

File No: LTD/1434

January 2010

**NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME
(NICNAS)**

FULL PUBLIC REPORT

Polymer in TC139

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 the Environment, Water, Heritage and the Arts.

For the purposes of subsection 78(1) of the Act, this Full Public Report may be inspected at our NICNAS office by appointment only at 334-336 Illawarra Road, Marrickville NSW 2204.

This Full 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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FULL PUBLIC REPORT**Polymer in TC139****1. APPLICANT AND NOTIFICATION DETAILS**

APPLICANT(S)

Baker Petrolite Corporation (A Division of Baker Hughes Australia Pty Ltd, ABN 20 004 752 050)
5 Walker Street, Braeside Victoria 3195

NOTIFICATION CATEGORY

Limited: Synthetic polymer with Mn \geq 1000 Da.

EXEMPT INFORMATION (SECTION 75 OF THE ACT)

Data items and details claimed exempt from publication:

Chemical Name, CAS Number, Molecular Formula, Structural Formula, Molecular Weight, Spectral Data and Polymer Composition

VARIATION OF DATA REQUIREMENTS (SECTION 24 OF THE ACT)

Variation to the schedule of data requirements is claimed as follows:

Melting point/Freezing point, Boiling Point, Density, Vapour Pressure, Water Solubility, Hydrolysis as a Function of pH, Partition Co-efficient, Adsorption/Desorption, Dissociation Constant, Flash Point, Flammability Limits and Autoignition Temperature

PREVIOUS NOTIFICATION IN AUSTRALIA BY APPLICANT(S)

None

NOTIFICATION IN OTHER COUNTRIES

USA (1989)

2. IDENTITY OF CHEMICAL

MARKETING NAME(S)

TC139 (~40% notified polymer)
Tretolite*RBW80243 (~40% notified polymer)
RBW24136 (~20% notified polymer)

OTHER NAME(S)

Polyamine dithiocarbamate

ANALYTICAL DATA

Reference NMR, GPC and MALLS (Multi Angle Laser Light Scattering) spectra were provided.

3. COMPOSITION

DEGREE OF PURITY Expected to be high

HAZARDOUS IMPURITIES/RESIDUAL MONOMERS Not known

NON HAZARDOUS IMPURITIES/RESIDUAL MONOMERS Not known

ADDITIVES/ADJUVANTS None

LOSS OF MONOMERS, OTHER REACTANTS, ADDITIVES, IMPURITIES

Under acidic conditions the notified polymer may release small amounts of hydrogen sulfide or carbon disulfide. However the notified polymer is formulated under basic conditions and is only used under pH neutral or basic conditions, and so release of these gases are not expected under normal conditions of use.

DEGRADATION PRODUCTS

Pyrolysis in the presence of strong acid produces hydrogen sulfide. Combustion would produce oxides of carbon, nitrogen and sulfur.

In the presence of high valent metal cations the notified polymer cross links to an insoluble solid.

4. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AT 20°C AND 101.3 kPa: yellow to amber liquid

Property	Value	Data Source/Justification
Boiling Point	Not determined	Expected to be high.
Density	1200 kg/m ³ at 16°C (TC139) 1080 kg/m ³ at 20°C (RBW24136)	MSDS
Vapour Pressure	Not determined	Based on the high molecular weight of the polymer the vapour pressure is expected to be low.
Water Solubility	Not determined	The notified polymer is expected to be readily soluble in water under neutral and alkaline conditions and chemically unstable under acidic conditions.
Hydrolysis as a Function of pH	Not determined	The notified polymer is expected to hydrolyse at acidic pH to generate hydrogen sulphide and carbon disulfide gases.
Partition Coefficient (n-octanol/water)	log P _{OW} = 0 – 3.9 (2.6 for weight average)	Measured
Adsorption/Desorption	Not determined	Although the notified polymer is a polyanion under neutral and alkaline conditions, it is expected to form insoluble polycations in the environment due to its tendency to complex with transition metal cations, especially ferrous ion. These insoluble cationic complexes will adsorb onto negative charges on surfaces and are therefore not expected to be mobile in the environment.
Dissociation Constant	Not determined	The notified polymer contains dithiocarbamate groups and is expected to be ionised in the environmental pH range of 4–9.
Particle Size	Not determined	The notified polymer is a liquid.
Flash Point	Not determined	Not expected to flash under normal conditions of use due to low volatility.
Flammability	Not determined	Not expected to flammable.
Autoignition Temperature	Not determined	Not expected to autoignite under normal conditions of use.
Explosive Properties	Not expected to be explosive.	Estimated based on the chemical structure.

DISCUSSION OF PROPERTIES

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

Reactivity

Hazardous polymerisation is not expected to occur. The notified polymer is considered to be stable under basic or neutral pH conditions, but may react under acidic conditions to release carbon disulfide or hydrogen sulfide.

5. INTRODUCTION AND USE INFORMATION

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

The notified polymer will not be manufactured in Australia. It will be imported in the product TC139 (or Tretolite*RBW80243) at 40% as an alkaline aqueous solution.

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

<i>Year</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
<i>Tonnes</i>	53.8	53.8	53.8	53.8	53.8

PORT OF ENTRY

Fremantle and Melbourne

IDENTITY OF RECIPIENTS

Baker Petrolite Corporation reformulation site in Braeside, VIC

Pascoes Pty Ltd reformulation site in Welshpool, WA

TRANSPORTATION AND PACKAGING

The product TC 139 (or Tretolite*RBW80243), containing approximately 40% of the notified polymer, will be imported in 205 L sealed, plastic lined drums, or in bulk tanks. The drums or tanks will be transported from the dockside to the reformulation sites by road. The final product, RBW24136, containing approximately 20% of the notified polymer, will be transported in sealed containers by road to the port and then by barge to the off-shore platform.

USE

The notified polymer will be used as a water clarifier in oil/gas production. Water clarifiers aid gravity settling and flotation processes for purification purposes.

OPERATION DESCRIPTION

Reformulation

Reformulation will involve a dilution process. The drums or tanks containing the imported products (~40% notified polymer) will be connected to the blend vessels by pipes/hoses using quick connect fittings. The imported product will be transferred to the blend vessels through a positive displacement pumping system. The blend vessels will not be sealed, but fitted with a fume extraction device. The diluted polymer solution, RBW24136 (approximately 20% notified polymer) will then be filled into drums or tote tanks.

End-use on off-shore oil platforms

The drums or tote tanks containing the notified polymer solution (approximately 20% notified polymer) will be transferred from the barge to a bunded area of the off-shore platform. The drum or tank will be connected using quick connect hose fittings to the separation system pipelines through a pump which delivers the notified polymer to the various application points of the system as needed. The notified polymer is expected to bind to the oil and particles in the oil and be processed at the refinery with the oil.

6. HUMAN HEALTH IMPLICATIONS

6.1 Exposure assessment

6.1.1 Occupational exposure

NUMBER AND CATEGORY OF WORKERS

<i>Category of Worker</i>	<i>Number</i>	<i>Exposure Duration (hours/day)</i>	<i>Exposure Frequency (days/year)</i>
Transportation workers	1-2	1	65
Blend plant workers	2	2-3	35
End use – Oil field technicians	1-2	0.5	25

EXPOSURE DETAILS

Transport and storage

Waterfront and transport workers are not expected to be exposed to the notified polymer except in the case of an accident involving spillage of the notified polymer.

Reformulation and End use on off-shore oil platform

Dermal or ocular exposure to product containing 20% or 40% of the notified polymer may occur due to accidental spills and splashes during the connecting and disconnecting of hoses. This exposure is expected to be minimised by the use of quick connect fittings (which reduce the time taken) and personal protective equipment (gloves, goggles and overalls). Inhalation exposure is not expected to be significant due to the anticipated low vapour pressure of the notified polymer. Potential for inhalation exposure will be minimised by the fume extraction equipment that will be used and the respiratory protection that is expected to be available when ventilation is not adequate.

6.1.2. Public exposure

The notified polymer is not sold to the public. Public exposure is only expected in the unlikely event of an accident during transport. The public exposure is therefore expected to be negligible.

6.2. Human health effects assessment

No toxicity data were submitted.

As the notified polymer has a relatively high molecular weight ($M_n > 1,000$ Da) it is unlikely to be absorbed across biological membranes.

The notified polymer contains structural alerts for irritancy and possible skin sensitisation. However, given the relatively high molecular weight of the polymer these effects are unlikely to be significant, but cannot be ruled out. The irritating nature of the product solution may increase the likelihood of skin penetration and may therefore enhance any sensitisation effects.

The notified polymer may undergo degradation under acidic conditions to form hydrogen sulfide or carbon disulfide, which are hazardous substances according to the HSIS (2010).

Hydrogen sulfide is extremely flammable (R12), very toxic by inhalation (R26) and very toxic to aquatic organisms (R50).

Carbon disulfide is highly flammable (R11), a reproductive and developmental toxicant (Cat. 3 R62-63), a toxicant causing serious damage to health by prolonged exposure through inhalation (R48/23) and an irritant to eyes and skin (R36/38).

However, as the notified polymer is formulated and used under basic conditions, release of these gases is not expected under normal use conditions.

Health hazard classification

Based on the data provided the notified polymer cannot be classified as hazardous according to the *Approved Criteria for Classifying Hazardous Substances* [NOHSC:1008(2004)].

However, based on structural alerts, the notified polymer may have eye and skin irritation and/or skin sensitisation properties.

6.3. Human health risk characterisation**6.3.1. Occupational health and safety**

Although the possibility of eye and skin irritancy and/or sensitisation effects cannot be ruled out, the risk of dermal and ocular exposure in workers during reformulation and end-use would be reduced due to the engineering controls, the use of personal protective equipment (PPE). Degradation to carbon disulfide is not expected to occur under normal conditions of use.

In summary, the notified polymer is not considered to pose an unacceptable risk to the health of workers.

6.3.2. Public health

The risk to public health associated with the notified polymer is not considered to be unacceptable due to the negligible exposure.

7. ENVIRONMENTAL IMPLICATIONS**7.1. Environmental Exposure & Fate Assessment****7.1.1 Environmental Exposure****RELEASE OF CHEMICAL AT SITE**

The blending of the imported product containing the notified polymer will be done in a bunded area. The mixing vessel and import containers will be cleaned with water and the rinsates charged to the next batch of blended product. Any liquid spills will flow to a collection pit and will be collected by a waste disposal company. No release of the notified polymer to the environment is anticipated from the reformulation process.

RELEASE OF CHEMICAL FROM USE

The notified polymer will be used at off-shore oil production facilities to clarify produced waters prior to discharge into the ocean. The locally blended product containing the notified polymer will be injected into a closed separation system directly from the container that is supplied to the oil platform. The lipophilic characteristics of the metal complexes formed by the notified polymer in produced waters aids in the coagulation of oil droplets that are dispersed in with the water. This oil/chemical mix forms a flocculent (containing the notified polymer) that rises to the oil/water interface. The flocculent travels with the oil to the refinery where it is expected that the notified polymer will be destroyed during processing. The notifier indicates that the notified polymer in the system is expected to remain with the oil floc, but it is possible for some of the notified polymer to remain in the discharged water phase if the use rates are greater than needed for the separation of the oil from the water.

The notifier indicates that typical application will be based on the total volume of water processed on an oil platform. If used properly no significant release to the water compartment is anticipated. There are no other water streams that are added to this prior to release overboard, hence there is no further dilution effect before discharge.

RELEASE OF CHEMICAL FROM DISPOSAL

Drums used to supply the notified polymer will be sent to an environmental drum cleaner for cleaning and recycling. Bulk tanks will be returned to the importer for re-use.

7.1.2 Environmental fate

In a biodegradability test in seawater, the notified polymer was degraded by 29% after 28 days. The results indicate that the notified polymer has a low potential to biodegrade in seawater. For the details of the environmental fate studies refer to Appendix C.

The vast majority of the notified polymer used off-shore is expected to remain in the oil extracted from the formation which will be transported to a refinery where it will be destroyed during refining processes. Off-shore, if any release to seawater occurred, the notified polymer is likely to be in the form of water insoluble and cross-linked metal complexes absorbed to particles. The notified polymer discharged to seawater is therefore not expected to be in a bioavailable form and will have little potential to bioaccumulate. The notified polymer is expected to degrade slowly in the environment primarily by abiotic routes to form water, oxides of carbon, and various inorganic salts.

7.1.3 Predicted Environmental Concentration (PEC)

It is expected that only a small fraction of the notified polymer used at each oil production facility will be released to seawater. However, the fraction released will depend on site-specific factors and it is therefore not possible to derive a typical discharge quantity. Consequently, a worst case scenario is derived by assuming that 100% of the notified polymer used in this manner will be released directly to the marine environment.

The maximum in-use concentration of the notified polymer in the produced water to be treated at a single site has been estimated to be 3 mg/L. Therefore, a PEC of 3 mg/L can be assumed for the worst case scenario in which 100% of the notified polymer added to produced water is retained in the water phase without consideration of the likely efficient partitioning of the polymer to the recovered oil phase which is retained for refining on-shore.

7.2. Environmental effects assessment

The results from ecotoxicological investigations conducted on the notified polymer (as a 40% aqueous solution) with representative marine species are summarised in the table below. Details of these studies can be found in Appendix C.

<i>Endpoint</i>	<i>Result</i>	<i>Assessment Conclusion*</i>
Fish Toxicity - Juvenile turbot	LC50 = 357.7 mg/L	Not harmful
Invertebrate Toxicity - <i>Acartia tonsa</i>	EC50 = 1.7 mg/L	Very toxic
Algal Toxicity - <i>Skeletonema costatum</i>	E _r C50 = 1.6 mg/L	Very toxic
Sediment Invertebrates - <i>Corophium volutator</i>	LC50 = 575 mg/kg (dry weight) of sediment	Slightly toxic

*Hazard ratings were derived after adjusting measured end-points to account for the nominal concentration of notified polymer in the tested formulated products.

Based on the available ecotoxicity results, the notified polymer is very toxic to algae and invertebrates, but does not appear to be harmful to fish. The notified polymer has some limited toxic effects on marine benthic invertebrates, but only at environmentally infeasible concentrations.

7.2.1 Predicted No-Effect Concentration

A predicted no-effect concentration (PNEC - aquatic ecosystems) has been estimated as 6.4 µg/L based on the most sensitive endpoint value of E_rC50 for algae (1.6 mg/L). This endpoint has been adjusted, as a worst case scenario, to 0.64 mg/L ($= 0.4 \times 1.6 \text{ mg/L}$) to account for the nominal concentration of the notified polymer in the formulations that were used for the ecotoxicity testing. A safety factor of 100 has been used in this calculation as acute toxicity data are available for three marine trophic levels.

7.3. Environmental risk assessment

The worst case concentration of the notified polymer in the produced waters discharged to the ocean in the immediate vicinity of an oil production facility is estimated as 3 mg/L. To achieve an acceptable risk quotient of < 1 ($= \text{PEC/PNEC}$), would require further dilution of the estimated discharge concentration by a factor of about 470. According to the CHARM (2001) model, the dilution factor at 500 m radius is approximately 1000. Therefore, the predicted environmental concentration (PEC) of the notified polymer at 500 m from the discharge line would be well below expected toxic levels at this distance, even assuming a worst case release rate. At distances closer to the discharge line the PEC will approach the value of the concentration at the discharge line. However, the potential for toxic effects of the notified polymer closer to the discharge line are expected to be mitigated by the anticipated low bioavailability of metal complexes of the notified polymer and their absorption to particles. Thus, even for a worst case with no partitioning to the recovered oil phase (which is a functional requirement), the use of the notified polymer for water clarification on off-shore oil production platforms is not expected to pose an unacceptable risk to the marine environment.

8. CONCLUSIONS AND REGULATORY OBLIGATIONS

Hazard classification

Based on the data provided, the notified polymer cannot be classified as hazardous according to the *Approved Criteria for Classifying Hazardous Substances* [NOHSC:1008(2004)].

and

The environmental classification of the notified polymer 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.

	<i>Hazard category</i>	<i>Hazard statement</i>
Environment	Acute Category 1	Very toxic to aquatic life
	Chronic Category 1	Very toxic to aquatic life with long lasting effects

Human health risk assessment

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

When used in the proposed manner, the notified polymer is not considered to pose an unacceptable 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 expected to pose a risk to the environment.

Recommendations

CONTROL MEASURES

Occupational Health and Safety

- Employers should implement the following engineering controls to minimise occupational exposure to the notified polymer in the imported product and formulated end-product:
 - Keep notified polymer in basic or neutral pH conditions.
- Employers should implement the following safe work practices to minimise occupational exposure during handling of the notified polymer in the imported product and formulated end-product:
 - Avoid skin and eye contact
- Employers should ensure that the following personal protective equipment is used by workers to minimise occupational exposure to the notified polymer in the imported product and formulated end-product:
 - Gloves, overalls

- Safety glasses

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

- A copy of the MSDS should be easily accessible to employees.
- If products and mixtures containing the notified chemical are classified as hazardous to health in accordance with the *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 polymer should be disposed of to landfill.

Storage

- The following precautions should be taken regarding storage of the notified chemical:
 - Store in a cool and well ventilated area
 - Keep away from acid

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 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 water clarifier in oil/gas production, or is likely to change significantly;
 - the amount of chemical being introduced has increased from 53.8 tonne per year, 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 product containing the notified polymer provided by the notifier was reviewed by NICNAS. The accuracy of the information on the MSDS remains the responsibility of the applicant.

APPENDIX A: PHYSICAL AND CHEMICAL PROPERTIES**Partition Coefficient (n-octanol/water)**log P_{OW} = 0 – 3.9 (2.6 for weight average)

Method	OECD TG 117 Partition Coefficient (n-octanol/water)
Remarks	HPLC Method. Three peaks were observed in the HPLC chromatogram with retention times 0.78, 4.89 and 19.04 min, corresponding to log P _{OW} of < 0 (95% area), 3.9 (5% area) and 5.6 (< 5% area), respectively. The log P _{OW} is therefore presented as 0 – 3.9 and the weight average log P _{OW} was calculated to be 2.6 based on the values for the peaks ≥ 5% in area.
Test Facility	KM Lab Oslo (1998a)

APPENDIX C: ENVIRONMENTAL FATE AND ECOTOXICOLOGICAL INVESTIGATIONS

C.1. Environmental Fate

C.1.1. Biodegradability in seawater

TEST SUBSTANCE	Notified polymer (40% aqueous solution)
METHOD	OECD TG 306 Biodegradability in Seawater - Closed bottle test (1992)
Inoculum	Micro-organisms present in the seawater only
Exposure Period	28 days
Auxiliary Solvent	None
Analytical Monitoring	Oxygen consumption was measured electrochemically.
Remarks - Method	The study was conducted by incubating the test samples (nominal 4.92 mg/L) in bottles at $20 \pm 3^\circ\text{C}$ for 28 days. The test samples were prepared by directly adding the test substance to the test medium followed by magnetically stirring for at least 15 min. Seawater was taken from Solbergstrand (Norway) and aged then treated by sedimentation and decanting to remove coarse particles before use for the test. Blank control, reference control (2.9 mg/L sodium benzoate) and toxicity control tests were also conducted. All the tests were conducted in duplicates.
	The formula of the test substance and its purity, or relative proportions of major components was not known, and therefore, the chemical oxygen demand (COD) was determined. The contributions to oxygen consumption by the nitrification process were determined and used to correct the BOD values.

RESULTS

<i>Incubation period</i> <i>Day</i>	<i>% Degradation</i>		
	<i>Test substance</i>	<i>Sodium benzoate</i>	<i>Sodium benzoate & test substance</i>
5	31	68	44
15	20	81	44
28	29*	82	51

* Oxygen consumption due to nitrification is taken into consideration

Remarks - Results	There were no significant deviations from the protocol. The reference substance degraded by more than 60% in 5 days and the blank respiration was < 10% over 28 days, thus validating the test.
	The notified polymer has a low potential for biodegradation in seawater since only 29% degradation was achieved in 28 days.
CONCLUSION	The notified polymer has a low potential to biodegrade in seawater.
TEST FACILITY	KM Lab Oslo (1998b)

C.1.2. Bioaccumulation

CONCLUSION	Test not conducted. The potential for bioaccumulation is expected to be low for the notified polymer based on its high molecular weight of > 1000 Da and the low bioavailability of iron complexes formed by the polymer in environmental waters.
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C.2. Ecotoxicological Investigations

C.2.1. Acute toxicity to fish

TEST SUBSTANCE	Notified polymer (40% aqueous solution)
METHOD	PARCOM method 1995, OECD TG 203 Fish, Acute Toxicity Test - semi-static, and STL Runcorn SOP III.6
Species	Juvenile turbot (<i>Scophthalmus maximus</i>)
Exposure Period	96 hours
Auxiliary Solvent	None
Water Hardness	Not reported
Analytical Monitoring	None
Remarks – Method	Following a range-finding test, 7 animals were exposed to each of the test solutions at nominal concentrations of 0.0, 100.0, 177.8, 316.2, 562.3 and 1000.0 mg/L for 96 hours at pH 8.0 – 8.29 and $15 \pm 1.5^{\circ}\text{C}$, in artificial sea water. The test media was replaced every 48 hours.
	The mortality data were analysed using the statistical computer programme Toxcalc, supplied by Tidepool Scientific (STL Runcorn SOP V. 1).

RESULTS

Concentration mg/L Nominal	Number of Fish	Mortality				
		0 h	24 h	48 h	72 h	96 h
0	7	0	0	0	0	0
100.0	7	0	0	0	0	0
177.8	7	0	0	0	0	0
316.2	7	0	1	1	2	2
562.3	7	0	7	7	7	7
1000.0	7	0	7	7	7	7
LC50	357.7 mg/L at 96 hours					
NOEC	177.8 mg/L at 96 hours					
Remarks – Results	No information about sub lethal effects was reported. A dose response was observed. The actual LC50 value for the pure notified polymer is likely to be lower than the detected value given the concentration of the notified polymer in the test substance. However, the notified polymer may not be harmful to fish ($357.7 \times 40\% = 143 \text{ mg/L}$) given the determined high LC50 for the test solution containing the notified polymer.					

CONCLUSION The notified polymer is not likely to be harmful to fish.

TEST FACILITY STL (2005)

C.2.2. Acute toxicity to aquatic invertebrates - *Acartia tonsa*

TEST SUBSTANCE	Notified polymer (40% aqueous solution)
METHOD	Standard Operating Procedure, Test Methods, <i>Acartia tonsa</i> (Marine) 48 h Lethality Test, S.O.P. Lab II 1.1, 1996 Version 6 (based on ISO/CD 14669 Standard Method, ISO, 1995).
Species	<i>Acartia tonsa</i>
Exposure Period	48 hours
Auxiliary Solvent	None
Water Hardness	Not reported
Analytical Monitoring	None
Remarks - Method	Following a range-finding test, the study was conducted by exposing the

species to the test substance in four replicates at four nominal concentrations at pH 8.82 – 8.74 and 19.2 – 21.6°C. The stock solution was prepared by dissolving the test substance in the filtered and aerated seawater.

A reference control test was conducted using 3,5-dichlorophenol at 1.0 mg/L.

The LC50s and confidence limits were calculated using the computer program LOTUS 1-2-3 for Windows 4.0.

RESULTS

Concentration mg/L Nominal	Number of <i>Acartia tonsa</i>	Mortality 48 h
0.0	20	0
0.1	20	0
0.5	20	2
2.5	20	13
10	20	20

LC50 1.7 mg/L at 48 hours (95% confidence limits 1.3 – 2.2 mg/L)
 NOEC (LC₅₀) 0.4 mg/L at 48 hours
 Remarks - Results All the test validity criteria are met. The lethality of the reference control at 1 mg/L was 50%.

A dose response relationship was observed. Considering the low 48 h LC50 (1.7 mg/L) and that only 40% of the notified polymer was present in the test substance, the notified polymer is considered very toxic to the test species.

CONCLUSION The notified polymer is very toxic to marine invertebrates

TEST FACILITY Aquateam (1998a)

C.2.3. Acute toxicity to sediment invertebrates - *Corophium volutator*

TEST SUBSTANCE Notified polymer (40% aqueous solution)

METHOD Draft Paris Commission Guideline “MAFF/ERT Harmonised Protocol. A Sediment Bioassay Using an *Amphipod Corophium sp.*” (PARCOM, 1994).

Species *Corophium volutator*

Exposure Period 10 days

Auxiliary Solvent None

Water Hardness Not reported

Analytical Monitoring None

Remarks - Method Adult *Corophium* were exposed to sediment spiked with the test substance for a period of 10 days at nominal levels of 50, 450, 1350, 4050 and 12150 mg/kg of sediment at 13.6 – 15.1°C and pH 7.9 – 8.2. The appropriate weight of the test substance was initially added to 100 mL of reference seawater before adding to the wet sediment. The sediment was left to settle in the test vessels overnight or for a minimum of 3 hours. Within 24 hours of the sediment being introduced to the test vessel, natural seawater was carefully added to each vessel to bring the total volume up to 800 mL. When the sediment had settled the vessels were aerated for 12 hours prior to the initiation of the test.

A blank control test was also conducted. Three replicates were conducted for each of the control and sample tests, and ten animals were used in

each replicate.

The LC50s and confidence limits were calculated from a Generalized Linear Model (Kerr, D. R. and Meador, J. P. 1995).

RESULTS

Concentration mg/kg Dry weight	Number of <i>Corophium volutator</i>	Mortalities 10 days
0.0	30	3
54	30	2
450	30	3
1,359	30	29
4,041	30	30
12,186	30	30

LC50 575 (95% confidence limits 423 – 780) mg/kg (dry weight) of sediment
 Remarks - Results All the test validity criteria are met. The test substance is considered to be slightly toxic to the test species based on the determined LC50 value of 575 mg/kg (dry weight) of sediment. The notified polymer is still expected to be slightly toxic to the test species even though the concentration of it is 40% in the test substance.

CONCLUSION The notified polymer is expected to be slightly toxic to *Corophium volutator*.

TEST FACILITY Aquateam (1998b)

C.2.4. Algal growth inhibition test

TEST SUBSTANCE Notified polymer (40% aqueous solution)

METHOD Marine Algal Growth Inhibition Test with *Skeletonema costatum* and *Phaeodactylum tricornutum*, 1991. (Draft International Standard ISO/DIS 10253).

Species *Skeletonema costatum*

Exposure Period 72 hours

Concentration Range Nominal: 0.0, 0.32, 0.56, 1.0, 3.2, 5.6 mg/L

Auxiliary Solvent None

Water Hardness Not reported

Analytical Monitoring None

Remarks - Method Following a range finding test, the tests were conducted in three replicates at pH 7.8 – 8.8 and $20 \pm 1^\circ\text{C}$ under continuous white light (6,000 – 10,000 lux). Seawater was filtered before use as the dilution water.

The EC50 values were estimated using a logarithm-linear or logarithm-probit plot of concentration and percent growth inhibition, as appropriate.

RESULTS

Biomass $E_b\text{C50 (mg/L at 72 h)}$	Growth $E_r\text{C50 (mg/L at 72 h)}$
1.0	1.6

Remarks - Results The cell density in the control increased exponentially by a factor of ~20 within 72 hours. A dose response was observed for the test samples. Considering the detected low 72 h $E_r\text{C50}$ value of 1.6 mg/mL and that only 40% of the notified polymer was present in the test substance, the

notified polymer is expected to be very toxic to marine algae.

CONCLUSION

The notified polymer is expected to be very toxic to marine algae.

TEST FACILITY

Hamilton Garrod Limited (1996)

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