File No PLC/458

19 April 2005

NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME (NICNAS)

FULL PUBLIC REPORT

Polymer in Ultimer 00LT053

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Director
Chemicals Notification and Assessment

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1. APPLICANT AND NOTIFICATION DETAILS

APPLICANT(S)
Nalco Australia Pty Ltd of 3 Anderston Street, Banksmeadow NSW 2019.

NOTIFICATION CATEGORY
Synthetic 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 and Impurities, and Purity.

VARIATION OF DATA REQUIREMENTS (SECTION 24 OF THE ACT)
No variation to the schedule of data requirements is claimed.

PREVIOUS NOTIFICATION IN AUSTRALIA BY APPLICANT(S)
No

NOTIFICATION IN OTHER COUNTRIES
USA and Canada

2. IDENTITY OF CHEMICAL

MARKETING NAME(S)
Polymer in Ultimer 00LT053

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
No Substantial Degradability	Yes
Not Water Absorbing	Yes
Low Concentrations of Residual Monomers	Yes
Not a Hazard Substance or Dangerous Good	Yes

The notified polymer meets the PLC criteria.

4. INTRODUCTION AND USE INFORMATION

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

Year	*1*	*2*	*3*	*4*	*5*
Tonnes	0.2	0.2	0.2	0.2	0.2

USE

The product containing 0.2% notified polymer is intended for use in solid/liquid separation in water clarification in mining and wastewater treatment. It is also expected to be used in the agricultural applications.

Equal amounts of the notified polymer is expected to be used in mining/waste water treatment and in agricultural applications.

5. PROCESS AND RELEASE INFORMATION

5.1. Operation Description

The product containing the notified polymer will be imported in 1 tonne polyethylene tote boxes or in polyethylene drums and pails. About 100 tonnes of the product (containing 0.2% notified polymer) will be imported per year. It will be transported from the dockside to a chemical warehouse, where it is stored in a bunded area. The polymer is homogenised in a blending vessel and repackaged into 20 L and 200 L polyethylene drums and pails, respectively.

6. EXPOSURE INFORMATION

6.1. Summary of Environmental Exposure

Since the notified polymer will not be manufactured locally, there will be no environmental exposure associated with this process in Australia. The greatest potential for release expected by the notifier will be during the product (containing the notified polymer) repackaging stage, where a total of less than 1 kg of the notified polymer will be released to the effluent system per annum. In the effluent system at Botany, the wastewater is pH adjusted (to pH 7 to 9), solids removed in sludge pits, analysed and diluted to a level below the Sydney Water License Agreement limits prior to discharge to Malabar.

Most of the notified polymer released during the repackaging stage in to the waste stream is expected to be adsorbed to solids and removed via the sludge pits or the solids removal system at Malabar.

The notifier estimates a total of less than 1 kg to be left in empty containers after use. The 20 L pails and the 1 tonne totes are recycled and the 200 L drums are destroyed.

The notifier has provided examples on the potential use of the product containing the notified polymer, at a goldmine, in water recycling and in onsite water treatment process.

During the two mining/water recycling applications, the polymer is expected to adsorb to solids and the solids disposed off to landfill. The treated water will be sent to tailings dam/impoundment and recycled. No trace of the notified polymer is expected in recycled water or process water in tailings dam in the gold mine. Discharge of process water is expected only at the coke plant, where a three stage settling system is used. When the product is applied at the optimal rate all the constituent polymers including the notified polymer are expected to settle to the bottom with solid particles resulting in acceptable water turbidity. If the product is overdosed, the water turbidity is increased and the water will be recirculated for additional clarification before discharge. The water will not be discharged in to the environment if the product is dosed at a sub-optimal rate.

The product containing the notified polymer is also used to reduce turbidity of irrigation water and to help influence water infiltration into the soil in irrigation applications. It is assumed that the product is mixed with irrigation water in the agricultural applications. The product used in agricultural applications will result in the notified polymer adsorbing to soil particles. Thus almost all the imported notified polymer imported will be either released directly to soil or disposed of to landfill. A small amount can be expected to be released at the water treatment facility whenever water is discharged into the creek.

The notified polymer can hydrolyse in theory but should not at environmental pH of 4 to 9. While it would favour aqueous phase it will bind with soils/solids due to its ionic character.

6.2. Summary of Occupational Exposure

During transport and storage, workers are unlikely to be exposed to the notified polymer except when packaging is accidentally breached.

Dermal and ocular exposure can occur during blending operation and packaging processes and end use.

6.3. Summary of Public Exposure

The notified polymer is intended only for use in industry.

7. PHYSICAL AND CHEMICAL PROPERTIES

Appearance at 20°C and 101.3 kPa	The product containing the notified polymer is a clear to slightly hazy, colourless to light amber liquid.
Melting Point	Not applicable
Autoignition temperature	Not applicable
Density (of the product containing notified polymer)	1.2 kg/m^3
Water Solubility	Not determined. The notifier claims that the water solubility of the notified polymer is complete.
Dissociation Constant	Not determined.
Explosive properties	Not applicable
Reactivity	Not applicable

8. HUMAN HEALTH IMPLICATIONS

8.1. Toxicology

The MSDS for the product containing the notified polymer provides the following toxicological information:

- No acute toxicity studies have been conducted on this product.
- The product is not expected to be a sensitiser.
- None of the ingredients of the product is listed as carcinogen in the IARC.

However, the product is of low pH (3.8-4.2). Therefore the product containing the notified polymer may be irritating to the skin and eye with prolonged contact.

8.2. Human Health Hazard Assessment

The notified polymer meets the PLC criteria and can therefore be considered to be of low hazard.

9. ENVIRONMENTAL HAZARDS

9.1. Ecotoxicology

The following toxicological studies and results were submitted:

Endpoint	*Result and Conclusion*
Fish toxicity (results based on a 1% aqueous solution of a similar product reported in the MSDS of the product containing a similar anionic polyacrylamide)	
Rainbow trout	96 hour LC50 > 1000 mg/L
Sheepshead Minnow	96 hour LC50 > 1000 mg/L
Aquatic invertebrate toxicity (results of a product containing 0.2% of the notified polymer and >20% of a similar anionic polyacrylamide) – (ASCI 2003)	
Daphnia magna	48 hour EC50 1470.6 mg/L (1400.0 – 1562.5 mg/L)
Ceriodaphnia dubia	48 hour EC50 295.5 mg/L (238.6 – 333.3 mg/L)
Test results based on a similar anionic polyacrylamide reported by Verhaar (2002)	
Fish toxicity - *Brachydanio rerio* (SEPC, 1995a)	96 hour LC50 = 357 mg/L
Daphnia toxicity - *Daphnia magna* (SEPC, 1995b)	48 hour EC50 = 212 mg/L
Algae toxicity – *Chlorella vulgaris* (SEPC, 1995c)	72 hour Ec_b50>1000 mg/L 72 hour Ec_r50>1000 mg/L
Inhibition of bacterial respiration – *Pseudomonas putida* (SEPC, 1996)	After 19.25 hours the EC50 = 892 mg/L

9.1.1. Discussion of observed effects

The daphnia study was conducted according to the US EPA guidelines under static conditions. Based on range finding test results, test concentrations of 0, 62.5, 125, 250, 500 and 1000 mg/L product for *Ceriodaphnia dubia* and 125, 250, 500, 1000 and 2000 mg/L product for *Daphnia magna* were used. Daphnids aged less than 24 hours were used. In both tests the highest test solution was reported to be a viscous and clear liquid. At 24 hours *C. dubia* in the 500 and 1000 mg/L test concentrations appeared sluggish. No other sub-lethal symptoms or physical effects were reported (Asci 2003).

The details available in the daphnia study report does not allow to quantify and differentiate the toxic effects of the notified polymer and the related polymer. The notified polymer is a partially hydrolysed polyacrylamide, which according to the literature are of concern due to their toxicity to daphnia (Lamberton 1995). However, conflicting evidence is presented by Verhaar (2002), providing aquatic toxicity end points that are considered to be representative worst-case values for anionic polyacrylamides. These include acute toxicity values for a 45 mole% anionic polyacrylamide polyelectrolyte towards fish and *Daphnia magna* and for a 40 mole % anionic polyacrylamide towards algae (*Selenastrum capricornutum* and *Chlorella vulgaris*).

These end points (except that on *Selenastrum capricornutum*) and one on inhibition of bacterial respiration determined by the SEPC studies are listed above. The results show that these anionic polyacrylamide polyelectrolytes are practically non-toxic to these aquatic organisms and to *Pseudomonas putida*. The notifier claims that the anionic polyacrylamide polyelectrolytes used in these studies closely resemble the product containing the notified polymer both in its chemical nature and the expected mechanism of action.

9.2. Environmental Hazard Assessment

The product tested in the daphnia study contains two polymer components (the notified polymer at 0.2% and a similar anionic polymer at >20%). The notifier claims that the ecotoxic effects observed during the study are due to both polymer components. The notified polymer concentration in the product is less than $1/100^{th}$ of that of the major polymer component. Therefore, it is claimed that the toxicity effect attributed to the notified polymer should be minor in comparison to that attributed to the major polymer component, which is present at a much higher concentration.

To support this argument further, the notifier refers to the toxicity values quoted by Verhaar (2002), which are much lower than those obtained by Lamberton (1995). The latter tested two anionic polyacrylamides of high MW (~10-20 X 10^6) to fish and daphnia and found very high toxicity to the latter (48 h EC50s in the range of 0.09-0.19 mg/L and NOECs 0.05-0.084 mg/L). These were commercially available latex emulsions in mineral oil and it is suggested that the presence of solvents and surfactants may have contributed to the much higher toxicity. The notifier claims that the product containing the notified polymer is a dispersion polymer, which is expected to be less toxic than an anionic latex polymer. The product does not contain hydrocarbon solvents or surfactants.

Another factor contributing to the differences in toxicities may be the differences in water hardness. The toxicity is expected to be mitigated as the hardness of dilution water/growth medium/receiving waters increases. Lamberton used purified water with 10.6 mg/L Ca ion, total hardness 45 mg/L $CaCO_3$, which would seem to maximize aquatic toxicity potential. The hardness of water used in the SEPC studies were reported as follows:

Study	*Hardness of test water mg* $CaCO_3$*/L*
Fish toxiciy (SEPC 1995a) - Dilution water	140
Daphnia toxicity (SEPC 1995b) - Dilution water	280
Algae toxicity (SEPC 1995c) – Culture medium	40

The hardness of test water is higher in both the SEPC fish and daphnia toxicity studies compared to that of 45 mg $CaCO_3$/L in Lamberton's fish and daphnia studies. The toxicity of the anionic polyacrylamide polyelectrolytes used in these studies could have been reduced due to the calcium ions. However, the lowest toxicity was observed in the algae test in spite of the comparably low hardness in the culture medium.

In support Biesinger et al. (1976) reported that the anionic polyelectrolytes tested in a 72 hour test were acutely non-toxic to fish (*Pimephales promelas*) and Biesinger and Stokes (1986) state that of 10 anionic compounds tested one experimental polyelectrolyte was toxic to daphnids but not to fathead minnows.

10. RISK ASSESSMENT

10.1. Environment

All of the imported notified polymer would eventually be released into the environment. The waste polymer resulting in mining/wastewater applications is expected to adsorb to solids during effluent treatment and the solids disposed off to landfill. In agricultural applications the product will be applied to crops with irrigation water to stabilise the soil surface and the notified polymer will be adsorbed to soil particles to produce the desired effect.

As it is not possible to differentiate between the ecotoxic effects of the two polymers in the mixture, the following risk assessment is based on a product basis. Considering that most of the notified polymer will be released to the environment and the use may be restricted to few locations in Australia, a worst-case scenario considered that 25% of the product containing the notified polymer (25 tonnes of product based on the maximum import volume) is released to sewer annually and not removed during sewage treatment processes. Considering the limited number of locations where the polymer will be used, a geographical location with a population equivalent to 25% of the Australian population was used. If it is assumed that each person contributes an average 200 L/day to overall sewage flows, the daily release to receiving waters is estimated to be 68.5 kg/day and the predicted concentration in sewage effluent is 68.5 μg/L. Based on the respective dilution factors of 1 and 10 for inland and ocean discharges of effluents, the PECs of the notified polymer in freshwater and marine water may approximate 68.5 and 6.85 μg/L, respectively.

As it is not possible to differentiate between the ecotoxic effects of the two polymers tested, and it is assumed both polymers are equally toxic and a 25% "active" basis, the 48 hour EC50 of the polymer mixture to *Ceriodaphnia dubia* is 74 mg/L based on the *Ceriodaphnia* result. A predicted no effect concentration (PNEC - aquatic ecosystems) of 74 μg/L (0.074 mg/L) was derived by dividing this EC50 value of 74 mg/L by a worst-case scenario uncertainty (safety) factor of 1000 (as toxicity data are available only for two trophic levels with one being for the similar unknown polymer).

The resulting worst-case risk quotients (RQ) for the aquatic environment are 0.9 and 0.09 for freshwater and marine water, respectively. These values are less than 1 and can be expected to be much lower due to adsorption of the notified polymer to sludge both during use and effluent treatment. If any polymer is released to the sewer, most can be expected to be adsorbed to sludge during sewage treatment and adsorbed to solids in the aquatic environment due to their anionic character. Note that Boethling and Nabholz (1997) indicate lower removal rates for polyanionics having appreciable solubility or dispersibility.

As aquatic toxicity data are available for anionic polyacrylamide polyelectrolytes claimed to be closely resembling the product containing the notified polymer if a safety factor of 100 is used to derive the PNEC value (740 μg/L) the resulting RQ values are 0.09 and 0.009 for freshwater and marine water, respectively.

The resulting worst-case risk quotients for the aquatic environment are 0.9 and 0.09 for freshwater and marine water, respectively. These values are less than 1 and can be expected to be much lower due to adsorption of the notified polymer to sludge both during use and effluent treatment. If any polymer is released to the sewer, most can be expected to be adsorbed to sludge during sewage treatment and adsorbed to solids in the aquatic environment due to their anionic character.

Once adsorbed to the sludge or soil particles, the polymers are not expected to be available for further environmental interaction. The notifier does not expect the product containing the notified polymer to readily biodegrade, however, both the notified polymer and the other anionic polymer is expected to eventually degrade due to slow abiotic processes. Further, the high molecular weight and water solubility indicate a low potential to bioaccumulate.

Although the use of the product containing the notified polymer will be concentrated in a limited number of locations within Australia, based on the above worst-case risk analysis it is unlikely that the product containing the notified polymer would exist at levels which could pose a threat to aquatic organisms.

Furthermore, in a recent review of the available information on the ecotoxicological and environmental effects of residual coagulants and flocculants on natural waters commissioned by the Auckland Regional Council of New Zealand, the impacts of polyelectrolytes on the aquatic environment are stated to be of low level. The residues bound to naturally occurring material pose no hazard to sediment biota and do not break down into toxic residuals. The report states that polyelectrolytes do not bioaccumulate and are highly biodegradable. Although there is not a great deal of data on degradation of non-ionic and anionic polymers, they are considered to be the safest in sensitive environments due to their low potential toxicity (ARC 2004).

Sojka and Surapaneni (2001) discussed the potential uses of polyacrylamides (PAMs) in Australian irrigated agriculture and other uses including water clarification in wetlands and mine spoil reclamation and erosion prevention. The benefits of applying PAM includes prevention of surface water pollution with nutrients and pesticides due to on-field soil retention. This paper indicated that the environmental and safety considerations of anionic PAMs have been reviewed in detail. The effects of PAM on biota are shown to be buffered due to their high affinity for suspended sediments and soil. PAM are extensively used in irrigated agriculture in the USA and in applications similar to those proposed in this notification including potable water treatment, dewatering sewage sludge and mining and drilling applications. Currently, PAMs are used widely for erosion control and infiltration management in some irrigated areas of Australia.

10.2. Occupational Health and Safety

The OHS risk presented by the notified polymer is expected to be low due to its overall low toxicity and low potential for exposure during blending to obtain a homogeneous mixture, QC operations and cleaning of equipment, and repackaging. Personal protective equipment worn by workers during blending operation and end-use will further reduce the risk of irritation.

10.3. Public Health

As there will be no exposure of the public to the product containing the notified polymer, the risk to the public from exposure to the notified polymer is considered low.

11. CONCLUSIONS – ASSESSMENT LEVEL OF CONCERN FOR THE ENVIRONMENT AND HUMANS

11.1. Environmental Risk Assessment

The polymer is not considered to pose a risk to the environment based on its reported use pattern.

11.2. Human Health Risk Assessment

11.2.1. Occupational health and safety

There is Low Concern to occupational health and safety under the conditions of the occupational settings described.

11.2.2. Public health

There is Negligible Concern to public health when used in the proposed manner.

12. MATERIAL SAFETY DATA SHEET

12.1. Material Safety Data Sheet

The MSDS of the product provided by the notifier was in accordance with the NOHSC *National Code of Practice for the Preparation of Material Safety Data Sheets*. It is published here as a matter of public record. The accuracy of the information on the MSDS remains the responsibility of the applicant.

13. 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 NOHSC *Approved Criteria for Classifying Hazardous Substances*, workplace practices and control procedures consistent with provisions of State and Territory hazardous substances legislation must be in operation.

Environment

Disposal

- The wastes containing the notified polymer should be disposed of in an approved incinerator or waste treatment/disposal site in accordance with all applicable regulations.
- The wastes should not be disposed of in sewer or with normal garbage.

- Empty containers should be triple rinsed (or equivalent) and offered for recycling or reconditioning, or puncture and dispose of in a sanitary landfill or by other procedures approved by state and local authorities.

Emergency procedures

- The product should be prevented from entering natural waterways or sewers.
- Soak up small spills with absorbent material and place in suitable, covered and properly labelled containers. Wash affected area.
- Soak up large spills as thoroughly as possible with inert absorbent material or sawdust. Do not wash the affected area until all possible traces are removed as water in contact with the product will create a voluminous and slippery gel.
- Disposed the contaminated recovered material via an approved waste hauler and in accordance with the disposal considerations.
- Do not use alkaline absorbent material, which will generate ammonia.

13.1. Secondary Notification

The Director of Chemicals Notification and Assessment must be notified in writing within 28 days by the notifier, other importer or manufacturer:

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

The Director will then decide whether secondary notification is required.

No additional secondary notification conditions are stipulated.

14. REFERENCES

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United Nations (2003) Globally Harmonised System of Classification and Labelling of Chemicals (GHS). United Nations Economic Commission for Europe (UN/ECE), New York and Geneva.