File No: LTD/2040

June 2018

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

# PUBLIC REPORT

## Poly(oxy-1,2-ethanediyl), α-hydro-ω-hydroxy-, mono[2-(4,5-dihydro-2-nortall-oil alkyl-1*H*-imidazol-1-yl)ethyl] ethers

This Assessment has been compiled in accordance with the provisions of the *Industrial Chemicals (Notification and Assessment) Act 1989* (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 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 and Energy.

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


| | |
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**Director**
**NICNAS**

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# SUMMARY

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

| ASSESSMENT REFERENCE | APPLICANT(S) | CHEMICAL OR TRADE NAME | HAZARDOUS CHEMICAL | INTRODUCTION VOLUME | USE |
|---|---|---|---|---|---|
| LTD/2040 | Newpark Drilling Fluids (Australia) Ltd | Poly(oxy-1,2-ethanediyl), α-hydro-ω-hydroxy-, mono[2-(4,5-dihydro-2-nortall-oil alkyl-1*H*-imidazol-1-yl)ethyl] ethers | ND* | < 1 tonne per annum | Component of a corrosion inhibitor in the oil and gas industry |

*ND = not determined

# CONCLUSIONS AND REGULATORY OBLIGATIONS

**Hazard classification**
As no toxicity data were provided, the notified polymer cannot be classified according to the *Globally Harmonised System of Classification and Labelling of Chemicals* (GHS), as adopted for industrial chemicals in Australia.

The environmental hazard classification according to the *Globally Harmonised System of 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 1) | H400 – Very toxic to aquatic life |
| Chronic (Category 1) | H410 – Very toxic to aquatic life with long lasting effects |

**Human health risk assessment**
Provided that the recommended controls are being adhered to, 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, the notified polymer is not considered to pose an unreasonable risk to the environment.

**Recommendations**

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 as introduced:
  - Adequate ventilation

- 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 as introduced:
  - Avoid contact with skin and eyes

- 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 as introduced:
  - Gloves
  - Goggles
  - Protective clothing

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

- A copy of the 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 of 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

- Where reuse or recycling are not appropriate, dispose of the notified polymer in an environmentally sound manner in accordance with relevant Commonwealth, state, territory and local government legislation.

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 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(1) of the Act; if
  - the importation volume exceeds one tonne per annum notified polymer;
  - the polymer is to be used for on-shore oil or gas well drilling;

or

(2) Under Section 64(2) of the Act; if
  - the function or use of the polymer has changed from a component of a corrosion inhibitor in the oil and gas industry, 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.

*Safety Data Sheet*

The SDS of the notified polymer and a product containing the notified polymer provided by the notifier was reviewed by NICNAS. The accuracy of the information on the SDS remains the responsibility of the applicant.

# ASSESSMENT DETAILS

## 1. APPLICANT AND NOTIFICATION DETAILS

APPLICANT(S)
Newpark Drilling Fluids (Australia) Ltd (ABN: 11 099 949 452)
11 Alacrity Place
HENDERSON WA 6166

NOTIFICATION CATEGORY
Limited-small volume: Synthetic polymer with Mn < 1,000 g/mol (1 tonne or less per year)

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

VARIATION OF DATA REQUIREMENTS (SECTION 24 OF THE ACT)
Variation to the schedule of data requirements is claimed as follows: boiling point, vapour pressure, hydrolysis as a function of pH, partition coefficient, adsorption/desorption, flash point, flammability and autoignition temperature.

PREVIOUS NOTIFICATION IN AUSTRALIA BY APPLICANT(S)
None

NOTIFICATION IN OTHER COUNTRIES
CEFAS, UK (March 2017)
DSI, Canada (listed)
TCSI, Taiwan (listed)
TSCA, USA (listed)

## 2. IDENTITY OF CHEMICAL

MARKETING NAME(S)
INCORR (product containing the notified polymer at < 10% concentration)

CAS NUMBER
68909-09-1

CHEMICAL NAME
Poly(oxy-1,2-ethanediyl), α-hydro-ω-hydroxy-, mono[2-(4,5-dihydro-2-nortall-oil alkyl-1*H*-imidazol-1-yl)ethyl] ethers

ANALYTICAL DATA
Reference NMR, IR, GPC and UV spectra were provided.

## 3. COMPOSITION

DEGREE OF PURITY
> 50%

## 4. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AT 20 °C AND 101.3 kPa: Dark brown liquid

| Property | Value | Data Source/Justification |
|---|---|---|
| Melting Range | -24 to 29 °C | Measured* |
| Boiling Point | > 150 °C at 101.3 kPa | SDS |
| Density | 1,048 kg/m$^3$ at 20 °C | Measured* |
| Vapour Pressure | ≤ 0.537 kPa at 25 °C | Calculated based on the boiling point |

| | | |
|---|---|---|
| Water Solubility | 1,000 g/L | Measured* |
| Hydrolysis as a Function of pH | Estimated | Contains functionalities that may hydrolyse; expected to be hydrolytically stable at environmental pH range (4-9) |
| Partition Coefficient (n-octanol/water) | Not determined | Expected to be surface active (contains hydrophilic and hydrophobic moieties) and remain at the phase boundary interface |
| Adsorption/Desorption | Koc = 805 | Estimated using EPIWIN version 4.1, based on the average number of repeat hydrophilic moieties; expected to have moderate affinity for organic carbon in sediment through hydrophobic interactions |
| Dissociation Constant | pKa = 6.5 | Measured* |
| Flash Point | > 100 °C | SDS |
| Flammability | Not determined | Introduced in an aqueous solution |
| Autoignition Temperature | Not determined | Introduced in an aqueous solution |
| Explosive Properties | Non-explosive | Contains no functional groups that would imply explosive properties |
| Oxidising Properties | Non-oxidising | Contains no functional groups that would imply oxidative properties |

* No details were provided for the tests.

DISCUSSION OF PROPERTIES
For melting range, density, water solubility and dissociation constant, the test results were provided in a summary table and no full study reports were available. The test results appeared reasonable based on the polymer structure.

*Reactivity*
The notified polymer is expected to be stable under normal conditions of use.

***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 of 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 not be manufactured within Australia. It will be imported in finished end use products at concentrations of < 10%.

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

| *Year* | *1* | *2* | *3* | *4* | *5* |
|---|---|---|---|---|---|
| *Tonnes* | < 1 | < 1 | < 1 | < 1 | < 1 |

PORT OF ENTRY
Perth

IDENTITY OF RECIPIENTS
Newpark Drilling Fluids (Australia) Ltd

TRANSPORTATION AND PACKAGING
The product containing the notified polymer will be transported and stored in 200 L steel drums and will be mainly distributed by road and sea to off-shore use sites. The notified polymer may also be transported by airlift under rare circumstances.

USE
The notified polymer (at < 10% concentration) functions as a surfactant and will be used as a corrosion inhibitor for drilling completion workovers and for water-based mud drilling processes in the oil and gas industry. The product containing the notified polymer will be used exclusively in off-shore oil and gas wells operations.

OPERATION DESCRIPTION
The imported product containing the notified polymer at < 10% concentration will not be reformulated or repackaged in Australia.

*Transport and storage workers*
The product containing the notified polymer will be transported and stored at off-shore oil well sites or mud drilling sites until being used.

*Drilling specialists*
The containers containing the notified polymer will typically be handled by automated equipment to be set above one of the pits on the rig for mixing. The product containing the notified polymer will be dissolved in the carrier brine at a final concentration of 5 kg/$m^3$, drained by gravity or pumped into the pit during the drilling processes. After the drilling applications, fluid containing the notified polymer will be pumped back to surface and stored in the pit for disposal processes. The operations will be performed in ventilated areas, and most handling and use of the notified polymer will occur outdoors.

## 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 workers* | 1 | 8 |
| Drilling fluid specialists | 6 | 8 |

* Estimated based on expected working times

EXPOSURE DETAILS
Exposure of workers to the notified polymer or during transport and storage will only occur in the event of an accident.

Dermal and ocular exposure to the notified polymer at concentrations < 10% may occur when handling the mixture containing the notified polymer during the well operations, including mixing, pumping and disposal processes. According to the notifier, workers will wear personal protective equipment (PPE) including impervious gloves, rubber aprons, goggles and, if necessary, respiratory protection to reduce the potential for exposure. Inhalation exposure to the notified polymer is not expected unless significant amount of aerosols are formed. The open air environment at the drilling sites, infrequent use and relative short time of handling of the notified polymer by the workers will further reduce the likelihood of exposure.

#### 6.1.2. Public Exposure
The notified polymer is intended only for use in oil and gas well drilling and public exposure to the notified polymer is not expected based on the assessed use pattern.

### 6.2. Human Health Effects Assessment
No toxicity data were submitted for the notified polymer.

Based on the relatively low molecular weight (Mn < 1,000 g/mol), high water solubility (1,000 g/L) and surface active properties of the notified polymer, absorption across the skin or biological membranes may occur. The acute and repeated dose toxicity of the notified polymer is unknown.

*Irritation and sensitisation*
The SDS for the notified polymer reported that the notified polymer may cause eye and skin irritation. The notified polymer contains a monomer constituent which may render irritation effects. However, the product introduced into Australia contains only < 10% concentration of the notified polymer.

Information on sensitisation properties of the notified polymer is not available.

***Health hazard classification***
As no toxicity data were provided, the notified polymer cannot be classified according to the *Globally Harmonised System of Classification and Labelling of Chemicals (GHS),* as adopted for industrial chemicals in Australia.

However, the SDS provided for the notified polymer includes the following classifications according to the GHS:

| *Hazard classification* | *Hazard statement* |
|---|---|
| Skin irritant (Category 2) | H315 – Causes skin irritation |
| Eye irritant (Category 2A) | H319 – Causes serious eye irritation |

### 6.3. Human Health Risk Characterisation

#### 6.3.1. Occupational Health and Safety
The notified polymer may be a skin and eye irritant and its acute or repeated dose toxicity and skin sensitisation effects are unknown. Industrial workers may have the potential for dermal and ocular exposure to the notified polymer at up to 10% concentration during the mixing of the notified polymer with brine prior to pumping down the well, and when the fluid is pumped back to the surface. The use of PPE such as gloves, goggles and protective clothing, as well as automated processes, are expected to minimise dermal and ocular exposure and therefore reduce the risk of skin and eye irritation.

Provided that the recommended controls are being adhered to, under the conditions of the occupational settings described, the notified polymer is not considered to pose an unreasonable risk to the health of workers.

#### 6.3.2. Public Health
The finished product containing the notified polymer is intended for industrial applications only, hence public exposure to the notified polymer is not expected.

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

## 7. ENVIRONMENTAL IMPLICATIONS

### 7.1. Environmental Exposure & Fate Assessment

#### 7.1.1. Environmental Exposure

RELEASE OF CHEMICAL AT SITE
No reformulation occurs in Australia and therefore, no environmental release is expected from manufacture or reformulation. Release of the notified polymer from transportation, storage and residue in empty containers is expected to be minimal. Accidental spills of the notified polymer are expected to be contained with inert absorbent material, swept up, placed into containers and disposed of after appropriate treatment.

RELEASE OF CHEMICAL FROM USE

The total import volume of the product containing the notified polymer will be used in drilling completion workovers for off-shore application. The product containing the notified polymer will be drained by gravity or pumped into pits, mixed and dissolved in the completion fluids.

The resulting completion fluid will then be pumped into the well and remain there to fulfil its function as a corrosion inhibitor. The concentration of the product in the completion mixture is reported by the notifier to be 5 kg/$m^3$ (5,000 mg/L). The preparation of the completion fluid containing the notified polymer and addition of the fluid to the well would be completed under controlled conditions by trained crew. The release of the notified polymer from this process is expected to be minimal.

RELEASE OF CHEMICAL FROM DISPOSAL
After drilling completion applications, the majority of the notified polymer will be retained in the formation by adsorption to the formation matrix during the operation. There will be a small fraction of the notified polymer

being returned to surface as a result of cleaning the completion fluids from the wells. The fraction of the notified polymer returning to surface is not reported by the notifier. However, the CHARM model (Thatcher et al., 2005, p. 51) estimates 10% of the total use amount of a chemical returns back to surface for this kind of completion application. Although the completion fluids containing the notified polymer may be collected for on-shore disposal, water soluble chemicals may be directly disposed of to seawater in Australia.

### 7.1.2. Environmental Fate

The notified polymer is not readily biodegradable in seawater (35.1% in 28 days). For the details of the environmental fate study, please refer to Appendix A. The notified polymer is not expected to bioaccumulate in biota based on its high water solubility and surfactant properties.

Most of the notified polymer may remain inside the well holes for one month to two years where it is expected to degrade eventually to form water and oxides of carbon and nitrogen. Approximately 10% of the total use of the notified polymer may return to surface and be discharged to seawater. Based on its high water solubility, the notified polymer is expected to dissolve in seawater and be dispersed by tidal and ocean currents following mixing of completion fluids with seawater around the discharge point. The notified polymer is expected to remain dissolved in seawater until it is degraded by biotic/abiotic processes to form water, oxides of carbon and nitrogen.

### 7.1.3. Predicted Environmental Concentration (PEC)

According to the CHARM model (Thatcher et al., 2005, p. 24), the PEC for completion chemicals in seawater is calculated using the following equation:

$$PEC_{water} = f_r \times C_{i,completion} \times D_{batch,completion}$$

In this relationship, $PEC_{water,}$ is related to fraction released chemical ($f_r$), the initial concentration of chemical in completion ($C_{i,\ completion}$, mg/L) and the batch-wise dilution factor ($D_{batch,\ completion}$).

The initial concentration of the product is 5, 000 mg/L in completion fluids. The product contains < 10% notified polymer and therefore, the initial concentration of the notified polymer in the completion fluid is approximately 500 mg/L. No specific values have been provided for operations under Australia conditions, hence, the default values for $f_r$ (0.1) and $D_{batch,\ completion}$ ($7.1 \times 10^{-5}$ at 500 m drilling depth) as specified in the CHARM model have been used. Based on these default values, the $PEC_{water}$ for the notified polymer is calculated to be 3.6 µg/L ($PEC_{water,batch} = 500\ mg/L \times 0.1 \times 7.1 \times 10^{-5} = 0.0036\ mg/L$).

The $PEC_{water,batch}$ calculated above is based on a theoretical values in which all of the mass of notified polymer discharged is present in seawater within a radius of 500 m from the discharge point. This PEC value is expected to represent the worst case polymer concentration in seawater given the notified polymer is highly water soluble and expected to be dispersed by tidal and ocean currents with seawater around the discharge point.

## 7.2. Environmental Effects Assessment

The results from ecotoxicological investigations conducted on the notified polymer are summarised in the table below. For full details of the studies on the notified polymer, refer to Appendix A.

| *Endpoint* | *Result (mg/L)* | *Assessment Conclusion* |
|---|---|---|
| Fish Toxicity (*Cyprinodon variegatus)* | 96 h LC50 > 0.53 | May be very toxic to marine fish |
| Invertebrate Toxicity (*Acartia tonsa)* | 48 h LC50 = 3.81 | Toxic to marine invertebrates |
| Invertebrate Toxicity (*Corophium volutator)* | 10 d LC50 ≥ 13471 | |
| Algal Toxicity (*Skeletonema costatum*) | 72 h ErC50 = 0.53 | Very toxic to marine algae |

Based on the above ecotoxicological endpoints, the notified polymer is considered to be acutely very toxic to algae. Therefore, under the *Globally Harmonised System of Classification and Labelling of Chemicals (GHS)* (United Nations, 2009), the notified polymer is formally classified as “Category 1, Very toxic to aquatic life”.

The notified polymer is not readily biodegradable and is acutely very toxic to algae. Therefore, under the GHS, the notified polymer is formally classified as “Category 1, Very toxic to aquatic life with long lasting effects”.

### 7.2.1. Predicted No-Effect Concentration

The predicted no-effect concentration (PNEC) for marine species has been calculated by using the endpoint of the most sensitive species, namely algae, 72 hours ErC50 = 0.53 mg/L. The PNEC is conservatively predicted

based on the acute result from algae and a safety factor of 100. A safety factor of 100 was used since acute endpoints for three trophic levels are available.

| Predicted No-Effect Concentration (PNEC) for the Aquatic Compartment | | |
|---|---|---|
| EC50 (algae) | 0.53 | mg/L |
| Assessment Factor | 100 | |
| PNEC | 5.3 | µg/L |

### 7.3. Environmental Risk Assessment

The notified polymer will be for off-shore application only. The risk quotient (Q = PEC/PNEC) has been calculated for discharge to marine water.

| Risk Assessment | PEC (µg/L) | PNEC (µg/L) | Q |
|---|---|---|---|
| Q - Ocean | 3.6 | 5.3 | 0.68 |

The PEC of the notified polymer in the vicinity of an off-shore drilling site is calculated based on a worst-case scenario of discharge of notified polymer over a short period into the ocean. The risk quotient (RQ = PEC/PNEC) for this release scenario is < 1, indicating that the use of the notified polymer as proposed is not expected to cause unreasonable risk to the environment. The notified polymer is expected to degrade and be dispersed by tidal and ocean currents with seawater around the discharge point.

# APPENDIX A: ENVIRONMENTAL FATE AND ECOTOXICOLOGICAL INVESTIGATIONS

## A.1. Environmental Fate

### A.1.1. Ready biodegradability

| | |
|---|---|
| TEST SUBSTANCE | Notified polymer |
| METHOD | OECD TG 306, Biodegradation in seawater |
| Inoculum | Natural seawater |
| Exposure Period | 28 days |
| Auxiliary Solvent | None |
| Analytical Monitoring | Dissolved oxygen measurement by oxygen meter |
| Remarks - Method | Following a preliminary test, the biodegradation test was conducted according to the test guideline above without significant deviation from the protocol. |

RESULTS

| *Test substance* | | *Sodium benzoate* | |
|---|---|---|---|
| *Day* | *% Degradation* | *Day* | *% Degradation* |
| 5 | 9.7 | 5 | 64.3 |
| 14 | 25 | 14 | 82.6 |
| 21 | 28.3 | 21 | 78.6 |
| 28 | 35.1 | 28 | 84.9 |

| | |
|---|---|
| Remarks - Results | The reference substance attained 64.3% degradation in 5 days and the degradation of the blank is less than 30%. The test results are considered to be valid. |
| CONCLUSION | The notified polymer is not readily biodegradable in seawater. |
| TEST FACILITY | Marine ecotoxicology (2011a) |

## A.2. Ecotoxicological Investigations

### A.2.1. Acute toxicity to fish

| | |
|---|---|
| TEST SUBSTANCE | Notified polymer |
| METHOD | OECD TG 203 Fish, Acute Toxicity Test (1993) – Semi-Static |
| Species | Sheepshead Minnow (*Cyprinodon variegatus*) |
| Exposure Period | 96 hours |
| Auxiliary Solvent | None |
| Water Hardness | Artificial seawater, Salinity = 30‰ |
| Analytical Monitoring | None |
| Remarks – Method | A limit test was conducted according to the test guideline above. The test substance was dissolved in artificial seawater directly to prepare the test solutions. The test solutions were renewed every 48 hours. |

RESULTS

| *Concentration mg/L* | | *Number of Fish* | *Mortality* | | | | |
|---|---|---|---|---|---|---|---|
| *Nominal* | *Actual* | | *2h* | *24 h* | *48 h* | *72 h* | *96 h* |
| Control | - | 10 | 0 | 0 | 0 | 0 | 0 |
| 0.53 | Not determined | 10 | 0 | 0 | 0 | 0 | 0 |

| | |
|---|---|
| LC50 | > 0.53 mg/L at 96 hours |
| Remarks – Results | No mortality or visible sub-lethal effect was observed at the nominal |

concentration of 0.53 mg/L.

The tested concentration was not confirmed during the test and the nominal concentration was used for the calculation.

CONCLUSION The notified polymer may be toxic to fish

TEST FACILITY CEIL (2016a)

**A.2.2. Acute toxicity to aquatic invertebrates**

TEST SUBSTANCE Notified polymer

METHOD ISO 1466:1999 "Water quality – Determination of acute lethal toxicity to marine copepods (Copepod, Crustacea)"- Static.

| | |
|---|---|
| Species | *Acartia tonsa* |
| Exposure Period | 48 hours |
| Auxiliary Solvent | None |
| Water Hardness | Natural seawater, Salinity = 29‰ |
| Analytical Monitoring | None |
| Remarks - Method | The tests were conducted according to the test guideline above. The test substance was dissolved in seawater directly to prepare the test solutions. A positive control (3,5 dichlorophenol) had been run less than six months prior to the study. |

RESULTS

| *Concentration mg/L* | | *Number of Acartia tonsa* | *Number Immobilised* | |
|---|---|---|---|---|
| *Nominal* | *Actual* | | *24 h* | *48 h* |
| Control | - | 20 | 1 | 1 |
| 0.032 | Not determined | 20 | 0 | 1 |
| 0.10 | Not determined | 20 | 1 | 3 |
| 0.32 | Not determined | 20 | 2 | 5 |
| 1.0 | Not determined | 20 | 0 | 3 |
| 3.2 | Not determined | 20 | 1 | 4 |
| 10 | Not determined | 20 | 16 | 20 |

| | |
|---|---|
| LC50 | 3.81 mg/L (log/logit) at 48 hours |
| Remarks - Results | The actual concentrations of the test substance during the test were not measured and the test results were based on nominal concentration.<br><br>All validity criteria for the test were satisfied. The dissolved oxygen concentration remained greater than 5.48 mg/L and less than 10% immobility was observed in the control. The positive control determined an LC50 of 0.63 mg/L, which was within the accepted range. |

CONCLUSION The notified polymer is toxic to aquatic invertebrates.

TEST FACILITY CEIL (2016b)

**A.2.3. Acute toxicity to aquatic invertebrates**

TEST SUBSTANCE Notified polymer

METHOD OSPAR/PARCOM protocols on methods for the testing of chemicals used in the off-shore industry 2006, Part A: "A sediment bioassay using an amphipod *Corophium sp*" - Static

| | |
|---|---|
| Species | *Corophium volutator* |
| Exposure Period | 10 days |

| | |
|---|---|
| Auxiliary Solvent | None |
| Water Hardness | Artificial seawater, Salinity = 34‰ |
| Analytical Monitoring | None |
| Remarks - Method | The tests were conducted according to the test guideline above without significant deviation from the protocol. The test substance was dissolved in seawater directly to prepare the test solutions. |

RESULTS

| *Nominal Concentration mg/L* | | *Number of Corphium sp* | *% Mortality* |
|---|---|---|---|
| *Wet sediment* | *Dry sediment* | | *10 days* |
| Control | Control | 20 | 0 |
| 95 | 128 | 20 | 5 |
| 305 | 411 | 20 | 5 |
| 977 | 1316 | 20 | 5 |
| 3125 | 4209 | 20 | 5 |
| 10000 | 13471 | 20 | 25 |

| | |
|---|---|
| LC50 | > 13,471 mg/kg at 10 days |
| NOEC | 4,209 mg/kg at 10 days |
| Remarks - Results | The actual concentrations of the test substance during the test were not measured and the test results were based on nominal concentration.<br><br>The test animals behaved abnormally in the sediment surface at the test concentration 13471 mg/kg (dry weight sediment). |

TEST FACILITY CEIL (2016C)

**A.2.4. Algal growth inhibition test**

TEST SUBSTANCE Notified polymer

METHOD ISO guideline 10253: water quality – Marine algal growth inhibition test with *Skeletonema costatum* and *Phaeodactylum tricornutum*, 1991

| | |
|---|---|
| Species | *Marine algae (Skeletonema costatum)* |
| Exposure Period | 72 hours |
| Concentration Range | Nominal: Control, 0.10, 0.18, 0.32, 0.58 and 1.05 mg/L<br>Actual: Not determined |
| Auxiliary Solvent | None |
| Water Hardness | Natural seawater, mg $CaCO_3$/L not reported |
| Analytical Monitoring | Not reported |
| Remarks - Method | The test was conducted on marine algae according to the test guidelines above, with no significant deviations reported. A range finding toxicity test was run with concentrations up to 100 mg/L. Based on this test concentrations between 0.10 and 1.05 mg/L were prepared by direct dissolution of the polymer in the test medium. A positive control (1.5 mg/L of 3,5 dichlorophenol) was run. |

RESULTS

| *Biomass* | | *Growth* | |
|---|---|---|---|
| *EC50* | *NOEC* | *EC50* | *NOEC* |
| *mg/L at 72 h* | *mg/L at 72 h* | *mg/L at 72 h* | *mg/L at 72 h* |
| Not determined | Not determined | 0.53 | 0.32 |

| | |
|---|---|
| Remarks - Results | The actual concentrations of the test substance during the test were not measured and the test results were based on nominal concentration.<br><br>The cell density increased by a factor of greater than 16 in 72 hour in the |

| | |
|---|---|
| | blank culture, indicating the test results were valid. The positive control inhibited 55.7% of growth rate in comparison with the control and was within the accepted range. |
| CONCLUSION | The notified polymer is very toxic to marine algae. |
| TEST FACILITY | Marine ecotoxicology (2011b) |

# BIBLIOGRAPHY

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