FOREWORD INTRODUCTION

N-(3-(TRIMETHOXYSILYl)PROPYL)EHTYLENEDIAMINE (AEAPTMS)

CAS N°: 1760-24-3

SIDS Initial Assessment Report

For

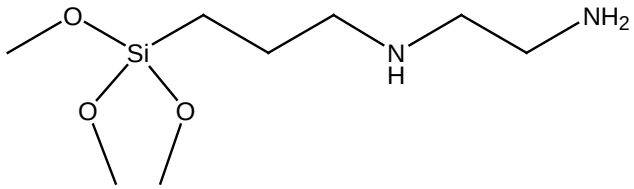
SIAM 17

Arona, Italy, 11-14 November 2003

1.	**Chemical Name:**	N-(3-(trimethoxysilyl)propyl)ethylenediamine (AEAPTMS)
2.	**CAS Number:**	1760-24-3
3.	**Sponsor Country:**	United States
		Oscar Hernandez Director, Risk Assessment Division (7403M) U.S. Environmental Protection Agency 1200 Pennsylvania Ave, N.W. Washington, DC 20460 Phone: 202-564-7641 Email: Hernandez.oscar@epa.gov
4.	**Shared Partnership with:**	**Silicones Environmental Health and Safety Council (SEHSC):** Clariant LSM (Florida), Inc. Degussa Corporation Dow Corning Corporation GE Silicones Rhodia Inc. Shin-Etsu Silicones of America Wacker Silicones, A Division of Wacker Chemical Corporation
5.	**Roles/Responsibilities of the Partners:**	
•	Name of industry sponsor /consortium	Silicones Environmental Health and Safety Council Contact point: Derek Swick SEHSC 703-904-4322 dswick@sehsc.com
•	Process used	The SEHSC produced the documents; EPA reviewed the documents and provided additional information where there were data gaps.
6.	**Sponsorship History**	
•	How was the chemical or category brought into the	Documents were prepared and reviewed by industry prior to submission to sponsor country. Sponsor country conducted

OECD HPV Chemicals Programme ?	reviews of submitted data and offered comments to industry. Industry prepared and resubmitted documents for consideration at SIAM 17. no testing (X) testing ( )
7. Review Process Prior to the SIAM:	The U.S. EPA reviewed this case.
8. Quality check process:	Literature searches were conducted by sponsor country to determine if all relevant data have been included in this submission.
9. Date of Submission:	August 2003
10. Comments:	

SIDS INITIAL ASSESSMENT PROFILE

CAS No.	1760-24-3
Chemical Name	N-[3-(trimethoxysilyl)propyl]ethylenediamine (AEAPTMS)
Structural Formula	

SUMMARY CONCLUSIONS OF THE SIAR

Human Health

The acute oral toxicity of N-[3-(trimethoxysilyl)propyl]ethylenediamine (AEAPTMS) is described by an LD50 in the rat of 2.4 g/kg. The dermal LD_{50} was 16 ml/kg in rabbits. In rabbits, AEAPTMS is moderately irritating to the skin and severely irritating to the eyes. AEAPTMS showed a skin sensitizing potential in a guinea pig maximization test.

AEAPTMS was tested in rats in a combined repeated dose toxicity test with a reproductive/developmental screening test, following the OECD test guideline 422 (28-39 days). Clinical findings attributed to the test substance included clear perioral soiling in several high dose animals and either increased nasal sounds, labored respiration, or soft vocalizations in approximately half of the high dose females and one high dose male. These signs were not seen in the control animals and infrequently seen in either of the two lower dose groups. Observations recorded at dosing indicated a dose-related resistance to dosing. Evaluating all 30 animals/dose over the entire dosing period, the incidence of resistance was 3, 5, 27 and 62% for the controls, 25, 125 and 500 mg/kg bw/day dose groups, respectively. Similar incidence patterns were noted for salivation just prior to dosing, wetness around the mouth at dosing, and wetness around the mouth 5-30 minutes following dosing. These clinical findings are anticipated based on the amine-functionality of the material and indicative of irritation, rather than systemic effects. There were no test substance-related effects on body weight, organ weights or organ-to-body weight ratios, food consumption, FOB or motor activity parameters, or hematology or serum chemistry parameters, and no macroscopic or microscopic findings were attributed to the test-substance. Based on the results of this study, the NOAEL for the systemic toxicity of this material in the rat via oral dosing for at least 28 consecutive days was considered to be 500 mg/kg bw/day.

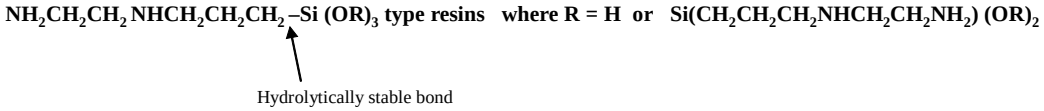
AEAPTMS has been tested in an Ames test, an *in vitro* Chinese hamster ovary cell HGPRT assay and sister chromatid exchange assay, and an *in vivo* mouse micronucleus assay. These *in vivo* and *in vitro* screening assays have not revealed any evidence of genotoxic potential of AEAPTMS.

Rats exposed to AEAPTMS by gavage to doses of 0, 25, 125, and 500 mg/kg bw/day, as part of an OECD guideline 422 study, no test substance-related effects were observed in any of the reproductive parameters evaluated. Based on the results of this reproductive/developmental screening study, the NOAEL for maternal (systemic toxicity) and developmental toxicity of AEAPTMS in the rat via the oral dosing was 500 mg/kg bw/day (the highest dose tested).

Environment

The vapor pressure is 0.002 hPa at 20 °C, the melting point is -38 °C and the boiling point is 264 °C at 1013 hPa. The estimated partition coefficient LogKow is 1.67 and the estimated water solubility is $1x10^6$ mg/l; these values may not be applicable because the material is hydrolytically unstable. The half-life in the atmosphere due to the reaction with photochemically induced OH radicals is estimated to be approximately one hour. However, photodegradation as a mode of removal is unlikely because AEAPTMS is hydrolytically unstable. Photodegradation of the parent silane is not expected to be a significant degradation process in the aquatic environment due to the rapid rate of hydrolysis.

AEAPTMS is hydrolytically unstable ($t_{1/2}$ < 1 hour) over a range of environmentally relevant pH and temperature conditions. At pH 7, the half-life = 0.025 hours. Rapid hydrolysis of this material produces methanol and trisilanols. The Si-C bond will not further hydrolyze. That bond is hydrolytically stable and the aminopropyl group will not cleave. Only the methoxy groups will be hydrolyzed. The transient silanol groups will condense with other silanols to yield:



As a result, aminoethylaminopropyl-functional resins are generated. The EQC Level III model was used to evaluate the fate, transport and distribution of AEAPTMS between environmental matrices. Level III fugacity modeling, using loading rates for air, soil, and water of 1000 kg/h for each media, shows the following percent distribution for AEAPTMS: air = 31.3%; soil = 63.6%; water = 5.2 %; sediment = 0.00 %. However, AEAPTMS is unlikely to be found in the environment, as this material is hydrolytically unstable. AEAPTMS is not readily biodegradable, the observed biodegradation (39% after 28 days) is of the hydrolysis products (methanol and trisilanols). The rapid hydrolysis of AEAPTMS means that it is unlikely to be present in the environment. Bioaccumulation is not anticipated since this material is hydrolytically unstable.

In spill conditions, the concentration of the parent silane is very high. The silanol concentration could also be high; however, the silanol rapidly self-condenses to form water insoluble, resinous oligomers and polymers. The molecular weight of the resulting oligomers and polymers is predicted to be over 1000. Anecdotal evidence suggests the molecular weight of the polymers resulting from spills is 5000 – 10000. As the parent silane and the resulting silanol are diluted, it is predicted that the polymers resulting from condensation will be of lower molecular weight. At sufficiently low silanol concentrations, low MW oligomers are favored. It is calculated that at 1000 ppm of a related trialkoxysilane, the equilibrium concentration will be 86% silanol monomer and 14% silanol dimer. At still lower concentrations, the silanol will exist as the uncondensed monomer. These polymers will not be bioavailable. However, such materials are likely to cause toxicity in aquatic species due to physical effects (encapsulation, blockage of gills). The 96-hour LC50 of AEAPTMS for three species of freshwater fish (*Lepomis macrochirus*, *Oncorhynchus mykiss* and *Pimephales promelas*) is greater than 100 mg/L. The 48 hour EC50 is 90 mg/L for the water flea (*Daphnia magna*). The EC50s for freshwater green algae *Selenastrum capricornutum* (green algae) are 5.5 mg/l for the 72-hour EbC50 and 8.8 mg/l for the 72-hour ErC50. Since AEAPTMS is sensitive to hydrolysis, which may occur during preparation of the dosing solutions and/or during the testing, the observed toxicity is likely due to the hydrolysis products methanol and trisilanols.

Exposure

The commercial uses of this material include various applications such as coupling agents and adhesion promoters in fiberglass, adhesives and sealants, foundry resins, and in pre-treatment for coatings. In production, this material is mostly handled in closed systems. Necessary engineering controls during production include proper ventilation, containment, safety equipment and actual hardware designed to minimize exposure through splashing, or exposure to the air. Transfer of this material is in closed pipes rather than in open systems to minimize loss of this material (hydrolysis) although some customers do transfer the material in open systems. AEAPTES is transported from the production site as the parent silane to processors/formulators. Generally, AEAPTMS is used by the processor/formulator at levels <1%. In some applications, AEAPTMS is used as a crosslinker; these use levels are higher and can approach 3 to 5 %. Once AEAPTMS is added to a consumer or industrial product, the parent silane reacts with the components of the formulation and is generally present as the parent silane at 0.1-0.2% until after curing (use). After curing the parent silane is consumed into the polymer matrix and no longer exists, which greatly reduces the potential for consumer or worker exposure. AEAPTMS polymerizes during use. Consumer products will be labeled as containing a sensitizer according to individual member country regulations. Any toxicological effects originating from the alkoxysilane or amine groups of the silane are greatly reduced as a result of this coupling process. The annual production volume of AEAPTMS in the Sponsor country was 871 tonnes in 2002.

RECOMMENDATION

The chemical is currently of low priority for further work.

RATIONALE FOR THE RECOMMENDATION AND NATURE OF FURTHER WORK RECOMMENDED

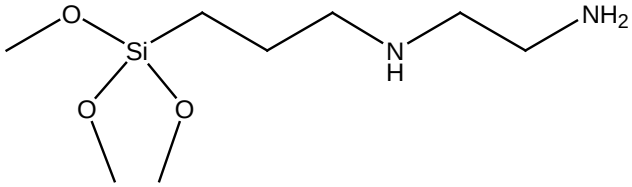
The chemical possesses properties indicating a hazard for human health (skin sensitization and skin and eye irritation) and to the environment (acute toxicity to algae). Based on data presented by the Sponsor country, adequate risk management measures are being applied, exposure to humans and the environment is anticipated to be low, and therefore this chemical is currently a low priority for further work.

SIDS Initial Assessment Report

1 IDENTITY

1.1 Identification of the Substance

CAS Number: 1760-24-3
IUPAC Name: 1,2-ethanediamine, N-[3-(trimethoxysilyl)propyl]-
Molecular Formula: C8H22N2O3Si
Structural Formula:



Molecular Weight: 222
Synonyms: AEAPTMS
(Trimethoxysilylpropyl)ethylenediamine
1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]-
3-[[[N-(2-Aminoethyl)amino]propyl]trimethoxy]silane
A-1120
AP 132
Dow Corning Z-6020 Silane
Ethylenediamine, N-[3-(trimethoxysilyl)propyl]-
KBM 603
N-(2-Aminoethyl)-3-(aminopropyl)trimethoxysilane
N-(2-Aminoethyl)-3-propylaminotrimethoxysilane
N-[(Trimethoxysilyl)propyl]ethylenediamine
N-[3-(Trimethoxysilyl)propyl]-1,2-ethylenediamine
N-[3-(Trimethoxysilyl)propyl]-ethylenediamine
SH 6020
Silicone A-1120
Trimethoxy[3-[(2-aminoethyl)amino]propyl]silane
[.gamma.-(.beta.-Aminoethylaminopropyl)]trimethoxysilane
[3-[(2-Aminoethyl)amino]propyl]trimethoxysilane
[N-(.beta.-Aminoethyl)-.gamma.-aminopropyl]trimethoxysilane

1.2 Purity/Impurities/Additives

Purity: >70 to 94 %

Impurities: Related siloxanes and silane esters (<30 %); Methanol (0.8 to <3%); Oligomers of aminoalkylmethoxysilanes (18 %)

1.3 Physico-Chemical properties

Table 1 Summary of physico-chemical properties

Property	Value	Comment
Physical state	Liquid	
Melting point	<-36°C	
Boiling point	264 deg C @ 1013 hPa	Menzie (1958), Smith (1986).
Relative density	1.03 @ 25°C	
Vapour pressure	0.4 hPa @ 20°C	Menzie (1958), Smith (1986), Flaningam and Smith (1994),
Water solubility	1 E-06 mg/L @ 25°C	Estimated. This value may not be applicable because the material is hydrolytically unstable
Partition coefficient n-octanol/water (log value)	- 1.67	Estimated. This value may not be applicable because the material is hydrolytically unstable
Henry's law constant	Not available	

2 GENERAL INFORMATION ON EXPOSURE

Human or environmental exposure to N-[(trimethoxysilyl)propyl]ethylenediamine (AEAPTMS) is limited to accidental acute exposures In production, this material is mostly handled in closed systems. Necessary engineering controls during production include proper ventilation, containment, safety equipment and actual hardware designed to minimize exposure, through splashing, or exposure to the air. Transfer of this material is in closed pipes rather than in open systems to minimize loss of this material (hydrolysis) although some customers do transfer the material open systems. AEAPTMS is transported from the production site as the parent silane to processors/formulators. After curing the parent silane is consumed into the polymer matrix and no longer exists and greatly reduces potential for consumer or worker exposure.

AEAPTMS is sensitive to hydrolysis, which may occur during testing, such that observed toxicity is likely due to the hydrolysis products methanol and trisilanols.

2.1 Production Volumes and Use Pattern

Production volume = 871 tonnes in 2002 (in the Sponsor Country). AEAPTMS is produced in North America, Europe and Asia.

The commercial uses of this material are numerous and include various applications such as coupling agents and adhesion promoters in fiberglass, adhesives and sealants, foundry resins, and in pre-treatment for coatings. This material is not sold in consumer markets.

As coupling agents and adhesion promoters, AEAPTMS is intentionally converted by hydrolysis to the trisilanols, which then bond molecularly to inorganic substrates. During hydrolysis, the methoxy- group is liberated as methanol. The silane-modified surfaces of these inorganic substrates become incorporated within polymeric resins by a chemical reaction with the amine group. This completes the coupling process. Since the amino-functional silane is converted and bound within the substrate by polymer coupling, free silane is not present within the final products.

The commercial uses of this material include various applications such as coupling agents and adhesion promoters in fiberglass, adhesives and sealants, foundry resins, and in pre-treatment for coatings. In production, this material is mostly handled in closed systems. Necessary engineering controls during production include proper ventilation, containment, safety equipment and actual hardware designed to minimize exposure through splashing, or exposure to the air. Transfer of this material is in closed pipes rather than in open systems to minimize loss of this material (hydrolysis) although some customers do transfer the material in open systems. AEAPTMS is transported from the production site as the parent silane to processors/formulators. Generally, AEAPTMS is used by the processor/formulator at levels <1%. In some applications, AEAPTMS is used as a crosslinker; these use levels are higher and can approach 3 to 5 %. Once AEAPTMS is added to a consumer or industrial product, the parent silane reacts with the components of the formulation and is generally present as the parent silane at 0.1-0.2% until after curing (use). After curing the parent silane is consumed into the polymer matrix and no longer exists, which greatly reduces the potential for consumer or worker exposure. AEAPTMS polymerizes during use.

2.2 Environmental Exposure and Fate

2.2.1 Sources of Environmental Exposure

The reactive nature of this material destroys the parent material in any moisture-containing environment, thus limiting environmental exposure to the silane. The parent material is hydrolyzed

in a spill situation; the rapid hydrolysis means that the parent silane is unlikely to be found in the environment. In an accidental release situation, monomer concentrations would usually be expected to be high enough so that polymerisation will occur without much production of the free triol. However, if AEAPTMS monomer is slowly released into the environment such that resulting concentrations of the parent compound are low, it is less likely that polymerisation will occur and more likely that free triol or short-chain oligomers will result. The spectrum of by-products will depend upon the initial concentration of the parent compound. It is anticipated that, in an accidental release, the initial concentration will be high, not favouring triol production. (Hopefully, this wording will satisfy the commenters that insist on using the triol to predict bioaccumulation, etc. - i.e., there probably won't be much triol formed)

2.2.2 Photodegradation

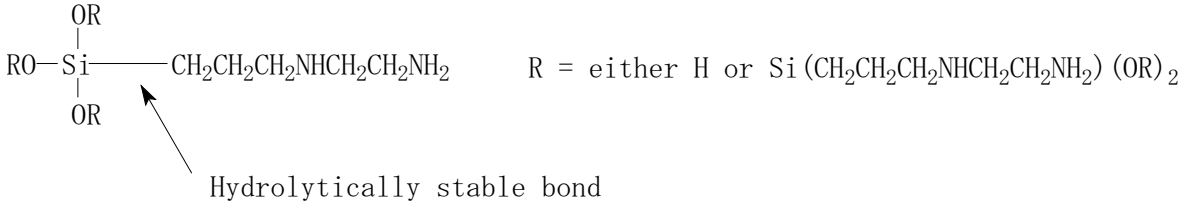
The hydroxyl radicals reaction was calculated using EpiWin version 3.10. The overall OH rate constant is 1.21E-10 cm3/molecule-sec with a half-life = 1 hour. The overall half-life will be even shorter, as concurrent hydrolysis is also occurring. However, because of the rapid hydrolysis of this material with moisture in the atmosphere, photolysis in the atmosphere is not predicted to be a significant mode of removal and should be considered secondary to hydrolysis. In addition, the parent silane contains no chromophors that would absorb visible or UV radiation so no direct photolysis reactions are predicted. The trisilanol resulting from hydrolysis in the atmosphere is similarly not predicted to undergo direct photolysis but could react with hydroxyl radicals or ozone.

2.2.3 Stability in Water

AEAPTMS is hydrolytically unstable ($t_{1/2}$ < 1 hour) over a range of environmentally relevant pH and temperature conditions (Kozerski and Tecklenburg, 2001):

	Half life (hours)		
pH	@10 deg C	@24.7 deg C	@37 deg C
4.0	0.23	0.10	0.066
5.0	1.5	0.32	0.26
7.0	0.10	0.025	0.0090

Rapid hydrolysis of this material produces methanol and trisilanols. The half-lives refer to the reaction to the mono-ol and the mono- and di-ol hydrolyze on a timescale similar to the silane. The Si-C bond will not undergo further hydrolysis. The Si-C bond is hydrolytically stable and the aminopropyl group will not cleave. Only the methoxy groups will be hydrolyzed. The transient silanol groups will condense with other silanols to yield:



As a result, aminopropyl-functional resins are generated.

2.2.4 Transport between Environmental Compartments

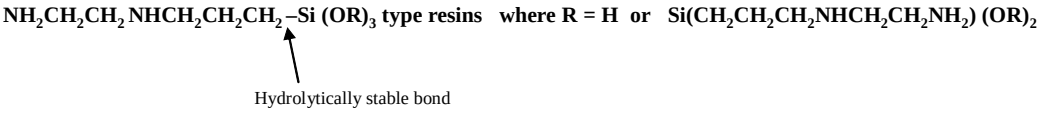
The EQC Level III Fugacity model (USEPA, 2000) was used to evaluate the fate, transport and distribution of AEAPTMS between environmental matrices. Level III Fugacity modelling, using loading rates for Air, Soil, and Water of 1000 kg/h for each media, shows the following percent distribution: Air = 31.3%; Soil = 63.6%; Water = 5.2 %; Sediment = 0.00 %. However, AEAPTMS is unlikely to be found in the environment, as this material is hydrolytically unstable.

2.2.5 Biodegradation

Available data (Huls AG, 1994) indicate that AEAPTMS is not "readily biodegradable" with degradation being 39% after 28 days. Based on the rapid hydrolysis of this material, the observed biodegradation is actually of the hydrolysis products (methanol and trisilanols - the hydrolysis products of the parent substance, AEAPTMS). AEAPTMS has a hydrolytic half-life of 1.5 min at 25 ºC and pH 7.0. Consequently, the only biodegradable materials in the test system will be methanol, the silanetriol, and condensed silanetriol materials. Total percent degradation is equal to the combined percent degradation of each material and the overall rate of degradation determined by the material that degrades most rapidly. The observation that total percent degradation reached a plateau after 7 days suggests that most of the degradation was associated with methanol. Methanol is degraded 76% in 5 days and 95% in 20 days; it is readily biodegradable.

2.2.6 Bioaccumulation

Bioaccumulation is not anticipated since this material is hydrolytically unstable. Rapid hydrolysis of this material produces methanol and trisilanols. The Si-C bond will not undergo further hydrolysis. That bond is hydrolytically stable and the aminopropyl group will not cleave. Only the methoxy groups will be hydrolyzed. The transient silanol groups will condense with other silanols to yield:



As a result aminoethylaminopropyl-functional resins are generated.

If the silane is slowly released such that the concentration of the resulting aminopropyl-functional silanetriol is not high enough to result in polymerization, the trisilanol will exist largely as a monomer. The monomer is known to be water soluble by virtue of the three hydroxy groups on the silicon. It is expected that this silanetriol will have a low Kow because of these hydroxy groups and so is not expected to bioaccumulate. The water solubility of the silanetriol can not be measured because of the tendency to condense at concentrations greater than 500 ppm. It is known however that the silanetriol and small condensation products will only precipitate out of water due to formation of larger, water insoluble polymeric resins.

2.3 Human Exposure

2.3.1 Occupational Exposure

In production, this material is mostly handled in closed systems. Necessary engineering controls during production include proper ventilation, containment, safety equipment and actual hardware designed to minimize exposure, through splashing, or exposure to the air. Transfer of this material

is in closed pipes rather than in open systems to minimize loss of this material (hydrolysis) although some customers do transfer the material open systems. Transport is a source of potential exposure through accidental releases. The material is shipped via air, road, and marine in returnable intermediate bulk containers (IBCs), drums, (plastic and steel) pails, cans, and non-returnable IBCs.

A worker may be exposed at the customer level to very low levels (generally <1%) of the silane during the preparation of the coating, sealant, etc. and to a much less extent, during its use in the final product. The low final percentage in the product (generally 0.1-0.2%) reflects the fact that this material is designed to be reactive and to not survive the application processing at the customer level. Potential routes of exposure for workers include dermal contact, although the MSDS properly warns against contact with the skin. There is no known production process that involves aerosolized material or sprayed material. Customers who manufacture treated fillers may spray the silane onto the filler. In coatings that are applied by spraying, very low levels of free silane may be present (generally 0.1-0.2%). In a spray application (for example, for a coating), the material sprayed is a pre-polymer of a silane at a very low concentration (again, (generally 0.1-0.2%). No free parent silane would be available for aerosol inhalation. The vapour pressure of this material is low enough that vapour inhalation is not considered a potential route of exposure.

2.3.2 Consumer Exposure

The use of AEAPTMS into the consumer market is limited; it is used in caulks as well as coatings (for example, paint for outdoor furniture). The substance is used at generally <1% in these formulations. Once added to the formulation, the final product will contain generally 0.1-0.2% parent silane; the remainder of the added substance will have reacted with the other components of the formation and is no longer present. After curing the parent silane is consumed into the polymer matrix and no longer exists, greatly reducing the potential for consumer exposure. In a final consumer product that utilizes an industrial sealant or coating, the inherent retention of the material is extremely low to the dual reactivity (both hydrolysis and curing). The curing time will vary among applications. Dermal exposure is a potential route for consumers. However, after curing the parent silane is consumed into the polymer matrix and no longer exists; this greatly reduces the potential for consumer exposure.

3 HUMAN HEALTH HAZARDS

3.1 Effects on Human Health

3.1.1 Toxicokinetics, Metabolism and Distribution

No data available.

3.1.2 Acute Toxicity

This material has been tested for acute toxicity by the oral and dermal routes of exposure.

Oral

The combined LD50 in male and female rats is 2.4 g/kg (Lheritier, M., 1992). Transient clinical signs included subdued behaviour, tremors and diarrhea. In a second study, four groups of rats received 16.0, 8.0, 4.0, or 2.0 ml/kg of undiluted AEAPTMS. There were no signs or symptoms of toxicity and the LD50 was 7.46 ml/kg (UCC, 1966).

Dermal

The dermal LD_{50} was 16 ml/kg in rabbits. Gross pathology indicated congested lungs, liver and spleen and pale kidney. (Union Carbide, 1966)

Studies in Humans

No data available.

3.1.3 Irritation

Skin Irritation

A four hour semi-occlusive application of 0.5 ml undiluted AEAPTMS to 6 rabbits resulted in minor erythema and edema, indicating the substance is non-irritating (Mercier, 1992a). Occlusive application of 0.5 ml undiluted AEAPTMS for 4 hours produced minor to moderate erythema on 6 of 6 rabbits, with minor edema on 4. Desquamation appeared on 3 animals within 3 to 7 days and remained on 2 after 10 days. No erythema or edema was evident at 10 days. These results indicate that these effects are reversible by the final day 10 observation period except for desquamation seen in two animals and that the substance is moderately irritating (Bushy Run Research Center (BRRC), 1985) in rabbits.

Eye Irritation

AEAPTMS is severely irritating to the eye of rabbits. Following the instillation of 0.1 ml undiluted AEAPTMS into 6 rabbit eyes, the average (24+48+72 hrs) was: 3.00 for chemosis to conjunctiva, 2.50 for erythema to conjunctiva, 1.00 for congestion to iris, 2.00 for opacity to cornea. The lesions observed at 72 hours were still observed in 5 out of 6 rabbits examined on Day 21 (Mercier, 1993). In two non-guideline studies, nine rabbits were dosed with 0.1 ml undiluted AEAPTMS. The treated eyes of six animals remained unwashed. The treated eyes of three animals were washed for 1 minute approximately 5 seconds after installation of the test article. The eyes were scored at 24, 48 and 72 hours, and on days 4, 7 and 8-14 after dosing. Corneal necrosis and signs of severe irritation were observed for all animals (ToxiGenics, 1981a, 1981b). This result is expected, as the test material is an aminofunctional silane.

Respiratory Tract Irritation

No data available.

Conclusion

AEAPTMS is moderately irritating to the skin, but is moderately to severely irritating to the eye.

3.1.4 Sensitisation

Skin

In a guinea pig maximization test, 20 animals were induced and challenged with AEAPTMS. This provoked a reaction of cutaneous sensitization in 6 of the 20 animals (30%). Thus, the substance showed a skin sensitizing potential in a guinea pig maximization test (Mercier, 1992b).

Conclusion

AEAPTMS is a moderate skin sensitizer in guinea pigs.

3.1.5 Repeated Dose Toxicity

Oral

AEAPTMS was tested in 10 rats/sex/group in a combined repeated dose toxicity test with a reproductive/developmental screening test, following the OECD test guideline 422 (28-39 days). A histopathologic exam was performed on all gross lesions, adrenals, brain, heart, kidneys, liver, lymph nodes, lungs, spinal cord, spleen, duodenum, jejunum, ileum, cecum, colon, stomach, peripheral nerve, thymus, thyroid, trachea, uterus, urinary bladder, bone marrow, ovaries, prostate and seminal vesicles from control and high dose male and female toxicity group animals. Clinical findings attributed to the test substance included clear perioral soiling in several high dose animals and either increased nasal sounds, labored respiration, or soft vocalizations in approximately half of the high dose females and one high dose male. These signs were not seen in the control animals and infrequently seen in either of the two lower dose groups. Observations recorded at dosing indicated a dose-related resistance to dosing. Evaluating all 30 animals/dose over the entire dosing period, the incidence of resistance was 3, 5, 27 and 62% for the controls, 25, 125 and 500 mg/kg/day dose groups, respectively. Similar incidence patterns were noted for salivation just prior to dosing, wetness around the mouth at dosing, and wetness around the mouth 5-30 minutes following dosing. These clinical findings are anticipated based on the amine-functionality of the material and indicative of irritation, rather than systemic effects. There were no test substance-related effects on body weight, organ weights or organ-to-body weight ratios, food consumption, FOB or motor activity parameters, or hematology or serum chemistry parameters, and no macroscopic or microscopic findings were attributed to the test-substance. Based on the results of this study, the NOAEL for the systemic toxicity of this material in the rat via oral dosing for at least 28 consecutive days was considered to be 500 mg/kg.

Studies in Humans

No data available.

3.1.6 Mutagenicity

In vivo Studies

Five mice/sex/group were dosed once via intraperitoneal injection with 87.5, 175, and 280 mg/kgAPTES. The high dose was equivalent to approximately 80% of the LD50. Blood smears were prepared at 30, 48 and 72 hours post-dosing and peripheral lymphocytes examined. APTES was not clastogenic in an *in vivo* mouse micronucleus assay (Guzzie, 1988).

In vitro Studies

Bacterial mutagenicity tests conducted with AEAPTMS indicate no mutagenic response at any concentration with or without metabolic activation (Guzzie, 1988; Hatano Research, 1977a; Forichon, A. 1992; Kennelly, 1988).

AEAPTMS was evaluated for potential genotoxic activity using the Chinese Hamster Ovary (CHO) Mutation test (Slesinski, 1988). This material did not produce any statistically significant increases in the incidence of mutations of CHO cells within a range of cytotoxic-to-non-cytotoxic concentrations between 2.5 to 4.0 mg/ml in test without a metabolic activation system. With metabolic activation, there was no reproducible increase in mutant incidence. No dose-related trend in mutant values was observed in the test with or without metabolic activation, indicating this material lacks significant genotoxic potential in the CHO/HGPRT system. AEAPTMS did not produce a dose-related increase in the incidence of Sister Chromatid Exchanges (SCEs) in CHO cells both with and without the incorporation of an S9 metabolic activation system (Slesinksi, 1988). Dose levels were 1.5 to 4.0 mg/ml without S9 activation; 1.0 to 3.5 mg/ml with S9 activation. Several of the dose levels in each test produced increases in SCEs which were statistically greater than the incidence of SCEs in the vehicle controls. The low level of the increases and absence of a dose-related trend in the SCE data indicated that the statistical differences did not represent a chemical-related effect.

Conclusion

An in vivo assay and several in vitro studies examining a range of genetic endpoints have not revealed any evidence of genotoxic potential for AEAPTMS.

3.1.7 Carcinogenicity

No data available.

3.1.8 Toxicity for Reproduction

Effects on Fertility

As part of the OECD guideline 422 study previously described in section 3.1.5 Repeated Dose Toxicity (DCC, 2002), female rats in the reproductive group were exposed to AEAPTMS by gavage for up to 39 days to doses of 0 (corn oil), 25, 125, and 500 mg/kg/day. Two females in the 500 mg/kg/day group were sacrificed or found dead in moribund condition. Both of these deaths were attributed to dosing-related errors. Clinical signs attributed to test substance included increased nasal sounds, labored respiration or soft vocalization. These signs were not seen in the control and infrequently seen in either of the two lower dose groups. There was no test substance-related effects on body weight, body weight gain or food consumption. Observations recorded at dosing indicate a dose-related resistance to dosing. No test substance-related effects were observed in any of the reproductive parameters evaluated. Two high dose (500 mg/kg/day) and one low dose (25 mg/kg/day) females that did not produce litters had positive evidence of copulation. Six of the

eight surviving high dose group females produced litters that were similar in all respects to control litters. Based on the results of this reproductive/developmental screening study, the NOAEL for maternal systemic toxicity of AEAPTMS in the rat via the oral dosing was considered to be 500 mg/kg/day.

Developmental Toxicity

As part of the OECD 422 described previously in section 3.1.5 and above (Effects on Fertility) (DCC, 2002), each litter was examined to determine the sex, number of fetuses, still births, runts and the presence of any gross abnormalities. No adverse effects on the number of live fetuses per litter, mean litter size and weights, sex ratio, or fetal body weight were observed. The incidence of fetal resorptions was not altered by the administration of AEAPTMS. The incidences of grossly visible external, visceral and skeletal foetal abnormalities were not altered by AEAPTMS treatment. Based on the results of this reproductive/developmental screening study, the NOAEL for developmental toxicity of AEAPTMS in the rat via the oral dosing was 500 mg/kg/day.

Conclusion

AEAPTMS did not cause reproductive or developmental effects at the highest dose tested, 500 mg/kg bw/day in an OECD guideline 422 study.

3.2 Initial Assessment for Human Health

The acute oral toxicity of N-[3-(trimethoxysilyl)propyl]ethylenediamine (AEAPTMS) is described by an LD50 in the rat of 2.4 g/kg. The dermal LD_{50} was 16 ml/kg in rabbits. In rabbits, AEAPTMS is moderately irritating to the skin and severely irritating to the eyes. AEAPTMS showed a skin sensitizing potential in a guinea pig maximization test.

AEAPTMS was tested in rats in a combined repeated dose toxicity test with a reproductive/developmental screening test, following the OECD test guideline 422 (28-39 days). Clinical findings attributed to the test substance included clear perioral soiling in several high dose animals and either increased nasal sounds, labored respiration, or soft vocalizations in approximately half of the high dose females and one high dose male. These signs were not seen in the control animals and infrequently seen in either of the two lower dose groups. Observations recorded at dosing indicated a dose-related resistance to dosing. Evaluating all 30 animals/dose over the entire dosing period, the incidence of resistance was 3, 5, 27 and 62% for the controls, 25, 125 and 500 mg/kg bw/day dose groups, respectively. Similar incidence patterns were noted for salivation just prior to dosing, wetness around the mouth at dosing, and wetness around the mouth 5-30 minutes following dosing. These clinical findings are anticipated based on the amine-functionality of the material and indicative of irritation, rather than systemic effects. There were no test substance-related effects on body weight, organ weights or organ-to-body weight ratios, food consumption, FOB or motor activity parameters, or hematology or serum chemistry parameters, and no macroscopic or microscopic findings were attributed to the test-substance. Based on the results of this study, the NOAEL for the systemic toxicity of this material in the rat via oral dosing for at least 28 consecutive days was considered to be 500 mg/kg bw/day.

AEAPTMS has been tested in an Ames test, an *in vitro* Chinese hamster ovary cell HGPRT assay and sister chromatid exchange assay, and an *in vivo* mouse micronucleus assay. These *in vivo* and *in vitro* screening assays have not revealed any evidence of genotoxic potential of AEAPTMS.

Rats exposed to AEAPTMS by gavage to doses of 0, 25, 125, and 500 mg/kg bw/day, as part of an OECD guideline 422 study, no test substance-related effects were observed in any of the reproductive parameters evaluated. Based on the results of this reproductive/developmental

screening study, the NOAEL for maternal (systemic toxicity) and developmental toxicity of AEAPTMS in the rat via the oral dosing was 500 mg/kg bw/day (the highest dose tested).

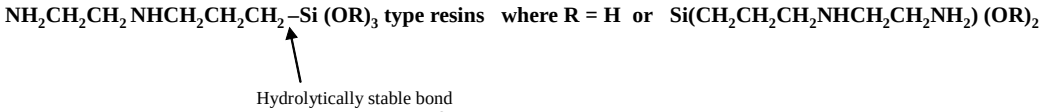
4 HAZARDS TO THE ENVIRONMENT

4.1 Aquatic Effects

The toxicity of AEAPTMS was determined by turbidity/growth procedures where the median inhibition concentration (IC50) is measured after 16 hours of incubation with sewage microorganisms (South Charleston Technical Center Aquatic Laboratory, 1993). The IC50 was 435 mg/l. Note that only a summary of this study was available and insufficient documentation was provided to validate the results. This result is indicative of a very low toxicity.

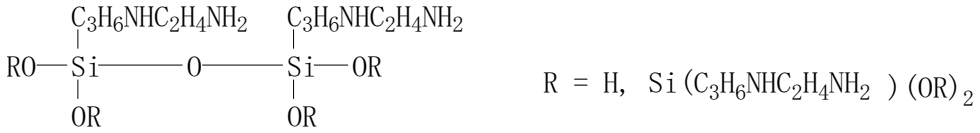
General

AEAPTMS undergoes rapid hydrolysis in aquatic media, and thus the exposures to AEAPTMS per se are likely to be transient. For much of the duration of the tests, the organisms will be exposed to the hydrolysis products, which include methanol and trisilanols. The C-Si bond is hydrolytically stable and the aminopropyl group will not by cleaved. Only the methoxy groups will be hydrolyzed. The transient silanol groups will condense with other silanols to yield:



As a result, aminoethylaminopropyl-functional resins are generated.

In spill conditions, the concentration of the parent silane is very high. The resulting silanol concentration is also high and the silanol rapidly self-condenses to form water insoluble, resinous oligomers and polymers. The molecular weight of the resulting oligomers and polymers is predicted to be over 1000. Anecdotal evidence suggests the molecular weight of the polymers resulting from spills is 5000 – 10000. The structure of the resulting resin (assuming pure silane is spilled) is :



As the parent silane and the resulting silanol are diluted, it is predicted that the polymers resulting from condensation will be of lower molecular weight. At sufficiently low silanol concentrations, low molecular weight oligomers are favored. It is calculated that at 1000 ppm of a related trialkoxysilane, the equilibrium concentration will be 86% silanol monomer and 14% silanol dimer. At still lower concentrations, the silanol will exist as the uncondensed monomer.

Acute Toxicity Test Results

The 96-hour LC50 of AEAPTMS for three species of freshwater fish (*Lepomis macrochirus, Oncorhynchus mykiss* and *Pimephales promelas*) is greater than 100 mg/L. (Annelin and McKinney, 1978, South Charleston Technical Center Aquatic Laboratory, 1993). The 48 hour EC50 is 90 mg/L for the water flea (*Daphnia magna*). (Annelin and McKinney, 1978, Machado, 2002, South Charleston Technical Center Aquatic Laboratory, 1993). The EC50s for freshwater green algae *Selenastrum capricornutum* (green algae) are 5.5 mg/l for the 72-hour EbC50 and 8.8 mg/l for the 72-hour ErC50. (Annelin and McKinney, 1978, Hoberg, J.R., 2002).

Chronic Toxicity Test Results

No data available.

4.2 Terrestrial Effects

No data available.

4.3 Other Environmental Effects

4.4 Initial Assessment for the Environment

The estimated water solubility of AEAPTMS is 1E-06 mg/l, the estimated log Kow of AEAPTMS is 1.67. These values may not be applicable because the chemical is hydrolytically unstable. The vapor pressure is 0.4 hPa @ 20 deg C. The melting point is -36 °C and the boiling point is 264 °C @ 1013 hPa. The half-life in the atmosphere due to the reaction with photochemically induced OH radicals is estimated to be approximately one hour. However, photodegradation as a mode of removal is unlikely because AEAPTMS is hydrolytically unstable. Photodegradation of the parent silane is not expected to be a significant degradation process in the aquatic environment due to the rapid rate of hydrolysis.

AEAPTMS is hydrolytically unstable ($t_{1/2}$ < 1 hour) over a range of environmentally relevant pH and temperature conditions. At pH 7, the half-life is = .025 hours. Rapid hydrolysis of this material produces methanol and trisilanols. The Si-C bond will not undergo further hydrolysis. The Si-C bond is hydrolytically stable and the aminopropyl group will not by cleaved. Only the methoxy groups will be hydrolyzed. The transient silanol groups will condense with other silanols to yield:

R-Si(OR')3 type resins where R = CH2CH2CH2NHC2H4NH2 and R' = either H or Si(R)(OR')

As a result, aminoethylaminopropyl-functional resins are generated.

The EQC Level III model (USEPA, 2000) was used to evaluate the fate, transport and distribution of AEAPTMS between environmental matrices, as recommended by EPA. Level III Fugacity modeling, using loading rates for Air, Soil, and Water of 1000 kg/h for each media, shows the following percent distribution: Air = 31.3%; Soil = 63.6%; Water = 5.2 %; Sediment = 0.00 %. However, AEAPTMS is unlikely to be found in the environment, as this material is hydrolytically unstable. AEAPTMS is not readily biodegradable. Note that hydrolysis of this material occurs rapidly, such that the observed biodegradation is of the hydrolysis products (methanol and trisilanols). The rapid hydrolysis of AEAPTMS means that it is unlikely to be present in the environment. Bioaccumulation is not anticipated since this material is hydrolytically unstable.

In spill conditions, the concentration of the parent silane is very high. The resulting silanol concentration is also high and the silanol rapidly self-condenses to form water insoluble, resinous oligomers and polymers. The molecular weight of the resulting oligomers and polymers is predicted to be over 1000. Anecdotal evidence suggests the molecular weight of the polymers resulting from spills is 5000 – 10000. As the parent silane and the resulting silanol are diluted, it is predicted that the polymers resulting from condensation will be of lower molecular weight. At sufficiently low silanol concentrations, low molecular weight oligomers are favored. It is calculated that at 1000ppm of a related trialkoxysilane, the equilibrium concentration will be 86% silanol monomer and 14% silanol dimer. At still lower concentrations, the silanol will exist as the uncondensed monomer. These polymers will not be bioavailable. Such materials are also likely to cause toxicity due to physical effects (encapsulation, blockage of gills). The 96-hour LC50 of AEAPTMS for three species of freshwater fish (*Lepomis macrochirus*, *Oncorhynchus mykiss* and *Pimephales promelas*)

is greater than 100 mg/L. The 48 hour EC50 is 90 mg/L for the water flea (*Daphnia magna*). The EC50s for freshwater green algae *Selenastrum capricornutum* (green algae) are 5.5 mg/l for the 72-hour EbC50 and 8.8 mg/l for the 72-hour ErC50. Since AEAPTMS is sensitive to hydrolysis, which may occur during preparation of the dosing solutions and/or during the testing, the observed toxicity is likely due to the hydrolysis products methanol and trisilanols.

5 RECOMMENDATIONS

The chemical is currently of low priority for further work.

The chemical possesses properties indicating a hazard for human health (skin sensitization and skin and eye irritation) and to the environment (acute toxicity to algae). Based on data presented by the Sponsor country, adequate risk management measures are being applied, exposure to humans and the environment is anticipated to be low, and therefore this chemical is currently a low priority for further work.

6 REFERENCES

Annelin, R.B. and C.D. McKinney (1978). Dow Corning Corporation, Report No. 1978-I0005-0589.

BRRC (1985). Various Silane and Silicone Samples, Primary Skin Irritancy Studies (IATA Classification), Report 48-110; September 4, 1985.

Dow Corning Corporation (2002). Report No. 9610. Prepared for the Silicone Environmental, Health and Safety Council.

Flaningam, O.L. and Smith, A.L. (1994). Dow Corning Corporation, Report No. 1994-I0000-39053.

Forichon, A. (1992), Hazelton France. Salmonella typhimurium/Mammalian microsome Plate Incorporation Assay (Ames Test), Report number 203301. Conducted for Wacker Chemie GmbH, 18 August, 1992.

Guzzie, P.J. (1988) Organofunctional Silane A-1120 In Vivo Mouse Micronucleus Study. Bushy Run Research Center Project Report Number 51-55, October 14, 1988.

Hoberg, J.R. (2002). Aminosilane - Toxicity to the Freshwater Green Alga, Pseudokirchneriella subcapitata. Springborn Smithers Laboratories, Wareham, MA. Report No. 12023.6132.

Huls AG (1994). Final Report DDA 85. Determination of the biodegradability of DYNASYLAN DAMO-T in DOC-DIE AWAY TEST. November 3, 1994.

Kennelly, JC (1988) Degussa-Huls AG #: 88-0299-FGM Study to determine the ability of nineteen compounds to induce mutation in three Histidine-requiring strains of Salmonella typhimurium.

Kozerski, G.E. and R.E. Tecklenburg. (2001). Determination of hydrolysis kinetics of N-[2-aminoethyl]-3-aminopropyl-trimethoxysilane as a function of pH and temperature using atmospheric pressure chemical ionization mass spectrometry: final report submitted to the Silicones Environmental, Health and Safety Council of North America (SEHSC). Dow Corning Technical Report 2001-I0000-50153. Dow Corning Corporation, Midland, MI, USA.

Lheritier, M. Hazelton France (1992). Test to Evaluate the Acute Toxicity Following a Single Oral Administration (LD50) in the Rat. Report No. 203308. Study conducted for Wacker Chemie, GmbH, 4 August, 1992.

Machado, M.W. (2002). Aminosilane - Acute Toxicity to Daphnids (Daphnia magna) Under Static Conditions. Springborn Smithers Laboratories, Wareham, MA. Report No. 12023.6133.

Menzie, G.K. (1958). Dow Corning Technical Report 1958-I0030-1625. Dow Corning Corporation, Midland, MI, USA.

Mercier, O. (1992a). Hazleton France. Test to evaluate the acute primary cutaneous irritation and corrositivity in the rabbit. Report number: 201350, Study conducted for Wacker Chemie GmbH.

Mercier, O. (1992b). Hazleton France Test to evaluate sensitizing potential in the guinea-pig. Guinea-pig Maximization Test. Report number: 201380,. Study conducted for Wacker Chemie GmbH, October 19, 1992.

Mercier, O. (1993). Hazleton France. Test to Evaluate the Acute Ocular Irritation and Reversibility in the Rabbit. Hazleton, France. (Hazleton Report No. 51792). 29 January 1993.

Slesinski, R.S. and P.J. Guzzie (1988) Organofunctional Silane A-1120 In Vitro Gentoxicity Studies: CHO/HGPRT Gene Mutation Test/Sister Chromatid Exchange Assay. Bushy Run

Research Center Project Report 51-51, August 15, 1988.

Smith, A.L. (1986). Dow Corning Corporation, Report No. 1986-I0032-53.

South Charleston Technical Center Aquatic Laboratory, (1993). Summary of Ecological Fate and Effects Data: Silane A-1120, EFED3.

Tanaka, Y. (1977) Hatano Institute. Test number 77-017-0107-3. Bacterial Mutagenicity Study with KBM-603.

ToxiGenics (1981a). Primary Eye Irritation Study in Rabbits of X-19381 Aminosilane, Study 410-0745; October 21. 1981.

ToxiGenics (1981b). Primary Eye Irritation Study in Rabbits of X-29381 Aminosilane, , Study 410-0746; October 21. 1981.

Union Carbide (1966) Silane A-1120, N(beta-Aminoethyl) gamma-Aminopropyltrimethoxysilane: Range Finding Toxicity Studies, Mellon Institute, Report 29-107; November 9, 1966.

United States Environmental Protection Agency. (2000). Estimations Programs Interface (EPI) Suite™. The EPI Suite™ and the individual models included within the software are owned and copyright protected by the U.S. Environmental Protection Agency.

I U C L I D

Data Set

Existing Chemical	:	ID: 1760-24-3
CAS No.	:	1760-24-3
EINECS Name	:	N-(3-(trimethoxysilyl)propyl)ethylenediamine
EC No.	:	217-164-6
Molecular Formula	:	C8H22N2O3Si

Producer related part

Company	:	Epona Associates, LLC
Creation date	:	16.06.2003

Substance related part

Company	:	Epona Associates, LLC
Creation date	:	16.06.2003
Status	:	
Memo	:	SEHSC
Printing date	:	11.03.2004
Revision date	:	
Date of last update	:	11.03.2004
Number of pages	:	1
Chapter (profile)	:	Chapter: 1, 2, 3, 4, 5, 6, 7, 8, 10
Reliability (profile)	:	Reliability: without reliability, 1, 2, 3, 4
Flags (profile)	:	Flags: without flag, confidential, non confidential, WGK (DE), TA-Luft (DE), Material Safety Dataset, Risk Assessment, Directive 67/548/EEC, SIDS

1.0.1 APPLICANT AND COMPANY INFORMATION

1.0.2 LOCATION OF PRODUCTION SITE, IMPORTER OR FORMULATOR

1.0.3 IDENTITY OF RECIPIENTS

1.0.4 DETAILS ON CATEGORY/TEMPLATE

1.1.0 SUBSTANCE IDENTIFICATION

IUPAC Name : N-[3-(trimethoxysilyl)propyl]-
Smiles Code : NCCNCCC[Si](OC)(OC)OC
Molecular formula : C8H22N2O3Si
Molecular weight : 222
Petrol class :

26.06.2003

1.1.1 GENERAL SUBSTANCE INFORMATION

Purity type : typical for marketed substance
Substance type : organic
Physical status : liquid
Purity : > 70 - 94
Colour :
Odour :

26.06.2003

1.1.2 SPECTRA

1.2 SYNONYMS AND TRADENAMES

(Trimethoxysilylpropyl)ethylenediamine

17.06.2003

1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]-

17.06.2003

3-[[[N-(2-Aminoethyl)amino]propyl]trimethoxy]silane

17.06.2003

A-1120

17.06.2003

AEAPTMS

14.01.2004

AP 132

17.06.2003

Ethylenediamine, N-[3-(trimethoxysilyl)propyl]-

17.06.2003

KBM 603

17.06.2003

N-(2-Aminoethyl)-3-(aminopropyl)trimethoxysilane

17.06.2003

N-(2-Aminoethyl)-3-propylaminotrimethoxysilane

17.06.2003

N-[(Trimethoxysilyl)propyl]ethylenediamine

17.06.2003

N-[3-(Trimethoxysilyl)propyl]-1,2-ethylenediamine

17.06.2003

N-[3-(Trimethoxysilyl)propyl]-ethylenediamine

17.06.2003

Silane, [3-(2-aminoethyl)aminopropyl]trimethoxy-

17.06.2003

Silicone A-1120

17.06.2003

Trimethoxy[3-[(2-aminoethyl)amino]propyl]silane

17.06.2003

[.gamma.-(.beta.-Aminoethylamino)propyl]trimethoxysilane

17.06.2003

[3-[(2-Aminoethyl)amino]propyl]trimethoxysilane

17.06.2003

[N-(.beta.-Aminoethyl)-.gamma.-aminopropyl]trimethoxysilane

17.06.2003

1.3 IMPURITIES

Purity : typical for marketed substance
CAS-No : 67-56-1
EC-No :
EINECS-Name : Methanol
Molecular formula :
Value : < 3

14.01.2004

Purity : typical for marketed substance
CAS-No :
EC-No :
EINECS-Name : Related siloxanes and silane esters
Molecular formula :
Value : < 30

26.06.2003

Purity : typical for marketed substance
CAS-No :
EC-No :
EINECS-Name : Oligomers of aminoalkylmethoxysilanes
Molecular formula :
Value : = 18

26.06.2003

1.4 ADDITIVES

1.5 TOTAL QUANTITY

Quantity : = 870.759 - tonnes in 2002

Remark : The production volume provided reflects the Sponsor countries production and use. AEAPTMS is produced in North America, Europe and Asia.
Source : SEHSC
Flag : confidential
14.01.2004

1.6.1 LABELLING

1.6.2 CLASSIFICATION

1.6.3 PACKAGING

1.7 USE PATTERN

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

Remark : In the sponsor country:

	Metric Tons	Percent
Use resulting in inclusion into or onto matrix	686.858	78.88
Use in closed systems	168.885	19.40
Non-dispersive use	3.814	1.29
Other (Unknown)	11.202	0.44
Total	870.759	10

Source : SEHSC
15.01.2004

Type of use : use
Category :

Remark : The use of AEAPTMS into the consumer market is limited; it is used in caulks as well as coatings (for example, paint for outdoor furniture). The substance is used at generally <1% in these formulations. Once added to the formulation, the final product will contain generally 0.1-0.2% parent silane; the remainder of the added substance will have reacted with the other components of the formation and is no longer present. After curing the parent silane is consumed into the polymer matrix and no longer exists, greatly reducing the potential for consumer exposure. In a final consumer product that utilizes an industrial sealant or coating, the inherent retention of the material is extremely low to the dual reactivity (both hydrolysis and curing). The curing time will vary among applications. Dermal exposure is a potential route for consumers. However, after curing the parent silane is consumed into the polymer matrix and no longer exists; this greatly reduces the potential for consumer exposure.
14.01.2004

1.7.1 DETAILED USE PATTERN

Industry category : 15/0 other
Use category : 55/0 other
Extra details on use category : No extra details necessary
No extra details necessary
Emission scenario document : not available
Product type/subgroup :
Tonnage for Application :
Year :
Fraction of tonnage for application :

Fraction of chemical in formulation :
Production **:** :
Formulation **:** :
Processing **:** :
Private use **:**
Recovery **:**

Remark **:** Industry Category:

Industry Category	Metric Tons	%
Chemical industry: chemicals used in synthesis;	12.99	1.49
Electrical/electronic engineering industry;	14.50	1.67
Polymers industry;	225.38	25.88
Textile processing industry;	34.00	3.9
Paints, lacquers and varnishes industry;	40.09	4.6
Other;		
Other Sealant	535.72	61.5
Other Automotive	3.36	0.39
Other (Construction industry, roof coatings)	0.90	0.1
Other unknown	3.81	0.44
TOTAL	870.75	99.97

Use Category:

	Metric Tons	%
Adhesive, binding agents;	271.024	31.13
Surface-active agents;	15.391	1.77
Vulcanizing agents;	35.911	4.12
0ther		
Other (Adhesion Promoter)	535.720	61.52
Other (Aerospace coating)	12.712	1.46
Total	870.758	100.00

Source **:** Lesser Ketones Manufacturing Association Leesburg, VA 07.05.2003

1.7.2 METHODS OF MANUFACTURE

1.8 REGULATORY MEASURES

1.8.1 OCCUPATIONAL EXPOSURE LIMIT VALUES

1.8.2 ACCEPTABLE RESIDUES LEVELS

1.8.3 WATER POLLUTION

1.8.4 MAJOR ACCIDENT HAZARDS

1.8.5 AIR POLLUTION

1.8.6 LISTINGS E.G. CHEMICAL INVENTORIES

1.9.1 DEGRADATION/TRANSFORMATION PRODUCTS

1.9.2 COMPONENTS

1.10 SOURCE OF EXPOSURE

Source of exposure : Human: exposure of the consumer/bystander
Exposure to the : Substance

Remark : The use of AEAPTMS into the consumer market is limited; it is used in caulks as well as coatings (for example, paint for outdoor furniture). The substance is used at generally <1% in these formulations. Once added to the formulation, the final product will contain generally 0.1-0.2% parent silane; the remainder of the added substance will have reacted with the other components of the formation and is no longer present. After curing the parent silane is consumed into the polymer matrix and no longer exists, greatly reducing the potential for consumer exposure. In a final consumer product that utilizes an industrial sealant or coating, the inherent retention of the material is extremely low to the dual reactivity (both hydrolysis and curing). The curing time will vary among applications. Dermal exposure is a potential route for consumers. However, after curing the parent silane is consumed into the polymer matrix and no longer exists; this greatly reduces the potential for consumer exposure.

14.01.2004

Source of exposure : Human: exposure by production
Exposure to the : Substance

Remark : The use of AEAPTMS into the consumer market is limited; it is used in caulks as well as coatings (for example, paint for outdoor furniture). The substance is used at generally <1% in these formulations. Once added to the formulation, the final product will contain generally 0.1-0.2% parent silane; the remainder of the added substance will have reacted with the other components of the formation and is no longer present. After curing the parent silane is consumed into the polymer matrix and no longer exists, greatly reducing the potential for consumer exposure. In a final consumer product that utilizes an industrial sealant or coating, the inherent retention of the material is extremely low to the dual reactivity (both hydrolysis and curing). The curing time will vary among applications. Dermal exposure is a potential route for consumers. However, after curing the parent silane is consumed into the polymer matrix and no longer exists; this greatly reduces the potential for consumer exposure.

14.01.2004

Source of exposure : Human: exposure of the operator by intended use
Exposure to the : Substance

Remark : A worker may be exposed at the customer level to very low levels

(generally <1%) of the silane during the preparation of the coating, sealant, etc. and to a much less extent, during its use in the final product. The low final percentage in the product (generally 0.1-0.2%) reflects the fact that this material is designed to be reactive and to not survive the application processing at the customer level. Potential routes of exposure for workers include dermal contact, although the MSDS properly warns against contact with the skin. There is no known production process that involves aerosolized material or sprayed material. Customers who manufacture treated fillers may spray the silane onto the filler. In coatings that are applied by spraying, very low levels of free silane may be present (generally 0.1-0.2%). In a spray application (for example, for a coating), the material sprayed is a pre-polymer of a silane at a very low concentration (again, (generally 0.1-0.2%). No free parent silane would be available for aerosol inhalation. The vapour pressure of this material is low enough that vapour inhalation is not considered a potential route of exposure.

14.01.2004

Source of exposure : other: Environment: General
Exposure to the : Substance

Remark : The reactive nature of this material destroys the parent material in any moisture-containing environment, thus limiting environmental exposure to the silane. The parent material is hydrolyzed in a spill situation; the rapid hydrolysis means that the parent silane is unlikely to be found in the environment.

14.01.2004

1.11 ADDITIONAL REMARKS

Memo : According to the EEC Directive 91/325 no risk symbol or sentence is required.

15.01.2004

1.12 LAST LITERATURE SEARCH

1.13 REVIEWS

2.1 MELTING POINT

Value : < -36 °C
Sublimation :
Method :
Year : 2001
GLP : no data
Test substance : as prescribed by 1.1 - 1.4

Source : Epona Associates, LLC
Test condition : At standard temperature and pressure
Test substance : Silquest A-1120 silane is >70% CAS No 1760-24-3
Reliability : (2) valid with restrictions
Flag : Critical study for SIDS endpoint
15.01.2004 (7)

2.2 BOILING POINT

Value : = 264 °C at 1013 hPa
Decomposition : ambiguous
Method : other: calculated
Year : 1986
GLP : no
Test substance : as prescribed by 1.1 - 1.4

Result : Coefficients for the Halm-Stiel equation were derived from regression of the following measured vapor pressure data (Menzie 1958):

T (°C)	P (mm Hg)	P (Pa)
121.0	5	667
137.0	10	1333
145.7	15	2000
159.2	25	3333
162.8	30	3999
170.9	40	5332
175.6	50	6665
180.6	60	7998
186.6	70	9331
190.9	80	10664
193.9	90	11997

Source : Lesser Ketones Manufacturing Association Leesburg, VA
Test condition : The best-fitting Halm-Stiel vapor pressure equation was used to extrapolate boiling point from vapor pressures measured at temperatures ranging from 121-194°C. The resulting boiling point is in agreement with values from peer review publications.
Test substance : N-(2-aminoethyl)-3-aminopropyltrimethoxysilane (CAS No. 1760-24-3)
Conclusion : Although the Halm-Stiel equation is valid for interpolations, serious error may result from extrapolations outside the limits of measured data. Hence, significant error may be associated with the reported boiling point for the test substance (CAS No. 1760-24-3). Nonetheless, the result is comparable to values obtained from the literature and other studies (see Supporting Data).
Reliability : (2) valid with restrictions
Review of the study report and raw data indicate that the

results are scientifically defensible and adequate for assessing the boiling point of the test substance (CAS No. 1760-24-3). The study is considered to be reliable with the following restrictions:
· study was not conducted under GLP
· purity of test substance was not documented
· methods used to generate vapor pressure/temperature data were not documented

Flag : Critical study for SIDS endpoint
15.01.2004 (29) (37)

Value : = 259 °C at 1013 hPa
Decomposition :
Method : other: calculated
Year : 1986
GLP : no
Test substance : as prescribed by 1.1 - 1.4

Remark : The best-fitting Halm-Stiel vapor pressure equation was used to extrapolate boiling point from vapor pressures measured at temperatures ranging from 121-194 deg C.
Source : Epona Associates, LLC
Reliability : (2) valid with restrictions
11.03.2004 (40)

Value : = 260 °C at 1013 hPa
Decomposition :
Method :
Year :
GLP : no data
Test substance : as prescribed by 1.1 - 1.4

Source : Epona Associates, LLC
Reliability : (2) valid with restrictions
15.01.2004 (16)

Value : = 275 °C at 1013 hPa
Decomposition :
Method :
Year : 1994
GLP : no data
Test substance : as prescribed by 1.1 - 1.4

Source : Epona Associates, LLC
Test condition : Extrapolated boiling point (Antoine equation)
Reliability : (2) valid with restrictions
15.01.2004 (13)

Value : = 275 °C at 1013 hPa
Decomposition :
Method :
Year : 1994
GLP : no data
Test substance : as prescribed by 1.1 - 1.4

Source : Epona Associates, LLC
Test condition : Extrapolated boiling point (Antoine equation)
Reliability : (2) valid with restrictions
15.01.2004 (13)

2.3 DENSITY

Type : relative density
Value : = 1.03 at 25 °C
Method :
Year : 2001
GLP : no data
Test substance : as prescribed by 1.1 - 1.4

Source : Epona Associates, LLC
Test condition : 1013 hPa
Test substance : Silquest A-1120 silane is >70% CAS No 1760-24-3
Reliability : (2) valid with restrictions
15.01.2004 (7)

2.3.1 GRANULOMETRY

2.4 VAPOUR PRESSURE

Value : = .004 hPa at 20 °C
Decomposition : ambiguous
Method : other (calculated)
Year : 1958
GLP : no
Test substance : as prescribed by 1.1 - 1.4

Result : Measured vapor pressure and temperature data:

T (°C)	P (mm Hg)	P (Pa)
121.0	5	667
137.0	10	1333
145.7	15	2000
159.2	25	3333
162.8	30	3999
170.9	40	5332
175.6	50	6665
180.6	60	7998
186.6	70	9331
190.9	80	10664
193.9	90	11997

The extrapolated vapor pressure of the test substance at 20°C was 0.4 Pa and 0.3 Pa, based on the Halm-Stiel equation (Smith 1986) and the Antoine equation (Flaningam and Smith 1994), respectively.

Source : Lesser Ketones Manufacturing Association Leesburg, VA
Test condition : The Halm-Stiel and Antoine equations were used to extrapolate vapor pressure at 20°C from vapor pressures measured at elevated temperatures ranging from 121-194°C.
Test substance : N-(2-aminoethyl)-3-aminopropyltrimethoxysilane (CAS No. 1760-24-3)
Conclusion Although the Halm-Stiel and Antoine equations are valid for interpolations, serious error may result from extrapolations outside the limits of measured data. Hence, significant error may be associated with the estimated vapor pressure of the test substance (CAS No. 1760-24-3) at 20°C.

Nonetheless, measured vapor pressures obtained at elevated temperatures are comparable to values obtained from other studies (see Supporting Data).

Reliability : (2) valid with restrictions
Review of the study report and raw data indicate that the results are scientifically defensible and adequate for assessing the vapor pressure of the test substance (CAS No. 1760-24-3). The study is considered to be reliable with the following restrictions:
· study was not conducted under GLP
· purity of test substance was not documented
· methods used to generate vapor pressure/temperature data were not documented
· vapor pressure at 20°C is extrapolated from vapor pressures measured at elevated temperatures ranging from 121-194°C.

Flag : Critical study for SIDS endpoint
08.03.2004 (14) (29) (37)

Value : = .0084 hPa at 25 °C
Decomposition :
Method : other (calculated)
Year : 2003
GLP : no
Test substance : as prescribed by 1.1 - 1.4

Result : Vapor pressure (Pa)=0.84 (Extrapolated from temperature-vapor pressure correlation)
Source : Epona Associates, LLC
Test condition : Vapor pressure of N-(2-aminoethyl)-3-aminopropyltrimethoxysilane at 25 °C was extrapolated from a temperature-vapor pressure relationship that was developed using experimental data measured at temperatures ranging from 121-194 °C.
Reliability : (2) valid with restrictions
Flag : Critical study for SIDS endpoint
15.01.2004

Value : = .0004 hPa at 20 °C
Decomposition :
Method :
Year :
GLP : no data
Test substance : as prescribed by 1.1 - 1.4

Source : Epona Associates, LLC
15.01.2004 (8)

Value : = .04 hPa at 20 °C
Decomposition :
Method :
Year :
GLP : no data
Test substance : as prescribed by 1.1 - 1.4

Source : Epona Associates, LLC
08.03.2004 (16)

Value : = 5.33 hPa at 120 °C
Decomposition :

Method :
Year : 1958
GLP : no
Test substance : as prescribed by 1.1 - 1.4

Result : Measured vapor pressures of 533 Pa at 120°C

Source : Epona Associates, LLC
Reliability : (2) valid with restrictions
08.03.2004 (39)

Value : = 20 hPa at 141 °C
Decomposition :
Method :
Year : 1958
GLP : no
Test substance : as prescribed by 1.1 - 1.4

Result : Measured vapor pressure of 2000 Pa at 141°C.
Source : Epona Associates, LLC
Reliability : (2) valid with restrictions
08.03.2004 (9)

2.5 PARTITION COEFFICIENT

Partition coefficient : octanol-water
Log pow : = -1.67 at 25 °C
pH value :
Method : other (calculated)
Year : 2003
GLP : no
Test substance : as prescribed by 1.1 - 1.4

Remark : Log Kow was
estimated using the SAR Model KOWWIN® (version 1.66).
The EQC Level III model (USEPA, 2000) was used to evaluate the fate, transport and distribution of this material between environmental matrices, as recommended by EPA. However, this material is unlikely to be found in the environment as it is hydrolytically unstable.

This value may not be applicable because the material is hydrolytically unstable
Result : Log Kow = -1.67 (Est. value)
Reliability : (2) valid with restrictions
Flag : Critical study for SIDS endpoint
08.03.2004

2.6.1 SOLUBILITY IN DIFFERENT MEDIA

Solubility in : Water
Value : = .001 g/l at 25 °C
pH value :
concentration : at °C
Temperature effects :
Examine different pol. :
pKa : at 25 °C
Description :

Stable	:	
Deg. product	:	
Method	:	other: Estimated
Year	:	2003
GLP	:	no
Test substance	:	as prescribed by 1.1 - 1.4
Remark	:	The EQC Level III model was used to evaluate the fate, transport and distribution of this material between environmental matrices, as recommended by EPA. However, this material is unlikely to be found in the environment as it is hydrolytically unstable. The water solubility of the triol (hydrolysis product) cannot be measured because at relatively low concentrations (a few hundred ppm), the silanol will start to condense. If a water solubility were estimated from a modelling program, it is likely it would be in the % range. At some concentration it will form a precipitate [resin (condensate)]. This value may not be applicable because the material is hydrolytically unstable Water solubility was estimated using the SAR Model WSKOWWIN® (version 1.40).
Result	:	Water solubility (g/m3)=1.0x-106 (or 1.0E-06 mg/liter) @ 25 deg C
Reliability	:	(2) valid with restrictions
Flag	:	Critical study for SIDS endpoint

08.03.2004

2.6.2 SURFACE TENSION

2.7 FLASH POINT

Value	:	= 138 °C
Type	:	closed cup
Method	:	other: Pensky-Martens closed cup ASTM D 93
Year	:	2001
GLP	:	no data
Test substance	:	as prescribed by 1.1 - 1.4
Source	:	Epona Associates, LLC
Test substance	:	Silquest A-1120 silane is >70% CAS No 1760-24-3
Reliability	:	(2) valid with restrictions

15.01.2004 (7)

2.8 AUTO FLAMMABILITY

2.9 FLAMMABILITY

2.10 EXPLOSIVE PROPERTIES

2.11 OXIDIZING PROPERTIES

2.12 DISSOCIATION CONSTANT

2.13 VISCOSITY

2.14 ADDITIONAL REMARKS

3.1.1 PHOTODEGRADATION

Type	:	air
Light source	:	
Light spectrum	:	nm
Relative intensity	:	based on intensity of sunlight
Conc. of substance	:	at 25 °C
DIRECT PHOTOLYSIS		
Halflife t1/2	:	= .1 day(s)
Degradation	:	% after
Quantum yield	:	
INDIRECT PHOTOLYSIS		
Sensitizer	:	
Conc. of sensitizer	:	
Rate constant	:	= .0000000001212176 cm³/(molecule*sec)
Degradation	:	% after
Deg. product	:	
Method	:	other (calculated): EpiWin
Year	:	2003
GLP	:	no
Test substance	:	as prescribed by 1.1 - 1.4
Method	:	Atmospheric Oxidation (25 deg C) [AopWin v1.91]
Remark	:	Photodegradation as a mode of removal is unlikely because AEAPTES is hydrolytically unstable. Photodegradation is not predicted to be a significant degradation process in the aquatic environment due to the rapid rate of hydrolysis. Vapor pressure of AEAPTES indicates that it resides in the atmosphere and may undergo photodegradation due to ozone and/or hydroxyl radicals. However, because of the rapid hydrolysis of this material with moisture in the atmosphere, photolysis in the atmosphere is not predicted to take place. The parent silane contains no chromaphors that would absorb visible or UV radiation so no direct photolysis reactions are predicted. The trisilanol resulting from hydrolysis in the atmosphere is similarly not predicted to undergo direct photolysis but could react with hydroxyl radicals or ozone.
Result	:	Hydroxyl Radicals Reaction: OVERALL OH Rate Constant = 121.2176 E-12 cm3/molecule-sec or 1.21E-10 cm3/molecule-second Half-Life = 0.088 Days (12-hr day; 1.5E6 OH/cm3) Half-Life = 1.059 Hrs Ozone Reaction: No Ozone Reaction Estimation
Source	:	Epona Associates, LLC
Reliability	:	(2) valid with restrictions
Flag	:	Critical study for SIDS endpoint

08.03.2004 (47)

3.1.2 STABILITY IN WATER

Type	:	abiotic
t1/2 pH4	:	= .1 hour(s) at 24.7 °C
t1/2 pH7	:	= 0 hour(s) at 24.7 °C
t1/2 pH9	:	at °C
t1/2 pH 5	:	= .3 hour(s) at 24.7 °C
Deg. product	:	yes
Method	:	OECD Guide-line 111 "Hydrolysis as a Function of pH"

Year : 2000
GLP : no
Test substance : as prescribed by 1.1 - 1.4

Method : OECD 111 and EPA OPPTS 835.2110/835.2130
Remark : Rapid hydrolysis of this material produces methanol and trisilanols. The Si-C bond will not further hydrolyze. That bond is hydrolytically stable and the aminopropyl group will not be cleaved. Only the methoxy groups will be hydrolyzed. The transient silanol groups will condense with other silanols to yield:

R-Si(OR')3 type resins where R = CH2CH2CH2NHC2H4NH2 and R' = either H or Si(R)(OR')

In other words, aminopropyl-functional resins are generated.

The study described was not designed to monitor the subsequent condensation reaction involving the silanetriol hydrolysis product. Evidence for this process, such as unexplained changes in analytical response for the silanetriol, was not observed on the timescale of the hydrolysis experiments. Concentration not directly measured; rate constants extracted from changes in analytical response for each component.

Result :

pH	4.0	5.0	7.0
t1/2 (hours) @			
10.0 °C:	0.23	1.5	0.10
24.7 °C:	0.10	0.32	0.025
37.0 °C:	0.066	0.26	0.0090

Table 1. Kinetic Constants for Hydrolysis Reactions of N-(2-aminoethyl)-3-aminopropyl-trimethoxysilane at 24.7 C.

Constant (units)	1st hydrolysis step	2nd step	3rd step
kH3O+ (M-1 s-1)	16.8	36.0	75.0
kNH3 (s-1)	1.36x10-2	5.24x10-3	NA(a)
k0, est. (s-1)	2.7x10-4	5.2x10-4	5.1x10-3

(a) Data not sufficiently precise for pH>6.4 to yield reliable estimate.

Based on the very rapid hydrolysis rates observed in the pH range 6.1-7.1 relative to a recent study of a similar compound, an alternate reaction mechanism was proposed involving intramolecular general base catalysis by the primary amine. In this pH range, the rate constants for the first and second hydrolysis reactions were shown to vary with hydronium ion concentration.

Over the pH range investigated, the intermediate silanol products (the mono- and di-ol) were observed to hydrolyze on a timescale similar to that of the original tri-alkoxysilane. Consequently, these breakdown products can be considered transient. The stability of the methanol co-product was not considered, but is probably stable under these conditions.

Source : Dow Corning Corporation
Test condition : The consecutive hydrolysis reactions were followed by mass spectrometry using atmospheric pressure chemical ionization (APCI-MS) with direct sample infusion using ammonium acetate and imidazole buffers of varying concentrations. The predominant ions in the mass spectrum were the protonated tri-alkoxysilane (m/z

223), mono- and di-ol intermediate hydrolysis products (m/z 209 and 195, respectively), and final silanetriol product (m/z 181). The data were modeled by multiple linear regression to determine quantitatively the effect of pH, i.e. hydronium ion concentration, and buffer concentration on rates of hydrolysis.

Test substance : N-(2-aminoethyl)-3-aminopropyl-trimethoxysilane [CAS 1760-24-3]

The identity and purity of the test substance were determined during a separate characterization study conducted according to EPA TSCA Good Laboratory Practice Standards (1). The purity of the test material was measured as 94.6%. The major impurity was identified as the cyclic silazane cyclo-[Si(OCH3)2(CH2)3NH(CH2)2NH-].

Conclusion : According to the definition put forth in the test guidelines, the test material was found to be hydrolytically unstable (t1/2<1 year) over a range of environmentally relevant pH and temperature conditions.

Reliability : (1) valid without restriction
(1) valid without restriction

08.03.2004 (3) (23) (34)

3.1.3 STABILITY IN SOIL

3.2.1 MONITORING DATA

3.2.2 FIELD STUDIES

3.3.1 TRANSPORT BETWEEN ENVIRONMENTAL COMPARTMENTS

Type : other: Fugacity Model Level I, II and III
Media : other
Air : 0 % (Fugacity Model Level I)
Water : 100 % (Fugacity Model Level I)
Soil : 0 % (Fugacity Model Level I)
Biota : % (Fugacity Model Level II/III)
Soil : % (Fugacity Model Level II/III)
Method : other: calulated
Year : 2002

Method : The EQC model (Mackay, 1996) was used for all fugacity calculations as recommended by EPA.

Remark : All simulations were conducted at a data temperature of 25 °C using default values of the model for compartment dimensions and properties. If chemical-specific data required for the simulations were not available, estimated values were obtained using structure activity relationship (SAR) models developed by the EPA Office of Pollution Prevention Toxics and Syracuse Research Corporation, as provided with the EPI Suite™ (version 3.10) package. Level-I, -II, and -III fugacitymodels for a Type-1 chemical (i.e., chemicals that partition into all environmental media) were used for the simulations.

Result : Level III Fugacity modeling, using loading rates for Air, Soil, and Water of

1000 kg/h for each media, shows the following percent distribution:

Air = 31.3%
Soil = 63.6%
Water = 5.2 %
Sediment = 0.00 %

Table 1. Physical and chemical properties of N-(2-aminoethyl)-3-aminopropyltrimethoxysilane (CAS No. 1760-24-3).

Molecular weight= 222
Data temperature (°C)= 25
Water solubility (g/m3)=1.0x-106 (Est.value Note1)
Vapor pressure (Pa)=0.84 (Extrapolated from temperature-vapor pressure correlation Note2)
Log Kow = -1.67 (Est. value Note3)
Melting point (°C)=-38 (ref 4)
Half-life in air (h)=0.224 (Est. value Note4)
Half-life in water (h)= 0.025 (Measured at pH 7.0, 25 °C) (ref 5)
Half-life in soil (h)=0.25 (Est. value Note5)
Half-life in sediment(h)= 0.025 (Est. value Note5)

Note 1 Water solubility of N-(2-aminoethyl)-3-aminopropyltrimethoxysilane at 25 °C was estimated using the SAR Model WSKOWWIN® (version 1.40). The model was used as received from the EPA.
Note 2 Vapor pressure of N-(2-aminoethyl)-3-aminopropyltrimethoxysilane at 25 °C was extrapolated from a temperature-vapor pressure relationship that was developed using experimental data measured at temperatures ranging from 121-194 °C.
Note 3 Log Kow of N-(2-aminoethyl)-3-aminopropyltrimethoxysilane at 25 °C was estimated using the SAR Model KOWWIN® (version 1.66). The model was used as received from the EPA.
Note 4 The half-life in air of N-(2-aminoethyl)-3-aminopropyltrimethoxysilane at 25 °C was estimated using the SAR Model APOWIN® (version 1.90). The model was used as received from the EPA.
Note 5 The overall half-life of N-(2-aminoethyl)-3-aminopropyltrimethoxysilane in soil and sediment were estimated as a function of the measured hydrolysis half-life and the estimated rate of biodegradation in water. Biodegradation was estimated using the SAR Model BIOWIN® (version 4.00), as received from the EPA (2). The BIOWIN result for ultimate biodegradation timeframe (2.7567; "weeks") was converted to an estimated half-life in water (360 hours) using the EPA default conversion factors in EPI Suite™. Biodegradation half-life in soil was assumed to be 2 times longer than the BIOWIN estimate for water. Biodegradation half-life in sediment was assumed to be 9 times longer than the BIOWIN estimate for water. The half-life in sediment was assumed to be equal to the measured hydrolysis half-life in water. Because of the decreased activity of water in soil, the hydrolysis half-life in soil was assumed to be 10 times longer than the measured half-life in water.

The measured hydrolysis half-life for N-(2-aminoethyl)-3-aminopropyltrimethoxysilane at pH 7.0 is 0.025 hours at 25 °C. As such, N-(2-aminoethyl)-3-aminopropyltrimethoxysilane will not exist in the environment, but will rapidly hydrolyze to methanol and 3-(2-aminoethyl)aminopropylsilanetriol. The environmental

fate, transport, and distribution of 3-(2-aminoethyl)aminopropylsilanetriol were evaluated to provide a more realistic assessment of N-(2-aminoethyl)-3-aminopropyltrimethoxysilane. Results from the simulation suggest that >99% of the total steady-state mass of 3-(2-aminoethyl)aminopropylsilanetriol will reside in the water and sediment compartments, and will not be found in air or sediment. It is expected that 65-85% of the 3-(2-aminoethyl)aminopropylsilanetriol produced by the steady-state hydrolysis of N-(2-aminoethyl)-3-aminopropyltrimethoxysilane will degrade in about 20-35 days.

Source : Dow Corning Corporation

Test substance : N-(2-aminoethyl)-3-aminopropyltrimethoxysilane (CAS No. 1760-24-3)

Upon contact with water or water vapor, this material generates methanol and the corresponding silanol, 3-(2-aminoethyl)aminopropylsilanetriol. Depending upon concentration, 3(2-aminoethyl)aminopropylsilanetriol will condense to form a highly-cross linked polymeric gel.

Conclusion : If released directly to air, about 70% of the steady-state emission is expected to degrade in air and about 30% expected to partition to and degrade in soil. When released directly to soil or water, 100% of the steady-state emission is expected to degrade in the compartment in which the material was released. Advection from the local environment is expected to be insignificant (£ 0.5% of the steady-state emission) for all emission scenarios. Global persistence of N-(2-aminoethyl)-3-aminopropyltrimethoxysilane in the model system is expected to be < 0.5 hours regardless of the compartment in which the material is released. If released simultaneously to all three compartments (i.e., air, water, and soil), essentially 100% of the steady-state emission degrades in < 0.5 hours. Based on Level-III modeling, it is expected that N-(2-aminoethyl)-3-aminopropyltrimethoxysilane will not be found in the environment.

Reliability : (2) valid with restrictions
(2) Valid with restrictions

Flag : Critical study for SIDS endpoint

05.08.2003 (23) (26) (27) (28) (47)

3.3.2 DISTRIBUTION

3.4 MODE OF DEGRADATION IN ACTUAL USE

3.5 BIODEGRADATION

Type : aerobic
Inoculum :
Contact time : 28 day(s)
Degradation : = 39 (±) % after 28 day(s)
Result : other: not readily biodegradable
Kinetic of testsubst. : 0 hour(s) = 0 %
3 hour(s) = 0 %
7 day(s) = 47 %
14 day(s) = 48 %
28 day(s) = 39 %
Control substance : Benzoic acid, sodium salt

Kinetic	:	28 day(s) > 98 % %
Deg. product	:	
Method	:	other
Year	:	1994
GLP	:	yes
Test substance	:	as prescribed by 1.1 - 1.4
Method	:	DOC-DIE AWAY TEST (EWG Guideline 79/831/EWG, Appendix V, Part C (updated edition dated July 1990), Method C.4-A.
Remark	:	Note that hydrolysis of this material occurs rapidly, such that the observed biodegradation is of the hydrolysis products (methanol and trisilanols). The test substance has a hydrolytic half-life of 1.5 min at 25 ºC and pH 7.0. Consequently, the only biodegradable materials in the test system will be methanol, the silanetriol, and condensed silanetriol materials. Total percent degradation is equal to the combined percent degradation of each material and the overall rate of degradation determined by the material that degrades most rapidly. The observation that total percent degradation reached a plateau after 7 days suggests that most of the degradation was associated with methanol. Methanol is degraded 76% in 5 days and 95% in 20 days; it is readily biodegradable.
Result	:	Degradation % after time: Duplicates run with test article: Flask 1: Percent degradation after 0 and 3 hours, and days 7, 14, 21, 27 and 28 was 0, 0, 47.59, 45.81, 48.98, 48.10, and 41.75%, respectively. Flask 2: Percent degradation after 0 and 3 hours, and days 7, 4, 21, 27 and 28 was 0, 0, 45.74, 49.25, 49.50, 51.75, and 35.84%, respectively. Results: Mean percent degradation for test article: 0, 0, 47, 48, 49, 50, and 39% for 0 and 3 hours, and days 7, 14, 21, 27, and 28 days, respectively. Kinetic (for sample, positive and negative controls): For each time period %, sample % degradation for each time period noted above. For positive control, sodium benzoate, > 98% degradation was reported for each time period in both duplicate samples. For the negative control, % degradation was not calculated, but raw data indicates no degradation at any of the time periods measured. Breakdown products (yes/no): Not analytically available. However, the test material is known to be hydrolytically unstable. When added to water, the test material rapidly hydrolyzes, generating methanol and transient silanetriol derivatives which will crosslink.
Source	:	Degussa
Test condition	:	Analytical method used to measure biodegradation: DOC analyses were in the form of a double determination of oxygen-enriched and de-gassed samples (removal of inorganic carbon), previously centrifuged at 3000 RPM for 15 minutes. The DOC analysis was performed using two-point calibration in a carbon analyzer (Shimadzu).
Test substance	:	Identity: N-(2-aminoethyl)-3-aminopropyltrimethoxysilane (CAS No. 1760-24-3) Material tested: DYNASYLAN DAMO-T Purity/components: 96.0 fluid % CAS No. 1760-24-3
Conclusion	:	Author: DYNASYLAN DAMO-T (96.0 fluid % CAS No. 1760-24-3) achieved a breakdown rate of 39%(DOC reduction) within 28 days. Based on these findings, DYNASYLAN DAMO-T was determined to be "not readily biodegradable". The control

substance, sodium benzoate, achieved a breakdown rate of 98.5% (DOC reduction) within 10 days and > 99% within 28 days. This leads to the conclusion that the culture used possessed adequate biological activity.

Reliability : (1) valid without restriction
Flag : Critical study for SIDS endpoint
08.03.2004 (21)

Type :
Inoculum : other
Contact time : 20 day(s)
Degradation : (±) % after
Result :
Kinetic of testsubst. : %
= %
%
%
%
Deg. product :
Method : other
Year : 1993
GLP : no data
Test substance : as prescribed by 1.1 - 1.4

Method : Standard Methods for the Examination of Water and Wastewater, 16th edition, Public Health Assoc (1985)
Result : Theoretical Oxygen Demand:
Measured ThOD (mg O2/mg compound): 1.76

Biochemical Oxygen Demand:
Day 5, % Biooxidation: 23-25
Day 10, % Biooxidation: 27-30
Day 20, % Biooxidation: 29-30
Source : Epona Associates, LLC
Test condition : Theoretical Oxygen Demand: Calculated value based on oxygen required to oxidize the chemical to carbon dioxide and water.

Biochemical Oxygen Demand: Biooxidation calculated as percentage ratio of BOD to ThOD x 100).
Test substance : 1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3
Conclusion : Only a summary of this study was available and insufficient documentation was provided to validate the results.
Reliability : (4) not assignable
05.08.2003 (38)

3.6 BOD5, COD OR BOD5/COD RATIO

3.7 BIOACCUMULATION

Elimination :
Method : other
Year : 2003
GLP : no
Test substance : as prescribed by 1.1 - 1.4

Remark : Bioaccumulation is not anticipated since this material is hydrolytically unstable. Rapid hydrolysis of this material produces methanol and trisilanols. The Si-C bond will not further hydrolyze. That bond is hydrolytically stable and the aminopropyl group will not be cleaved. Only the methoxy groups will be hydrolyzed. The transient silanol groups will condense with other silanols to yield:

R-Si(OR')3 type resins where R = CH2CH2CH2NHC2H4NH2 and R' = either H or Si(R)(OR')

In other words, aminoethylaminopropyl-functional resins are generated.

If the silane is slowly released such that the concentration of the resulting aminopropyl-functional silanetriol is not high enough to result in polymerization, the trisilanol will exist largely as the monomer. The monomer is known to be water soluble by virtue of the three hydroxy groups on the silicon. It is expected that this silanetriol will have a low Kow because of these hydroxy groups and so is not expected to bioaccumulate. The water solubility of the silanetriol can not be measured because of the tendency to condense at concentrations greater than 500 ppm. It is known however that the silanetriol and small condensation products will only precipitate out of water due to formation of larger, water insoluble polymeric resins.

Source : Epona Associates, LLC
08.03.2004 (33)

3.8 ADDITIONAL REMARKS

4.1 ACUTE/PROLONGED TOXICITY TO FISH

Type	:	Static
Species	:	Lepomis macrochirus (Fish, fresh water)
Exposure period	:	96 hour(s)
Unit	:	mg/l
NOEC	:	= 100
LC50	:	= 200
LOEC	:	= 180
Limit test	:	No
Analytical monitoring	:	No
Method	:	other
Year	:	1978
GLP	:	No
Test substance	:	as prescribed by 1.1 - 1.4
Method	:	EPA-660/3-75-009 (USEPA 1975) Statistical methods: Probit analysis (Finney, 1952)
Remark	:	In spill conditions, the concentration of the parent silane is very high. The silanols concentration could also be high; however, the silanol rapidly self-condenses to form water insoluble, resinous oligomers and polymers. The molecular weight of the resulting oligomers and polymers is predicted to be over 1000. Anecdotal evidence suggests the molecular weight of the polymers resulting from spills is 5000 - 10000. As the parent silane and the resulting silanol are diluted, it is predicted that the polymers resulting from condensation will be of lower molecular weight. At sufficiently low silanol concentrations, low molecular weight oligomers are favored. It is calculated that at 1000ppm of a related trialkoxysilane, the equilibrium concentration will be 86% silanol monomer and 14% silanol dimer. At still lower concentrations, the silanol will exist as the uncondensed monomer. These polymers will not be bioavailable. However, such materials are likely to cause toxicity in aquatic species due to physical effects (encapsulation, blockage of gills). Since APTES is sensitive to hydrolysis, which may occur during preparation of the dosing solutions and/or during the testing, the observed toxicity is likely due to the hydrolysis products ethanol and trisilanols. This material is sensitive to hydrolysis, which may occur during preparation of the dosing solutions and/or during the testing. Rapid hydrolysis of this material produces ethanol and trisilanols. In spill conditions, the concentration of the parent silane is very high. The resulting silanol concentration is also high and the silanol rapidly self-condenses to form water insoluble, resinous oligomers and polymers. The molecular weight of the resulting oligomers and polymers is predicted to be over 1000. Anecdotal evidence suggests the molecular weight of the polymers resulting from spills is 5000 - 10000. As the parent silane and the resulting silanol is diluted, it is predicted that the polymers resulting from condensation will be of lower molecular weight. At sufficiently low silanol concentrations, low MW oligomers are favored. It is calculated that at 1000ppm of a related trialkoxysilane, the equilibrium concentration will be 86% silanol and 14% silanol dimer. At still lower concentrations, the silanol will exist as the uncondensed monomer. An SEHSC member company has provided these results from an internal study on the equilibrium of methylsilanetriol in water. The methylsilanetriol was formed from methyltrimethoxysilane. It is in equilibrium with the dimer, trimer and other higher oligomers depending on the concentration of the

starting methyltrimethoxysilane solution. Based on the equilibrium constants derived from the study, it was calculated that a 1000 ppm solution of methyltrimethoxysilane in water will form an equilibrium solution of roughly 860 ppm silanol monomer and 140ppm silanol dimer.

Due to the insolubility in water of the higher MW oligomers and polymers, testing of such materials is not anticipated. These polymers will not be bioavailable. Such materials are also likely to cause toxicity due to physical effects (encapsulation, blockage of gills). Ecotoxicity of the silanols may be predicted using modeling programs such as ECOSAR.

This material is sensitive to hydrolysis, which may occur during preparation of the dosing solutions and/or during the testing. Rapid hydrolysis of this material produces methanol and trisilanols.

Result : No mortality observed in controls. The one mortality observed in the 100 mg/l exposure (NOEC) at 24 hour observation was not considered dose related (no additional mortality was observed and results were identical to the 180 mg/l exposure). Sublethal efects, if any, were not recorded.

(mg/L nominal concentrations)

96-h NOEC = 100	96-h LC10 = 127 (65-161; 95% CI)
96-h LOEC = 180	96-h LC50 = 200 (157-258; 95% CI)
100% mortality = 320	96-h LC90 = 315 (247-632; 95% CI)

Source : Lesser Ketones Manufacturing Association Leesburg, VA

Test condition :
·design: static exposure, no solution renewal
·dilution water: reconstituted soft-water prepared from glass-distilled water, EPA-660/3-75-009 (USEPA 1975)
·water chemistry: not documented, (except for pH and dissolved oxygen). Based on EPA-660/3-75-009, the expected hardness would be 40 to 48 mg CaCO3/L, expected alkalinity 3 to 35 mg CaCO3/L, and expected pH 7.2 to 7.6. Measured pH at test initiation ranged from 7.2 to 7.3 (mean 7.2). Hardness and alkalinity were not measured. Total organic carbon (TOC) was not measured but expected to be insignificant.
·test substance stability: test substance not stable in aqueous solutions; measured hydrolysis half-life is 1.5 to 6.0 min at 25ºC over the pH range of 4 to 7
·exposure vessel: polyethylene-lined vessels containing 10 L of dilution water; vessels aerated prior to study initiation but not during study
·dosing solutions: no dosing solutions used; Test substance (CAS No. 1760-24-3) was added directly to exposure vessels and 4.2 mL of methanol added to controls because methanol is released on hydrolysis of test substance. Manner of addition of test substance to dilution water not documented. Test solutions for range-finding study were prepared 30 minutes prior to addition of fish. Time of test solution preparation and time of fish addition were not recorded for the definitive study.
·carrier solvent: none
·exposure concentrations: nominal - 0, 10, 100, 180, 320, 560, 1000 mg/L; measured - concentrations not analytically verified
·replication: duplicate controls and single exposure concentrations
·test system: juvenile bluegill sunfish having a mean total length of 3.4 cm (range 2.8-4.2 cm); fish were

acclimated to laboratory conditions a minimum of two weeks before testing; loading rate of 10 fish per exposure vessel; total of 80 fish
·observations: 0, 24, 48, 72, 96 h after study initiation
·photo-period: not specified
·temperature: 22°C in water bath (mean and ranges not documented)
·dissolved oxygen: initiation (t = 0 h): mean 13.4 mg/L (range 13.0-13.5 mg/L); termination (t = 96 h): mean 8.4 mg/L (range 8.0-8.5 mg/L)
·pH: initiation (t = 0 h): mean 7.2 (range 7.2-7.3); 48 h observation: mean 8.5 (range 7.4-9.6)

Test substance : N-(2-aminoethyl)-3-aminopropyltrimethoxysilane (CAS No. 1760-24-3)

Purity of the test substance was measured by gas chromatography and reported as 96%. The test substance is not stable in water and rapidly hydrolyzes to methanol and aminoethylaminopropyl-silanetriol (R-Si(OH)3 where R = -(CH2)3NH(CH2)2NH2). The measured hydrolysis half-life for the test substance is 1.5 to 6.0 min at 25ºC over the pH range of 4 to 7 (Kozerski 2001).

Conclusion : Based on results from the study (NOEC = 100 mg/L, LOEC = 180 mg/L, and LC50 = 200 mg/L), the test substance and hydrolytic degradation products are considered practically non-toxic (LC50 > 100 mg/L) to bluegill sunfish under the described conditions of exposure. The NOEC, LOEC, and LC50 obtained from this study are nearly identical to those for rainbow trout.

Reliability : (2) valid with restrictions
This study was not conducted in full compliance with OECD 203. However, the study design, documentation of data, and results are scientifically defensible and adequate for assessing the acute toxicity of the test substance (CAS No. 1760-24-3) to freshwater fish. The study is considered to be reliable with the following restrictions:
- study was not conducted under GLP
- water chemistry not documented
- exposure concentrations were not analytical verified
- exposure concentrations were not replicated
- temperature not documented for the entire study
- sublethal effects were not documented

Flag : Critical study for SIDS endpoint

19.01.2004 (3) (12) (23) (45)

Type	:	Static
Species	:	Oncorhynchus mykiss (Fish, fresh water)
Exposure period	:	
Unit	:	mg/l
NOEC	:	= 56
LC50	:	= 213
Limit test	:	
Analytical monitoring	:	No
Method	:	other
Year	:	1978
GLP	:	No
Test substance	:	as prescribed by 1.1 - 1.4

Method : The static acute toxicity of the test substance (CAS No. 1760-24-3; purity reported as 96%) to rainbow trout (Oncorhynchus mykiss) was determined in reconstituted soft water following guideline EPA-660/3-75-009 (USEPA 1975). Hardness, alkalinity, and total organic carbon (TOC) were not

measured. Based on EPA-660/3-75-009, the expected hardness would be 40 to 48 mg CaCO3/L, expected alkalinity 3 to 35 mg CaCO3/L, and expected pH 7.2 to 7.6. Juvenile rainbow trout (size not documented) were exposed in single replicates (loading rate of 10 fish per vessel) to nominal concentrations of 0, 56, 180, 320, 560, and 1000 mg/L. The test substance was added directly to the exposure vessels (polyethylene-lined containers with 10 L of dilution water), a carrier solvent was not used. Manner of addition of test substance to dilution water was not documented. Test solutions were prepared 10 minutes prior to addition of fish. The non-GLP study was conducted at 12°C. Exposure concentrations were not analytically verified. Mean dissolved oxygen was 11.6 mg/L (range 11.5-12.0 mg/L) at test initiation and 6.4 mg/L (range 4.5-7.5 mg/L) at test termination.

Remark : This material is sensitive to hydrolysis, which may occur during preparation of the dosing solutions and/or during the testing. Rapid hydrolysis of this material produces methanol and trisilanols.
This material is sensitive to hydrolysis, which may occur during preparation of the dosing solutions and/or during the testing. Rapid hydrolysis of this material produces methanol and trisilanols.

In spill conditions, the concentration of the parent silane is very high. The resulting silanol concentration is also high and the silanol rapidly self-condenses to form water insoluble, resinous oligomers and polymers. The molecular weight of the resulting oligomers and polymers is predicted to be over 1000. Anecdotal evidence suggests the molecular weight of the polymers resulting from spills is 5000 - 10000.

As the parent silane and the resulting silanol is diluted, it is predicted that the polymers resulting from condensation will be of lower molecular weight. At sufficiently low silanol concentrations, low MW oligomers are favored. It is calculated that at 1000ppm of a related trialkoxysilane, the equilibrium concentration will be 86% silanol and 14% silanol dimer. At still lower concentrations, the silanol will exist as the uncondensed monomer.

Due to the insolubility in water of the higher MW oligomers and polymers, testing of such materials is not anticipated. These polymers will not be bioavailable. Such materials are also likely to cause toxicity due to physical effects (encapsulation, blockage of gills). Ecotoxicity of the silanols may be predicted using modeling programs such as ECOSAR.

Result : Mean pH was 7.4 (range 7.4-7.5) at test initiation and 8.4 (range 7.3-10.0) at test termination. Results from the study were reported as follows (mg/L, nominal concentrations):

·96-h NOEC = 56
96-h LC10 = 142 (49-182; 95% CI)
96-h LOEC = 180
96-h LC50 = 213 (151-270; 95% CI)
100% mortality = 560
96-h LC90 = 318 (255-734; 95% CI)

Based on results from the study (NOEC = 56 mg/L, LOEC = 180 mg/L, and LC50 = 213 mg/L), the test substance and hydrolytic degradation products are considered practically non-toxic (LC50 > 100 mg/L) to rainbow trout under the described conditions of exposure.

Source : Dow Corning Corporation

Reliability : (2) valid with restrictions
This study was not conducted in full compliance with OECD 203. However, the study design, documentation of data, and results are considered scientifically defensible and adequate for assessing the acute toxicity of the test substance (CAS No. 1760-24-3) to freshwater fish. The study is considered to be reliable with the following restrictions:

*study was not conducted under GLP
*water chemistry not documented
*exposure concentrations were not analytical verified
*exposure concentrations were not replicated
*temperature not documented for the entire study
*sublethal effects were not documented
*the dissolved oxygen appeared to fall to 4.5 mg/l in some chambers (which is lower than the 60% saturation value recommended in the current OECD 203 test guideline).
*the pH in some chambers appeared to increase to 10 at the end of the test (the current test guideline recommends the pH to be between 6 and 8.5)

15.01.2004 (3)

Type	:	Other
Species	:	Pimephales promelas (Fish, fresh water)
Exposure period	:	96 hour(s)
Unit	:	mg/l
Limit test	:	No
Analytical monitoring	:	no data
Method	:	other
Year	:	1993
GLP	:	no data
Test substance	:	as prescribed by 1.1 - 1.4
Method	:	Procedures published by EPA and ASTM
Result	:	(mg/L nominal concentrations) 96-hour LC50 = 168
Source	:	Epona Associates, LLC
Test substance	:	Silane A-1120: N-(2-aminoethyl)-3-aminopropyltrimethoxysilane (CAS No. 1760-24-3)
Conclusion	:	Only a summary of this study was available and insufficient documentation was provided to validate the results.
Reliability	:	(4) not assignable

05.08.2003 (38)

Type	:	
Species	:	
Exposure period	:	96 hour(s)
Unit	:	mg/l
LC50	:	= 136000
Method	:	other: ECOSAR
Year	:	2003
GLP	:	No
Test substance	:	other TS: aliphatic amine
Remark	:	Given the rapid hydrolysis of this substance, the available aquatic toxicity tests are likely to reflect the toxicity of the degradation products. The toxicity of the possible trisilanol degradation products was estimated (the alcohol degradation products are unlikely to contribute significantly to the toxicity at the concentrations tested). An estimate of the possible toxicity of a likely trisilanol degradation product for this substance using the ECOSAR program is provided. There will be a large uncertainty associated with these estimates, but they do show that the hydrolysis product is likely to have a reasonably low toxicity and are reasonably consistent with the actual toxicity data reported for the substance.

Source	:	UK Environment (2003) Comments Posted on EDG for 3-Aminopropyltriethoxysilane CAS No. 1760-24-3
Test condition	:	SMILES : NCCNCCC[Si](O)(O)(O) CHEM : CAS Num: ChemID1: ChemID2: ChemID3: MOL FOR: C5 H16 N2 O3 Si1 MOL WT : 180.28 Log Kow: -3.37 (KowWin estimate) Melt Pt: Wat Sol: 2.406E+008 mg/L (calculated) ECOSAR Class(es) Found --- Aliphatic Amines
Reliability	:	(2) valid with restrictions

15.01.2004

4.2 ACUTE TOXICITY TO AQUATIC INVERTEBRATES

Type	:	Static
Species	:	Daphnia magna (Crustacea)
Exposure period	:	48 hour(s)
Unit	:	mg/l
NOEC	:	< 63
EC50	:	= 90
Analytical monitoring	:	No
Method	:	OECD Guide-line 202
Year	:	2002
GLP	:	Yes
Test substance	:	as prescribed by 1.1 - 1.4
Method	:	Daphnia were exposed for 48 hours to 63, 130, 250, 500, and 1000 mg/L EEC Guideline Number: Annex V-C.2 and OPPTS Draft Guideline Number 850.1010 Statistical methods: Probit analysis
Remark	:	In spill conditions, the concentration of the parent silane is very high. The silanols concentration could also be high; however, the silanol rapidly self-condenses to form water insoluble, resinous oligomers and polymers. The molecular weight of the resulting oligomers and polymers is predicted to be over 1000. Anecdotal evidence suggests the molecular weight of the polymers resulting from spills is 5000 - 10000. As the parent silane and the resulting silanol are diluted, it is predicted that the polymers resulting from condensation will be of lower molecular weight. At sufficiently low silanol concentrations, low molecular weight oligomers are favored. It is calculated that at 1000ppm of a related trialkoxysilane, the equilibrium concentration will be 86% silanol monomer and 14% silanol dimer. At still lower concentrations, the silanol will exist as the uncondensed monomer. These polymers will not be bioavailable. However, such materials are likely to cause toxicity in aquatic species due to physical effects (encapsulation, blockage of gills). Since APTES is sensitive to hydrolysis, which may occur during preparation of the dosing solutions and/or during the testing, the observed toxicity is likely due to the hydrolysis products ethanol and trisilanols. This material is sensitive to hydrolysis, which may occur during preparation of the dosing solutions and/or during the testing. Rapid hydrolysis of this

material produces ethanol and trisilanols.

In spill conditions, the concentration of the parent silane is very high. The resulting silanol concentration is also high and the silanol rapidly self-condenses to form water insoluble, resinous oligomers and polymers. The molecular weight of the resulting oligomers and polymers is predicted to be over 1000. Anecdotal evidence suggests the molecular weight of the polymers resulting from spills is 5000 - 10000.

As the parent silane and the resulting silanol is diluted, it is predicted that the polymers resulting from condensation will be of lower molecular weight. At sufficiently low silanol concentrations, low MW oligomers are favored. It is calculated that at 1000ppm of a related trialkoxysilane, the equilibrium concentration will be 86% silanol and 14% silanol dimer. At still lower concentrations, the silanol will exist as the uncondensed monomer. An SEHSC member company has provided these results from an internal study on the equilibrium of methylsilanetriol in water. The methylsilanetriol was formed from methyltrimethoxysilane. It is in equilibrium with the dimer, trimer and other higher oligomers depending on the concentration of the starting methyltrimethoxysilane solution. Based on the equilibrium constants derived from the study, it was calculated that a 1000 ppm solution of methyltrimethoxysilane in water will form an equilibrium solution of roughly 860 ppm silanol monomer and 140ppm silanol dimer.

Due to the insolubility in water of the higher MW oligomers and polymers, testing of such materials is not anticipated. These polymers will not be bioavailable. Such materials are also likely to cause toxicity due to physical effects (encapsulation, blockage of gills). Ecotoxicity of the silanols may be predicted using modeling programs such as ECOSAR.

This material is sensitive to hydrolysis, which may occur during preparation of the dosing solutions and/or during the testing. Rapid hydrolysis of this material produces methanol and trisilanols.

Result **:** Following 48 hours of exposure (test termination), 10, 90, 100, 100 and 100% immobilization was observed among daphnids exposed to the 63, 130, 250, 500, and 1000 mg/L treatment level, respectively. No immobilization was observed in daphnids exposed to the control or solvent control. No adverse effects were observed among mobile daphnids exposed to the 63 mg/L treatment level or the control or the solvent control. All mobile daphnids in the 130 mg/L treatment level were observed to be lethargic and swimming on the bottom of the test vessel.

The 48-hour EC50 for aminosilane and daphnids was calculated using probit analysis to be 90 mg/L, with 95% confidence intervals of 77 to 110 mg/L. The No-Observed-Effect Concentration (NOEC) was determined to be less than 63 mg/l.

· Biological observations:

o Number immobilized as compared to the number exposed: Number immobilized: 80, Number exposed: 140 (includes controls)

o Concentration response with 95% confidence limits: 90 mg/L, with 95% confidence intervals of 77 to 110 mg/L

o Cumulative immobilization: 10, 90, 100, 100 and 100% immobilization was observed among daphnids exposed to the 63, 130, 250, 500, and 1000 mg/L treatment level, respectively.

o Was control response satisfactory (yes/no/unknown): Yes. No immobilization or adverse effects were observed in daphnids exposed to the control or solvent control.

Source : SEHSC

Test condition : · Test organisms: Daphnia magna
o Source, supplier, any pretreatment, breeding method: Springborn Smithers culture facility. Daphnids were cultured in 1.0-L glass vessels containing 0.80 L of water. Water used to culture the daphnids was be prepared in the same manner and has the same characteristics as the dilution water. Daphnids were fed a unicellular green algae, Ankistrodesmus falcatus (4 x 107 cells/mL) and YCT (yeast, cereal leaves and flaked fish food) suspension, daily, at a rate of 1 mL algae and 0.5 mL YCT solution per vessel per day. Daphnids were obtained by removing all immature daphnids from the culture vessel, thus isolating mature gravid daphnids #24 hours prior to initiating the test. Young produced by these organisms were subsequently pipetted into the test beakers.
o Age at study initiation: < 24 hours
o Control group: dilution water and solvent control
· Test conditions:
o Stock solutions preparation (vehicle, solvent, concentrations) and stability: A 1.0 mg/mL stock solution was prepared by placing 2.450 mL (2.5186g based on a density of 1.028 g/mL) of aminosilane in a 3.8-L glass jar and diluting with 2500 mL of dilution water containing 0.250 mL dimethylformamide (DMF, CAS # 68-12-2). The solution was stirred for approximately 5 minutes with a magnetic stir bar and stir plate. Each test concentration was prepared by adding the appropriate amount of the 1.0 mg/mL stock solution to an intermediate vessel and diluting to 1000 mL with dilution water.
o Test temperature range: 20 to 21 °C
o Exposure vessel type (e.g., size, headspace, sealed, aeration, # per treatment): The toxicity test was conducted in 250-mL glass beakers, each containing 200 mL of test solution. Four replicate test vessels were established for each treatment level and a dilution water and solvent control. No aeration was provided to the test vessels.
o Dilution water source: Fortifying well water based on the formula for hard water (U.S. EPA, 1975).
o Dilution water chemistry (hardness, alkalinity, pH, TOC, TSS, salinity, Ca/Mg ratio, Na/K ratio): The dilution water had a total hardness and alkalinity as CaCO3 of 170 mg/L and 120 mg/L, respectively, a pH of 7.8 and a specific conductivity of 500 µmhos/cm. The TOC concentration of the dilution water source was 0.60 mg/L for the month of January 2002.
o Lighting (quality, intensity, and periodicity): The test area was illuminated with Sylvania Octron® fluorescent bulbs at an intensity range of 70 to 90 footcandles at the solutions' surface. The test area received a regulated photoperiod of 16 hours of light and 8 hours of darkness. Sudden transitions from light to dark and vice versa were avoided. Light intensity was measured once during the test.
o Water chemistry in test (D.O., pH), in the control, and at least one concentration where effects were observed: The dilution water and solvent control vessels had a measured DO concentration of 8.9 and 8.7 mg/L respectively, at test initiation and 8.2 and 8.3 mg/L respectively, at test termination. pH measured in the dilution water and solvent control vessels was 8.0 and 7.9 respectively, at test initiation and 7.9 and 8.0 respectively, at test

termination. The 130 mg/L treatment level had a measured DO concentration of 8.6 mg/L at test initiation and 8.3 mg/L at test termination. pH measured in the 130 m/L treatment level was 8.9 at test initiation and 8.2 at test termination.
· Element (unit) basis (i.e., immobilization): Immobilization
· Test design (number of replicates, individuals per replicate, concentrations): Twenty daphnids were impartially selected and distributed to each concentration and the controls (five daphnids per replicate vessel). Test concentrations were 63, 130, 250, 500 and 1000 mg/L.
· Method of calculating mean measured concentrations (i.e., arithmetic mean, geometric mean, etc.): Not applicable.
· Exposure period: 48-hours
· Analytical monitoring: No analytical monitoring was conducted during this test. Test results are reported on nominal concentrations.

Test substance : 1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3

Purity 101.1% (used as 100%)

Reliability : (1) valid without restriction
19.01.2004 (25) (45)

Type	:	Static
Species	:	Daphnia magna (Crustacea)
Exposure period	:	48 hour(s)
Unit	:	mg/l
NOEC	:	= 0
EC50	:	= 37
EC100	:	= 1000
EC90	:	= 319
Analytical monitoring	:	No
Method	:	other
Year	:	1978
GLP	:	No
Test substance	:	as prescribed by 1.1 - 1.4

Method : EPA-660/3-75-009 (USEPA 1975).

Statistical Methods: Probit analysis (Finney, 1952)

Daphnids were exposed for 48 hours to 10, 100, 1000 and 10,000 mg/l test substance.

Remark : This material is sensitive to hydrolysis, which may occur during preparation of the dosing solutions and/or during the testing. Rapid hydrolysis of this material produces methanol and trisilanols.
This material is sensitive to hydrolysis, which may occur during preparation of the dosing solutions and/or during the testing. Rapid hydrolysis of this material produces methanol and trisilanols.

In spill conditions, the concentration of the parent silane is very high. The resulting silanol concentration is also high and the silanol rapidly self-condenses to form water insoluble, resinous oligomers and polymers. The molecular weight of the resulting oligomers and polymers is predicted to be over 1000. Anecdotal evidence suggests the molecular weight of the polymers resulting from spills is 5000 - 10000.

As the parent silane and the resulting silanol is diluted, it is predicted that the polymers resulting from condensation will be of lower molecular weight.

At sufficiently low silanol concentrations, low MW oligomers are favored. It is calculated that at 1000ppm of a related trialkoxysilane, the equilibrium concentration will be 86% silanol and 14% silanol dimer. At still lower concentrations, the silanol will exist as the uncondensed monomer.

Due to the insolubility in water of the higher MW oligomers and polymers, testing of such materials is not anticipated. These polymers will not be bioavailable. Such materials are also likely to cause toxicity due to physical effects (encapsulation, blockage of gills). Ecotoxicity of the silanols may be predicted using modeling programs such as ECOSAR.

Result : One immobilization (5%) observed in controls at 24 and 48 hours. Sublethal effects, if any, were not documented.

Source : Dow Corning Corporation

Test condition : test design: static exposure, no solution renewal

dilution water: reconstituted hard-water; glass-distilled water reconstituted with 192 mg/L NaHCO3, 120 mg/L CaSO4, 120 mg/L MgSO4, and 8 mg/L KCl (pH adjusted to 7.5 with NaOH)

water chemistry: not documented

test substance stability: test substance not stable in aqueous solutions; estimated hydrolysis half-life < 10 min at pH 7

exposure vessel: 250-mL glass beakers containing 200 mL of dilution water; vessels aerated prior to but not after study initiation; vessels covered with Saran WrapÒ during exposure

dosing solutions: no dosing solutions used; neat test material added directly to exposure vessels

carrier solvent: none

exposure concentrations: nominal - 0, 10, 100, 1000, 10,000 mg/L; measured - concentrations not analytically verified

replication: duplicate controls and exposure concentrations

test system: Daphnia magna neonates (age not documented) from laboratory cultures (original source not documented) maintained under testing conditions; loading rate of 10 organisms per exposure vessel; total of 100 organisms

observations: 0, 24, 48 h after study initiation

photo-period: 18-h light/6-h dark; 600 foot-candle

temperature: 23 ± 1°C in environmental chamber

dissolved oxygen: not documented

pH: not documented

Test substance : N-(2-aminoethyl)-3-aminopropyltrimethoxysilane (CAS No. 1760-24-3)

Purity of the test substance was measured by gas chromatography and reported as 96%. The test substance is not stable in water and rapidly hydrolyzes to methanol and

aminoethylaminopropylsilanetriol (R-Si(OH)3 where R = -(CH2)3NH(CH2)2NH2). The hydrolysis half-life for the test substance is estimated to be < 10 min at pH 7 (Blum et. al., 1991; Wilkinson 1997).

Conclusion : The exposure concentrations were based on a exponential series and spaced too far apart to allow an accurate assessment of the test substance toxicity, including the NOEC and LOEC. Nonetheless, results from the study (NOEC = 0 mg/L, LOEC = 10 mg/L, and EC50 = 37 mg/L) suggest that the test substance (CAS No. 1760-24-3) and hydrolytic degradation products are slightly toxic (10 mg/L < LC50 < 100 mg/L) to Daphnia magna under the described conditions of exposure.

Reliability : (2) valid with restrictions
This study was not conducted in full compliance with OECD 202. However, the study design, documentation of data, and results are scientifically defensible and appear adequate for assessing the acute toxicity of the test substance (CAS No. 1760-24-3) to freshwater macroinvertebrates. The study is considered to be reliable with the following restrictions:

- study was not conducted under GLP
- exponential series of exposure concentrations
- exposure concentrations were not analytical verified
- age of neonates was not documented
- sublethal effects were not documented
- water chemistry, including pH and dissolved oxygen, was not documented

15.01.2004 (3) (4) (12) (45) (49)

Type : Other
Species : Daphnia magna (Crustacea)
Exposure period : 48 hour(s)
Unit : mg/l
Analytical monitoring : no data
Method : Directive 84/449/EEC, C.2 "Acute toxicity for Daphnia"
Year : 1993
GLP : no data
Test substance : as prescribed by 1.1 - 1.4

Result : (mg/L nominal concentrations)

48-hour LC50 = 87.4

Source : Epona Associates, LLC
Test substance : Silane A-1120: 1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3
Conclusion : Only a summary of this study was available and insufficient documentation was provided to validate the results.
Reliability : (4) not assignable
05.08.2003 (38)

Type :
Species :
Exposure period : 48 hour(s)
Unit : mg/l
EC50 : = 5012
Method : other: ECOSAR
Year : 2003
GLP : No
Test substance : other TS: aliphatic amines

Remark	:	Given the rapid hydrolysis of this substance, the available aquatic toxicity tests are likely to reflect the toxicity of the degradation products. The toxicity of the possible trisilanol degradation products was estimated (the alcohol degradation products are unlikely to contribute significantly to the toxicity at the concentrations tested). An estimate of the possible toxicity of a likely trisilanol degradation product for this substance using the ECOSAR program is provided. There will be a large uncertainty associated with these estimates, but they do show that the hydrolysis product is likely to have a reasonably low toxicity and are reasonably consistent with the actual toxicity data reported for the substance.
Source	:	UK Environment (2003) Comments Posted on EDG for 3-Aminopropyltriethoxysilane CAS No. 1760-24-3
Test condition	:	SMILES : NCCNCCC[Si](O)(O)(O) CHEM : CAS Num: ChemID1: ChemID2: ChemID3: MOL FOR: C5 H16 N2 O3 Si1 MOL WT : 180.28 Log Kow: -3.37 (KowWin estimate) Melt Pt: Wat Sol: 2.406E+008 mg/L (calculated) ECOSAR Class(es) Found ---------- Aliphatic Amines

15.01.2004

4.3 TOXICITY TO AQUATIC PLANTS E.G. ALGAE

Species	:	Selenastrum capricornutum (Algae)
Endpoint	:	Other
Exposure period	:	96 hour(s)
Unit	:	mg/l
NOEC	:	= 1.6
EC50	:	= 11
72-hour EbC50	:	= 5.5
72-hour ErC50	:	= 8.8
Limit test	:	No
Analytical monitoring	:	No
Method	:	other
Year	:	2002
GLP	:	Yes
Test substance	:	as prescribed by 1.1 - 1.4
Method	:	OECD Guideline 201 and EC Guideline Number Annex V - PART C.3 Statistical methods: Shapiro-Wilks Test, Bartlett's Test, William's Test, Kruskal-wallis' Test Nominal concentrations of test substance: 1.6, 3.1, 6.3, 13, 25 and 50 mg/l
Remark	:	In spill conditions, the concentration of the parent silane is very high. The silanols concentration could also be high; however, the silanol rapidly self-

condenses to form water insoluble, resinous oligomers and polymers. The molecular weight of the resulting oligomers and polymers is predicted to be over 1000. Anecdotal evidence suggests the molecular weight of the polymers resulting from spills is 5000 - 10000. As the parent silane and the resulting silanol are diluted, it is predicted that the polymers resulting from condensation will be of lower molecular weight. At sufficiently low silanol concentrations, low molecular weight oligomers are favored. It is calculated that at 1000ppm of a related trialkoxysilane, the equilibrium concentration will be 86% silanol monomer and 14% silanol dimer. At still lower concentrations, the silanol will exist as the uncondensed monomer. These polymers will not be bioavailable. However, such materials are likely to cause toxicity in aquatic species due to physical effects (encapsulation, blockage of gills). Since APTES is sensitive to hydrolysis, which may occur during preparation of the dosing solutions and/or during the testing, the observed toxicity is likely due to the hydrolysis products ethanol and trisilanols.
This material is sensitive to hydrolysis, which may occur during preparation of the dosing solutions and/or during the testing. Rapid hydrolysis of this material produces ethanol and trisilanols.

In spill conditions, the concentration of the parent silane is very high. The resulting silanol concentration is also high and the silanol rapidly self-condenses to form water insoluble, resinous oligomers and polymers. The molecular weight of the resulting oligomers and polymers is predicted to be over 1000. Anecdotal evidence suggests the molecular weight of the polymers resulting from spills is 5000 - 10000.

As the parent silane and the resulting silanol is diluted, it is predicted that the polymers resulting from condensation will be of lower molecular weight. At sufficiently low silanol concentrations, low MW oligomers are favored. It is calculated that at 1000ppm of a related trialkoxysilane, the equilibrium concentration will be 86% silanol and 14% silanol dimer. At still lower concentrations, the silanol will exist as the uncondensed monomer. An SEHSC member company has provided these results from an internal study on the equilibrium of methylsilanetriol in water. The methylsilanetriol was formed from methyltrimethoxysilane. It is in equilibrium with the dimer, trimer and other higher oligomers depending on the concentration of the starting methyltrimethoxysilane solution. Based on the equilibrium constants derived from the study, it was calculated that a 1000 ppm solution of methyltrimethoxysilane in water will form an equilibrium solution of roughly 860 ppm silanol monomer and 140ppm silanol dimer.

Due to the insolubility in water of the higher MW oligomers and polymers, testing of such materials is not anticipated. These polymers will not be bioavailable. Such materials are also likely to cause toxicity due to physical effects (encapsulation, blockage of gills). Ecotoxicity of the silanols may be predicted using modeling programs such as ECOSAR.

This material is sensitive to hydrolysis, which may occur during preparation of the dosing solutions and/or during the testing. Rapid hydrolysis of this material produces methanol and trisilanols.

Source : SEHSC

Test condition : Element basis (i.e. number of cells/ml, area under the curve, growth rate, etc.): Inhibition of 96-hour cell density, 0- to 72-hour biomass (area under the growth curve) and 0 to 72-hour growth rate (µave) relative to the performance of the pooled control

Nominal concentrations in mg/L: 1.6, 3.1, 6.3, 13, 25 and 50

Test Organisms: Pseudokirchneriella subcapitata, formerly

Selenastrum capricornutum, strain 1648, Class Chlorophyceae. The alga was obtained from Carolina Biological Supply Co., Burlington, North Carolina, and was maintained in stock culture at Springborn Smithers. The stock cultures were maintained within the following conditions: a shaking rate of 100 ± 10 rpm, a temperature of 24 ± 1 °C and continuous illumination at the surface of the medium with an intensity of approximately 300 to 500 footcandles (3200 to 5400 lux). Lighting was supplied by Duro-Test® Vita-Lite® fluorescent bulbs. Culture flasks were agitated continuously on an orbital shaker.

· Test Conditions:

o Test temperature range: 23 to 24 °C

o Growth/test medium: The culture medium used was Algal Assay Procedure (AAP) medium prepared with sterile, deionized water.

o Exposure vessel type: The test was conducted in sterile 250-mL Erlenmeyer flasks containing 100-mL of test solution. All test vessels were fitted with stainless steel caps which permit gas exchange.

o Water chemistry in test: TOC concentration of the AAP sample collected in January 2002 was 0.47 mg/L. The dilution water and solvent control vessels both had a specific conductivity of 80 mmhos/cm at test initiation and at test termination. pH measured in the dilution water and solvent control vessels were 7.3 and 7.2 respectively, at test initiation and 7.8 and 8.0 respectively, at test termination. The 50 mg/L treatment level had a specific conductivity of 90 mmhos/cm at test initiation and test termination. pH measured in the 50 mg/L treatment level was 8.7 at test initiation and 8.0 at test termination.

o Stock solution preparation: A 50 mg/L stock solution was prepared by placing 0.049 mL (density = 1.028 g/mL) of aminosilane in a 1000?mL volumetric flask and diluting to volume with sterile AAP medium containing 0.10 mL/L of dimethyl formamide (DMF, CAS No. 68-12-2). Nominal test concentrations were prepared from dilutions of the 50 mg/L stock solution.

o Light levels and quality during exposure: 320 - 420 footcandles (3400 - 4500 lux). The photosynthetically-active radiation (PAR) of the test area measured at test initiation ranged from 50 to 69 µE/m2/s.

· Test Design: Approximately 10 minutes after the test solutions were added to the test flasks (100 mL per flask), a 0.323-mL inoculum of Pseudokirchneriella subcapitata cells, at a density of approximately 310 x 104 cells/mL, was aseptically introduced into each flask. This inoculum provided the required initial (0 hour) cell density of approximately 1.0 x 104 cells/mL. Three replicate test vessels were established for each treatment level, the dilution water control and the solvent control. Test concentrations were 1.6, 3.1, 6.3, 13, 25 and 50 mg/L.

· Method of calculating mean measured concentrations (i.e. arithmetic mean, geometric mean, etc.): Not applicable

Test substance : Identity: N-[3-(trimethoxysilyl)propyl]-ethylene-diamine

o Synonym: Aminosilane

o Lot No.: 13114LU

o CAS No.: 1760-24-3

o Purity: 101.1% (used as 100%)

o Expiration Date: Not available

Conclusion : · Cell Density
Cell densities in the 1.6, 3.1, 6.3, 13, 25 and 50 mg/L treatment levels averaged 142, 159, 122, 86, 1 and 0 x 104 cells/mL, respectively. Statistical analysis (Williams' Test), determined a significant reduction in cell density in the 13, 25 and 50 mg/L treatment levels tested as compared to the pooled control. Therefore, the NOEC was determined to be 6.3 mg/L. The 96-hour EC50 for cell density was determined to be 11 mg/L, with 95% confidence limit of 2.2 to 61 mg/L.

· Biomass
Biomass in the 1.6, 3.1, 6.3, 13, 25 and 50 mg/L treatment levels averaged 25, 23, 14, 2.8, -2.1 and ?1.7 cells·days/mL, respectively. Statistical analysis (Kruskal-Wallis Test) determined a significant difference in biomass in the 25 mg/L treatment level when compared to the biomass in the pooled control. Since a substantial reduction in biomass was observed at concentrations >3.1 mg/L, the NOEC was empirically estimated to be 1.6 mg/L, the highest concentration tested with <10% inhibition of total biomass. The 72-hour EbC50 was determined to be 5.5 mg/L, with 95% confidence limits of 1.8 to 17 mg/L.

· Growth Rate
The 0- to 72-hour growth rate in the 1.6, 3.1, 6.3, 13, 25 and 50 mg/L treatment levels averaged 1.32, 1.34, 1.15, 0.76, -0.38 and -0.38 days-1, respectively. Statistical analysis (Williams' Test) determined a significant reduction in the 6.3, 13, 25 and 50 mg/L treatment levels tested when compared to the growth rate in the pooled control. The NOEC was determined to be 3.1 mg/L. The 72-hour ErC50 was extrapolated to be 8.8 mg/L with 95% confidence limit of 2.3 to 34 mg/L.

Reliability : (1) valid without restriction
Flag : Critical study for SIDS endpoint
19.01.2004 (19)

Species : Selenastrum capricornutum (Algae)
Endpoint :
Exposure period : 7 day(s)
Unit :
Limit test :
Analytical monitoring : No
Method : other
Year : 1978
GLP : No
Test substance : as prescribed by 1.1 - 1.4

Method : EPA-670/4-73-00 (USEPA 1973)

Statistical methods: Probit analysis (Finney, 1952); calculations as described by Stein (1973)

Remark : Supporting Data: Annelin, R.B. and C.D. McKinney. 1978. Dow Corning Corporation, Report No. 1978-I0005-0589. The static acute toxicity of the test substance (CAS No. 1760-24-3; purity reported as 96%) to blue-green algae (Anabaena flos-aquae) was determined in sterile algal broth prepared from glass-distilled water and powdered nutrient media (Difco Laboratories), following guideline EPA-670/4-73-00 (USEPA 1973). Blue-green algae (laboratory

culture, original source and method of cultivation not documented) were exposed in triplicate replicates (cell density of 1.00´104 cells/mL at test initiation) to nominal concentrations of 0, 125, 150, 175, 200 mg/L. The test substance was added directly to the exposure vessels (125-mL polycarbonate Erlenmeyer flasks containing 40 mL of sterile algal broth), a carrier solvent was not used. The non-GLP study was conducted under continuous lighting (600 foot-candle) in an environmental chamber maintained at 23 ± 1°C. Exposure concentrations were not analytically verified and water chemistry parameters, including pH, were not documented. Response of the controls was acceptable with exponential growth demonstrated (cell concentration in the controls increased by a factor of 11 during the 7-day study). Results from the study were reported as follows (mg/L, nominal concentrations):

Final Yield (mg/L nominal concentrations)
·7-d NOEC <1 · 7-d EC10 = 72 (34-95; 95% CI)
·7-d LOEC = 125 7-d EC50 = 173 (159-196; 95% CI)
· 7-d EC90 = 412 (300-1014; 95% CI)

Growth Inhibition (mg/L nominal concentrations)
·7-d NOEC <1 · 7-d EC10 = 82 (49-101; 95% CI)
·7-d LOEC = 125 7-d EC50 = 175 (163-196; 95% CI)
· 7-d EC90 = 374 (288-710; 95% CI)

Based on results from the study for final yield (NOEC <1 mg/L, LOEC = 125 mg/L, and EC50 = 173 mg/L) and growth inhibition (NOEC <1 mg/L, LOEC = 125 mg/L, and EC50 = 175 mg/L), the test substance and hydrolytic degradation products are considered practically non-toxic (LC50 > 100 mg/L) to Anabaena flos-aquae (bluegreen algae) under the described conditions of exposure. The test substance is considerably more toxic to green algae (see Key Study).

This study was not conducted in full compliance with OECD 201. However, the study design, documentation of data, and results are considered scientifically defensible and adequate for assessing the acute toxicity of the test substance (CAS No. 1760-24-3) to freshwater algae. The study is considered to be reliable with the following restrictions:

- study was not conducted under GLP
- original supplier of the test system not documented
- cultivation methods for laboratory culture not documented
- source of dilution water not documented
- water chemistry not documented
- exposure concentrations not analytically verified

This material is sensitive to hydrolysis, which may occur during preparation of the dosing solutions and/or during the testing. Rapid hydrolysis of this material produces methanol and trisilanols.
This material is sensitive to hydrolysis, which may occur during preparation of the dosing solutions and/or during the testing. Rapid hydrolysis of this material produces methanol and trisilanols.

In spill conditions, the concentration of the parent silane is very high. The resulting silanol concentration is also high and the silanol rapidly self-condenses to form water insoluble, resinous oligomers and polymers. The molecular weight of the resulting oligomers and polymers is predicted to be over 1000. Anecdotal evidence suggests the molecular weight of the

polymers resulting from spills is 5000 - 10000.

As the parent silane and the resulting silanol is diluted, it is predicted that the polymers resulting from condensation will be of lower molecular weight. At sufficiently low silanol concentrations, low MW oligomers are favored. It is calculated that at 1000ppm of a related trialkoxysilane, the equilibrium concentration will be 86% silanol and 14% silanol dimer. At still lower concentrations, the silanol will exist as the uncondensed monomer.

Due to the insolubility in water of the higher MW oligomers and polymers, testing of such materials is not anticipated. These polymers will not be bioavailable. Such materials are also likely to cause toxicity due to physical effects (encapsulation, blockage of gills). Ecotoxicity of the silanols may be predicted using modeling programs such as ECOSAR.

Result : Final Yield (mg/L nominal concentrations)
- 7-d NOEC <1
- 7-d LOEC = 1
- 7-d EC10 = 0.2 (0.1-0.3; 95% CI)
- 7-d EC50 = 1.5 (1.0-2.1; 95% CI)
- 7-d EC90 = 15 (11-23; 95% CI)

Growth Inhibition (mg/L nominal concentrations)
- 7-d NOEC <1
- 7-d LOEC = 1
- 7-d EC10 = 3.1 (1.5-4.7; 95% CI)
- 7-d EC50 = 31 (23-48; 95% CI)
- 7-d EC90 = 302 (143-1184; 95% CI)

Response of the controls was acceptable with exponential growth demonstrated (cell concentration in the controls increased by a factor of 34 over the 7-day study).

Source : Lesser Ketones Manufacturing Association Leesburg, VA

Test condition : Test design: static exposure, no solution renewal

Growth medium: sterile algal broth prepared from glass-distilled water and powdered nutrient media (DifcoÒ Laboratories); source of dilution water not documented

Water chemistry: not documented

Test substance stability: test substance not stable in aqueous solutions; estimated hydrolysis half-life < 10 min at pH 7

Exposure vessel: 125-mL polycarbonate Erlenmeyer flasks containing 40 mL of sterile algal broth; aseptic technique used throughout study

Dosing solutions: 0.1% solution of test material in dilution water used to dose exposure vessels

Carrier solvent: none

Exposure concentrations: nominal - 0, 1, 10, 18, 25, 50 mg/L measured - concentrations not analytically verified

Replication: triplicate controls and exposure concentrations

Test system: Selenastrum capricornutum, 5.00´104 cells/mL at test initiation; laboratory culture (original source and method of cultivation not documented)

Observations: 0, 3, 4, 5, 6, 7 d after study initiation

Photo-period: 24-h light/0-h dark; 600 foot-candle

Temperature: 23 ± 1°C in environmental chamber
pH: not documented

Test substance : N-(2-aminoethyl)-3-aminopropyltrimethoxysilane (CAS No. 1760-24-3)

Purity of the test substance was measured by gas chromatography and reported as 96%. The test substance is not stable in water and rapidly hydrolyzes to methanol and aminoethylaminopropylsilanetriol (R-Si(OH)3 where R = -(CH2)3NH(CH2)2NH2). The hydrolysis half-life for the test substance is estimated to be < 10 min at pH 7 (Blum et. al., 1991; Wilkinson 1997).

Conclusion : Based on results from the study for final yield (NOEC <1 mg/L, LOEC = 1 mg/L, and EC50 = 1.5 mg/L) and growth inhibition (NOEC <1 mg/L, LOEC = 1 mg/L, and EC50 = 31 mg/L), the test substance and hydrolytic degradation products are considered moderately toxic (1 mg/L < LC50 < 10 mg/L) to Selenastrum capricornutum (green algae) under the described conditions of exposure. The test substance is considerably less toxic to bluegreen algae.

Reliability : (2) valid with restrictions
This study was not conducted in full compliance with OECD 201. However, the study design, documentation of data, and results are scientifically defensible and adequate for assessing the acute toxicity of the test substance (CAS No. 1760-24-3) to freshwater green algae. The study is considered to be reliable with the following restrictions:

- study was not conducted under GLP
- original supplier of the test system not documented
- cultivation methods for laboratory culture not documented
- source of dilution water not documented
- water chemistry not documented
- exposure concentrations not analytically verified

08.03.2004 (2) (11) (12) (41) (48)

Species : Anabaena flos-aquae (Algae)
Endpoint : growth rate
Exposure period : 7 day(s)
Unit : mg/l
NOEC : < 125
LOEC : = 125
EC10 : = 82
EC50 : = 175
Method : other: EPA-670/4-73-00
Year : 1978
GLP : no
Test substance : as prescribed by 1.1 - 1.4

Remark : This material is sensitive to hydrolysis, which may occur during preparation of the dosing solutions and/or during the testing. Rapid hydrolysis of this material produces methanol and trisilanols.
This material is sensitive to hydrolysis, which may occur during preparation of the dosing solutions and/or during the testing. Rapid hydrolysis of this material produces methanol and trisilanols.

In spill conditions, the concentration of the parent silane is very high. The resulting silanol concentration is also high and the silanol rapidly self-condenses to form water insoluble, resinous oligomers and polymers. The molecular weight of the resulting oligomers and polymers is predicted to be over 1000. Anecdotal evidence suggests the molecular weight of the

polymers resulting from spills is 5000 - 10000.

As the parent silane and the resulting silanol is diluted, it is predicted that the polymers resulting from condensation will be of lower molecular weight. At sufficiently low silanol concentrations, low MW oligomers are favored. It is calculated that at 1000ppm of a related trialkoxysilane, the equilibrium concentration will be 86% silanol and 14% silanol dimer. At still lower concentrations, the silanol will exist as the uncondensed monomer.

Due to the insolubility in water of the higher MW oligomers and polymers, testing of such materials is not anticipated. These polymers will not be bioavailable. Such materials are also likely to cause toxicity due to physical effects (encapsulation, blockage of gills). Ecotoxicity of the silanols may be predicted using modeling programs such as ECOSAR.

Result : Results from the study were reported as follows (mg/L, nominal concentrations):

Final Yield (mg/L nominal concentrations)
·7-d NOEC = <125
·7-d EC10 = 72 (34-95; 95% CI)
·7-d LOEC = 125
·7-d EC50 = 173 (159-196; 95% CI)
·7-d EC90 = 412 (300-1014; 95% CI)

Growth Inhibition (mg/L nominal concentrations)
·7-d NOEC = <125
·7-d EC10 = 82 (49-101; 95% CI)
·7-d LOEC = 125
·7-d EC50 = 175 (163-196; 95% CI)
·7-d EC90 = 374 (288-710; 95% CI)

Test condition : The static acute toxicity of the test substance (CAS No. 1760-24-3; purity reported as 96%) to blue-green algae (Anabaena flos-aquae) was determined in sterile algal broth prepared from glass-distilled water and powdered nutrient media (DifcoÒ Laboratories). Blue-green algae were exposed in triplicate replicates (cell density of 1.00´104 cells/mL at test initiation) to nominal concentrations of 0, 125, 150, 175, 200 mg/L. The test substance was added directly to the exposure vessels (125-mL polycarbonate Erlenmeyer flasks containing 40 mL of sterile algal broth), a carrier solvent was not used. The study was conducted under continuous lighting (600 foot-candle) in an environmental chamber maintained at 23 ± 1°C. Exposure concentrations were not analytically verified and water chemistry parameters, including pH, were not documented. Response of the controls was acceptable with exponential growth demonstrated (cell concentration in the controls increased by a factor of 11 during the 7-day study).

Test substance : Purity = 96%

Conclusion : Based on results from the study for final yield (NOEC <125 mg/L, LOEC = 125 mg/L, and EC50 = 173 mg/L) and growth inhibition (NOEC <125 mg/L, LOEC = 125 mg/L, and EC50 = 175 mg/L), the test substance and hydrolytic degradation products are considered practically non-toxic (LC50 > 100 mg/L) to Anabaena flos-aquae (bluegreen algae) under the described conditions of exposure.

Reliability : (2) valid with restrictions
This study was not conducted in full compliance with OECD 201. However, the study design, documentation of data, and

results are considered scientifically defensible and adequate for assessing the acute toxicity of the test substance (CAS No. 1760-24-3) to freshwater algae. The study is considered to be reliable with the following restrictions:

- study was not conducted under GLP
- original supplier of the test system not documented
- cultivation methods for laboratory culture not documented
- source of dilution water not documented
- water chemistry not documented
- exposure concentrations not analytically verified

15.01.2004 (2)

Species	:	
Endpoint	:	
Exposure period	:	96 hour(s)
Unit	:	mg/l
EC50	:	= 1481
Method	:	other: ECOSAR
Year	:	2003
GLP	:	no
Test substance	:	other TS: aliphatic amines
Remark	:	Given the rapid hydrolysis of this substance, the available aquatic toxicity tests are likely to reflect the toxicity of the degradation products. The toxicity of the possible trisilanol degradation products was estimated (the alcohol degradation products are unlikely to contribute significantly to the toxicity at the concentrations tested). An estimate of the possible toxicity of a likely trisilanol degradation product for this substance using the ECOSAR program is provided. There will be a large uncertainty associated with these estimates, but they do show that the hydrolysis product is likely to have a reasonably low toxicity and are reasonably consistent with the actual toxicity data reported for the substance.
Source	:	UK Environment (2003) Comments Posted on EDG for 3-Aminopropyltriethoxysilane CAS No. 1760-24-3
Test condition	:	SMILES : NCCNCCC[Si](O)(O)(O) CHEM : CAS Num: ChemID1: ChemID2: ChemID3: MOL FOR: C5 H16 N2 O3 Si1 MOL WT : 180.28 Log Kow: -3.37 (KowWin estimate) Melt Pt: Wat Sol: 2.406E+008 mg/L (calculated) ECOSAR Class(es) Found --- Aliphatic Amines
Reliability	:	(2) valid with restrictions

15.01.2004

4.4 TOXICITY TO MICROORGANISMS E.G. BACTERIA

Type	:	aquatic

Species	:	other bacteria
Exposure period	:	16 hour(s)
Unit	:	mg/l
IC50	:	= 435 measured/nominal
Analytical monitoring	:	no data
Method	:	other
Year	:	1993
GLP	:	no data
Test substance	:	as prescribed by 1.1 - 1.4
Method	:	Determined by turbidity/growth procedures where the median inhibition concentration (IC50) is measured after 16 hours of incubation with sewage microorganisms.
Remark	:	Only a summary of this study was available and insufficient documentation was provided to validate the results
Result	:	(mg/L nominal concentrations) · IC50 = 435
Source	:	Epona Associates, LLC
Test substance	:	1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3
Reliability	:	(4) not assignable

05.08.2003 (38)

4.5.1 CHRONIC TOXICITY TO FISH

4.5.2 CHRONIC TOXICITY TO AQUATIC INVERTEBRATES

4.6.1 TOXICITY TO SEDIMENT DWELLING ORGANISMS

4.6.2 TOXICITY TO TERRESTRIAL PLANTS

4.6.3 TOXICITY TO SOIL DWELLING ORGANISMS

4.6.4 TOX. TO OTHER NON MAMM. TERR. SPECIES

4.7 BIOLOGICAL EFFECTS MONITORING

4.8 BIOTRANSFORMATION AND KINETICS

4.9 ADDITIONAL REMARKS

5.0 TOXICOKINETICS, METABOLISM AND DISTRIBUTION

5.1.1 ACUTE ORAL TOXICITY

Type : LD50
Value : = 2413 mg/kg bw
Species : Rat
Strain : Sprague-Dawley
Sex : male/female
Number of animals : 10
Vehicle : Other
Doses : 0, 2009, 2519, 3162 mg/kg
Method : OECD Guide-line 401 "Acute Oral Toxicity"
Year : 1992
GLP : Yes
Test substance : as prescribed by 1.1 - 1.4

Method : OECD 401, EEC 67/548 1967)-79/831 (1979) - 84/449 - Annex V - method B1 (1984) - 91/325 (1991)
Result : Value [LD50 or LC50] with confidence limits if calculated: 2413 mg/kg (2154-2702 mg/kg) by Bliss' method; 2451 mg/kg (2147 - 2798 mg/kg) by Litchfield & Wilcoxon's method

Time of death (provide individual animal time if less than 24 hours after dosing): No deaths were observed among the control animals. One male animal died on Day 2 in the 2009 mg/kg dose group. Three males died on Day 2 and an additional male died on Day 4 in the 2519 mg/kg dose group, while 1 female died on Day 1 and 3 females in this group died on Day 2. Three males and 1 female died on Day 1 in the 3162 mg/kg dose group, with an additional male and 3 additional females dying on Day 2.

Description, severity, time of onset and duration of clinical signs at each dose level:

At 2009 mg/kg subdued behavior was noted in all animals at 4 hours. Surviving animals were normal on Day 2.

At 2519 mg/kg subdued behavior was noted on Day 1. In some cases subdued behavior, tremors, and diarrhea were noted between Days 2 and 4. All surviving animals were normal by Day 4.

At 3162 mg/kg All animals showed subdued behavior on Day 1. All surviving animals were normal on Day 2.

Mean body weight (g):
Males:

	Day-1	Day1	Day8	Day15
Group 1(0 mg/kg)	183.4	171.4	244.2	295
Group 2(2009 mg/kg)	183.6	174	242.25	303.25
Group 3(2519 mg/kg)	186.2	163.6	-	-
Group 4(3162 mg/kg)	186	171.4	-	-

Mean body weight gains for males for the period from Day-1 to Day 15 were 11.6 and 118.75 g for Groups 1 and 2, respectively.

Females:

	Day-1	Day1	Day8	Day15
Group 1 (0 mg/kg)	176.2	162.8	210	232
Group 2(2009 mg/kg)	175.8	162.6	198	221.4
Group 3(2519 mg/kg)	177.2	162.6	-	-
Group 4(3162 mg/kg)	176.8	165.8	-	-

Mean body weight gains for females for the period from Day-1 to Day 15 were 55.8 and 45.6 g for Groups 1 and 2, respectively.
Necropsy findings, included doses affected, severity and number of animals affected: Animals which died prematurely showed lung congestion, autolysis of the alimentary canal, and pale livers. No abnormalities were noted in animals surviving to the end of the study.

Potential target organs (if identified in the report): none

Source : Wacker

Test condition :
- Doses (OECD guidelines 401 and 425 do not provide dose levels, so these must be described in detail): 0, 2009, 2519, 3162 mg/kg
- Doses per time period: 1
- Volume administered or concentration: neat, controls received 3.10 ml/kg purified water
- Post dose observation period: Fifteen minutes after dosing, at 1, 2, 4 hours post-dosing, daily for 14 days. Animals were weighed Day -1, Day of dosing (Day 1), Day 8, and Day 15 and at time of death.

Test substance : 1, 2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3

Conclusion : LD50 approximately 2400 mg/kg, according to the EEC directive 91/325, no risk symbol or sentence is required.

Reliability : (1) valid without restriction

Flag : Critical study for SIDS endpoint

05.08.2003 (24)

Type : LD50
Value :
Species : Rat
Strain : Wistar
Sex : male/female
Number of animals : 10
Vehicle : Other
Doses : 3.85, 2.96, 2.28, 1.75, 1.35, 1.04, 0.84 ml/kg body weight
Method :
Year :
GLP : no data
Test substance : as prescribed by 1.1 - 1.4

Result : Description, severity, time of onset and duration of clinical signs at each dose level: Clinical signs of sedation, diarrhea and watery eyes were observed in the 2.96 and 3.85 ml/kg groups.

Necropsy findings, included doses affected, severity and number of animals affected: changes were noted as follows: red colored sores and apoplexy in the glandulae gastricae, and discoloration in the wall of the intestine.

Value [LD50 or LC50] with confidence limits if calculated: With 95% confidence limits: 2.25 (1.91 to 2.66) ml/kg body weight for males and 1.68 (1.52 to 1.86) ml/kg body weight for females.

Source : Lesser Ketones Manufacturing Association Leesburg, VA

Test condition :
- Age: Can not determine
- Doses (OECD guidelines 401 and 425 do not provide dose levels, so these must be described in detail): 3.85, 2.96, 2.28, 1.75, 1.35, 1.04, 0.84 ml/kg body weight
- Doses per time period: One
- Volume administered or concentration: Can not determine
- Post dose observation period: 72 hours

Test substance : 1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3

Conclusion : The LD50 was determined to be: 2.25 (1.91 to 2.66) ml/kg body weight for males and 1.68 (1.52 to 1.86) ml/kg body weight for females.

Reliability : (3) invalid
The original report was not available. Only a summary was obtained. No study details were provided.

15.01.2004 (1)

Type : LD50
Value : = 7.46 ml/kg bw
Species : Rat
Strain : Wistar
Sex : Male
Number of animals : 5
Vehicle : other: none
Doses : 2.0, 4.0, 8.0 and 16.0 ml/kg
Method : other: similar to OECD Guide-line 401
Year : 1966
GLP : No
Test substance : as prescribed by 1.1 - 1.4

Result : LD50: 7.46 (5.15to 10.8)ml/kg

Number of deaths at each dose level:

Dosage (ml/kg)	Dead/Dosed	Days to Death	Weight Change
16.0	5/5	0	NA
8.0	3/5	2	The surviving two animals gained weight
4.0	0/5	N/A	All animals gained weight
2.0	0/5	N/A	All animals gained weight

There were no signs or symptoms of toxicity. All survivors gained weight.
Gross Pathology: Observations included congestion throughout the lungs and the abdominal viscera with some hemorrhage present in the intestines. The surface of the livers, stomachs and intestines were whitish in appearance.

Source : Epona Associates, LLC

Test condition : Each rat received a single dose of the test substance. The rats weighed 90 - 120 grams at dosing and were three to four weeks of age. The rats were not fasted prior to dosing. Rats were weighed prior to dosing and at study termination. Four groups of rats received 16.0, 8.0, 4.0, or 2.0 ml/kg of the undiluted test substance. Rats were observed for

fourteen days. The LD50 was calculated by the moving average method based on a 14-day observation period.

Test substance : 1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3

Reliability : (2) valid with restrictions

03.08.2003 (46)

5.1.2 ACUTE INHALATION TOXICITY

Type : Other
Value :
Species : Rat
Strain : no data
Sex : no data
Number of animals : 6
Vehicle : Other
Doses : Saturated vapors
Exposure time : 8 hour(s)
Method : other
Year : 1966
GLP : No
Test substance : as prescribed by 1.1 - 1.4

Remark : This study was not conducted in conformance with OECD test guidelines and is of limited valu

Result : Exposure Time | Exposure Concentration | Dead/Dosed | Days to Death

8 hr | Not measured | 0/6 | Not applicable

There were no signs or symptoms of toxicity. All animals gained weight. Gross pathology showed nothing remarkable.

Source : Epona Associates, LLC

Test condition : Substantially saturated vapor was prepared by spreading 50 grams of chemical over 200 cm2 area on a shallow tray placed near the top of a 120-liter glass chamber which was then sealed for at least 16 hours while an intermittently operated fan agitated the internal chamber atmosphere. Rats were then introduced in a gasketed drawer-type cage designed and operated to minimize vapor loss. The test was conducted at 20.5oC. The duration of exposure was eight hours. Animals were observed during a 14-day post?exposure observation period. Animals were weighed prior to test initiation and at test termination.

Test substance : 1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3

Reliability : (3) invalid
The method of test article generation is insufficient to produce an exposure atmosphere.

15.01.2004 (46)

5.1.3 ACUTE DERMAL TOXICITY

Type : LD50
Value : = 16 ml/kg bw
Species : Rabbit
Strain : New Zealand white

Sex	:	Male
Number of animals	:	4
Vehicle	:	
Doses	:	8.0, 16.0 ml/kg
Method	:	other: similar to OECD Guide-line 402
Year	:	1966
GLP	:	no
Test substance	:	as prescribed by 1.1 - 1.4
Remark	:	This study was not conducted in full conformance with OECD test guidelines
Result	:	LD50: 16.0ml/kg Number of deaths at each dose level: Dosage (ml/kg) Dead/Dosed Days to Death 16.0 1/2 7 8.0 0/4 Not applicable There were no signs or symptoms of toxicity. The surviving animal dosed at 16.0 mg/kg and three of the four animals dosed at 8.0 mg/kg gained weight during the study. Gross Pathology observations included congested lungs, liver and spleen, and pale kidneys
Source	:	Epona Associates, LLC
Test condition	:	The rabbits were three to five months of age at dosing. The rabbits were weighed prior to dosing and at study termination. Each rabbit received a single dermal application of the undiluted test substance and impervious polyethylene sheeting was used to retain the dose in contact with the clipped skin of the trunk and was immobilized for the 24?hour skin contact period. Two groups of rabbits were dosed at 16.0 (2 animals) or 8.0 (4 animals) ml/kg of the undiluted test substance. After 24 hours, the polyethylene sheeting was removed and the excess test article was removed to prevent ingestion. The animals were observed for fourteen days. The LD50 was calculated by the moving average method based on a 14-day observation period.
Test substance	:	1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3
Reliability	:	(2) valid with restrictions

15.01.2004 (46)

5.1.4 ACUTE TOXICITY, OTHER ROUTES

5.2.1 SKIN IRRITATION

Species	:	rabbit
Concentration	:	undiluted
Exposure	:	Semiocclusive
Exposure time	:	4 hour(s)
Number of animals	:	6
Vehicle	:	
PDII	:	
Result	:	not irritating
Classification	:	not irritating

Method	:	OECD Guide-line 404 "Acute Dermal Irritation/Corrosion"
Year	:	1992
GLP	:	yes
Test substance	:	as prescribed by 1.1 - 1.4
Result	:	Mean Values for cutaneous irritation: At 24 hours: Erythema 1.33 Edema 1.17 At 48 hours: Erythema 1.33 Edema 0.50 At 72 hours: Erythema 1.17 Edema 0.33 Global average was: Erythema 1.28 Edema 0.6 Number of deaths at each dose level: No mortality was observed The mean values for cutaneous irritation were as follows: at 24 hrs - erythema=1.33; edema=1.17 at 48 hrs - erythema=1.33; edema=0.50 at 72 hrs - erythema=1.17; edema=0.33 The average (24 hrs+48hrs+72hrs)- erythema=1.28; edema=0.67 Lesions observed at 72 hours were totally reversible at the reading performed on day 14.
Source	:	Lesser Ketones Manufacturing Association Leesburg, VA
Test condition	:	Doses: 0.5 ml per animal Doses per time period: One Volume administered or concentration: Neat Post dose observation period: 1, 24, 48, 72 hours, 7 and 14 days
Test substance	:	1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3; purity = 97.9%
Conclusion	:	From the results of this study, application of CAS No. 1760-24-3 to rabbit skin can be designated as a non irritant.
Reliability	:	(1) valid without restriction
16.01.2004		(30)
Species	:	rabbit
Concentration	:	undiluted
Exposure	:	Occlusive
Exposure time	:	4 hour(s)
Number of animals	:	3
Vehicle	:	
PDII	:	1.62
Result	:	slightly irritating
Classification	:	
Method	:	OECD Guide-line 404 "Acute Dermal Irritation/Corrosion"
Year	:	1985
GLP	:	yes
Test substance	:	as prescribed by 1.1 - 1.4
Result	:	Application of 0.5 ml for 4 hours produced minor to moderate erythema on 6 of 6 rabbits, with minor edema on 4. Desquamation appeared on 3 animals within 3 to 7 days and remained on 2 after 10 days. No erythema or edema was evident at 10 days.

		Total scores for 6 animals Erythema Edema 1 hr 6 2 24 hr 10 3 48 hr 7 3 72 hr 6 2
Source	:	Epona Associates, LLC
Test condition	:	Rabbits were dosed with 0.5 ml. The dose was applied to the clipped, intact skin under a gauze patch and was loosely covered with impervious sheeting for a contact period of 4 hours. The animals were restrained for the four-hour contact period. Excess sample was removed after contact. The skin reactions were scored by the method of Draize at one hour and 1, 2, 3, 7, and 10 days after application (as necessary).
Test substance	:	1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3. Although not provided in the study report, other testing conducted during the same time period at this laboratory indicates the purity would have been 77%.
Conclusion	:	Although no GLP Statement is provided in this report, it is assumed that this study was conducted under GLP. Bushy Run Research Center was a certified GLP laboratory during the conduct of this study. The test article was moderately irritating under the conditions of the study.
Reliability	:	(1) valid without restriction
15.01.2004		(5)

Species	:	rabbit
Concentration	:	undiluted
Exposure	:	
Exposure time	:	no data
Number of animals	:	5
Vehicle	:	
PDII	:	
Result	:	moderately irritating
Classification	:	
Method	:	
Year	:	1966
GLP	:	no
Test substance	:	as prescribed by 1.1 - 1.4
Result	:	Observations included moderate erythema on one animal and moderate to marked capillary injection on four others, corresponding to a grade 3 in the 10-grade rating system.
Source	:	Epona Associates, LLC
Test condition	:	The uncovered application of 0.01 ml of the test substance to the clipped skin of the rabbit belly was evaluated in five rabbits. Ten grades are recognized based on appearance of moderate or marked capillary injection, erythema, edema, or necrosis within 24 hours. No injury from undiluted test article would be scored as a Grade 1.
Test substance	:	1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3
Conclusion	:	The test materials was moderately irritating.
Reliability	:	(3) invalid The protocol of this study was not conducted in full conformance with OECD test guidelines and does not meet the criteria of the current standard methods (dose volume; un-occluded contact).
18.06.2003		(46)

5.2.2 EYE IRRITATION

Species	:	rabbit
Concentration	:	undiluted
Dose	:	.1 ml
Exposure time	:	unspecified
Comment	:	
Number of animals	:	6
Vehicle	:	none
Result	:	irritating
Classification	:	irritating
Method	:	OECD Guide-line 405 "Acute Eye Irritation/Corrosion"
Year	:	1993
GLP	:	yes
Test substance	:	as prescribed by 1.1 - 1.4
Result	:	Mean values for ocular irritation were as follows: at 24 hrs: chemosis=3.00, enanthema=2.00, congestion=1.00, opacity=2.00 at 48 hrs: chemosis=3.00, enanthema=2.67, congestion=1.00, opacity=2.00 at 72 hrs: chemosis=3.00, enanthema=2.83, congestion=1.00, opacity=2.00 The average (24+48+72 hrs) was: 3.00 for chemosis to conjuntiva 2.50 for enanthema to conjunctiva 1.00 for congestion to iris 2.00 for opacity to cornea. The lesions observed at 72 hours were still observed in 5 out of 6 rabbits examined on Day 21. From the results obtained under the experimental conditions employed, application of this test article to the rabbit's eye can be designated as "Irritant".
Source	:	Lesser Ketones Manufacturing Association Leesburg, VA
Test condition	:	I. Age: ~ 3 months II. Doses per time period: one III. Volume administered or concentration: 0.1 ml IV. Post dose observation period: 21 days
Test substance	:	1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3
Conclusion	:	According to the guide to the labeling of dangerous substances published in the Official Journal of the European Communities (EEC Directive 91/325), this test article can be labeled as follows: Symbol: XI, Irritant Risk sentence: R 41. risk of serious damage to eyes
Reliability	:	(1) valid without restriction

05.08.2003 (32)

Species	:	rabbit
Concentration	:	undiluted
Dose	:	.1 ml
Exposure time	:	
Comment	:	other
Number of animals	:	9

Vehicle	:	none
Result	:	highly irritating
Classification	:	
Method	:	other: similar to OECD Guide-line 405
Year	:	1981
GLP	:	yes
Test substance	:	as prescribed by 1.1 - 1.4
Result	:	Unwashed group: Corneal opacities were observed in three animals on days 7 and 8, and four animals on days 9-14. Corneal necrosis was observed for all animals at 24 hours to day 10, and persisted in three animals on days 13 and 14. Iritis was observed for 2-3 animals from 24 hours until day 10. Redness, chemosis and discharge were observed in all animals by 24 hours, and persisted in at least two animals by day 14. Blistering of the conjunctivae was observed for the majority of the animals at 24 and 48 hours and persisted today 7 for some animals. Washed group: Corneal opacity was observed in one animal on days 9 to 14. Corneal necrosis was observed for all animals at 24 and 48 hours, and persisted in two animals until study termination. Redness, chemosis and discharge were observed in all animals by 24 hours, and persisted in one animal by day 14. Blistering of the conjunctivae was observed in one animal at 24 and 48 hours.
Source	:	Lesser Ketones Manufacturing Association Leesburg, VA
Test condition	:	Rabbits were dosed with 0.1 ml. The dose was instilled into the lower conjunctival sac of one eye per animal. The other eye served as the untreated control. The treated eyelids were held together for one second. The treated eyes of six animals remained unwashed. The treated eyes of three animals were washed for 1 minute approximately 5 seconds after installation of the test article. The eyes were scored at 24, 48 and 72 hours, and on days 4, 7 and 8-14 after dosing. The test article was given a descriptive rating using the method of Kay and Calandra.
Test substance	:	1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3
Conclusion	:	This material is severely irritating to the eye.
Reliability	:	(2) valid with restrictions

15.01.2004 (43)

Species	:	rabbit
Concentration	:	undiluted
Dose	:	
Exposure time	:	
Comment	:	
Number of animals	:	9
Vehicle	:	none
Result	:	highly irritating
Classification	:	
Method	:	other: similar to OECD Guide-line 405
Year	:	1981
GLP	:	yes
Test substance	:	as prescribed by 1.1 - 1.4
Result	:	Unwashed group: Corneal opacities were observed in four animals on day 7 and five animals on days 8-14. Corneal necrosis was observed for all animals at 24 hours to day 10,

and persisted in one animal on day 14. Iritis was initially observed for 4 animals at 24 hours and persisted in one animal until day 14. Redness, chemosis and discharge were observed in all animals by 24 hours, and persisted in at least four animals by day 14. Blistering of the conjunctivae was observed at 24 and 48 hours.

Washed group: Corneal opacities were observed beginning at 72 hours, and were observed in all animals by study termination. Corneal necrosis was observed for all animals at 24 hours, and persisted in two animals until day 13. Iritis was initially observed for 1 animal at 24 hours and in all animals for days 4?10. Iritis persisted in one animal until day 13. Redness, chemosis and discharge were observed in all animals by 24 hours, and persisted in at least two animals by day 14. Blistering of the conjunctivae was observed in all animals at 24 hours and one animal at 48 hours.

Source : Lesser Ketones Manufacturing Association Leesburg, VA
Test condition : Rabbits were dosed with 0.1 ml. The dose was instilled into the lower conjunctival sac of one eye per animal. The other eye served as the untreated control. The treated eyelids were held together for one second. The treated eyes of six animals remained unwashed. The treated eyes of three animals were washed for 1 minute approximately 5 seconds after installation of the test article. The eyes were scored at 24, 48 and 72 hours, and on days 4, 7 and 8-14 after dosing. The test article was given a descriptive rating using the method of Kay and Calandra.
Test substance : 1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3
Conclusion : This material is severely irritating to the eye.
Reliability : (2) valid with restrictions
15.01.2004 (44)

Species : rabbit
Concentration : undiluted
Dose : .5 ml
Exposure time : unspecified
Comment :
Number of animals : 5
Vehicle : other
Result :
Classification :
Method : other
Year : 1966
GLP : no
Test substance : as prescribed by 1.1 - 1.4

Result : Instillation of either 0.005 ml undiluted or 0.5 ml of a 15% solution in propylene glycol produced moderately severe corneal necrosis. A 5% solution in propylene glycol caused no injury in two eyes and only traces of diffuse corneal necrosis in three others. Grade 8 in the 10-grade rating system.
Source : Epona Associates, LLC
Test condition : Single instillations of 0.005 ml undiluted, 0.5 ml of a 15% dilution in propylene glycol, or 0.5 ml of a 5% dilution in propylene glycol were instilled into the conjunctival sac of 5 rabbits/dose group. The eyes were read within one hour (unstained) and at 24 hours (fluorescein stained), with one

of ten grades recognized. A trace injury or no injury from 0.5 ml undiluted would be scored as a Grade 1.

Test substance : · N-(2-aminoethyl)-3-aminopropyltrimethoxysilane (CAS No. 1760-24-3)

Reliability : (3) invalid
The study was not conducted in compliance with OECD guidelines (dose volume) and the scoring criteria are inappropriate compared to current procedures.

18.06.2003 (46)

5.3 SENSITIZATION

Type : Guinea pig maximization test
Species : guinea pig
Number of animals : 20
Vehicle : no data
Result :
Classification : sensitizing
Method : Directive 84/449/EEC, B.6 "Acute toxicity (skin sensitization)"
Year : 1992
GLP : yes
Test substance : as prescribed by 1.1 - 1.4

Method : OECD guideline 406; Directive 84/449/EEC, B.6 "Acute toxicity (Skin sensitization)"

Result : Signs of irritation were noted during the induction. Macroscopic and histopathological examinations revealed pathological lesions of delayed hypersensitivity in 6 out of 20 treated animals. A weak irritation was noted in one control animal. No other cutaneous abnormality was noted in the other 19 control animals.

Source : Lesser Ketones Manufacturing Association Leesburg, VA

Test condition : Doses (OECD guidelines 401 and 425 do not provide dose levels, so these must be described in detail): Please see below.

· Doses per time period and Volume administered or concentration:

Ø Treated Group: Intradermal-3 series of 2 X 0.1 ml injections

1. Freund's complete adjuvant at 50 % (V/V) in an isotonic injectable solution
2. Test article in a 0.1% (V/V) solution in sterile Codex liquid paraffin
3. Mixture 50/50 (V/V): test article in a 0.2% (V/V) in sterile Codex liquid paraffin plus Freund's complete adjuvant at 50 % (V/V) in an isotonic injectable solution for a final 0.1% concentration of the test article

Ø Treated Group: Topical occlusive for 48 hours

1. Test article- 0.5 ml in a 10% (V/V) solution in sterile Codex liquid paraffin

Ø Control group: Intradermal-3 series of 2 X 0.1 ml injections and Topical occlusive for 48 hours

1. Same conditions as treated group with sterile Codex liquid paraffin replacing the test article.

Ø Challenge treatment-topical occlusive application for 24 hours in treated and control group with the test article in a 10% (V/V) solution in sterile Codex liquid paraffin at the

rate of 0.5 ml. The vehicle was also applied during the challenge.

· Post dose observation period: 11 days
· Number of deaths at each dose level: There were no mortalities during the study

Test substance : 1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3

Conclusion : The test article, CAS No. 1760-24-3 provoked a reaction of cutaneous sensitization in 30% of the animals examined. Based on the Magnusson and Kilgman classification, its sensitizing potential to guinea-pig skin is moderate (Grade III). According to the EEC Directive 91/325 the the risk symbol and phrase of "R43: May cause sensitization by skin contact" is justified.

Reliability : (1) valid without restriction
05.08.2003 (31)

5.4 REPEATED DOSE TOXICITY

Type	:	Sub-acute
Species	:	rat
Sex	:	male/female
Strain	:	Sprague-Dawley
Route of admin.	:	gavage
Exposure period	:	28 days
Frequency of treatm.	:	Daily, 7 days per week for at least 28 days
Post exposure period	:	
Doses	:	0, 25, 125, and 500 mg/kg/day
Control group	:	yes
NOAEL	:	= 500 mg/kg bw
Method	:	other: OECD 422
Year	:	2002
GLP	:	yes
Test substance	:	as prescribed by 1.1 - 1.4

Method : OECD Guideline 422; US EPA Guideline OPPTS 870.3650 (2000)

Data were analyzed by Bartlett's and Kolmogorov-Smirnov tests. Parametric data was analyzed by ANOVA followed by Dunnett's test; Non-parametric data was tested by Kruskal-Wallis test followed by Wilcoxon test. Significance levels were reported as either $P< 0.05$ or $P< 0.01$

Remark : The test substance was shown to be stable in the vehicle (as a dosing solution).

Result : One male in the 125 mg/kg/day dose group was found dead due to renal disease unrelated to treatment. Clinical signs attributed to test substance included clear perioral soiling in several high dose animals and increased nasal sounds, labored respiration or soft vocalizations in approximately half of the high dose females and one high dose male. The signs were not seen in the control animals and infrequently seen in either of the two lower dose groups. Observations recorded at dosing indicated a dose-related resistance to dosing.

There were no test substance-related effects on body weight or food consumption for any of the dose group. No test substance-related changes on FOB and Motor activity

parameters were observed in the male and female animals evaluated. There were no dose-related changes in hematology and serum chemistry parameters for these animals. No treatment-related effects were observed at the macroscopic examinations for any of the animals. There were no effects on mean organ weights or organ to body weight ratios attributable to the test substance for organs evaluated. The histopathologic examination performed on all gross lesions, selected tissues and organs for control and high dose group animals revealed no effects attributable to test substance treatment.

Source : Dow Corning Corporation

Test condition : Dose levels were selected based on the outcome of a seven-day oral range-finding study. In this range-finding study, 3 rats/sex were dosed by gavage at dose levels of 125, 250, 500 or 1000 mg/kg/day (in corn oil) or corn oil alone once daily for seven days. One high dose (1000 mg/kg/day) female animal was found dead on day four. A high dose male animal was found moribund on study day 6 and euthanized. The cause of death for these animals could not be determined. All other animals survived until scheduled necropsy. Varying effects were noted on body weight and food consumption among all dose groups. Test-article related clinical signs (rales and soiling and wetness around the muzzle) were evident in animals treated with 1000 mg/kg/day. Some animals in the lower dose groups (125-500 mg/kg/day) exhibited sporadic incidences of rales, wetness around the nose and/or mouth, or soiling of the muzzle. Necropsy of the two animals that died showed gas distension of the GI tract and small dark livers. No findings were noted in the remaining animals at necropsy. The results of this range-finding study indicate that a dose level of 1000 mg/kg/day exceeds the maximum tolerated dose for repeated gavage in rats. A maximum dose level of 500 mg/kg/day was selected for the repeated dose oral gavage study.

Detailed physical examinations were performed before the first dosing and weekly thereafter. The animals were observed twice daily (once daily on weekends) for mortality/viability. The animals were observed for clinical signs once daily within one hour post dosing outside their home cages. Clinical findings attributed to the test substance included clear perioral soiling in several high dose animals and either increased nasal sounds, labored respiration, or soft vocalizations in approximately half of the high dose females and one high dose male. These signs were not seen in the control animals and infrequently seen in either of the two lower dose groups. Observations recorded at dosing indicated a dose-related resistance to dosing. Evaluating all 30 animals/dose over the entire dosing period, the incidence of resistance was 3, 5, 27 and 62% for the controls, 25, 125 and 500 mg/kg/day dose groups, respectively. Similar incidence patterns were noted for salivation just prior to dosing, wetness around the mouth at dosing, and wetness around the mouth 5-30 minutes following dosing. These clinical findings are anticipated based on the amine-functionality of the material and indicative of irritation, rather than systemic effects. There were no test substance-related effects on body weight, organ weights or organ-to-body weight ratios, food consumption, FOB or motor activity parameters, or hematology or serum chemistry parameters, and no macroscopic or microscopic findings were attributed to the test-substance. Based on the results of this study, the NOAEL for the systemic toxicity of this material in the rat via oral dosing for at least 28 consecutive days was considered to be 500 mg/kg.

Test Subjects
·Age at study initiation: Minimum 8 weeks old
·No. of Animals per sex per dose: 10

Study Design
·Vehicle: Corn oil
·Satellite groups and reasons they were added: None
·Clinical observations performed and frequency: Clinical observations were performed at least once a day.
·Organs examined at necropsy (macroscopic and microscopic): At the end of dosing a complete necropsy was performed on all animals. The liver, kidneys, adrenal glands, brain, heart, spleen, thymus, testes, epididymides, seminal vesicles, prostate, ovaries and uterus were taken and weighed. A set of tissues were collected and retained in 10% neutral buffered formalin. The designated organs and tissues from control and high dose groups were processed histologically and examined microscopically. A histopathologic exam was performed on all gross lesions, adrenals, brain, heart, kidneys, liver, lymph nodes, lungs, spinal cord, spleen, duodenum, jejunum, ileum, cecum, colon, stomach, peripheral nerve, thymus, thyroid, trachea, uterus, urinary bladder, bone marrow, ovaries, prostate and seminal vesicles from control and high dose male and female toxicity group animals.

Test Subjects
·Age at study initiation: Minimum 8 weeks old
·No. of Animals per sex per dose: 10

Study Design
·Vehicle: Corn oil
·Satellite groups and reasons they were added: None
·Clinical observations performed and frequency: Clinical observations were performed at least once a day.
·Organs examined at necropsy (macroscopic and microscopic): At the end of dosing a complete necropsy was performed on all animals. The liver, kidneys, adrenal glands, brain, heart, spleen, thymus, testes, epididymides, seminal vesicles, prostate, ovaries and uterus were taken and weighed. A set of tissues were collected and retained in 10% neutral buffered formalin. The designated organs and tissues from control and high dose groups were processed histologically and examined microscopically. A histopathologic exam was performed on all gross lesions, adrenals, brain, heart, kidneys, liver, lymph nodes, lungs, spinal cord, spleen, duodenum, jejunum, ileum, cecum, colon, stomach, peripheral nerve, thymus, thyroid, trachea, uterus, urinary bladder, bone marrow, ovaries, prostate and seminal vesicles from control and high dose male and female toxicity group animals.

Test substance : 1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3

Conclusion : Based on the results of this study, the no-observed-adverse-effect-level for 1,2-Ethanediamine, N-{3-(trimethoxysilyl) propyl}- in the rat via the oral dosing for at least 28 consecutive days was considered to be 500 mg/kg.

Reliability : (1) valid without restriction

08.03.2004 (10)

Type : Sub-acute
Species : rabbit
Sex : male
Strain : other
Route of admin. : dermal
Exposure period : 1.5 - 2 hours/day

Frequency of treatm.	:	One group of four male albino rabbits received a total of 8 inunctions (Monday (M), Wednesday (W), and Friday (F) the first week; M, W, F the second week; M, W the third week) at 2.0 ml/kg over 19 days
Post exposure period	:	Not applicable.
Doses	:	2.0 ml/kg test article or distilled water
Control group	:	yes
Method	:	other
Year	:	1975
GLP	:	no
Test substance	:	as prescribed by 1.1 - 1.4
Method	:	Statistical method: Statistical comparisons were performed by the homogeneity and analysis of variance procedures.
Result	:	No deaths occurred during the study. There were no statistically significant differences in body weight or body weight gain and absolute or relative liver and kidney weights when the test article-treated animals were compared to controls. Moderate skin responses were noted from application of the test material, including erythema, major desquamation and small fissures. Based on these results, it was concluded that the dosage level applied (2.0 ml/kg/day) was without major ill effect.
Source	:	Lesser Ketones Manufacturing Association Leesburg, VA
Test condition	:	Groups of four male albino rabbits, between 2.0 - 2.3 kg, received 8 dermal applications over a 19 day period. In a previous study, the skin penetration of the undiluted test material killed 1 of 2 rabbits at 16 ml/kg and 0 of 4 at 8 ml/kg. Therefore, 2.0 mg/kg was the dosage level selected for study because this volume is the maximum that can be retained on the clipped skin. The dose was gently massaged, using a glass test tube as the applicator, into the clipped skin on the belly, flanks and back because of the size of the dose and the skin irritation that resulted. As the daily dose of the test material was so large that it could not be applied in one inunction, one-fourth of the dose was applied for one minute of each 15?minute interval during a one-hour period. One hour after the last application, the skin was gently blotted with cleansing tissue to remove any unabsorbed liquid and to prevent ingestion by licking of the skin. The rabbits were weighed before study initiation, before each daily dose, and two days following the final application (study termination). The liver and kidney were weighed at study termination.
Test substance	:	1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3
Conclusion	:	Based on these results, it was concluded that the dosage level applied (2.0 ml/kg/day) was without major ill effect.
Reliability	:	(2) valid with restrictions

15.01.2004 (35)

Type	:	Sub-acute
Species	:	rat
Sex	:	male/female
Strain	:	Fischer 344
Route of admin.	:	dermal
Exposure period	:	11 days
Frequency of treatm.	:	a total of nine applications (6 hours/day, occluded) over an 11-day period
Post exposure period	:	19 days for half of the control and 1545 mg/kg bw/day groups
Doses	:	0.25, 0.75 and 1.5 ml/kg bw/day (equivalent to 257.5, 772.5, and 1545.0 mg/kg bw/day)
Control group	:	other: concurrent treated with Milli-Q filtered water (1.5 ml/kg bw/day)

LOAEL	:	= 257.5 mg/kg bw
Method	:	other
Year	:	1993
GLP	:	yes
Test substance	:	as prescribed by 1.1 - 1.4
Result	:	Probe studies: Severe skin irritation was observed in rats treated with undiluted test substance at 4 ml/kg or 2 ml/kg. Findings for these animals were barely perceptible to well-defined erythema, barely perceptible to moderate edema, exfoliation, excoriation, fissures and/or necrosis. In the rats treated with 1 ml/kg or 0.5 ml/kg of A-1120, barely perceptible to well-defined erythema, exfoliation, and excoriation were observed. Minor irritation was observed in the 0.25 ml/kg A-1120 treated rats and included barely perceptible erythema, exfoliation, or excoriation. Barely perceptible erythema, exfoliation, and/or excoriation were observed in animals treated with a 50% solution of A-1120 (applied at 2.0 ml/kg) in corn oil. The only skin finding observed in animals treated with a 25% solution of A-1120 (applied at 2.0 ml/kg) was exfoliation. Residues of test substance were noted on the skin of treated rats, especially of rats treated with a 25 or 50% solution of A-1120. Definitive study: No mortality or treatment-related clinical signs, except skin irritation at the application site were observed. Barely perceptible erythema was observed occasionally in males of the 772.5 and 1545 mg/kg/day groups and in females of the 1545 mg/kg/day group during the first week of treatment. Exfoliation and/or excoriation were observed during the treatment period in males and females of the 772.5 and 1545 mg/kg/day groups. One female of the 257.5 mg/kg/day group also showed excoriation during the treatment period. During the 19-day recovery period, exfoliation and excoriation were observed in the A-1120-treated animals. No skin lesions were observed after Day 17. Decreases in food consumption, body weight, and body weight gain were observed in males of the 772.5 and 1545 mg/kg/day groups during the treatment period. Body weight gain was also decreased in males of the 257.5 mg/kg/day group. Various signs of irritation were observed at gross and microscopic evaluation of the treated skin of males in the 772.5 and 1545 mg/kg/day groups and of females in all treated groups. Exfoliation and excoriation were the findings noted at the necropsy at the end of the treatment period. Microscopic findings observed were hyperkeratosis, acanthosis, epidermitis, and dermatitis. Ulceration and dermal fibrosis were observed occasionally in these same treated groups. Residual effects, as indicated by minimal hyperkeratosis and dermatitis, were observed in males and females of the 1545 mg/kg/day group at the end of the 19-day recovery period.
Source	:	Epona Associates, LLC
Test condition	:	In order to establish dose levels for this study, two probe studies were conducted. In the first probe study, one rat/sex/group was treated with undiluted A-1120 at 0.5, 1.0, 2.0, or 4.0 ml/kg. In the second probe study, one rat/sex/group was treated with undiluted A-1120 at 0.25, 0.5, and 1.0 mg/kg or with a 25 or 50% solution of A-1120 in corn oil at 2.0 ml/kg. Rats were treated for 5 consecutive days. Draize scores and clinical observations were recorded

on Days 1-5 and Day 8 (no dosing). Body weight weights were collected on Days 1 (the first day of dosing) and 5. No further evaluations were made.

Definitive study: Fischer 344 rats were treated percutaneously with undiluted Organofunctional A-1120 at doses of 0.25, 0.75, or 1.5 ml/kg body weight/day (equivalent to 257.5, 772.5, or 1545.0 mg/kg body weight/day). Animals in the control group were treated with Milli-Q(R) filtered water at a volume of 1.5 mg/kg body weight/day. Twenty rats/sex were assigned to the control and 1545 mg/kg/day groups and ten rats/sex were assigned to the 257.5 and 772.5 mg/kg/day groups. Animals were treated for a total of nine applications (6 hours/day, occluded) over an 11-day period and sacrificed on the twelfth day. Ten animals/sex of the control and 1545 mg/kg/day groups were held an additional 19 days following the final treatment to determine the reversibility of any observed toxic effects. Monitors for toxicity were clinical signs of toxicity including skin irritation (using a modified Draize scoring system), food consumption, water consumption, body weights and weight gain, hematology (erythrocyte count, hemoglobin, hematocrit, mean corpuscular hemoglobin, mean corpuscular volume, mean corpuscular hemoglobin, platelet count, total leukocyte count, and differential leukocyte count), clinical chemistry (AST, ALT, alkaline phosphatase, gamma glutamyl transferase, creatine kinase with CK isoenzymes, lactate dehydrogenase with LD isoenzymes, sorbitol dehydrogenase, albumin, globulin, creatinine, total bilirubin, direct bilirubin, indirect bilirubin, urea nitrogen, total protein, phosphorus, calcium, sodium, potassium, chloride, and glucose), urinalysis (total volume, specific gravity, protein, ketone, blood, microscopic elements, N-acetyl-beta-D-glucosaminidase (NAG) activity, color and appearance, pH, glucose, bilirubin, and urobilinogen), organ weights (liver, kidneys, brain, heart, adrenals, and testes), gross pathology and histopathology were evaluated.

Statistical Evaluations: Data for continuous, parametric variables were intercompared for the dose and control groups by use of Levene's test for homogeneity of variances, by analysis of variance, and by pooled variance t-tests. The t-tests were used if the analysis of variance was significant, to delineate which groups differed from the control group. If Levene's test indicated heterogeneous variances, the groups were compared by an analysis of variance for unequal variances followed, when appropriate, by separate variance t-tests. Non-parametric data were analyzed by the Kruskal-Wallis test followed, when appropriate, by the Wilcoxon rank sum test as modified by Mann-Whitney. Frequency data were compared using Fisher's exact tests where appropriate. All statistical tests were performed using BMDP Statistical Software or appropriate statistical programs (Dixon, 1990; Bioemtry, Sokal and Rohlf, 1981). The probability value of 0.05 (two-tailed) was used as the critical level of significance.

Test substance : N-beta-(aminoethyl)-gamma-aminopropyltrimethoxysilane; Organofunctional Silane A-1120: purity of 77.6 for prestudy and 77.3 for poststudy

Conclusion : Treatment of rats with A-1120 for 9 cutaneous applications

during an 11-day period produced transient clinical, necropsy and microscopic observations indicative of mild to moderate skin irritations in males of the 772.5 and 1545 mg/kg/day groups and females of all treated groups. Treatment of A-1120 also resulted in decreased food consumption in males of the 772.5 and 1545 mg/kg/day groups and decreased body weight and/or body weight gain in males of all treated groups. However, there was no indication o specific organ systemic toxicity. Thus, a no-observed-effect level was not established in this study, although the effects at the low dose were minimal.

Reliability : (1) valid without restriction
04.11.2003 (6)

5.5 GENETIC TOXICITY 'IN VITRO'

Type	:	Ames test
System of testing	:	Bacterial
Test concentration	:	0, 0.1, 0.5, 1.0, 2.5, 5 mg/plate, tested in triplicate
Cycotoxic concentr.	:	With metabolic activation: slight cytotoxicity in all strains at 2.5 and 5 mg/plate; Without metabolic activation: slight cytotoxicity in all strains at 2.5 and 5 mg/plate
Metabolic activation	:	with and without
Result	:	negative
Method	:	OECD Guide-line 471
Year	:	1992
GLP	:	yes
Test substance	:	as prescribed by 1.1 - 1.4

Method	:	OECD 471 (1983) - EEC 84/449 - annex V - method B14 (1984)
Result	:	No mutagenic potential was observed in any strain at any dose concentration
Source	:	Wacker
Test substance	:	1, 2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3
Conclusion	:	1, 2-ethanediamine, N-[3-(trimethoxysilyl)propyl]- (CAS No. 1760-24-3) is not mutagenic with or without metabolic activation.
Reliability	:	(1) valid without restriction
Flag	:	Critical study for SIDS endpoint

05.08.2003 (15)

Type	:	Ames test
System of testing	:	Bacterial
Test concentration	:	up to 5000 ug/plate
Cycotoxic concentr.	:	>5000 ug/plate
Metabolic activation	:	with and without
Result	:	negative
Method	:	other
Year	:	1988
GLP	:	yes
Test substance	:	as prescribed by 1.1 - 1.4

Method	:	Mutation Research 31, 347-364 (1975)
Result	:	The material was not mutagenic in this bacterial mutagenicity assay.
Source	:	Epona Associates, LLC
Test condition	:	Salmonella typhimurium strains TA100, TA975 and TA98 with and without metabolic activation

Reliability : (2) valid with restrictions
Important study details are missing.
11.08.2003 (22)

Type : Ames test
System of testing : Bacterial
Test concentration :
Cycotoxic concentr. : 100 ul/plate
Metabolic activation : with and without
Result : Negative
Method : Other
Year : 1977
GLP : no data
Test substance : as prescribed by 1.1 - 1.4

Method : Japanese guidelines for testing of chemicals
Source : Epona Associates, LLC
Reliability : (4) not assignable
Important study details are missing.
05.08.2003 (42)

Type : Ames test
System of testing : TA 98, TA 100, TA 1535, TA 1537, TA 1538
Test concentration : 0.03, 0.1, 0.3, 1 and 3 mg/plate without metabolic activation; 0.1, 0.3, 1, 3 and 10 mg/plate with metabolic activation
Cycotoxic concentr. : 3 mg/plate and above without metabolic activation; 10 mg/plate and above with metabolic activation
Metabolic activation : with and without
Result : Negative
Method : other: EPA Health Effects Test Guidelines, HG-Gene Muta-S. typhimurium, EPA Report 560/6-84-002, 1984
Year : 1988
GLP : Yes
Test substance : as prescribed by 1.1 - 1.4

Result : Preliminary test: Based on the results of the preliminary toxicity test, five doses ranging from 0.03 to 3 mg/plate were selected for testing without S9, and five doses ranging from 0.1 to 10 mg/plate were selected for the definitive mutagenicity experiments performed with S9.

Definitive test: Mutagenic activity was not observed with any of the five bacterial strains tested with or without the presence of an Aroclor 1254-induced rat liver S9 metabolic activation system. All average colony numbers were less than two times the respective concurrent solvent control values. The reliability and sensitivity of the test system was confirmed by appropriate responses with the positive and negative control articles.
Source : Epona Associates, LLC
Test condition : Dimethylsulfoxide was used as the solvent and diluent.

Preliminary toxicity test: A preliminary toxicity test with one plate per test concentration was performed using strain TA100 to determine the level of toxicity of the test substance. Ten doses (0.01 to 103 mg/plate) were tested for toxicity with a plate assay performed in the manner used for mutagenicity determinations. Toxicity was assessed approximately 48 hours after treatment by observing growth inhibition of the background lawn and/or a reduction in the

number of spontaneous mutants.

Definitive test: Triplicate plates were used for each dose tested. The metabolic activation system used was an S9 homogenate of liver prepared from Aroclor 1254-induced Sprague-Dawley rats. After a suitable period of incubation (48-72 hours), revertant colonies were counted. Test chemicals which produced at least a 2-fold and dose-related increase in mutant colonies over the concurrent solvent control values were considered to be bacterial mutagens and suspect mammalian-cell mutagens. Concurrent positive (4-nitro-o-phenylenediamine, sodium azide, 9-aminoacridine, and 2-aminoanthracene) and negative (solvent DMSO) control articles were tested to confirm the sensitivity of the test system.

Test substance : 1,2-ethanediamine, n-[3-trimethoxysilyl)propyl)-; Organofunctional Silane A-1120 (purity - 77.2%)

Conclusion : Under the conditions of this assay, Organofunctional Silane A-1120 was not mutagenic in the Salmonella/microsome mutagenicity assay.

Reliability : (1) valid without restriction

03.11.2003 (18)

Type : HGPRT assay
System of testing : Chinese hamster ovary cells
Test concentration : 0.1 to 4.0 mg/ml without S9; 2.0 to 5.0 mg/ml with S9 activation (the highest five doses which permitted adequate cell survival were assessed for mutation induction)
Cycotoxic concentr. : 6 mg/ml and higher in tests with and without S9 activation
Metabolic activation : with and without
Result : Negative
Method : other: EPA Health Effects Test Guidelines, HG-Gene Muta-Somatic cells, EPA Report No. 560-83-001, October 1983
Year : 1988
GLP : Yes
Test substance : as prescribed by 1.1 - 1.4

Result : Cytotoxicity test: A-1120 was highly cytotoxic when tested with or without S9 metabolic activation at doses of 6 mg/ml or higher. A dose of 3 mg/ml produced 58.8 and 54.7% growth inhibition of CHO cell growth in tests with and without S9 activation, respectively.

Definitive assay: Organofunctional Silane A-1120 did not product any statistically significant increases in the incidence of mutations of CHO cells within a range of cytotoxic-to-noncytotoxic concentrations between 2.5 to 4.0 mg/ml in tests without an S9 metabolic activation system. With S9 activation, one intermediate dose of 2.5 mg/ml produced a mutant incidence in one of the two dosed cultures which was statistically greater than the concurrent controls. No dose-related trend in mutant values was observed in the test with or without S9 activation. The biological significance of the single increase was evaluated by determining reproducibility in an independent repeat test over a narrower range of concentrations with S9 activation. No significant or dose-related increases were observed in the repeat test.

Appropriate responses were noted for the positive and negative controls.

Source : Epona Associates, LLC
Test condition : Dose Selection - Appropriate concentrations for mutagenicity testing were determined by preliminary measurements of cytotoxicity to CHO cells of a range of concentrations tested both in the presence and absence of a rat-liver S9 metabolic activation system. Selection of a suitable range of concentrations for testing was based upon an estimate of the doses which would not produce excessive cytotoxicity to the treated cells. Dimethylsulfoxide (DMSO) was used as the solvent for dilutions. All dilutions were prepared immediately prior to testing.

Test Procedure - Duplicate cultures of CHO cells were exposed for 5 hours to a minimum of five concentrations of Organofunctional Silane A-1120 in test both with and without the addition of a rat-liver S9 metabolic activation system. Various dose levels of Organofunctional Silane A-1120 for testing were attained by direct addition of various aliquots of the diluted test agent into the cell culture medium. The surviving fraction was determined at 18 to 24 hours after the removal of the test chemical using 4 plates/culture and 100 cells/plate. The mutant fraction was determined after a 9 to 12 day sub-culturing period to allow "expression" of the mutant phenotype. The mutant fraction was assessed in selective medium with 2 x 10E5 cells/plate in 5 plates/dosed culture (i.e. 1 x 10E6 total cells/dosed culture). The plating efficiency of these cells was assessed in non-selective medium using 4 plates/dosed culture with 100 cells/plate. The mutagenicity/survival/plating efficiency data from at least the top five concentrations which allowed sufficient cell survival for assessment of survival and quantification of mutants were recorded. The percentage of cells surviving the treatment, the numbers of mutant colonies, the percentage of clonable cells and the calculated number of mutants/10E6 clonable cells were presented.

Positive (dimethylnitrosamine with S9 activation and ethylmethanesulfonate without S9 activation) and vehicle control (cell culture medium and DMSO) materials were tested concurrently to assure both the sensitivity of the test system.

Statistical Analyses: The data were analyzed in comparison to concurrent control values after transformation of the mutation frequencies (MF) and SCE values according to the conversion method of Box and Cox (1964). This procedure for CHO data follows procedures described by Snee and Irr: (MF + 1)^0.15 (Snee, R.D. and J.D. Irr, Mutation Research, 85 (1981), 77-93). Data for positive and negative controls were compared to historical ranges but were not analyzed statistically.
Test substance : Organofunctional Silane A-1120: 77.2% N-beta-(aminoethyl)-gamma-aminopropyltrimethoxysilane, 6.65% bis A-1120, 8.75% siloxanes, 1.56% ethylenediamine and 2.1% monocyclic bis A-1120.
Reliability : (1) valid without restriction
03.11.2003 (36)

Type : Sister chromatid exchange assay
System of testing : Chinese hamster ovary cells

Test concentration	:	1.5 to 4.0 mg/ml without S9 activation; 1.0 to 3.5 mg/ml with S9 activation
Cycotoxic concentr.	:	6 mg/ml in tests with and without metabolic activation
Metabolic activation	:	with and without
Result	:	Negative
Method	:	other: EPA Health Effects Test Guidelines, HG-Gene Muta-Somatic cells, EPA Report No. 560-83-001, October 1983
Year	:	1988
GLP	:	Yes
Test substance	:	as prescribed by 1.1 - 1.4
Result	:	Cytotoxicity test: A-1120 was highly cytotoxic when tested with or without S9 metabolic activation at doses of 6 mg/ml or higher. For the SCE test maximum concentrations tested were 4.0 mg/ml without S9 and 3.5 mg/ml with S9 activation. Definitive assay: Organofunctional Silane A-1120 did not produce a dose-related increase in the incidence of SCEs in CHO cells in test both with and without the incorporation of an S9 metabolic activation system. However, several of the dose levels in each test produced increases in SCEs which were statistically greater than the incidence of SCEs in the vehicle controls. The low level of the increases and absence of a dose-related trend in the SCE data indicated that the statistical differences did not represent a chemical-related effect. Appropriate responses were noted for the positive and negative controls.
Source	:	Epona Associates, LLC
Test condition	:	Dose Selection - Selection of a suitable range of doses for testing was based either upon cytotoxicity data obtained as part of the CHO mutation test or from preliminary experiments to determine relative cytotoxicity of the test chemical. Test Procedure - Production of SCEs following exposure to various concentrations of A-1120 were studied with duplicate cultures of CHO cells tested both with and without the incorporation of a rat-liver S9 metabolic activation Various concentrations of A-1120 for testing were attained by direct addition of various aliquots of the undiluted test agent into the culture medium. For determination of direct genotoxic action, CHO cells were exposed to A-1120 and appropriate controls for 5 hours without S9 activation. Indirect activity, requiring metabolic activation by liver S9 homogenate, was studies with a 2-hour exposure period. Bromodeoxyuridine (BrdU), required to differentiate between the individual "sister" chromatids by SCE staining, was present at a concentration of 3 ug/ml in the growth medium during treatment and during the culture period following exposure. A total of twenty-five cells/concentration was examined for SCE frequencies using duplicate cultures. At least 5 dose levels were tested both with and without metabolic activation. SCE production was determined for the highest 3 doses which did not produce excessive cytotoxic inhibition of cell division. The number of SCEs/cell, mean number of SCEs/chromosome and the level of statistical significance of the increases above the concurrent solvent control values were reported. Data were analyzed by Student's t-test by comparing individual test groups with the combined solvent

control groups.

Positive (dimethylnitrosamine with S9 activation and ethylmethanesulfonate without S9 activation) and vehicle control (cell culture medium and DMSO) materials were tested concurrently to assure both the sensitivity of the test system.

Test substance : Organofunctional Silane A-1120: 77.2% N-beta-(aminoethyl)-gamma-aminopropyltrimethoxysilane, 6.65% bis A-1120, 8.75% siloxanes, 1.56% ethylenediamine and 2.1% monocyclic bis A-1120.

Conclusion : A-1120 was considered to lack significant genotoxic potential under the conditions of the SCE test system.

Reliability : (1) valid without restriction

03.11.2003 (36)

5.6 GENETIC TOXICITY 'IN VIVO'

Type : Micronucleus assay
Species : mouse
Sex : male/female
Strain : Swiss Webster
Route of admin. : i.p.
Exposure period : 30, 48 and 72 hours
Doses : 87.5, 175, and 280 mg/kg
Result : negative
Method : other: EPA Health Effect Test Guidelines, EPA Report 560/6-83-001
Year : 1988
GLP : yes
Test substance : as prescribed by 1.1 - 1.4

Method : The specific test system employed peripheral blood erythrocytes from mice following improved procedures for the micronucleus test suggested by Schlegel and MacGregor (Mutation Research, 104, 367-369, 1982)

Result : Definitive toxicity study: The combined LD50 was determined to be 354 mg/kg with a 95% fiducial interval of 276 to 453 mg/kg. At 48 hours after dosing, the PCE/NCE ratios of both the male and the female mice injected with 250 mg/kg of A-1120 were reduced to approximately 80% of the concurrent control values. By 72 hours after injection, the PCE/NCE ratios had increased to 90% and 114% of the concurrent control values for the male and female mice, respectively.

Definitive micronucleus test: Results indicated that A-1120 did not produce statistically significant (< or = 0.01) or dose-related increases in the incidence of micronuclei in peripheral blood polychromatic erythrocytes of the test animals at any of the sample periods tested. Data from the positive and negative control groups of animals demonstrated the appropriate responses for the animals in this test system, consistent with a valid test.

Source : Epona Associates, LLC

Test condition : Definitive toxicity study: A definitive toxicity study was conducted using 5 males and 5 females per dosage group. Animals were dosed with the test and control materials by i.p. injection. Doses evaluated were 125, 250, 500, 1000 and 2000 mg/kg. Animals were observed for clinical signs and change in body weight over a 3 day period after dosing.

The PCE/NCE ratio was determined 48 hr and 72 hr after dosing for the vehicle control animals and for the highest dose group in which at least 3 animals survived. Determination of the PCE/NCE ratio for the groups of animals with partial mortality was performed to evaluate the possibility of bone marrow cytotoxicity from the test chemical.

Definitive micronucleus test: Based on the results of the definitive toxicity study, three dose levels for the definitive micronucleus test were chosen at intervals of approximately 80%, 50% and 25% of the LD50 280, 175, and 87.5 mg/kg) to order to evaluate the effects upon the incidence of micronuclei using a minimum of five animals/sex/group. Three extra animals were dosed with the highest concentration of 280 mg/kg to assure that a sufficient number of animals survived for micronucleus evaluation. Blood samples were taken at 3 time periods at approximately 30, 48 and 72 hr after dosing. A minimum of 1000 polychromatic erythrocytes was examined microscopically for each animal per sample time, unless cytotoxicity of the test material prevented this goal. The polychromatic:normochromatic erythrocyte ratio for approximately 1000 total cells was calculated and recorded and these data were reported.

Evaluation of test results: Data were compared for significant differences from the vehicle control frequencies using the Fisher's Exact Test (Sokal and Rohlf, 1981). When statistical tests showed that there was no significant difference in micronuclei frequencies between sexes, data for males and females for each sample period were combined for analyses. A positive result in the micronucleus test was concluded if at least one statistically significant ($p <$ or $= 0.01$) increase above the vehicle control was observed with an indication of a dose-related effect of treatment. A test result was considered to be negative if no statistically significant or dose-related increases were apparent between the vehicle control and groups of animals treated with A-1120.

Concurrent positive (triethylenemelamine) and negative (corn oil) control agents, administered by i.p. injection, were used to demonstrate the reliability and sensitivity of the micronucleus test system.

Test substance : Organofuntional Silane A-1120: purity of 77.2%

Conclusion : Organofunctional Silane A-1120 was not considered to be clastogenic in vivo under the conditions of the micronucleus test system.

Reliability : (1) valid without restriction

03.11.2003 (17)

5.7 CARCINOGENICITY

5.8.1 TOXICITY TO FERTILITY

5.8.2 DEVELOPMENTAL TOXICITY/TERATOGENICITY

Species	:	rat
Sex	:	male/female
Strain	:	Sprague-Dawley
Route of admin.	:	gavage
Exposure period	:	up to 39 days
Frequency of treatm.	:	Daily, 7 days per week for up to 39 days
Duration of test	:	39 days
Doses	:	0, 25, 125 and 500 mg/kg/day
Control group	:	yes
NOAEL maternal tox.	:	= 500 mg/kg bw
NOAEL teratogen.	:	= 500 - mg/kg bw
Method	:	other: OECD 422
Year	:	2002
GLP	:	yes
Test substance	:	as prescribed by 1.1 - 1.4

Method : Statistical Methods: Data were analyzed by Bartlett's and Kolmogorov-Smirnov tests. Parametric data was tested by using ANOVA followed by Dunnett's test; Non-parametric data was analyzed by Kruskal-Wallis test followed by Wilcoxon test. Significance levels were either $P<0.05$ or $P<0.01$.

Result : Two females in the 500 mg/kg/day group were sacrificed or dead in moribund condition. Both of these deaths were attributed to dosing-related errors. Clinical signs attributed to test substance included increased nasal sounds, labored respiration or soft vocalization. These signs were not seen in the control and infrequently seen in either of the two lower dose groups. Observations recorded at dosing indicate a dose-related resistance to dosing.

No test substance-related effects were observed in any of the reproductive parameters evaluated. Two high dose (500 mg/kg/day) and one low dose (25 mg/kg/day) females that did not produce litters had positive evidence of copulation. Six of the eight surviving high dose group females produced litters that were similar in all respects to control litters.

Mortality and day of death: One female (500 mg/kg/day group) was euthanized in moribund condition on study day 3. Another female in the same group died on study day 17. Both these deaths were attributed to dosing-related errors.

Number pregnant per dose level: 10 in Group 1 (control), 9 in Group 2 (25 mg/kg), 10 in Group 3 (125 mg/kg) and 6 in Group 4 (500mg/kg).
Number aborting: None
Number of resorptions, early/late if available: N/A
Number of implantations: Group1-14.1, Group 2- 15, Group 3- 12.9, Group 4- 13.7

Pre and post implantation loss, if available: N/A
Number of corpora lutea (recommended): Group 1- 18.1, Group 2- 18.2, Group 3- 16.7, Group 4- 15.8.
Duration of Pregnancy: Group1- 21.5, Group 2- 21.4, Group 3- 21.2, Group 4- 21.5.
Body weight: Overall Body Weight Gain: Group 1-99.3, Group 2- 96.7, Group 3- 96.7, Group 4- 103.9 g.
Food/water consumption: No effects were observed in weekly food consumption.

Description, severity, time of onset and duration of clinical signs:
Gross pathology incidence and severity: N/A
Organ weight changes, particularly effects on total uterine weight: N/A
Histopathology incidence and severity: N/A
Fetal data, provide at a minimum qualitative descriptions of responses where dose related effects were seen:

Litter size and weights: Group 1- 12.9 (81.6 g), Group 2- 14.2 (89.4 g), Group 3- 12.4 (75.6 g), Group 4- 13.2 (82.4 g).

Number viable (number alive and number dead): Group 1- 12.5, Group 2- 13.9, Group 3- 12.2, Group 4- 12.5.

Sex ratio: M/F : Group1- 1.2, Group 2- 1.0, Group 3- 0.8, Group 4- 1.3

Grossly visible abnormalities, external, soft tissue and skeletal abnormalities: No effects observed on any of these parameters at any dose level.

Source : Dow Corning Corporation

Test condition : Age at study initiation: Minimum 8 Weeks

- Number of animals per dose per sex: 10
- Vehicle: Corn oil
- Clinical observations performed and frequency: Clinical signs were observed once a day.
- Mating procedures (M/F ratios per cage, length of cohabitation, proof of pregnancy): A 1:1 mating (M/F) ratio was used. The female animal was housed with the male until evidence of mating occurred or two weeks have elapsed. The females were evaluated daily for evidence of copulation, vaginal plug or sperm in the vaginal smear.
- Parameters assessed during study (maternal and fetal): Mean body weight and food consumption of dams were recorded. Duration of gestation, evidence of parturation and parturation difficulties were observed. Each litter was examined to determine the number of fetuses, sex, still births, runts and the presence of any gross abnormalities.
- Organs examined at necropsy (macroscopic and microscopic): None

Test substance : 1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3

Conclusion : No test substancr-related effects were observed in any of the reproductive parameters evaluated. Based on the results of this reproductive/developmental screening study, the NOAEL for maternal and developmental toxicity of 1,2-Ethanediamine, N-{3-(trimethoxysilyl) propyl}- in the rat via the oral dosing was considered to be 500 mg/kg/day.

Reliability : (1) valid without restriction

Flag : Critical study for SIDS endpoint

05.08.2003 (10)

5.8.3 TOXICITY TO REPRODUCTION, OTHER STUDIES

Type : other: screening study
In vitro/in vivo : In vivo
Species : rat
Sex : male/female
Strain : Sprague-Dawley
Route of admin. : gavage
Exposure period : not applicable
Frequency of treatm. : Daily, 7 days per week for up to 39 days
Duration of test : 39 days
Doses : 0, 25, 125 and 500 mg/kg/day

Control group	:	yes
Method	:	other: OECD 422
Year	:	2002
GLP	:	yes
Test substance	:	as prescribed by 1.1 - 1.4

Result :

Two females in the 500 mg/kg/day group were sacrificed or dead in moribund condition. Both of these deaths were attributed to dosing-related errors. Clinical signs attributed to test substance included increased nasal sounds, labored respiration or soft vocalization. These signs were not seen in the control and infrequently seen in either of the two lower dose groups. Observations recorded at dosing indicate a dose-related resistance to dosing.

No test substance-related effects were observed in any of the reproductive parameters evaluated. Two high dose (500 mg/kg/day) and one low dose (25 mg/kg/day) females that did not produce litters had positive evidence of copulation. Six of the eight surviving high dose group females produced litters that were similar in all respects to control litters.

· Mortality and day of death: One female (500 mg/kg/day group) was euthanized in moribund condition on study day 3. Another female in the same group died on study day 17. Both these deaths were attributed to dosing-related errors.
· Number pregnant per dose level: 10 in Group 1 (control), 9 in Group 2 (25 mg/kg), 10 in Group 3 (125 mg/kg) and 6 in Group 4 (500mg/kg).
· Number aborting: None
· Number of resorptions, early/late if available: N/A
· Number of implantations: Group1-14.1, Group 2- 15, Group 3- 12.9, Group 4- 13.7
· Pre and post implantation loss, if available: N/A
· Number of corpora lutea (recommended): Group 1- 18.1, Group 2- 18.2, Group 3- 16.7, Group 4- 15.8.
· Duration of Pregnancy: Group1- 21.5, Group 2- 21.4, Group 3- 21.2, Group 4- 21.5.
· Body weight: Overall Body Weight Gain: Group 1-99.3, Group 2- 96.7, Group 3- 96.7, Group 4- 103.9 g.
· Food/water consumption: No effects were observed in weekly food consumption.
· Description, severity, time of onset and duration of clinical signs:
· Gross pathology incidence and severity: N/A
· Organ weight changes, particularly effects on total uterine weight: N/A
· Histopathology incidence and severity: N/A
· Fetal data, provide at a minimum qualitative descriptions of responses where dose related effects were seen:
Ø Litter size and weights: Group 1- 12.9 (81.6 g), Group 2- 14.2 (89.4 g), Group 3- 12.4 (75.6 g), Group 4- 13.2 (82.4 g).
Ø Number viable (number alive and number dead): Group 1- 12.5, Group 2- 13.9, Group 3- 12.2, Group 4- 12.5.
Ø Sex ratio: M/F : Group1- 1.2, Group 2- 1.0, Group 3- 0.8, Group 4- 1.3
Ø Grossly visible abnormalities, external, soft tissue and skeletal abnormalities:

Source	:	Dow Corning Corporation

Test condition : EPA OPPTS 870.3600

Statistical Methods: Data were analyzed by Bartlett's and Kolmogorov-Smirnov tests. Parametric data was tested by using ANOVA followed by Dunnett's test; Non-parametric data was analyzed by Kruskal-Wallis test followed by Wilcoxon test. Significance levels were either P<0.05 or P<0.01.

Detailed physical examinations were performed before the first dosing and weekly thereafter. The animals were observed twice daily (once daily on weekends) for mortality/viability. The animals were observed for clinical signs once daily within one hour post dosing outside their home cages. Clinical findings attributed to the test substance included clear perioral soiling in several high dose animals and either increased nasal sounds, labored respiration, or soft vocalizations in approximately half of the high dose females and one high dose male. These signs were not seen in the control animals and infrequently seen in either of the two lower dose groups. Observations recorded at dosing indicated a dose-related resistance to dosing. Evaluating all 30 animals/dose over the entire dosing period, the incidence of resistance was 3, 5, 27 and 62% for the controls, 25, 125 and 500 mg/kg/day dose groups, respectively. Similar incidence patterns were noted for salivation just prior to dosing, wetness around the mouth at dosing, and wetness around the mouth 5-30 minutes following dosing. These clinical findings are anticipated based on the amine-functionality of the material and indicative of irritation, rather than systemic effects. There were no test substance-related effects on body weight, organ weights or organ-to-body weight ratios, food consumption, FOB or motor activity parameters, or hematology or serum chemistry parameters, and no macroscopic or microscopic findings were attributed to the test-substance. Based on the results of this study, the NOAEL for the systemic toxicity of this material in the rat via oral dosing for at least 28 consecutive days was considered to be 500 mg/kg.

- Age at study initiation: Minimum 8 Weeks
- Number of animals per dose per sex: 10
- Vehicle: Corn oil
- Clinical observations performed and frequency: Clinical signs were observed once a day.
- Mating procedures (M/F ratios per cage, length of cohabitation, proof of pregnancy): A 1:1 mating (M/F) ratio was used. The female animal was housed with the male until evidence of mating occurred or two weeks have elapsed. The females were evaluated daily for evidence of copulation, vaginal plug or sperm in the vaginal smear.
- Parameters assessed during study (maternal and fetal): Mean body weight and food consumption of dams were recorded. Duration of gestation, evidence of parturation and parturation difficulties were observed. Each litter was examined to determine the number of fetuses, sex, still births, runts and the presence of any gross abnormalities.
- Organs examined at necropsy (macroscopic and microscopic): None

Test substance : 1,2-Ethanediamine, N-[3-(trimethoxysilyl)propyl]- CAS No. 1760-24-3

Conclusion : No test substance-related effects were observed in any of the reproductive parameters evaluated. Based on the results of this reproductive/developmental screening study, the NOAEL for maternal and developmental toxicity of 1,2-Ethanediamine, N-{3-(trimethoxysilyl) propyl}- in the rat via the oral dosing was considered to be 500 mg/kg/day.

Reliability : (1) valid without restriction

Flag : Critical study for SIDS endpoint

08.03.2004 (10)

5.9 SPECIFIC INVESTIGATIONS

5.10 EXPOSURE EXPERIENCE

Type of experience : other

Remark : A worker was patch tested and a positive reaction to a silane component of the binder material that bonds onto the glass fibers beofre curing in an oven. The compnents of the material were identified as CAS no 1760-24-3 and methanol.

Reliability : (4) not assignable
Insufficient infromation was provided in the article to evaluate reliability of the study conduct.

19.01.2004 (20)

5.11 ADDITIONAL REMARKS

(1) Acute Oral toxicity in Rats: Test report number 76-003-0101-J, From the Tejin Institute.

(2) Annelin, R.B. and C.D. McKinney (1978).

(3) Annelin, R.B. and C.D. McKinney (1978). Dow Corning Corporation, Report No. 1978-I0005-0589.

(4) Blum, F.D., W. Meesiri, H.J. Kang, and J.E. Gambogi. 1991. Hydrolysis, adsorption, and dynamics of silane coupling agents on silica surfaces. J. Adhesion Sci. Technol. 5:479-496. (Cited Documents)

(5) BRRC (1985). Various Silane and Silicone Samples, Primary Skin Irritancy Studies (IATA Classification), Report 48-110; September 4, 1985.

(6) Chun, J.S. and C.L. Wagner. 1993. Organofunctional Silane A-1120: Nine-Day Repeated Cutaneous Dose Toxicity Study in Fischer 344 Rats. Bushy Run Research Center, Laboratory Project ID 91U0024, August 17, 1993.

(7) Crompton (2001) Material Safety Data Sheet Silquest A-1120 silane Revision 1.4 05/17/2001

(8) Dow Corning Corporation, physical properties database.

(9) Dow Corning Corporation (1958) Report No. 1958-I0030-1713.

(10) Dow Corning Corporation (2002). Report No. 9610. Prepared for the Silicone Environmental, Health and Safety Council.

(11) Dow Corning Corporation, Report No. 1978-I0005-0589.

(12) Finney, D.J. 1952. Statistical Method in Biological Assay. New York, Hafner, 661 p.

(13) Flaningam O.L. and A.L. Smith (1994) Dow Corning Corporation, Report No. 1994-I0000-39053.

(14) Flaningam, O.L. and Smith, A.L. (1994). Dow Corning Corporation, Report No. 1994-I0000-39053.

(15) Forichon, A. (1992), Hazelton France. Salmonella typhimurium/Mammalian microsome Plate Incorporation Assay (Ames Test), Report number 203301. Conducted for Wacker Chemie GmbH, 18 August, 1992.

(16) General Electric, physical properties database.

(17) Guzzie, P.J. 1988. Organofunctional Silane A-1120 In Vivo Mouse Micronucleus Study. Bushy Run Research Center Project Report Number 51-55, October 14, 1988.

(18) Guzzie, P.J. and E.R. Morabit. 1988. Organofunctional Silane A-1120 Salmonella/Microsome (Ames) Bacterial Mutagenicity Assay. Bushy Run Research Center Project Report 51-30, May 23, 1988.

(19) Hoberg, J.R. (2002). Aminosilane - Toxicity to the Freshwater Green Alga, Pseudokirchneriella subcapitata. Springborn Smithers Laboratories, Wareham, MA. Report No. 12023.6132.

(20) Hughes TM (2001) Occupational sensitization to methoxysilane in fibreglass production. Contact Dermatitis: 44: 129-130.

(21) Huls AG (1994). Final Report DDA 85. Determination of the biodegradability of DYNASYLAN DAMO-T in DOC-DIE AWAY TEST. November 3, 1994.

(22) Kennelly, JC (1988)Degussa-Huls AG (1988). #: 88-0299-FGM Study to determine the ability of nineteen compounds to induce mutation in three Histidine-requiring strains of Salmonella typhimurium.

(23) Kozerski, G.E. and R.E. Tecklenburg. (2001). Determination of hydrolysis kinetics of N-[2-aminoethyl]-3-aminopropyl-trimethoxysilane as a function of pH and temperature using atmospheric pressure chemical ionization mass spectrometry: final report submitted to the Silicones Environmental, Health and Safety Council of North America (SEHSC). Dow Corning Technical Report 2001-I0000-50153. Dow Corning Corporation, Midland, MI, USA.

(24) Lheritier, M. Hazelton France (1992). Test to Evaluate the Acute Toxicity Following a Single Oral Administration (LD50) in the Rat. Report No. 203308. Study conducted for Wacker Chemie, GmbH, 4 August, 1992.

(25) Machado, M.W. (2002). Aminosilane - Acute Toxicity to Daphnids (Daphnia magna) Under Static Conditions. Springborn Smithers Laboratories, Wareham, MA. Report No. 12023.6133.

(26) Mackay, D., A. Di Guardo, S. Paterson, C.E. Cowan. 1996. Evaluating the environmental fate of a variety of types of chemicals using the EQC model. Environ. Toxicol. Chem. 15:1627-1637.

(27) Material Safety Data Sheet. CAS No. 1760-24-3. Wacker Chemie GmbH. Effective date 29 June 1999.

(28) Menzie, G.K. 1959. Dow Corning Technical Report 1958-I0030-1625. Dow Corning Corporation, Midland, MI, USA.

(29) Menzie, G.K. (1958). Dow Corning Technical Report 1958-I0030-1625. Dow Corning Corporation, Midland, MI, USA.

(30) Mercier, O. (1992a). Hazleton France. Test to evaluate the acute primary cutaneous irritation and corrositivity in the rabbit. Report number: 201350, Study conducted for Wacker Chemie GmbH.

(31) Mercier, O. (1992b). Hazleton France Test to evaluate sensitizing potential in the guinea-pig. Guinea-pig Maximization Test. Report number: 201380,. Study conducted for Wacker Chemie GmbH, October 19, 1992.

(32) Mercier, O. (1993). Hazleton France. Test to Evaluate the Acute Ocular Irritation and Reversibility in the Rabbit. Hazleton, France. (Hazleton Report No. 51792). 29 January 1993.Mercier, O. (1992) Test to Evaluate the Acute Ocular Irritation and Reversibility in the Rabbit. Hazleton, France. (Hazleton Report No. 51792). 29 January 1993.

(33) Merrifield, J. (2003) Personal Communication.

(34) Miller, J.A. 2000. Characterization of N-[3-(trimethoxysilyl)propyl]-ethylenediamine (lot #13114LU). Technical Report No. 2000-I0000-48796; Dow Corning Corporation, Midland, Michigan.

(35) Silicone A-1120: Eight Rabbit Skin Inunctions During 19 Calendar days; Carnegie-Mellon Institute of Research; Special Report 38-102; August 13, 1975.

(36) Slesinski, R.S. and P.J. Guzzie. 1988. Organofunctional Silane A-1120 In Vitro Gentoxicity Studies: CHO/HGPRT Gene Mutation Test/Sister Chromatid Exchange Assay. Bushy Run Research Center Project Report 51-51, August 15, 1988.

(37) Smith, A.L. (1986). Dow Corning Corporation, Report No. 1986-I0032-53.

(38) South Charleston Technical Center Aquatic Laboratory, (1993). Summary of Ecological Fate and Effects Data: Silane A-1120, EFED3.

(39) Speier, J.L. and G.K. Menzie (1958).

(40) Spivack, J.L., E.R. Pohl, and P. Kochs (1997) Organoalkoxysilanes, organosilanols, and organosiloxanols, in G. Chandra (ed.), The Handbook of Environmental Chemistry, Vol. 3, Part H, Organosilicon Materials. Springer-Verlag, Berlin, p 105.

(41) Stein, J. 1973. Handbook of Phycological Methods, Culture Methods and Growth Measurements. J. Stein (ed.), Cambridge Press, pp 220-229.

(42) Tanaka, Y. (1977) Hatano Institute. Test number 77-017-0107-3. Bacterial Mutagenicity Study with KBM-603.

(43) ToxiGenics (1981a). Primary Eye Irritation Study in Rabbits of X-19381 Aminosilane, Study 410-0745; October 21. 1981.

(44) ToxiGenics (1981b). Primary Eye Irritation Study in Rabbits of X-29381 Aminosilane, , Study 410-0746; October 21. 1981.

(45) U.S. EPA. 1975. Methods for Acute Toxicity Tests with Fish, Macroinvertebrates and Amphibians. Ecological Research Series (EPA-660/3-75-009). 61 pp.

(46) Union Carbide Silane A-1120, N(beta-Aminoethyl) gamma-Aminopropyltrimethoxysilane: Range Finding Toxicity Studies, Mellon Institute, Report 29-107; November 9, 1966.

(47) United States Environmental Protection Agency. (2000). Estimations Programs Interface (EPI) Suite™. The EPI Suite™ and the individual models included within the software are owned and copyright protected by the U.S. Environmental Protection Agency.

(48) USEPA. 1973. Biological field and laboratory methods. The algal assay proceedure: bottle test. United States Environmental Protection Agency, EPA-670/4-73-00. (Cited Documents)

(49) Wilkinson, T.J. 1997. Dow Corning Corporation, Report No. 1997-I0000-42725. (Cited Document)