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NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME (NICNAS)

FULL PUBLIC REPORT

Starch Copolymer in Poroseal

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 Full Public Report may be inspected at our NICNAS office by appointment only at Level 7, 260 Elizabeth St, SURRY HILLS NSW 2010.

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

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1. APPLICANT AND NOTIFICATION DETAILS

APPLICANT(S)
M-I Australia Pty Ltd (ABN 67 009 214 162)
11/251 Adelaide Terrace
PERTH WA 6000

NOTIFICATION CATEGORY
Limited: Synthetic polymer with Mn ≥ 1000 Da.

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, polymer constituents, residual monomers/impurities, use details and import volume.

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

PREVIOUS NOTIFICATION IN AUSTRALIA BY APPLICANT(S)
None

NOTIFICATION IN OTHER COUNTRIES
EU

2. IDENTITY OF CHEMICAL

MARKETING NAME(S)
Poroseal (product containing the notified polymer at 40-50%)

MOLECULAR WEIGHT
Mn >10,000 Da.

ANALYTICAL DATA
Reference GPC spectrum was provided.

3. COMPOSITION

DEGREE OF PURITY >99%

ADDITIVES/ADJUVANTS
None

LOSS OF MONOMERS, OTHER REACTANTS, ADDITIVES, IMPURITIES
None

DEGRADATION PRODUCTS
None

4. PHYSICAL AND CHEMICAL PROPERTIES

The following information on the physical and chemical properties of the notified polymer is based on the product Poroseal containing the notified polymer at 40-50% concentration in water. No data were submitted on the notified polymer itself.

APPEARANCE AT 20°C AND 101.3 kPa: Milky white liquid

Property	Value	Data Source/Justification
Boiling Point	100°C at 101.3 kPa	MSDS
Density	1110 kg/m^3	MSDS
Vapour Pressure	<1.3x10^{-9} kPa	Estimated based on NAMW > 1000 Da. (US EPA, 2007)
Water Solubility	Not determined	The notified polymer is reported to be partly soluble
Hydrolysis as a Function of pH	Not determined	The notified polymer is not expected to hydrolyse under environmental conditions
Partition Coefficient (n-octanol/water)	log Pow < 0	Estimated. The notified polymer forms an emulsion in a water/octanol mixture
Adsorption/Desorption	Not determined	The notified polymer is expected to adsorb to soils and sediment based on its high molecular weight
Dissociation Constant	Not determined	The notified polymer has no dissociable functions
Particle Size[1]	Average particle size = 0.201 µm	Measured
Flash Point	Not determined	Expected to have a high flash point based on molecular weight
Flammability	Not determined	Not expected to be flammable
Autoignition Temperature	Not determined	Not expected to autoignite
Explosive Properties	Not determined	Not expected to be explosive

[1] Particle size measurement relates to the notified polymer in powder form.

DISCUSSION OF PROPERTIES

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

Reactivity

The notified polymer is expected to be stable under normal ambient conditions.

Dangerous Goods classification

Based on the estimated and submitted physical-chemical data in the above table the notified polymer is not classified according to the Australian Dangerous Goods Code (NTC, 2007). However the data above do not address all Dangerous Goods endpoints. Therefore consideration of all endpoints should be undertaken before a final decision on the Dangerous Goods classification is made by the introducer of the polymer.

5. INTRODUCTION AND USE INFORMATION

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

The notified polymer will be imported in a formulation at 40-50% concentration in 208 L drums by sea.

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

Year	*1*	*2*	*3*	*4*	*5*
Tonnes	<300	<300	<300	<300	<300

PORT OF ENTRY

Perth

IDENTITY OF MANUFACTURER/RECIPIENTS

M-I Australia Pty Ltd

TRANSPORTATION AND PACKAGING
The notified polymer will be imported at 40-50% concentration in water in 208 L drums for use in offshore oil and gas drilling operations. Once imported, it will be transported to a warehouse in Perth prior to distribution to customers for offshore use.

USE
The notified polymer will be used at ≤5% concentration as an additive for water-based drilling fluids in offshore oil and gas drilling operations.

OPERATION DESCRIPTION
The notified polymer will be imported at 40-50% concentration and transported to the notifier's warehouse for storage prior to distribution to customer's drilling facilities offshore. At the offshore drilling operations, the product containing the notified polymer will be weighed and transferred manually to a hopper where it will be mixed at a concentration of ≤5% with other components of the drilling fluids. The drilling fluids will then be pumped into the drill holes and returned to the surface in drilling mud cuttings.

6. HUMAN HEALTH IMPLICATIONS

6.1 Exposure assessment

6.1.1 Occupational exposure

EXPOSURE DETAILS
Transport and warehousing workers may come into dermal and ocular contact with the notified polymer through accidental leaks and spillages of the drums and containers.

During mixing of the product into drilling fluids, workers will manually weigh and transfer the polymer product (containing the notified polymer at 40-50% concentration) to the hopper for mixing which may lead to dermal, inhalation and ocular exposure. Workers will wear appropriate personal protective equipment (PPE) such as impermeable gloves, eye protection and coats to minimise dermal and ocular exposure. Inhalation exposure to aerosols of the notified polymer created during the mixing and transfer processes is also possible. However, this is expected to be lowered by conducting transfers in well-ventilated areas and/or by using local exhaust ventilation. Inhalation exposure to vapours of the notified polymer is not anticipated to be significant due to its low vapour pressure.

Workers may also encounter dermal and ocular exposure to the notified polymer at ≤5% in drilling mud cuttings when they are returned to the surface. However, exposure will be minimised by the use of PPE such as impermeable gloves, eye protection and overalls.

6.1.2. Public exposure
The notified polymer is intended for industrial use on specific sites and therefore public exposure is not anticipated.

6.2. Human health effects assessment

No toxicity data were submitted on the notified polymer.

The notified polymer has a high molecular weight (> 10000 Da.) and is not expected to be absorbed via the oral, dermal or inhalation route.

Health hazard classification
No toxicity data are provided for the notified polymer. Therefore, it cannot be classified according to the *Approved Criteria for Classifying Hazardous Substances* (NOHSC, 2004).

6.3. Human health risk characterisation

6.3.1. Occupational health and safety

Workers may encounter dermal and ocular exposure to the notified polymer (40-50%) during manual transfer of the notified polymer to the hopper for mixing and at ≤5% concentration in drilling mud cuttings when they are returned to the surface. The anticipated use of PPE such as protective clothing, safety goggles and impermeable gloves during these processes is expected to minimise the potential for dermal and ocular exposure and therefore the risk via these routes of exposure is not considered unacceptable.

The risk posed by inhalation of the notified polymer in aerosol form is uncertain. Inhalation exposure is expected to be minimised by the processes taking place in a well-ventilated area which may include the use of local exhaust ventilation.

Overall, the risk presented by the notified polymer to workers is not considered to be unacceptable, based on the expected control measures and PPE in use.

6.3.2. Public health

The notified polymer is intended only for use at specific industrial sites and as such public exposure to the notified polymer is not expected.

7. ENVIRONMENTAL IMPLICATIONS

7.1. Environmental Exposure & Fate Assessment

7.1.1 Environmental Exposure

RELEASE OF CHEMICAL AT SITE

The notified polymer will be imported as a component of a finished end-use product and will not be reformulated in Australia. Release to the environment during shipping, transport and warehousing could occur through accidental spills or leaks of the drums or containers. During formulation and packaging, spills are expected to be minimal. When spills occur, they will be contained by diking, collected with absorbent material and sent to a licensed off site waste disposal centre. Empty drums from import will be sent to drum reconditioners. Total waste from all sources is expected to constitute approximately 2% of the total import volume.

RELEASE OF CHEMICAL FROM USE

It is assumed that a total of 2000 kg of the notified polymer will be added to drilling muds for each well that is drilled with the majority added initially and smaller amounts added throughout the drilling operation. All drilling will be off-shore and a single drilling operation is expected to last between 1 – 6 weeks. The notified polymer will be used in water-based muds. During gas and oil well drilling operations, drilling mud containing up to ≤5% of the notified polymer will be pumped down the drill shaft where it functions as a combination of filtration control, carrier for the solid cuttings, and shale sealant to minimise drilling fluid loss into the formations during drilling of deep wells. The drilling mud will eventually be pushed out of the well and transferred to the surface for solids processing. This involves a sifting step along with low speed centrifugation in order to remove the drill cuttings. The drilling mud containing the notified polymer will be recovered and then replenished with additional mud containing more notified polymer and then transferred back down into the well. The drill cuttings that represent about 5-10% of the material transferred to the surface contain some adhered drilling mud. After separation, we estimate that the drill cuttings will contain approximately 5-15% entrained drilling mud based on a literature value of 15% for a worst case and 5% for modern practices. Although it is possible for cuttings to be re-injected into the well or collected for on-shore disposal or re-use as general fill, it would appear that this is not generally practiced in Australia. Consequently, in the case of off-shore drilling, the cuttings (and the entrained mud) will be discharged into the ocean. Thus, it is estimated that 5% of the notified polymer that is used in drilling mud for each well (100 kg) will be released into the ocean with drill cuttings during drilling operations off-shore.

RELEASE OF CHEMICAL FROM DISPOSAL

After the completion of off-shore drilling operations, the used drilling mud along with the remaining notified polymer will be discharged into the ocean. For the purposes of assessment, it is assumed that all of the notified polymer that is not released with the drill cuttings (95% or 1900 kg per well) will be subsequently discharged along with the used mud.

7.1.2 Environmental fate

Water-based muds and cuttings containing the notified polymer will be discharged to the ocean. The notified polymer is reported as being partly soluble in water and therefore some of the notified polymer will be dispersed by tidal and ocean currents following mixing of the waste drilling mud and cuttings with sea water around the discharge point. Most of the polymer is expected to sediment to the sea bed with the cuttings. A study submitted by the notifier indicates that the notified polymer is inherently biodegradable in seawater. Based on its high molecular weight, it is expected that the majority of the notified polymer will associate with solids and sediments, and degrade to water and oxides of carbon. Based on its high molecular weight, the notified polymer is not expected to bioaccumulate.

For the details of the environmental fate studies, refer to Appendix B.

7.1.3 Predicted Environmental Concentration (PEC)

The notified polymer was reported as being partly soluble in water, however no quantitative data was provided to support this. Therefore, the PEC for the two-worst case scenarios were calculated. The first scenario a $PEC_{sediment}$ was calculated assuming that all of the notified polymer is deposited on the seafloor beneath the discharge point along with the cuttings and entrained mud. The second scenario a $PEC_{water,batch}$ was calculated assuming a batch-wise discharge of the water based mud.

Scenario 1
An estimate of the $PEC_{sediment}$ can be made in accordance with the CHARM model assuming that the greatest effect of the notified polymer will occur within a radius (r) of 500 m from the discharge line. In this case, the total volume of sediment affected is $\pi r^2 d$. If the depth of sediment (d) is taken to be 5 cm, the resulting volume of affected sediment is 39,300 m^3. If the density of the sediment is approximately 1000 kg/m^3, then the mass of affected sediment is 39,300 tonnes. If it is further assumed for a worst case that all of the discharged mass of notified polymer in a batch of used water based mud (2000 kg) is deposited in this layer of sediment, then the $PEC_{sediment}$ for the notified polymer in the benthic system is estimated to be 51 mg/kg.

Scenario 2
In the CHARM model (Thatcher et al., 2005, p. 23), the PEC for drilling chemicals in seawater resulting from batch-wise discharge of water-based muds ($PEC_{water,batch}$/ mg L^{-1}) is calculated using the following equation:

$$PEC_{water,batch} = \frac{M}{V_m} \times D_{batch} \times 10^3$$

In this relationship, $PEC_{water,batch}$ is related to the amount of chemical discharged (M/kg), the volume of mud discharged for the specific section drilled (V_m/m^3), and the dilution factor for batch-wise discharges (D_{batch}). The specific values for volume of mud discharged and the dilution factor have not been provided for operations under Australian conditions. Hence, the default values for V_m (375 m^3 for a 1500 m drill length) and D_{batch} (7.7×10^{-5}) as specified in the CHARM model for the batch-wise discharge scenario have been used for this calculation (Thatcher et al., 2005, p. 46). Based on these default values, and the worst case discharge of 1900 kg of notified polymer in a single batch of used mud, the $PEC_{water,batch}$ for the notified polymer is calculated to be 0.39 mg/L.

7.2. Environmental effects assessment

The results from marine ecotoxicological investigations conducted on the notified polymer are summarised in the table below. Details of these studies can be found in Appendix B.

Endpoint	*Result*	*Assessment Conclusion*
Fish Toxicity		
Cyprinodon variegatus (96 hours)	LC50 > 63.3 mg/L	Potentially harmful
Invertebrate Toxicity		
Arcatia tonsa (48 hours)	EC50 = 311 mg/L	Not harmful
Corophium volutator (10 days)	LC50 > 72 mg/kg dry weight sediment	Not classifiable
Algal Toxicity		

Skeletonema costatum (72 hours)	E_rC50 = 63 mg/L	Harmful

The notified polymer is classified as harmful to aquatic life under the Globally Harmonised System of Classification and Labelling of Chemicals (United Nations, 2009). The notified polymer has a low potential to biodegrade in seawater and has an acute toxicity endpoint < 100 mg/L and therefore it is chronically classified as harmful to aquatic life with long lasting effects.

Based on the indicated toxicity of the notified polymer to the algae, *Skeletonema costatum*, marine algae are the most sensitive biota to toxic effects of the notified polymer. The toxicity of the notified polymer to the sediment dwelling organism, *Corophium volutator,* has been evaluated in an acute toxicity test which found some toxicity, but only at very high sediment concentrations.

7.2.1 Predicted No-Effect Concentration

Ecotoxicity data was provided for pelagic and benthic biota, hence PNECs were calculated for the sediment and aquatic compartments. $PNEC_{aquatic}$ was based on the endpoint for algae as it was the most sensitive aquatic species. Since three aquatic ecotoxicological studies were available, an assessment factor of 100 was used giving a $PNEC_{aquatic}$ of 0.63 mg/L. The $PNEC_{sediment}$ was based on the only benthic endpoint available (*Corophium volutator)* and had an assessment factor of 1000 applied. The $PNEC_{sediment}$ was calculated to be 0.072 mg/kg.

7.3. Environmental risk assessment

The notified polymer is used for a specific application in the oil and gas-drilling industry at off-shore sites in Western Australia. The environmental exposure of the notified polymer is therefore concentrated to one location. The main route for exposure of the environment to the notified polymer is through the discharge of drill cuttings and used drilling muds overboard at off-shore drilling sites. All of the notified polymer used in water-based muds is expected to be discharged to the ocean at the completion of drilling.

The risk quotient (RQ=PEC/PNEC) has been calculated for the worst case discharge scenario in the aquatic compartment and is 0.62. However, based on the expected low concentration of the notified polymer in the water column and its inability to bioaccumulate, there is a low risk to pelagic biota from this polymer when it is discharged in mud and cuttings into the ocean.

The majority of discharged mass of this polymer is expected to remain associated with the insoluble minerals and other solids discharged overboard, based on the expected partial solubility of the notified polymer in water. Most of the notified polymer is therefore expected to deposit on the sea floor beneath the discharge point along with the mud and cuttings.

Based on a sediment density value of 1000 kg/m^3, the PNEC value for the formulated product, and, worst case, a discharge of 2000 kg of notified polymer per well depositing on the sea floor beneath the discharge point, the mass of sediment required to produce an acceptable level of risk is $< 2.78 \times 10^{10}$ kg ($= 2 \times 10^9$ mg $\div > 0.072$ mg/kg), and the volume would be $< 2.78 \times 10^7$ m^3 ($= < 2 \times 10^{10}$ kg $\div$ 1000 kg/m^3). If the aerobic zone of the sediment is assumed to be 5 cm and the release pattern cylindrical into the sediment (with an affected volume of $\pi r^2 h$), then the use of this notified polymer may have the potential to have an adverse effect on sediment-dwelling organisms at a radius up to 13,303 m ($= \sqrt{(2.78 \times 10^7 \text{ m}^3/0.05\pi)}$) from the point of release.

The potential impact radius in the aerobic zone of sediment for the notified polymer is over twenty times the radius (500 m) from an off-shore drilling location assumed in the CHARM model. However, this calculation is based on conservative estimates for both discharge volumes, the deposit radius [mounds of cuttings are known to be up to 2 m high, for example, in the NW Shelf (p 85, Oil and Gas Producers, 2003)] and sediment toxicity. Also, the deposition of cuttings may result in physical smothering of benthic organisms regardless of the nature of the cuttings (p. 29, Oil and Gas Producers, 2003) which, in this case, would be more likely to have adverse effects than any potential chemical toxicity of the notified polymer.

Conclusion

Based on the expected low concentration of the notified polymer in the water column and its inability to bioaccumulate, there is a low risk to pelagic biota from this polymer when it is discharged in mud and cuttings into the ocean.

Based on conservative risk analyses for sediment organisms exposed to water based muds, the notified polymer is not expected to have adverse effects on benthic biota outside the immediate vicinity of off-shore oil and gas sites following a worst case discharge of the muds. Some transient toxic effects may occur beneath the discharge point, but in this case these are not likely to be significant given the potential for physical effects on

biota resulting from deposition of mud and cuttings on the sea floor.

The environmental risks associated with the introduction and intended use of the notified polymer are therefore acceptably low.

8. CONCLUSIONS AND REGULATORY OBLIGATIONS

Hazard classification
No toxicity data are provided for the notified polymer. Therefore, it cannot be classified according to the *Approved Criteria for Classifying Hazardous Substances* (NOHSC, 2004).

The classification of the notified polymer using the Globally Harmonised System for the Classification and Labelling of Chemicals (GHS) (United Nations 2003) is presented below. This system is not mandated in Australia and carries no legal status but is presented for information purposes.

	Hazard category	***Hazard statement***
Environment	Acute	Harmful to aquatic life
	Chronic	Harmful 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
Based on its reported use pattern and low toxicity to marine biota, the notified polymer is not considered to pose a risk to the environment.

Recommendations

CONTROL MEASURES
Occupational Health and Safety

- Employers should implement the following safe work practices to minimise occupational exposure during handling of the notified polymer as imported at 40-50% concentration in the product Starch Copolymer in Poroseal:
  - Local exhaust ventilation

- Employers should ensure that the following personal protective equipment is used by workers to minimise occupational exposure to the notified polymer as imported at 40-50% concentration in the product Starch Copolymer in Poroseal and during use at concentration of ≤5%:
  - Safety gloves
  - Safety glasses
  - Overalls

  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.

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(1) of the Act; if
  - the polymer is intended to be introduced in powder form

or

(2) Under Section 64(2) of the Act; if
  - the function or use of the polymer has changed from drilling fluid additive at concentrations ≤5% for use in offshore oil and gas drilling operations, or is likely to change significantly;
  - the amount of polymer being introduced has increased from 300 tonnes, 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.

Material Safety Data Sheet
The MSDS of a 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

Density 1110 kg/m^3

Method	Not provided.
Test Facility	Confidential

Partition Coefficient (n-octanol/water) log Pow < 0 (estimated)

Method	OECD TG 117 Partition Coefficient (n-octanol/water)
Remarks	In a pre-screening test the test substance (30-60% notified polymer in water) was found to be unsuitable for HPLC analysis. The test substance was reported to be partly soluble in water and insoluble in methanol, octanol and the HPLC mobile phase (25% water, 75% methanol). The test substance formed an emulsion in an octanol/water mix. No quantitative results were reported. Based on its solubility, the notified polymer was estimated to have a log Pow < 0.
Test Facility	M-I SWACO (2010a)

APPENDIX B: ENVIRONMENTAL FATE AND ECOTOXICOLOGICAL INVESTIGATIONS

B.1.1 Environmental Fate

B.1.1. Biodegradability in seawater

TEST SUBSTANCE	Notified polymer (30 – 60%) in water
METHOD	OECD TG 306 Biodegradation in seawater: Closed bottle method
Inoculum	Natural seawater (salinity 31.7‰)
Exposure Period	28 days
Auxiliary Solvent	None reported
Analytical Monitoring	Oxygen meter
Remarks - Method	Seawater was collected from a depth of 40 m and had a salinity of 31.7‰. The test substance was added to seawater to make up a concentration of 2.7 mg/L.

RESULTS

Test substance		*Sodium benzoate*	
Day	*% Degradation*	*Day*	*% Degradation*
0	0	0	0
7	19	7	61
14	36	14	74
21	36	21	78
28	36	28	69

Remarks - Results	During the test the temperature was in the range 15 - 20ºC and oxygen consumption in the control media was 30% of the original amount (day 0) which are indicative of a valid test. Sodium benzoate degraded >60% in 14 days indicating microbial activity was satisfactory. The inhibitory test resulted in 57% degradation of sodium benzoate after 28 days indicating there is no interference between the two compounds. No O_2 consumption was observed during the abiotic test.
CONCLUSION	The notified polymer has a low potential to biodegrade in seawater.
TEST FACILITY	M-I SWACO (2010b)

B.2. Ecotoxicological Investigations

B.2.1 Acute toxicity to fish

TEST SUBSTANCE	Notified polymer (30 – 60%) in water
METHOD	OECD TG 203 Fish, Acute Toxicity Test – Semi-static – 96h (1993), modified to marine conditions. OSPAR / PARCOM Protocols on Methods for the Testing of Chemicals Used in the Offshore Industry 2006 (OSPAR, 2006).
Species	Juvenile sheepshead minnow (*Cyprinodon variegatus*)
Exposure Period	96 h
Auxiliary Solvent	None reported
Water Hardness	Not reported
Analytical Monitoring	Not reported
Remarks – Method	The test substance was dissolved directly into test vessels with natural seawater used as the dilution medium (salinity = 31.5‰). Throughout the study the temperature was within the range 19.4 – 20.7ºC and pH 7.8 – 8.1. Fish were only exposed to a single concentration of the test substance (211 mg/L). The test and control solutions were renewed at 48 hours.
RESULTS	The concentrations tabulated below are of the test substance (30-60%

solution).

Concentration mg/L		Number of Fish	Mortality				
Nominal	*Actual*		*0 h*	*24 h*	*48 h*	*72 h*	*96 h*
0	0	10	0	0	0	0	1
211	Not determined	10	0	0	0	0	0

LC50	> 63.3 mg/L at 96 hours
NOEC	63.3 mg/L at 96 hours
Remarks – Results	The response of a reference compound (3,5 dichlorophenol) was found to be in the acceptable range. The mortality of the blank did not exceed 10% and the dissolved oxygen concentration was >60% of air saturation throughout the test. Hence the test is considered valid. There was no analytical monitoring of the test substance. The results have been corrected to reflect the potentially most dilute concentration (30%) of the notified polymer in the test substance. These results do not exclude the possibility that the notified polymer has an LC50 ≤ 100 mg/L which is the upper limit for chemicals classified as harmful to aquatic life under the under the Globally Harmonised System of Classification and Labelling of Chemicals (United Nations, 2009). A conservative assumption was therefore made that the notified polymer is potentially harmful to marine fish.
CONCLUSION	The notified polymer is potentially harmful to marine fish.
TEST FACILITY	M-I SWACO (2010c)

B.2.2. Toxicity to sediment dwelling organisms

TEST SUBSTANCE	Notified polymer (30 – 60%) in water
METHOD	OSPAR / PARCOM Protocols on Methods for the Testing of Chemicals Used in the Offshore Industry 2006 (OSPAR, 2006).
Species	*Corophium volutator*
Exposure Period	10 days
Auxiliary Solvent	None reported
Water Hardness	Not reported
Analytical Monitoring	None reported
Remarks - Method	Dry sediment was spiked with the test substance and further blended into wet sediment. Seawater was then carefully poured over the sediment without any resuspension of the sediment into seawater. Seawater volume was maintained by replacement of evaporated water with freshwater purified by reverse osmosis. Each test vessel was aerated. Throughout the study the temperature was 14.7 – 16.6ºC, salinity was 32.4 – 35.8‰, pH was 7.6 – 8.1 and the oxygen saturation was >85%.
RESULTS	The concentrations tabulated below are of the test substance (30-60% solution).

Concentration mg/kg		Number of C. volutator	Mortality (day 10)	% Mortality (day 10)
Nominal	*Actual*			
0	0	40	4	10
240	Not determined	20	3	15

LC50	> 72 mg/kg dry weight sediment at 10 days
Remarks - Results	No analysis of test solutions was reported. The data were not suitable for probit analysis. The results have been corrected to reflect the potentially most dilute concentration (30%) of the notified polymer in the test

substance.

CONCLUSION The notified polymer may exhibit some toxicity to the sand dwelling marine amphipod, *Corophium volutator,* at high nominal loadings, but the toxicity cannot be classified.

TEST FACILITY M-I SWACO (2010d)

B.2.3. Acute toxicity to aquatic invertebrates

TEST SUBSTANCE Notified polymer (30 – 60%) in water

METHOD ISO 14669:1999
Species *Acartia tonsa*
Exposure Period 48 hours
Auxiliary Solvent None reported
Water Hardness Not reported
Analytical Monitoring None reported
Remarks - Method Seawater was collected from a depth of 40 m and had salinity of 31.5‰ on the collection day. Throughout the study the temperature was 19.2 – 20.7ºC, pH was 8.1 – 8.2 and the oxygen saturation was >80%. At each test concentration there were 4 replicates with 5 animals in each vessel. Organisms were also exposed to 3,5-dichlorophenol as the toxic reference.

RESULTS The concentrations tabulated below are of the test substance (30-60% solution).

Concentration mg/L	*Number of A. tonsa*	*Number Dead*	
Nominal		*24 h*	*48 h*
0	20	0	2
100	20	0	0
178	20	0	2
316	20	0	4
563	20	0	1
1001	20	0	7
3,5-dichlorophenol (1 mg/L)	20	16	18

LC50 311 mg/L at 48 h
NOEC 178 mg/L at 48 h
Remarks - Results A sigmoid response curve was observed on *Acartia tonsa* indicating mortality due to the notified polymer. The results have been corrected to reflect the potentially most dilute concentration (30%) of the notified polymer in the test substance. In the control 10% of the animals died which did not affect the validity of the test. The LC50 (48 h) of 3,5-dichlorophenol is anticipated to be 1.0 mg/L. At this concentration there was 80% mortality indicating an acceptable response of organisms.

CONCLUSION The notified polymer is not harmful to marine zooplankton

TEST FACILITY M-I SWACO (2010e)

B.2.4. Algal growth inhibition test

TEST SUBSTANCE Notified polymer (30 – 60%) in water

METHOD ISO/DP 10253

Species	*Skeletonema costatum*
Exposure Period	72 hours
Concentration Range	Nominal: 99 - 1011 mg/L (WAF) Actual: Not reported
Auxiliary Solvent	None reported
Water Hardness	Not reported
Analytical Monitoring	None reported
Remarks - Method	Seawater was collected from a depth of 40 m and had salinity of 31.1‰ on the collection day. Throughout the study the temperature was 20 – 21ºC. At 72 h the pH was 7.6 – 8.3. The algae was exposed to the reference chemical 3,5-dichlorophenol at a concentration of 1.6 mg/L.

RESULTS

The concentrations tabulated below are of the test substance (30-60% solution).

Biomass		*Growth*	
E_bC50	NOEC	E_rC50	NOEC
mg/L at 72 h	mg/L	mg/L at 72 h	mg/L
Not calculated	Not calculated	63	Not provided

Remarks - Results

The response to the reference chemical was within the range for a valid test. The test substance had a sigmoid response on *Skeletonema costatum* in the test range. The E_rC50 was calculated by Probit analysis. It does not state in the report that particulate matter (i.e. undissolved notified polymer) was observed in the WAF. The results have been corrected to reflect the potentially most dilute concentration (30%) of the notified polymer in the test substance.

CONCLUSION

The notified polymer is not harmful to marine algae

TEST FACILITY

M-I SWACO (2010f)

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