-h LC_{50} >1000 mg/L.	
Rev. note	Information is confined to what is included in the above summary. In the description of the test the test substance is not specified, further no specifications are available of pH, O_2, concentration test substance, loading rate.	
Reliability	4 .	

Title	Bericht über die Überprüfung von 2,4,6-trichlor-1,3,5-triazin auf toxikologisches Verhalten gegenüber Fischen und Bakterien und Bestimmung der Parameter zur Kennzeichnung des “Abwasserverhaltens”	
Date of report	January 16, 1979.	
GLP	No.	
Reference	21.	
Test substance	Cyanuric chloride, purity not indicated.	
Guideline	DIN 38421/15.	
Stat. method	Not applicable.	
Test system	**Species**	Goldorfe (*Leuciscus idus melanotus*), length 50-60 mm.
	No. of fish	10/vessel, 1 vessel/treatment.
	Concentrations	Nominal: 17.5, 35, 70, 140, 280, 350 and 525 mg/L.
	Test conditions	48-h test at 20±1°C in test vessels containing 10 L water (pH 7-8; hardness 255 mg/L $CaCO_3$).
	Phys. meas.	O_2 ≥64%; temperature 20±1°C.
Results	**Biological**	No toxic effects in fish.
Conclusions	48-h LC_{50} >525 mg/L (note 2).	
Rev. note	1 Only an abstract of the test is available. The information is essentially confined to what included in the above summary. 2 During the test cyanuric chlorid is expected to be transformed to cyanuric acid and HCl by hydrolysis.	
Reliability	4	

Title	96-hour acute toxicity study in the guppy with 2-chlor-4,6-dihydroxy-1,3,5-triazin, mononatriumsalz	
Date of report	March 12, 1990.	
GLP	Yes.	
Reference	49.	
Test substance	2-chlor-4,6-dihydroxy-1,3,5-triazin, mononatriumsalz, purity 97.5%.	
Test method	OECD 203, EEC 84/449/C.1.	
Stat. method	Not applicable.	
Test system	**Species**	Guppy (*Poecilia reticulata*), length 20±10 mm.
	No. of fish	10/vessel, 3 vessels/treatment and 1 vessel/control.
	Concentrations	Nominal: 1000 mg/L, untreated control.
	Test conditions	96-h static test at 21-30°C in 1 L glass vessels containing test water (hardness 201 mg/L $CaCO_3$); 16 h light; unfed; loading <1 g/L.
	Analyses	Analyses were performed during the range finding test for 0 and 1000 mg/L at 0, 24 and 96 h by dilution/HPLC.
	Phys. meas.	Daily in all replicates: overall ranges for pH 8.0-8.4; O_2 88-147%; temperature 21-24°C (one control vessel).
	Observations	Mortality/symptoms at 7, 24, 48, 72 and 96 h.
Results	**Ref. product**	The result of a test with the reference substance pentachlorophenol, performed one month earlier, was included. The 96 h-EC_{50} of pentachlorophenol calculated by the reviewer using untrimmed SPK was 0.67 mg/L.
	Analytical	The measured concentration was 94-97% of nominal.
	Biological	Biological results see 1st table below.

Biological results.

		Nominal concentration [mg/L]	
Parameter	**Time [h]**	**0**	**1000**
Mortality [%]	96	None	
Symptoms	0-96	No treatment related effects	

Conclusion	96-h LC50 >1000 mg/L.
Rev. note	No analyses were performed during the definitive test. Since the analytical results during the rang-finding test show the stability of the test concentration and the test solution was prepared correctly, the study reliability is not lowered.
Reliability	1

Title	Biodegradation and bioaccumulation data of existing chemicals based on the CSCL Japan
Date of report	October, 1992.
GLP	No.
Reference	20.
Test substance	Cyanuric acid, purity not indicated.
Test method	OECD 305C (1981).
Stat. method	Not indicated.
Procedure	The carp (*Cyprinus carpio*) had a weight of ~30 g and a length of ~10 cm. They were exposed to 1 and 10 mg/L cyanuric acid for 6-8 weeks. Different vehicles and surfactants were used with very low toxicity to red killifish (48-h LC_{50} ≥1000 mg/L). The test was conducted under flow-through (3-12 changes/24 h) at 25±2°C and 69-99% O_2 in glass vessels containing 100 L of water. The treatment was performed with initially 15-20 carps (loading 0.4-2 g fish/L/24 h). Fish were fed twice daily. Twice a week a water sample was removed for analysis. Two fish samples were removed every two weeks for test fish and at start and end of exposure for control fish.
Conclusion	BCF < 0.1 (10 mg/L); < 0.5 (1 mg/L).
Rev. note	1. Deviations from the guideline: large fish used (10 cm, OECD 305: 5.0±3.0 cm); large loading rate (0.4-2.0 g fish/L/day, OECD 305: 0.1-1 g fish/L/d); rather high temperatures (25±2°C, OECD 305: 20-25°C). 2. There is only limited information on the study design. There is no information about the depuration phase; no results on the test concentration and purity of the test substance, while analyses were performed; actual flow rates during the study, only a range is

reported (OECD 305, <20% variation between test chambers); results pH and TOC measurements were not included; reaching of equilibration phase at calculation of the BCF was not reported.

Reliability 4

4.2. Acute toxicity to aquatic invertebrates

Title Acute toxicity study in *Daphnia magna* with 2-chlor-4,6-dihydroxy-1,3,5-triazin, mononatriumsalz
Date of report April 5, 1990.
GLP Yes.
Reference 47.
Test substance 2-chlor-4,6-dihydroxy-1,3,5-triazin, mononatriumsalz, purity 97.5%.
Test method OECD 202, EEC 84/449/C.2.
Stat. method Maximum likelihood estimation method (Finney, D.J., 1971), Logit model (Cox, D.R., 1977).
Test system
- **Species** *Daphnia magna*, <24 h old.
- **No. of daphnids** 10/replicate, 2 replicates/treatment.
- **Concentrations** Nominal: 1000 mg/L (no vehicle); untreated controls.
- **Test conditions** Static without aeration; in 250 mL glass beakers containing 100 mL of water (hardness 201 mg/L as $CaCO_3$), 16 h light, unfed.
- **Analyses** No analyses were performed.
- **Phys. meas.** At 0 and 24 h for all replicates; overall ranges for pH 8.2-8.3; O_2 95-106%, temperature 18-19°C (for one control vessel).
- **Observations** Immobility at 24 h.

Results
- **Ref. product** A test with the reference substance $K_2Cr_2O_7$ was performed at the same time. The 24 h-EC_{50} of $K_2Cr_2O_7$ was 1.57 mg/L.

Biological results

		Nominal concentration [mg/L]	
Parameter	**Time [h]**	**0**	**1000**
Immobility [%]	24	None	

Conclusions 24-h EC_{50} >1000 mg/L.
Rev. note No analyses were performed to confirm the concentration of the test substance during the test. In reference 49 analyses were performed at 1000 mg/L and after 96 h no loss of test substance was seen. So probably during this test the initial test concentration was also maintained.
Reliability 1

4.3. Acute toxicity to aquatic plants

Title Toxicity to *Selenastrum capricornutum* ATCC 22662.
Date of report 1996.
GLP Yes.
Reference 80.
Test substance Isocyanuric acid, purity 99.7%.
Test method OECD 201.
Stat. method Not indicated.
Test system
- **Species** *Selenastrum capricornutum* ATCC 22662.
- **Endpoint** Biomass.
- **Concentrations** Nominal: 62.5, 125, 250, 500 and 1000 mg/L.
- **Exposure** 72 h; static.
- **Analytical monitoring** Yes.

Results
- **Biomass** EC_{50} (72 h) = 620 mg/L; NOEC = 62.5 mg/L.

Rev. note The EC_{50} value for biomass was calculated based on the measured concentrations of the nominal concentrations. No solubiliser was used. Concentrations of the test substance were kept close to the nominal conentrations throughout the 72-h test (98-105%).
Reliability 4

4.4. Acute toxicity to bacteria

Title	Bericht über die Überprüfung von 2,4,6-trichlor-1,3,5-triazin auf toxikologisches Verhalten gegenüber Fischen und Bakterien und Bestimmung der Parameter zur Kennzeichnung des "Abwasserverhaltens"
Date of report	January 16, 1979.
GLP	No.
Reference	21.
Test substance	Cyanuric chloride, purity not indicated.
Guideline	Deutsche Einheitsverfahren L3.
Stat. method	Not applicable.
Procedure	Dehydrogenase activity micro-organisms in water containing 0.72-576 mg/L cyanuric chloride was measured at pH 7.5±0.2 and 20°C. The activity was compared to a blank control.
Results	No inhibition of the dehydrogenase activity compared to the control.
Conclusions	No inhibition.
Rev. note	1
Reliability	

Title	Decomposition of cyanuric acid by microbes.
Date of report	1980.
GLP	No.
Reference	57.
Test substance	^{14}C-cyanuric acid.
Test method	Not specified.
Test system	**Procedure** An inoculate of *Sporthrix schenkii* (used in wastewater) was incubated in a medium containing 1 g/L ^{14}C-cyanuric acid. Graphic comparison of fungal growth and decomposition of cyanuric acid, with and without the addition of 0.6 g NH_4NO_3, was performed.
Findings	The curves indicate that *S. Schenkii* grew best when NH_4NO_3 was added, whereas the decomposition of ^{14}C-cyanuric acid was greater without the addition of NH_4NO_3.
Conclusion	Cyanuric acid can serve as nitrogen source, but is not the ideal source for *S. Schenkii*
Rev. note	The information was essentially confined to what is included in the above summary.
Reliability	4 .

Title	Rapid degradation of cyanuric acid by *Sporothrix schenkii*
Date of report	1981.
GLP	No.
Reference	58.
Test substance	^{14}C-cyanuric acid (purity ≥97%)+ unlabelled cyanuric acid.
Test method	Not specified.

Test system Cultures of *Sporothrix schenkii*, *Stachybotrys chartarum* and *Hendersonula toruloidea* were incubated aerobic in an aqueous medium (pH 7, at 30°C) containing diluted ^{14}C-Cyanuric acid (200 rpm). Cell growth was measured by filtrating/weighing (d.w.) or additionally by spectrophotometry (546 nm) for *S. schenkii* (strain 6.2).
Degradation of (^{14}C)-Cyanuric acid was determined by measuring:
(1) Loss of radioactivity (from culture medium or buffer) using LSC and TLC;
(2) Amount of $^{14}CO_2$ trapped in a basic solution of methanol/ ethanolamine (4/1).

Test 1: Degradation of cyanuric acid to carbon dioxide was determined on three different media (see table below). Radioactivity of the cultures was determined daily for 5 days.
Test 2: Growth (dry weight) was measured on media consisting of basal medium supplemented with 5 g/L glucose, 5 g/L sucrose and 1 g/L ammonium nitrate (⇔ 350 mg N/L) or 1 g/L cyanuric acid (⇔ 326 mg N/L).
Test 3: Growth (spectrophotometric; 546 nm) of *S. schenkii* (strain 6.2) on different nitrogen sources.
Test 4: Specific rate of cyanuric acid degradation was determined for *S. schenkii* (strain 6.2) on different nitrogen sources (besides cyanuric acid), of cells pregrown on cyanuric acid.

Composition of media

Supplement	Amount of supplements (g/L) to basal medium		
	medium I	medium II	medium III
Ammonium nitrate	0.6	0.6	None
Glucose	2.5	5	5
Sucrose	2.5	5	5
(^{14}C)-Cyanuric acid	40	40	40
yeast extract	None	5	5

Findings *Test 1*: TLC analyses showed none intermediate degradation products. Recovery radioactivity (^{14}C) ≥95%. Radioactivity remaining in medium after 5 days incubation: see table below

Strains	Radioactivity (%) after 5 days in		
	Medium I	Medium II	Medium III
Sporothrix schenkii (strain 6.2)	5	5	5
Sporothrix schenkii (strain CBS 472.48)	60	45	10
Stachybotrys chartarum (strain *Martin*)	95	5	10
Stachybotrys chartarum (strain *Haider*)	80	5	10
Sporothrix schenkii (strain CBS 359.36), *Hendersonula toruloidea* (strain M*artin*)	100	100	100

Test 2: see table below.

Strains	Dry weight (mg/L) in medium with:	
	NH_4NO_3	Cyanuric acid
Sporothrix schenkii (strain 6.2)	2.93	3.03
Sporothrix schenkii (strain CBS 472.48)	3.59	0.51
Stachybotrys chartarum (strain *Martin*)	0.79	2.37
Stachybotrys chartarum (strain *Haider*)	0.76	2.34

Test 3: Growth rate of *S. schenkii* (strain 6.2) was comparable with growth rates of other N-sources.
Test 4: The influence of other N-sources on the mean degradation rate of cyanuric acid over 2 hours was 62-115%.

Conclusion Cyanuric acid can serve as nitrogen source for *S. Schenkii* (except strain CBS 359.36) and *Stachybotrys chartarum.*

Rev. note The test was performed with only one of 160 strains isolated from waste water or soil. It is not clear whether this strain is capable of degrading cyanuric acid from wate water and soil

completely.

Reliability 4 .

Title Cyanuric acid as nitrogen source for micro-organism
Date of report 1969.
GLP No.
Reference 56.
Test substance Cyanuric acid.
Test method Not specified.
Test system **Procedure** In this test cyanuric acid is used as nitrogen source for the fungi *Penicillium varians*, *Penicillium armillatum* and *Hormodendrum sp.*. A medium with soil extract containing micro-organisms and cyanuric acid as nitrogen source was incubated at 25°C.

The following was included in the test:

1. The use of cyanurate acid as nitrogen source by the fungi (50 mL medium, 0.04% cyanuric acid = 6.5 mg N/culture).
2. A comparison between cyanurate acid and ammoniumsulphate, urea and biuret (25 mL medium, 3.5 mg N per culture); incubation 7 d (*P. varians*, *P. armillatum*) or 11d (*Hormodendrum sp.*).
3. Influence of pH on usage as nitrogen source (25 mL medium, 0.04% cyanuric acid, incubation 9 days) on growth of *P. varians* and *Hormodendrum sp.*.
4. Effect on concentration of cyanuric acid on growth of *Hormodendrum sp.* (25 ml medium, incubation 9 days).

Findings 1. Use of cyanurate-N (6.5 mg N/culture)

Organism	**Incubation (days)**	**Mycelium, per culture**		**Recovery of cyanurate-N (%)**
		Dry matter (mg)	**N (mg)**	
P. varians	7	99	3.8	56
	10	122	4.4	66
	15	115	4.5	67
Basal	***15***	***10***	***0.11***	
P. armillatum	10	42	1.7	25
	15	141	4.3	65
	20	124	4.2	64
Basal	***20***	***14***	***0.05***	
Hormodendrum sp.	10	131	4.1	61
	15	184	5.1	76
	20	169	5.0	75
Basal	***20***	***15***	***0.15***	

2. Comparison nitrogen sources (3.5 mg N/culture)

N-source	**Mycelium, dry matter (mg) per culture of:**		
	P. varians	***P. armillatum***	***Hormodendrum***
Cyanurate	79	79	53
$(NH_4)_2SO_4$	63	77	62
Urea	79	90	78
Biuret	72	48	36
Basal	*0*	*17*	*3*

3. Growth at varying pH

pH initial	*P. varians*		*Hormodendrum sp.*	
	Mycelium, d.m./culture	pH, final	Mycelium, d.m./culture	pH, final
3.0	50	3.4-3.6	3	3.3-3.4
4.0	55	4.9-5.1	42	6.0
5.0	56	4.9-5.3	60	6.2-6.4
6.0	61	4.2-3.8	38*	6.3-6.4
7.0	30	5.9-6.1	29	6.6-6.9
8.0	6	7.2-7.3	24	7.5-7.6

* disagreement between duplicates.
4. Growth at varying concentrations cyanuric acid.

Cyanuric acid concentration		Mycelium, dry matter (mg) per culture
%	mM	
0.02	1.55	26
0.04	3.1	55
0.08	6.2	89
0.12	9.3	95

Conclusion At least for some fungi cyanuric acid can serve as nitrogen source and subsequently is not toxic to these organisms.

Rev. note This study cannot be used for the determination of a DT_{50}-soil or for the determination of the effect on micro-organisms because of the limited information and the test set up.

Reliability 4

Title s-Triazines as nitrogen sources for bacteria
Date of report 1981.
GLP No.
Reference 62.
Test substance U-^{14}C-Cyanuric acid; radiochemical purity 100%.
Test method Not specified.
Test system *Test 1:* Incubation of medium containing test substance (≤2.5 mM N) with inoculum (originating from s-triazine treated agricultural fields or sewage) at 30°C in N_2-free environment (aerated with O_2/He: 20/80).
Test 2: Bacterial growth was determined at 30°C (150 rpm) with 250 mL cultures of *Pseudomonas sp*. and *K. pneumoniae* containing cyanuric acid (~2.5 N). Controls with NH_4^+ were included.
Test 3: Degradation test with non-growing suspensions of bacteria *Pseudomonas sp*. and *K. pneumoniae* grown with ammelide (AD), N-isopropylammelide (NID) or cyanuric acid (CN) as nitrogen source.
Findings *Test 1*: *Pseudomonas sp.* (strain D and F) incubated with soil-inoculum were able to use CN as nitrogen source for growth. *Pseudomonas sp.* (strain A) and *K. pneumoniae* (strain 90 and 99) incubated with sewage-inoculum were able to use cyanuric acid as nitrogen source for growth.
Test 2: The cell growth was comparable to the control.
Test 3: see table below.

Organism	Grown with N-source	Conc. substr.(mM)	Substrate	$^{14}CO_2$ (%)	Residual ^{14}C (%)
Pseudomonas, str. D	NID	0.7	CN	85	0
Pseudomonas, str. A	CN	0.75	CN	56	36
K. pneumoniae, str. 90	AD	0.70	CN	34	59

Conclusion *Pseudomonas sp.* and *K. pneumoniae* can use cyanuric acid as their only nitrogen-source. Growing strains of *Pseudonomonas sp.* (strain A) and *K. pneumoniae* (strain 90) were better capable of degradaing cyanuric acid than do not-growing strains.

Rev. note The report is not valid to give reliable information about the nitrification rate of bacteria under influence of s-triazines. The test is not performed in accordance with the guidelines, the soil used is pre-adapted to triazines by the use of herbicides on the soil and only secondary literature is available.

Reliability 3 Pre-adapted soil.

4.5. Chronic toxicity to aquatic organisms

4.6. Toxicity to terrestrial organisms

4.6.1. Toxicity to soil dwelling organisms

Title	Cyanuric acid – a s-triazine derivative as a nitrogen source for some soil microorganisms
Date of report	1983.
GLP	No.
Reference	60.
Test substance	Cyanuric acid (test 1), ^{15}N-cyanuric acid (test 2).
Test method	Not specified.
Test system	*Test 1:* The effect of cyanuric acid on the development and activity of natural associations of bacteria and fungi was examined in chernozem (2.2% C, pH 7.5, note 1) after 3, 10, 30 and 60 days. The dose rate of cyanuric acid was about 0.2, 0.8, 4 g/kg (corresponding with 50, 250 and 1250 mg N/kg). *Test 2:* Two isolated fungal strains (*Aspergillus minutus* and *Pseudogymnoascus sp.*) were incubated in liquid medium containing ^{15}N-cyanuric acid at 27-28°C for 10 and 23 days respectively. At the end of the incubation period the biomass of the fungi was determined. The rate of nitrogen intake by the tested fungi was estimated by the determination of the nitrogen content in the fungal biomass, in proteins extracted from the mycelial mats and in culture filtrates. Also the presence of N-NH_4, N-NO_3 and cyanuric acid in the culture filtrates was determined by colorimetric method or TLC.
Findings	*Test 1*: Addition of cyanuric acid to chernozem caused in most cases an increase of bacteria and actinomycetes; no effect in fungi in most cases. *Test 2:* For *A. minutus* 7% cyanuric acid-N was utilised after 10 days (70% in biomass); for *Pseudogymnoascus sp.* 13% cyanuric acid was utilised after 23 days (89% in biomass). No N-NH_4, N-NO_3 was found in the filtrates. All nitrogen remaining in the filtrates was in the form of cyanuric acid
Conclusion	The examined fungi are able to cleave the triazine ring of cyanuric acid and utilize its nitrogen. No or a positive effect on microbial growth was seen.
Rev. note	1. Chernozem is black soil, formed under continental conditions and characteristic of subhumid to temperature grasslands. 2. This test is not a standard investigation and no EC_{50} was determined.
Reliability	4 .

4.6.2. Toxicity to terrestrial plants

4.6.3. Toxicity to other non-mammalian terrestrial species (including avian)

Title	Report on acute oral LD50 in the adult japanese quail of GS 41711	
Date of report	September 2, 1981.	
GLP	No.	
Reference	64.	
Test substance	Cyanuric chloride, purity 99%.	
Test method	Not specified.	
Stat. method	Logit model.	
Test system	**Species**	Japanese quail, age 60-70 days, mean weight 139-144 g.
	No. of animals	10/treatment.
	Dosage	Single oral dose by intubation at 50, 250 and 1000 mg/kg bw (vehicle: PEG 400, 10 mL/kg bw); vehicle controls; food was withheld overnight prior to dosing.
	Observations	• Mortality/symptoms at least daily for 14 days.

- Body weights on day 0, 7 and 14.

Results

Dose [mg/kg bw]\effect	0	50	250	1000	DR
MORTALITY [%]	0	0	70	100	X
Clinical signs*		+	+	+	X
Body weight	No treatment related effects				

* Symptoms included sedation, dyspnoea, ruffled fur, curved, ventral or lateral body position and/or ataxia.

Conclusion Acute oral LD_{50} 192 mg/kg bw (95% CI: 102-313 mg/kg bw).

Rev. note
1. Male and female birds were used in this study, but in the report no distinction is made between sexes. So it is not possible to establish a possible sex difference in the japanese quail for the toxicity of cyanuric chloride.
2. No necropsy was performed during the test (OECD 401, necropsy of all animals).
3. *Minor remark*. At study initiation the body weights were rather low. Normally birds of 6-8 weeks old weight already 150 g.

Reliability 1

Title Report on 8-day feeding toxicity of technical GS 41'711 in Peking ducklings
Date of report July 17, 1981.
GLP No.
Reference 27.
Test substance Cyanuric chloride, >99%.
Test method EPA 163, 71-2, 11.
Stat. method Logit method.
Test system
Species Peking ducklings, age 3-5 days, mean weight 174-206 g.
No. of animals 10/treatment.
Dosage *Ad libitum* dietary administration at 10, 40, 200 and 1000 mg/kg diet for 5 days followed by 3 days post exposure; vehicle controls (olive oil) and positive controls (Dieldrin).
Analysis No analyses were performed.
Observations
- Mortality and clinical signs daily.
- Body weights on days 1, 5 and 9, food consumption daily.

Results **Pos. control** 8-day LC_{50} (dieldrin) 320 mg/kg diet.

Dose [mg/kg diet]\effect	0	10	40	200	1000
MORTALITY [%]	0	0	0	20	0
Clinical signs*		+	+	+	+
Body weight gain	No treatment related effects				
Food consumption				d	d

* Symptoms included curved body position and sedation

Conclusion 8-day LC_{50} >1000 mg/kg diet.

Rev. note Homogeneous substance feed mixtures were reported to be prepared daily. However no analyses were performed to confirm (a) the homogeneity of the test diet, (b) the accuracy of preparation and (c) the stability of the test substance in the diet.

Reliability 2 No analyses.

4.7. Biological effects monitoring

4.8. Biotransformation and kinetics

Title Ring cleavage and degradative pathway of cyanuric acid in bacteria
Date of report 1985.
GLP No.
Reference 63.
Test substance [U-^{14}C]Cyanuric acid, [carboxyl-^{14}C]allophanic acid (biuret), urea.
Test method Not applicable.
Test system *Pseudomonas* (strains A and D), *Klebsiella pneumoniae (strain* 99).

Analyses Cyanuric acid and biuret by reverse phase HPLC; bBiuret by MS; urea by the diacetyl-mono-oxime method and TLC; NH_4^+ by Berthelot reaction, protein by method of Kennedy and Fewson and CO_2 manometrically.

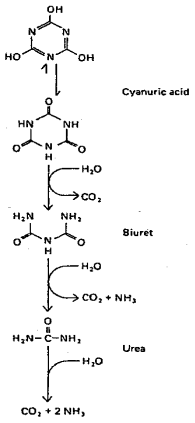
Procedures *test 1.* Bacterial cultures were grown with cyanuric acid, biuret or urea as sole and limiting nitrogen source. Control cultures were grown on NH_4^+.
test 2. Stored cells were thawed, suspended and disrupted and centrifuged. The supernatant was used for enzyme assays. Cyanuric acid, biuret and urea added to measure substrate disappearance and to identify the metabolites formed. Enzymes were separated on a DEAE-column to test cyanuric acid degenerating enzymes.

Results *test 1.* Strain A and 99 showed monophasic growth, strain D biphasic.

Strain /substrate	D		A		99	
	Spec. growth(h^{-1})	Spec.degr. (mkat/kg protein)	Spec.growth (h^{-1})	Spec.degr. (mkat/kg protein)	Spec.growth (h^{-1})	Spec.degr. (mkat/kg protein)
NH_4^+	0.30	1.9	0.50	2.7	0.87	4.1
Cyanuric acid	0.33	0.6	0.28	0.5	0.46	1.3
Biuret	0.26	0.6	0	0	0	0
Urea	0.30	1.0	0.53	1.4	0.39	0.9

test 2. Enzyme activities for the degradation of cyanuric acid and urea were present in all strains. Strain A and 99, but not strain D, lacked the capacity to degrade biuret.

Conclusion Supposed degradation pathway via cleavage of the triazine ring.



Rev. note No information was present on the analytical method used to determine radio-activity. It is not clear whether or not the compounds used in the tests described were radio active.

Reliability 4 .

Title Enzymatic cleavage of cyanuric acid by a hydrolase
Date of report 1980.
GLP No.
Reference 61.
Test substance Cyanuric acid.
Test method Not applicable.
Test system Test 1: *Klebsiella pneumoniae* 99B.
Test 2: cell-free extract of *Klebsiella pneumoniae* 99B (desalted).
Findings Test 1: bacteria were able to grow in presence of cyanuric acid as sole nitrogen source (growth rate0.58 h^{-1}). Mechanism of degradation via biuret and urea.
Test 2: both under aerobic and anaerobic circumstances cyanuric acid was degraded to NH_3 and CO_2. Biuret and urea were also degraded by the test system.

Conclusion Supposed pathway via cleavage of the triazine ring, preliminary results.
Reliability 4

Title The degradative pathway of the s-triazine melamine. The steps to ring cleavage
Date of report 1982.
GLP No.
Reference 65.
Test substance Cyanuric acid (purity ≥98%).
Test method Not specified.
Test system **Test strain** *Pseudomonas*, strain A
Description The degradative pathway of melamine was examined and the resulting compounds were identified by different methods.
Conclusion *Pseudomonas sp.* (strain A) is able to degrade cyanuric acid.
Rev. note 1. This test is not a standard investigation and no EC_{50} was determined.
2. Other strains showed similar effects.
Reliability 4 .

4.9. Additional information

Title Anaerobic degradation of cyanuric acid, cysteine, and atrazine by a facultative anaerobic bacterium
Date of report January, 1983.
GLP No.
Reference 66.
Test substance Cyanuric acid (purity 98%), Atrazine (purity 99.9%).
Test method Not specified.
Test system **Bacterium** A facultative anaerobic bacterium (gram-negative), capable of degrading cyanuric acid (CA) as a carbon and energy source, was isolated from inoculum (originating from sediment of an industrial holding pond).
Description Multiple tubes of FeS-medium were inoculated with cyanuric acid (additional also CYS-medium) in an, oxygen-free, nitrogen gas flushed system. Two pooled samples of six culture tubes were analysed at each sampling time. Analyses were performed for colony-forming units in brain heart infusion agar for the determination of viable cell counts (after plating subsamples). The remaining medium was assayed for cyanuric acid and ammonia by respectively HPLC and the “phenate” method. For the test with cyanuric acid in CYS-medium also cysteine was measured by the “ninhydrin” method

Medium	Time (d)	CFU (log_{10}/mL)	Cyanuric acid (mg/mL)	NH_3 (μg/mL)	Cysteine (mg/mL
CYS (CA)	0	2.7	1.6	38	39
	1	4.5	1.6	35	36
	2	6.2	1.5	45	30
	3.5	8.0	0.1	255	0
	4	8.4	0	268	0
	5	6.8	0	273	0
	7	4.7	0	275	0
FeS (CA)	0	3.9	1.1	35	N/A
	2	5.6	0.74	100	N/A
	3	6.8	-	-	N/A
	3.5	6.1	0.61	121	N/A
	6	5.0	0.49	133	N/A
	8	4.1	0.44	144	N/A

Conclusion An anaerobic bacterium isolated from sludge was able to use cyanuric acid as nitrogen source under anaerobic conditions. Degradation of cyanuric acid was 60% in FeS-medium after 8 days. Degradation of cyanuric acid in CYS-medium was 100% after 4 days.
Rev. note 1. This test is not a standard investigation and no EC_{50} was determined.
2. Compounds that are subject to chlorine substitution (e.g. cyanuric chloride) on the

ring carbons may be more resistant to biodegradation than the unsubstituted derivatives.

Reliability 4

Title Demande de brevet d'invention no 78 00488

Date of report January 10, 1978.
GLP No.
Reference 69.
Test substance Cyanuric acid.
Test method Not indicated.
Tests The document contains summaries of acute toxicity studies with molluscs and daphnia, of daphnia reproduction toxicity study and of a micro-cosm study.
Procedures
1. Molluscs were exposed for 20 days to cyanuric acid in 15L aquaria at 20±2°C; exposure to 1000 ppm with aeration or 500 ppm without aeration.
2. *Daphnia magna* Straus (age <72h, 5/vessel, 4 vessels/treatment) were exposed for 24 h at 20°C.
3. Daphnia were exposed (4 vessels/concentration) to 125, 250 and 500 ppm during 14-days in 1.25 L vessels containing 1L medium(fed daily); 30% of the medium was exchanged once weekly; young were counted and removed every two days.
4. Exposure of algae, fish and molluscs during 2 months in 45L aquaria at 20-22°C with aeration to a saturated solution of cyanuric acid.

Findings
1. Survival 12-14 days (without aeration), prolonged survival (with aeration) compared to unaerated test.
2. No effects on mobility for concentrations between 620 and 1800 ppm.
3. No effects on population growth at all tested concentrations.
4. No effects on algae and fish, all molluscs were found dead or affected.

Conclusion Under aerobic conditions survival of moluscs is expected to be lower than under anaerobic conditions. The effect level is ≥ 500 ppm.
Cyanuric acid does not affect daphnia at 125 mg/L and above (test 3)
Rev. note Limited information on the tests was available. The test design for the daphnia tests differs from OECD requirements.
Reliability 4

5. MAMMALIAN TOXICITY

5.1. Pharmacokinetics

5.2. Acute toxicity

Oral

Title Akute Toxizität. Prüfung der akuten Toxizität nach einmaliger oraler Applikation an der Ratte.
Date of report September 19, 1986.
GLP No.
Reference 23.
Test substance Cyanuric chloride, purity not indicated.
Guideline OECD 401, 84/449/EEC.
Stat. method Probit analysis.
Test system
Species Rat (Wistar), age males 9-10 weeks and females 11-12 weeks, weight males 201-225 g and females 163-186 g.
No. of animals 5/sex/treatment.
Dosage Single oral (gavage) administration at 464, 1000, 1470 and 2150 mg/kg bw; dose volume 10.0, 14.7 or 21.5 ml/kg bw; vehicle peanut oil; food and water *ad libitum* (food was withheld 16 h prior to dosing).
Observations According to OECD 401.

Results

Dose [mg/kg bw] \ effect	Day	464		1000		1470		2150		DR	
Sex		**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Mortality		0/5	0/5	1/5	1/5	5/5	5/5	5/5	5/5		
Clinical signs(A)				+	+	+	+	+	+	x	x
Body weight gain(B)	0-14	No treatment related effects									
Necropsy(C)				+	+	+	+	+	+		

(A) During the first week post dosing: piloerection, diarrhoea and ataxia. Decreased muscle tonus and loss of righting reflex were noted in females only.

(B) Body weight loss noted during the first week post dosing.

(C) Macroscopic findings in animals found dead concluded: dark areas in the glandular stomach, in some animals with erosion.

Conclusions Oral LD_{50} 1143 mg/kg.
Rev. note
1 The purity of the test substance is not indicated.
2 Dose volumes exceeded the maximum volume for non-aqueous vehicles (10 ml/kg bw).
3 No table with macroscopic findings present.
Reliability 2 No purity of the test substance (note 1). Dose volumes were too high (note 2).

Title Testing the acute toxicity after single oral administration in rats.
Date of report October 15, 1988.
GLP No.
Reference 24.
Test substance Cyanuric chloride, purity >95%.
Guideline OECD 401, 84/449/EEC.
Stat. method Probit analysis.
Test system
Species Rat (Wistar), age males 6-10 weeks and females 8-10 weeks, weight males 215-400 g and females 190-250 g.
No. of animals 5/sex/treatment.
Dosage Single oral (gavage) administration at 240, 300, 325, 375 and 470 mg/kg bw; vehicle polyethylene glycol; food and water *ad libitum* (food was withheld 16 h prior to dosing).

Observations Mainly as required by OECD 401(No body weights on day 7).

Results

Dose [mg/kg bw] \ effect	Day	240		300		325		375		470		DR	
Sex		**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Mortality[A]	0-14	0/5	0/5	0/5	0/5	4/5	5/5	5/5	2/5	5/5	5/5		
Clinical signs[B]	0-14			+	+	+	+	+	+	+	+	x	x
Body weight gain	0-14					d	N/A	N/A		N/A	N/A		
Necropsy[C]	0-14	+	+	+	+	+	+	+	+	+	+	x	x
Histopathology[D]	0-14				+	+	+	+	+	+	+	x	x

(A) Deaths occurred within 30 minutes to 3 hours post dosing.

(B) Consisted of: hypokinesia, somnolency, decreased muscle tone, loss of righting reflex, loss of pain reflex, loss of corneal reflex, piloerection, accelerated respiration and decreased body temperature.

(C) Macroscopic findings noted at necropsy included: stomach lesions such as reddening, inflation, reddened gastric mucous membrane, thickened fundus, fusion with peritoneum/liver/spleen and reddening of the intestinal mucosa.

(D) In animals found dead: diffuse necrosis, purulent exudate and ulceration (female high dose only) in the forestomach and glandular stomach, peritonitis and congestion and/or vacuolisation of the liver. In survivors (day 14): focal acanthosis and hyperkeratosis, subchronic submucosal inflamatory tissue and subacute/subchronic ulceration in the forestomach and subchronic submucosal inflamatory tissue in the glandular stomach.

Conclusions Oral LD_{50} 315 mg/kg (males) and 327 mg/kg (females).
Rev. note
1. No body weight on day 7.
2. The LD_{50} for females was recalculated by the reviewer using the Finney model The calculations in the report were based on 3 instead of 5 deaths in 325 mg/kg group.

Reliability 2 Non-GLP.

Title Acute oral toxicity (LD50) study with cyanurchlorid in rats.
Date of report August 6, 1985.
GLP No.
Reference 5.
Test substance Cyanuric chloride, purity not indicated.
Guideline OECD 401, 84/449/EEC.
Stat. method Logit analysis.
Test system
Species Rat (KFM-Han. Wistar), age 8-10 weeks, weight males 173-202 g and females 157-178 g.
No. of animals 5/sex/treatment.
Dosage Single oral (gavage) administration of 50, 100, 300 and 500 mg/kg bw; vehicle polyethylene glycol; food and water *ad libitum* (food was withheld 12-18 h prior to dosing and 1 h after dosing).
Observations As required by OECD 401.

Results

Dose [mg/kg bw] \ effect	Day	50		100		300		500		DR	
Sex		**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Mortality[A]	1-15	0/0	0/0	0/0	0/0	5/5	5/5	5/5	5/5		
Clinical signs[B]	1-15	+	+	+	+	+	+	+	+	x	x
Body weight gain	1-15					N/A	N/A	N/A	N/A		
Necropsy[C]	1-15	-	-	-	-	+	+	+	+	x	x

(A) Deaths occurred within 3 hours to 3 days post dosing.

(B) Consisted of: sedation, dyspnea, curved and/or ventral or latero-abdominal position, ruffled fur.

(C) Macroscopic findings noted at necropsy included: foam excretion from the nose, discoloured and mottled lungs, stomach perforation, reddening/discolouring of the stomach and intestine and meteorism.

Conclusion Oral LD_{50} 100-300 mg/kg (males and females).

Rev. note
1. The LD_{50} mentioned in the report was calculated by the logit analysis, but this method cannot be used for response values of 0 and 100%, because it is a logaritmic method. Therefore, the LD50 value mentioned in the report is not reliable. Recalculation by the reviewer with simple linear regression of the LD50 yielded a value above 200 mg/kg bw. Moreover, recalculation using the Spearman-Karber analysis yielded a value of 200 mg/kg bw, which is higher than the reported LD50 of 166 mg/kg bw.
2. This study is not performed under GLP.

Reliability 2

Title Acute oral toxicity study.
Date of report November 25, 1975.
GLP No.
Reference 85.
Test substance Cyanuric chloride, purity not indicated.
Guideline Not indicated.
Stat. method Not indicated.
Test system
Species Rat; 200-300 g for males and females.
No. of animals 5/sex/treatment.
Dosage Single oral (gavage) administration at 0.5, 1.0, 1.25, 1.6, 2.0, 4.0 and 8.0 g/kg bw; vehicle propylene glycol.
Observations Clinical symptoms and mortality daily for 14 days.

Results

Dose [g/kg bw] \ effect	Day	0.5		1.0		1.25		1.6		2.0		4.0		8.0		DR	
Sex		**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Mortality	1-7	0/5	0/5	3/5	3/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5	x	x
Clinical signs(A)	1-14	+	+	+	+	+	+	+	+	+	+	+	+	+	+	x	x

(A) Sluggish and impaired locomotion at 0.5 g/kg; staggering gait, impaired locomotion and prior to death hematuria at 1.0 g/kg; extreme lethargy and ruffled unkempt coats at 1.25 g/kg and higher.

Conclusions Oral LD_{50} = 0.93 g/kg for males and females.
Rev. note
1. The purity of the test substance is not indicated.
2. Necropsy is not performed.

Reliability 2

Title Acute oral LD50 in the rat of technical GS 41'711.
Date of report 1981.
GLP No.
Reference 92.
Test substance Cyanuric chloride, purity >99%.
Guideline Not indicated.
Stat. method Logit analysis.
Test system
Species Rat (Tif: RAIf (SPF)), 7-8 weeks old, weight males 163-178 g and females 157-177 g.
Source Internal breeding facilities.
No. of animals 5/sex/treatment.
Dosage Single oral (gavage) administration at 50, 100, 250, 500 and 1000 mg/kg bw; dose volume 10.0 ml/kg bw; vehicle polyethylene glycol 400; food and water *ad libitum.*
Observations According to OECD 401.

Results

Dose [mg/kg bw] \ effect	Day	50		100		250		500		1000		DR	
Sex		**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Mortality	1-2	0/5	0/5	0/5	0/5	3/5	5/5	4/5	5/5	5/5	5/5	x	x
Clinical signs(A)		+	+	+	+	+	+	+	+	+	+	x	x
Body weight gain	0-14	No treatment related effects											
Necropsy(B)								+	+	+	+		

(A) During the first week post dosing: sedation, dyspnoea, exophthalmos, ruffled fur and curved body position; ventral and lateral body position, convulsions at 250 mg/kg and higher.

(B) Macroscopic findings in animals found dead included: oedema of the lungs and rhinorrhea.

Conclusions Oral LD_{50} 208 mg/kg.
Rev. note 1. Individual data for clinical signs are not given.
Reliability 1

Title Acute oral LD50 in the rat of technical GS 41'711.
Date of report 1981.
GLP No.
Reference 92.
Test substance Cyanuric chloride, purity >99%.
Guideline Not indicated.
Stat. method Logit analysis.
Test system
Species Rat (Tif: RAIf (SPF)), 7-8 weeks old, weight males 163-178 g and females 157-177 g.
Source Internal breeding facilities.
No. of animals 5/sex/treatment.
Dosage Single oral (gavage) administration at 50, 100, 250, 500 and 1000 mg/kg bw; dose volume 10.0 ml/kg bw; vehicle polyethylene glycol 400; food and water *ad libitum.*
Observations According to OECD 401.

Results

Dose [mg/kg bw] \ effect	Day	50		100		250		500		1000		DR	
Sex		**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Mortality	1-2	0/5	0/5	0/5	0/5	3/5	5/5	4/5	5/5	5/5	5/5	x	x
Clinical signs(A)		+	+	+	+	+	+	+	+	+	+	x	x
Body weight gain	0-14	No treatment related effects											
Necropsy(B)								+	+	+	+		

(A) During the first week post dosing: sedation, dyspnoea, exophthalmos, ruffled fur and curved body position; ventral and lateral body position, convulsions at 250 mg/kg and higher.

(B) Macroscopic findings in animals found dead included: oedema of the lungs and rhinorrhea.

Conclusions Oral LD_{50} 208 mg/kg.
Rev. note 2. Individual data for clinical signs are not given.
Reliability 1

Title Cyanur chlorid.
Date of report 1972.
GLP Not applicable.
Reference 96.
Test substance Cyanuric chloride.
Test method Not applicable.
Remark Oral LD_{50} = 1170 mg/kg.
Oral LD_{50} = 860 mg/kg.
Rev. note Table containing only values.
Reliability 4

Title Acute oral toxicity study.
Date of report November 25, 1975.
GLP No.
Reference 85.
Test substance Cyanuric chloride, purity not indicated.
Guideline Not indicated.
Stat. method Not indicated.
Test system
Species Rat; 200-300 g for males and females.
No. of animals 5/sex/treatment.

Dosage Single oral (gavage) administration at 0.5, 1.0, 1.25, 1.6, 2.0, 4.0 and 8.0 g/kg bw; vehicle propylene glycol.
Observations Clinical symptoms and mortality daily for 14 days.

Results

Dose [g/kg bw] \ effect	Day	0.5		1.0		1.25		1.6		2.0		4.0		8.0		DR	
Sex		**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Mortality	1-7	0/5	0/5	3/5	3/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5	5/5	x	x
Clinical signs[(A)]	1-14	+	+	+	+	+	+	+	+	+	+	+	+	+	+	x	x

(A) Sluggish and impaired locomotion at 0.5 g/kg; staggering gait, impaired locomotion and prior to death hematuria at 1.0 g/kg; extreme lethargy and ruffled unkempt coats at 1.25 g/kg and higher.

Conclusions Oral LD_{50} = 0.93 g/kg for males and females.
Rev. note 1. The purity of the test substance is not indicated.
2. Necropsy is not performed.
Reliability 2

Dermal

Title Testing the acute toxicity after single dermal administration in rats
Date of report October 15, 1988.
GLP No.
Reference 28.
Test substance Cyanuric chloride, purity >95%.
Guideline OECD 402, 84/449/EEC.
Stat. method Not applicable (limit study).
Test system
Species Rat (Wistar), age 10 weeks, weight 330-435 g.
No. of animals 5 males.
Dosage Single dermal application at 5000 mg/kg bw (exposure area 20 cm^2); food and water *ad libitum* (food was withheld 16 h prior to dosing).
Observations Mainly as required by OECD 402.

Results

Dose [mg/kg bw] \ effect	5000
Sex	**Males**
Mortality[(A)]	2/5
Clinical signs[(B)]	+
Body weight gain	No treatment related effects
Pathology[(C)]	+

(A) Killed after removal of the dressing due to ethical reasons.

(B) No systemic toxicity. At the application site: skin necrosis, penetrating and/or oozing wounds.

(C) Pathology findings included: necrosis of the epidermis, dermis, subcutaneous tissues and muscles, thrombosis in blood vessels of dermis ulcerations. After 14 days: epidermis ulcerations with epithelium regeneration; in dermis, within ulcerations and under regenerating epithelium, hyperplasia of fibrous connective tissue; granulation tissue was growing into deeper layers of dermis penetrating between sceletal muscles and superficial layers of body integuments.

Conclusions Dermal LD_{50} 5000 mg/kg.
Rev. note
1 No females tested.
2 It is not clear why food was withheld for 16 h prior to dosing.
3 Deviations from OECD 402 consisted of: no body weight on day 7, exposure area slightly less than 10% of the total body surface.
4 No tables with macroscopic and microscopic findings included.
Reliability 3 Only males were tested.

Title Toxikologische Prüfung nach einmaliger dermaler Applikation am Kaninchen.
Date of report October 4, 1988.
GLP No.

Reference 29.
Test substance Cyanuric chloride, purity not indicated.
Guideline OECD 402, 84/449/EEC.
Stat. method Not applicable (limit study).
Test system
Species Rabbit (Russian White), age males 18-24 weeks and females 22-24 weeks, weight males 2.2-2.3 kg and females 2.5-2.7 kg.
No. of animals 3 males and 3 females
Dosage Single dermal application at 2000 mg/kg bw (24 hours) under occlusion; vehicle paraffin oil.
Observations Mainly as required by OECD 402.

Results

Dose [mg/kg bw] \ effect	**2000**	
Sex	**Males**	**Females**
Mortality	None	
Clinical signs(A)	+	+
Body weight gain	No treatment related effects	
Pathology(B)	+	+

(A) No systemic toxicity. At the application site: red/brown staining, swelling and hardening.

(B) Pathology findings included: acanthosis, hyperkeratosis, subepidermal mixed inflammatory cell infiltration, erosion, superficial exudate, subepidermal haemorrhages, ulceration, epidermal proliferation, secondary builded hairfollicle cysts, epidermal necrosis and slight pustule forming.

Conclusions Dermal LD_{50} exceeding 2000 mg/kg (males or females).
Rev. note 1. Deviation from OECD 402: no indication size exposure area.
Reliability 2 Exposure area not indicated.

Inhalation
Title Cyanurchlorid, Untersuchungen zur akuten Inhalationstoxizität an der Ratte nach OECD-No. 403
Date of report October 14,1992.
GLP Yes.
Reference 78.
Test substance CAS 108-77-0 (cyanuric chloride), purity >= 93.6%.
Guideline OECD 403.
Stat. method Bliss, 1938.
Test system
Species Rat (Wistar, WISW), age 2-3 months, weight males 173 - 205 g, females 173-193 g.
No. of animals 5/sex/dose.
Treatment Nose only exposure for 4 h.
Concentration (measured): 37.6, 150.6, 177.3, 289.3 and 449.1 mg/m3, generated by a Wright Dust Feeder.
Air changes: probably 15-24/hour.
Analyses 3 samples/concentration during exposure by GC;
Particle size analysed by Berner impactor-II and an aerodynamic Particle Sizer.
Observations
- Mortality/clinical signs frequently on day of exposure (but not during exposure) and days 1, 2, 3, 7, 14 and 28
- Body weights on days 0, 3, 7 and 14, 21 and 28
- Body temperature at end of exposure
- Reflexes on days 0, 1, 4 (at 150.6 mg/m^3), 5 (at 177.3 mg/m^3), 3 and 6 (at 289.3 mg/m^3) and 5 and 8 (at 449.1 mg/m^3)
- Necropsy on day 28

Results
Analyses Exposure to both vapour and dust of the test substance. Concentrations mentioned are the sum of both fractions.
Particle size: 2.21-2.72 µm (Mass Mean Aerodynamic Diameter) ⇒ respirable.

Dose [mg/m^3]\effect	**0**		**37.6**		**150.6**		**177.3**		**289.3**		**449.1**		**DR**
Sex	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	
Mortality	0/5	0/5	0/5	0/5	3/5	1/5	3/5	2/5	5/5	4/5	5/5	5/5	

Body weight (gain) (week 1)[A]					d	d	d	d	d	d	d	d	
Clinical signs[B]			1		1,2		1,2,3		1,2,3		1,2,3		X
Necropsy[C]					+		+		+		+		
Reflexes[D]					+		+		+		+		X
Body temperature			d		d		d		d		d		X

(A) Recovery of normal growth during the following weeks in survivors.
(B) Clinical signs included 1: heavy and slow breathing, discharge from nose, reduced motility, poor coat condition, 2: piloerection, gasping, bloody and crusted nose, periorbital crusts, cyanosis and cachexia, 3: abnormal gait, shortness of breath
(C) Survivors:bloated, oedematous lungs (with bronchia filled with slime in males)
Intercurrent deaths: bloated, oedematous and discoloured lungs with bronchia filled with slime, hydrothorax, red staining of the nose, pale liver and kidneys, liver lobulated, bloody-slimy contents of gastrointestinal tract and red staining of mucosa of small intestine
(D) Diminished grip strength and diminished reaction to external stimuli (tail-pinch and startle) was observed

Conclusions Acute 4-h LC_{50} males 150 mg/m^3
Acute 4-h LC_{50} females 201 (95%: 158-258) mg/m^3
Acute 4-h LC_{50} combined 170 (95%: 137-213) mg/m^3

Rev. note Minor remarks:
- Humidity in the inhalation chamber was below guideline values (OECD 403). This was justified, however, as the test substance was sensitive to hydrolytic degradation. The number of air-changes was slighly higher than indicated by OECD 403.
- Airflow was slightly above the recommended range. Airflow is not clearly stated in the report; therefore the mentioned values are not definite.

Reliability 1

Title 4-hour vapour inhalation toxicity study with cyanurchloride in rats. Project 072112.
Date of report October 30, 1986.
GLP No.
Reference 87.
Test substance CAS 108-77-0 (cyanuric chloride), purity 99-100%.
Guideline OECD 403.
Stat. method Logit analysis; could not be applied to results.
Test system
Species Rat (Wistar, KFM-HAN), 8-12 weeks old, 216-277 g for males and 185-226 g for females.
Source Kleintierfarm Madoerin AG, Switzerland.
No. of animals 5/sex/dose.
Treatment Nose only exposure for 4 h.
Concentration (measured): 50, 150, 180 and 300 mg/m^3 generated by bubbling air through the test substance.
Analyses Analytical determination was performed spectrophotometrically at 440 nm once during exposure.
Observations
- Mortality: once per hour during exposure and daily thereafter for 15 days (50 mg/m^3) or 22 days at the other doses.
- Clinical signs: once per hour during exposure and daily thereafter.
- Body weights on days 1, 8, 15 and 22 (only at 150, 180 and 300 mg/m^3).
- Necropsy on all animals.

Results

Dose [mg/m^3]\effect	50		150		180		300		DR	
Sex	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Mortality	0/5	0/5	1/5	1/5	3/5	1/5	3/5	1/5	x	x
Body weight (week 1)[A]			dc	d	dc	dc	dc	dc	x	x
Clinical signs[B]	1	1	2	2	3	3	4	4	x	x
Necropsy[C]			+	+	+	+	+	+	x	x

(A) Recovery of normal growth during the following weeks in survivors.
(B) Clinical signs included 1: Sedation, rales, dyspnea, chromodacryorrhea, ruffled fur and emaciation (females only); 2: symptoms at 1 and additionally, rhinorrhea, hunched body posture and

emaciation; 3: symptoms at 2 and ataxia, opacity of the eye and stiff gait; 4: symptoms at 3 and nervousness. The intensity of symptoms increased at higher doses.

(C) Discoloured lungs in animals that died and animals at 300 mg/m^3. Incidentally meteorism in GI tract among animals treated at 150 mg/m^3 and above.

Conclusion Acute 4-h LC_{50} = 150-180 mg/m^3.

Rev. note
1. The number of air changes/h and the particle size are not determined.
2. Non-GLP study.

Reliability 2

Title 4-hour acute inhalation toxicity study with cyanuric chloride – non-micronized - aerosol in rats. Project 291172.

Date of report September 13, 1991.

GLP Yes.

Reference 88.

Test substance CAS 108-77-0 (cyanuric chloride), purity ≥99%.

Guideline OECD 403.

Stat. method Logit analysis.

Test system

Species Rat (Wistar, Han-Ibm), 8-week old males and 10-week old females, 180-200 g for males and females.

Source Biological Research Laboratories Ltd., Switzerland.

No. of animals 5/sex/dose.

Treatment Nose only exposure for 4 h.
Concentration (measured by gas chromatography): 42, 50 and 138 mg/m^3 generated by a RBG 1000 Palas aerosol generator.
Air changes: ca. 70-90/h.

Analyses Analytical determination was performed by gas chromatography and, gravimetrically 4 times during exposure.
Particle size was analysed by a cascade impactor once during each exposure.

Observations
- Mortality: once per hour during exposure, once post-exposure on day 1 and twice daily thereafter for 14 days (21 days at 50 mg/m^3 and 28 days at 42 mg/m^3).
- Clinical signs: once per hour during exposure, once after exposure on day 1 and daily thereafter.
- Body weights on days 1, 8 and 15 (and 22 at 50 mg/m^3 and 29 at 42 mg/m^3).
- Necropsy on all animals.

Results **Analysis** Particle size 100% < 5µm.

Dose [mg/m^3]\effect	42		50		138		DR	
Sex	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Mortality	1/5	2/5	2/5	0/5	5/5	2/5	x	x
Body weight (week 1)[(A)]	dc	dc	dc	dc	dc	dc		
Clinical signs[(B)]	+	+	+	+	+	+	x	x
Necropsy[(C)]	+	+	+	+	+	+		

(A) Recovery of normal growth during the following weeks in survivors.

(B) Clinical signs included: Hunched posture, stiff gait, dyspnea, labored respiration, rales, swelling (abdomen; females only), ruffled fur, rhinorrhea and chromodacryorrhea; 2: same as 1, but no chromodacryorrhea; 3: same as one, but no swelling in abdomen; salivation in one female.

(C) Discoloured lungs, incidentally foamy fluid in bronchi and dark red foci.

Conclusion Acute 4-h LC_{50} = 86 mg/m^3 (mean for both sexes).

Rev. note
1. The number of air changes/h is very high compared to the 12-15 air changes/h required by OECD 403.
2. In the report the LC50 for females was determined by extrapolation, which means the mean value based on it is also less reliable.

Reliability 1

Title 4-hour acute inhalation toxicity study with cyanuric chloride vapor in rats. Project 291150.

Date of report September 12, 1991.
GLP Yes.
Reference 89.
Test substance CAS 108-77-0 (cyanuric chloride), purity ≥99%.
Guideline OECD 403.
Stat. method Not applicable.
Test system
Species Rat (Wistar, Han-Ibm), 8-week old males and 10-week old females, 180-200 g.
Source Biological Research Laboratories Ltd., Switzerland.
No. of animals 5/sex/dose.
Treatment Nose only exposure for 4 h.
Concentration (measured by gas chromatography): 17 and 152 mg/m^3 generated by a RBG 1000 Palas aerosol generator.
Air changes: ca. 80-90/h.
Analyses Analytical determination was performed by gas chromatography and, gravimetrically 4 times during exposure.
Particle size was analysed by a cascade impactor once during each exposure.
Observations
- Mortality: once per hour during exposure, once post-exposure on day 1 and twice daily thereafter for 14 days.
- Clinical signs: once per hour during exposure, once after exposure on day 1 and daily thereafter.
- Body weights on days 1, 8 and 15.
- Necropsy on all animals.

Results **Analysis** Particle size 100% < 5µm.

Dose [mg/m^3]\effect	17		152		DR	
Sex	**M**	**F**	**M**	**F**	**M**	**F**
Mortality	0/5	0/5	2/5	0/5		
Body weight (week 1)(A)	d	d	d	d	x	x
Clinical signs(B)	1	1	2	2	x	x
Necropsy(C)			+	+	x	x

(A) Recovery of normal growth during the following weeks in survivors.
(B) Clinical signs included 1: Hunched posture, labored respiration and ruffled fur (rales in females only); 2: apathy and tremor (males only), hunched posture, stiff gait, labored respiration, rales (females only), swelling, ruffled fur, rhinorrhea, chromodacryorrhea.
(C) Discoloured lungs with foci.

Conclusion Acute 4-h LC_{50} > 152 mg/m^3.
Rev. note
1. The number of air changes/h is high.
2. It is not clear whether the concentration measured by gas chromatography and that measured gravimetrically have to be added to obtain the total concentration for vapour and aerosol.

Reliability 2

Title 4-hour acute inhalation toxicity study with cyanuric chloride micronized aerosol in rats. Project 291161.
Date of report September 25, 1991.
GLP Yes.
Reference 90.
Test substance CAS 108-77-0 (cyanuric chloride), purity ≥99%.
Guideline OECD 403.
Stat. method Not applicable due to the unexpectedly high analytical value of the low dose group.
Test system
Species Rat (Wistar, Han-Ibm), 8-week old males and 10-week old females, 180-200 g.
Source Biological Research Laboratories Ltd., Switzerland.
No. of animals 5/sex/dose.
Treatment Nose only exposure for 4 h.
Concentration (nominal/measured): 22/110, 54/60 and 140/174 mg/m^3 generated by a RBG 1000 Palas aerosol generator.
Air changes: ca. 70-90/h.
Analyses Analytical determination was performed by gas chromatography and

gravimetrically 2-4 times during exposure.
Particle size was analysed by a cascade impactor.

Observations
- Mortality: once per hour during exposure, once post-exposure on day 1 and twice daily thereafter for 14 days; the two lowest dose groups were observed for 29 days.
- Clinical signs: once per hour during exposure, once after exposure on day 1 and daily thereafter.
- Body weights on days 1, 8 and 15 (also days 22 and 29 for two lowest doses).
- Necropsy on all animals.

Results **Analysis** Particle size 100% < 5µm.

Dose [mg/m^3]\effect	22[A]		60		176		DR	
Sex	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Mortality	1/5	0/5	3/5	3/5	5/5	5/5	x	x
Body weight (week 1)[B]	dc	dc	dc	dc			x	x
Clinical signs[C]	1	1	2	2	3	3	x	x
Necropsy[D]							x	x

(A) The nominal value is indicated here, because the analytical value does not correspond with the experimental set-up and the clinical signs and mortality rate observed.
(B) Body weight decrease for some animals at 60 mg/m^3 also in week 2. Animals in the highest dose group had died before day 8.
(C) Clinical signs included 1: Hunched posture, stiff gait, dyspnea, laboured respiration, ruffled fur, rhinorrhea, watery discharge from eyes; 2: symptoms at 1 and rales, abdominal swelling and chromodacryorrhea; 3: symptoms at 2 and salivation.
(D) Discoloured lungs with foci.

Conclusion Acute 4-h LC_{50} < 60 mg/m^3.

Rev. note
1. The number of air changes/h is high.
2. The LC_{50} could not be determined because of the inconsistency between expected and measured concentrations. Measured concentrations are less reliable.

Reliability 2

Title Report on acute vapor inhalation toxicity in the rat of cyanuric chloride (GS-41711).
Date of report January 22,1981.
GLP No.
Reference 91.
Test substance CAS 108-77-0 (cyanuric chloride), purity not indicated.
Guideline Proposed guideline of the Environmental Protection Agency (Fed. Reg. August 22, 1978).
Stat. method Probit analysis (Litchfield and Wilcoxon); analysis of variance and F-test.

Test system
Species Rat (Tif: RAIf (SPF)), 189-288 g for males and 183-227 g for females.
Source Internal breeding facilities.
No. of animals 9/sex/dose; 10/sex for control.
Treatment Nose only exposure for 4 h.
Concentration (measured): 5.0, 7.0, 18.3, 18.5, 40.5, 108 and 495 mg/m^3 generated by a Grafix Exaktomat injector.
Air changes: ca. 6/hour.
Analyses By gas chromatography (GC) at hourly intervals total amount (vapour and aerosol) and for the 2 highest concentrations gravimetrically (aerosol) 5 times during exposure.
Particle size twice analysed by Cascade impactor.
Observations
- Mortality/clinical signs at 1, 2, 4 hours during exposure, 2 hours post-exposure and daily thereafter for 14 days; the two highest dose groups were observed for at least 38 days.
- Body weights on days 0, 7 and 14.
- Necropsy on all animals.

Results **Analyses** Exposure to both vapour and aerosol of the test substance.
Concentrations mentioned are the sum of both fractions.
Particle size: 42-60% ≤ 7µm.

Dose [mg/m^3]\effect	**0**		**5.0**		**7.0**		**18.3**		**18.5**		**40.5**		**108**		**495**		**DR**	
Sex	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**

Mortality	0/10	0/10	0/9	0/9	0/9	0/9	1/9	0/9	0/9	0/9	6/9	0/9	9/9	6/9	9/9	9/9	x	x
Body weight (week 1)[A]											dc	dc	dc	dc			x	x
Clinical signs[B]			1	1	2	2	3	3	4	4	5	5	6	6	6	6	x	x
Necropsy[C]	0/9	0/9	9/9	8/9	9/9	9/9	1/9	0/9	9/9	9/9	2/8	2/9	6/9	4/9	2/9	1/9	x	x

(A) Recovery of normal growth during the following weeks in survivors. Animals in highest dose group died within 7 days.

(B) Clinical signs included 1: dyspnea and ruffled fur; 2: symptoms at 1 and abnormal body position; 3: symptoms at 2 and chromodacryorrhea and diarrhea; 4: symptoms at 3 and cyanosis; 5: dyspnea, chromodacryorrhea, rinorrhea, ruffled fur and abnormal body position; 6: dyspnea, chromodacryorrhea, rinorrhea and ruffled fur. Dyspnea and ruffled fur prolonged till day 25 at 108 mg/m^3.

(C) Discoloured lungs. Enlarged or oedematous lungs were seen at 40.5 mg/m^3 in 6 males and in males and females at 495 mg/m^3.

Conclusion Acute 4-h LC_{50} = 18.5-40.5 mg/m^3.

Rev. note
1. Non-GLP study.
2. The number of air changes/h is low compared to the 12-15 air changes/h required by OECD 403.

Reliability 2

5.3. Corrosiveness/irritation

5.3.1. Skin irritation

Title Bericht über die Prüfung der lokalen Reizwirkung von 2,4,6-Trichlor-1,3,5-triazin (Cyanurchlorid) nach einmaliger Applikation an der Haut des Kaninchens (Patch-Test).
Date of report June 16, 1982.
GLP No.
Reference 30.
Test substance Cyanuric chloride, purity 99-100%.
Guideline OECD 404.
Test system
Species Rabbit (New Zealand White), weight 2.5-3.0 kg.
No. of animals 6 males.
Dosage Application of 0.5 g test substance, moistened with 0.32 ml aqua dest, on the clipped skin under semi occlusion.
Observations Skin observations at 1, 24, 48 and 72 h and at 7 days after removal of the dressing.

Results

Animal	1		2		3		4		5		6	
Time	E	O	E	O	E	O	E	O	E	O	E	O
1 h	0	1	0	1	1	3	0	2	0	3	1	3
24 h	0	1	0	1	2	2	1	2	1	2	1	2
48 h	2	0	1	1	2	1	1	1	1	1	1	1
72 h	2	0	1	0	2	1	1	0	1	1	1	1
7 days	2	0	1	0	1	0	2	0	1	1	1	1

E=erythema O=oedema

Conclusions Irritating

Rev. note
1. The results of the 1 hour exposure with occlusive or semi occlusive dressing and the 4 hour exposure with occlusive dressing on the same animals were not summarised.
2. Minor deviation OECD 404: Time between clipping and dose application not indicated.
3. Since skin effects were present at the end of the observation period, the test should have been extended for an additional period (maximum up to 21 days).

Reliability 2 Effects present at study termination (note 3).

Title Studies on the design of animal tests for the corrosiveness of industrial chemicals
Date of report 1985.

GLP No.
Reference 31.
Test substance Cyanuric chloride, purity not indicated.
Guideline OECD 404.
Test system
Species Rabbit (New Zealand White), weight 2-4 kg.
No. of animals 6 males/females.
Dosage Application of 0.5 g test substance on the clipped skin under semi-occlusion or occlusion for 1 and 4 hours.
Observations Skin observations at 1, 24, 48 and 72 h and at 7 days after removal of the dressing.

Results

Exposure	1 hour (semi-occl.)	1 hour (occl.)	4 hours (semi-occl.)	4 hour (occl.)
Effect	Not irritating	Not irritating	Not irritating	Not irritating

Conclusions Not irritating.
Rev. note The report was limited to the above mentioned. It is not clear why the results differ from other reports.
Reliability 3

Title Testing the primary irritancy after single and repeated application to the skin of the rabbit
Date of report December 6, 1993.
GLP No.
Reference 32.
Test substance Cyanuric chloride, purity > 95%.
Guideline OECD 404, EEC 84/449/EEC.
Test system
Species Rabbit (White Vienna), weight 3.6-4.0 kg, age 28-38 weeks.
No. of animals 6 males (test 1), 4 males/group (test 2).
Dosage Test 1: Application of 0.3 g test substance, moistened with polyethylene glycol on the skin (2.5 X 2.5 cm) under occlusion for 24 h.
Test 2: Daily application of 2% or 10% suspension in polyethylene glycol on the internal area of the ear for 10 days.
Observations Test 1: Skin observations at 1, 24, 48 and 72 h and daily until day 29.
Test 2: Daily skin observation (alternating between just before and just after application)

Results
Test 1 The results of a test with abraded skin were not included.

Animal	1		2		3		4		5		6	
Time	**E**	**O**	**E**	**O**	**E**	**O**	**E**	**O**	**E**	**O**	**E**	**O**
1 h	4	1	2.5	0	3-4	1	3-4	1	3	0	3	0
24 h	4	1	2.5	0	3-4	1	3-4	1	3	0	3	0
48 h	3	0	4	0	3	0	4	0	2.5	0	3	0
72-96 h	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
5 days	2	0	3	0	4	0	4	0	3	0	4	0
6-7 days	1	0	2	0	3	0	3	0	2.5	0	3	0
8 days	0	0	0	0	0	0	2	0	2	0	0	0
9 days	0	0	0	0	0	0	3	0	2	0	1	0
10-11 days	0	0	0	0	0	0	1	0	1	0	0	0
12-29 days	0	0	0	0	0	0	0	0	0	0	0	0

E=erythema O=oedema

Test 2 No oedema was seen, erythema scores are presented in the table below.

Dose	2%				10%			
Animal	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Day								
1	0	0	0	0	+	+	+	+
2	0	0	0	0	+	+	?	+
3	0	0	0	0	+	+	?	+
4	0	0	0	0	++	+	++	+
5	0	0	0	0	++	++	++	+
6-10	0	0	0	0	++	++	++	++

0= no erythema += slight ++ well-defined to moderate ? not indicated

Conclusions Irritating (based on the results of test 1).
Rev. note
1. The test substance was applied during 24 h (test 1). This represents a worst case situation.
2. The amount applied in test 1 was lower than required by OECD 404 (i.e. 0.5 g). It can not be excluded that after application of this higher dose, the effects would have been more severe. The validity of the results is lowered.
3. Minor deviation from OECD 404: Time between clipping and dose application not indicated.

Reliability 2 Amount applied too low (note 2).

Title Cyanuric Chloride In Patty's Industrial Hygiene and (via personal communication of E. Flint).
Date of report 1981.
GLP Not applicable.
Reference 99.
Test substance Cyanuric chloride.
Test method Not indicated.
Remark A skin absorption study on rabbits has shown severe skin irritation but no deaths at 3000 mg/kg.
Reliability 4

5.3.2. Eye irritation

Title Report on eye irritation in the rabbit after single application of GS 41711
Date of report October 5, 1981.
GLP No.
Reference 33.
Test substance GS 41711 (cyanuric chloride), purity not indicated.
Guideline Not indicated.
Test system
Species Rabbit (New Zealand White), weight 2-3 kg.
No. of animals 1 male and 1 female.
Dosage Application of 0.1 g test substance into the conjunctival sac; the eye of one animal was rinsed within 30 sec. after application with physiological saline.
Observations Observations at 24, 48, 72 and 96 h.

Results

Animal	**1**				**2 (rinsed)**			
Effect	C	I	Conj		C	I	Conj	
Time			Red	Ch			Red	Ch
24 h	3	2	3	3	1	0	3	2
48 h	3	2	3	3	1	1	3	2
72 h	3	2	3	3	2	1	3	2
96 h	4	2	3	3	3	2	3	2

C=corneal opacity I=Iris Conj=conjunctiva Red=redness Ch=chemosis

Conclusions Irritating.
Rev. note The test substance was identified by the producer as cyanuric chloride, however information on purity is missing.
Reliability 2 Purity of the test substance not indicated.

Title Testing the primary irritancy after single application to the eye of the rabbit
Date of report December 6, 1993.
GLP No.
Reference 34.
Test substance Cyanuric chloride, purity > 99%.
Guideline OECD 405, EEC 84/449/EEC.

Test system	**Species**	Rabbit (New Zealand White), weight 2.5-3.0 kg, age 4-12 weeks.
	No. of animals	4 (sex not indicated).
	Dosage	Application of 0.1 g test substance into the conjunctival sac.
	Observations	Observations at 1, 24, 48 and 72 h and 7 and 30 days.

Results

Time	Index of ocular lesions*
1 h	23
24 h	58
48 h	66
72h	70
7days	78
30 days	recovery

*According to Draize (mean values for 4 rabbits)

Conclusions Irritating.
Rev. note No individual data were presented. Therefore calculations could not be checked by the reviewer.
Reliability 2 No individual data.

5.4. Skin sensitization

Title Testing the cutaneous sensitising properties in the guinea-pig (maximization test)
Date of report January 26, 1994.
GLP No.
Reference 35.
Test substance Cyanuric chloride, purity >95%.
Guideline OECD 406, EEC 84/449/EEC.

Test system	**Species**	Guinea-pig (Hartley), age 9-10 weeks, weight 270-410 g.
	No. of animals	12 females/treatment, 8 females for controls.
	Procedure	As per OECD 406: Intradermal induction (0.01% in polyethylene glycol) on day 1, topical induction on day 8 (2% in polyethylene glycol), challenge on day 22 (1% in polyethylene glycol), skin reading after 24 and 48 h (day 24 and 25).
	Observations	Skin reactions 24 and 48 hours after the challenge exposure. Mortality/clinical signs (frequency not indicated). Body weight on day 2 and weekly thereafter.
	Pos. control	p-phenylene-diamine.

Stat. method Not applied.

Results

Dose/effect	Control	Treatment
No. of animals	8	12
Mortality/clinical signs	None	
Body weight	No treatment related effects	
Challenge		
No. with erythema/oedema score > 0 (24/48h)	0/0	12/12

Conclusions Sensitising.
Rev. note
1. The results of the positive control were not reported. However, the test system seems to respond to sensitising agents, as the test substance induces effects.
2. Polyethylene glycol was used as a vehicle for the intradermal challenges in which FCA was involved. This may lead to necrotic reactions at the induction sites. It is preferred to use water or physiological saline (OECD 406).

Reliability 1

Title A murine local lymph node assay for the identification of contact allergens. Assay development and results of an initial validation study.
Date of report January 24, 1989.
GLP No.
Reference 75.
Test substance Cyanuric chloride, purity not indicated.

Guideline Not applicable.
Stat. method Not indicated.
Test system
Species Mouse (CBA/Ca), age 6-8 weeks, weight and sex not indicated.
No. of animals 3/test concentration.
Dosage Daily application for 3 consecutive days on the dorsum of the ear of test concentrations of 0, 2.5, 5 and 10%; vehicle acetone/olive oil.
Negative control Sodium lauryl sulphate (SDS).
Procedure On day 6 draining lymph nodes were removed and weighed; lymphocytes were cultured in the presence of [^{3}H]thymidine for 24 hours (with and without interleukin-2); lymphocyte suspensions were stained with pyronin/methyl green to determine pyroninophilic cells.
Observations Lymph node cell (LNC) proliferation as incorporation of [^{3}H]thymidine by β-scintillation counting; lymph node weight; frequency of pyroninophilic cells by oil-immersion microscopy.

Results SDS < 0.56 x 10^{-3} cpm.

Dose (%)/effect	**0**	**2.5**	**5**	**10**
LNC proliferation (cpm)				
Without IL-2	1.0	63	55	64
With IL-2	1.2	91	81	87
Mean lymph node weight (mg)	1.0	7.7	7.6	6.3
Frequency of pyronin positive cells **(%)**	<1	6.2	7.2	7.1

Conclusions Sensitising.
Rev. note
1. The purity of the test substance is not indicated.
2. The assay is not yet installed as an official guideline for the determination of sensitizing properties.

Reliability 2 No purity of the test substance indicated (note 1) and the assay is not validated (note 2) .

Title Draining lymph node cell activation in guinea pigs: Comparisons with murine local lymph node assay.
Date of report 1991.
GLP No.
Reference 76.
Test substance Cyanuric chloride, purity not indicated.
Guideline Not applicable.
Stat. method No.
Test system
Species Guinea pig (Dunkin-Hartley –Pirbright), weight 300-350 g, sex not indicted.
Mouse (CBA/Ca), age 6-8 weeks, weight and sex not indicated.
No. of animals 3/test concentration.
Dosage Daily application for 3 consecutive days on the dorsum of both ears of 50 µl (guinea pigs) or 25 µl (mice) of test concentrations at 0, 0.5, 1, 2 and 5%;
Vehicle for guinea pigs dimethylacetamide/acetone/ethanol (4/4/3) or DMF and for mice acetone/olive oil (4/1).
Negative control Sodium lauryl sulphate (SDS).
Procedures On day 4 (mouse) or 5 (guinea pig) draining lymphnodes were removed and weighed.
Guinea pig: lymphocytes were cultured for 24 or 48 hours (48-h assay in presence and absence of inter-leukine 2) in the presence of [^{3}H]thymidine.
Mouse: lymphocytes were cultured in the presence of [^{3}H]thymidine for 24 hours.
Observations Lymph node cell (LNC) proliferation as incorporation of [^{3}H]thymidine by β-scintillation counting; lymph node weight (guinea pig).

Results SDS < 4.9 x 10^{-3} cpm in guinea pig assay and <1 x 10^{-3} cpm in mouse assay.

Dose (%)/effect	**0**	**0.5**	**1**	**2**	**5**

Guinea pig					
LNC proliferation (cpm x 10^{-3})					
24 h without IL-2	4.7	27	27	36	25
48 h without IL-2	0.6	2.0	1.5	6.1	5.0
48 h with IL-2	1.3	8.7	11	22	14
Mean lymph node weight (mg ± SE)	11.1±0.9	16.5±1.8	28.1±2.8	34.8±2.9	21.7±0.9
Mouse					
LNC proliferation (cpm x 10-3)	1.7	22	31	43	-*

* not tested.

Conclusions Sensitising.

Rev. note
1. The purity of the test substance is not indicated.
2. The assay is not yet installed as an official guideline for the determination of sensitising properties.

Reliability 2 No purity of the test substance indicated (note 1) and the assay is not validated (note 2).

5.5. Repeated dose toxicity

Title	Exploratory 5-day oral toxicity study in rats.	
Date of report	February 24, 1983.	
GLP	No.	
Reference	36.	
Test substance	Cyanuric chloride Technical, purity not indicated.	
Guideline	No (range finding study).	
Stat. method	Not applicable.	
Test system	**Species**	Rat (CD), males weight 173-194 g and females 126-142 g.
	No. of animals	5/sex/dose level.
	Dosage	Oral gavage once daily for 5 days at 0, 10, 20, 40, 80, 160 or 320 mg/kg body weight.; vehicle mineral oil.
	Observations	Daily clinical signs and mortality, body weight and food consumption at initiation (day 1) and termination (day 6) of the study. Macroscopic examination on the day of death or at termination.

Results

Dose (mg/kg bw)\effect	**0**		**10**		**20**		**40**		**80**		**160**		**320**		**DR**	
Sex	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Mortality	0	0	0	0	0	0	0	1	2	4	4	4	5	5	x	x
Clinical signs[(A)]					+	+	+	+	+	+	+	+	+	+	x	x
Body weight					d	d	d	d	d	d	d	d	d	d	x	x
Food consumption					d	d	d	d	d	d	d	d	d	d	x	x
Macroscopic findings[(B)]					+	+	+	+	+	+	+	+	+	+	x	x

(A) Rales, excesssive salivation, labored breathing, gasping, cool to touch, decreased motor activity, brown material around mouth/nose, moist areas of yellow material on several body regions, dry/red material around eye(s)/mouth and black material around anal opening were seen.
(B) Dark discolouration (with foci), haemorrhage and erosions or ulcerations in the glandular stomach and/or nonglandular stomach.

Conclusion	Effects were seen at and above 20 mg/kg bw.
Rev. note	1. This study represents a preliminary investigation for a study of longer duration. Therefore, GLP compliance and a full correspondence with the repeated dose toxicity guideline (OECD 407) is not required. 2. The purity of the test substance is not indicated.
Reliability	2 Limited parameters evaluated, therefore, limited interpretation possible (note 1) and no purity of the test substance (note 2).

Title	21-day dermal toxicity study in rabbits.	
Date of report	November 15, 1983.	
GLP	Yes.	
Reference	37.	
Test substance	Cyanuric chloride Technical, purity not indicated.	
Guideline	Not indicated.	
Stat. method	ANOVA, Bartlett's test, t-test according to Steel and Torrie, Dunnett's test, non-parametric test according to Conover and Iman.	
Test system	**Species**	Rabbit (New Zealand White), age 12-14 weeks, weight males 2,3-3,2 kg and females 26-3,2 kg.
	No. of animals	6/sex/dose level.
	Dosage	Dermal administration for 4 weeks (6h/day, 5 days/week) at 0, 50, 150 and 500 mg/kg bw on the clipped dorsal skin under occlusion (30% of body surface); vehicle mineral oil; vehicle and untreated controls.
	Observations	As required by OECD 410. Histopathology on treated and untreated skin, kidney, liver and gross lesions.

Results

Dose mg/kg bw)	**0 (untreated)**		**0 (vehicle)**		**50**		**150**		**500**		**DR**	
Sex	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**

Mortality	1/6				1/6		1/6			
Clinical signs	No treatment related effects									
Local effects (A)	+	+	+	+	+	+	+	+	x	x
Body weight					d		d	dc		
Food consumption	No treatment related effects									
Haematology:										
Erythrocytes								ic		
MCV								dc		
Leucocytes					ic		i			
Segmented neutrophils			ic		ic		ic			
Clinical biochemistry:										
ALP				d	dc	d	dc	dc		
Albumin					d		dc	dc		
Globulin					ic		ic	ic		
Glucose					ic					
Organ weight	No treatment related effects									
Necropsy(B)		+	+	+	+	+	+	+	x	x
Histopathology (C)	+	+	+	+	+	+	+	+	x	x

(A) Effects included erythema and oedema in all groups (not untreated control) ; blanching, fissuring, desquamation, eschar formation and exfoliation in 50, 150 and 500 mg/kg groups.
(B) Treated skin: thickening/hardeness in all groups (not untreated control and males vehicle control); eschar formation and corrugation in 50, 150, and 500 mg/kg groups.
(C) Epidermal hyperkeratosis and acanthosis, follicular hyperkeratosis and acanthosis in all groups treated with test substance and the vehicle control group (dose related increase). Intraepidermal suppuration, ulceration of the epidermis and increased relative severity of dermal inflammation in 50, 150 and 500 mg/kg groups.

Conclusions NOAEL (systemic) 150 mg/kg bw (see rev. note).

Rev. note

1. The purity of the test substance is not indicated.
2. Slight deviations from the OECD 410 guideline included: no temperature and relative humidity ranges given; initial weight range exceeded the upper OECD limit (3.0 kg); no acclimatisation period given; exposed skin area 30% of the total surface area (OECD ≥ 10%); food consumption estimated instead of measured; no indication of paring/pregnancy status of females. These deviations were considered not to have affected the study outcome. Exposure of 30% surface area under occlusion considered to be worst case.
3. Increased leucocytes and segmented neutrophils among males may be related to the local damage of the exposed skin.
4. Decreased ALP values were considered biologically not meaningful. Variations in blood proteins and glucose remained within normal biological limits.
5. In this study a No Observed Effect Level could not be established based on the local irritant effect on the treated skin area. The body weight loss seen at 150 and 500 mg/kg bw may be at least partly related to stress due to the repeated use of bandages and the skin damage. Since at 150 mg/kg bw effects on body weight were seen in males only, it was concluded that the No Observed Adverse Effect Level (systemic) was 150 mg/kg bw.
6. The histopathology was performed according to the requirements of OECD 410. However, in view of the development of other OECD guidelines on repeated exposure (e.g. OECD 407), the histopathology performed in this study was considered to be minimal.

Reliability 2 No purity of the test substance indicated (note 1).

Title Summary: Repeated dose oral toxicity - 28 days
Date of report 1989.
GLP Not indicated.
Reference 73.
Test substance CAS 108-77-0 (Cyanuric chloride), purity not indicated.
Guideline Not indicated.
Stat. method Not indicated.
Test system **Species** Rat (Wistar)

	No. of animals	6/sex/dose level.
	Dosage	Daily oral doses of 0, 4, 20 and 100 mg/kg bw.
	Observations	Not specified
Results	Mortality: at 4 mg/kg bw 1 female, at 20 mg/kg bw 1 male and 2 females and at 100 mg/kg bw 6 males and 3 females. Animals that died showed atrophic spleen lymphatic nodules and gastritis. In survivors dose related effects included erosion and ulceration of the stomach mucosa and focal papillomatous proliferation and hyperkeratosis of the forestomach epithelium. Active germinal centers of lymphatic nodules in the small intestine were seen at 20 and 100 mg/kg bw. At 100 mg/kg bw vacuolisation of hepatocytes and polymorphism of hepatocyte nuclei was reported. Food consumption and body weight were decreased at 100 mg/kg bw. Liver and adrenal weights were increased and red blood cell count, haemoglobin concentration and haematocrit were lowered at 100 mg/kg bw. An increase in alkaline phosphatase activity was seen at 100 mg/kg bw.	
Conclusions	No conclusions can be drawn based on the limited information available.	
Rev. note	Only an abstract available	
Reliability	4	

Title	Cyanuric chloride (2,4,6-trichloro-1,3,5-triazine): 90-days repeated exposure inhalation toxicity study in rats.	
Date of report	August 6, 1994.	
GLP	No.	
Reference	74.	
Test substance	CAS 108-77-0 (Cyanuric chloride), purity >95%.	
Guideline	OECD 413, EEC 84/449/EEC.	
Stat. method	Bartlett's test for homogeneity of variance, ANOVA, Dunnett's test, Kruskal-Wallis test, Dunn's summed rank test, Jonkheere's test for trend and ANCOVA.	
Test system	**Species**	Rat, DAK Wistar; 6-8 weeks old, weighing 145-190 g (males) and 120-160 g (females).
	Source	The Nofer institute of Occupational Medicine.
	No. of animals	10/sex/treatment.
	Type of exposure	Whole-body inhalation exposure system.
	Dosage	0.01, 0.05 and 0.25 mg/m^3, air-exposed controls.
	Exposure period	13 weeks, 5 days per week, 6 hours per day.
	Air changes	7.2/hour.
Investigations	**General**	Mortality daily; Clinical signs daily before and after exposure; Body weight at study initiation and weekly thereafter; Food consumption.
	Clinical pathology	Blood chemistry at end of treatment period: aspartate aminotransferase (ASAT), alanine aminotransferase (ALAT), sorbitol dehydrogenase (SDH), γ-glutamyl transpeptidase (GGT), alkaline phosphatase (ALP), ornithine carbamoyltransferase (OCT), total billirubin, total protein, albumin, blood urea nitrogen (BUN), glucose, natrium, potassium, chloride, inorganic phosphate and calcium; Hematology at end of treatment period: red blood cell count (RBC), white blood cell count (WBC), hemoglobin, hematocrit value, mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), platelet count, percentage of reticulocytes and differential leukocyte count.
	Necropsy	Macroscopy: external appearance, body orifices, body cavities and their contents; Organ weights: brain, lungs, heart, liver, kidneys, adrenals, thymus, ovaries/testes and spleen; Histopathology: nose, trachea, lungs, heart, liver, kidneys, adrenal gland, spleen, stomach, duodenum, pancreas, small and large intestine, testes and epididymides/uterus and ovaries, brain,

cerebellum, (para)thyroid, salivary gland, thymus, oesophagus, mediastinal lymph nodes, urinary bladder, prostate gland, seminal vesicles, mammary glands, lacrimal glands, eye with optic nerve, skin, femur muscles, spinal cord and spinal medulla.

Analysis of test substance Analysis of test substance concentrations at least every two hours by gas chromatography.

Results

Dose	**Control**		**0.01 mg/m^3**		**0.05 mg/m^3**		**0.25 mg/m^3**		**Dose related**	
Sex	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Mortality	None									
Clinical Signs	No symptoms were observed									
Body weight /food consumption	No treatment related effects									
Hematology										
Hemoglobin				d		d		dc		+
Reticulocytes				d		d	d	d	+	
WBC			dc		dc		dc			
Young neutrophils			i		i		i	i		+
Eosinophils				i	i	i	i	i		
Clinical chemistry										
Phosphate					ic					
Glucose						ic				
Macroscopy (A)							+	+		
Organ weights										
Testes			dc^{ar}							
Adrenals						dc^{r}				
Heart						dc^{r}		dc^{r}		
Microscopy										
Nose (B)							+*			
Trachea (tracheitis) (C)							+			
Bronchi (D)							+			
Lungs (E)			+		+	+	+*	+		
Small intestine (F)				+						
Liver (G)					+		+*			
Testes/epidymides/prostate/seminal vesicles	No treatment related effects									
Uterus/ovaries	No treatment related effects									

Where i=increase; d=decrease; ic=significant increase; dc=significant decrease; ^{a}=absolute; ^{r}=relative, * incidence of findings significantly higher than control group.

(A) Consisting an of increased amount of yellowish exudate in the nose of males (6/10), and congested lungs. In control and other treatment groups incidence of exudate was 0-1/10 males and 2/10 females.
(B) Presence of PMN in the lumen.
(C) Incidence 5/10. Also findings in females. Increased incidence at all treatment groups and controls (1-3/10)
(D) Higher incidence of increased cellularity of BALT in high dose males compared to control and other groups.
(E) Congestion and/or foamy macrophages in alveoli and/or interstitial lymphocytic infiltrations; effects in females appeared less frequently.
(F) Proliferation of lymphatic tissue.
(G) Fast red (+) droplets in hepatocytes

Analyses of test substance 0.012, 0.051 and 0.241 mg/m^3 for nominal concentrations of 0.01, 0.05 and 0.25 mg/m^3 resp.

Conclusions NOAEC = 0.25 mg/m^3 for systemic toxicity.
NOAEC = 0.05 mg/m^3 for local effects.

Rev. note
1. The study is not performed under GLP.
2. All changes in blood chemistry, hematology and organ weights were considered not treatment-related, since no dose-response relationship became apparent, or the observation was found only in one sex. Effects on hemoglobin, reticulocytes and young neutrophils showed a high inter-individual variance.
3. The list of examined organs is not fully in accordance with OECD 413.
4. The effects on the lower airways were attributed to a viral infection by the author of the report. The presence of yellowish exudate in females of treated and control groups, the presence of interstitial lymphocyte infiltration in alveolar septa of the lungs, and foamy macrophages in all dose groups may indicate the study was performed with non-SPF rats.
5. It is not specified if several slides of nasal and laryngeal tissues were examined.
6. No ophthalmologic examinations were performed.
7. Air changes were below OECD recommendations (10-12/h rec.)
8. The analytical report did not include many details. No information on the validation of the method used. No chromatograms were included. Between 28 and 33 samples were investigated.

Reliability 2 Non-GLP

Title Zur Toxizität des Cyanurchlorids (translation from Russian).
Date of report 1968.
GLP No.
Reference 68.
Test substance CAS 108-77-0 (Cyanuric chloride), purity not indicated.
Guideline Not indicated.
Stat. method Not applicable.

Test system

Species	Rat.
No. of animals	10//treatment.
Dosage	0, 1.88 and 0.3 mg/m^3.
Exposure period	4 hours for 5 days/week for 2.5-5 months.

Investigations Mortality, clinical signs, body weight, body temperature, haematology, clinical chemistry, urine analysis, necropsy.

Results

Mortality	3/10 at 1.88 mg/m^3.
Clinical signs	At 1.88 mg/m^3: Inflammation of the conjunctiva and the higher respiratory tract, hypokinesis,
Body weight	At 1.88 mg/m^3 a initial decrease followed by recovery relative to starting weight.
Body temperature	At 1.88 mg/m^3 a mean decrease of 1 degree was observed after 6 weeks of exposure.
Blood chemistry	At 1.88 mg/m^3 decrease in haemoglobin and erythrocytes. Ammonium thiocyanate in blood serum was below the norm (0.4-0.6 mg%). Prothrombin decreased.
Macroscopy	Tracheitis, bronchitis, peribronchitis, pneumonia, dystrophy of the liver, kidneys and myocardis at 1.88 mg/m^3.
Histopathology	Animals deceased at 1.88 mg/m^3: bronchopneumonia. Discoloured lungs, swollen lungs and brain, inflammation of the respiratory tract, dystrophy of liver and kidneys and decrease of lipids in adrenal glands.
Other	Decreased oxygen consumption from 1.5 months onwards.

Conclusions NOAEL = 0.3 mg/m^3.
Rev. note
1. The report was limited to the above summary.
2. Non-GLP study.

Reliability 4

Title	Is cyanuric chloride an immunotoxicant?	
Date of report	1993.	
GLP	No.	
Reference	77.	
Test substance	Cyanuric chloride, purity not indicated.	
Guideline	Not indicated.	
Stat. method	Not indicated.	
Test system	**Species**	Rat (Wistar).
	No. of animals	Not indicated.
	Dosage	Inhalation exposure for 4 weeks (6h/day, 5 days/week) at 0, 0.04, 0.2, 0.4, 1.0 and 1.5 mg/m^3.
	Observations	Routine toxicometric methods, biochemistry, histopathology, morphometry and popliteal lymph node assay (PLNA).
Results	In higher doses increased mortalitity, decreased body weight gain and food consumption and histopathological changes in the lungs. At 1 mg/m^3 an increase of bronchoalveolar lymphatic tissue. Atrophia of the thymus cortex , enlargement of the mesenteric lymph nodes and increase of lymph node weights and cell numbers (from PLNA).	
Conclusions	The data are too limited to draw a conclusion	
Rev. note	From the study only a short abstract was available.	
Reliability	2	

Title	Cyanuric Chloride In Patty's Industrial Hygiene and (via personal communication of E. Flint).
Date of report	1981.
GLP	Not applicable.
Reference	99.
Test substance	Cyanuric chloride.
Test method	Not indicated.
Remark	A subacute feeding study on rabbits has shown no injury at 37 mg/kg bw.
Reliability	4 .

Title	Cyanuric Chloride In Patty's Industrial Hygiene and (via personal communication of E. Flint).
Date of report	1981.
GLP	Not applicable.
Reference	99.
Test substance	Cyanuric chloride.
Test method	Not indicated.
Remark	A 30-day feeding study in rats gave a NOEL of 0.02% in diet (20 mg/kg bw). At 0.1 and 0.2% reduced body weight gain was reported
Reliability	4 .

5.6. Genetic toxicity

5.6.1. Chromosomal aberration

Title	Mouse micronucleus test (single oral administration)	
Date of report	April 16, 1987.	
GLP	Yes.	
Reference	39.	
Test substance	Cyanuric chloride, purity 97%.	
Guideline	OECD 474, EC 4/449 B12..	
Stat. method	Poisson test.	
Test system	**Species**	Mouse (NMRI), 6 weeks old, 26-39 g.
	No. of animals	7/sex/sampling time (controls 6/sex/sampling time).
	Dosage	Single oral administration (gavage) at 619 mg/kg bw; vehicle (peanut oil controls), dosing volume 10 mL/kg bw. Dose selection was based on preliminary study at 1000 mg/kg bw, which showed deaths and clinical symptoms.
	Sampling time	At 24, 48 and 72 hours post-dose.
	Pos. control	Cyclophosphamide (in 0.9% saline at 51 mg/kg bw) gave the expected response.
	Scoring	For 5 animals/sampling time, the following proportions were determined in bone marrow smears: Micronucleated PolyChromatic Erythrocytes (MPCE) per 1000 PCE. Ration PCE/NCE (NormoChromatic Erythrocytes).

Results

Dose [mg a.i./kg bw]/effect	**0**		**619**	
Sex	**M**	**F**	**M**	**F**
Mortality			2/21	2/21
Clinical signs[(A)]			+	
% MPCE	No treatment related effects			
PCE/NCE			d	

(A) Salivation, forced respiration, ruffled fur, hypokinesia, tremor and disturbance of the general condition was seen among animals.

Conclusion	Not clastogenic.
Rev. note	1. In one animal at the first sampling time a strongly increased number of micronuclei was seen. However in all other animals at this and the other sampling times no differences compared to controls were seen. Therefore the effect in this animal is considered to have occured by chance. 2. *Minor remarks* The number of normochromatic erythrocytes was not reported. The proportion of MPCE was determined for 1000 PCE. This is in agreement with OECD 474 (1983); OECD 474 (1997) requires evaluation of 2000 PCE.
Reliability	1

5.6.2. Gene mutation

Date of report	January 26, 1994	
GLP	No.	
Reference	38.	
Test substance	Cyanuric chloride, purity >95%.	
Guideline	OECD 471, 84/449/EEC.	
Stat. method	Not performed.	
Test system	**Bacterial strains**	TA97a, TA98, TA100, and TA102.
	Metabolic activation	Male rat liver S9 mix (Aroclor 1254 induced)
	Test concentration	1, 10, 100 and 500 μg/plate (based on toxicity in TA97a).
	Controls	Negative: vehicle (DMSO). Positive: *Without activation*: 4-nitro-o-phenylenediamine (TA98), sodium azide (TA100), 4-nitroquinoline-N-oxide (TA97a,

TA102),
With activation: 2-aminofluorene (TA97a, TA100, TA102), benzo(a)pyrene (TA98).

Procedure Plate incorporation assay according to OECD 471.

Results

Tester strain	Test result[(A)]	
	Without activation	**With activation**
TA97a	-	-
TA98	-	-
TA100	-	-
TA102	-	-

(A) +/- : positive/negative result; positive controls gave expected responses.

Conclusion Not mutagenic.

Rev. note *Minor remark*. Only four strains were tested (OECD 471 five). The initial number of cells is not reported.

Reliability 1

5.7. Carcinogenicity

Title Blastomogene Effekte von Cyanurchlorid (translation from Russian).

Date of report 1966.

GLP No.

Reference 97.

Test substance CAS 108-77-0 (Cyanuric chloride), purity 96.9%; impurity is cyanuric acid.

Guideline Not indicated.

Stat. method Not applicable.

Test system

Species Rat; male/female; 100-110 g.

No. of animals 50/treatment.

Dosage **Test 1** (25 male/25 female): once weekly subcutanous injection of 10 mg in 0.5 ml sunflower oil for 3.5 months and subsequently, 6 times/week 10 mg in 0.5 ml sunflower oil in the diet for 20.5 months.
Test 2 (27 males/23 females): 6 times/week 10 mg in 0.5 ml sunflower oil in the diet for 24 months.

Investigations Tumour development, macroscopic and microscopic investigation of tumours

Results **Test 1**: From 17 months onwards 9 rats of 34 survivors developed subcutaneous masses (one animal developed also a mass of the preputial gland) and one animal had a mass in the left hip. No metastases were apparent.
All tumours were identified as sarcomas (1 osteosarcoma (hip), 4 spindle cell sarcomas, 2 fibrosarcomas, 1 neurosarcoma and 2 lymphosarcomas). The tumour of the preputial gland was possible malign.
Test 2: From 17 months onwards 8 rats of 45 survivors developed fibroadenomas of the mammary gland (5), ileocaecal lymphosarcoma (1), carcinoma of the prostate (1) and leiomyosarcoma in the uterus (1). The mammary tumours are considered benign and the 3 other tumpours malign.
Other effects in both tests were renal changes (renal dystrophy, glomerulosclerosis) and cysts in the liver (related to invasion with parasites).

Conclusions Cyanuric chloride may induce tumours at the injection site associated with the development of necrosis due to its highly irritating/caustic properties. The other tumours found in both tests were considered incidental findings without relationship to the treatment with cyanuric chloride.

Rev. note Translation of a Russian article with extensive description of pathology.

Reliability 4

5.8. Reproductive toxicity

Title	Teratology study in rats.	
Date of report	October 28, 1983.	
GLP	Yes.	
Reference	40.	
Test substance	Cyanuric chloride Technical, purity not indicated.	
Guideline	Not indicated.	
Stat. method	ANOVA, Bartlett's test for homogeneity of variances, t-test, Chi-square test, Fisher's Exact probability test, Mann-Whitney U-test.	
Test system	**Species**	Rat (CD), 17 weeks old at gestation day 0, weight 228-383 g.
	No. of animals	25 mated females/dose group.
	Dosage	Oral gavage at 0, 5, 25 and 50 mg/kg bw; vehicle mineral oil.
	Procedures	Female rats were mated with untreated stock males (1/1) from the same strain and source. The day of observation of a vaginal plug was defined as day 0 of gestation. Females were treated daily from day 6 to 19 of gestation inclusive. Mortality/clinical symptoms of females were observed daily from day 0 to 20. Body weights were recorded on gestation days 0, 6, 9, 12, 16 and 20. On day 20, all females were subjected to macroscopic examination. The uteri were removed and examined for no. of corpora lutea, total no. of implantation sites, no. and location of viable and non-viable foetuses and the no. of resorptions. Foetuses were inspected on the sex, weight, external malformations/variations and visceral (1/2 of foetuses) and skeletal (1/2 of foetuses) defects.

Results

Dose (mg/kg bw)	**0**	**5**	**25**	**50**	**DR**
Maternal data					
Mortality	0/25	0/25	1/25[#]	0/25	
Clinical signs [(A)]				+	
Body weight gain (day 6-19 and 0-20)				d	
Necropsy		No treatment related effects			
No. of pregnant females	17	18	21	22	
No. of corpora lutea/dam		No treatment related effects			
No. of implantation sites /dam		No treatment related effects			
Post-implantation loss				i	
Pre-implantation loss/ resorptions		No treatment related effects			
No. live foetuses/ dam				d	
Foetal data					
No. of litters included in evaluations	17	18	20	22	
Foetal weight		No treatment related effects			
External examination / sex		No treatment related effects			
Anomalies: visceral		No treatment related effects			
skeletal		No treatment related effects			

Due to an intubation error: d = decreased; I = slightly increased
(A)Dry matter around the face, forelimbs and anogenital area, matted haircoat, excessive salivation, respiratory rales.

Conclusions	NOAEL for maternal toxicity: 25 mg/kg. NOAEL for developmental effects: 25 mg/kg.
Rev. note	1. Purity of test substance not indicated. 2. Deviations from the OECD 414 guideline included: No food consumption and no uterus weights. The omission of these parameters was considered not to have adversely affected the outcome of the study.
Reliability	2 No purity of the test substance (note 1).

Number	
Title	Exploratory range-finding teratology study in rats.
Date of report	October 27, 1983.

GLP No.
Reference 93.
Test substance Cyanuric chloride Technical, purity not indicated.
Guideline Not indicated.
Stat. method Not indicated.
Test system
Species Rat (CD), 12 weeks old at gestation day 0, weight 224-271 g.
Source Charles River Breeding Laboratories Inc., Portage, Michigan.
No. of animals 5 mated females/dose group.
Dosage Oral gavage at 0, 5, 10, 20, 30 and 40 mg/kg bw; vehicle mineral oil.
Procedures Female rats were mated with untreated stock males (1/1) from the same strain and source. The day of observation of a vaginal plug was defined as day 0 of gestation. Females were treated daily from day 6 to 19 of gestation inclusive. Mortality/clinical symptoms of females were observed daily from day 0 to 20. Body weights were recorded on gestation days 0, 6, 9, 12, 16 and 20. On day 20, all females were subjected to macroscopic examination. The uteri were removed and examined for no. of corpora lutea, total no. of implantation sites, no. and location of viable and non-viable foetuses and the no. of resorptions.

Results

Dose (mg/kg bw)	0	5	10	20	30	40	DR
Maternal data							
Mortality	0/5	0/5	0/5	0/5	0/5	0/5	
Clinical signs (A)	No treatment related effects						
Body weight gain (day 0-20)	No treatment related effects						
Necropsy (B)	No treatment related effects						
No. of pregnant females	4	4	4	5	5	5	
No. of corpora lutea/dam	15.8	15.8	15.8	16.8	16.6	15.6	
No. of implantation sites /dam	14.0	14.8	14.8	12.6	14.2	15.0	
Post-implantation loss	1.5	1.3	1.0	0.4	1.2	1.2	
No. live foetuses/ dam	12.5	13.5	13.8	12.2	13.0	13.8	

(A) At doses above 5 mg/kg bw incidentally hair loss. At 40 mg/kg bw rales, decreased activity, soft stool and emaciation in one female.
(B) Incidentally hydronephrosis and distended ureter in all groups. Distended intestines in one female at 40 mg/kg bw (see clinical signs).

Conclusions NOAEL for maternal toxicity: 40 mg/kg.
NOAEL for reproductive effects: 40 mg/kg.
Rev. note 1. Purity of test substance is not indicated.
2. No foetal parameters were established. The study is a dose-range finding study.
Reliability 2 Dose-range finding study.

5.9. Other relevant information

Title Testing the respiratory irritation in mice
Date of report March 3, 1994.
GLP No.
Reference 41.
Test substance Cyanuric chloride, purity >95%.
Guideline Not applicable.
Stat. method Probit method.
Test system
Species Mouse (Balb/C), age 2-3 months, weight 18-20 g.
No. of animals 10 males/group.
Dosage 15 minutes exposure (nose only) at 2.1, 6.7, 9.1, 11.7 and 14.6 mg/m^3; food and water *ad libitum* (food was withheld 16 h prior to dosing).
Analyses 5 L air (rate 0.5 L/min) from the inhalation chamber was passed through an impinger (with toluene) and analysed by GC/NPD.
Observations Respiratory rate before, during and after exposure for 10, 15 and 5 min. resp. by whole body plethysmography.
Results Between 8 and 15 minutes a plateau was reached

Measured concentration [mg/m^3] \ effect	**2.1**	**6.8**	**9.3**	**11.7**	**14.6**
Mean decrease respiratory rate during plateau phase [%]	32	52	59	68	75

Conclusions RD_{50} 5.9 mg/m^3 (based on values found in plateau phase).
Rev. note
1. No females tested.
2. It is not clear why food was withheld for 16 h prior to dosing.
3. No information on particle size and stability of the aerosols was provided

Reliability 3 Only males were tested, limited analyses performed (note 3).

5.10. Experience with human exposure

Title Problems of industrial hygiene in the production of cyanuric chloride
Date of report 1964.
GLP No.
Reference 42.
Test substance Cyanuric chloride.
Test method Not applicable.
Results Cyanuric chloride can be found in the atmosphere of industrial premises. The substance can be released during individual operations, technicological sampling and due to imperfectly sealing of equipment.
Rev. note The reference consists of an article in Russian. Only an abstract in English was available.
Reliability 4 .

Title Occupational hygiene in the manufacture of simazin
Date of report 1962.
GLP No.
Reference 43.
Test substance Cyanuric chloride.
Procedure During the production of the pesticide simazin air concentrations for the initial material cyanuric chloride (400 samples) were measured according to a method from the Gorki Scientific Institute of Occupational Hygiene and Occupational Diseases. Cyanuric chloride may be released during its loading into the reactor.
Results Cyanuric chloride was present in 84 samples at a highest concentration of 0.1 mg/m^3
Conclusion Occupational exposure up to 0.1 mg/m^3 is possible.
Rev. note
1. No information on sampling time, place and time spacing was provided.
2. The analytical method was not further described.

Reliability 4 .

Title Su di un caso di intossicazione acuta professionale da 2-4-6 trichloro-1-triazina (chloruro di cianurile)
Date of report 1987.
GLP No.
Reference 45.
Test substance Cyanuric chloride.
Case An, in general, healthy male (age 54) was exposed to cyanuric chloride during an inspection in a factory where herbicides were produced. Cyanuric chloride (one of the basic materials) was accidentally released, because a vessel got broken. The man was totally submerged under the powder.
Signs of intoxication consisted of irritation of the skin, eyes and pharynx, followed by serious obstructive pulmonary syndrome with impairment of alveolar capillary exchanges. No effects on the heart function was seen (although a slightly abnormal ECG was reported from an pre-exposure investigation). The man recovered within 20 days.
Conclusion Acute poisoning with cyanuric acid will lead to transient irritating effects.
Rev. note No information on the exposure level was present.
Reliability 4 .

Title	Resilient-viscous properties of the arterial vessels in workers contacting with cyanourchloride
Date of report	February 20, 1987.
GLP	No.
Reference	46.
Test substance	Cyanuric chloride.
Test method	Not applicable.
Procedures	Two times per year (for 4 year) workers (n=38) exposed to cyanuric chloride were investigated. Results were compared with an unexposed control group (n=30).
Results	An effect on the viscous properties of the walls of the arterial vessels was seen.
Rev. note	The reference consists of an article in Russian. Only an abstract in English was available. From the text it can be deduced that most probably the tension in muscles of the arterial walls was increased.
Reliability	4 .

Title	Cyanurchlorid - Arbeitsmedizinische-toxikologische Bewertung der Exposition in der Produktion unter Aspekten der Arbeitssicherheit
Date of report	1998.
GLP	No.
Reference	79.
Test substance	Cyanuric chloride.
Test method	1. 39 workers with known history of long-term exposure to cyanuric chloride (between 1 and 22 years) were investigated. Investigations included anamnesis, physical examination (with special attention to lungs, skin and eyes), lung function (forced expiratory volume) and blood pressure measurements. 2. Medical records of another 21 workers previously exposed to incidental high concentrations, who had changed jobs in the mean time, were checked. 3. Determination of concentrations at the workplace. Samples (30-60 min) were taken during the filling procedure (worst case) and during normal production procedures (both room and personal monitoring). The samples were analysed after adsorption tosilicagel, desorption with H_2SO_4, hydrolysis to cyanuric acid (70 min at 70ºC) and analysis of the cyanuric acid by HPLC with UV detection.
Results	1. No effects on any of the measured parameters were found. FEV was within normal ranges. 2. Accidental acute exposure to high doses of cyanuric chloride was reported to lead to irritation/corrosion of the conjunctiva and skin irritation. After inhalation of the test substance coughing, breathing problems and shortness of breath were seen. These effects disappeared completely after a short time and did not result in persisting problems. 3. Measured concentrations were 7.09 ± 9.22 $\mu g/m^3$, 4.43 ± 2.72 $\mu g/m^3$ and 92.76 ± 147.52 $\mu g/m^3$, for filling, room and personal monitoring, resp..
Rev. note	For test 3 the number of samples was not indicated. The information available is confined to the above mentioned. No individual data (on subjects or samples) are provided, except for FEV measurements.
Reliability	4 .

Title	Vesication and some vesicants.
Date of report	1945.
GLP	No.
Reference	82.
Test substance	Cyanuric chloride.
Test method	Not applicable.
Results	Cyanuric chloride is a lachrymator and an irritant to the eyes and nose. Exposure of a laboratory assistant to a small amount of vapour resulted in rash on the neck and behind the ears with irritation. Closer contact is expected to produce marked vesication as with exposure to analogous compounds happened.
Reliability	4 .

Title	Einwirkungen von Cyanurchlorid auf den menschlichen Organismus
Date of report	1984.
GLP	No.
Reference	84.
Test substance	Cyanuric chloride.
Test method	Not applicable.
Test system	Male workers exposed to cyanuric chloride regularly (n=30) or exposed to cyanuric chloride occasionally (n=27-30) were followed over a 5-year period. Sampling of air concentrations in the plant showed values above the current MAK value (1984). Workers were examined twice yearly for clinical signs, cardiovascular effects and lung function. Blood was investigated for glutathion, ascorbic acid, heterophilic agglutines, specific immuglobulins (A, G, M) and hepatitis-antibodies. Urine was investigated for ascorbic acid.
Results	In the high exposure group complaints of headache and pain in the epigastric and/or heart region were significantly more frequent than in low exposed workers. The number of subjects with hypertension in the high exposure group was significantly increased (29% at high exposure and 4% at low exposure). Effects on the nervous system including decreased heart tonus, irritability, tearful and depression were observed more frequently in the high exposure group. All these effects were associated with vegetative-vascular dystonia (33% at high exposure and 11% at low exposure). . In 53% of the investigated workers rhinitis and pharyngitis was observed. 9 exposed subjects developed dermatitis. Lung function was mainly unaffected. Slight myocardial changes were observed (leading to increased incidences of bradycardia, tachycardia and arrhytmia). Initially there was a tendency of increased elasticity of the vessel walls, which normalised after prolonged exposure. Blood glutathion was decreased and ascorbic acid in blood and urine was decreased. General decrease of natural antibodies and decreased IgA were reported.
Conclusion	Cyanuric chloride may exhibit effects on the nervous system, immune system and concomitant effects on heart and blood vessels.
Rev. note	The study is poorly described. For several effects no distinction between high and low exposed workers was made, making analysis of the findings complicated, as no relationship between exposure concentration and severity of response can be established.
Reliability	4

Title	BUA-Bericht "Cyanurchlorid" – Eintrag in die Umwelt.
Date of report	August 31, 1992.
GLP	Not applicable.
Reference	95.
Test substance	Cyanuric chloride.
Test method	Not applicable.
Remark	The total emission of cyanuric chloride into the atmosphere is estimated to be less than 50 kg/year, including diffuse emission sources like repair and service work. The emission of hydrolysis products of cyanuric chloride into the hydrosphere is estimated to be in the range of 15 tonnes per year.
Rev. note	Letter.
Reliability	4 .

Title	Cyanuric Acid and Cyanuric Chloride In Ullmann's Encyclopedia of Industrial Chemistry.
Date of report	1987.
GLP	Not applicable.
Reference	98.
Test substance	Cyanuric chloride.
Test method	Not applicable.
Remark	Worldwide annual production exceeds 100,000 t/a. Approximately 80% of production is used for pesticides, especially herbicides. More than 10% is converted into optical

brigntheners and approximately 2% is used for reactive dyes and certain anthraquinone dyes.

Reliability 4

Title BUA-Bericht "Cyanurchlorid" – Produktionsmengen, Verarbeitung, Anwendung, Verbrauchsmengen (letter).
Date of report 1992.
GLP Not applicable.
Reference 100.
Test substance Cyanuric chloride.
Test method Not applicable.
Remark
Production In 1990 about 27.000 tonnes of cyanuric chloride was produced in Western Germany, an estimated 48.000 tonnes in Western Europe and world-wide (without Eastern Europe, GUS, China and India) an estimated 108-118.000 tonnes.

Use Estimation of cyanuric chloride use in 1990:

- 50% pesticides
- 15-30% optical brightners
- 5-10% dyes
- 5-10% plastic additives

Reliability 4

Title BUA-Bericht "Cyanurchlorid" – Beschreibung des Herstellungsverfahrens und des Umwelteintrages (letter).
Date of report 1992.
GLP Not applicable.
Reference 101.
Test substance Cyanuric chloride.
Test method Not applicable.
Remark
Waste Cyanuric chloride is produced in a closed system. The air from the production building (suppressed atmosphere) is cleaned by alkali water (complete hydrolysis to cyanuric acid) and/or thermal afterburning at 1000^{o}C of evaporated dangerous substances. The air from the production apparatus containing solid cyanuric chloride is led through a filter and subsequently through alkali water. Less than 0.08 mg/m^3 air of cyanuric chloride could be detected.
The active carbon from the cyanuric chloride reactor is washed by water until free of smell and burned afterwards.
Waste water is directly or after a biological waste water treatment dumped in the river. About 12 tonnes per year of hydrolysis product is released into the environment.
Influence of cyanuric chloride on the geo- and biosphere is not to be expected.

Reliability 4

Title Langzeitfolgen einer einmaligen (unfallmäβigen) Einwirkung von Cyanurchlorid auf Mitarbeiter des Betriebes.
Date of report 1991.
GLP Not applicable.
Reference 102.
Test substance Cyanuric chloride.
Test method Not applicable.
Remark Exposure of workers to cyanuric chloride in 1971-75 and from 1984 onwards. Exposure to cyanuric chloride dust may result in irritation of the respiratory tract, bronchitis, severe eye irritation and skin burns. Incidentally bronchitis with obstruction was reported (n=2). However, routine investigation of lung function over a period of 2 years after exposure showed no irreversible effects.

Reliability 4

Title Cyanurchlorid (letter).
Date of report 1982.
GLP Not applicable.
Reference 103.
Test substance Cyanuric chloride.
Test method Not applicable.
Remark Exposure of workers to cyanuric chloride dust may result in irritation of the respiratory tract, eye irritation and contact dermatitis (corrosion). Repeated exposure may lead to skin sensitisation.
Yearly physical research of 75 workers during 24 years showed no permanent effects.
Reliability 4

Title Eventuelle Gesundheitsschäden durch Umgang mit Cyol und MMA (letter).
Date of report 1980.
GLP Not applicable.
Reference 104.
Test substance Cyanuric chloride.
Test method Not applicable.
Remark Exposure of workers to cyanuric chloride dust may result in skin irritation. In 20-30% of exposed workers urticaria and asthma bronchitis is observed, which was reversible after transfer to another firm (not producing cyanuric chloride).
Reliability 4

Title Cyanurchlorid – MDT (letter).
Date of report 1979.
GLP Not applicable.
Reference 105.
Test substance Cyanuric chloride.
Test method Not applicable.
Remark Yearly physical research including an ECG in people working on the production of cyanuric chloride resulted in no cardiovascular effects during 21 years.
Reliability 4

Title Cyanurchlorid (Degussa brochure).
Date of report 1987.
GLP Not applicable.
Reference 106.
Test substance Cyanuric chloride, purity ≥99%.
Test method Not applicable.
Remark Cyanuric chloride is a starting material for 2-methylmercapto-4,6-dichlorotriazine (MDT), an intermediate for producing triazine herbicides. It is also used as optical brightner and in dyes.
Reliability 4

Ref	Author	Year	Title	Source/performing laboratory
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2	Matsui K. & Sakamoto I.	1960	On the hydrolysis of cyanuric chloride (japanese)	J. Synth. Org. Chem. Jap., 18: 175-183
3	Lonza AG	1992	Unpublished letter	Telefax of Lonza AG to Dr. W. Mayr of Degussa AG
4	Hoppe W. von, Lenne H.U. & Morandi G.	1957	Strukturbestimmung von Cyanursäuretrichlorid $C_3N_3Cl_3$ mit Verwendung der diffusen Röntgenstreustrahlung zur Bestimmung der Molekülorienterungen	Zeischrift fur Kristallographie, Bd. 108:, 321-327
5.	Degussa AG	1985	Acute oral toxicity (LD50) study with cyanurchlorid in rats	Degussa, 85-0047-DKT
6	Bienert K., Klamt A., Krockenberger D., Nader F., Sewekow B. & Wittlinger R.	1993	Zum Bioakkumulationspotential von Chlororganika	UWSF – Z. Umweltchem. Ökotox. 5 (4), 228-234
7	Horrobin S.	1963	The hydrolysis of some chloro-1,3,5-triazines: Mechanism: Structure and reactivity	p 4130-4145
8	Jäckel H., Müller M., Nendza M., Klein W. & Gies-Reuschel A.	1993	Abschätzung des umweltchemischen und ökotoxikologischen Verhaltens von Stoffen durch computergestützte Analyse von Struktur und verhalten sowie von Struktur und Wirkung	UWSF – Z. Umweltchem. Ökotox. 5 (1): 11-18
9	Bacaloglu R. & Havlik J.	1983	Nucleophile Substitutionen in der 1,3,5-Triazinreihe. VIII. Zur Hydrolyse des Cyanurchloride in Dioxan-Wasser	Journal f. prakt. chemie. 325 (2): 309-318
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11	Degussa AG	1978	Hydrolytische Zersetzung von Cyanurchlorid und MDT	Degussa, 78-0007 DKO
12	Degussa AG	1985	Bestimmung der Geschwindigkeitskonstanten für die Bildung von Cyanursäure in Abhängigkeit von der Temperatur und dem pH-Wert	Degussa, 85-0045 DKO
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15	Rys P., Schmitz A. & Zollinger H.	1971	Der Mechanismus der Hydrolyse con Chlortriainen in protischen Lösungsmitteln	Helvetica Chimica Acta, 54/1 (14): 163-176
16	Scheinost & Mertschenk	1990	Brief: Hydrolyse von Cyanurchlorid	Letter of SKW Trostberg Aktiengesellschaft to Dr. W. Mayr of Degussa AG
17	Degussa AG	1993	Berechnung der Henrykonstante von	Degussa AG, unpublished

Ref	Author	Year	Title	Source/performing laboratory
			Cyanurchlorid	results
18	Fränzle O.	1993	Brief: Bodensorptionspotential	Letter of Geographisches Institut of the Christian-Albrechts-Universität zu Kiel to C. Jacobs of Degussa AG.
19	Hansch C. & Leo A.	1979	The FRAGMENT method of calculating partition coefficients	Substituent constants for correlation analysis in chemistry and biology, chapter IV, p. 18-37, Pomona College, New York.
20	Chemical inspection & Testing institute Japan (Ed.)	1992	Biodegradation and bioaccumulation. Data of existing chemicals based on the CSCL Japan	Japan Chemical Industry Ecology-Toxicology & Information Center
21	Degussa AG	1979	Bericht über die Überprüfung von 2,4,6-Trichlor-1,3,5-triazin auf toxikologisches Verhalten gegenüber Fischen und Bakterien und Bestimmung der Parameter zur Kennzeichnung des “Abwasserverhaltens”	Degussa, 79-0013 DKO
22	Wakabayashi K., Okuzu M.	1970	Hydroxy-s-triazines (Japanese)	Nippon Doj0-Hiryogaku Zasshi, 41: 237-245
23	Degussa AG	1986	Cyanurchlorid. Akute Toxizitat. Prufung der akuten Toxizitat nach einmaliger oraler Applikation an der Ratte	Degussa, 86-0063 DKT
24	Rydzyński K.	1993	Cyanuric chloride (2,4,6-trichloro-1,3,5-triazine). Testing the acute toxicity after single oral administration in rats	The Nofer intitute of occupational medicine, Lodz, Poland
25	Kugler-Laffont J. & Rouquier-Fourmaud A.	1988	Bio-accumulation de l’acide cyanurique chez les mollusques bivalves et conséquences histologiques de sa toxicité chez *Anodonta cygnea*	Bull. Soc. Hist. Nat., Toulouse, 124: 101-106
27	Kobel W.	1981	Report on 8-day feeding toxicity of technical GS 41’711 in Peking ducklings	CIBA-GEIGY Limited, Basle, Switzerland
28	Rydzyński K.	1993	Cyanuric chloride (2,4,6-trichloro-1,3,5-triazine). Testing the acute toxicity after single dermal administration in rats	The Nofer intitute of occupational medicine, Lodz, Poland
29	Degussa AG	1988	Cyanurchlorid. Akute Toxicität. Toxikologische Prüfung nach einmaliger dermaler Applikation am Kaninchen	Degussa, 88-0023 DKT
30	Degussa AG	1982	Bericht über die Prüfung der lokalen Reizwirkung von 2,4,6-trichlor-1,3,5-triazin (Cyanurchlorid) Nach einmaliger Applikation an der Haut des Kaninchens (Patch-Test)	Degussa, 82-0038 DKT
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32	Rydzyński K.	1993	Cyanuric chloride (2,4,6-trichloro-1,3,5-triazine). Testing the primary irritancy after single and repeated application to the skin of the rabbit	The Nofer intitute of occupational medicine, Lodz, Poland
33	Kobel W.	1981	Report on eye irritation in the rabbit after single application of GS 41711	CIBA-GEIGY Limited, Basle, Switzerland
34	Rydzyński K.	1993	Cyanuric chloride (2,4,6-trichloro-1,3,5-	The Nofer intitute of

Ref	Author	Year	Title	Source/performing laboratory
			triazine). Testing the primary irritancy after single application to the eye of the rabbit	occupational medicine, Lodz, Poland
35	Rydzyński K.	1994	Cyanuric chloride (2,4,6-trichloro-1,3,5-triazine). Testing the cutaneous sensitizing properties in the guinea pig (maximization test)	The Nofer intitute of occupational medicine, Lodz, Poland
36	Goldenthal E.I.	1983	Exploratory 5 day oral toxicity study in rats	International Research and Development Corporation, Mattawan, Michigan, USA
37	Goldenthal E.I.	1983	21-day dermal toxicity study in rabbits	International Research and Development Corporation, Mattawan, Michigan, USA
38	Janik-Spiechowicz E. & Rydzyński K.	1994	Cyanuric chloride (2,4,6-trichloro-1,3,5-triazine). Testing for mutagenic activity in the Ames test	The Nofer intitute of occupational medicine, Lodz, Poland
39	Degussa AG	1987	2,4,6-trichloro-1,3,5-triazine (cyanurchloride) Mouse Micronucleus test (Single oral administration)	Degussa, 87-0021-DGM
40	Schardein J.L.	1983	Teratology study in rats	International Research and Development Corporation, Mattawan, Michigan, USA
41	Rydzyński K.	1994	Cyanuric chloride (2,4,6-trichloro-1,3,5-triazine). Testing the respiratory irritation in mice	The Nofer intitute of occupational medicine, Lodz, Poland
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46	Soboleva L.P.	1987	Resilient-viscous properties of the arterial vessels in workers contacting with cyanourchloride (Russian article)	Vrach. Delo, 9: 103-105
47	Degussa AG	1990	Acute toxicity study in Daphnia magna with 2-chlor-4,6-dihydroxy-1,3,5-triazin, mononatriumsalz	Degussa, 90-0016 DGO
48	Degussa AG	1990	Ready biodegradability: “modified OECD screening test” for 2-chloro-4,6-dihydroxy-1,3,5-triazin, mononatriumsalt	Degussa, 90-0014 DGO
49	Degussa AG	1990	96-hour acute toxicity study in the guppy with 2-chlor-4,6-dihydroxy-1,3,5-triazin, mononatriumsalz	Degussa, 90-0015 DGO
50	Degussa AG	1992	Bestimmung des Verteilungsgleichgewichts von Cyol nach der OECD-Richtlinie Testing of Chemicals Nr. 117 vom 03.03.1989 und 107 vom 12-05-1981	Degussa, 92-0176 DKP
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Ref	Author	Year	Title	Source/performing laboratory
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Ref	Author	Year	Title	Source/performing laboratory
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93	Cuddeback, B.	1983	Exploratory range-finding teratology study in rats with technical cyanuric chloride	Int. R&D Corp. Michigan USA
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Ref	Author	Year	Title	Source/performing laboratory
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103	Jacobs, K.	1982	Cyanurchlorid	Degussa AG, Internal letter 17-03-82, Wesseling
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105		1979	Cyanurchlorid - MDT.	Degussa AG, Internal letter 11-05-79
106		1987	Cyanurchlorid (Degussa brochure).	Degussa AG
107	Häusler, A.	1989	Anaerober Abbau von Cyanursäure in diskontinuierlichen Suspensionsreaktoren und kontinuierlich betriebenen Festbett-Umlaufreaktoren	Diplomarbeit, Technischen Hochschule Darmstadt

* Not used because it was written in a language that we could not read.
+ The data from this reference were only used to complete the assessment if necessary.