File No PLC/876

December 2009

NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME (NICNAS)

FULL PUBLIC REPORT

XPR 134/ADAPTA

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)
Halliburton Australia Pty Ltd (ABN 73 009 000 775)
Level 2, 256 St Georges 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, Use Details, Manufacture/Import Volume, and Site of Reformulation.

NOTIFICATION IN OTHER COUNTRIES
China (1997)
Korea (1997)
USA (1998)
Canada (1999)
New Zealand (2006)

2. IDENTITY OF CHEMICAL

CHEMICAL NAME
2-Propenoic acid, 2-methyl-, 1,1'-(1,2-ethanediyl) ester, polymer with 1-ethenyl-4-methylbenzene, 2-ethylhexyl 2-propenoate and 2-methylpropyl 2-methyl-2-propenoate

OTHER NAME(S)
2-Propenoic acid, 2-ethylhexyl ester, polymer with 1,2-ethanediyl bis(2-methyl-2-propenoate), 1-ethenyl-4-methylbenzene and 2-methylpropyl 2-methyl-2-propenoate (9CI)

2-Propenoic acid, 2-methyl-, 1,2-ethanediyl ester, polymer with 1-ethenyl-4-methylbenzene, 2-ethylhexyl 2-propenoate and 2-methylpropyl 2-methyl-2-propenoate (9CI)

2-Propenoic acid, 2-methyl-, 2-methylpropyl ester, polymer with 1,2-ethanediyl bis(2-methyl-2-propenoate), 1-ethenyl-4-methylbenzene and 2-ethylhexyl 2-propenoate (9CI)

Benzene, 1-ethenyl-4-methyl-, polymer with 1,2-ethanediyl bis(2-methyl-2-propenoate), 2-ethylhexyl 2-propenoate and 2-methylpropyl 2-methyl-2-propenoate (9CI)

CAS NUMBER
118922-87-5

MARKETING NAME(S)
XPR 134
ADAPTA

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

4. PHYSICAL AND CHEMICAL PROPERTIES

Appearance at 20°C and 101.3 kPa:	Off-white powder
Glass Transition Temp	51-61°C
Density	1030 kg/m^3 at 25°C
Water Solubility	Not determined. Expected to be low based on the manufacturing process and the predominately hydrophobic chemical structure of the polymer.
Dissociation Constant	Not determined as the notified polymer contains no dissociable groups.
Particle Size	17.4% < 125 µm; 10% < 72 µm
Reactivity	The notified polymer contains hydrolysable functionality but hydrolysis is not expected to occur in the environmental pH range (4 – 9).
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	30-100	30-100	100-200	100-200	100-200

Use
The notified polymer will be used in petroleum production.

Mode of Introduction and Disposal
The notified polymer will be imported at concentrations of > 98% in 25 kg paper sacks with plastic lining. The notified polymer will be blended into a non-aqueous drilling fluid in a mixing tank, tested and transferred to bulk storage tanks. When required, it will be pumped from the storage tank and shipped to offshore drilling sites then pumped into wells. Some of the notified polymer may be transported directly to the offshore drill sites for blending at higher concentrations before transfer into wells.

6. HUMAN HEALTH IMPLICATIONS

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

However, the notified polymer is a high molecular weight, insoluble polymer that is likely to have some particles of respirable size. Respirable, high molecular weight, insoluble polymer particles are considered to be of some concern, due to studies in which irreversible lung damage was linked with inhalation of respirable particles of water-insoluble polymers*. This is expected to be a physical effect; i.e. deposition of particles to the deep lung from where they cannot be removed by normal clearance mechanisms. This may lead to lung overloading at higher exposure levels. Normal lung clearance mechanisms are expected to tolerate low exposures to the notified polymer.

Occupational Health and Safety Risk Assessment
Dermal and ocular exposure of workers to the notified polymer may occur when opening imported packages of the notified polymer, manually emptying them into a mixing tank for blending and when connecting and

disconnecting pump lines. Workers involved in these processes are expected to wear protective clothing, footwear, safety glasses and gloves to minimise the potential for exposure by dermal or ocular routes.

Inhalation exposure to the notified polymer (< 98%) may also occur during manual emptying of the imported product. However, such exposure is expected to be minimised by performing operations in a well-ventilated area and the wearing of respirators.

The OHS risk presented by the notified polymer is not expected to be unacceptable assuming that measures are taken to minimise dust levels as much as possible** and correctly fitted particle filter masks or respirators are worn by workers during manual transfer of the notified polymer.

* US EPA (2007) High Molecular Weight Polymers in the New Chemicals Program (http://www.epa.gov/oppt/newchems/pubs/hmwtpoly.htm) (Accessed: 25 September 2009)

**The Australian recommended exposure standard for dust is 10 mg/m^3 [NOHSC 3008:(1995)], but a recommended exposure limit of 3 mg/m^3 has been suggested by the American Conference of Governmental Industrial Hygienists (ACGIH) for "respirable (insoluble) particulates (not otherwise regulated)". Dust levels should be minimised as much as possible during manual transfer of the notified polymer from the imported packaging into the mixing tank. A correctly fitted particle filter mask or respirator should be worn by workers involved in manual transfer of the notified polymer.

Public Health Risk Assessment
The notified polymer is intended only for use in industry at specific sites and as such public exposure to the notified chemical is not expected.

7. ENVIRONMENTAL IMPLICATIONS

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. Therefore, no environmental release is expected from manufacture or reformulation in Australia. Release from the solid residue in imported multi-walled paper and plastic inlay sacks is expected to be minimal (< 0.1% of the imported volume). The emptied sacks and residues will be disposed to landfill. Accidental spills of the product will be contained, retrieved and disposed to landfill by certified waste treatment plant operators.

At the on-shore Liquid Mud Plant (LMP) the notified polymer will be blended into the base fluid (e.g. paraffins, esters, olefins) and with other chemicals in a mixing hopper to produce non-aqueous drilling fluids (NADFs). The NADFs are then stored in storage tanks. When required off-shore they will be transferred to the supply boat via a truck. Blending of the notified polymer and drilling fluid will also occur off-shore. Any spills and cleaning wastes are expected to be minimal and will be contained, retrieved and disposed to landfill by certified waste treatment plant operators.

RELEASE OF CHEMICAL FROM USE
The notifier has indicated that up to 20 000 kg of the notified polymer (20% per annum of the import quantity over the first 2 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 to 6 months. During gas and oil well drilling operations, drilling mud containing up to 2.6% 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 will contain some adhered drilling mud. After separation, the notifier indicates that the drill cuttings will contain approximately 5 – 10% 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, for a worst case, up to 10% of the notified polymer that is used in drilling mud for each well (up to 2000 kg) is expected to be released into the ocean with drill cuttings during drilling

operations off-shore.

RELEASE OF CHEMICAL FROM DISPOSAL
After the completion of drilling operations, the used NADFs, along with incorporated notified polymer, are usually shipped to the next off-shore well for further use. Occasionally the mud will require reconditioning which is either done on the rig or at the on-shore LMP. Any cleaning waste generated from the reconditioning process will be sent to a certified waste treatment plant for treatment and disposal. No whole volumes of NADFs are discharged to the marine environment.

7.1.2 Environmental fate

The notified polymer has a hydrophobic structure and is expected to have low water solubility. When it is released into seawater in the vicinity of off-shore drilling sites, 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 fluids, 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 very hydrophobic residual notified polymer 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, 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 seawater that was aged under aerobic conditions and was supplemented with nutrients according to the Guideline. The biodegradation of the notified polymer was evaluated at the nominal test concentration of 3.2 mg/L of a formulated product containing the notified polymer (> 90%). The reference substance used to monitor microbial activity was sodium benzoate. The dissolved oxygen concentration in the treatment bottles was determined after 0, 5, 15 and 28 days incubation at 15.0 – 15.6ºC in the dark. The test results were valid since the biodegradation of the reference substance was > 60% complete after 5 days, and the average respiration in the blank test chambers was ~10% over the 28 day test period. The biodegradation of the notified polymer was ≤ 2% based on the chemical oxygen demand. The limited degradation of the test substance under the conditions of this test indicates that this polymer has a low potential for biodegradation in seawater. This low potential is expected 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 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. In a worst case scenario, up to 10% of the notified polymer that is used in drilling mud for each well (2000 kg) will be released into the ocean with drill cuttings and therefore the

$PEC_{sediment}$ is estimated to be 50.9 mg/kg.

7.2. Environmental effects assessment

The results from ecotoxicological investigations conducted on formulated products containing > 90% notified polymer, are summarised in the table below.

Endpoint	*Result*	*Assessment Conclusion*
Invertebrate Toxicity		
Acartia tonsa (48 hours)	LL50 > 33 000 mg/L	Not harmful
Sediment Dwelling Organism Toxicity		
Corophium volutator (10 days)	LC50 >105 000 mg/kg (dry wt)	Not harmful
Leptocheirus plumulosis (96 hours)*	LC50 >83 300 mg/kg (dry wt)	Not harmful
Algal Toxicity		
Skeletonema costatum (72 hours)	E_rL50 >100 000 mg/L[#]	Not harmful

* Summary only provided
[#] Negative inhibition at 1000 mg/L (nominal)

The notified polymer is insoluble in water and both aquatic toxicity tests were performed using water accommodated fractions. There were no significant harmful effects observed on the marine zooplankton and algal species tested. The algal toxicity test was complicated by a lack of growth in the controls and negative inhibition at all nominal test concentrations of the notified polymer. There were no confirmed toxic effects on the two sediment dwelling species tested, even at the test concentrations that are infeasible in the environment.

Study Summary
The study most relevant to this risk assessment, namely Toxicity to Sediment Dwelling Organisms, was conducted on *Corophium volutator* under static conditions with continuous aeration over 10 days according to the draft PARCOM method. Calculated amounts of the formulated product containing the notified polymer at > 90% were added to sieved marine sediment and mixed thoroughly with seawater. Five replicate vessels for each test concentration and the control were prepared and test organisms were added at a density of 10 per vessel. Evaporative losses from the overlying seawater in the test vessels were replaced periodically with distilled water. The dissolved oxygen concentration in the water compartment over the test interval ranged 95 – 112%, the temperature ranged 14.7 ± 1.2°C, pH ranged 7.65 – 8.26 and salinity ranged 30 to 37%. These values were within the PARCOM recommended normal ranges except for salinity (normal range is ± 1.5 from the initial value). The variation in salinity resulted from evaporation of overlying water in the test vessels and hence increased concentrations of salt (salinity was measured before each vessel was topped up with distilled water). Few organisms were observed on the sediment surface or swimming in the overlying seawater. Organisms which were immobile at the end of the study were recorded as mortalities. Missing organisms were assumed to have died and decomposed during the test and hence this approach overestimates the endpoints. A high mortality rate (>10%) was observed for the control even though the water quality should not have affected them (*C. volutator* can tolerate a wide range of salinities). The mortality rate is expected to be overestimated as it is possible some of the missing did not die but were not found when the sediment was sieved (insufficient animals of the correct size were available for the test so smaller animals may have been used). For similar reasons, the LOEL is difficult to determine. Typical behaviour patterns of stressed *Corophium* (e.g. erratic swimming) were not observed. In conclusion, the formulated product, and by inference the notified polymer, have no harmful effects on the sediment dwelling marine amphipod, *Corophium volutator*.

7.2.1 Predicted No-Effect Concentration

As only one full study on marine sediment ecotoxicology was submitted (*Corophium volutator)*, 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*)	>105 000	mg/kg
Assessment Factor	1000	
PNEC:	>105	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 is used for a specific application in the oil and gas-drilling industry at off-shore sites in the West and North West Coasts, off the Western Australian coast, and the Bass Strait. The environmental exposure of the notified polymer is therefore concentrated in a few locations that are geographically dispersed around the north western to southern margins of the continent. 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.

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, the absence of any significant acute toxicity effects to species from two marine trophic levels, and its inability to bioaccumulate indicate 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 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.

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 50.9 mg/kg of this polymer (worst case) in the top 5 cm of sediment in the near vicinity of the discharge point. The PNEC for sediment dwellers is > 105 mg/kg and the risk quotient (RQ = PEC/PNEC) for the notified polymer in NADFs is calculated as < 0.48. This value indicates a low risk to sediment dwellers associated with the chemical toxicity of the notified polymer.

Based on conservative risk analyses for sediment organisms exposed to drilling 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 its reported use pattern and apparent low toxicity to marine biota, 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 safe work practices to minimise occupational exposure to the notified polymer as introduced in powder form
  - Ensure adequate ventilation is in place to minimise dust levels.
  - The level of atmospheric dust should be maintained as low as possible. The Australian recommended exposure standard for dust is 10 mg/m^3 [NOHSC 3008:(1995)]. The ACGIH exposure standard for atmospheric dust is 3 mg/m^3.

- Employers should ensure that the following personal protective equipment is used by workers to minimise occupational exposure to the notified polymer during the application where dust may be generated:
  - Correctly fitted particle filter mask or respirator (adequate for respirable particle sizes)

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

- Employers should implement the following safe work practices to minimise occupational exposure during handling of the notified chemical in resin form:
  - Avoid the formation of airborne dusts

- 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:

(1) Under Section 64(1) of the Act; if
- the notified polymer is introduced in a chemical form that does not meet the PLC criteria.

or

(2) Under Section 64(2) of the Act; if
- the function or use of the notified polymer has changed from petroleum production, 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 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.