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September 2011

NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME (NICNAS)

PUBLIC REPORT

Ethanaminium, N,N-dimethyl-2-[(1-oxohexadecyl)oxy]-N-[2-[(1-oxohexadecyl)oxy]ethyl]-, chloride (1:1) (INCI name: Dipalmitoylethyl dimonium chloride)

This Assessment has been compiled in accordance with the provisions of the *Industrial Chemicals (Notification and Assessment) Act 1989* (Cwlth) (the Act) and Regulations. This legislation is an Act of the Commonwealth of Australia. The National Industrial Chemicals Notification and Assessment Scheme (NICNAS) is administered by the Department of Health and Ageing, and conducts the risk assessment for public health and occupational health and safety. The assessment of environmental risk is conducted by the Department of Sustainability, Environment, Water, Population and Communities.

For the purposes of subsection 78(1) of the Act, this Public Report may be inspected at our NICNAS office by appointment only at Level 7, 260 Elizabeth Street, Surry Hills NSW 2010.

This Public Report is also available for viewing and downloading from the NICNAS website or available on request, free of charge, by contacting NICNAS. For requests and enquiries please contact the NICNAS Administration Coordinator at:

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Director
NICNAS

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SUMMARY

The following details will be published in the NICNAS *Chemical Gazette:*

ASSESSMENT REFERENCE	APPLICANT(S)	CHEMICAL OR TRADE NAME	HAZARDOUS SUBSTANCE	INTRODUCTION VOLUME	USE
STD/1397	Akzo Nobel Pty Limited	Ethanaminium, N,N-dimethyl-2-[(1-oxohexadecyl)oxy]-N-[2-[(1-oxohexadecyl)oxy]ethyl]-, chloride (1:1) (INCI name: Dipalmitoylethyl dimonium chloride)	ND*	≤ 20 tonnes per annum	A component in household and cosmetic products

*ND = not determined

CONCLUSIONS AND REGULATORY OBLIGATIONS

Hazard classification
Based on the available data the notified chemical is not classified as hazardous according to the *Approved Criteria for Classifying Hazardous Substances* [NOHSC:1008(2004)].

and

The classification of the notified chemical using the Globally Harmonised System for the Classification and Labelling of Chemicals (GHS) (United Nations 2009) is presented below. This system is not mandated in Australia and carries no legal status but is presented for information purposes.

	Hazard category	*Hazard statement*
Environment	Acute Category 1	Very toxic to aquatic life
	Chronic Category 3	Harmful to aquatic life with long lasting effects

Human health risk assessment
Under the conditions of the occupational settings described, the notified chemical is not considered to pose an unreasonable risk to the health of workers.

When used in the proposed manner, the notified chemical is not considered to pose an unreasonable risk to public health.

Environmental risk assessment
On the basis of the PEC/PNEC ratio and the assessed use pattern, the notified chemical is not considered to pose an unreasonable risk to the environment.

Recommendations

CONTROL MEASURES
Occupational Health and Safety

- Employers at reformulation plants should implement the following safe work practices to minimise occupational exposure during handling of the notified chemical:
  - Avoid contact with eyes and skin.

- 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 *Approved Criteria for Classifying Hazardous Substances* [NOHSC:1008(2004)] workplace practices and control procedures consistent with provisions of State and Territory hazardous substances legislation must be in operation.

Disposal

- The notified chemical should be disposed of to landfill.

Emergency procedures

- Spills or accidental release of the notified chemical should be handled by physical containment, collection and subsequent safe disposal.

Regulatory Obligations

Secondary Notification
This risk assessment is based on the information available at the time of notification. The Director may call for the reassessment of the chemical under secondary notification provisions based on changes in certain circumstances. Under Section 64 of the *Industrial Chemicals (Notification and Assessment) Act (1989)* the notifier, as well as any other importer or manufacturer of the notified chemical, have post-assessment regulatory obligations to notify NICNAS when any of these circumstances change. These obligations apply even when the notified chemical is listed on the Australian Inventory of Chemical Substances (AICS).

Therefore, the Director of NICNAS must be notified in writing within 28 days by the notifier, other importer or manufacturer:

(1) Under Section 64(2) of the Act; if
- the function or use of the chemical has changed from a component in household and cosmetic products, or is likely to change significantly;
- the amount of chemical being introduced has increased from 20 tonnes, or is likely to increase, significantly;
- the chemical has begun to be manufactured in Australia;
- additional information has become available to the person as to an adverse effect of the chemical on occupational health and safety, public health, or the environment.

The Director will then decide whether a reassessment (i.e. a secondary notification and assessment) is required.

No additional secondary notification conditions are stipulated.

Material Safety Data Sheet
The MSDS of the notified chemical provided by the notifier was reviewed by NICNAS. The accuracy of the information on the MSDS remains the responsibility of the applicant.

ASSESSMENT DETAILS

1. APPLICANT AND NOTIFICATION DETAILS

APPLICANT(S)
Akzo Nobel Pty Limited (ABN 59 000 119 424)
8 Kellaway Place
WETHERILL PARK, NSW 2164

NOTIFICATION CATEGORY
Standard: Chemical other than polymer (more than 1 tonne per year).

EXEMPT INFORMATION (SECTION 75 OF THE ACT)
Data items and details claimed exempt from publication: impurities, additives/adjuvants and import volume.

VARIATION OF DATA REQUIREMENTS (SECTION 24 OF THE ACT)
Variation to the schedule of data requirements is claimed as follows: melting point/boiling point, vapour pressure, water solubility, hydrolysis as a function of pH, partition coefficient, adsorption/desorption, dissociation constant, particle size, flammability limits, autoignition temperature, explosive properties, acute dermal toxicity, acute inhalation toxicity, repeat dose toxicity, genotoxicity, ready biodegradability, bioaccumulation, acute toxicity to fish, acute toxicity to aquatic invertebrates and algal growth inhibition test.

PREVIOUS NOTIFICATION IN AUSTRALIA BY APPLICANT(S)
None

NOTIFICATION IN OTHER COUNTRIES
Canada 2010

2. IDENTITY OF CHEMICAL

MARKETING NAME(S)
Armocare VGH-70 (contains > 70% notified chemical)

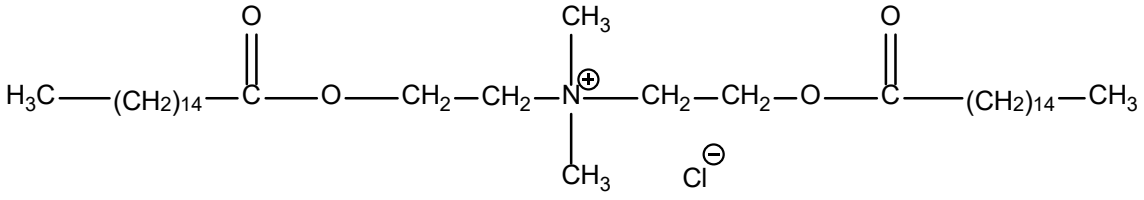
CAS NUMBER
97158-31-1

CHEMICAL NAME
Ethanaminium, N,N-dimethyl-2-[(1-oxohexadecyl)oxy]-N-[2-[(1-oxohexadecyl)oxy]ethyl]-, chloride (1:1)

OTHER NAME(S)
Dipalmitoylethyl dimonium chloride (INCI name)
Ethanaminium, N,N-dimethyl-2-[(1-oxohexadecyl)oxy]-N-[2-[(1-oxohexadecyl)oxy]ethyl]-, chloride (9CI)

MOLECULAR FORMULA
$C_{38}H_{76}NO_4.Cl$

STRUCTURAL FORMULA



MOLECULAR WEIGHT
646.47 Da

ANALYTICAL DATA

METHOD	Infrared Spectroscopy
Remarks	The IR spectrum is consistent with the structure of the notified chemical.
TEST FACILITY	Akzo Nobel

3. COMPOSITION

DEGREE OF PURITY > 90%

HAZARDOUS IMPURITIES/RESIDUAL MONOMERS Below classification cut-off levels

4. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AT 20°C AND 101.3 kPa: Solid

Property	Value	Data Source/Justification
Melting Point*	37°C	MSDS
Boiling Point	Decomposes at > 150°C	Estimated (HERA, 2008)
Density*	950 kg/m^3 at 70°C	MSDS
Viscosity*	210 cp at 70°C 47 cp at 80°C 33.6 cp at 90°C	Measured
Vapour Pressure	2.29 × 10^{-19} kPa at 25°C	Calculated using the Modified Grain Method (MPBPVP v1.43, US EPA 2011)
Water Solubility	< 0.001 mg/L	Calculated (HERA, 2008). However, the notified chemical is expected to be surface active and water dispersible.
Hydrolysis as a Function of pH	$t_{1/2}$ = 212 hours at 25°C at pH 8.2	Measured for analogue 1 (HERA, 2008)
Partition Coefficient (n-octanol/water)	log Kow = 3.1	Measured for analogue 2 (HERA, 2008). However, the notified chemical is a surfactant and will tend to accumulate at the phase interface of octanol and water and hence this value should be treated with caution.
Adsorption/Desorption	Not determined	The notified chemical is a cationic surfactant and is expected to appreciably adsorb to soil and sediment
Dissociation Constant	Not determined	The notified chemical is a salt and expected to be ionised in the environment
Charge Density*	1.04 – 1.12 meq/g	Measured
Particle Size	Not determined	The product containing > 70% notified chemical is a soft solid
Flash Point*	93.33°C (Pensky Martens closed cup)	Measured
Flammability	Not determined	Not expected to be highly flammable
Autoignition Temperature*	> 300°C	MSDS
Explosive Properties	Not expected to be explosive	The structural formula contains no explosophores.

* For product containing > 70% notified chemical.

DISCUSSION OF PROPERTIES

For full details of tests on physical and chemical properties, refer to Appendix A.

Reactivity

Stable under normal conditions of use.

5. INTRODUCTION AND USE INFORMATION

MODE OF INTRODUCTION OF NOTIFIED CHEMICAL (100%) OVER NEXT 5 YEARS

The notified chemical will not be manufactured within Australia.

The notified chemical will be imported as a component of the raw product Armocare VGH-70 (containing > 70% notified chemical) for reformulation within Australia. The notified chemical will also be imported as a component of household and cosmetic products.

MAXIMUM INTRODUCTION VOLUME OF NOTIFIED CHEMICAL (100%) OVER NEXT 5 YEARS

Year	*1*	*2*	*3*	*4*	*5*
Tonnes	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20

PORT OF ENTRY
Sydney

TRANSPORTATION AND PACKAGING
When the notified chemical is imported in the raw product Armocare VGH-70 (contains > 70% notified chemical) it will be in 25 kg plastic drums on pallets. When the notified chemical is imported in finished products it will typically be packaged in 1 L containers for household products and 400 mL containers for hair care products. Transportation of products containing the notified chemical throughout Australia will predominantly be by road.

USE
The notified chemical will be used as a component of household and cosmetic products. The notified chemical will be used at a concentration of up to 6% in regular fabric conditioners, 21% in two-in-one fabric conditioners and ironing aids, 23% in concentrated fabric conditioners and 25% in fabric conditioning sheets. The notified chemical will be used at a concentration of up to 10% in cosmetic products, which will mainly be hair care products such as leave on hair styling products and rinse off products such as shampoo and conditioner.

OPERATION DESCRIPTION
The notified chemical will not be manufactured within Australia. When the notified chemical is imported in finished products they will be warehoused prior to distribution to customers.

Reformulation
When imported as a component of the raw product Armocare VGH-70 (containing > 70% notified chemical), quality assurance tests will be undertaken prior to the notified chemical being reformulated into household and hair care products. The raw product containing the notified chemical will then be weighed before being manually added to the mixing tank. The mixing facilities are expected to be fully automated, well ventilated (local exhaust ventilation) and closed systems. After being reformulated, the finished products containing the notified chemical at concentrations up to 25% will undergo further quality assurance tests before being packaged into containers.

End use
The finished products containing the notified chemical will be used by the public and may also be used occupationally by hairdressers.

6. HUMAN HEALTH IMPLICATIONS

6.1. Exposure Assessment

6.1.1. Occupational Exposure

NUMBER AND CATEGORY OF WORKERS

Category of Worker	*Number*	*Exposure Duration (hours/day)*	*Exposure Frequency (days/year)*
Transport and Storage	10	4	12
Professional compounder	1	8	12
Chemist	1	3	12
Packers (Dispensing and Capping)	2	8	12
Store Persons	2	4	12
End Users	3×10^5	8	365

EXPOSURE DETAILS
Transport and warehousing
It is expected that transport and warehouse workers handling the imported aqueous solution containing > 70% notified chemical will only be exposed to the notified chemical in the event of spills due to an accident or as a result of a drum leakage. Following reformulation into household and hair care products, transport, warehouse and retail workers handling products will be exposed to concentrations of up to 25% notified chemical in the case of an accident when packaging is breached. The main route of exposure in these situations will be dermal.

Reformulation

During reformulation, dermal and ocular exposure of workers to the raw product containing the notified chemical (at > 70%) may occur when weighing and transferring to the mixing tank. It is expected that negligible exposure will occur during the fully automated and closed blending process. Workers involved in the reformulation process are expected to wear impermeable gloves, goggles or face shield and protective clothing to further minimise exposure. Exposure to the notified chemical at concentrations up to 25% during transfer of the formulated product to packaging is expected to be low due to the largely automated processes used.

Inhalation exposure is expected to be negligible given the very low calculated vapour pressure of the notified chemical. In addition, blending and packaging facilities are expected to be well ventilated and generally will also use local exhaust ventilation. Inhalation exposure to the notified chemical as a solid particulate is not expected as it will be imported as soft pellets.

End use
Hairdressers will be exposed to cosmetic products containing the notified chemical (≤ 10%) during application of the products to their clients' hair. The main route of exposure is expected to be dermal, although ocular exposure to splashes is possible. Inhalation of product mist is also possible, particularly for hair styling products applied by spray. PPE is not expected to be worn, however good hygiene practices are expected to be in place.

6.1.2. Public Exposure

Public exposure to the notified chemical is expected to be widespread and frequent through daily use of household and cosmetic products containing the notified chemical. Exposure to the notified chemical will vary depending on individual use patterns. The principal route of exposure will be dermal, while ocular and inhalation exposure are also possible, particularly if products are applied by spray. Accidental ingestion from the use of these types of products is also possible.

Public exposure from transport, storage, reformulation or disposal is considered to be negligible.

Household products
The maximum exposure to the notified chemical from the use of fabric conditioners can be obtained from estimates provided for similar esterquat chemicals used at the same concentrations. Refer to the HERA (2009) report for details of such calculations; the estimates used for this assessment include direct skin contact from hand-washing laundry and from wearing clothes treated with fabric conditioner. The systemic exposure to the notified chemical from use in fabric conditioners is therefore not expected to exceed 0.033 mg/kg bw/day (i.e., 0.021 mg/kg bw/day from hand-washing laundry, and 0.012 mg/kg bw/day from wearing treated clothes) (HERA, 2009). This figure assumes concentrations of the notified chemical of 5.3% in regular fabric conditioners, 20.3% in "Two in One" fabric conditioners and ironing aids, 23% in concentrated fabric conditioners, and 25% in fabric conditioner sheets (AISE, 2002).
The AISE (2002) concentrations are similar to those that the notified chemical will be present at, in these household products.

Cosmetic products
Public exposure to the notified chemical in Australia from the use of cosmetic products has been estimated using the Scientific Committee on Consumer Safety (SCCS) Notes of Guidance for the Testing of Cosmetic Ingredients and their Safety Evaluation (SCCS, 2010), and applying the following assumptions:

- Body weight (BW) of 60 kg for females (SCCS, 2010);
- The maximum concentration of the notified chemical in cosmetic products is 10%;
- 2% dermal absorption (DA) (see section 6.2: Toxicokinetics, metabolism and distribution)
- An individual uses all product types containing the notified chemical.

Product type	**Daily amount applied - DAp** (mg/day)	**Concentration - C** (%)	**Retention Factor - RF** (unitless)	**Daily exposure* – DE** (mg/day)	**Daily systemic exposure* - DSE** (mg/kg bw/day)
Leave on					
Hair styling products	4,000	10	0.1	40	0.013
Total (Leave on)					**0.013**

Rinse off					
Shower gel	18,670	10	0.01	18.67	0.0062
Shampoo	10,460	10	0.01	10.46	0.0035
Conditioner	3,920	10	0.01	3.92	0.0013
Total (Rinse off)					**0.011**
Total					**0.024**

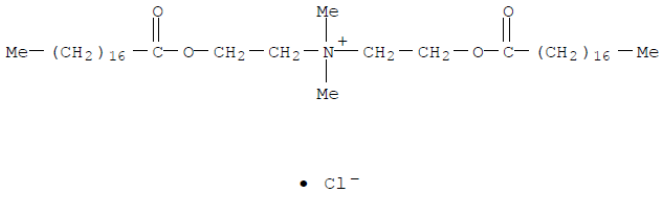
*DE = DAp × (C/100) × RF;
**DSE = DE x (DA/100) / BW

The potential combined total systemic exposure to the public from the use of the notified chemical in household and hair care products is therefore 0.057 mg/kg bw/day.

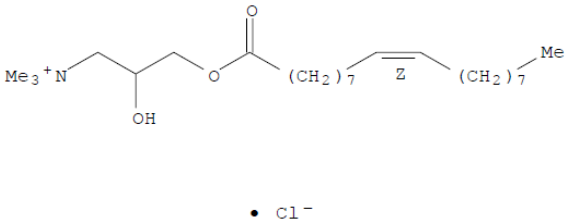
6.2. Human Health Effects Assessment

The results from toxicological investigations conducted on the notified chemical and suitable analogues are summarised in the table below. Details of the studies on the notified chemical can be found in Appendix B.
The identity of the analogues is as follows:

Analogue 1
Chemical name: Ethanaminium, N,N-dimethyl-2-[(1-oxooctadecyl)oxy]-N-[2-[(1-oxooctadecyl)oxy]ethyl]-, chloride (1:1)
CAS Number: 67846-68-8
Structure:

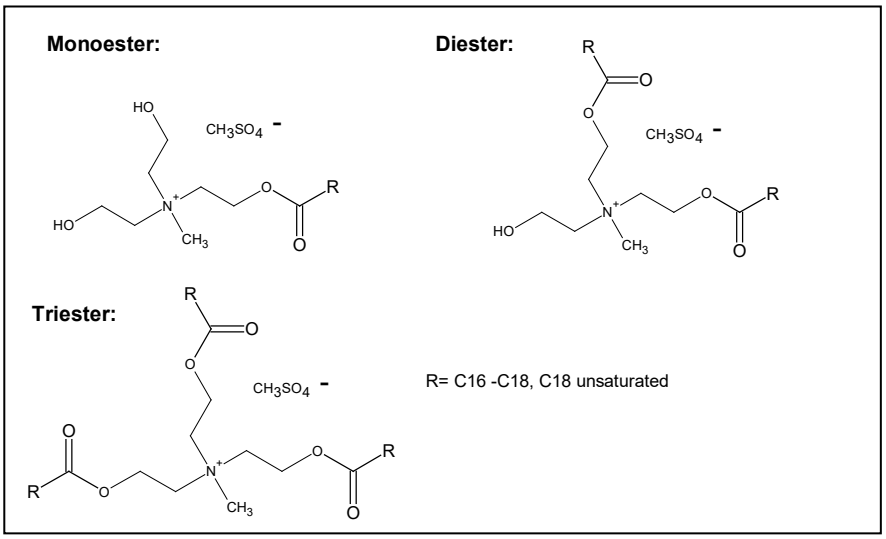


Analogue 2
Chemical name: (Z)-2-hydroxy-3-[(1-oxo-9-octadecenyl)oxy]propyltrimethylammonium chloride
CAS Number: 19467-38-0
Structure:



Analogue 3
Chemical name: Ethanaminium, 2-hydroxy-N,N-bis(2-hydroxyethyl)-N-methyl-, esters with C16-18 and C18-unsatd. fatty acids, Me sulfates (salts)
CAS Number: 157905-74-3

Structure:



Analogue 4
Chemical name: Fatty acids, C10-20 and C16-18-unsatd., reaction products with triethanolamine, di-Me sulfate-quaternized
CAS Number: 91995-81-2

Analogue 5
Chemical name: Fatty acids, tallow, reaction products with triethanolamine, di-Me sulfate-quaternized
CAS Number: 93334-15-7

Justification for the analogues
Of the analogues listed analogue 1 is expected to have overall properties most similar to the notified chemical due to the only difference being the length of the fatty acid fragment of the ester attached to the quaternary amine. Analogue 1 is two carbons longer on each fatty acid fragment of the ester compared to the notified chemical. In some of the studies reported for analogue 1, and in particular the ecotoxicological studies, the test substance may have been a mixture of the notified chemical with analogue 1.

Analogue 2 has one less aliphatic alcohol/fatty acid chain bound to the quaternary amine than the notified chemical. However, all of the functional groups are either the same or not expected to contribute any hazardous properties to the chemical and therefore analogue 2 is considered to give a reasonable indication of the toxicological properties of the notified chemical.

Analogues 3, 4 and 5 are very similar to one another and based on ethanol, 2,2',2"-nitrilotris- (CAS number 102-71-6). The difference between them is the composition of the fatty acid chains. In addition, all of the functional groups of the analogues are present in the notified chemical with the main difference being the presence of an extra aliphatic alcohol/fatty acid bound to the quaternary amine. As such, analogues 3, 4 and 5 are considered to be suitable analogues for the notified chemical.

Generally, the physical/chemical properties of the analogues are sufficiently close to those measured or estimated for the notified chemical (refer HERA, 2008, Section 3.3.2). In summary, for the above mentioned reasons, the combined use of the five analogues provides a sufficient indication of the toxicity of the notified chemical.

Endpoint	*Test substance*	*Result and Assessment Conclusion*
Rat, acute oral toxicity	Notified chemical	LD50 > 2,000 mg/kg bw; low toxicity
Rat, acute dermal toxicity	Analogue 2	LD50 > 1,640 mg/kg bw; low toxicity
	Analogue 3	LD50 > 2,000 mg/kg bw; low toxicity

	Analogue 4	LD50 > 2,000 mg/kg bw; low toxicity
Rabbit, skin irritation	Notified chemical	slightly irritating
Rabbit, eye irritation	Notified chemical	slightly irritating
Guinea pig, skin sensitisation – adjuvant test	Notified chemical	no evidence of sensitisation
Rat, repeat dose oral (gavage) toxicity – 28 days.	Analogue 3	NOAEL > 800 mg/kg bw/day
	Analogue 1	NOEL > 1,000 (Females) NOEL = 100 (Males) mg/kg bw/day
Rat, repeat dose oral (diet) toxicity – 28 days.	Analogue 2	NOAEL > 820 mg/kg bw/day
Rat, repeat dose oral (gavage) toxicity – 90 days.	Analogue 5	NOAEL = 300 mg/kg bw/day
	Analogue 1	NOEL > 500 mg/kg bw/day
Rat, repeat dose oral (drinking water) toxicity – 90 days.	Analogue 3/4/5*	NOEL ≈ 247 – 703 mg/kg bw/day
Mutagenicity – bacterial reverse mutation	Notified chemical	non mutagenic
Genotoxicity – in vitro mammalian chromosome aberration test (chinese hamster V79 Cells)	Analogue 3	non genotoxic
Genotoxicity – in vitro mammalian gene mutation test (Chinese hamster ovary/HRTP locus assay)	Analogue 2	non genotoxic
Genotoxicity – in vitro mammalian forward mutation assay (mouse lymphoma L578Y cells)	Analogue 1	non genotoxic
Genotoxicity – in vitro mammalian chromosome aberration test (human lymphocytes)	Analogue 1	non genotoxic
Genotoxicity – in vivo Mammalian Mouse micronucleus Test	Analogue 4	non genotoxic
Developmental effects	Analogue 2	NOAEL > 1,000 mg/kg bw/day
Developmental effects	Analogue 1	NOAEL > 1,000 mg/kg bw/day

* The exact identity was not specified but the test substance is expected to be very similar to or the same as these analogues.

Toxicokinetics, metabolism and distribution.
Toxicokinetic data on the notified chemical was not provided. The notified chemical has a molecular weight of 646.47 Da and a water solubility of < 0.001 mg/L and partition coefficient of log Kow = 3.1. The moderately high molecular weight and hydrophobicity of the notified chemical suggest that absorption across the lipid rich environment of the stratum corneum into the epidermis would be slow. This hypothesis is supported by dermal toxicokinetic studies on analogue chemicals. In an *in vitro* study on radiolabelled analogue 2 with porcine skin approximately 40% was hydrolysed over 24 hours, equivalent to a rate of about 86 ng/hr/cm^2 (HERA, 2009). In *in vivo* studies using ^{14}C radio labelling analogue 1 showed absorption of approximately 0.2%, while analogue 2 showed absorptions of 0.7% and 2% depending on the position of the ^{14}C atom in the analogue. Based on the weight of evidence it is unlikely that the dermal absorption of the notified chemical would exceed 2%.

Acute toxicity.
The notified chemical is considered to be of low acute toxicity via the oral route. The acute dermal toxicity of analogues 2, 3 and 4 was shown to be low based on tests in rats (HERA, 2009). Based on the results from these analogues the notified chemical is not expected to be acutely toxic via the dermal route. There is no data available on the inhalation toxicity of the notified chemical or suitable analogues.

Irritation and Sensitisation.
Based on tests conducted in rabbits the notified chemical is considered to be slightly irritating to the skin and eye. The notified chemical did not induce sensitisation in guinea pigs at challenge concentrations up to 50%.

Repeated Dose Toxicity (sub acute, sub chronic, chronic).
A 28 day oral study in rats with analogue 3 gave a NOAEL of > 800 mg/kg bw/day. No mortality, morbidity or significant changes of any of the investigated parameters were noted (HERA, 2009).

A further 28-day oral gavage study in rats at doses of 10, 100 or 1,000 mg/kg bw/day was conducted with analogue 1 (HERA, 2009). No mortality or any clinical signs or changes were attributable to the treatment apart from in male animals receiving 1,000 mg/kg bw/day, where there was an indication of suppression in arousal processes, which were still apparent after the 4-week recovery. The toxicological importance of these changes is limited by the absence of any pathological changes. In conclusion, 1,000 mg/kg bw/day was established as the

NOEL for female rats and the NOAEL for male rats, with the NOEL for male rats being 100 mg/kg bw/day.

In a 28-day dietary study (OECD TG 407), rats were fed with a diet containing 0%, 0.008%, 0.04%, 0.2% or 1% of analogue 2 (HERA, 2009). Neither mortality nor significant toxicity was observed in the animals as a result of the treatment with analogue 2. As a result, the NOAEL was considered to be approximately 1,000 mg/kg bw/day of the test substance or 820 mg/kg bw/day of analogue 2 (corrected for impurities/adjuvants).

The subchronic toxicity of analogue 5 was evaluated in an oral gavage study at dose levels of 0, 100, 300 or 1000 mg/kg bw/day (HERA, 2009). Animals of the high dose groups displayed potentially substance related increases of blood liver enzymes, signs of gastric irritation and regressive epithelial changes in the bladder, therefore a NOEL of 300 mg/kg bw/day was assigned by the study authors.

Analogue 1 was further investigated in a 90-day oral gavage study with rats dosed at 0, 10, 100 or 500 mg/kg/day (HERA, 2009). No adverse effects were reported and thus, the high dose level of 500 mg/kg bw/day was considered the NOEL for this study.

Finally, a 90-day study investigated the subchronic toxicity of an esterquat analogue very similar or the same as analogues 3, 4 and 5 in rats (HERA, 2009). In this study, the test material was given in drinking water in concentrations of 0, 0.01%, 0.32% and 1.6% v/v. The only effects in this study were relatively minor changes in the male high dose group and therefore a NOEL of 247-703 mg/kg bw/day was established.

A 13-week neurotoxicity study was conducted on analogue 2 using oral gavage doses of up to 1,000 mg/kg bw/day (HERA, 2009). No signs of neurotoxicity were observed and hence the NOAEL was set at 1,000 mg/kg bw/day.

Based on the above analogue studies the notified chemical is not expected to cause adverse effects as a result of repeated oral exposure to doses of up to 300 mg/kg bw/day, based on the NOAEL in the 90-day study with analogue 5, which is the lowest from subacute and subchronic studies.

Mutagenicity.
The notified chemical was found to be non mutagenic using a bacterial reverse mutation test.

No genotoxic effects were seen in 4 different in vitro studies and 1 in vivo study (which included evidence that the test substance reached the bone marrow) involving the analogues 1, 2, 3 and 4. The notified chemical is not expected to be genotoxic based on the results seen in these tests.

Developmental Toxicity.
Two studies (one using analogue 1 and the other analogue 2) have been conducted where female rats were orally dosed at concentrations of up to 1,000 mg/kg bw/day from day 6 to 15 post mating before being sacrificed on day 21 (HERA, 2009). A slight but statistically significant post-implantation loss was noted with analogue 1 in the high dose group, although the rate was still within that seen in the historical controls. No other adverse effects were noted in either study and hence the NOAEL was the highest dose tested. The notified chemical is not expected to cause teratogenic effects based on the results of the tests conducted using analogues 1 and 2.

Health hazard classification
Based on the available data the notified chemical is not classified as hazardous according to the *Approved Criteria for Classifying Hazardous Substances* (NOHSC, 2004).

6.3. Human Health Risk Characterisation

6.3.1. Occupational Health and Safety
Based on data provided the notified chemical is a slight eye and skin irritant. The risk of systemic effects is expected to be low based on the expected low dermal absorption of the notified chemical and the absence of effects seen in a range of acute and systemic toxicity tests on the notified chemical and analogous chemicals.

Although reformulation workers will handle the neat notified chemical at concentrations from > 70%, exposure is expected to be low given the proposed use of PPE and largely enclosed, automated processes used in reformulation facilities. The risk to the occupational health and safety of reformulation workers is therefore not considered unreasonable, due to the expected low exposure and the low hazardous nature of the notified chemical.

Hairdressers will be exposed to cosmetic products containing the notified chemical (≤ 10%) during application of the products to their clients. Although hairdressers are not expected to use PPE considering the low hazardous nature of the notified chemical the risk to these workers is not considered unreasonable.

6.3.2. Public Health

The general public will be repeatedly exposed to the notified chemical during the use of household and cosmetic products containing the notified chemical at up to 25% concentration.

Local effects

The notified chemical is a slight skin and eye irritant. However, the notified chemical will be present in cosmetic products at concentrations ≤ 10% and therefore irritancy in consumers is not expected.

The notified chemical will also be present at concentrations ≤ 25% in fabric conditioning products, however, exposure to such concentrations will only be accidental, such as in the case of product spills in the laundry. When used in the wash, the concentration of the notified chemical will be significantly reduced, through dilution of the conditioning product in water. Exposure to garments or solutions treated with such fabric softener products will be negligible; only 1% of the residual concentration of the notified chemical in treated clothes is expected to be transferred and remain on skin (Vermeire cited in HERA, 2009, p. 10), with only 2% of the amount remaining on skin expected to be absorbed (Unilever cited in HERA, 2009, p. 8). Hence the risk to the public of irritation from exposure to fabric conditioning products containing the notified chemical is not expected to be unreasonable.

Systemic effects

The potential combined total systemic exposure to the public from the use of the notified chemical in household and cosmetic products was estimated to be 0.057 mg/kg bw/day. Using a NOAEL of 300 mg/kg bw/day based on studies using suitable analogues the MOE is expected to be at least 5,263. An MOE greater than or equal to 100 is considered acceptable to account for intra- and inter-species differences. Therefore the risk of adverse systemic effects following exposure via consumer products is not considered to be unreasonable.

7. ENVIRONMENTAL IMPLICATIONS

7.1. Environmental Exposure & Fate Assessment

7.1.1. Environmental Exposure

RELEASE OF CHEMICAL AT SITE

The notified chemical will be imported as a component in household and cosmetic products and also as a component in a raw product for reformulation into household and cosmetic products. Release of the notified chemical to the environment may occur as accidental spills during transport or handling. During reformulation, the raw product containing the notified chemical will be blended with other ingredients and packaged into containers. Spills of raw product containing the notified chemical are expected to be absorbed with an inert substance, such as sand, and disposed of to landfill. It is estimated that up to 1% of the annual import volume of the notified chemical may remain in raw material containers and are expected to be either recycled or disposed of to landfill.

RELEASE OF CHEMICAL FROM USE

As the notified chemical is used in cosmetics and household products such as hair conditioners and fabric softeners, it is expected that the majority of the annual import volume will be released to sewer through consumer use. A small proportion (estimated to be ≤ 3%) may remain as residues within end-use containers.

RELEASE OF CHEMICAL FROM DISPOSAL

It is expected that end use containers containing residues of the notified chemical will either be recycled or disposed of as domestic garbage and end up in landfill sites.

7.1.2. Environmental Fate

No environmental fate data for the notified chemical were provided. However, a report that summarised environmental fate studies conducted on analogue 1 and the notified chemical was submitted (HERA 2008). The

test substance consisted of a mixture of two quaternary ammonium compounds with different aliphatic chain lengths (C_{16} and C_{18}). The test substance is considered to be suitable with respect to biodegradation as it contains the notified chemical (the C_{16} component) and analogue 1 that only differs by two CH_2 units. The summary of biodegradation studies conducted on the test substance and the result of each study is shown in the table below. No other test details were provided.

Test type (protocol)	*Result (% Degradation or half life)*
Ready (OECD 301 B)	80%
Ready (OECD 301 F)	90%
Inherent (OECD 302 B)	75%
Inherent (OECD 302 A)	> 99.7%
River die away test (no protocol)	$t_{1/2}$ = 1 – 2 days
Biodegradation in soil (OECD 304)	57 – 71%
Biodegradation in soil (protocol not reported)	52 – 62%
Biodegradation in soil (protocol not reported)	$t_{1/2}$ = 18 days

The data indicates that the test substance (analogue 1/notified chemical) is both readily and inherently biodegradable in the aquatic environment and degrades substantially in soils. Thus, the notified chemical is expected to be readily biodegradable and largely degraded during sewage treatment. Due to its cationic functional group a high proportion of the notified chemical is expected to sorb to sludge in sewage treatment plants (STPs). The sludge containing notified chemical residues may be sent to landfill or applied to soils for land remediation. Due to its dispersibility, a small proportion of the notified chemical may be discharged in treated effluent to receiving waters where the chemical is expected to disperse and degrade. Bioaccumulation is not expected as the notified chemical is likely to have low bioavailability, due to rapid sorption to charged surfaces in the aquatic environment, and is readily biodegradable. The notified chemical is expected to ultimately degrade biotically and abiotically to form water and oxides of carbon and nitrogen and inorganic salts.

7.1.3. Predicted Environmental Concentration (PEC)

A worst-case predicted environmental concentration (PEC) was calculated assuming that all of the total import volume of notified chemical will be released to sewers with removal of the notified chemical by sewerage treatment plants (STPs) calculated by SimpleTreat (European Commission, 2003). It is assumed the release of the notified chemical will occur over 365 days per annum into the total Australian effluent volume.

Predicted Environmental Concentration (PEC) for the Aquatic Compartment		
Total Annual Import/Manufactured Volume	20,000	kg/year
Proportion expected to be released to sewer	100%	
Annual quantity of chemical released to sewer	20,000	kg/year
Days per year where release occurs	365	days/year
Daily chemical release:	54.79	kg/day
Water use	200	L/person/day
Population of Australia (Millions)	21,161	million
Removal within STP	68%	
Daily effluent production:	4,232	ML
Dilution Factor - River	1.0	
Dilution Factor - Ocean	10.0	
PEC - River:	4.14	µg/L
PEC - Ocean:	0.41	µg/L

The notified chemical is expected to be readily biodegradable, hence the removal of the notified chemical from influent by sewage treatment plant (STP) processes is likely. It was estimated by SimpleTreat that 65% of the notified chemical would be removed from influent due to biodegradation and 3% due to sorption to sludge. The sorption of sludge was based on an analogue measurement of Kow. The proportion of notified chemical sorbing to sludge, however, is expected to be higher based on its cationicity.

STP effluent re-use for irrigation occurs throughout Australia. The agricultural irrigation application rate is assumed to be 1000 L/m^2/year (10 ML/ha/year). The notified chemical in this volume is assumed to infiltrate and accumulate in the top 10 cm of soil (density 1500 kg/m^3). Using these assumptions, irrigation with a

concentration of 4.143 µg/L may potentially result in a soil concentration of approximately 27.62 µg/kg. Assuming accumulation of the notified chemical in soil for 5 and 10 years under repeated irrigation, the concentration of notified chemical in the applied soil in 5 and 10 years may be approximately 138 µg/kg and 276 µg/kg, respectively. However, based on the likely high sorption to sludge of the notified chemical due to its cationicity, these values represent maximum concentrations only.

7.2. Environmental Effects Assessment

No ecotoxicity data were submitted for the notified chemical. However, a report that summarised acute and chronic ecotoxicity studies conducted on analogue 1 and the notified chemical was submitted (HERA 2008). The test substance consists of a mixture of two quaternary ammonium compounds with different aliphatic chain lengths (C_{16} and C_{18}). The test substance contains a mixture of the notified chemical (C_{16} component) and analogue 1. Analogue 1 contains the same functional groups as the notified chemical and is expected to have very similar physico-chemical properties to the notified chemical. Analogue 1 is therefore considered to be suitable with respect to ecotoxicity.

Acute Ecotoxicity

A very brief summary of the acute tests performed on test substance (analogue 1/notified chemical) was available and are listed here. A semi-static fish test was conducted with 91.4% pure test substance in 9.4% isopropanol on *Danio rerio* (zebrafish) and resulted in the endpoint LC50 (96 h) = 2.8 mg/L based on measured test substance concentrations. A static aquatic invertebrate test was conducted with 83.4% pure test substance in 15% ethanol on *Daphnia magna* and resulted in the endpoint EC50 (48 h) = 4.0 mg/L based on nominal test substance concentrations. A static algal test was conducted with 83.4% pure test substance in 15% ethanol on *Selenastrum capricornutum* with synthetic water and resulted in the endpoints E_rC50 (72 h) = 0.93 mg/L and E_bC50 (72 h) = 0.24 mg/L based on nominal test substance concentrations. An activated sludge test under static conditions gave a NOEC (3 h) = 48.6 mg/L based on nominal concentrations, which indicates no significant inhibition of microbial respiration by analogue 1.

The data summarised above should be treated with caution as although the studies were rated as reliable by the authors, relatively high concentrations of co-solvents were used and the study reports were not available. However, the data is consistent with acute ecotoxicity data for analogue 1 in a publication for an overseas regulatory agency (Madsen et al., 2001) and is therefore considered acceptable for regulatory purposes. A summary of the results from acute studies conducted on the analogue reported in the Madsen et al. publication are listed here. A fish study on *Brachydanio rerio* (zebrafish) resulted in an LC50 (96 h) = 5.2 mg/L. An aquatic study on *Daphnia magna* resulted in an EC50 (24 h) = 14.8 mg/L. An algal study on *Selenastrum capricornutum* resulted in an EC50 (24 h) = 2.9 mg/L.

Chronic Ecotoxicity

A very brief summary of the chronic tests performed on the test substance (analogue 1/notified chemical) was available and are listed here. A flow-through fish test was conducted on *Pimephales promelas* (fathead minnow) with river water and resulted in the endpoint NOEC (35 d, post fry mortality) = 0.63 mg/L based on nominal test substance concentrations. A flow-through aquatic invertebrates was conducted on *Daphnia magna* with river water and resulted in the endpoint NOEC (21 d) = 1.0 mg/L based on measured test substance concentrations. A static algal test was conducted with on *Selenastrum capricornutum* with synthetic medium and resulted in the endpoint E_rC10 (72 h) = 0.48 mg/L based on nominal test substance concentrations.

As for the acute ecotoxicity studies, the chronic data summarised above is consistent with data conducted on analogue 1 in a publication for an overseas regulatory agency (Madsen et al. 2001) and is therefore considered acceptable for regulatory purposes. A summary of the results from chronic studies conducted on the analogue reported in the Madsen et al. publication are listed here. A fish study on *Pimephales promelas* (Fathead minnow) resulted in a NOEC (35 d, growth) = 0.68 mg/L. An aquatic study on *Daphnia magna* resulted in a NOEC (21 d, life cycle) = 1.0 mg/L. No chronic algal result was available.

The lowest relevant ecotoxicity endpoints from the available data on the test substance (analogue 1/notified chemical) are outlined below.

Endpoint	*Duration*	*Result*	*Assessment Conclusion*
Acute Toxicity			
Fish Toxicity	96 h	LC50 = 2.8 mg/L	Toxic to fish

Daphnia Toxicity	48 h	EC50 = 4.0 mg/L	Toxic to aquatic invertebrates
Algal Toxicity	72 h	E_rC50 = 0.93 mg/L	Very toxic to algae
Chronic Toxicity			
Fish Toxicity	35 d	NOEC = 0.63 mg/L	Harmful to fish with long lasting effects
Daphnia Toxicity	21 d	NOEC = 1.0 mg/L	Harmful to aquatic invertebrates with long lasting effects
Algal Toxicity	72 h	E_rC10 = 0.48 mg/L	At least harmful to algae with long lasting effects

Under the Globally Harmonised System of Classification and Labelling of Chemicals (GHS; United Nations, 2009) the notified chemical is considered to be acutely toxic to fish and aquatic invertebrates, very toxic to algae, chronically harmful to fish and daphnia and at least chronically harmful to algae. Based on the toxicity to aquatic biota the notified chemical is formally classified under the GHS as "Acute category 1; Very toxic to aquatic life". The lowest chronic endpoint available is the algal E_rC10 value indicating that the algal NOEC is < 0.48 mg/L. This endpoint is consistent with, and more conservative than, the chronic endpoints from fish and daphnia and hence it is considered reasonable to assume the E_rC10 endpoint is indicative of the NOEC in this case. The E_rC10 can therefore be used to determine the formal chronic classification of the notified chemical as "Chronic category 3; Harmful to aquatic life with long lasting effects" under the GHS.

7.2.1. Predicted No-Effect Concentration

The lowest endpoint from chronic ecotoxicological studies on the acceptable analogue 1 for the notified chemical was used to calculate the Predicted No-Effect Concentration (PNEC). An assessment factor of 50 was used as although chronic toxicity endpoints are available for the effects on an analogue of the notified chemical on aquatic species for three different trophic levels, only two endpoints are NOECs.

Predicted No-Effect Concentration (PNEC) for the Aquatic Compartment		
Algae E_rC10(72 h)	0.48	mg/L
Assessment Factor	50	
PNEC:	9.6	µg/L

7.3. Environmental Risk Assessment

Risk Assessment	PEC µg/L	PNEC µg/L	Q
Q - River	4.14	9.6	0.432
Q - Ocean	0.41	9.6	0.0432

As a result of its use pattern, the majority of the total annual import volume is expected to be disposed of to the sewer. In sewage treatment plants the notified chemical is expected to sorb to sludge and/or biodegrade. Notified chemical released to surface waters has a low potential to bioaccumulate and is not expected to persist in the environment. The Risk Quotients (Q = PEC/PNEC) for the discharge scenario have been calculated to be < 1 for the river and ocean compartments. Therefore, the notified chemical is not considered to pose an unreasonable risk to the aquatic environment based on its assessed use pattern at the proposed import quantity.

APPENDIX A: PHYSICAL AND CHEMICAL PROPERTIES

Charge Density 1.04 – 1.12 meq/g

Method	Determination of total and quaternary activity by potentiometric titration
Remarks	The titration was conducted in a hot solvent mix with sodium tetraphenylboron solution. Measurement of the total activity (includes free amine and the amine salts) and the corrected activity of the long chain quaternary ammonium salts.
Test Facility	Akzo Nobel Surfactants (2008)

APPENDIX B: TOXICOLOGICAL INVESTIGATIONS

B.1. Acute toxicity – oral

TEST SUBSTANCE: Notified chemical

METHOD: OECD TG 401 Acute Oral Toxicity.
EC Directive 92/69/EEC B.1 Acute Toxicity (Oral).

Species/Strain	Rat/Wistar
Vehicle	Water
Remarks - Method	No significant protocol deviations

RESULTS

Group	*Number and Sex of Animals*	*Dose mg/kg bw*	*Mortality*
I	5 per sex	2,000	0/10

LD50	> 2,000 mg/kg bw
Signs of Toxicity	There were no deaths. The only clinical sign observed during the study was uncoordinated movements. This was observed in all animals approximately 4 hours after dosing.
Effects in Organs	No abnormalities were noted at necroscopy
Remarks - Results	Body weight gains were as expected.

CONCLUSION: The notified chemical is of low toxicity via the oral route.

TEST FACILITY: NOTOX (1994a)

B.2. Irritation – skin

TEST SUBSTANCE: Notified chemical

METHOD: OECD TG 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	3 (male)
Vehicle	Water
Observation Period	7 Days
Type of Dressing	Semi-occlusive.
Remarks - Method	No significant protocol deviations

RESULTS

Lesion	*Mean Score* Animal No.*			*Maximum Value*	*Maximum Duration of Any Effect*	*Maximum Value at End of Observation Period*
	1	2	3			
Erythema/Eschar	2	1.7	0.3	2	< 7 days	0
Oedema	0	0	0	1	< 24 hours	0

*Calculated on the basis of the scores at 24, 48, and 72 hours for EACH animal.

Remarks - Results	A single 4-hour, semi-occluded application of the test material to the intact skin of the three rabbits produced very slight erythema at the 1 hour observation in all rabbits and very slight oedema in one rabbit. At the 24-hour observation no oedema was observed but the erythema had increased to well defined in two of the three rabbits. At the 48-hour observation one rabbit appeared normal with the other two still having well defined erythema. Very slight erythema was present on one rabbit and well defined erythema on one further rabbit at the 72-hour observation. All treated skin

sites appeared normal at the 7-day observation. No corrosive effects were noted. Scaliness was observed in one animal only at the final 7-day observation.

CONCLUSION The notified chemical is slightly irritating to the skin.

TEST FACILITY NOTOX (1994b)

B.3. Irritation – eye

TEST SUBSTANCE Notified chemical

METHOD OECD TG 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 (male)
Observation Period 14 Days
Remarks - Method No significant protocol deviations

RESULTS

Lesion	*Mean Score* Animal No.*			*Maximum Value*	*Maximum Duration of Any Effect*	*Maximum Value at End of Observation Period*
	1	2	3			
Conjunctiva: redness	2	2.3	2.3	3	< 14 Days	0
Conjunctiva: chemosis	0.7	1.3	1.3	2	< 7 Days	0
Conjunctiva: discharge	0.7	1	1	1	< 7 Days	0
Corneal opacity	0	0	0	0	-	0
Iridial inflammation	0	0.3	0	1	< 48 Hours	0

*Calculated on the basis of the scores at 24, 48, and 72 hours for EACH animal.

Remarks - Results A single application of the test material to the non-irrigated eye of three rabbits resulted in adverse effects on the conjunctivae in all three animals, which had completely resolved within 14 days after installation. Iridic irritation was observed in one animal at the 24 hour observation only. Ocular corrosion was not observed in any of the rabbits.

CONCLUSION The notified chemical is slightly irritating to the eye.

TEST FACILITY NOTOX (1994c)

B.4. Skin sensitisation

TEST SUBSTANCE Notified chemical

METHOD OECD TG 406 Skin Sensitisation – Guinea Pig Maximisation Test.
EC Directive 96/54/EC B.6 Skin Sensitisation - Guinea Pig Maximisation Test.

Species/Strain Guinea pig/Himalayan
PRELIMINARY STUDY Maximum Non-irritating Concentration:
intradermal: < 5%
topical: 50%
MAIN STUDY
Number of Animals Test Group: 20 Control Group: 10
INDUCTION PHASE Induction Concentration:
intradermal: 5% in water (0.1 mL) and 10% in 50:50 Freunds' Complete Adjuvant
topical: 50% in water
Signs of Irritation Signs of irritation were seen in 9/20 of the test group animals and 4/10 of the control group animals during the induction phase.

CHALLENGE PHASE

1st challenge	topical: 10%, 25%, 50%
Remarks - Method	No significant protocol deviations GLP compliant

RESULTS

Animal	*Challenge Concentration*	*Number of Animals Showing Skin Reactions after: 1st challenge*	
		24 h	*48 h*
Test Group	50	0/20	1/20
	25	0/20	0/20
	10	0/20	0/20
Control Group	50	0/10	0/10
	25	0/10	0/10
	10	0/10	0/10

Remarks - Results: There were no deaths or substance-related signs of toxicity during the study. After challenge 1/20 (5%) of the animals showed a score of 1 at the 48 hour observation. This was below the 30% cut-off for evidence of positive responses to meet the classification criteria. The positive control confirmed the sensitivity of the test system.

CONCLUSION: The test substance was not a skin sensitiser under the conditions of the test.

TEST FACILITY: NOTOX (1994d)

B.5. Genotoxicity – bacteria

TEST SUBSTANCE: Notified chemical

METHOD: OECD TG 471 Bacterial Reverse Mutation Test.
EC Directive 2000/32/EC B.13/14 Mutagenicity – Reverse Mutation Test using Bacteria.
Plate incorporation procedure

Species/Strain	*S. typhimurium*: TA1535, TA1537, TA98, TA100
Metabolic Activation System	S9 fraction from Aroclor 1254-induced rat liver.
Concentration Range in Main Test	*Test 1* a) With metabolic activation: 33 – 3,330 µg/plate b) Without metabolic activation: 10 – 1,000 µg/plate *Test 2* a) With metabolic activation: 33 – 3,330 µg/plate b) Without metabolic activation: 10 – 1,000 µg/plate
Vehicle	Dimethyl sulfoxide
Remarks - Method	Two main tests were conducted for independent validation purposes. No significant protocol deviations.

RESULTS

Metabolic Activation	*Test Substance Concentration (µg/plate) Resulting in:m*			
	Cytotoxicity in Preliminary Test	*Cytotoxicity in Main Test*	*Precipitation*	*Genotoxic Effect*
Absent				
Test 1	≥ 3,330	> 1,000	≥ 333	Negative
Test 2		≥ 1,000	≥ 333	Negative

Present				
Test 1	≥ 3,330	> 3,330	≥ 333	Negative
Test 2		≥ 3,330	≥ 333	Negative

Remarks - Results

The test material was tested up to the maximum non-cytotoxic dose levels of 3,330 µg/plate both with and without metabolic activation. No toxicologically significant increases in the frequency of revertant colonies were recorded for any of the bacterial strains, with any dose of the test material, either with or without metabolic activation.

All the positive control chemicals used in the test induced marked increases in the frequency of revertant colonies thus confirming the activity of the S9-mix and the sensitivity of the bacterial strains.

CONCLUSION

The notified chemical was not mutagenic to bacteria under the conditions of the test.

TEST FACILITY

NOTOX (1994e)

BIBLIOGRAPHY

AISE (2002). Table of habits and practices for consumer products in Western Europe, developed within the HERA project in 2002.

European Commission (2003). Technical Guidance Document on Risk Assessment in Support of Commission Directive 93/67/EEC on Risk Assessment for New Notified Substances and Commission Regulation (EC) No 1488/94 on Risk Assessment for Existing Substances and Directive 98/8/EC of the European Parliament and of the Council Concerning the Placing of Biocidal Products on the Market – Part II. Institute for Health and Consumer protection, European Chemicals Bureau, European Communities. <http://oktatas.ch.bme.hu/oktatas/konyvek/mezgaz/kornybio/elm/EuTGD/7%20FEJEZET.pdf>. Accessed 2011, Aug 01.

HERA (2008). Human and Environmental Risk Assessment on Ingredients of Household Cleaning Products (HERA), Avenue Herrmann Debroux ISA, B-1160 Brussels Belgium. Edition 1.0 March 2008. Esterquats Environmental Risk Assessment Report. <http://www.heraproject.com/files/17-E-01-03-2008%20%20HERA%20EQ%20Environment%20Final%20Draft.pdf>. Accessed 2011, July 27.

HERA (2009). Human and Environmental Risk Assessment on Ingredients of Household Cleaning Products (HERA), Avenue Herrmann Debroux ISA, B-1160 Brussels Belgium. Edition 1.0 November 2009. Esterquats Human Health Risk Assessment Report. <http://www.heraproject.com/files/17-HH-HERA-EQ-HH-TM-finalDraft-24Nov%20web.pdf>. Accessed 2011, July 27.

Madsen T, Boyd HB, Nylén D, Pederson AR & Simonsen F (2001). Environmental Project No. 615; Environmental and Health Assessment of Substances in Household Detergents and Cosmetic Detergent Products. CETOX, Miljøprojekt, pp 201. <http://www2.mst.dk/udgiv/publications/2001/87-7944-596-9/pdf/87-7944-597-7.pdf.>. Accessed 2011, Jul 27.

NOHSC (1994) National Code of Practice for the Labelling of Workplace Substances [NOHSC:2012(1994)]. National Occupational Health and Safety Commission, Canberra, Australian Government Publishing Service.

NOHSC (2003) National Code of Practice for the Preparation of Material Safety Data Sheets, 2nd edition [NOHSC:2011(2003)]. National Occupational Health and Safety Commission, Canberra, Australian Government Publishing Service.

NOHSC (2004) Approved Criteria for Classifying Hazardous Substances, 3rd edition [NOHSC:1008(2004)]. National Occupational Health and Safety Commission, Canberra, AusInfo.

NOTOX (1994a) Assessment of Acute Oral Toxicity with the Notified Chemical in the Rat (Study Project Number: 119104, 05 July 1994) NOTOX B.V., 's-Hertogenbosch, Netherlands. (Unpublished report provided by the notifier).

NOTOX (1994b) Primary Skin Irritation/Corrosion Study with the Notified Chemical in the Rabbit (4-hour Semi-Occlusive Application) (Study Project Number: 119115, 23 June 1994) NOTOX B.V., 's-Hertogenbosch, Netherlands. (Unpublished report provided by the notifier).

NOTOX (1994c) Acute Eye Irritation/Corrosion Study with the Notified Chemical in the Rabbit (Study Project Number: 119126, 23 June 1994) NOTOX B.V., 's-Hertogenbosch, Netherlands. (Unpublished report provided by the notifier).

NOTOX (1994d) Assessment of Contact Hypersensitivity to the Notified Chemical in the Albino Guinea Pig (Maximisation-Test) (Study Project Number: 119137, 07 July 1994) NOTOX B.V., 's-Hertogenbosch, Netherlands. (Unpublished report provided by the notifier).

NOTOX (1994e) Evaluation of the Mutagenic Activity of the Notified Chemical in the Ames Salmonella/Microsome Test (with Independent Repeat) (Study Project Number: 119148, 07 July 1994) NOTOX B.V., 's-Hertogenbosch, Netherlands. (Unpublished report provided by the notifier).

NTC (National Transport Commission) 2007 Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG code), 7th Edition, Commonwealth of Australia

SCCS (2010) The SCCS's Notes of Guidance for the Testing of Cosmetic Ingredients and Their Safety Evaluation, 7th Revision. Adopted by the Scientific Committee on Consumer Safety (SCCS) during the 9th plenary meeting of 14 December 2010.

United Nations (2009) Globally Harmonised System of Classification and Labelling of Chemicals (GHS), 3rd revised edition. United Nations Economic Commission for Europe (UN/ECE), <http://www.unece.org/trans/danger/publi/ghs/ghs_rev03/03files_e.html >.

US EPA (2011) Estimation Programs Interface Suite™ for Microsoft® Windows, v 4.00. United States Environmental Protection Agency. Washington, DC, USA, <http://www.epa.gov/oppt/exposure/pubs/episuite.htm >. Accessed 2011, June 27.