

July 2001

**NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION
AND ASSESSMENT SCHEME**

FULL PUBLIC REPORT

Z-36

This Assessment has been compiled in accordance with the provisions of the *Industrial Chemicals (Notification and Assessment) Act* 1989 (the Act) and Regulations. This legislation is an Act of the Commonwealth of Australia. The National Industrial Chemicals Notification and Assessment Scheme (NICNAS) is administered by the National Occupational Health and Safety Commission which also conducts the occupational health & safety assessment. The assessment of environmental hazard is conducted by the Department of the Environment and the assessment of public health is conducted by the Department of Health and Aged Care.

For the purposes of subsection 78(1) of the Act, copies of this full public report may be inspected by the public at the Library, National Occupational Health and Safety Commission, 92-94 Parramatta Road, Camperdown NSW 2050, between the following hours:

Monday - Wednesday	8.30 am - 5.00 pm
Thursday	8.30 am - 8.00 pm
Friday	8.30 am - 5.00 pm

Copies of this full public report may also be requested, free of charge, by contacting the Administration Coordinator on the fax number below.

For enquiries please contact the Administration Coordinator at:

Street Address: 92 -94 Parramatta Rd CAMPERDOWN NSW 2050, AUSTRALIA
Postal Address: GPO Box 58, SYDNEY NSW 2001, AUSTRALIA
Telephone: (61) (02) 9577 9514 FAX (61) (02) 9577 9465

Director
Chemicals Notification and Assessment

NA/774

FULL PUBLIC REPORT

Z-36

1. APPLICANT

Lubrizol International Ltd. (ACN 002 747 944) of 28 River Street, Silverwater, NSW 2128 has submitted a limited notification statement in support of their application for an assessment certificate for Z-36.

2. IDENTITY OF THE POLYMER

The polymer name, molecular and structural formulae, molecular weight, spectral data, details of the polymer composition and details of exact import volume have been exempted from publication in the Full Public Report and the Summary Report.

Marketing Name: Z-36

3. PHYSICAL AND POLYMER PROPERTIES

The following properties refer to the notified polymer alone without additives.

Appearance at 20°C & 101.3 kPa: Brown viscous liquid

Particle Size: Not applicable (liquid)

Pour Point: 44±3°C.

Boiling Point: >360°C at 97.67 kPa.

Relative Density: 0.943 at 20±0.5°C.

Vapour Pressure: <6.8x10⁻⁸ kPa at 25°C

Water Solubility: 1.58x10⁻³ g/L at 20±0.5°C.

Partition Co-efficient (n-octanol/water): log P_{ow} > 6.2. (estimated)

Hydrolysis as a Function of pH: Not determined. Not expected to hydrolyse being an emulsifying agent. See comments below.

Adsorption/Desorption:	$\log_{10} K_{oc} > 5.63$.
Dissociation Constant:	Not determined.
Flash Point:	$115 \pm 2^{\circ}\text{C}$.
Flammability Limits:	Not flammable.
Autoignition Temperature:	$386 \pm 5^{\circ}\text{C}$.
Explosive Properties:	Not expected.
Reactivity/Stability:	Polymer is not expected to undergo oxidation and is stable up to 160°C .

Comments on Physico-Polymer Properties

Tests were performed according to EEC/OECD test guidelines at facilities complying with OECD Principles of Good Laboratory Practice.

Determination of the boiling point was attempted using differential scanning calorimetry (Safepharm Laboratories Limited, 1999a). No phase transition or decomposition of the test material was apparent up to 360°C .

Attempts to determine the vapour pressure (VP) were made (Safepharm Laboratories Limited, 1999b) using a balance system where the vapour pressure was determined at a number of temperatures using a mass difference technique, and the data then extrapolated to provide a value for 25°C . There was a good deal of scatter in the data, and for the recorded balance readings were very low (indicative of low vapour pressure). Accordingly no definitive value for the vapour pressure at 25°C could be calculated, and the best estimate derivable from the data was that the vapour pressure at this temperature was $< 6.8 \times 10^{-8}$ KPa. A very low vapour pressure could be expected for relatively high molecular weight polymer containing polar "head groups".

The water solubility was determined (Safepharm Laboratories Limited, 1999a) in triplicate using the flask method. Approximately 120-145 mg of the test material was weighed into three separate flasks, and then shaken with 1,100 mL of double-distilled water at 30°C . After standing at 20°C for periods of 24, 48 and 72 hours the resulting solutions were centrifuged, filtered and duplicate samples analysed for the dissolved material using Gel Permeation Chromatography (GPC). Each water solution was evaporated to dryness, and the residues taken up in tetrahydrofuran solvent for performance of the GPC. The water solubility at 20°C was determined as 1.59, 1.55 and 1.60 mg/L for the solutions prepared using 1, 2 and 3 days agitation respectively and it is apparent that the agitation time had no bearing on the individual results. The mean water solubility at 20°C was determined as 1.58 mg/L, and the pH of the solutions was always slightly alkaline and was between 7.7 and 8.1 due to the residual amine.

Hydrolytic degradation of the polymer was apparently not studied. However, while the polymer contains ester linkages, these are unlikely to undergo significant hydrolytic cleavage in the usual environmental pH region where $4 < \text{pH} < 9$. The low water solubility indicates very little

contact between water and these groups which would further reduce the potential for hydrolysis.

The n-octanol/water partition coefficient was determined (SafePharm Laboratories Limited, 1999a) using the HPLC method. In this method the retention time for the test polymer on a C18 HPLC column is used to derive Log P_{ow} from a calibration curve prepared by plotting the retention times of a series of seven reference compounds against their known values for K_{ow} . The reference compounds used ranged from benzonitrile with Log P_{ow} of 1.6 to DDT with Log P_{ow} of 6.2, and since the retention time of the new polymer was greater than that of DDT the value of log P_{ow} was determined as being greater than 6.2.

A calculated estimate for log P_{ow} using the atom fragment method (Meylan and Howard, 1995) was also presented which gave the estimated Log P_{ow} >8. A high value of Log P_{ow} could be expected for compounds which contains a high proportion of aliphatic hydrocarbon.

The value for Log K_{oc} , which is a measure of the compound's ability to bind to the organic component of soils and sediments (SafePharm Laboratories Limited, 1999a) using a standard HPLC method was determined to be greater than 5.63. As with Log P_{ow} , the high hydrocarbon content and very low water solubility of the polymer indicate high affinity for the organic component of soils and sediments.

No dissociation constant data was provided, but the zwitterionic head group could be expected to make the molecule cationic under conditions of low pH (pH<4) and anionic at high pH (>11). Due to the excess of amine in the final product, it is expected to exhibit slightly alkaline behaviour in an aqueous environment, and this is supported by the pH of 7.7-8.1 exhibited by the aqueous solutions.

The notified polymer is a powerful emulsifying agent specially suited to the stabilisation of water in oil emulsions. As such, the effectiveness of the polymer depends on it having negligible true water solubility, although the formation of colloidal aggregated structures such as micelles may be possible. All the polymer constituents contains a large branched chain aliphatic hydrocarbon portion coupled to a polar end group, and as such will be amphoteric in nature. This constitution indicates that the polymer will have powerful surfactant properties.

4. PURITY OF THE POLYMER

Degree of Purity:	High
Hazardous Impurities:	None
Non-hazardous Impurities (> 1% by weight):	None
Additives/Adjuvants:	None

5. USE, VOLUME AND FORMULATION

The notified polymer will be imported as a component of an additive package (PuriNOx 20)

for diesel fuel at a concentration of < 25%. No manufacture will occur in Australia. Annual import volumes of the notified polymer will be < 100 tonnes per year for the first five years.

The blending operation is performed by pumping metered volumes of diesel fuel, water and the PuriNOx 20 added through dedicated pumping lines to a high sheer mixing tank. Typically 20% water would be mixed with 78.5% of diesel together with 1.5% of PuriNOx 20. The water forms very small droplets dispersed through the oil phase and these become “coated” with the new polymer (and other stabilisers present in the PuriNOx 20 formulation) which effectively “solubilise” the droplets in the oil and stabilise them against coalescence. The resultant product is a homogeneous white emulsion containing very small water droplets, and is stable against phase separation under most conditions. Information submitted by the notifier indicated that some separation may be evident after extended storage times (2 months) at room temperature, and it is expected that phase separation would be exacerbated at lower storage temperatures although this may be mitigated by use of other additives (Lubrizol Corp., 2000).

The polymer will be present in diesel fuel at < 1%.

6. OCCUPATIONAL EXPOSURE

Import, Transport and Storage

The notified polymer will be imported in IBCs (1250 L or 208 L) or 37 900 L to 75 0800 L ISO containers and transferred to customer depots or terminals by road or rail. Occupational exposure of dockside or transport workers is not expected except in the event of a spill. No repackaging or decanting is required as the drums are delivered directly to customer sites.

Blending Sites

The diesel additive package will be used at approximately 5 blending sites around Australia. The emulsified fuel is prepared in a special blending unit. This unit connected to “feed” lines from the drums containing the additive package, water and fuel storage tanks. Blending takes place within an automated unit by a high sheer blending mechanism. When finished the resulting emulsion is pumped directly into a holding tank.

At each blending site one worker will operate a blending unit. Skin contamination may occur, from drips and spills when connecting and disconnecting hoses. Workers wear neoprene or nitrile gloves, protective aprons and boots during the blending process. The notifier does not foresee the need for regular cleaning of the blending system. Annual maintenance is expected to be limited to metering accuracy. However, the drums may be cleaned with diesel fuel, that is subsequently sent for incineration. Worker exposure, predominantly by the dermal route, may occur when cleaning out drums.

End Use – Service Stations

The notifier has not provided details of end use of the additised fuel. The finished fuel will be sold to diesel refuelling stations. The transport, storage and retail sale of the fuel will involve a large number of workers, but should involve little risk of exposure to the notified polymer due to its low concentration in the fuel and the precautions normally taken to prevent

contact with diesel.

7. PUBLIC EXPOSURE

The notified polymer is present in diesel fuel at < 1%. The public may be exposed to the notified polymer in diesel during vehicle refilling. However, the potential for exposure is minimised due to its presence at low concentrations in fuel. Accidental exposure to the notified polymer will only occur in the event of a spill.

8. ENVIRONMENTAL EXPOSURE

Effects on Vehicle Exhaust Emissions

It is claimed that the use of the emulsified fuels (containing up to 20% water) substantially reduces exhaust emissions of nitrogen oxides (NO_x) and particulate matter, and consequently reduces the polluting effects of these emissions on the atmosphere. Both NO_x and particulate material originating from vehicle exhausts are known to contribute to photopolymer smog. Information provided by the notifier (Lubrizol Corp., 2000) indicated that the use of emulsion fuels in place of “conventional” diesel oil may result in a reduction of up to 40% NO_x and up to 50% particulate matter in engine exhaust. This report also indicated that a test of PuriNox diesel fuel containing 20% water (stabilised in the fuel by the new polymer) against Ultra Low Sulphur Diesel (ULSD) in a London bus showed 30% or better reduction in the particulate matter in the <1, < 2.5, < 5 and < 10 micron categories. However, it appears that the levels of improvement in these emissions is dependent on the engine type, and also the reduced pollutant emissions resulting from the emulsified water in the fuel are obtained at the expense of up to 15% reduction in the mechanical power developed by the engines.

Two technical papers Barnes *et al.*, 2000 and Brown *et al.*, 2000, and two additional reports detailing the characteristics of exhaust emissions from engines run with the water blend fuels were submitted as part of the notification package.

In a report prepared for registration of the water blend fuels in the United States, the emissions of hydrocarbons, NO_x, CO and particulate matter from a near new heavy duty commercial diesel engine run on a water blend fuel containing 20% water in a baseline diesel oil were compared with those emitted when running on the baseline diesel fuel alone (Southwest Research Institute, 2000). The motor was run on each fuel continuously over a 5 hour period according to a previously defined duty cycle designed to simulate typical engine operating conditions (the Detroit Diesel Corporation 12.7 durability truck cycle) and exhaust samples collected and analysed. The results were reported in grams (of emitted pollutant) per brake horsepower/hour and indicated that the water blend fuel produced approximately 10% reduction in NO_x emissions and approximately 30% reduction in particulate emissions. There was also an apparent small reduction in CO emissions but a possible slight increase in hydrocarbon content although these were not quantified.

The relative quantities of C1-C12 hydrocarbons, alcohols, aldehydes, ketones, ethers and aromatic hydrocarbons emitted in the exhausts from both fuel types were also determined during this study. No significant differences in the relative quantities of any particular compound or compound class was discernible in the emissions resulting from combustion of each fuel.

Barnes *et al.* described a series of 6 tests (each test conducted in triplicate) which compared the exhaust emissions of NO_x, CO, CO₂, hydrocarbons and particulate matter from a London bus running on ULSD containing less than 50 ppm sulphur with those using a water blend fuel containing 10% water, but made up with the same ULSD. This series of tests compared the effects of oxidation catalysts and of particulate traps on the exhaust emissions when the vehicles were operated with both fuels. Each test consisted of two phases which broadly corresponded to urban and suburban operations (in London) respectively. For the tests conducted with neither oxidation catalyst nor particulate trap the results indicated that the 10% water blend fuel reduced NO_x and particulate matter by 9.3-9.5 and by 15-30% respectively¹ compared with the ULSD emissions. Reductions in CO₂ emissions were less dramatic at 1.4-2.3% while for CO and hydrocarbons small increases (up to 5.3% for CO) were noted for the water blend fuel compared with the ULSD. Although 7.3% more fuel was consumed when the bus was operated with the water blend, this is understandable given that this fuel contained 10% water which has no intrinsic fuel value.

When a catalytic converter (oxidation catalyst consisting of fine platinum particles coated onto a molecular sieve substrate) was fitted onto the exhaust system of the bus running on the ULSD around 95% reduction in hydrocarbons, 96% reduction in CO and around 20% reduction in particulate material was observed compared with the ULSD alone, although only modest (around 1.5%) reduction in NO_x was observed together with a slight increase (1-2.5%) in CO₂ emission. When the 10% water blend fuel was used together with the catalyst further improvements in particulate (36-40%), NO_x (13.8-15.4%), hydrocarbon (17-36%) and CO₂ (6.1-8%) emission were observed compared with the equivalent system using ULSD alone, although a small increase in CO (around 4%) was also recorded. The use of particulate trap had very significant effects on particulate emission with an 81% reduction observed for the ULSD fuel, and although the use of the water blend fuel also produced comparable reductions in particulate emission, it is not clear whether the use of this fuel and particulate trap produced significant improvement over the ULSD fuel and particulate trap system. Overall the use of the 10% water blend fuel appeared to produce reduced NO_x, hydrocarbon and CO₂ emissions compared with the ULSD fuel, and also gave significant reductions in particulate emission except where a particulate trap was fitted, when the particulate emissions from both fuels appeared comparable.

Brown *et al.* referred to the results reported by Barnes *et al.*, and also supplied information on improvements in diesel engineering, the use of diesel oxidation catalysts and new diesel fuel technologies in respect of diesel exhaust emissions – particularly in respect of NO_x and particulate material. In addition to summarising the test results from the London bus trials described above, these authors also summarised data from other tests, which reached the same broad conclusions in respect of emissions. In particular they reported exhaust emission results on a test of the London bus fitted with a diesel oxidation catalyst which was operated on a 20% (rather than the 10%) water in diesel blend fuel compared with the ULSD baseline fuel, and the histograms presented indicated that in this system the water blend fuel resulted in significantly reduced emissions of particulate matter and slightly reduced emissions of NO_x and CO₂ compared with the baseline fuel. The overall conclusions from this paper were

¹ In respect of these data, it should be noted that the emissions of all species were recorded in grams per kilometre travelled and not referred to grams per litre of fuel consumed. Consequently the stated improvements in pollutant emissions using the water blend fuel may not be correlated simply with the presence of lesser hydrocarbon content in this fuel, but appear to be truly attributable to the improvements in combustion and burning properties of the water in fuel emulsion compared with those of the ULSD fuel.

that very significant reductions in emissions of hydrocarbons, CO and particulate matter can be achieved using catalytic oxidation converters, and that reductions in NOx together with further reductions in particulate emissions can be achieved using water blend fuels.

Another report provided by the notifier (Perkins Technology, undated) was concerned with the emissions of NOx, CO, hydrocarbons and particulate material from a large diesel engine (rated at 70.7-72.9 kW) operated using ULSD, a 10% water in ULSD blend and a 20% water in ULSD blend fuels, a 10% water in reference off highway diesel and a 20% water in reference off highway diesel, and the results compared with those from the reference off highway diesel. The overall conclusions were that compared with the reference fuel the ULSD produced 4% reduction in NOx, 1% reduction in CO, 14% reduction in hydrocarbons and 21% reduction in particulate matter. The blending of water with the diesel fuels (either the ULSD or the reference fuel) provided significant reductions in NOx and particulate emissions, with the 10% water in fuel blends giving 18% (reference fuel) and 17% (ULSD) reduction in NOx, together with a 17% (reference fuel) and 33% (ULSD) reduction in particulate emissions. With the fuel blends contained 20% water the corresponding reductions in NOx emissions were 30% (reference fuel) and 29% (ULSD) while particulate emissions were reduced by 28% (reference fuel) and 40% (ULSD). However, the use of the water blend fuels in this engine resulted in significantly increased emissions of CO (up to 43% increase for the 20% water in reference fuel blend, and 24% for the 20% ULSD blend) and up to 100% increase in hydrocarbon emissions for the 10% water in fuel blends (both reference fuel and ULSD) compared with the reference fuel.

While the results for the NOx and particulate emissions are broadly in accordance with those presented by Barnes *et al.* and Brown *et al.*, there appears to be some disparity in respect of the CO and hydrocarbon emissions. However, the test report for the Perkins study was not detailed, and the mechanical characteristics of this large engine may have been significantly different from those of the engines used in the other studies.

The polymer and physical mechanisms responsible for the dramatic reductions in pollutant emissions appears to be dependent on the presence of water in the fuel emulsion (Brown *et al.*, 2000) which aids the production of fine water droplets facilitating even and efficient fuel burn in the cylinders, and also lowers overall combustion temperatures which decreases the rate of conversion of N₂ to NOx.

Release

Very little of the PuriNOx 20 would be lost during transfer operations from the ISO containers to the blending vessel, and that this transfer system is designed to minimise or eliminate such losses. While these losses were not quantified by the notifier, as a worst case scenario it is estimated that up to 85 kg of the polymer could be lost in this manner annually. Since the polymer will be used at 5 blending sites, up to 17 kg may be released from each facility each year. All such losses would be contained in bunded areas and would be adsorbed with sand and incinerated.

Up to 850 kg of the polymer may be left in the “emptied” ISO containers and drums annually, and it was indicated that these would be cleaned out and recycled. Typically the unused polymer remaining in these containers is washed out with diesel oil, and then incinerated. However, some container recycling facilities use steam cleaning procedures and/or detergents

for removing residuals, and in these cases the residual polymer becomes associated with waste sludge and is either sent to landfill or is incinerated.

During fuelling operations some spillage is inevitable. Spillage of fuel is estimated to account for up to 425 kg of the new polymer released to the environment annually. However, this release will be very diffuse and due to the high value of Log K_{oc} the spilt polymer would become associated with soil and sediments.

Given the assumptions above, overall annual release from all causes is estimated to be around 1,360 kg from reformulation (85 kg), wastage in empty containers (850 kg) and spillage of fuel (425 kg). Most of the released polymer is likely to become associated with soil although some may be incinerated.

Fate

Most of the new polymer in the fuel and would be destroyed during combustion with production of water vapour and oxides of carbon and nitrogen². Any polymer entering the soil compartment (eg. as a result of fuel spills) would become strongly associated with the organic component of soils and sediments and is not expected to be mobile in these media.

No reports on biodegradation for the notified polymer were submitted. However, the notifier provided a report on the biodegradation of a structurally related polymer. The biodegradation of the structural analogue was determined (Wildlife International, 1997) using the CO₂ evolution method of OECD TG 301 B. After 28 days with sewage bacteria incubation (triplicate samples) less than 10% of the theoretical maximum amount of CO₂ had been evolved which indicates that the polymer is not readily biodegradable but is nevertheless slowly degraded through biological action. In contrast, triplicate samples of canola oil were degraded to > 85% over the same period which established the viability of the bacterial culture used in the test. It is expected that the new polymer would exhibit similar behaviour to that of the structural analogue, and the polymer released to the soil compartment is expected to be eventually mineralised to oxides of carbon and nitrogen, possibly with some production of ammonia which would become assimilated by plants.

9. EVALUATION OF TOXICOLOGICAL DATA

No toxicological data was provided for the notified polymer. However, according to the Material Safety Data Sheet (MSDS) for the notified polymer, it is expected to exhibit low acute oral (LD₅₀>5 000 mg/kg) and dermal (LD₅₀>2 000 mg/kg) toxicity based on studies conducted on similar polymers. It is likely to be weak to moderate eye irritant but not skin irritant.

10. ASSESSMENT OF ENVIRONMENTAL EFFECTS

The notifier supplied the following test reports for ecotoxicity against aquatic organisms. The

² It should be noted that most of the nitrogen oxides produced during combustion of hydrocarbon fuels originate from the atmospheric nitrogen introduced to the cylinders with the oxygen. The nitrogen oxides produced from destruction of the new polymer would be a very small percentage of the total, and as indicated above the use of fuels emulsified with water through use of the new polymer are claimed to reduce overall NO_x emissions through promotion of more efficient combustion of the fuel hydrocarbons.

data was not generated for the notified polymer, but was instead generated for close structural analogues. The identity of the analogues is exempt from publication in the Full Public Report.

<i>Test</i>	<i>Species</i>	<i>Results</i>
Acute Toxicity (freshwater fish) OECD TG 203	Fathead minnow <i>Pimephales promelas</i>	LC ₅₀ (96 h) > 1,000 mg/L.
Inhibition of Bacterial Respiration: OECD 209 OECD TG 209	Sewage sludge Bacteria	EC ₅₀ (3 h) > 10,000 mg/L.

Fish

Juvenile Fathead minnow were exposed to solutions of test substance prepared at nominal loading rates of 0 (control), 0.33, 3.3, 33, 330 and 3,300 mg/L by stirring the test polymer with water. The test was conducted (T R Wilbury Laboratories Inc., 1996) over a 96 hour test period under static test conditions at 22±1°C, using ten fish in each test chamber. The solution prepared at nominally 33 mg/L was cloudy throughout the test period while those prepared at higher concentrations had insoluble material floating on the surface of the water. Water solubility data for the test substance was not provided but given the structural similarity between the test substance and the notified polymer this is expected to be of similar magnitude. It should be noted that except for the 0.33 mg/L solution all the nominal concentrations exceeded the water solubility of the polymer which is 1.58 mg/L at 20°C. Except for the death of one fish at the nominally 3.3 mg/L all fish survived over the 96 hour period in the nominally 330 mg/L solution and at lower concentrations, but all fish had died after 72 hours exposure to the nominally 3,300 mg/L preparation. Based on these results the 96 hour LC₅₀ was determined to be 1,000 with 95% confidence interval 330-3,300 mg/L using a binomial/non-linear interpolation method. The no observed effect concentration was determined as nominally 330 mg/L. It was possible that the fish suffered non lethal effects in the nominally 33 and 330 mg/L preparations, but the fish could not be properly examined because of the presence of insoluble material.

Microorganisms

The effect of the structural analogue on the respiration of activated sewage sludge microorganisms was studied (Woodward Clyde Consultants, 1994). Sewage bacteria were exposed to 5 concentrations of the test material with nominal concentrations between 1, 10, 100, 1,000 and 10,000 mg/L and the respiration rate of the bacteria determined after 3 hr exposure to each solution. The new polymer impaired the respiration rate of the sewage bacteria at all test concentrations, with the rate of oxygen uptake 19.8% less (relative to the control) in the nominally 1 mg/L solution rising to 47.8% inhibition for the nominally 10,000 mg/L preparation. Nevertheless, the dose-response curve is very flat and the 3 hour EC₅₀ was determined as > 10,000 mg/L. It should be noted that the solubility of the new polymer is 1.58 mg/L, and all exposure levels except the lowest exceeded this value. In connection with this it was noted in the report that insoluble test material was observed floating on the surface of the test media in all non-control test vessels throughout the study.

Given that the LC50 and EC50 values for both fish and bacteria are considerably greater than the water solubility it is possible that the toxic effects were physical in origin rather than due to specific polymer toxicity. No data on toxicity of the new polymer or analogues to either aquatic invertebrates or algae was provided, but the Material Safety Data Sheet (MSDS) for Z-36 contained the following supplementary information although the origin of this data was not provided.

Acute Toxicity (salt water fish)	Not Specified	LC ₅₀ (96 h) >1,000 mg/L
Acute Toxicity (saltwater invertebrate)	Not Specified	LC ₅₀ (96 h) >100 mg/L

11. ASSESSMENT OF ENVIRONMENTAL HAZARD

The new polymer is to be used as an additive to aid the emulsification of water with diesel oil, and the resultant emulsion used as a fuel in diesel engines. The use of such fuels has a major positive impact on the levels of nitrogen oxides and particulate material released in the engine exhaust emissions, albeit at the expense of slightly reduced (up to 15%) engine power output.

For a typical engine, reductions of up to 10% in NO_x emissions and up to 30% in particulate emissions are likely. However, some increase in CO and hydrocarbon emissions may accompany these reductions, although overall emissions of these can be significantly reduced through the use of catalytic converters and/or particulate traps in the exhaust train. Overall it appears that the use of the water blend diesel fuels prepared with the new polymer can offer significant reductions in exhaust pollutant emissions, but maximum benefit is achieved in conjunction with the addition of oxidation catalysts and/or particulate traps. It is also apparent from the available data that the extent of reductions in these pollutants achieved through use of these fuels may also depend on the type and design of the engines themselves.

The mechanisms whereby the pollutant emissions are reduced appear to be associated with the presence of significant quantities of dispersed water droplets within the diesel fuel emulsion which when atomised in the engine cylinders promote more even fuel combustion at lower combustion temperatures.

Although the decrease in engine power output translates into increased volume in fuel consumption, since the PuriNO_x fuel contains 10-20% of water which has no fuel value the actual consumption of hydrocarbons is not very different from the consumption of conventional diesel fuel.

In the worst case scenario it is anticipated that annually 1,360 kg would be released to the environment as a result of fuel emulsion production and spillage of the fuel, and most of this would be released to the soil compartment although some may be incinerated. This release is expected to be diffuse, although higher releases may be expected in the vicinity of the fuel blending facilities as a result of inappropriate practices in removing residual polymer from empty containers prior to their re-use.

The polymer is not expected to be readily biodegradable but in association with soils is expected to be slowly mineralised to water, carbon dioxide and ammonia. Most of the polymer will be destroyed in the cylinders and exhaust train of diesel engines through combustion with the fuel oil, producing water vapour and oxides of carbon and nitrogen. Little of the polymer is expected to reach the water compartment, and except in the case of transport accidents any polymer released to water would be at very low levels and would reach this compartment in a very diffuse manner. The limited toxicity data available indicates that the polymer would have no adverse effects on aquatic organisms at the concentrations at which it is likely to reach the water compartment.

12. ASSESSMENT OF PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY EFFECTS

Hazard Assessment

No toxicological information has been provided for the notified polymer. Therefore, the substance cannot be assessed against the NOHSC *Approved Criteria for Classifying Hazardous Substances* (NOHSC, 1999). The additive package, PuriNOx 20, is a hazardous substance according to the product label MSDS.

The MSDS for PuriNOx 20 indicates that it is a skin, eye and respiratory irritant and a skin and respiratory sensitiser. Symptoms including headaches, dizziness, nausea, behavioural changes, weakness, drowsiness or possible stupor and dermatitis are also listed as possible health effects. These symptoms relate mainly to the additive aliphatic naphtha rather than the notified polymer.

The polymer itself is not reactive and non-volatile, and because of the high molecular weight it is not expected to cross biological membranes.

Occupational Health and Safety

The additive package containing the notified polymer will be imported in drums or in bulk and reformulated by blending with diesel fuel and water. The final product is then transferred to road tankers for bulk delivery to diesel refuelling stations.

During transport and storage, worker exposure to the notified polymer is unlikely except in the event of a spill. Spillage will be handled in accordance with practices recommended in the MSDS.

Reformulation of the additive package is an automated process. Worker exposure may only occur when connecting and disconnecting transfer hoses and cleaning out drums. The protective equipment specified for use during these activities, including gloves, protective aprons and boots will be sufficient to minimise dermal exposure to the notified polymer. Inhalation exposure is not expected to be significant given the low vapour pressure and automated nature of the reformulation process. The use of dedicated transfer lines, the enclosed and automated blending process and protective equipment will reduce the likelihood of exposure to the additive package. Given the low exposure, the health risk expected for workers at the blending sites would be low.

The additised fuel contains <1% notified polymer resulting in low potential exposure of

tanker drivers, service station workers and mechanics. Therefore, the risk of adverse health effects for these workers arising from exposure to the notified polymer is low.

Public Health

There is negligible potential for public exposure to the notified polymer arising from its use as an emulsifying agent in diesel fuels. The low concentration of the notified polymer diesel fuel presents a negligible risk public health.

13. RECOMMENDATIONS

Control measures (for formulator)

OHS

Employees should wear the following personal protective equipment to minimise occupational exposure to the notified chemical:

- industrial clothing including protective aprons;
- neoprene or nitrile gloves; and
- occupational footwear.

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.

Spills of the notified chemical should be cleaned up promptly with absorbents which should be put into containers for disposal.

If products and mixtures containing the notified chemical are hazardous to health in accordance with the NOHSC *Approved Criteria for Classifying Hazardous Substances* (NOHSC, 1999), then workplace practices and control procedures consistent with provisions of State and Territory hazardous substances legislation must be in operation.

Environmental

In order to reduce air pollution the notifier should consult the Air Quality Section of the Atmosphere and Sustainable Transport Branch of the Department of the environment and Heritage and the Australian Greenhouse Office in respect of introduction of this new fuel technology into Australia.

Secondary notification

If the notifier or any other importer or manufacturer of the notified polymer becomes aware of any circumstances listed in subsection 64(2) of the Act, they must notify the Director in

writing within 28 days. The Director will then decide whether secondary notification is required.

14. MATERIAL SAFETY DATA SHEET

The MSDS for a typical additive package containing the notified polymer was provided in a format consistent with the *National Code of Practice for the Preparation of Material Safety Data Sheets* (National Occupational Health and Safety Commission, 1994).

This MSDS was provided by the applicant as part of the notification statement. The MSDS for the additive package is reproduced here as a matter of public record. The accuracy of this information remains the responsibility of the applicant.

15. REFERENCES

Barnes, A, Duncan, D, Marshall, J, Psaila, A, Chadderton, J and Eastlake, A; Evaluation of Water Blend Fuels in a City Bus and an Assessment of Performance with Emission Control Devices; Society of Automotive Engineers, 2000-01-1915, 2000.

Brown, K W, Chadderton, J, Daly, D T, Langer, D A and Duncan, D; Opportunity for Diesel Emission Reductions Using Advanced Catalyst and Water Blend Fuel; Society of Automotive Engineers, 2000-01-0182, 2000.

Lubrizol Corp. (2000): Delivering Fresher Air by the Gallon. Wickliffe, Ohio, US (trade brochure).

Meylan, W M and Howard, P H; "Method for Estimation Octanol-Water Partition Coefficients"; J. Pharm. Sci, 84(1) 1995.

National Occupational Health and Safety Commission (1994) National Code of Practice for the Preparation of Material Safety Data Sheets [NOHSC:2011(1994)]. Australian Government Publishing Service, Canberra.

National Occupational Health and Safety Commission (1999) Approved Criteria for Classifying Hazardous Substances [NOHSC:1008(1999)]. Australian Government Publishing Service, Canberra.

Perkins Technology Consultancy (undated): The Effect of Purinox Additives on the Performance and Emissions of a Perkins 1004.4T turbocharged, 4 cylinder, 1 litre/cylinder diesel engine (report reference XC570/GBIRCH/TP01).

Safepharm Laboratories Limited (1999a): OS 144254: Determination of General Physico-Polymer Properties (SPL Project No. 525/164), Derby, UK, Safepharm Laboratories Limited (unpublished report).

Safepharm Laboratories Limited (1999b): OS 144254: Determination of Vapour Pressure (SPL Project No. 525/166). Derby, UK, Safepharm Laboratories Limited (unpublished report).

Southwest Research Institute (2000): Fuel Registration Testing for the Lubrizol Corporation (Report reference SwRI-03479). San Antonio, Texas, US, Southwest Research Institute (unpublished report).

T R Wilbury Laboratories Inc (1996): Acute Toxicity of OS 47550 to the Fathead Minnow, *Pimephales Promelas* (Study No. 762-LU). Marblehead, Massachusetts, US, T R Wilbury Laboratories Inc. (unpublished report).

Wildlife International (1997): Aerobic Aquatic Biodegradation of Lubricants by the Carbon Dioxide Evolution Method (Project No. 331E-106A). Eastern, Maryland, US (unpublished report).

Woodward Clyde Consultants (1994): The Effect of Lubrizol OS #47550W on the Respiration of Activated Sludge - Expanded Range Assessment (WCC INV #119325).; Woodward Clyde Consultants, Franklin, Tennessee, US (unpublished report).

