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NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME (NICNAS)

FULL PUBLIC REPORT

1,3-Propanediamine, N,N''-1,2-ethanediylbis-, reaction products with cyclohexane and peroxidized N-butyl-2,2,6,6-tetramethyl-4-piperidinamine-2,4,6-trichloro-1,3,5-triazine reaction products (Flamestab NOR 116FF/TKA 45009)

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Director
Chemicals Notification and Assessment

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(Flamestab NOR 116FF/TKA 45009)

1. APPLICANT

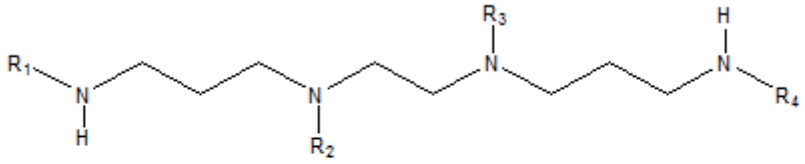
Ciba Specialty Chemicals Ltd of 235 Settlement Road THOMASTOWN VIC 3074 has submitted a standard notification statement in support of their application for an assessment certificate for 1,3-Propanediamine, N,N''-1,2-ethanediylbis-, reaction products with cyclohexane and peroxidized N-butyl-2,2,6,6-tetramethyl-4-piperidinamine-2,4,6-trichloro-1,3,5-triazine reaction products (Flamestab NOR 116FF /TKA 45009).

2. IDENTITY OF THE CHEMICAL

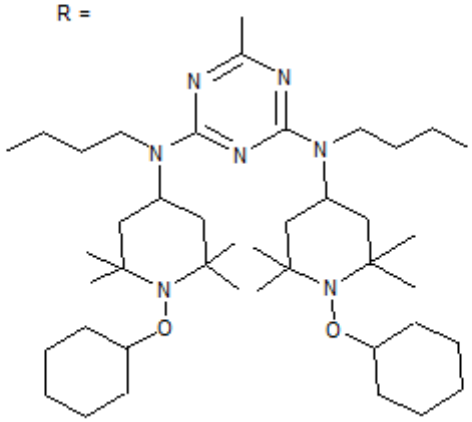
The notifier has not applied for any information relating to the notified chemical to be exempt from publication in the Full Public Report and Summary Report.

Chemical Name:	1,3-Propanediamine, N,N''-1,2-ethanediylbis-, reaction products with cyclohexane and peroxidized N-butyl-2,2,6,6-tetramethyl-4-piperidinamine-2,4,6-trichloro-1,3,5-triazine reaction products
Chemical Abstracts Service (CAS) Registry No.:	191680-81-6
Other Names:	N,N''-1,2-Ethanediylbis-1,3-propanediamine reaction products with cyclohexane and peroxidized N-butyl-2,2,6,6-tetramethyl-4-piperidiamine-2,4,6-trichloro-1,3,5-triazine reaction products
Marketing Name:	Flamestab NOR 116FF TKA 45009 CGL 116
Molecular Formula:	Complex and variable – see structure and notes below.

Structural Formula:



R =



R1 = R 2= R3 = R4 = R or H
The NO-cyclohexyl can be replaced by N-H

Molecular Weight:

MW	%
>2 500	33.1
1 900-2 500	33.9
1 300-1 900	22.5
670-1 300	3.4
<670	4.6

Method of Detection and Determination: UV/visible, IR and NMR.

Spectral Data: IR peaks were observed at 3 450, 3 000-2 800, 1 533, 1 475, 1 400 and 809 cm^{-1}.

Comments on chemical identity

The notified chemical is a relatively complex mixture of molecules based on a substituted aliphatic tetramine. As indicated in the structure above the substituents on the amine groups may be either H- (ie. no real substitution) or the complex moiety designated as "R-" above. Due to the incomplete substitution of the amino nitrogens in the tetramine a variety of molecules may be present in the commercial product, and so the material has no well defined molecular weight.

3. PHYSICAL AND CHEMICAL PROPERTIES

The notifier provided test reports and data on the determination of the physico-chemical properties listed below. The data were generated using accepted OECD or EEC test methods.

Appearance at 20°C & 101.3 kPa: White to off-white yellowish powder with little or no odour.

Boiling Point: Did not boil, but decomposed at 260ºC under reduced pressure.

Melting Point: 113-121°C

Specific Gravity: 1 100 kg/m^3

Vapour Pressure: <1x10^{-7} kPa at 20°C (estimated).

Water Solubility: <0.04 mg/L at 20°C

Fat Solubility: 290-390 g/kg at 30°C (EEC method A.7).

Partition Co-efficient (n-octanol/water): log P_{ow}>10 (estimated).

Hydrolysis as a Function of pH: Not determined (see comments below).

Adsorption/Desorption: Not determined (see comments below).

Dissociation Constant: pK_a=2.4-10.2 (see comments below).

Particle Size:

Size (µm)	%
> 1000	3.5
500-1 000	2.6
212-500	3.9
125-212	16.6
75-125	46.7
63-75	9.1
45-63	3.0

Average size is 6.6 x 10.7 µm.
Particles tend to be aggregated.

Flash Point: >110°C

Flammability: Not flammable (EEC method A.10).

Autoignition Temperature: >400°C

Explosive Properties: Not explosive (EEC method A.14).

Reactivity/Stability: Not an oxidising agent.

3.1 Comments on Physico-Chemical Properties

In an attempt to use the boiling point for estimation of vapour pressure (Ciba, 1997a) it was found that the compound decomposes without boiling, even under significantly reduced pressures. At 6 kPa the compound began to decompose at 260ºC.

The melting point was determined using differential scanning calorimetry (Ciba, 1997b) and an endotherm with a trough at 120.43 ºC ascribed to the melting point of the chemical.

The vapour pressure of the compound could not be determined experimentally, and instead this was estimated from the molecular structure using the procedure outlined in OECD TG 104.

Determination of the water solubility (Ciba, 1997c) was attempted using the procedures of OECD TG 105, but found to be below the level of detection of the GPC instrumentation used for the solution analysis, ie. $40x10^{-3}$ mg/L.

Experimental determination of the rate of hydrolysis was not attempted due to the low water solubility, but the new compound contains no groups which are susceptible to hydrolysis in the environmental pH region of 4 to 9.

Experimental determination of the n-octanol/water partition coefficient of the notified chemical was not attempted. Instead this parameter was calculated (Novartis, 1997) using a calculation method based on summing contributions to log Pow from functional groups within the molecule and making appropriate allowances for various intramolecular interactions and other structural features. Calculations were performed for various of the congeners likely to be present (see notes on chemical identity above) with estimated values of log Pow for the neutral form of the molecule ranging between 15 and 49. Similar estimates for the protonated forms (ie. protonation of the basic amino groups – see notes below) furnished log Pow values between 12 and 46. These estimated values for Pow are unrealistically high by many orders of magnitude and, in the authoritative work by Lyman *et al* (1990), estimates of log Pow derived from molecular fragmentation methods greater than 6 should be treated with great caution. Nevertheless, since the molecule contains a large hydrocarbon component, it is expected to have a high affinity for the oil phase and little for water, so that it would have a large log Pow, possibly > 6. The real value for log Pow is expected to be very much lower than the calculated estimates.

Although no data were provided, in keeping with the expected low water solubility and high affinity for the oil phase, the chemical would be expected to have a high affinity for the organic component of soils and sediments and most likely would be immobile in these media.

The aliphatic secondary and tertiary amine groups are expected to have pKa values between 9.5 and 10.5. The triazine nitrogens are not basic, with pKa around 2.5.

4. PURITY OF THE CHEMICAL

Degree of Purity: 96.2 (89.7-98.5)%

Hazardous & Non-hazardous Impurities:

Chemical name:	*Weight percentage:*
By-products	2.37
Impurities	
SOLVENTS	0.2
Water	0.4
Inorganics	0.54
Chlorine	0.33
Total:	*3.8*

Additives/Adjuvants: None.

5. USE, VOLUME AND FORMULATION

The notified chemical will be used as a flame retarder and light stabiliser in plastic products.

The annual import volume of the notified chemical as follows:

Year	1	2	3	4	5
Volume (tonne)	1-5	2-7	3-8	4-9	5-10

The notified chemical will not be manufactured in Australia. It will be imported in a powder form packaged in 2x20 kg polythene bags in fibreboard box. The notified chemical will be incorporated into masterbatch formulations of the base polymer at rates between 10-15%. The final concentration of the notified chemical in plastic products will be 0.1-2%.

6. OCCUPATIONAL EXPOSURE

Transport and storage
Storage and transport workers are unlikely to be exposed to the notified chemical unless the packaging is breached.

Formulation of masterbatch pellets
The notified chemical is to be imported in a commercial free-flowing powder form. It will be compounded with other ingredients by extrusion to produce a masterbatch containing approximately 10 to 15% notified chemical. Three factory sites will produce masterbatch containing the notified chemical. Overall in Australia, 15 workers will handle the notified chemical up to 200 days per year at the formulation sites. Each site will have 2 weighing/blending operators, 2 extrusion plant operators, and one laboratory technician. Workers will weigh and add the notified chemical into a blending vessel where the notified chemical is mixed with other ingredients. The mix containing up to 2% the notified chemical is extruded and diced to produce the masterbatch in pellet form. During the hot-melt extrusion process, the notified chemical becomes encapsulated within the polymer matrix.

The plastic pellets are bagged and ready for distribution to customers.

Little portion of the powder is in the inspirable range as the particles tend to be aggregated. The main exposure to the notified chemical occurs by skin contact during weighing and feeding of the powder into the blending vessel. All workers involved in the production of masterbatch will wear personal protective equipment including gloves, safety glasses and overalls. Respiratory equipment is available for use if the local exhaust ventilation is inadequate. Local exhaust ventilation is employed during weighing, dispensing, blending and packing of pellets containing the notified chemical. Similarly, the extruder loading and exit areas are fitted with local exhaust ventilation to capture fugitive emissions from the heated polymer.

Manufacture of plastic products
At the manufacturing sites, the masterbatch will be added and mixed with other ingredients into the hopper of an injection moulding or film-making machine. Once heated, the polymer melt is injected into a mould to form the shape of the plastic article required.

Since the notified chemical is encapsulated in the compounded plastic pellets or films, worker exposure to the notified chemical *per se* during incorporation with plastic products is not possible. During these activities, workers are required to wear gloves and eye protection. Local exhaust ventilation is in place, and would capture any fugitive emissions from the notified chemical when heated.

End use
End users of plastic articles and films containing the notified chemical will be diverse, for example, films will be used mainly by rural horticultural workers. Since the notified chemical is encapsulated in these products, worker exposure to the notified chemical is negligible.

7. PUBLIC EXPOSURE

The public may be exposed to the notified chemical in its powder form following transport accidents *en-route* from the point of importation to the master-batch producer sites. The fibreboard boxes in which the notified chemical is imported and transported are sturdy and not likely to break. In spills that do occur the windborne dispersal of any escaping powder may cause the lodgement of the notified chemical powder onto the skin or into the mouth, nose and eyes of nearby persons. This contact is likely to be minimal and of a transient nature. The powder particles are large and are not likely to reach the lungs. The notified chemical is not volatile and the inhalation of vapour is unlikely.

Members of the public are also unlikely to contact the notified chemical as an environmental contaminant. During the production of master-batch pellets and end use products there is no uncontrolled escape of the notified chemical into the environment. The disposal of end use articles at the end of their lifetime is by controlled land-fill.

In the course of consumer use of the end use products, the notified chemical is an integral part of the matrix of the article and is not accessible to human contact. The potential for exposure of the public to the notified chemical is therefore minimal.

8. ENVIRONMENTAL EXPOSURE

8.1 Release

Small quantities of the notified chemical could be lost during preliminary mixing with polymer and other components prior to extrusion of the masterbatch fibres, and all of this is likely to be placed into landfill. Small spills of chemical would be swept up and be either returned to the mix or be disposed of with other factory waste to landfill. It is expected that the mixing and extrusion operations would be performed using vacuum extraction/filtration so that any particulate matter released to the air during operations would be captured and retained on the filters, and all solid material retained on the filters also placed into landfill.

On occasions the extrusion equipment would be cleaned out and some solid scrap material would be removed from the equipment and also placed into landfill, as would any of the granulated masterbatch lost during packaging.

Apart from spills no release of the chemical during dry mixing of the masterbatch compound with polymer, filler and other materials is expected during injection moulding of the final articles although it is possible that some scrap plastic may be produced during finishing of the final products. All such waste would be placed into landfill.

While no details of likely release of the notified chemical were provided, large releases are not expected. If it is assumed that 2% is lost during masterbatch preparation and a further 3% lost as scrap and waste from injection moulding, then total losses associated with manufacturing activities are 5%, which amounts to a maximum annual release of 500 kg, all placed into landfill.

Although no supporting documentation was provided, the notifier indicated that the notified chemical does not bloom from the polymer into which it is incorporated (ie. does not slowly diffuse from the polymer matrix to the surface of articles), and so release of the chemical to the environment during the service life of finished articles is not expected.

8.2 Fate

From the above discussion on release patterns, it is apparent that the fate of most of the notified chemical will be involved with degradation processes taking place in landfill situations.

The notifier provided a report (Toxicon, 1997a) on the ready biodegradation of the notified chemical determined by a CO_2 evolution test (modified Sturm test) performed according to the protocols of OECD TG 301 B.

Two duplicate tests were conducted with the test material (nominal concentration equivalent to approximately 20 mg/L organic carbon based on the molecular formula for TKP 45009 incubated with sewage sludge bacteria over a 28 day test period. The quantity of CO_2 evolved was monitored over this period and, when compared with the theoretical quantity of CO_2 associated with complete degradation, the results indicated an average of only 4.37 % degradation over the 28 day test period. In contrast to these results, a reference compound (not specified) was degraded to 80% over the test period, which demonstrated the viability of

the bacteria used in the test. While the degradation figures above appear to be small, it is probable that the compound would be ultimately degraded after prolonged residence in landfill.

Toxicity control test where both the reference compound and the notified chemical were incubated together with the sludge indicated that the presence of the test material had no inhibitory effect on the respiration of the sewage bacteria.

Although it is likely that the plastic in some of the pipe and other articles containing the notified chemical may be recycled into other products, eventually all the notified chemical is expected to report to landfill.

Most of the notified chemical deposited into landfill will be enclosed within a polymer matrix with only the small quantities resulting from spills of the chemical left in the free state. Nevertheless, as the polymer matrices are broken down by the slow biological and abiotic processes operative in landfills, the chemical will be liberated and then slowly attacked and degraded by the native bacteria. During biodegradation under aerobic conditions, the notified chemical would eventually be mineralised to water and oxides of carbon and nitrogen.

Although very little of the notified chemical likely to be released to the water compartment, the relatively high average molecular weight (90% > 1300 g/mole) indicates low potential for bioaccumulation despite the expected low water solubility and high value of Log Kow (Connell, 1990).

9. EVALUATION OF TOXICOLOGICAL DATA

9.1 Summary of Toxicological Investigations

Endpoint & Result	*Assessment Conclusion*
Rat, acute oral LD50 >5 000 mg/kg bw	low toxicity
Rat, acute dermal LD50 >2 000 mg/kg bw	low toxicity
Rabbit, skin irritation	non-irritating
Rabbit, eye irritation	slightly irritating
Guinea pig, skin sensitisation - adjuvant test.	no evidence of sensitisation.
Rat, oral Repeat Dose Toxicity - 28 Days.	NOAEL = 1 000 mg/kg/day
Genotoxicity - bacterial reverse mutation	Non mutagenic
Genotoxicity – in vitro chromosomal aberration	Non genotoxic

9.2 Acute Toxicity

9.2.1 Acute Oral Toxicity

TEST SUBSTANCE	TKA 45009
METHOD	OECD 401 Acute Oral Toxicity – Limit Test.
Species/Strain	Rat/Wistar albino
Vehicle	0.2% methyl cellulose
Remarks - Method	GLP & QA.

RESULTS

Group	*Number & Sex of Animals*	*Dose mg/kg bw*	*Mortality*
1	5/sex	5 000	*0*

LD50	> 5 000 mg/kg bw
Signs of Toxicity	Instances of transient weight loss were observed in 2 females. One female had dyspnea, lethargy, emaciation, ataxia and weight loss throughout the study period.
Effects in Organs	Necropsy revealed that cause of the female which had signs of toxicity was due to a dosing error.
Remarks - Results	None.
CONCLUSION	The notified chemical is of low toxicity via the oral route.
TEST FACILITY	MB Research Labs (1997a)

9.2.2 Acute Dermal Toxicity

TEST SUBSTANCE	TKA 45009
METHOD	OECD 402 Acute Dermal Toxicity – Limit Test.
Species/Strain	Rabbit/New Zealand White
Vehicle	Saline.
Type of dressing	Semi-occlusive
Remarks - Method	GLP & QA.

RESULTS

Group	*Number & Sex of Animals*	*Dose mg/kg bw*	*Mortality*
1	5/sex	2 000	*0*

LD50	> 2 000 mg/kg bw
Signs of Toxicity - Local	Draize scores for erythema and oedema were zero in all animals during 0.5-72 hours post patch removal.

	One male had anogenital soiling.
- Systemic	One male had rales and mucoid diarrhea, one female had diarrhea.
Effects in Organs	One female had white cheesy material encapsulated in lung (approximately 2x2 cm).
Remarks - Results	None.

CONCLUSION	The notified chemical is of low toxicity via the dermal route.
TEST FACILITY	MB Research Labs (1997b)

9.2.3 Acute Inhalation Toxicity

The notifier did not provide a study report on acute inhalation toxicity for assessment.

9.2.4 Skin Irritation

TEST SUBSTANCE	TKA 45009
METHOD	OECD 404 Acute Dermal Irritation/Corrosion. EC Directive 92/69/EEC B.4 Acute Toxicity (Skin Irritation).
Species/Strain	Rabbit/New Zealand White.
Number of Animals	6 females.
Observation Period	72 hours.
Vehicle	Distilled water.
Type of Dressing	Semi-occlusive.
Remarks - Method	GLP & QA.

RESULTS

Lesion	*Mean Score**	*Maximum Value*	*Maximum Duration of Any Effect*	*Maximum Value at End of Observation Period*
Erythema/Eschar	0	1	30-60 min	0
Oedema	0	0	-	0

*Calculated on the basis of the scores at 24, 48, & 72 hours for ALL animals.

Remarks - Results	Two animals had Draize scores of 1 during 30-60 minutes after treatment.
CONCLUSION	The notified chemical is non-irritating to skin.
TEST FACILITY	MB Research Labs (1997c)

9.2.5 Eye Irritation

TEST SUBSTANCE TKA 45009

METHOD OECD 405 Acute Eye Irritation/Corrosion.
EC Directive 92/69/EEC B.5 Acute Toxicity (Eye Irritation).

Species/Strain	Rabbit/New Zealand White
Number of Animals	3/sex
Observation Period	72 hours
Remarks - Method	GLP & QA. Vehicle was not stated.

RESULTS

Lesion	*Mean Score**	*Maximum Value*	*Maximum Duration of Any Effect*	*Maximum Value at End of Observation Period*
Conjunctiva: redness	0.39	2	48 hours	0
Conjunctiva: chemosis	0.17	2	24 hours	0
Conjunctiva: discharge	0.22	2	24 hours	0
Corneal opacity	0	0	-	0
Iridial inflammation	0	1	1 hour	0

*Calculated on the basis of the scores at 24, 48, & 72 hours for ALL animals.

Remarks - Results None.

CONCLUSION The notified chemical is slightly irritating to the eye.

TEST FACILITY MB Research Labs (1997d)

9.2.6 Skin Sensitisation

TEST SUBSTANCE TKA 45009

METHOD OECD 406 Skin Sensitisation - Magnusson & Kligman Maximization Test.

Species/Strain	Guinea pig/Hartley
PRELIMINARY STUDY	Maximum non-irritating concentration: intradermal: <0.05% topical: 5%
MAIN STUDY	
Number of Animals	Test Group: 20 Control Group: 10
INDUCTION PHASE	Induction Concentration intradermal: 0.5% topical: 25%
Signs of Irritation	No irritation observed.
CHALLENGE PHASE	

Challenge	topical application: 5%
Remarks - Method	GLP & QA.

RESULTS

Animal	*Challenge Concentration*	*Number of Animals Showing Skin Reactions after: challenge*		
		24 h	*48 h*	*72 h*
Test Group	5%	0/20	0/20	0/20
Vehicle control group	5%	0/10	0/10	0/10
Naive control Group	5%	0/10	0/10	0/10

Remarks - Results	No skin reactions were observed at the sites where the vehicle, diethyl phthalate was applied during the challenge process in all animals
CONCLUSION	There was no evidence of reactions indicative of skin sensitisation to the notified chemical under the conditions of the test.
TEST FACILITY	Hill Top Research Ltd (1997).

9.3 Repeat Dose Toxicity

TEST SUBSTANCE	TKA 45009
METHOD	OECD 407 Repeated Dose 28-day Oral Toxicity Study in Rodents.
Species/Strain	Rat/Sprague-Dawley
Route of Administration	Oral – gavage.
Exposure Information	Total exposure days: 28 days; Dose regimen: 7 days per week; Post-exposure observation period: 14 days (last 5/sex in group 1 and 4 were designated to undergo a 14-day post-treatment recovery period).
Vehicle	0.5% methylcellulose.
Remarks - Method	GLP & QA.

RESULTS

Group	*Number & Sex of Animals*	*Dose mg/kg bw/day*	*Mortality*
1 (control)	10/sex	0	*0*
2 (low)	5/sex	10	0
3 (mid)	5/sex	100	0
4 (high)	10/sex	1 000	0

Mortality & Time to Death
All animals survived to scheduled necropsy.

Clinical Observations
There were no treatment related changes in clinical observations, body-weights, food consumption or ophthalmic examinations.

Laboratory Findings – Clinical Chemistry, Haematology, Urinalysis
There were no treatment related changes in serum biochemistry or haematology.

Effects in Organs
Organ weight, macro- and microscopic findings in test groups did not show any changes were treatment related when comparing with control group data..

Remarks – Results
The notified chemical when given orally for at least 28 days at levels up to 1 000 mg/kg/day, did not show toxicity in rats. All observations in the test groups were comparable to the controls and were of the type commonly noted in rats.

CONCLUSION
The NOAEL for the notified chemical from this study was determined to be > 1 000 mg/kg/day.

TEST FACILITY Covance Laboratories (1997a).

9.4 Genotoxicity

9.4.1 Genotoxicity-Bacteria

TEST SUBSTANCE TKA 45009

METHOD	OECD 471 Bacterial Reverse Mutation Test. EC Directive 2000/32/EC B.13/14 Mutagenicity – Reverse Mutation Test using Bacteria. Plate incorporation procedure/Pre incubation procedure
Species/Strain	*S. typhimurium*: TA1535, TA1537, TA98, TA100. *E. coli*: WP2 uvrA.
Metabolic Activation System	Liver fraction (S9 mix) from rats pretreated with Aroclor 1254.
Concentration Range in Main Test	a) With metabolic activation: 0-5 000 µg/plate. b) Without metabolic activation: 0-5 000 µg/plate.

Vehicle	Tetrahydrofuran.
Remarks - Method	GLP & QA.

RESULTS

Metabolic Activation	*Test Substance Concentration (µg/plate) Resulting in:*			
	Cytotoxicity in PreliminaryTest	*Cytotoxicity in Main Test*	*Precipitation*	*Genotoxic Effect*
Present				
Test 1	>5 000	>5 000	333	Not seen.
Test 2		>5 000	333	Not seen.
Absent				
Test 1	> 5 000	>5 000	333	Not seen.
Test 2		>5 000	333	Not seen.

Remarks - Results	In Test 1, TA100 data were not generated due to bacterial contamination. The positive control without S9-mix for WP2uvrA did not induce higher revertants per plate. This strain was tested again, and the results were acceptable. In Test 2, vehicle controls for TA100 with and without S9-mix were not within the acceptable range. Thus, this strain was re-tested twice, and the results were acceptable.
CONCLUSION	The notified chemical was not mutagenic to bacteria under the conditions of the test.
TEST FACILITY	Covance Laboratories (1997b)

9.4.2 Genotoxicity-In Vitro

TEST SUBSTANCE	TKA 45009
METHOD	OECD 473 In vitro Mammalian Chromosomal Aberration Test.
Cell Type/Cell Line	Chinese hamster ovary (CHO) cells
Metabolic Activation System	Liver fraction (S9 mix) from rats pretreated with Aroclor 1254.
Vehicle	Tetrahydrofuran
Remarks - Method	GLP & QA.

Metabolic Activation	*Test Substance Concentration (µg/mL)*	*Exposure Period*	*Harvest Time*
Present			
Test 1	15.7, 31.3*, 62.5, 125*, 250* and 499*	3 hr	24 hr
Test 2	31.3*, 62.5, 125*, 250* and 499*	3 hr	24/48.1 hr
Absent			
Test 1	15.7, 31.3*, 62.5, 125*, 250* and 499*	21.8 hr	24 hr
Test 2	31.3*, 62.5, 125*, 250* and 499*	21.8/45.8 hr	24/48.1 hr

* selected for metaphase annlysis.

RESULTS

Metabolic Activation	*Test Substance Concentration (µg/mL) Resulting in:*			
	Cytotoxicity in Preliminary Test	*Cytotoxicity in Main test*	*Precipitation*	*Genotoxic Effect*
Present				
Test 1	> 499	31.3	62.5	Not seen.
Test 2		31.3	62.5	Not seen.
Absent				
Test 1	4.99	31.3	62.5	Not seen.
Test 2		<31.3	62.5	Not seen.

Remarks - Results

No positive control data were provided in test 2 (48.1 hr, +S9 and -S9).

Some differences in mitotic index were observed between the negative control (McCoy's 5a medium) and the solvent control (tetrahydrofuran).

CONCLUSION

The notified chemical was not clastogenic to CHO cells under the conditions of the test.

TEST FACILITY

Covance Laboratories (1997c).

9.4.3 Genotoxicity-In Vivo

The notifier did not provide a study report of genotoxicity in vivo for assessment.

9.5 Overall Assessment of Toxicological Data

The notified chemical was of very low acute oral toxicity in rats and low acute dermal toxicity in rabbits. It was not a skin irritant in rabbits or a skin sensitiser in guinea pigs, but a slight eye irritant in rabbits.

The NOAEL established from a 28-day oral study in rats was 1 000 mg/kg/day, the highest dose in the study. No significant effects were observed in the study.

The notified chemical was neither mutagenic in bacteria with or without S9-mix activated system, nor clastogenic in Chinese hamster ovary cells in vitro.

Based on the available data, the notified chemical is not classified as a hazardous substance according to the NOHSC *Approved Criteria for Classifying Hazardous Substances* (NOHSC, 1999).

10. ASSESSMENT OF ENVIRONMENTAL EFFECTS

The notifier supplied the following data on the toxicity of the notified chemical against fish, Daphnia, green algae and sewage bacteria (Toxicon, 1998, 1997b,c,d). The reports for these tests indicate that the tests were conducted according to OECD test protocols.

TEST	SPECIES	END POINT (Measured concentrations)
Acute toxicity against fish OECD TG 203	*Pimephales promelas* *Fathead minnow*	96 h LC50 > 0.268 mg/L 96 h NOEC = 0.268 mg/L
Immobilisation of *Daphnia* *OECD TG 202*	*Daphnia magna*	48 h EC50 > 0.312 mg/L 48 h NOEC = 0.312 mg/L
Algal growth inhibition OECD TG 201	*Selenastrum capricornutum*	72 h E_bC50 > 0.083 mg/L 72 h NOEC = 0.083 mg/L
Inhibition of bacterial respiration OECD TG 209	Sewage bacteria	*Not inhibitory at nominal levels <= 100 mg/L.*

The low solubility of the test material in water meant that the tests on fish, *Daphnia* and algae were conducted in solutions prepared by serial dilution of supersaturated solutions of the compound prepared by sonication and filtration.

The fish test was conducted using semi-static methodology (medium renewal on day 2), as was the *Daphnia* test (medium renewal on day 1), while the algal test was conducted using a static procedure without renewal of the test medium. For all these tests physico-chemical parameters such as water hardness, alkalinity, pH, dissolved oxygen levels and temperature were within the appropriate limits as specified in the respective OECD test protocols. In all three tests the medium was analysed for content of the notified chemical by HPLC throughout the test duration.

The tests on fish were performed using solutions with mean measured concentrations of the test compound of 0 (control), 0.080, 0.179 and 0.268 mg/L using 10 fish in each test chamber. No mortality or sub-lethal effects were observed over the 96 hour test duration, and accordingly the LC50 was determined as > 0.268 mg/L, while the NOEC for these test conditions was determined as 0.268 mg/L.

The tests on Daphnia were performed using solutions with mean measured concentrations of the test compound of 0 (control), 0.03, 0.058, 0.108, 0.226 and 0.312 mg/L using 20 *Daphnia* in each test chamber. Although one animal was dead (immobile) in each of the two most concentrated solutions, these observations were not considered statistically significant, and

accordingly the 48 hour EC50 was determined as > 0.312 mg/L and the NOEC for these test conditions determined as 0.312 mg/L.

The tests on green algae were performed using solutions with measured concentrations after 72 hours of the test compound of 0 (control), 0.022, 0.029, 0.045, and 0.083 mg/L using 5 replicates each concentration. The growth of the algal biomass was monitored over the test period and, since no significant inhibition of algal growth was observed at any test concentration compared with that of the controls, the E_bC50 was determined as > 0.083 mg/L and the NOEC for these test conditions as 0.083 mg/L.

The test on inhibition of aerobic bacteria respiration was conducted by measuring the rate of oxygen consumption in artificial sewage containing sewage bacteria and the notified chemical at nominal loading up to 500 mg/L. The bacteria were exposed to the test chemical for three hours under aeration, and then the air was turned off and the rate of O_2 uptake measured and compared with that of controls (no test chemical). The notified chemical was found to have no statistically significant inhibitory effect on the bacterial respiration at any of the concentrations tested.

The measured end point concentration data for the fish, *Daphnia* and algal tests appear to exceed the water solubility of the notified chemical (< 0.040 mg/L), and so presumably the life-forms were exposed to the compound under saturated solution conditions.

Consequently, the results of these tests indicate that the notified chemical is not toxic to aquatic species up to the limit of its water solubility.

11. ASSESSMENT OF ENVIRONMENTAL HAZARD

It is not expected that the notified chemical will constitute a hazard to the environment when used as a light stabiliser/flame retardant additive in polymer products in the manner indicated by the notifier.

A maximum of 500 kg of the chemical may be placed into landfill each year with waste resulting from formulation and manufacture of polymer masterbatches as well as from end use injection moulding of polymer into final products such as plastic pipe and other articles. At the end of their useful lives old pipe and other articles containing the chemical would most likely be placed into landfill although some may be recycled for recovery of the polymers.

After incorporation into polymer articles, the notified chemical is bound into the polymer matrix with little potential for release during the service life of finished articles, and consequently little release of the chemical to the environment is expected during the service life of polyethylene pipes and other articles.

However, once placed into landfill it is expected that the polymer matrix would be slowly degraded and broken down through the agency of slow abiotic and biological processes operative in these situations, and this may lead to release of the chemical. It is probable that the liberated chemical would become associated with the soil, and here it would slowly degrade through biological and abiotic processes. The notified chemical will be mineralised to water and oxides of carbon and nitrogen.

Very little of the notified chemical is expected to be released to the water compartment, but the available ecotoxicity information indicates that it is not toxic to aquatic species in any trophic level up to the limit of its water solubility. The compound is not expected to bioaccumulate, and no hazard to the aquatic compartment is likely when it is used as a light stabiliser/flame retardant in polymer products as indicated.

12. ASSESSMENT OF PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY EFFECTS

Hazard Assessment

The notifier provided a number of toxicological studies in support of this application. The notified chemical exhibited low acute oral and dermal toxicity in rat. It was not irritating to the skin of rabbits, nor did it sensitise the skin of guinea pigs in a maximisation test. However, it was a slight eye irritant in rabbits. The NOAEL for the notified chemical was determined to be >1 000 mg/kg/day (highest dose) in a repeat dose study in rat. The notified chemical was negative in bacterial mutagenicity assays with *Salmonella typhimurium* and *Escherichia coli*. In another *in vitro* genotoxicity test, it was not clastogenic in Chinese hamster ovary cells. The high molecular weight of the chemical will minimise absorption across biological membranes.

Based on the data provided, the notified chemical is not classified to be a hazardous substance under the NOHSC *Approved Criteria for Classifying Hazardous Substances* (NOHSC, 1999) and will not require labelling with specific risk phrases.

Occupational Health and Safety

The notified chemical will be imported as a commercial free-flowing powder. It will be mixed and extruded with other ingredients to give a masterbatch suitable for use in plastic manufacture. During further processing into finished articles and films, the notified chemical is bound within a polymer (plastic) matrix.

There is potential for dermal exposure when handling the notified chemical with eye contamination also possible. The potential for inhalation exposure is low because little of the powder is in the inspirable range as the particles tend to be aggregated.

During masterbatch production, operators opening the bags, weighing and adding the notified chemical to containers in preparation for mixing and extrusion may experience dermal exposure to the notified chemical. Workers involved in the processes such as extrusion and bagging of plastic pellets would have low exposure since after compounding in the extruder, the notified chemical is encapsulated in the masterbatch pellets. The masterbatch formulation, which contains up to 15% notified chemical, is formulated as pellets, which should minimise worker exposure to chemical dust and therefore the risk of eye irritation. Local exhaust ventilation is fitted at the weighing, dispensing, blending and packing areas. Workers involved in the production of the masterbatch pellets will wear gloves, safety glasses and overalls. Respiratory protection is available when the local exhaust ventilation is inadequate. Considering the low toxicity of the notified chemical, low concentrations in the masterbatch together with these industrial controls and personal protective equipment, the occupational health risk to workers is low.

At the customer sites, the masterbatch pellets will be mixed with other ingredients and

processed to form plastic articles and films. Since the notified chemical is encapsulated within the polymer matrix in masterbatch, occupational exposure to the notified chemical cannot occur before or after the articles are made. Thus, the health risk to operators of injection moulding or film-making machines arising from exposure to the notified chemical is very low. Similarly, the health risk to end users is low.

Under normal working conditions, storage and transport workers will be handling sealed packages of products containing the notified chemical. There are negligible occupational health risks for these workers.

Public Health

Public exposure to the notified chemical is expected to be limited to unlikely transport accidents involving damage to the packaging of the imported powder form. In the unlikely event of the powder becoming windborne the aggregated nature of the powder will prevent the breathing in of the powder and contact with the lungs is unlikely. However the powder may contact the skin, mouth, nose and eyes. This contact is likely to be minimal and transient. The notified chemical is of low toxicity and contact with it in this manner is not likely to cause any significant effects. A slight irritation of the eyes is possible. The notified chemical has a high molecular weight and is not likely therefore to penetrate any biological membranes in contact with it. In the end-use products, the notified chemical is present as an integral part of the matrix and is not accessible to human contact. The low likelihood of exposure to the notified chemical and its low toxicity suggest that it will not pose a significant hazard to public health when used in the proposed manner.

13. RECOMMENDATIONS

CONTROL MEASURES

Occupational Health and Safety

- Employers should implement the following engineering controls to minimise occupational exposure to the notified chemical:
  - Local exhaust ventilation at the formulation sites.

- Employers should implement the following safe work practices to minimise occupational exposure during handling of the notified chemical:
  - Spillage of the notified chemical should be avoided. Spillages should be cleaned up promptly then be put into containers for disposal;

- Employers should ensure that the following personal protective equipment is used by workers to minimise occupational exposure to the notified chemical:
  - Gloves
  - Safety glasses
  - Overalls
  - Respirator (when ventilation is inadequate).

  Guidance in selection of personal protective equipment can be obtained from Australian, Australian/New Zealand or other approved standards.

- A copy of the MSDS should be easily accessible to employees.

- If products and mixtures containing the notified chemical are classified as hazardous to health in accordance with the NOHSC *Approved Criteria for Classifying Hazardous Substances*, workplace practices and control procedures consistent with provisions of State and Territory hazardous substances legislation must be in operation.

Secondary notification

The Director of Chemicals Notification and Assessment must be notified in writing within 28 days by the notifier, other importer or manufacturer:

Under Subsection 64(2) of the Act:
- if any of the circumstances listed in the subsection arise.

The Director will then decide whether secondary notification is required.

No additional secondary notification conditions are stipulated.

14. MATERIAL SAFETY DATA SHEET

The MSDS for the notified chemical was provided in a format consistent with the *National Code of Practice for the Preparation of Material Safety Data Sheets* (NOHSC, 1994).

This MSDS was provided by the applicant as part of the notification statement. It is reproduced here as a matter of public record. The accuracy of this information remains the responsibility of the applicant.

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Toxicon (1997c) TKA 45009: Toxicity to the Freshwater Green Alga *Selenastrum capricornutum* Under Static Test Conditions; Toxicon Project J9703009c; Toxicon Environmental Sciences, 106 Coastal Way, Jupiter, Florida US.

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Toxicon (1998) TKA 45009: Acute Toxicity to the Fathead Minnow *Pimephales promelas* Under Static Renewal Test Conditions; Toxicon Project J9703009a; Toxicon Environmental Sciences, 106 Coastal Way, Jupiter, Florida US.

Attachment 1

The Draize Scale (Draize, 1959) for evaluation of skin reactions is as follows:

Erythema Formation	*Rating*	*Oedema Formation*	*Rating*
No erythema	0	No oedema	0
Very slight erythema (barely perceptible)	1	Very slight oedema (barely perceptible)	1
Well-defined erythema	2	Slight oedema (edges of area well-defined by definite raising	2
Moderate to severe erythema	3	Moderate oedema (raised approx. 1 mm)	3
Severe erythema (beet redness)	4	Severe oedema (raised more than 1 mm and extending beyond area of exposure)	4

The Draize scale (Draize *et al*., 1944) for evaluation of eye reactions is as follows:

CORNEA

Opacity	*Rating*	*Area of Cornea involved*	*Rating*
No opacity	0 none	25% or less (not zero)	1
Diffuse area, details of iris clearly visible	1 slight	25% to 50%	2
Easily visible translucent areas, details of iris slightly obscure	2 mild	50% to 75%	3
Opalescent areas, no details of iris visible, size of pupil barely discernible	3 moderate	Greater than 75%	4
Opaque, iris invisible	4 severe		

CONJUNCTIVAE

Redness	*Rating*	*Chemosis*	*Rating*	*Discharge*	*Rating*
Vessels normal	0 none	No swelling	0 none	No discharge	0 none
Vessels definitely injected above normal	1 slight	Any swelling above normal	1 slight	Any amount different from normal	1 slight
More diffuse, deeper crimson red with individual vessels not easily discernible	2 mod.	Obvious swelling with partial eversion of lids	2 mild	Discharge with moistening of lids and adjacent hairs	2 mod.
Diffuse beefy red	3 severe	Swelling with lids half-closed	3 mod.	Discharge with moistening of lids and hairs and considerable area around eye	3 severe
		Swelling with lids half-closed to completely closed	4 severe		

IRIS

Values	*Rating*
Normal	0 none
Folds above normal, congestion, swelling, circumcorneal injection, iris reacts to light	1 slight
No reaction to light, haemorrhage, gross destruction	2 severe

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