File No PLC/841

September 2009

NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME (NICNAS)

FULL PUBLIC REPORT

Polymer in EMI-759

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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1. APPLICANT AND NOTIFICATION DETAILS

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

NOTIFICATION CATEGORY
Polymer of Low Concern

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, Import Volume

VARIATION OF DATA REQUIREMENTS (SECTION 24 OF THE ACT)
Variation to the schedule of data requirements is claimed as follows:
Melting Point, Density, Water Solubility, Dissociation Constant

NOTIFICATION IN OTHER COUNTRIES
Europe
Canada (2005)

2. IDENTITY OF CHEMICAL

MARKETING NAME(S)
EMI-759 (contains ≤ 23% notified polymer)

MOLECULAR WEIGHT (MW)
Number Average Molecular Weight (Mn) >1000 Da

REACTIVE FUNCTIONAL GROUPS
The notified polymer contains only low concern functional groups.

3. PLC CRITERIA JUSTIFICATION

Criterion	*Criterion met*
Molecular Weight Requirements	Yes
Functional Group Equivalent Weight (FGEW) Requirements	Yes
Low Charge Density	Yes
Approved Elements Only	Yes
Stable Under Normal Conditions of Use	Yes
Not Water Absorbing	Yes
Not a Hazard Substance or Dangerous Good	Yes

The notified polymer meets the PLC criteria.

4. PHYSICAL AND CHEMICAL PROPERTIES

Appearance at 20°C and 101.3 kPa:	Colourless liquid
Melting Point/Glass Transition Temp	Not determined. Expected to be low (< 10°C) based on similar polymers. The notified polymer will only be introduced in solution.
Density	850 kg/m^3 (for product EMI-759)
Water Solubility	Not determined. Expected to be low based on the predominately hydrophobic chemical structure of the polymer.
Dissociation Constant	Not determined. The notified polymer contains carboxylic acid functionality and may be ionised under normal environmental conditions.
Reactivity	The notified polymer contains functional groups that may be slowly hydrolysed in the environment.
Degradation Products	None under normal conditions of use

5. INTRODUCTION AND USE INFORMATION

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

Year	*1*	*2*	*3*	*4*	*5*
Tonnes	1 – 10	1 – 10	1 – 10	10 – 20	10 – 20

Use
The notified polymer will be used as a weighting additive for drilling fluid used in offshore drilling applications.

At the drill site, workers will connect the IBC to a welden pump for pumping across to a mixing system consisting of a hopper, mixing pump and storage fluid pit. The bottom of the hopper is connected to a pipe/tube through which the drilling mud is transported under pressure and at high speed to the centre of the drill string. The transport of the mud pulls in the product containing the notified polymer from the hopper by the Venturi effect and mixes it into the drilling mud. The hopper will be rinsed with water to ensure the residual product enters the delivery pipe.

Mode of Introduction and Disposal
The notified polymer will be imported at ≤ 23% in the product EMI-759 in 1000 L intermediate bulk containers (IBCs).

6. HUMAN HEALTH IMPLICATIONS

Hazard Characterisation
No toxicological data were submitted. The notified polymer meets the PLC criteria and is therefore assumed to be of low hazard.

Occupational Health and Safety Risk Assessment
Workers may encounter dermal and ocular exposure to the notified polymer (≤ 23%) during connection and disconnection of hoses from IBCs to the mixing system as well as during preparation of the drilling mud, cleaning and maintenance of the drill bits. The anticipated use of personal protective equipment such as protective clothing, safety goggles and protective gloves is expected to minimise the potential for dermal and ocular exposure.

Overall, the risk presented by the notified polymer to workers is not expected to be unacceptable, based on the minimal likely exposure and its assumed low hazard.

Public Health Risk Assessment
The notified polymer is intended only for use in industry and as such public exposure to the notified polymer is not expected. As the public is not expected to be exposed to the notified polymer the risk is not considered to be unacceptable.

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 product and will not be reformulated in Australia. Release from the liquid residue in imported containers is expected to be minimal (1%; up to 100 kg per annum in the first 3 years and 200 kg per annum in the next 2 years). The empty containers will be returned to the supply base for cleaning. Typically the equipment and containers will be steam-cleaned and the resultant emulsion will be sent to a site waste treatment facility where the oils are separated from the water and will eventually become incorporated into waste sludge. The sludge, including the notified polymer, is expected to be typically disposed to landfill. Accidental spills of the product are expected to be absorbed with inert absorbent material, swept up and placed into containers for disposal to landfill.

RELEASE OF CHEMICAL FROM USE

The notifier has indicated that a total of 2000 kg of the notified polymer (20% per annum of the import quantity over the first 3 years) 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 can be used in either water-based muds or non-aqueous drilling fluids (NADFs). The initial plan is just in NADFs. During gas and oil well drilling operations, drilling mud containing up to 1% w/w of the notified polymer will be pumped down the drill shaft where it functions as a combination of lubricant for the drill bit, carrier for the solid cuttings, and 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, the notifier indicates that the drill cuttings will contain approximately 5% entrained drilling mud. This is consistent with the 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

Water-Based Drilling Muds

After the completion of drilling operations, used water-based 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.

Non-Aqueous Drilling Fluids (NADFs)

After the completion of drilling operations, used NADFs, along with incorporated notified polymer, are returned on-shore for future re-use by workboats. On-shore facilities recondition and clean the NADF by centrifugation to separate the drill solids from the fluid. The clean NADF is then re-shipped to off-shore locations for reuse. The solids, with any adhering drilling fluid including incorporated notified polymer, will be disposed to landfill.

7.1.2 Environmental fate

The notified polymer has a predominately hydrophobic structure and is expected to have very low water solubility. When it's released into seawater in the vicinity of off-shore drilling sites, incorporated in water-based muds or non-aqueous drilling fluids (NADFs), it is expected to remain closely associated with the mineral components of the drilling mud and cuttings by adsorption and entrainment between particles of the cuttings.

Initial deposition is largely dependent on water depth and currents, as well as volume and density of the discharged cuttings. In deeper seawater, higher levels of entrained residual NADFs migrate to the seawater and lower levels are associated with the deposited cuttings. The low density non-aqueous base fluid, which incorporates the notified polymer that does migrate to the seawater is expected to agglomerate on the surface of the water, potentially forming a "slick" in calm seas and smaller aggregates in rougher seas. However, such

surface accumulation is expected to be rapidly dispersed by wave action and evaporation of the base fluid to the atmosphere. The residual notified polymer at the surface would be expected to partition to suspended solids which will eventually settle to the sea floor. The notified polymer is expected to slowly degrade, principally by abiotic processes.

The notified polymer associated with the deposited cuttings, accumulates in piles of waste material on the ocean floor beneath the discharge point. Persistence on the seafloor is related to sediment transport and resuspension as well as biodegradation of the base fluid. As the notified polymer has low potential to biodegrade in seawater (study summarised below), degradation due to abiotic and biotic processes can be expected to be very slow considering the conditions in the piles of drill cuttings and mud, including low temperatures and low density of bacteria.

The notified polymer is not expected to bioaccumulate in pelagic or benthic biota, due to its high average molecular weight.

Study Summary: Biodegradability in Seawater

The environmental fate study was conducted according to OECD TG 306 Biodegradability in seawater: Closed Bottle Method. The test medium was coarse filtered, natural seawater that was aged under appropriate aerobic conditions and was supplemented with nutrients, presumably according to the method recommended in the Guideline. The biodegradation of the notified polymer was evaluated at two nominal test concentrations of 5.00 and 7.00 mg/L of the formulated product, EMI-759. The reference substance used to monitor microbial activity was sodium benzoate. The dissolved oxygen concentration in the treatment bottles was determined after 0, 3, 7, 14, 21, and 28 days incubation at 15.5 – 19.0ºC in the dark. The test results were valid since the biodegradation of the reference substance was >90% complete after 3 days, and the average respiration in the blank test chambers was 9% over the 28 day test period. There was significant oxygen consumption in the test substance chambers after 28 days. In the 5 mg/L test chamber, oxygen consumption was equivalent to a BOD for the test substance of 1.22 mg O_2/mg test substance. In the 7 mg/L test chamber, the BOD was 0.96 mg O_2/mg test substance. The 28 day percentage biodegradability of the test substance was estimated as >100% based on a chemical oxygen demand measurement for the test substance (COD = 0.729 mg O_2/ mg test substance; titration method). However, this figure is considered a significant overestimate because the test sample contains a high percentage of paraffins whose COD is expected to be high (e.g. ThOD (octane) = 3.51 mg O_2/mg). The paraffinic components of the test substance are expected to be significantly more susceptible to biodegradation than the notified polymer. The oxygen consumption observed in this test is therefore taken to indicate biodegradation of the base fluid rather than the polymer. The notified polymer is expected to have low potential for biodegradation in seawater based on structural considerations.

7.1.3 Predicted Environmental Concentration (PEC)

Based on the expected low water solubility of the notified polymer, the concentration of soluble notified polymer in seawater is expected to be very low. The major proportion of notified polymer discharged at each site is expected to deposit on the seafloor beneath the discharge point along with the cuttings and entrained mud. The concentration of the notified polymer in sediment ($PEC_{sediment}$) is therefore of potential significance. 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. For NADFs, 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 and therefore the $PEC_{sediment}$ is estimated to be 2.6 mg/kg.

7.2. Environmental effects assessment

The results from ecotoxicological investigations conducted on the formulated end-use product, EMI-759, containing 23% notified polymer in kerosine, are summarised in the table below.

Endpoint	*Result*	*Assessment Conclusion*
Fish Toxicity		

Scophthalmus maximus (96 hours)	LL50 >1000 mg/L	Not harmful
Invertebrate Toxicity		
Arcatia tonsa (48 hours)	EL50 46.3 mg/L	Harmful
Sediment Dwelling Organism Toxicity		
Corophium volutator (10 days)	LC50 >10 000 mg/kg (dry wt)	Unclassifiable
Algal Toxicity		
Skeletonema costatum (72 hours)	E_rL50 >1000 mg/L	Not harmful

Based on the indicated toxicity of EMI-759 to the marine copepod, *Arcatia tonsa*, marine invertebrates 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.

Study Summary:
The study: Toxicity to Sediment Dwelling Organisms, was conducted on *Corophium volutator* under static conditions with continuous aeration over 10 days according to methods PARCOM 1995 and STL Runcorn SOP III.33. Calculated amounts of the formulated product (EMI-759) were added to sieved marine sediment and mixed thoroughly with 100 mL of artificial seawater with 25-35% salinity. Three replicate vessels for each test concentration and five replicates for the control were prepared. The dissolved oxygen concentration, temperature and pH of the water compartment over the test interval were acceptable. Test organisms at all nominal concentrations reached the sediment surface within 30 minutes of addition to the test vessels. Organisms which became opaque and were lying on the sediment surface, or exhibited no movement or response to stimuli at the end of the study were recorded as mortalities. The mortality data were analysed with Toxcalc and there was no evidence of a dose response. A high mortality rate (> 10%) was observed for the control, but an explanation was not provided. The result raises doubts as to the validity of the study. Also, the mortality results indicate a more appropriate LOEC is 3162.3 mg/kg (nominal concentration), but again the control results raises doubts as to the actual value for this endpoint. In conclusion, the formulated product, and by inference the notified polymer, may have some harmful effects on the sediment dwelling marine amphipod, *Corophium volutator,* at high nominal concentrations, but the toxicity cannot be classified.

7.2.1 Predicted No-Effect Concentration

As only one sediment ecotoxicology study was submitted, the endpoint for this species is divided by a safety factor of 1000.

Sediment PNEC

Predicted No-Effect Concentration (PNEC) for the Sediment Compartment		
LC50 (*Corophium volutator*)	> 10 000	mg/kg
Assessment Factor	1000	
Mitigation Factor	1.00	
PNEC:	> 10	mg/kg

There is not expected to be significant exposure of biota to the notified polymer in the water column near off-shore drilling sites due to the low water solubility of the polymer and its entrainment within mud and cuttings. A PNEC for the water compartment has therefore not been calculated in this case.

7.3. Environmental risk assessment
The notified polymer will be used for a specific application in the oil and gas-drilling industry at off-shore sites in the North West Shelf, South Australia and the Gippsland Basin. 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 notified polymer used in water-based muds is expected to be discharged to the ocean at the completion of drilling.
Based on the expected low water solubility of the notified polymer, the concentration of soluble notified polymer in seawater is expected to be very low. The low concentration of the notified polymer in the water column and its inability to bioaccumulate indicate there is a low risk to pelagic biota from the notified polymer when it is discharged in mud and cuttings into the ocean.

The majority of discharged mass of the notified polymer is expected to remain associated with the insoluble minerals and other solids discharged overboard, based on the expected low solubility of the notified polymer in

water. The majority of the notified polymer is therefore expected to deposit on the sea floor beneath the discharge point along with the mud and cuttings.

NADFs
The deposition of the notified polymer in sediments on the ocean floor beneath the discharge point resulting from discharge of non-aqueous based mud entrained in cuttings is expected to produce concentrations of up to 2.6 mg/kg of this polymer in the top 5 cm of sediment in the near vicinity of the discharge point. The PNEC (EMI-759) for sediment dwellers is > 10 mg/kg. Assuming the notified polymer has the same PNEC as EMI-759, and the study is valid, then the risk quotient (RQ = PEC/PNEC) for the notified polymer in NADFs is calculated as < 0.26. This value indicates a low risk to sediment dwellers associated with the chemical toxicity of the notified polymer in the NADFs.

Water based muds
Based on a sediment density value of 1000 kg/m^3, the PNEC value for the formulated product, and worst case 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 x 10^8 kg (= 2 x 10^9 mg ÷ >10 mg/kg), and the volume would be < 2 x 10^5 m^3 (= 2 x 10^8 kg ÷ 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 1130 m (= $\sqrt{(2 \times 10^5 \ m^3/0.05\pi)}$) from the point of release.

The potential impact radius in the aerobic zone of sediment for the notified polymer is a little over twice 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) and sediment toxicity. Also, the deposition of cuttings may result in physical smothering of benthic organisms regardless of the nature of the cuttings 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 NADFs and 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 RECOMMENDATIONS

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 the 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

- No specific engineering controls, work practices or personal protective equipment are required for the safe use of the notified polymer itself, however, these should be selected on the basis of all ingredients in the formulation.

  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 polymer 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 and/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 polymer under secondary notification provisions based on changes in certain circumstances. Under Section 64 of the *Industrial Chemicals (Notification and Assessment) Act (1989)* the notifier, as well as any other importer or manufacturer of the notified polymer, have post-assessment regulatory obligations to notify NICNAS when any of these circumstances change. These obligations apply even when the notified polymer is listed on the Australian Inventory of Chemical Substances (AICS).

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

(2) Under Section 64(2) of the Act; if
  - the function or use of the notified polymer has changed from additive to drilling fluids for use in offshore drilling applications, or is likely to change significantly;
  - the amount of notified polymer being introduced has increased, or is likely to increase, significantly;
  - the notified polymer 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.

Material Safety Data Sheet
The MSDS of products containing the notified polymer provided by the notifier were reviewed by NICNAS. The accuracy of the information on the MSDS remains the responsibility of the applicant.