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NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME (NICNAS)

PUBLIC REPORT

Ebecryl 40

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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SUMMARY

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

ASSESSMENT REFERENCE	APPLICANT(S)	CHEMICAL OR TRADE NAME	HAZARDOUS CHEMICAL	INTRODUCTION VOLUME	USE
STD/1478	Flint Group Australia Pty Ltd & Allnex Australia Pty Ltd	Ebercyl 40	Yes	< 30 tonnes per annum	Component of ink products

CONCLUSIONS AND REGULATORY OBLIGATIONS

Hazard classification
Based on the available information, the notified polymer is recommended for hazard classification according to the *Globally Harmonised System for the Classification and Labelling of Chemicals (GHS),* as adopted for industrial chemicals in Australia. The recommended hazard classification is presented in the table below.

Hazard classification	*Hazard statement*
Skin Sensitisation – Category 1	H317 – May cause an allergic skin reaction
Eye Irritation – Category 2A	H319 - May cause serious eye irritation

Based on the available information, the notified polymer is recommended for hazard classification according to the *Approved Criteria for Classifying Hazardous Substances* (NOHSC, 2004) with the following risk phrase:

R36: Irritating to eyes.
R43: May cause sensitisation by skin contact.

The environmental hazard classification according to the *Globally Harmonised System for the Classification and Labelling of Chemicals* (GHS) is presented below. Environmental classification under the GHS is not mandated in Australia and carries no legal status but is presented for information purposes.

Hazard classification	*Hazard statement*
Acute (Category 3)	H402 - Harmful to aquatic life

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

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

Environmental risk assessment
On the basis of the PEC/PNEC ratio and the reported use pattern, the notified polymer is not considered to pose a risk to the environment.

Recommendations

REGULATORY CONTROLS
Hazard Classification and Labelling

- The notified polymer should be classified as follows:

  H317 – May cause an allergic skin reaction
  H319 – May cause serious eye irritation

- The following should be used for products/mixtures containing the notified chemicals:
  - Conc. ≥ 10%: H317, H319
  - ≥ 1% Conc. < 10%: H317

Health Surveillance

- As the notified polymer is a skin sensitiser, employers should carry out health surveillance for any worker who has been identified in the workplace risk assessment as having a significant risk of skin sensitisation.

(Material) Safety Data Sheet

- The (M)SDS for the notified polymer and products containing the notified polymer should reflect the hazards associated with the notified polymer, as noted above.

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CONTROL MEASURES

Occupational Health and Safety

- A person conducting a business or undertaking at a workplace should implement the following engineering controls to minimise occupational exposure to the notified polymer:
  - Ventilation system including local exhaust ventilation
  - Use of enclosed, automated processes, where possible

- A person conducting a business or undertaking at a workplace should implement the following safe work practices to minimise occupational exposure during handling of the notified polymer:
  - Avoid contact with eyes and skin
  - Avoid inhalation
  - Clean up any spills or soiled personal protective equipment promptly

- A person conducting a business or undertaking at a workplace should ensure that the following personal protective equipment is used by workers to minimise occupational exposure to the notified polymer:
  - impervious gloves
  - goggles
  - protective clothing
  - respiratory protection, if 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 (M)SDS should be easily accessible to employees.

- If products and mixtures containing the notified polymer are classified as hazardous to health in accordance with the *Globally Harmonised System for the Classification and Labelling of Chemicals (GHS)* as adopted for industrial chemicals in Australia, workplace practices and control procedures consistent with provisions of State and Territory hazardous substances legislation should be in operation.

Disposal

- The notified polymer should be disposed of to landfill.

Storage

- The handling and storage of the notified polymer should be in accordance with the Safe Work Australia Code of Practice for *Managing Risks of Hazardous Chemicals in the Workplace* (SWA, 2012b) or relevant State or Territory Code of Practice.

Emergency procedures

- Spills or accidental release of the notified polymer 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 polymer, have post-assessment regulatory obligations to notify NICNAS when any of these circumstances change. These obligations apply even when the notified polymer 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 polymer has changed from use in industrial printing inks or is likely to change significantly;
- the amount of polymer being introduced has increased, or is likely to increase, significantly;
- the polymer has begun to be manufactured in Australia;
- additional information has become available to the person as to an adverse effect of the polymer 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 (M)SDS of the notified polymer provided by the notifier was reviewed by NICNAS. The accuracy of the information on the (M)SDS remains the responsibility of the applicant.

ASSESSMENT DETAILS

1. APPLICANT AND NOTIFICATION DETAILS

APPLICANT(S)
Flint Group Australia Pty Ltd (ABN: 37 098 105 901)
25-51 Berends Drive
DANDENONG VIC 3175

Allnex Australia Pty Ltd (ABN: 24 160 397 768)
Level 12, 680 George Street,
SYDNEY NSW 2000

NOTIFICATION CATEGORY
Standard: Synthetic polymer with Mn < 1000 Da (more than 1 tonne per year).

EXEMPT INFORMATION (SECTION 75 OF THE ACT)
Data items and details claimed exempt from publication: chemical name, other names, CAS number, molecular and structural formulae, molecular weight, analytical data, degree of purity, polymer constituents, residual monomers, impurities, additives/adjuvants, use details, import volume, and analogue data.

VARIATION OF DATA REQUIREMENTS (SECTION 24 OF THE ACT)
Variation to the schedule of data requirements is claimed as follows: all physiochemical endpoints except for melting point and water solubility, acute dermal toxicity, acute inhalation toxicity, skin sensitisation, repeat dose toxicity and all ecotoxicity and environmental endpoints.

PREVIOUS NOTIFICATION IN AUSTRALIA BY APPLICANT(S)
None

NOTIFICATION IN OTHER COUNTRIES
None

2. IDENTITY OF CHEMICAL

MARKETING NAME(S)
Ebecryl 40 radiation curing resins

MOLECULAR WEIGHT
Number average molecular weight, Mn < 500 Da

ANALYTICAL DATA
Reference NMR, MS, FTIR and UV spectra data were provided.

3. COMPOSITION

DEGREE OF PURITY > 99%

4. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AT 20 ºC AND 101.3 kPa: Clear pale yellow liquid

Property	Value	Data Source/Justification
Melting Point/Freezing Point	- 64 °C	Measured by DSC
Boiling Point	> 100 °C at 101.3 kPa	SDS
Density	1,150 kg/m^3 at 20 °C	SDS
Vapour Pressure	1.33 x 10^{-1} kPa at 20 °C	SDS
Water Solubility	Not determined	Observed to be dispersible based on test results
Hydrolysis as a Function of pH	Not determined	The notified polymer contains hydrolysable functionalities. However, no significant hydrolysis is expected to occur under normal environmental conditions (pH 4-9).
Partition Coefficient (n-octanol/water)	log Pow = - 1.13 to – 0.45 at 25 °C	Calculated (KOWWIN v1.68; US EPA, 2011)
Adsorption/Desorption	log K_{oc} = - 0.88 to – 0.09 at 25 °C	Calculated (KOCWIN v2.00, US EPA 2011)
Dissociation Constant	Not determined	No dissociable functionality
Particle Size	Not determined	Liquid
Flash Point	> 100 °C at 101 kPa	SDS
Flammability	Not determined	Not expected to be flammable based on flash point.
Autoignition Temperature	Not determined	Not expected to undergo autoignition.
Explosive Properties	Not determined	Not expected to have explosive properties based on lack of structural alerts.
Oxidising Properties	Not determined	Not expected to have oxidising properties.

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

Reactivity
The notified polymer may undergo crosslinking in the presence of UV light or initiators.

Physical hazard classification
Based on the submitted physico-chemical data depicted in the above table, the notified polymer is not recommended for hazard classification according to the *Globally Harmonised System for the Classification and Labelling of Chemicals (GHS),* as adopted for industrial chemicals in Australia.

5. INTRODUCTION AND USE INFORMATION

MODE OF INTRODUCTION OF NOTIFIED CHEMICAL (100%) OVER NEXT 5 YEARS
The notified polymer will be imported into Australia, as the neat liquid (> 99% concentration) or as a component of a formulated product (40% concentration) for local reformulation of inks, or as a component of finished inks (< 20% concentration).

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

Year	*1*	*2*	*3*	*4*	*5*
Tonnes	< 30	< 30	< 30	< 30	< 30

PORT OF ENTRY
Sydney and Melbourne.

TRANSPORTATION AND PACKAGING
The notified polymer will be imported in 205 L drums until required for printing application. The finished inks (containing up to 20% of the notified polymer) will be imported in 5 kg bottles or 10 kg plastic buckets and will be transported from port of entry to notifiers' warehouse facilities by road.

USE
The notified polymer will be used as an additive in UV/EB cured ink products for flexographic and lithographic printing.

OPERATION DESCRIPTION
Reformulation
The notified polymer may be imported neat or as a component of a product at 40% concentration for reformulation into ink products locally. This will involve typical liquid blending process. The imported containers will be opened and hose and pumping equipment will be attached to the container. The required amount of the notified polymer will be dosed into a closed blending tank. When blending is complete, a sample will be taken from a sampling port by QA staff for testing. The finished ink product containing the notified polymer at up to 20% concentration will then be pumped to a filling machine and the ink filled into ink containers. These will then be distributed to the end users.

End use
The printing processes are largely automated, though some parts require manual assistance. Ink bottles will be manually connected to the printing machine via an inlet and attached to a flexible tube which supplies the ink head. Inks will be automatically injected into printing machines.

While printers are running, printer operators monitor the operation and keep the substrate feeder stocked and attend to substrate jams. Any residual ink within printing equipment will be removed using cleaning rags and solvents. After printing, the notified polymer will be cured (UV or EB) with other ink ingredients onto the substrate matrix.

6. HUMAN HEALTH IMPLICATIONS

6.1. Exposure Assessment

6.1.1. Occupational Exposure

CATEGORY OF WORKERS

Category of Worker	*Exposure Duration (hours/day)*	*Exposure Frequency (days/year)*
Transport and Storage	4 - 8	50
Blending operators	8	12-24
Quality control/chemist and technical service	0.5 - 6	25
Printer operators	1 - 2	25
Service technicians	8	200
Wholesale printer supplies	8	200

EXPOSURE DETAILS

Transport and storage workers are unlikely to be exposed to the notified polymer (at concentrations up to 100%) except in the unlikely event of an accident where its packaging may be breached.

Reformulation will be largely enclosed and automated; however workers may be exposed (dermal, ocular and inhalation) to the notified polymer at up to 100% concentration when connecting and disconnecting transfer hoses and during quality control testing. Dermal and ocular exposure to workers should be mitigated through the use of personal protective equipment (PPE) including protective coveralls, impervious gloves and goggles. Inhalation exposure should be minimised through the use of local exhaust ventilation and respirators when opening the import containers and connecting/disconnecting hoses.

The printing process will be largely enclosed and automated; however workers (printing operators and service technicians) may be exposed (dermal, ocular and perhaps inhalation) to the notified polymer at up to 20% concentration during manual connection of ink bottles to the printing machine, replacement of ink bottles, colour matching processes, quality control operations, and maintenance and service tasks.

Once the inks are cured and dried, the notified polymer will be bound within a polymer matrix and will not be bioavailable.

Dermal and ocular exposure to workers should be mitigated through the use of PPE including protective coveralls, impervious gloves and goggles. Inhalation exposure should be minimised by the use of local exhaust ventilation in areas around the printing machines.

6.2. Human Health Effects Assessment

The results from toxicological investigations conducted on the notified polymer are summarised in the following table. For full details of the studies, refer to Appendix B.

Endpoint	*Result and Assessment Conclusion*
Rat, acute oral toxicity	LD50 > 2000 mg/kg bw; low toxicity
Rabbit, skin irritation	non-irritating
Rabbit, eye irritation	irritating
Mutagenicity – bacterial reverse mutation	non-mutagenic
Genotoxicity – in vivo Micronucleus Test	non-genotoxic

Additional information on the expected health effects of the notified polymer is based on analogues of the notified polymer (Analogue 1 and 2).

Analogues 1 and 2 have a similar structure to the notified polymer however they are of lower molecular weight and are expected to have a lower water solubility that is expected to result in higher absorption across biological membranes. Thus, the systemic toxicity in mammals for Analogue 1 and 2 is expected to represent a worst case estimate for the notified polymer. Analogues 1 and 2 are therefore considered acceptable analogues for the notified polymer.

The results from toxicological investigations of Analogues 1 and 2 are summarised in the following table.

Endpoint	*Result and Assessment Conclusion*
Rabbit, acute dermal toxicity	LD50 > 2000 mg/kg bw; low toxicity
Rat, acute inhalation toxicity	ALC* Between 0.0081 and 0.1028 mg/L 4 hour; toxic
Mouse, skin sensitisation – Local lymph node assay and mouse ear swelling test	Evidence of sensitisation
Rat, combined repeat dose gavage toxicity – 28 days and	75 mg/kg bw/day NOAEL
reproductive and developmental toxicity#	200 mg/kg bw/day NOAEL

*ALC – Approximate lethal concentration
Analogue 1 data (remaining endpoints were performed using Analogue 2)

Toxicokinetics
The notified polymer is of low molecular weight (< 500 Da) therefore absorption across biological membranes may occur. Dermal absorption, however, may be limited given the expected low partition coefficient (log Pow (calculated) = - 1.13 to – 0.45 at 25 °C).

Acute toxicity.
The notified polymer was shown to have low acute oral toxicity in rats. Based on a study conducted on Analogue 2, the notified polymer is also expected to be of low acute dermal toxicity.

Analogue 2 data was shown to be very toxic in an acute inhalation toxicity study with an approximate lethal concentration (ALC) between 0.0081 and 0.1028 mg/L 4 hour exposure. However, the quality of the study is questionable. The study was non-GLP and was not conducted to OECD test guidelines. The study was conducted on the vapour of Analogue 2 that was formed by heating to 150 °C in a stream of air that may have caused the formation of decomposition products. Indeed there was a significant difference between the nominal and analytical concentrations of the test substance in the test chambers. Furthermore, the specific cause of animal deaths could not be assigned by the study authors as no gross or microscopic alterations attributable to inhalation of the test material were observed and they advised that further experimental work should be performed. In addition, Analogue 2 is not classified as toxic by the inhalation route under HSIS and ECHA's CLP. Therefore, based on the results of this study with Analogue 2, the acute inhalation toxicity of the notified polymer cannot be determined with certainty.

Because of the difference in nominal and actual test substance concentrations and the inability to assign a specific cause for the animal deaths, the authors recommend further experimental work.

Irritation and sensitisation.
The notified polymer was non-irritating to the skin of rabbits. In two eye irritation studies, the notified polymer was irritating to the eyes of rabbits.

The skin sensitisation potential of Analogue 2 was evaluated using the mouse ear swelling test and local lymph node assay (LLNA) (NTP, 2005). In the mouse ear swelling test, significant increases in percent ear swelling as compared to the control was observed at a test concentration of 0.045%. In the LLNA assay, a stimulation index of greater than 3 was observed at a concentration of 0.025%. The results from both assays therefore suggest that Analogue 2 is a sensitiser. Therefore, by inference, the notified polymer has the potential to be a skin sensitiser.

Repeated Dose Toxicity.
In a 28-day combined repeated dose toxicity and reproduction/developmental toxicity study in rats, Analogue 2 was administered by oral gavage at doses of 25, 75 or 200 mg/kg bw/day.

Two males in the 75 mg/kg/day group and 2 males and 3 females in the 200 mg/kg/day group were found dead or euthanized *in extremis*. However, the deaths were attributed by the study authors to test substance administration.

The No Observed (Adverse) Effect Level (NO(A)EL) was established as 75 mg/kg bw/day for general systemic toxicity based on test-substance related lower mean body weight gains during the overall study for the 200 mg/kg bw/day males as well as a lower mean body weight on study day 27. Adverse effects relating to

mortality/morbidity, adrenal gland weights, neutrophil counts, macroscopic and/or microscopic findings of the stomach, adrenal cortex and thymus were attributed by the study authors to the irritative properties of the test substance and corresponding stress, rather than systemic toxicity.

No test substance related effects were observed for reproductive performance at any dose level. No effects on the general physical condition of the F1 pups were observed. Therefore the NOAEL was established as 200 mg/kg bw/day for reproductive and developmental toxicity based on no adverse effects at the maximum dose tested.

Mutagenicity/Genotoxicity.
The notified polymer was negative in a bacterial reverse mutation assay and negative in an *in vivo* mouse micronucleus test. Based on these studies, the notified polymer is not expected to be genotoxic.

Health hazard classification
Based on the available information, the notified polymer is recommended for hazard classification according to the *Globally Harmonised System for the Classification and Labelling of Chemicals (GHS),* as adopted for industrial chemicals in Australia. The recommended hazard classification is presented in the following table.

Hazard classification	*Hazard statement*
Skin Sensitisation – Category 1	H317 – May cause an allergic skin reaction
Eye Irritation – Category 2A	H319 - May cause serious eye irritation

Based on the available information, the notified polymer is recommended for hazard classification according to the *Approved Criteria for Classifying Hazardous Substances* (NOHSC, 2004), with the following risk phrase(s):

R36: Irritating to eyes.
R43: May cause sensitisation by skin contact.

6.3. Human Health Risk Characterisation

6.3.1. Occupational Health and Safety
Based on the available information the notified polymer is an eye irritant and has the potential to cause skin sensitisation. Toxicity by inhalation cannot be ruled out. There is also potential for systemic toxicity from repeated exposure, although dermal absorption is expected to be limited given the low partition coefficient.

Reformulation
Reformulation workers may be at risk of adverse effects when handling the notified polymer at up to 100% concentration, in particular during transfer operations. However, the risk is expected to be minimised by the use of largely enclosed and automated processes, exhaust ventilation and use of appropriate PPE including coveralls, impervious gloves, eye protection and respiratory protection.

Provided the stated control measures are in place to limit exposure, the risk to the health of reformulation workers is not considered to be unreasonable.

End-use
Printer operators and service technicians may be at risk of adverse effects when handling the notified polymer at up to 20% concentration in ink products during printer operations. However, the risk is expected to be minimised by the use of automated printing processes, exhaust ventilation and use of appropriate PPE, including coveralls, impervious gloves, eye protection and respiratory protection, if ventilation is inadequate.

Provided the stated control measures are in place to limit exposure, the risk to workers involved in printing operations is not considered to be unreasonable.

6.3.2. Public Health
The ink products containing the notified polymer will not be sold to the public. The public may have contact with the dried printed materials. However, once cured, the notified polymer will be bound within a polymer matrix and will not be bioavailable. Hence, public exposure to the notified polymer is not expected, and the risk to health of the public 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 polymer will not be manufactured within Australia. However, the notified polymer will be imported to Australia as a raw material for local reformulation of inks. During reformulation, spills and leaks are expected to be collected using suitable absorbent materials and placed in closed containers for disposal to landfill. The notified polymer is not expected to be released to sewers during reformulation. Empty containers are likely to be disposed of to landfill. Residues in the empty containers and waste water from equipment washings are expected to be collected and disposed of to waste facility.

RELEASE OF CHEMICAL FROM USE

The majority of the release of the notified polymer to the environment from use will be from ink spills, wash-downs of printing equipment and from disposal of empty containers containing residual ink. The notified polymer is UV-cured (chemically reacted) and it is expected to be stable within an inert matrix on printed substrate once it is cured. A maximum of 3% of ink was estimated by the notifier to be released to sewer from equipment washing and ink colour matching.

RELEASE OF CHEMICAL FROM DISPOSAL

The notified polymer (up to 80% of the total import volume) in ink is expected to be used for printing on vinyl, canvas and plastic packaging. The notified polymer is expected to share the fate of the printed articles which are expected to be disposed of to landfill. Up to 20% of the total import volume of the notified polymer in ink will be used for paper printing and 50% of the printed papers are expected to be recycled. Hence, 10% of the total import volume of the notified polymer may be released to sewers. Empty containers containing residues of the notified polymer (up to 1% of the total import volume) are expected to be disposed of to landfill.
Hence, the majority of the total import volume of the notified polymer is expected to be disposed of to landfill with a potential for some release to sewer.

7.1.2. Environmental Fate

For the details of the environmental fate studies please refer to Appendix C. A fate study provided for an analogue of the notified polymer indicated that the analogue substance is readily biodegradable. The analogue substance is considered to be acceptable with respect to biodegradation due to the similar structure. Therefore, the notified polymer is likely to be readily biodegradable and is not expected to persist in the environment.

Approximately half of the paper to which the ink containing the notified polymer is applied to is likely to be recycled. During recycling processes, waste paper is repulped using a variety of chemical agents which, amongst other things, enhance detachment of ink from the fibres. However, the notified polymer is UV/EB cured (chemically reacted) into the ink matrix and is unlikely to be released into the supernatant waters during recycling processes. The majority of the cured notified polymer is anticipated to sorb to sludge and sediment where it is expected to degrade biotically and abiotically. The notified polymer is not expected to have a potential for bioaccumulation as its calculated log Pow values are low. Notified polymer applied to substrates will be UV/EB cured (chemically reacted) and is not expected to be bioavailable. The majority of the cured notified polymer is expected to be disposed of to landfill where it is anticipated to degrade by biotic and abiotic processes to form water and oxides of carbon.

7.1.3. Predicted Environmental Concentration (PEC)

The calculation for the Predicted Environmental Concentration (PEC) is summarised in the table below. Based on the reported use in printing, it is conservatively assumed that 50 % of the total import volume of polymer is released to sewer over 260 days per annum corresponding to release only on working days. It was also assumed for the worst case scenario that there is no removal of the notified polymer during sewage treatment plant (STP) processes.

Predicted Environmental Concentration (PEC) for the Aquatic Compartment			
Total Annual Import/Manufactured Volume	30,000		kg/year
Proportion expected to be released to sewer	50 %		
Annual quantity of chemical released to sewer		15,000	kg/year
Days per year where release occurs	260		days/year
Daily chemical release:	57.69		kg/day
Water use	200		L/person/day
Population of Australia (Millions)	22.613		million
Removal within STP	0 %		
Daily effluent production:	4,523		ML
Dilution Factor - River	1.0		
Dilution Factor - Ocean	10.0		
PEC - River:	12.76		µg/L
PEC - Ocean:	1.28		µg/L

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 polymer 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 12.8 µg/L may potentially result in a soil concentration of approximately 85.0 µg/kg. Assuming accumulation of the notified polymer in soil for 5 and 10 years under repeated irrigation, the concentration of notified polymer in the applied soil in 5 and 10 years may be approximately 425.2 µg/kg and 850.4 µg/kg, respectively.

7.2. Environmental Effects Assessment

No ecotoxicological data were submitted for the notified polymer. The results from ecotoxicological investigations conducted on an analogue substance are summarised in the table below. Details of the studies can be found in Appendix C.

The analogue substance is used as read across to the notified polymer due to its similar structure. The difference between the analogue substance and the notified polymer being the water solubility. The notified polymer is more soluble in water, and hence it is expected to have lower toxicity to aquatic species than the analogue. Hence, the analogue is expected to conservatively represent the ecotoxicological properties of the notified polymer. The results are summarised in the table below.

The ecotoxicity endpoints were compared with those calculated by ECOSAR v1.00 (US EPA 2011) using the class specific to the notified polymer, and are tabulated below. The notified polymer was within the domain of the ECOSAR class utilised.

Endpoint	*Result*	*Assessment Conclusion*
Acute – Analogue data		
Fish (96 h)	LC50 = 3.0 mg/L (WAF)*	Toxic to fish
Daphnia (48 h)	EC50 = 13.0 mg/L (WAF)*	Harmful to aquatic invertebrates
Algae (96 h)	E_rC50 = 12 mg/L (WAF)*	Harmful to algae
ECOSAR (v1.00) data for the notified polymer		
Acute		
Fish (96 h)	LC50 = 71.5 mg/L	Harmful to fish
Daphnia (48 h)	LC50 = 340.1 mg/L	Not harmful to aquatic invertebrates
Algae (96 h)	EC50 = 17.3 mg/L	Harmful to algae
Chronic		
Fish (96 h)	ChV (30 d) = 18.9 mg/L	Not harmful to fish with no long lasting effects
Daphnia (48 h)	ChV = 52.6 mg/L	Not harmful to aquatic invertebrates with no long lasting effects
Algae (72 h)	ChV = 7.9 mg/L	Not harmful to algae with no long lasting effects

* Water accommodated fraction

The notified polymer belongs to a group of chemicals with demonstrated acute and chronic aquatic toxicity. ECOSAR is deemed reliable for providing an indication of ecotoxicity for this polymer. The calculated data determined for the notified polymer are considered to be more indicative of the acute toxicity of the notified polymer than simple read-across from measured analogue data.

On the basis of acute toxicity data of the notified polymer predicted by ECOSAR, the notified polymer is expected to be harmful to fish and algae, but not harmful to aquatic invertebrates. Therefore, under the Globally Harmonised System of Classification and Labelling of Chemicals (GHS; United Nations, 2009), the notified polymer is formally classified as Acute Category 3; Harmful to aquatic life.

As the notified polymer belongs to a group of chemicals that have a demonstrated chronic toxicity to aquatic organisms, endpoints were calculated by ECOSAR and used to provide representative chronic endpoints in the absence of measured data on the notified polymer. The chronic ecotoxicological endpoints calculated by ECOSAR were utilised to determine the GHS rating.

The GHS classifications for long-term hazard are based on NOEC (or equivalent EC*x*) endpoints, whereas the available endpoints are chronic values [ChV = (LOEC × NOEC)^{½}], i.e. the geometric mean of the LOEC and NOEC. Since the LOEC is by definition greater than the NOEC it follows that, for each endpoint, the NOEC must be less than the ChV. Under the GHS the notified polymer is considered to be chronically not harmful to any of the species tested with no long lasting effects. Therefore, based on its predicted chronic toxicities and expected rapid degradability, the notified polymer has not been formally classified for chronic hazard under the GHS.

7.2.1. Predicted No-Effect Concentration

The predicted no-effect concentration (PNEC) for the notified polymer has been calculated and is presented in the table below. For risk assessment purposes, the PNEC is calculated based on the endpoint for the most sensitive species (daphnia, EC50) for the analogue. The ecotoxicity endpoints of the analogue are expected to be more toxic than those of the notified polymer. Hence, an assessment factor of 100 has been used since endpoints for three trophic levels are available for a conservative analogue substance.

Predicted No-Effect Concentration (PNEC) for the Aquatic Compartment

EC50 (Invertebrates).	3.0	mg/L
Assessment Factor	100	
PNEC:	30	µg/L

7.3. Environmental Risk Assessment

Risk Assessment	***PEC µg/L***	***PNEC µg/L***	***Q***
Q - River:	12.76	30	0.43
Q - Ocean:	1.28	30	0.04

The risk quotient (Q = PEC/PNEC) for aquatic exposure is calculated to be < 1 based on the above calculated PEC and PNEC values. Therefore, the notified polymer is unlikely to result in ecotoxicologically significant concentrations in the aquatic environment. The notified polymer is expected to be readily biodegradable, thus it is unlikely to persist in surface waters or soils. The notified polymer is considered to have low potential for bioaccumulation. Therefore, the notified polymer is not expected to pose an unreasonable risk to the aquatic environment from the assessed use pattern.

APPENDIX A: PHYSICAL AND CHEMICAL PROPERTIES

Water Solubility Dispersible

Method	In house
Remarks	The test substance, notified polymer, (100 mL) was mixed with 1 L of distilled water. The test substance and water was mixed using a magnetic stirrer for 24 hours at a constant temperature, and allowed to stand for 2 hours. The mixture of water and test substance appeared as a milky white suspension after the 2 hour period of standing. The 2 h cut-off time limit was insufficient to obtain a full separation of two phases (the test substance and water). Hence, the test substance had some affinity to water and formed a dispersion. However, the two phases did not combine into one clear solution; therefore, the test substance is not readily soluble in water.
Test Facility	Cleymans (Undated)

APPENDIX B: TOXICOLOGICAL INVESTIGATIONS

B.1. Acute toxicity – oral

TEST SUBSTANCE: Notified polymer

METHOD: EC Council Regulation No 440/2008 B.1 bis Acute toxicity (oral) fixed dose method.

Species/Strain	Rat/Sprague-Dawley
Vehicle	None
Remarks - Method	No significant protocol deviations

RESULTS

Group	*Number and Sex of Animals*	*Dose mg/kg bw*	*Mortality*
I	5F/5M	2000	0/10

LD50	> 2000 mg/kg bw
Signs of Toxicity	Piloerection was observed in all rats within five minutes of dosing, accompanied at this time in all animals by walking on toes and increased salivation. In addition, the hunched posture, waddling/unsteady gait, lethargy, pallid extremities, soft to liquid faeces and ungroomed appearance were seen in all rats at later intervals during the study. There were no other clinical signs and recovery was complete in all animals at Day 6.
Effects in Organs	Macroscopic examination of animals euthanized on Day 15 revealed no abnormalities.

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

TEST FACILITY: Huntingdon (1998a)

B.2. Acute toxicity – dermal

TEST SUBSTANCE: Analogue 2

METHOD: In-house method.

Species/Strain	Rabbit/Albino
Vehicle	None
Type of dressing	Details not provided.
Remarks - Method	No GLP certifications were provided with the study. The test substance was applied to abraded (1M/1F) and unabraded (1M/1F) sites.

RESULTS

Group	*Number and Sex of Animals*	*Dose mg/kg bw*	*Mortality*
I	2F/2M	2000	0/4

LD50	> 2000 mg/kg bw
Signs of Toxicity - Local	The test material was severely irritating to the skin of the animals. Skin changes at 24 hours were characterised by pale red to red, well-defined erythema, moderate to severe edema, second degree burns and subdermal hemorrhages. Pale red to red, well defined erythema, second degree burns, escharosis, wrinkling and fissuring were noted at 7 days.

	Escharosis was observed at 14 days.
Signs of Toxicity - Systemic	Not provided.
Effects in Organs	Necropsy examination revealed mottled kidneys in 1 male and both females. No other gross pathologic alterations were noted expected for the local skin changes.
CONCLUSION	Analogue 2 is of low toxicity via the dermal route.
TEST FACILITY	BIO-TEST (1976)

B.3. Acute toxicity – inhalation

TEST SUBSTANCE	Analogue 2
METHOD	Similar to OECD guidelines. No GLP certifications were provided with the study.
Species/Strain	Rat/ChR-CD male.
Vehicle	None
Method of Exposure	Whole-body exposure.
Exposure Period	4 hours/day for 10 days.
Physical Form	Vapour.
Remarks - Method	The method involved determining the approximate lethal concentration (ALC), by measuring mortality with a four point concentration assay. The vapour for this method was produced by heating the test substance to 150 ºC.

RESULTS

Group	*Number and Sex of Animals*	*Concentration <mg/L>*		*Mortality**
		Nominal	*Actual*	
I	6M	1.62	0.1661	6/6
II	6M	0.62	0.1028	6/6
III	6M	0.43	ND	2/6
IV	6M	0.06	0.0081	0/6
V	6M	0.099	ND	0/6
VI	6M	Control		0/6

* Mortalities occurred within 18 hours.

ALC	Between 0.0081 and 0.1028 mg/L
LC50	Not determined for this study.
Signs of Toxicity	Group I and II symptoms included inactivity, gasping, salivation, hypermia, face-pawing, pallor, and severe weight loss. Group I and II animals all died within 18 hours post-exposure. Group III symptoms included inactivity, laboured and irregular respiration and severe weight loss. Group IV symptoms included mild weight loss, inactivity, shallow respiration and hypermia. Group V symptoms included inactivity, mild hypermia and shallow respiration. No symptoms were observed for the control group.
Effects in Organs	No gross or microscopic alterations attributable to inhalation of the test material were observed.
Remarks - Results	Because of the difference in nominal and actual test substance concentrations and the inability to assign a specific cause for the animal deaths, the authors recommend further experimental work. Furthermore, the method for formation of the test substance vapour may have caused the formation of decomposition products.
CONCLUSION	The results of this study are inconclusive as to the inhalation toxicity of

Analogue 2

TEST FACILITY Haskell (1974)

B.4. Irritation – skin

TEST SUBSTANCE Notified polymer

METHOD EC Directive 84/449/EEC B.4 Acute Toxicity (Skin Irritation).
Species/Strain Rabbit/New Zealand White
Number of Animals 3
Vehicle None
Observation Period 72 hours
Type of Dressing Semi-occlusive.
Remarks - Method No significant protocol deviations

RESULTS
Remarks - Results No skin irritation was reported for any animal at any time point.

CONCLUSION The notified polymer is non-irritating to the skin.

TEST FACILITY Huntingdon (1992)

B.5. Irritation – skin

TEST SUBSTANCE Notified polymer

METHOD OECD TG 404 Acute Dermal Irritation/Corrosion.
EC Commission Directive 92/69/EEC B.4 Acute Toxicity (Skin Irritation).
Species/Strain Rabbit/New Zealand White
Number of Animals 3
Vehicle None
Observation Period 72 hours
Type of Dressing Semi-occlusive.
Remarks - Method Unintentionally 2 animals were observed at 69 hours rather than 72 hours.

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	0	0	0.7	0	< 72 h	0
Oedema	0	0	0	0	-	-

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

Remarks - Results Very slight erythema in the treated skin areas of two rabbits. The skin irritation had resolved within 24 or 69 hours after exposure. There was no evidence of a corrosive effect or staining of the skin. No symptoms of systemic toxicity were observed and no mortality occurred.

CONCLUSION The notified polymer is non-irritating to the skin.

TEST FACILITY NOTOX (2004a)

B.6. Irritation – eye

TEST SUBSTANCE Notified polymer

METHOD EC Directive 92/69/EC B.5 Acute Toxicity (Eye Irritation).

Species/Strain	Rabbit/New Zealand White
Number of Animals	3
Observation Period	14 days
Remarks - Method	No significant protocol deviation. Observations were made 1, 24, 48 and 72 hours and 4, 7 and 14 days after instillation.

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	2.3	3	3	3	< 14 days	0
Conjunctiva: chemosis	2.3	3.7	3	4	< 14 days	0
Corneal opacity	1.7	2.7	3	4	< 14 days	0
Iridial inflammation	0	0.7	0	2	< 7 days	0

*Calculated on the basis of the scores at 24, 48, and 72 hours for EACH animal.
Animal 3 euthanized on day 4, therefore not used to determine maximum value at End of Observation Period

Remarks - Results	Corneal opacities developed in all three animals. Iridial inflammation was seen in two animals and in one of the animals grade 2 iridial damage was seen. A crimson or beefy red colouration of the conjuctivae was seen in all three animals, accompanied by swelling with the eyelids about half closed or more than half closed. One animal was anesthetised four days after instillation due to severity of the reactions. The eyes were normal in two animals 14 days after instillation
CONCLUSION	The notified polymer is irritating to the eye.
TEST FACILITY	Huntingdon (1998b)

B.7. Irritation – eye

TEST SUBSTANCE	Notified polymer
METHOD	OECD TG 405 Acute Eye Irritation/Corrosion. EC commission Directive No 92/69/EEC B.5 Acute Toxicity (Eye Irritation). US EPA, OPPTS 870.2400, Acute Eye Irritation, (1998) and JMAFF guidelines
Species/Strain	Rabbit/New Zealand White (SPF quality)
Number of Animals	3
Observation Period	21 Days
Remarks - Method	No significant protocol deviation. Observations were made 1, 24, 48 and 72 hours and 7, 14 and 21 days after instillation.

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	3	3	3	3	< 21 days	0
Conjunctiva: chemosis	3.7	3.7	3.7	4	< 14 days	0

Conjunctiva: discharge	2	2.3	3	3	< 21 days	0
Corneal opacity	1	1	1	1	< 7 days	0
Iridial inflammation	0.7	0.3	0	1	< 7 days	0

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

Remarks - Results

The corneal injury consisted of opacity (maximum grade 1) and epithelial damage (maximum 35% and 50% cornea area). As a result of the corneal injury, pannus was apparent in two animals 7 days after instillation. The cornea injury had resolved with 7 days in one animal and 14 days in two animals. Iridial irritation grade 1 was observed had resolved within 7 days. The irritation of the conjunctivae consisted of redness, chemosis and discharge and had completely resolved within 21 days.

A bald area was noted around the left eye in all animals at 7 and 14 days after treatment.

No ocular corrosion was observed and no evidence of systemic toxicity during the test period and no mortality.

CONCLUSION

The notified polymer is irritating to the eye.

TEST FACILITY

NOTOX (2004b)

B.8. Repeat dose toxicity

TEST SUBSTANCE

Analogue 1

METHOD

OECD TG 422 Combined Repeated Dose Toxicity Study with the Reproduction/Developmental Toxicity Screening Test.

Species/Strain: Cr1:CD(SD)/rats
Route of Administration: Oral – gavage
Exposure Information: Total exposure days:
Males: 28 days commencing 2 weeks before pairing
Females: Two weeks before pairing then throughout pairing and gestation until Day 4 of lactation
Dose regimen: 7 days per week
Vehicle: Corn oil
Remarks - Method: No significant protocol deviations

RESULTS

Group	*Number and Sex of Animals*	*Dose mg/kg bw/day*	*Mortality*
control	12M/12F	0	0
low dose	12M/12F	25	0
mid dose	12M/12F	75	2M
high dose	12M/12F	200	2M/3F

Mortality and Time to Death

Two males in the 75 mg/kg/day group and 2 males and 3 females in the 200 mg/kg/day group were found dead or euthanized *in extremis*. The deaths were attributed to test substance administration.

Clinical Observations

Clinical findings were noted in a dose-related manner across all dosage levels and included: salivation, yellow and red material primarily around the mouth, and wiping of mouth in the bedding (females only). Incidences of rales were also noted in the 75 and 200 mg/kg/day group males and females sporadically during the treatment period. These findings were observed within 1 hour of administration and therefore not considered to be adverse, but attributed to the irritative properties of the test substance.

In the 200 mg/kg/day group males, lower mean body weight gains were noted when the overall pre-mating (study days 0-13) and treatment (study days 0-27) periods were evaluated; correspondingly lower mean food consumption was noted during the pre-mating period. As a result, mean male body weight in this group was 8.4% lower than the control group on study day 27. For the 75 mg/kg/day group males, slightly lower mean body weight gains were noted throughout treatment period, although not significant compared to control. Mean body weight gains were unaffected in the 25 mg/kg/day group males or in the 25, 75 and 200 mg/kg/day group females.

Parameters included to investigate the reproductive and developmental toxic potential of the test substance showed male and female mating and fertility, male copulation and female conception indices, mean number of days between pairing and coitus, gestation length and the process of parturition were unaffected by test substance administration at all doses. Administration of the test substance also showed that there were no clinical signs of adverse effects on the number of pups born, litter size, percentage of males at birth and mean pup body weights.

Laboratory Findings – Clinical Chemistry, Haematology, Urinalysis

Higher mean absolute neutrophil counts were noted for the 75 and 200 mg/kg/day group male and females.

No test substance-related clinical finding or macroscopic findings for pups that were found dead were noted at any dosage level

Effects in Organs

Stomach

In the 75 and 200 mg/kg/day group, test substance-related ulceration and associated inflammation, consistent with the increase in neutrophil count, and thickened non-glandular stomach. Test substance-related histopathological alterations included ulceration, epithelial hyperplasia and hyperkeratosis and/or chronic – active inflammation in the non-glandular stomach in both the 75 and 200 mg/kg/day group males and females.

Liver and Spleen

In the 200 mg/kg/day group males, adhesion to the liver and spleen were observed.

Adrenal cortex, thymus and lymph

In the 75 and 200 mg/kg/day group males and females, a higher mean adrenal gland weight gain and lower mean thymus weight in the 200 mg/kg/day group females were observed. Hypertrophy of the adrenal gland, zona fasciculata, and lymphoid depletion were noted in the 200 mg/kg/day group males and females, respectively.

Reproductive organs

Mean number of corpora lutea, unaccounted for sites, and implantation site in the 25, 75 and 200 mg/kg/day groups were similar to the control group values.

Remarks – Results

Mortality and clinical observations were recorded for concentrations at and above 75 mg/kg/day.
No adverse effects were seen on the reproductive/ developmental screening parameters at any dose level.

CONCLUSION

The No Observed (Adverse) Effect Level (NO(A)EL) was established as 75 mg/kg bw/day for general systemic toxicity based on test-substance related lower mean body weight gains during the overall study for the 200 mg/kg bw/day males as well as a lower mean body weight on study day 27. Adverse effects relating to mortality/morbidity, adrenal gland weights, neutrophil counts, macroscopic and/or microscopic findings of the stomach, adrenal cortex and thymus were attributed to the irritative properties of the test substance and corresponding stress, rather than systemic toxicity.

The NOAEL was established as 200 mg/kg bw/day for reproductive and developmental toxicity based on no adverse effects at the maximum dose tested.

TEST FACILITY WIL (2011)

B.9. Genotoxicity – bacteria

TEST SUBSTANCE	Notified polymer
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 *E. coli*: WP2uvrA
Metabolic Activation System	Liver preparations (S9 mix) from rats treated with phenobarbital and β-naphthoflavone
Concentration Range in Main Test	a) With metabolic activation: 15-5000 µg/plate b) Without metabolic activation: 50-5000 µg/plate
Vehicle	Dimethyl formamide
Remarks - Method	No significant protocol deviation.

RESULTS

Metabolic Activation — Test Substance Concentration (µg/plate) Resulting in:

	Cytotoxicity in Preliminary Test	*Cytotoxicity in Main Test*	*Precipitation*	*Genotoxic Effect*
Absent				
Test 1	> 5000	> 5000	> 5000	negative
Test 2	> 5000	> 5000	> 5000	negative
Present				
Test 1	> 5000	> 5000	> 5000	negative
Test 2	> 5000	> 5000	> 5000	negative

Remarks - Results	The test substance was tested up to the maximum recommended dose level of 5000 µg/plate. No toxicologically significant increases in the frequency of revertant colonies were recorded for any of the bacterial strains, with any dose of the test substance, 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 polymer was not mutagenic to bacteria under the conditions of the test.
Test Facility	Safepharm (2006a)

B.10. Genotoxicity – in vivo

TEST SUBSTANCE	Notified polymer
METHOD	OECD TG 474 Mammalian Erythrocyte Micronucleus Test. EC Directive 2000/32/EC B.12 Mutagenicity - Mammalian Erythrocyte Micronucleus Test.
Species/Strain	Mice/Crl:CD-1^{TM}(ICR)BR
Route of Administration	Intraperitoneal (ip) route
Vehicle	Arachis oil
Remarks - Method	

Group	*Number and Sex of Animals*	*Dose mg/kg bw*	*Sacrifice Time hours*

Ia (vehicle control)	7M	0	24
Ib (vehicle control)	7M	0	48
II (low dose)	7M	7.5	24
III (mid dose)	7M	15	24
IVa (high dose)	7M	30	24
IVb (high dose)	7M	30	48
V (positive control, CP)	5M	50	24

CP=cyclophosphamide.

RESULTS

Doses Producing Toxicity

There were no mortalities during the period of the study.

In preliminary toxicity tests no toxicity was observed via the oral route with 2000 mg/kg/day therefore systematic absorption could not be confirmed using this dose route. In animals dosed with the test material via the ip route premature deaths occurred at and above 50 mg/kg bw/day. Animals dosed at 30 mg/kg bw/day showed clinical signs of toxicity including hunched posture, ptosis, distended abdomen, piloerection, lethargy, ataxia, decreased respiratory rate, laboured respiration, comatose and hypothermia. All animals at this dose survived until scheduled termination on Day 3 and therefore considered the maximum tolerated dose. The test material showed no responses in female mice, and therefore considered acceptable to use on males only for the main test.

In the main test no clinical signs were observed for the vehicle control. Clinical signs were observed in animal dosed with the test material at 30 mg/kg in both 24 and 48-hour, these were as follows: Hunched posture and ptosis.

Genotoxic Effects

The test substance did not cause any statistically significant increases in the number of micronucleated polychromatic erythrocytes or normachromatic erythrocytes. No statistically significant decrease in the proportion of polychromatic erythrocytes was observed, demonstrating that the test substance was not cytotoxic to the bone marrow.

There was a statistically significant increase in the number of micronucleated cells in the positive control group, as compared to the vehicle control group, thus validating the conduct of assay.

CONCLUSION

The notified polymer was not clastogenic under the conditions of this in vivo micronucleus test.

TEST FACILITY

Safepharm (2006b)

APPENDIX C: ENVIRONMENTAL FATE AND ECOTOXICOLOGICAL INVESTIGATIONS

C.1. Environmental Fate

C.1.1. Ready biodegradability

TEST SUBSTANCE: Analogue 3

METHOD: OECD TG 301 B Ready Biodegradability: CO_2 Evolution Test.

Inoculum	Activated sludge
Exposure Period	28 days
Auxiliary Solvent	None reported
Analytical Monitoring	CO_2 evolution
Remarks - Method	The test was conducted according to the guidelines above. No significant deviations from the test guidelines were reported.

RESULTS

Test substance		*Sodium benzoate*	
Day	*% Degradation*	*Day*	*% Degradation*
7	1	7	68
14	45	14	101
18	64	18	103
21	73	21	103
28	86	28	105

Remarks - Results: All validity criteria for the test were satisfied. The reference compound reached the 60% pass level by day 14 indicating the suitability of the inoculum. The toxicity control exceeded 55% and 82% biodegradation after 14 and 28 days respectively, implying that the test substance was not toxic to micro-organisms. The mean cumulative net CO_2 evolved (percent biodegradation) from the aqueous medium containing the test substance was 86% on day 28. Since biodegradation reached the pass level of > 60% CO_2 production within the 10 day window, the test substance can be classed as readily biodegradable.

CONCLUSION: The analogue and, by inference, the notified polymer are readily biodegradable.

TEST FACILITY: Exempt information

C.2. Ecotoxicological Investigations

C.2.1. Acute toxicity to fish

TEST SUBSTANCE: Analogue 1

METHOD: OECD TG 203 Fish, Acute Toxicity Test -Static

Species	*Cyprinus carpio*
Exposure Period	96 hours
Auxiliary Solvent	None reported
Water Hardness	180 mg $CaCO_3$/L
Analytical Monitoring	Acquity UPLC system
Remarks – Method	The test was conducted according to the guidelines above and good laboratory practice (GLP) principles. No significant deviations from the test guidelines were reported. Water Accommodated Fractions (WAFs) at

each loading rate were individually prepared by a one-day stirring period followed by a settlement period of 35 minutes and subsequent collection of the water phase by siphoning. The final test solutions were all clear and colourless.

RESULTS

Concentration mg/L		*Number of Fish*	*Mortality(%)*
*Nominal (WAFs)**	*Actual*		*96 h*
Control	0	7	0
1.0	0.87	7	0
2.2	2.14	7	0
4.6	4.32	7	100
10	8.64	7	100
22	18.9	7	100

* Water accommodated fractions (WAFs)

LC50	3.2 (2.2 – 4.6) mg/L at 96 hours
NOEC	2.2 mg/L at 96 hours.
Remarks – Results	All validity criteria for the test were satisfied. The test substance was not completely soluble in the test medium at loading rates exceeding 22 mg/L. The 96-hour LC_{50} was calculated as $(AB)^{1/2}$, where A is the highest concentration at which 0% mortality occurred and the B is the lowest concentration at which 100% mortality was observed. A and B are the lower and upper limits, respectively, of the 95% confidence interval (CI). DSEWPaC notes that the LC50 was not calculated based on the measured concentration although it was mentioned in the study report that the EC50 value including its confidence intervals was based on the measured concentrations. The LC50 and 95% CI have been calculated by the method above to be 3.0 (2.14 – 4.32) mg/L at 96 hours.
CONCLUSION	The analogue and, by inference, the notified polymer are toxic to fish.
TEST FACILITY	NOTOX (2010a)

C.2.2. Acute toxicity to aquatic invertebrates

TEST SUBSTANCE	Analogue 1
METHOD	OECD TG 202 *Daphnia* sp. Acute Immobilisation Test - Static
Species	*Daphnia magna*
Exposure Period	48 hours
Auxiliary Solvent	None reported
Water Hardness	None reported
Analytical Monitoring	Acquity UPLC system
Remarks - Method	The test was conducted according to the guidelines above and good laboratory practice (GLP) principles. No significant deviations from the test guidelines were reported. Water Accommodated Fractions (WAFs) at each loading rate were individually prepared by a one-day stirring period followed by a settlement period of 35 minutes and subsequent collection of the water phase by siphoning. The final test solutions were all clear and colourless.

RESULTS

Concentration (mg/L)		*Number of D. magna*	*% Immobilised (48 h)*
*Nominal(WAFs)**	*Actual*		
Control	0	20	10
10	5.3	20	5
18	10.3	20	0
32	14.5	20	90
56	38.1	20	100
100	64.4	20	100

* Water accommodated fractions (WAFs)

LC50	13 (12 – 13) mg/L at 48 hours (based on measured concentrationc)
NOEC	10.3 mg/L at 48 hours
Remarks - Results	All validity criteria for the test were satisfied. The 10% percent mortality of the test organism in the control was within the allowable limit. The 5% mortality found in the lowest treatment concentration was also within the partial mortality range. The test substance was not completely soluble in the test medium at the concentrations tested. The 96-hour LC_{50} was calculated by Probit method
CONCLUSION	The analogue and, by inference, the notified polymer are harmful to aquatic invertebrates.
TEST FACILITY	NOTOX (2010b)

C.2.3. Algal growth inhibition test

TEST SUBSTANCE	Analogue 1
METHOD	OECD TG 201 Alga, Growth Inhibition Test
Species	Freshwater green algae (*Selenastrum capricornutum*)
Exposure Period	96 hours
Concentration Range	Nominal: 10, 18, 32, 56 and 100 mg/L Actual: 0.35, 3.5, 18.2, 41.8 and 81.0 mg/L
Auxiliary Solvent	None reported
Water Hardness	None reported
Analytical Monitoring	Acquity UPLC system
Remarks - Method	The test was conducted according to the guidelines above and good laboratory practice (GLP) principles. No significant deviations from the test guidelines were reported. Water Accommodated Fractions (WAFs) at each loading rate were individually prepared by a one-day stirring period followed by a settlement period of 35 minutes and subsequent collection of the water phase by siphoning. The final test solutions were all clear and colourless.

RESULTS

Biomass (96 h)		*Growth (96 h)*	
E_yC_{50} (mg/L)	*NOE_yC (mg/L)*	*E_rC_{50} (mg/L)*	*NOE_rC (mg/L)*
3.2 (0.74 – 14)	0.31	12 (17.8 – 20)	0.31

Remarks - Results	Bonferroni t- test (ANOVA; TOXSTAT 3.5) was used for statistical comparisons between the control and the treatment groups to determine which treatment groups revealed significant reduction of growth rate or inhibition of yield. E_yC_{50} and E_rC_{50} values were calculated by using log-linear regression analysis of the percentages of growth rate reduction and yield inhibition rate. The test results were calculated based on the Time Weight Average (TWA) concentrations determined for the test substance. TWA concentrations used for calculations were 0.31, 3.3, 15.9, 30.3 and 41.8 mg/L.
CONCLUSION	The analogue and, by inference, the notified polymer are harmful to algae.
TEST FACILITY	NOTOX (2010c)

C.2.4. Inhibition of microbial activity

TEST SUBSTANCE	Analogue 3
METHOD	ISO 8192 (Test for Inhibition of Oxygen Consumption by Activated Sludge)
Inoculum	Activated sludge
Exposure Period	30 min
Concentration Range	Not reported
Remarks – Method	No significant deviation from the protocol was reported
RESULTS	
EC20	625 mg/L
NOEC	None reported
Remarks – Results	Based on the test result, the test substance is not expected to inhibit the respiration and biodegradation activities of microorganisms within an STP

CONCLUSION	The analogue and, by inference, the notified polymer are not expected to inhibit respiration of microorganisms
TEST FACILITY	Exempt information

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