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NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME (NICNAS)

FULL PUBLIC REPORT

Polyram SL

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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.

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Street Address:	334 - 336 Illawarra Road MARRICKVILLE NSW 2204, AUSTRALIA.
Postal Address:	GPO Box 58, SYDNEY NSW 2001, AUSTRALIA.
TEL:	+ 61 2 8577 8800
FAX	+ 61 2 8577 8888
Website:	www.nicnas.gov.au

Director
NICNAS

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Polyram SL

1. APPLICANT AND NOTIFICATION DETAILS

APPLICANT(S)
Arkema Pty Ltd (ABN 44 000 330 772) of Ground Floor, 600 Victoria Street, Richmond VIC 3121

NOTIFICATION CATEGORY
Standard: Chemical other than polymer (more than 1 tonne per year).

EXEMPT INFORMATION (SECTION 75 OF THE ACT)
Data items and details claimed exempt from publication:

Chemical Name, Other Names, CAS Number, Molecular Formula, Structural Formula, Molecular Weight, Spectral Data, Purity, Hazardous impurities, Non-hazardous impurities, Additives/adjuvants, Import volume, Specified Use

VARIATION OF DATA REQUIREMENTS (SECTION 24 OF THE ACT)
Variation to the schedule of data requirements is claimed as follows:

Boiling point, Vapour pressure, Water solubility, Hydrolysis as a function of pH, Partition coefficient, Adsorption and desorption, Flamability Limits, Autoignition temperature, Explosive properties, Eye Irritation

PREVIOUS NOTIFICATION IN AUSTRALIA BY APPLICANT(S)
CEC/724

NOTIFICATION IN OTHER COUNTRIES
USA (PMN), EU

2. IDENTITY OF CHEMICAL

MARKETING NAME(S)
Polyram SL
Polyram L80 (<80% solution of the notified chemical)

MOLECULAR WEIGHT
<600 Da

ANALYTICAL DATA
Reference IR spectra were provided.

3. COMPOSITION

DEGREE OF PURITY >90%

HAZARDOUS IMPURITIES
Both Polyram SL and Polyram L80 contain several hazardous impurities, classified as mutagenic, carcinogenic or sensitising in contact with skin, in the range of <0.001 to <0.1% (w/v).

4. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AT 20°C AND 101.3 kPa
Brown liquid

Property	Value	Data Source/Justification
Melting Point/Freezing Point	Not determined	Liquid
Solidification Point	9ºC	Measured
Density	920 kg/m^3 at 20ºC 901 kg/m^3 at 50ºC	Measured
Vapour Pressure	<0.0013 kPa at 20ºC <0.00026 kPa (estimated)	Analogue data (Analogue 2)
Water Solubility	Dispersible: 10-50 g/L at 20ºC Soluble: <0.6 g/L	Measured
Hydrolysis as a Function of pH	Not determined	No hydrolysable groups
Partition Coefficient (n-octanol/water)	Not determined	logP_{ow} cannot be determined for surfactants
Adsorption/Desorption	Not stated	Analogue data
Dissociation Constant	pKa = 6.6	Measured
Particle Size	Not determined	The notified chemical is a liquid
Flash Point	>100ºC (pressure unknown) >159ºC (estimated)	Measured Analogue data (Analogue 2)
Flammability	Not determined	Not expected to be highly flammable
Autoignition Temperature	~270ºC	Analogue data (Analogue 2)
Explosive Properties	Not determined	Not expected to be explosive

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

Reactivity
The notified chemical is stable under normal conditions of use. It is incompatible with strong oxidants, strong acids and organohalogenated compounds. Oxides of carbon, nitrogen and other hazardous organic compounds are expected to be produced upon thermal decomposition.

5. INTRODUCTION AND USE INFORMATION

MODE OF INTRODUCTION OF NOTIFIED CHEMICAL (100%) OVER NEXT 5 YEARS
The notified chemical will be imported as a <80% solution (Polyram L80) into Australia in 750 kg wire-cased polyethylene Intermediate Bulk Containers (IBCs).

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

Year	*1*	*2*	*3*	*4*	*5*
Tonnes	<150	<150	<150	<150	<150

PORT OF ENTRY
Melbourne, Perth and Adelaide.

IDENTITY OF MANUFACTURER/RECIPIENTS
The notifier will supply the notified chemical to Australian road-making companies.

TRANSPORTATION AND PACKAGING
The notified chemical (within the imported IBCs) will be transported within Australia by road.

USE
Polyram functions as a surfactant to create a stable reverse bitumen emulsion to enable transport of >50% bitumen-in-water emulsions by tanker to road repair sites in country areas. The notified chemical bonds to the bitumen molecules to produce a stable emulsion. The emulsion will be used in the deposition of bitumen at road resurfacing sites, at ambient temperatures (no heating of the bitumen is required). When mixed with aggregate (≤5 mm), the emulsion is destabilised, forming a set bituminised asphalt surface.

OPERATION DESCRIPTION

One end user routinely uses the notified chemical (under a commercial evaluation permit) in the processing of bituminous emulsions in its emulsion depot sites. The details of current operations are described below:

IBCs containing the notified chemical are delivered to site, unloaded with forklift, placed in a bunded storage area. During handling, a forklift is used to relocate IBC from storage to platform scales, where a hose is connected to the IBC and the desired volume is pumped into a storage tank. It is then transferred into a dilute tank, where mineral or organic acids and water are added, diluting the notified chemical 1:10 to form the desired batch size (at 30-40ºC). From the dilute tank it is further diluted 1:3 and mixed with the bitumen to form an emulsion. The bitumen undergoes a shearing process before it is stored in tanks in a bunded storage area.

The bitumen emulsion (<3% notified chemical) is transported to the road repair site. The bitumen emulsion is then connected by hose to the tanker by the tanker driver and emulsion pumped from the tanker into a holding tank on the large road repair machine. The machine has storage for both emulsion and aggregate. Both ingredients are continuously fed at ambient temperatures into the mixing section of the road machine called the "pug mill" to form "cold mixed" asphalt. This mill holds 1-1.5 m^3 of continuously mixed asphalt (<0.1% notified chemical). Being a through-flow process, the most processed mix moves forward to the road paving section, where the asphalt road surface is spread across a 2.4 m wide surface and compacted. The road-making machine does this operation without human intervention, and does not require cleaning.

Road crew may occasionally perform small repairs after the surface is laid, using hand tools. Within 20 minutes, the road surface is set sufficiently to enable traffic, and it reaches >95% strength within 10 hours.

6. HUMAN HEALTH IMPLICATIONS

6.1 Exposure assessment

6.1.1 Occupational exposure

NUMBER AND CATEGORY OF WORKERS

Category of Worker	*Number*	*Exposure Duration (hours/day)*	*Exposure Frequency (days/year)*
Transport and Storage			
Dock to reformulation site (with loading/unloading) or to road-making sites	3	4	54
Reformulation			
Emulsion formulation	3	8	260
QC testing	1	8	260
Filling into storage tanks	3	8	260
Maintenance workers	2	8	260
Road making			
Road machine driver	1	8	150
Road machine Operator	1	8	150
Ground crew	3-5	1.6	150

EXPOSURE DETAILS

Transport and Storage

Exposure is unlikely to the chemical during transportation and storage. Dermal or possibly ocular exposure may result where contact is made with accidental spills or leaks from the IBCs.

Reformulation

Emulsion formulation: Dermal or ocular exposure to the notified chemical (at <80%) may be experienced by workers during the connecting of hoses to IBCs, from drips, spills or splashes. Workers will wear a minimum of chemical apron, goggles and gloves as standard PPE, which is expected to be worn due to the corrosive nature of the notified chemical. Inhalation exposure during blending is expected to be low due to the enclosed processes used, the exhaust ventilation system and the low vapour pressure of the notified chemical.

QC testing: Dermal and ocular exposure is possible from drips, spills and splashes during batch adjustment and when taking and testing samples. The exposure of these workers is expected to be minimised by the wearing of boiler suits and gloves as standard PPE.

Filling of bitumen emulsions into storage tanks and tankers: Dermal or ocular exposure to the notified chemical in bitumen emulsions may be possible due to drips and spills when connecting lines. This is expected to be minimal due to the low concentration of the notified chemical and because of the standard PPE that is worn (boiler suits and gloves). The finished product is filled into storage tanks under local exhaust ventilation.

Maintenance workers: There is the possibility of dermal and ocular exposure to the notified chemical during equipment maintenance. Workers wear boiler suit and gloves as standard PPE to minimise exposure.

Road making

The number of workers involved in resurfacing varies depending on the road terrain and layout. For instance, wide roads need more workers than medium roads, roads needing repairs need more workers and winding roads need more workers to ensure edges are cleanly laid. No exposure of workers is expected during the primary laying of the road by the road-making machinery.

The road crews consist of teams of 3-5 workers, who normally use hand tools. It is estimated that these workers spend 15-20% of their working time handling asphalt mix containing the notified chemical. These workers will experience predominantly dermal exposure to the notified chemical during road making, where it is incorporated in a viscous mixture with aggregate; no splashing or aerosol formation is expected that might lead to eye or inhalation exposure.

The notified chemical is non-volatile, and the lack of inhalation exposure during this kind of work is supported by the findings of two studies. The airborne exposure of workers involved with road surfacing using cold bitumen-in-water emulsions has been measured using a sensitive air sampling technique combined with liquid chromatography (Campbell *et al*, 1998). This study found that during slurry surfacing, the highest emission was ammonia (200 ppb), and other alkylamines (0.2 ppb). Further studies investigated airborne exposures during the use of an emulsifier (similar to the notified chemical) at 0.2% in spraying operations onto road surfaces at 50-60ºC (Campbell *et al*, 2000). In this study, the only detected emission was ammonia (3-20 ppb). No emulsifier was detected in the air during road surface sealing in either study.

In finished asphalt, the notified chemical is expected to remain bound to aggregate, with only trace levels present at the surface for contact. Road crews wear boiler suits and working gloves, working with shovels and rakes; therefore, direct contact with the notified chemical is expected to be minimal.

6.1.2. Public exposure

Exposure of the public to concentrated solutions of the notified chemical is not expected, given its industrial use. Significant exposure might only be expected in the unlikely event of a spill or transportation accident.

Members of the general public will make dermal exposure to the notified chemical at a concentration of <0.1% in roadways and footpaths made of bitumen emulsion. However, the notified chemical is expected to remain trapped within finished asphalt, with only trace levels present at the surface for contact. In addition, footwear would eliminate most direct contact with the road surface and any associated exposure to the notified chemical.

6.2. Human health effects assessment

The results from toxicological investigations conducted on the notified chemical or on its analogues are summarised in the table below. Details of these studies can be found in Appendix B. Data for Analogue 1 is considered to be representative for the determination of the notified chemical's toxicology, whereas that for Analogue 2 is only considered as supportive to other studies.

Endpoint	*Result and Assessment Conclusion*
Rat, acute oral toxicity	LD_{50} 500-2000 mg/kg bw; Harmful
Rat, acute dermal toxicity	LD_{50} >2000 mg/kg bw; Low toxicity
Rabbit, skin irritation	Corrosive, with a risk of serious burns
Rabbit, eye irritation	Corrosive (assumed from skin irritation test outcome)
Guinea pig, skin sensitisation – adjuvant test	Inadequate evidence of sensitisation
Rat, repeat dose toxicity – 15 days	Max. tolerable dose ~91 mg/kg bw/day (Analogue 1)
Rat, repeat dose oral toxicity – 28 days	LOAEL 45.3 mg/kg bw/day (Analogue 1)
Mutagenicity – bacterial reverse mutation	Non-mutagenic
Mouse, Genotoxicity – *in vivo* micronucleus test	Non-genotoxic (Analogue 1)
Rat, Genotoxicity – *in vivo* micronucleus test	Non-genotoxic (Analogue 2)

Toxicokinetics
Given the systemic toxicity of the notified chemical in multiple animal oral toxicity studies, it is expected to be absorbed after an oral dose. Due to its surface-active nature, absorption is most likely to occur from the intestine, through micellar uptake into the lymphatic system. This conclusion is supported by the findings of the repeat dose oral toxicity study, where lymphadenitis and enlargement of the mesenteric lymph node were observed. These effects were likely to be caused by the strongly irritant nature of the analogue of the notified chemical acting on the lymphatic tissues of the mesentery.

Due to its polarity and molecular weight, the notified chemical is not expected to be transdermally absorbed in the absence of severe damage to the stratum corneum. Rather, it is expected to be bound within this skin layer, and be sloughed away with normal skin shedding.

For similar reasons, any absorbed notified chemical might be excreted primarily via the bile.

Acute toxicity
It is apparent that the notified chemical is acutely toxic upon oral administration. In the acute oral toxicity study, the notified chemical killed >50% of the animals treated with 2000 mg/kg bw. Acute lethality was also observed in the 15-day repeat dose toxicity study, where high levels of mortality were observed amongst the two highest, fixed dose test animal groups after only a small number of administrations (≥3 doses). Based on the observed LD_{50} value, the notified chemical is classified as R22, Harmful if swallowed (NOHSC, 2004).

In contrast, however, the notified chemical showed no lethality in an acute dermal toxicity study. This correlates with the notified chemical's predicted lack of transdermal absorption.

Irritation and sensitisation
The notified chemical is a potentially cationic surfactant and emulsifier, and as such would be expected to be an irritant. Surface-active agents cause skin irritation by reacting with skin proteins and disrupting lipids in the stratum corneum, leading to skin permeability and eventually damage to deeper epidermal or dermal layers (Walker *et al*, 2004). In addition, the notified chemical contains at least two structural alerts for skin irritation/corrosion potential (Hulzebos *et al*, 2004). All of these predictions were found to be accurate in the skin irritation study, where the notified chemical was corrosive and/or caused burns, after either 3 minutes or 4 hours of skin contact. Evidence of skin irritation was also observed in the acute dermal toxicity study, where persistent erythema and necrosis were observed at skin application sites. Similar effects were observed for Analogue 2, suggesting a similar mode of action for the two structurally related chemicals (IUCLID, 2006). Therefore, the notified chemical is classified C: R35, Corrosive: causes severe burns (NOHSC, 2004).

The ability of the notified chemical to cause severe eye irritation or corrosion is implied from the skin irritation test result.

A guinea pig maximisation study was performed, which showed no sensitisation potential of the notified chemical. No sensitisation data was available for the two analogue chemicals.

Repeated dose toxicity
The majority of the findings observed in the range-finding study and the repeat-dose toxicity relate directly or indirectly to the irritant nature of the analogue of the notified chemical (excessive salivation, hypoactivity, diarrhoea, stomach ulceration and keratinisation, reduced food intake, enlarged mesenteric lymph node with lympadenitis). Findings without a direct correlation with irritancy included neutrophilia and reductions in blood parameters (haemoglobin level, packed cell volume and mean cellular volume). Sporadic elevations of serum liver enzyme activities were also observed, and these may be suggestive of liver damage, perhaps occurring during biliary excretion of this analogue of the notified chemical.

A similar spectrum of effects have also been reported for Analogue 2 (IUCLID, 2006), supporting the conclusion that the majority of the observed repeated dose effects are likely to be related to the irritant nature of the two chemicals.

The LOAEL of 45.3 mg/kg bw/day (for the analogue of the notified chemical) is below the classification threshold (NOAEL ≤150 mg/kg bw/day for a 28-day study), and in addition, irreversible effects and treatment-related deaths were observed during the study. Therefore, classification of the notified chemical as Xn: R48, Harmful: Danger of serious damage to health by prolonged exposure, is warranted (NOHSC, 2004). This analogue is sufficiently identical to the notified chemical for this classification to be made without any reservations.

Mutagenicity
The notified chemical is not expected to be mutagenic or genotoxic based on its structure; however, *in vivo* metabolism cannot easily be accounted for. The data presented is superficially suggestive of a negative outcome.

High levels of cytotoxicity were observed in the Ames test performed on the notified chemical, confounding the negative result. Ames test data for Analogue 2 indicated similar levels of cytotoxicity, and the result was similarly negative (IUCLID, 2006). Given the surfactant nature of the notified chemical, similar toxicity might be expected if it were tested in any *in vitro* cultured cell system. The notifier has indicated that no *in vitro* chromosome aberration data is available for either the notified chemical or its analogues.

Data from two *in vivo* micronucleus studies were also negative, for two different analogue chemicals. Both of these studies were, however, weakened by the lack of any observed cytotoxicity. Cytotoxicity would be expected for such test substances if they reached the bone marrow. Therefore, a negative genotoxic conclusion cannot be made with confidence, as it is unknown if the target tissue received adequate levels of the notified chemical.

Overall, the available data does not indicate any mutagenic or genotoxic effects of the notified chemical. However, several weaknesses in the test data prevent a confident exclusion of the possibility of such effects.

Hazard classification
Based on its ability to cause skin corrosion, its low LOAEL and LD_{50} values, and the observation of treatment-related deaths, the notified chemical is classified as hazardous under the *Approved Criteria for Classifying Hazardous Substances* (NOHSC, 2004).

Xn: R22	Harmful if swallowed
Xn: R48/22	Harmful: danger of serious damage to health by prolonged exposure if swallowed
C: R35	Causes severe burns

Dangerous Goods classification
Based on the available data the notified chemical is classified as follows according to the Australian Dangerous Goods Code (FORS, 1998):

Class 8 (Corrosive)

6.3. Human health risk characterisation

6.3.1. Occupational health and safety
The primary risk of the notified chemical is likely to result from corrosive effects resulting from dermal exposure. It is acutely toxic following oral exposure, but it is unlikely to be ingested under any of the occupational settings described. As inhalation toxicity is unlikely for the proposed use, the risk to workers' health via this route is not considered to be significant.

The risk to the health of **transport and storage workers** is not considered to be significant, due to the lack of probable exposure and the high level of training that Dangerous Goods-accredited drivers should possess. The main risk to these workers is expected to be during the coupling and uncoupling of connections during the filling and unloading of trucks with bitumen emulsions containing the notified chemical (see below).

Reformulation workers will likely experience the greatest risk posed by the notified chemical, from exposure to concentrated solutions. During bitumen emulsion formulation, workers may experience dermal and ocular exposure, and this is likely to present a significant risk of corrosive effects, such as burns. As the concentrated solution of the notified chemical will be handled and processed in largely contained and isolated processes, exposure is expected to be mainly accidental, such as from drips and spills during the connection and disconnection of feed lines. Therefore, the risk of adverse effects is likely to be low, given appropriate handling. The wearing of PPE, training of workers and the availability of adequate emergency facilities (e.g. emergency showers and eyewash stations) are expected to reduce the severity of any effects that might result from accidental exposure.

Exposure to the notified chemical in **bitumen emulsions** (<3%) is not expected to present a significant risk where these are handled appropriately. Exposure is only likely during the filling of trucks and during road making, and is expected to be mainly dermal. Appropriate PPE (coveralls, gloves) is expected to minimise any risk to workers health that might result from dermal exposure. Ocular exposure may be complicated by the presence of bitumen, but is unlikely to occur under the operations proposed by the notifier. Therefore, the risk associated with the handling of bitumen emulsions containing the notified chemical is expected to be minimal provided that workers follow good working practices that limit human intervention and contact.

During **road surfacing**, ground crews will be exposed to slurries of bitumen emulsion and aggregate (<0.1% notified chemical). However, due to its low concentration, the application mainly by machinery and the viscous nature of the slurries, the probable level of dermal exposure is unlikely to cause significant corrosion or burns. In addition, the notified chemical should adsorb onto the aggregate component of the slurry, and thus

not be available for exposure in the same way that it might be in a bitumen emulsion.

6.3.2. Public health

Given the lack of significant exposure to the notified chemical, a significant risk to public health is unlikely to be presented during the proposed use of the notified chemical. The low concentrations of the notified chemical that remains in bitumen road surfaces after surfacing is not expected to present any risk of corrosive irritation.

7. ENVIRONMENTAL IMPLICATIONS

7.1. Environmental Exposure & Fate Assessment

7.1.1 Environmental Exposure

RELEASE OF CHEMICAL AT SITE

The notified chemical is a potentially cationic surfactant, which creates a stable reverse bitumen emulsion for road repair. It is imported from overseas and thus there are no environmental implications from the manufacture of the notified chemical. The 750 kg IBCs are stored in a bunded area to prevent accidental leakage from escaping from the manufacturer's site. The IBCs will only have 1-2 L (~0.1-0.2%) residue remaining after being emptied. It will then be double rinsed with approximately 100 L of water, with the rinses being added to the bitumen emulsion. The notified chemical is expected to be non-volatile due to its cationic nature and relatively high molecular weight. Studies have also indicated that during resealing, including in hot mix applications, the notified chemical was not detected, although ammonia, propylene and volatile amines could be detected at low levels (Campbell *et al*, 1998; Campbell *et al*, 2000).

There is a scope for accidental spillage to occur whilst loading the notified chemical into the mixing vessel at the first stage of manufacturing the emulsion. Should a spill occur, it is expected to be contained to the plant by bunding. As mixing is carried out at low temperatures during the first stage, and at ambient for the rest of the process, there would be negligible release to the atmosphere. All material collected from any spill will be disposed off-site by a licensed waste disposal contractor.

RELEASE OF CHEMICAL FROM USE

The bitumen emulsion containing the notified chemical is then used for road repairs. Larger sections will have a solid gravel surface laid and compacted before applying the emulsion. Small repairs will require quantities of bitumen emulsion coated gravel. Dedicated tanks are used for the bitumen and cleaning of tanks is not expected on a regular basis. If cleaning occurs the rinsate is expected to be added to the next batch of bitumen with no environmental release. Polyram emulsions are used specifically with the road machine to resurface roads, and the practice is that no cleaning is required for the road machine. Thus there is little environment implication from the application process.

However, run-off from roads as a result of rainfall may lead to aquatic exposure. Studies were provided with slurry emulsifiers of acceptable analogues indicating that emulsifiers are unlikely to move through the soil and contaminate groundwater. Soil adsorption measurements using OECD guidelines indicate emulsifiers are strongly adsorbed (70-99.9%) and not desorbed on washing (Campbell *et al*, 1998). The soil adsorption studies were repeated using a more specific analytical method showed that the soil adsorption was >99.9993%. In addition, no detectable levels of emulsifier were present in the wash water following simulated rainfall in laboratory studies. These results suggest that most of the emulsifier would remain in the asphalt; the small amount released would be expected to remain close to the roadway and adsorb onto soil. Eventually the emulsifiers would be expected to biodegrade over time.

RELEASE OF CHEMICAL FROM DISPOSAL

The IBC used for import are returned for refilling. Residues of the notified chemical will be flushed out with water and added to the next batch of emulsion. Therefore, the release to the environment of the notified chemical resulting from disposal is expected to be minimal.

7.1.2 Environmental fate

For the details of the environmental fate studies please refer to Appendix C.

The cationic sites of the notified chemical are expected to bind strongly with the negatively charged mineral (gravel) surfaces and break the emulsion. Published data from studies on emulsifiers with similar structures indicate that most of the emulsifier will remain in the asphalt. Only low amounts will be released from the cured asphalt surface to the environment, specifically the immediately surrounding area, where the emulsifier will

strongly adsorb onto soil (Campbell *et al*, 1998; Campbell *et al*, 2000). The emulsifier is not expected to be readily biodegradable, but will slowly biodegrade over time.

A ready biodegradation test was provided for the notified chemical, indicating that the notified chemical is not readily biodegradable, with less than 60% biodegradation after 28 days. The bioaccumulation of an unacceptable analogue on fish (*Cyprinus carpio*) was presented and a BCF value of <300 was claimed. However, due to the differences between this analogue and the notified chemical, little can be inferred from this test result. Furthermore, BCF of surfactants cannot be measured or calculated and bioconcentration is not expected to pose an unacceptable risk based on the present knowledge.

7.1.3 Predicted Environmental Concentration (PEC)

The main concern from the proposed use of the notified chemical is the run-off from roads leading to aquatic exposure. It is conceivable that the notified chemical from run-off could move through soil and eventually contaminate rivers or aquifers before having a chance to degrade. From the data provided, a predicted environmental concentration (PEC) could not be calculated with any certainty. A value of ≤0.5 mg/L in the run-off water has been estimated in a laboratory experiment, although this is likely to be an overestimation. Based on the adsorption studies of run-off waters onto soil samples, the % adsorption to soils were determined to be >99.98%. Therefore, the amount that would not be adsorbed from the worst-case run-off concentration of 0.5 mg/L would correspond to 0.02% of 0.5 mg/L. Thus the worst case PEC is calculated to be 0.1 µg/L for run-off water from soils into the aquatic compartment.

7.2. Environmental effects assessment

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

Endpoint	*Result*	*Assessment Conclusion*
Fish Toxicity	96 h EC_{50} = 45 µg/L	Very toxic
Daphnia Toxicity	48 h EC_{50} = 63 µg/L	Very toxic
Algal Toxicity	72 h ErC_{50} = 10 µg/L (CI: 7.5-13)	Very toxic

These results indicate that the notified chemical is considered to be very toxic to aquatic organisms.

7.2.1 Predicted No-Effect Concentration

A predicted no effect concentration (PNEC) can be calculated as 0.1 µg/L from the ErC50 of 10 µg/L for alga and applying a safety factor of 100 (as three trophic levels are available for the notified chemical).

Predicted No-Effect Concentration (PNEC) for the Aquatic Compartment		
72 h ErC50	0.01	mg/L
Assessment Factor	100	
Mitigation Factor	1.00	
PNEC:	0.1	µg/L

7.3. Environmental risk assessment

Risk Assessment	PEC (µg/L)	PNEC (µg/L)	Q
Run-off water from treated road direct into the aquatic compartment	500	0.1	5000
Run-off water from soil on the side of the road into the aquatic compartment	0.1	0.1	1

The resulting worst-case risk quotient (Q = PEC/PNEC) calculated from run-off water from treated road into the aquatic compartment results in a value of 5000. Even allowing for a lower concentration of the notified chemical and considerable dilution as would be expected in a run-off event, the RQ may exceed 1 if the run-off comes in direct contact with the aquatic environment.

The notified chemical from run-off onto shoulders and soil on the side of the road is expected be mostly adsorbed due to its strong positive charge. The run-off is expected to be intercepted in many cases by drains earthen (such as table drains) or be drained naturally. In many cases the table drains do not flow into waterways

but merely collect the water in the depression. In cases where natural drainage occurs, the worst case Q value was determined to be 1, indicating acceptable risk to the aquatic environment.

Under the proposed use pattern, the risk to the aquatic environment will be acceptable where run-off from roads flows onto soil. However, where the run-off flows directly into the aquatic environment, from the data available the risk is considered unacceptable.

8. CONCLUSIONS AND REGULATORY OBLIGATIONS

Hazard classification
Based on the available data the notified chemical is classified as hazardous under the *Approved Criteria for Classifying Hazardous Substances* [NOHSC:1008(2004)]. The classification and labelling details are:

Xn: R22	Harmful if swallowed
Xn: R48/22	Harmful: danger of serious damage to health by prolonged exposure if swallowed
C: R35	Causes severe burns
R50/53	Very toxic to aquatic organisms; may cause long-term adverse effects in the aquatic environment
S23	Do not breathe gas/fumes/vapour/spray
S24/25	Avoid contact with skin and eyes
S26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S28	After contact with skin, wash immediately with plenty of water.
S36/37/39	Wear suitable protective clothing, gloves and eye/face protection.
S61	Avoid release to the environment. Refer to special instructions/safety data sheet.

and

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

	Hazard category	***Hazard statement***
Corrosive	1C	Danger: Causes severe skin burns and eye damage
Acute toxicity	4	Warning: Harmful if swallowed
Health Hazard	2	Warning: May cause death through prolonged or repeated oral exposure
Environment	Acute and Chronic I	Very toxic to aquatic organisms

Dangerous Goods classification
Based on the available data the notified chemical is classified as follows according to the Australian Dangerous Goods Code (FORS, 1998):

Class 8 (Corrosive)

Human health risk assessment
Under the conditions of the occupational settings described, the risk to workers is considered to be acceptable, provided that the notified chemical is handled in such a way as to minimise any potential exposure. Good working practices should be followed and appropriate personal protective equipment should be used where exposure might occur during handling.

When used in the proposed manner the risk to the public is considered to be acceptable.

Environmental risk assessment
On the basis of the PEC/PNEC ratio, the notified chemical is considered to pose a risk to the environment based on its reported use pattern. The use of the notified chemical should be controlled such that no direct exposure to the aquatic environment will occur.

Recommendations

REGULATORY CONTROLS
Hazard Classification and Labelling

- The Office of the ASCC, Department of Employment and Workplace Relations (DEWR), should consider the following health and environmental hazard classification for the notified chemical:
  - *Xn: R22 Harmful if swallowed*
  - *Xn: R48/22 Harmful: danger of serious damage to health by prolonged exposure if swallowed*
  - *C: R35 Causes severe burns*
  - *R50/53 Very toxic to aquatic organisms; may cause long-term adverse effects in the aquatic environment.*

- Use the following risk phrases for products/mixtures containing the notified chemical:
  - *≥25%: C: R35, Xn: R22, Xn: R48/22*
  - *10% ≤ conc < 25%: C: R35, Xn: R48/22*
  - *5% ≤ conc < 10%: C: R34*
  - *1% ≤ conc < 5%: R36/38*

- The notified chemical should be classified as follows under the ADG Code:
  - *Class 8 (Corrosive)*

- Suppliers should label the notified chemical as a Class 8 dangerous good with the signal word "Corrosive" and the risk and safety phrases listed above.

CONTROL MEASURES
Occupational Health and Safety

- Employers should implement the following engineering controls to minimise occupational exposure to the notified chemical as introduced:
  - *Prevent leaks and spills*
  - *Wherever possible, direct handling of the notified chemical should be avoided; rather, some remote handling apparatus should be used.*

- Employers should implement the following safe work practices to minimise occupational exposure during handling of the notified chemical as introduced:
  - *Avoid contact with skin, eyes and clothing.*
  - *Avoid breathing vapours or mists.*
  - *A shower and eyewash station should be available.*
  - *Avoid spills and splashing during use.*
  - *After exposure, any contaminated PPE should be thoroughly cleaned before re-use.*

- Employers should ensure that the following personal protective equipment is used by workers to minimise occupational exposure to the notified chemical as introduced:
  - *Chemical resistant gloves*
  - *Face-shield*
  - *Chemical resistant clothing which protects the body, arms, legs and feet*

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

- Only workers with sufficient education on the hazards of the notified chemical should handle it in any concentrated form, such as the imported product.

- A copy of the MSDS should be easily accessible to employees.

- If products and mixtures containing the notified chemical are classified as hazardous to health in accordance with the *Approved Criteria for Classifying Hazardous Substances* [NOHSC:1008(2004)] workplace practices and control procedures consistent with provisions of State and Territory hazardous substances legislation must be in operation.

Environment

- Avoid any release to the aquatic environment.

- Water run-off from road surfaces containing the notified chemical, or run-off from engineered drainage of such roads, should not flow directly into the aquatic environment. Such situations would include but not limited to bridges and fords and their proximity.

Disposal

- The notified chemical should be disposed of by landfill.

Emergency procedures

- Spills or accidental release of the notified chemical should be handled by placing inert absorbent material onto spillage. Use clean non-sparking tools to collect the material and placed into a suitable labelled container. Wash the floor with copious quantities of water. Dispose of waste according to federal and state regulations. If large quantities of this material enter any waterways, contact your local Waste Management Authority.

Regulatory Obligations

Secondary Notification
This risk assessment is based on the information available at the time of notification. The Director may call for the reassessment of the chemical under secondary notification provisions based on changes in certain circumstances. Under Section 64 of the *Industrial Chemicals (Notification and Assessment) Act (1989)* the notifier, as well as any other importer or manufacturer of the notified chemical, have post-assessment regulatory obligations to notify NICNAS when any of these circumstances change. These obligations apply even when the notified chemical is listed on the Australian Inventory of Chemical Substances (AICS).

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

(1) Under Section 64(2) of the Act; if
- the function or use of the chemical has changed from as a bitumen additive for road repair, or is likely to change significantly;
- the amount of chemical being introduced has increased from 150 tonnes/year, or is likely to increase, significantly;
- if the chemical has begun to be manufactured in Australia;
- the use of the chemical in Australia has changed, or is likely to change, in a way that may result in an increased risk of an adverse effect of the chemical on occupational health and safety, public health, or the environment;
- 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.

No additional secondary notification conditions are stipulated.

AICS Annotation
When the notified chemical is listed on the Australian Inventory of Chemical Substances (AICS) the entry should be annotated with the following statement(s):
- *for use as bitumen additive for road repair only*
- *not to be used where direct release to water may occur*

Material Safety Data Sheet

The MSDS of the notified chemical and products containing the notified chemical provided by the notifier were reviewed by NICNAS. The accuracy of the information on the MSDS remains the responsibility of the applicant.

APPENDIX A: PHYSICAL AND CHEMICAL PROPERTIES

Data for an analogue of the notified chemical, Analogue 2, is expected to be sufficiently equivalent to the notified chemical for the endpoints described.

Melting Point/Freezing Point 9ºC

Method Claimed equivalence to OECD TG 102 Melting Point/Melting Range
Remarks No test report was available.

Density 920 kg/m^3 at 20ºC
901 kg/m^3 at 50ºC

Method Claimed equivalence to OECD TG 109 Density of Liquids and Solids
Remarks No test report was available.

Vapour Pressure <0.13 kPa at 20ºC
<0.00026 kPa (estimated)

Method Method unknown
Remarks Value given is that of Analogue 2; the notified chemical is expected to have a lower vapour pressure due to its greater molecular weight and polarity.

The vapour pressure of Analogue 2 has also been estimated to be <0.00026 kPa using EPIWIN v2.0b (IUCLID, 2006).

Water Solubility Dispersible: 10-50 g/L at 20ºC
Soluble: <0.6 g/L

Remarks Water solubility tests at concentrations between 0.1 and 0.5% of the notified chemical are said to give translucent suspensions, indicating that it is dispersible but not soluble in this range at 20°C. In ecotoxicity studies solutions of up to 1 mg/L appeared to be soluble.

Adsorption/Desorption Not stated

Method OECD TG 106 Adsorption - Desorption Using a Batch Equilibrium Method.
Remarks A test was performed on an unacceptable analogue which was considered to be immobile in Cranfield 164 silt loam soil, Cranefield 266 clay soil, *Oostvaardersplassen* sediment silt loam and sewage sludge DBI silty clay. However, no test report was provided (refer to Section C.1.3 for adsorption studies of acceptable analogues).

Dissociation Constant pKa = 6.6

Method OECD TG 112 Dissociation Constants in Water.
Remarks The analysis was conducted by potentiometric measurement with electrode of combined glass for pH. However, no test report was provided except for a test protocol.

Flash Point >100ºC
>159ºC (estimated from measured data for Analogue 2)

Method Claimed equivalence to EC Directive 92/69/EEC A.9 Flash Point.
Remarks Pensky-Martens closed cup method. No test report was available. The flash point of an analogue for the notified chemical, was ~159ºC in an open-cup test.

Flammability Not determined

Remarks Not expected to be highly flammable, based on the predicted low vapour pressure and low flash point of the notified chemical. The notified chemical is expected to be combustible.

Autoignition Temperature ~270ºC

Method German standard test method DIN 51794
Remarks The autoignition temperature reported is that of Analogue 2.

Explosive Properties Not expected to be explosive.

Remarks Estimated from the lack of explosophores in the structural formula.

APPENDIX B: TOXICOLOGICAL INVESTIGATIONS

B.1. Acute toxicity – oral

TEST SUBSTANCE: Notified chemical

METHOD
- Species/Strain: Rat/Sprague-Dawley OFA, IFFA-CREDO
- Vehicle: 0.5% carboxymethylcellulose
- Remarks - Method: The doses were chosen based on a preliminary study, performed on a few animals (test report not provided).

RESULTS

Dose (mg/kg bw)	*Number and Sex of Animals*	*Mortality*
500	5M, 5F	0
2000	5M, 5F	4M, 3F

- LD_{50}: 500-2000 mg/kg bw
- Signs of Toxicity: Mortalities chiefly occurred 6-72 hours after treatment, although one male died at day 6 after treatment. Another was sacrificed at day 10 for humane reasons.
  In animals treated with 2000 mg/kg bw, severe piloerection, abdominal meteorism and diarrhoea were observed in the surviving animals for about a week after treatment. No significant signs of toxicity were observed in animals treated with 500 mg/kg bw within the observation period, apart from transient piloerection (0.5-24 hours).
- Effects in Organs: Macroscopic examination of deceased animals treated with 2000 mg/kg bw found congestive changes in lungs, liver, kidneys and spleen, as well as distension of the intestine. In the animal that was sacrificed on day 10, stomach adhesions with liver, spleen and abdominal wall were observed, along with distension of the intestine with fluid.
  No gross lesions were observed upon necropsy in animals treated with 500 mg/kg bw, or in those treated with 2000 mg/kg bw and which survived until the end of the observation period.

CONCLUSION: The notified chemical is harmful via the oral route.

TEST FACILITY: EVIC-CEBA (1997)

B.2. Acute toxicity – dermal

TEST SUBSTANCE: Notified chemical

METHOD: OECD TG 402 Acute Dermal Toxicity – Limit test
EC Directive 92/69/EEC B.3 Acute Toxicity (Dermal) – Limit test
- Species/Strain: Rat/Sprague-Dawley ICO:OFA-SD (IOPS Caw)
- Vehicle: None (administered undiluted)
- Type of dressing: Semi-occlusive
- Remarks - Method: The notified chemical was applied to 10% of each animal's skin surface for 24 hours, followed by observation for 14 days.

RESULTS

Dose (mg/kg bw)	*Number and Sex of Animals*	*Mortality*
2000	5M, 5F	0

- LD_{50}: >2,000 mg/kg bw
- Signs of Toxicity - Local: Well-defined erythema was observed in all animals on day 2, and this

	persisted in three females until sacrifice at day 15. Necrosis was observed in two animals (one male and one female) between days 4 and 7. Crusts were noted at the treatment site in all animals from day three until the end of the study, and dryness of the skin was observed in two males on days 14 and 15.
Signs of Toxicity - Systemic	No clinical signs were observed during the study. One male and two females showed reduced body weight gain between days 1 and 8, after which it returned to normal.
Effects in Organs	No apparent abnormalities were observed upon necropsy.
Remarks - Results	All observed effects are expected to be due to the corrosive nature of the notified chemical.

CONCLUSION The notified chemical is of low toxicity via the dermal route.

TEST FACILITY CIT (1998a)

B.3. Irritation – skin

TEST SUBSTANCE Notified chemical

METHOD

Species/Strain	Rabbit/New Zealand White, elevage BERTHO
Number of Animals	3 females
Vehicle	None (applied undiluted)
Observation Period	14 days
Type of Dressing	Semi-occlusive
Remarks - Method	Initially, a 4-hour contact period was used, but subsequently a 3-minute contact duration was also tested on an intact skin site.

RESULTS

Lesion	*Mean Score* Animal No.*			*Maximum Value*	*Maximum Duration of Any Effect*	*Maximum Value at End of Observation Period*
	1	2	3			
4-hours contact						
Erythema/Eschar	3.0	2.3	3.0	3	>14 days	1
Oedema	2.0	3.0	3.7	4	>14 days	1
3-minutes contact						
Erythema/Eschar	1.7	2.0	0.3	2	>14 days	1
Oedema	2.0	1.0	1.3	2	11 days	0

*Calculated on the basis of the scores at 24, 48, and 72 hours for EACH animal.

Remarks - Results	The notified chemical showed a contact time-dependent worsening of observed effects. Erythemae regressed slowly in all animals. After 48 hours following the 4-hour application, lesions as burns and loss of skin elasticity were observed in all animals. In one animal, a slight scab broke out 72 hours later, and scar formation was visible at the end of the observation period.

CONCLUSION The notified chemical is corrosive to the skin, with a risk of serious burns.

TEST FACILITY EVIC-CEBA (1996)

B.4. Skin sensitisation

TEST SUBSTANCE Notified chemical

METHOD OECD TG 406 Skin Sensitisation – Maximisation test.
EC Directive 96/54/EC B.6 Skin Sensitisation - Maximisation test.

Species/Strain	Guinea pig/Dunkin-Hartley
PRELIMINARY STUDY	Maximum Non-irritating Concentration: intradermal: 0.1% (w/w) topical: 10% (w/w)
MAIN STUDY	
Number of Animals	Test Group: 20 Control Group: 10
INDUCTION PHASE	Induction Concentration: intradermal: 0.1% (w/w) topical: 10% (w/w)
Signs of Irritation	In the preliminary study, severe erythema, moderate oedema, necrosis and crusting were noted after treatment with 100% or 50% test substance. In the main test, undescribed signs of irritation were observed after induction at the administration site in both control and treated animals.
CHALLENGE PHASE	
1st challenge	topical: 1% (w/w)
Remarks - Method	The notified chemical was administered as a 10% (w/w) emulsion in 0.9% NaCl. This whitish emulsion was found to easily pass through the syringe for intradermal injection. As the notified chemical was an irritant under the conditions of the preliminary test, the test site was not pre-treated with sodium lauryl sulfate before test substance administration in the main test. Only one challenge was performed.

RESULTS

Animal	*Challenge Concentration*	*Number of Animals Showing Skin Reactions after challenge*	
		24 h	*48 h*
Test Group	1%	0	0
Control Group	1%	0	0

CONCLUSION	There was no evidence of reactions indicative of skin sensitisation to the notified chemical under the conditions of the test.
TEST FACILITY	CIT (1998b)

B.5. Repeat dose toxicity – 15 days (dose range-finding study)

TEST SUBSTANCE	Analogue 1 (an acceptable analogue of the notified chemical)
METHOD	No standard guideline. The test was performed to determine the maximum tolerated dose level and to select the dose levels for the 28-day study.
Species/Strain	Rat/Sprague-Dawley
Route of Administration	Oral – gavage
Exposure Information	Total exposure days: 15 days Dose regimen: Daily Post-exposure observation period: None
Vehicle	None (administered undiluted) except for the 0.25 mL/kg bw/day group, in which it was diluted 1:1 with 1% aqueous carboxymethylcellulose.
Remarks - Method	No concurrent control group was used. One test group was treated with an ascending dose-level, from 0.1 mL/kg bw/day, increasing by 0.1 mL/kg bw/day every 2-3 days over the duration of the test, to 0.7 mL/kg bw/day. Due to mortality, treatment was terminated at 4 days in the 0.5 mL/kg bw/day group, and at Day 14 in the 0.3 mL/kg bw/day group.

RESULTS

Dose (mL/kg bw/day)	*Equivalent dose (mg/kg bw/day)*	*Number and Sex of Animals*	*Mortality*

0.1-0.7	91-634	5M, 5F	10
0.5	453	5M, 5F	10
0.3	272	2M, 2F	4
0.2	181	2M, 2F	2
0.1	91	2M, 2F	1
0.25*	226	2M, 2F	0 (1)

* Diluted 1:1 in vehicle.

Mortality and Time to Death

- In the ascending dose group, mortality appeared from 0.6 mL/kg bw/day, and all animals were found dead between days 10-15.
- At 0.5 mL/kg bw/day, mortality occurred between days 3 and 13, and all animals had lost body weight prior to death.
- At 0.3 mL/kg bw/day, all of the animals died between days 3 and 4.
- At 0.2 mL/kg bw/day, two males were found dead before dosing on day 9. Body weight losses were recorded until day 8 of treatment.
- At 0.1 mL/kg bw/day, one female was found dead on day 12. This animal had lost body weight 2 days prior to death.
- At 0.25 mL/kg bw/day, no treatment-related mortality was observed. One animal died from gavage error.

Clinical Observations

The major clinical signs noted were excessive salivation, hypoactivity and diarrhoea; the severity of these increased in a dose-dependent fashion. Notably, these effects were minimal or absent in animals treated with 0.1 or 0.25 mL/kg bw/day.

Laboratory Findings – Clinical Chemistry, Haematology, Urinalysis

Plasma urea levels and increased liver enzyme activities (SGPT (ALT) and SGOT (AST)) were elevated in animals of the ascending and highest fixed dose groups.

Effects in Organs

Erosion, partial autolysis, and ulceration of the keratinised squamous epithelium of the stomach were observed in the ascending and highest fixed-dose animals. This was associated with inflammatory cell infiltration in the lamina propria and hyperkeratosis of stomach epithelium.

Remarks – Results

No concurrent control group was used, so some observed effects could not be correlated with test substance treatment (eg plasma urea or enzyme levels).

CONCLUSION

The maximum tolerable dose was determined to be ~0.1 mL/kg bw/day (91 mg/kg bw/day) in this study, based on the lack of significant mortality or clinical signs. The test substance was clinically more favourably tolerated when formulated in vehicle.

TEST FACILITY IFM (1981), CECA (2007)

B.6. Repeat dose toxicity – 28 days

TEST SUBSTANCE	Analogue 1 (an acceptable analogue of the notified chemical)	
METHOD	OECD TG 407 Repeated Dose 28-day Oral Toxicity Study in Rodents.	
Species/Strain	Rat/Sprague-Dawley	
Route of Administration	Oral – gavage	
Exposure Information	Total exposure days:	28 days
	Dose regimen:	7 days per week
	Post-exposure observation period:	14 days
Vehicle	1% aqueous carboxymethylcelluose	
Remarks - Method	Five males and five females from each dose group (40 rats in total) were examined for reversibility of effects in a 14-day post-exposure treatment-free period.	

Only some organs specified for examination in the test guideline were microscopically examined. No details were recorded of the performance of neurological tests, although behaviour and other symptomatology have been evaluated.

RESULTS

Dose (mL/kg bw/day)	*Equivalent dose (mg/kg bw/day)*	*Number and Sex of Animals*	*Mortality*
0	0	10M, 10F	0
0 (recovery)	0	5M, 5F	(2F*)
0.05	45.3	10M, 10F	0
0.05 (recovery)	45.3	5M, 5F	0
0.1	91	10M, 10F	0
0.1 (recovery)	91	5M, 5F	(1F*)
0.2	181	10M, 10F	3F (1M*)
0.2 (recovery)	181	5M, 5F	0

* Deaths were not considered to be related to treatment.

Mortality and Time to Death
At 0.2 ml/kg bw/day, one female was found dead on day 9 following significant weight loss. Two others at the same dose level were sacrificed on days 9 and day 12 following significant weight losses and deteriorations in clinical condition (see below). Several other deaths were observed immediately after blood sampling was carried out; these were not considered to be related to treatment with the test substance.

Clinical Observations
No relevant clinical signs were observed in control animals, or in animals receiving 0.05 mL/kg bw/day. In the 0.1 and 0.2 mL/kg bw/day group, excessive salivation was observed immediately after treatment and throughout the study (10 mins to 1 hour duration). In animals treated with 0.2 mL/kg bw/day and which died or were sacrificed prematurely, transient diarrhoea and pigmented nasal secretions were also observed.

Body weight gain was similar between the control animals and those receiving 0.05 and 0.1 mL/kg bw/day. Animals treated with 0.2 mL/kg bw/day showed a significantly lower mean body weight gain during the treatment period. This effect was reversible during the recovery period, with a higher mean body weight gain observed in males than in females.

No treatment-related effects were observed on water consumption at any dose, and no effect was seen on food consumption in animals treated with 0.05 mL/kg bw/day. In the higher treatment groups, minimal (0.1 mL/kg bw/day) to moderate/marked (0.2 mL/kg bw/day) reductions in food consumption were observed. These effects were reversible during the recovery period.

Laboratory Findings – Clinical Chemistry, Haematology, Urinalysis
At 0.05 and 0.1 mL/kg bw/day, a higher mean leucocyte count, associated with elevated neutrophil levels, was observed. In the males of the 0.1 mL/kg bw/day treatment group, lower mean haemoglobin level, packed cell volume and mean cellular volume were also observed. These effects were all reversible after during the recovery period.

At 0.2 mL/kg bw/day, a higher mean leucocyte count, associated with elevated neutrophil levels, was observed. This effect was dose-dependent in males, but not in females. The lower mean haemoglobin level, packed cell volume and mean cellular volume seen in males at the intermediate dose (above) were observed in both males and females of the highest dose group. These effects were only partially reversible during the recovery period.

Females treated with 0.2 mL/kg bw/day were found to have slightly lower mean blood glucose levels and markedly higher serum alkaline phosphatase levels. One male of this dose group also had elevated serum liver enzyme activities (ALT and AST).

Reductions in total serum protein were noted in all treatment groups, but this was considered to be a result of reduced food consumption and not treatment-related. This effect was partially reversible during the recovery period.

No changes in urinalysis parameters were observed in any animals except one high dose male (leucocytes and granular cylinders).

Effects in Organs

Mesenteric lymph node volume was increased with a higher incidence than control at all doses. This effect was not reversible during the recovery period. Microscopic examination revealed lymphadenitis, the severity of which was not dose dose-dependent. Increased cytoplasmic basophilia was noted in all treated groups until the end of the recovery period, and was only partially reversible in the female groups.

No treatment-related changes in organ weights were observed. A significant reduction in kidney weights in the high dose males was not considered to be toxicologically relevant due to the lack of microscopic correlates.

Remarks – Results
At the end of the recovery period, a complete reversibility was observed in clinical effects, but only slight reversibility of haematological parameters was observed. No reversibility was observed for most of the histopathological findings.

CONCLUSION
The No Observed Adverse Effect Level (NOAEL) could not be established in this study, as treatment-related effects were observed at all dose levels. Therefore, the Lowest Observed Adverse Effect Level (LOAEL) is considered to be 0.05 mL/kg bw/day (45.3 mg/kg bw/day).

TEST FACILITY IFM (1981), CECA (2007)

B.7. Genotoxicity – bacteria

TEST SUBSTANCE Notified chemical

METHOD OECD TG 471 Bacterial Reverse Mutation Test.
EC Directive 2000/32/EC B.13/14 Mutagenicity – Reverse Mutation Test using Bacteria.
Plate incorporation (test 1) and pre-incubation (test 2) procedures.

Species/Strains	*S. typhimurium*: TA1535, TA1537, TA98, TA100, TA102	
Metabolic Activation System	Aroclor 1254-induced rat liver S9 mix	
Concentration Range in Main Test	a) Without metabolic activation:	0.032-20 µg/plate (test 1)
		0.0195-20 µg/plate (test 2, TA1535)
		0.078-80 µg/plate (test 2, TA1535)
	b) With metabolic activation:	0.16-100 µg/plate (test 1)
		0.078-80 µg/plate (test 2)
Vehicle	DMSO	
Remarks - Method	A range-finder experiment was performed, using TA100 only, at doses of 8-5000 µg/plate. Toxicity (in the form of cell death) was observed at doses of ≥40 µg/plate (-S9) and ≥200 µg/plate (+S9). The maximum of the dose ranges in the main test were determined as estimates of the likely lower limit of toxicity.	

RESULTS

Metabolic Activation	*Test Substance Concentration (µg/plate) resulting in:*			
	Cytotoxicity in Preliminary Test	*Cytotoxicity in Main Test*	*Precipitation*	*Genotoxic Effect*
Absent	≥40			
Test 1		≥20*	>20	Negative
Test 2		≥20	>20	Negative
Test 2 (TA1535)		≥80	>80	Negative
Present	≥200			
Test 1		≥100	>100	Negative
Test 2		≥80	>80	Negative

* No cytotoxicity observed for strain TA1535.

Remarks - Results Cytotoxicity was observed as a reduction, thinning or absence of the background bacterial lawn.
There were no statistically significant increases in revertant frequency in any strain, under any of the treatment conditions.

CONCLUSION The notified chemical was not mutagenic to bacteria under the conditions of the test.

TEST FACILITY Covance (1998)

B.8. Genotoxicity – *in vivo*

TEST SUBSTANCE Analogue 1 (an acceptable analogue of the notified chemical)

METHOD Test guideline not specified.
Species/Strain Mouse/Crl:Cobs CD-1(1CR)BR
Route of Administration Oral – gavage
Vehicle 1% carboxymethylcellulose
Remarks - Method The method used was comparable to the test guideline, but two main differences were present:

- Medullar toxicity was tested through haematological analysis rather than via the PCE/NCE ratio; and
- Five animals per sex are recommended by the test guideline (c.f. four animals per sex used in this study).

The doses were selected on the basis of a pre-test using 2 males and 2 females, which were administered 0.5 mL/kg/bw of the test substance to determine the optimal sacrifice time. The highest numbers of micronucleated cells were found at 30 hours after the first administration.

Two doses were administered in the main test, 24 hours apart.

Group	*Number and Sex of Animals*	*Dose (mL/kg bw/day)*	*Equivalent Dose (mg/kg bw/day)*	*Sacrifice Time (hours after first dose)*
I (vehicle control)	4M, 4F	0	0	30
II (low dose)	4M, 4F	0.1	91	30
III (mid dose)	4M, 4F	0.2	181	30
IV (high dose)	4M, 4F	0.5	453	30
V (positive control*)	4M, 4F	-	100/500*	48

* cyclophosphamide (100 mg/kg bw/day) and benzo[a]pyrene (500 mg/kg bw/day), administered intraperitoneally.

RESULTS
Doses Producing Toxicity No clinical signs were observed. One positive control male died after administration of the second dose, but no other mortality was observed. No effects on haematological parameters were observed in the three treatment groups. Piloerection was noted in the animals during the pre-test.
Genotoxic Effects No significant differences were observed in the number of polychromatic erythrocytes between the negative control group and the test groups.
Remarks - Results There were no changes in haematological parameters that might suggest that cytotoxicity occurred to the bone marrow. Consequently, there is no evidence that the test substance was able to reach the target tissue.
The positive control animals yielded the expected increases in micronuclei. However, the different route of administration used casts doubt on their usefulness as parallel positive controls.

CONCLUSION This analogue of the notified chemical was not clastogenic under the conditions of this *in vivo* micronucleus test.

TEST FACILITY Centre de Recherche des Industriels Français du Médicament (1981), IUCLID (2007)

B.9. Genotoxicity – *in vivo*

TEST SUBSTANCE	Analogue 2 (supporting data only)
METHOD	OECD TG 474 Mammalian Erythrocyte Micronucleus Test.
Species/Strain	Rat/Sprague-Dawley
Route of Administration	Oral – gavage
Vehicle	Sesame oil
Remarks - Method	Only a single dose of the test substance was administered. Further details of the method were not available for review.

Group	*Number and Sex of Animals*	*Dose (mg/kg bw/day)*	*Sacrifice Time (hours after first dose)*
Vehicle control	5M, 5F	0	unknown**
Test substance I	5M, 5F	2000	24
Test substance II	5M, 5F	2000	48
Positive control*	5M, 5F	unknown**	unknown**

* Cyclophosphamide
** Dose level or sacrifice time not reported.

RESULTS	
Doses Producing Toxicity	No premature deaths occurred.
Genotoxic Effects	No significant differences were observed in the number of polychromatic erythrocytes between the negative control group and the test groups.
Remarks - Results	There were no changes in the PCE/NCE ratio with treatment, indicating that cytotoxicity to the bone marrow did not occur. Consequently, there is no evidence that the test substance was able to reach the target tissue. The positive control animals yielded the expected increases in micronuclei.
CONCLUSION	This analogue of the notified chemical was not clastogenic under the conditions of this *in vivo* micronucleus test.
TEST FACILITY	IUCLID (2006)

APPENDIX C: ENVIRONMENTAL FATE AND ECOTOXICOLOGICAL INVESTIGATIONS

C.1. Environmental Fate

C.1.1. Ready biodegradability

TEST SUBSTANCE	Notified chemical
METHOD	OECD TG 301D Ready Biodegradability: Closed Bottle Test. Directive 92/69CEE C.4-E
Inoculum	Not stated
Exposure Period	28 days
Auxiliary Solvent	Not stated
Analytical Monitoring	Not stated
Remarks - Method	No details of the procedure was provided but expected to have followed the guideline. A series of bottles containing the reference sodium benzoate was prepared in order to detect any inhibitory effect of the test substance.

RESULTS

Test substance		*Sodium benzoate*	
Day	*Mean % Degradation*	*Day*	*Mean % Degradation*
7	-2	7	91
14	-5	14	89
21	-7	21	87
28	-5	28	92

Remarks - Results	Under the test conditions, the % degradation of the test substance was <10% in 28 days. The results in the inhibition control of the reference substance showed that there was an inhibition rate of 27% in 14 days. Thus the notified chemical had an inhibiting effect on the biodegradability of the reference substance. The % of degradation of the reference substance in the inoculum was 89% within 14 days and thus validating the test.
CONCLUSION	The notified chemical is considered not readily biodegradable.
TEST FACILITY	Elf Atochem SA (1998)

C.1.2. Bioaccumulation

The bioaccumulation of a claimed analogue chemical on fish (*Cyprinus Carpio)* has been presented and a BCF value of <300 is claimed. However, as this is an unacceptable analogue, little can be inferred from this test result. While the BCF of surfactants cannot be measured or calculated, bioconcentration is not expected to pose an unacceptable risk based on the present knowledge (CESIO, 2003).

C.1.3. Special Studies

A study was conducted on the fate of surfactants which may run off the roadway into the surrounding soil by determining the adsorption/desorption of emulsifiers with similar overall structures considered as acceptable analogues for the notified chemical from run-off onto typical soil samples (Campbell *et al*, 1998). To provide samples of run-off water, an open-graded mix design was selected as it provided a worst-case scenario because the low surface area of the aggregates will retain less emulsifier. An adsorption method (OECD TG 106) was used for the study. Three types of soils (Type I: very strongly acidic sandy soil, Type II: moderately or slightly acid loamy soil and Type III: slightly alkaline loamy soil) were used together with two types of run-off water derived from both limestone and granite aggregates with Redicote EM26 emulsions. The soils were preconditioned by shaking with 10 mM $CaCl_2$ solution for 16 h and then centrifuged. The $CaCl_2$ solution was then used to dilute the test solutions of emulsifier. The run-off water samples were prepared from laboratory mixes with either limestone or granite aggregates by mixing emulsions containing Redicote EM26 at levels of 1.2% or 1.7% with either limestone or granite aggregates. The aggregates were pre-wetted with 4% water and the level of emulsion was 9%. The adsorption test involved conditioning the soil samples with the run-off

solutions by shaking for 16 h and analysis for the residual emulsifier and for total nitrogen by the Kjeldahl method. The results for the adsorption test are shown in the following table.

Table 1: Adsorption of run-off waters onto soil samples

Run-off samples	*% Adsorbed*		
	Soil type I	*Soil type II*	*Soil type III*
Limestone 1.2% EM26[a]	74	82	82
Limestone 1.7% EM26[a]	77 (74)[c]	84	85
Granite 1.2% EM26[a]	82	94	94
Granite 1.7% EM26[a]	89 (99)[c]	95	92
Granite 1.7% EM26[b]	89 (>99.98)*	(>99.98)*	(>99.98)*

[a]starting concentration 10 mg/L nitrogen; [b]starting concentration 9 mg/L nitrogen; [c] starting concentration 12 mg/L nitrogen and second contact with fresh soil.
* Starting concentration 400 mg/L emulsifier and a more specific analytical method was used for the emulsifier.

The results provide the worst-case limit on the amount of emulsifier that was not adsorbed. Between 74-99% of any nitrogen (derived from the bitumen and emulsifier present in the run-off water) was adsorbed on the soil. However, the method was used for analysis for nitrogen only and a more specific method for the emulsifier was used indicating practically 100% of the emulsifier was adsorbed (see Table 1 results in brackets). This is because the lower adsorption estimates obtained by the nitrogen analysis method was that adsorption of emulsifier could lead to desorption of naturally occurring ammonium ions from the soil surface into the water phase.

Less than 5% was desorbed in the first step and typically none desorbed in the second step based on the soil samples from the desorption tests.

Another study was conducted on the concentration of a potentially cationic emulsifier which is considered an acceptable analogue in run-off waters from laboratory-produced slurry seals, the simulation of rainfall on cured seals, and a repeated adsorption measurement of the emulsifier from run-off water onto standard soils using a more specific analytical method for the emulsifier (Campbell *et al*, 2000).

Run-off water from a dense-graded slurry surfacing mixture was analysed for emulsifier using Mass Spectrometry. A slurry was made in the laboratory using 100 g type II aggregate, 1.0 g cement, 9.0 g water and 17.0 g emulsion (1.2% Redicote EM25, 65% Asphalt). Samples of run-off water were obtained by forming the mixture into a ball and squeezing out approximately 3 mL of water. Samples were taken 5, 10 and 15 minutes after mixing the ingredients. The results are shown in the following table:

Table 2: Analysis of run-off water from slurry surfacing

Time after mixing (min)	*Emulsifier in run-off (mg/L)*	*% retained*
5	0.3	99.9996
10	0.5	99.9993
25	0.2	99.9997

The data indicate that >99.99% of the emulsifier was adsorbed in the seal and the run-off water contained ≤0.5 mg/L of emulsifier. As this is the only data available for run-off, it will be used as a worst-case calculation for PEC.

In order to simulate the effect of rain on the partly and fully cured slurry surfacing, samples were subjected to contact with water. This was performed by curing the slurry cake for 24 h to 40 days, adding water and allowing it to equilibrate for 2 h and for 40 days before it was analysed. The results indicate that in all cases no emulsifier was detected in the water samples indicating that washing off by rainfall did not lead to significant concentration of emulsifier in the water samples.

On the basis of the more accurate analytical method for the repeated adsorption test (see Table 1 results in bracket), the results also indicate that practically 100% of the emulsifier was adsorbed onto soil following run-off from granite. The adsorption of 99.98% will be used to determine the PEC following adsorption to soils.

C.2. Ecotoxicological Investigations

C.2.1. Acute toxicity to fish

TEST SUBSTANCE Notified chemical

METHOD OECD TG 203 Fish, Acute Toxicity Test - static conditions.

	EC Directive 92/69/EEC C.1 Acute Toxicity for Fish - static conditions
Species	Freshwater fish (*Danio rerio*)
Exposure Period	96 h
Auxiliary Solvent	None
Water Hardness	The sum of the Ca^{2+} and Mg^{2+} ions in the dilution water was 2.5 mmol/L.
Analytical Monitoring	LCMS
Remarks – Method	No significant protocol deviations.

RESULTS

Nominal Concentration (mg/L)	*Measured concentration (mg/L)*	*Number of Fish*	*Mortality %*			
			24 h	*48 h*	*72 h*	*96 h*
0 (control)	0	10	0	0	0	0
0.093	0.01	10	0	0	0	0
0.130	0.015	10	0	0	0	0
0.182	0.02	10	0	0	0	0
0.255	0.05	10	70	30	60	80
0.357	0.13	10	100	100	100	100
0.5	0.18	10	100	100	100	100

LC_{50}	0.045 mg/L at 96 hours (measured concentration).
NOEC	0.02 mg/L at 96 hours (measured concentration)
Remarks – Results	The examination of the fish in the control did not reveal any signs of abnormal behaviour. At nominal concentrations of 0.357 and 0.5 mg/L, 100% mortality was observed at the end of the test. At the nominal concentration of 0.255 mg/L at 24 h, 70% mortality was observed. The test solutions were clear and uncoloured, with no precipitation observed at the end of the test. Dissolved oxygen and pH were within acceptable limits. The results of the analyses showed that the final concentrations have not been maintained within the limits of 80% of the initial concentrations as the values ranged from 22-109%. Thus the LC_{50} was determined using geometric mean concentration.

CONCLUSION The notified chemical is considered to be very toxic to fish.

TEST FACILITY Arkema (2007a)

C.2.2. Acute toxicity to aquatic invertebrates

TEST SUBSTANCE Notified chemical

METHOD	OECD TG 202 *Daphnia* sp. Acute Immobilisation Test and Reproduction Test – static condition EC Directive 92/69/EEC C.2 Acute Toxicity for Daphnia – static condition
Species	*Daphnia magna*
Exposure Period	48 hours
Auxiliary Solvent	None
Water Hardness	Sum of Ca and Mg ions in dilution water was 2.5 mmol/L
Analytical Monitoring	LCMS
Remarks - Method	No significant protocol deviations.

RESULTS

Concentration (mg/L)		*Number of D. magna*	*Number Immobilised*	
Nominal	*Actual**		*24 h*	*48 h*
0 (control)	0	20	0	0
0.025	<LOQ**	20	0	0
0.046	<LOQ**	20	0	0
0.085	0.047	20	0	5
0.16	0.072	20	0	50
0.29	0.124	20	25	100
0.54	0.185	20	75	100
1	0.431	20	100	100

* Concentrations calculated with geometric average value of initial and final concentrations
** Limit of quantitation (LOQ) = 0.04 mg/L

LC_{50}	0.16 (95% CI: 0.12-0.22) mg/L at 24 hours 0.063 mg/L at 48 hours
NOEC	<0.04 mg/L at 48 hours
Remarks - Results	The examination of the daphnia in the control did not reveal any signs of immobilisation. At a nominal concentration of 0.29 mg/L, 100% immobilisation was observed at the end of the test. At the nominal concentration of 0.085 mg/L, 5% immobilisation was observed at 48 h. The test solutions were clear, uncoloured and no precipitation was observed at the end of the test. Dissolved oxygen and pH were within acceptable limits. The results of the analyses showed that the final concentrations have not been maintained within the limits of 80% of the initial concentrations as the values ranged from 70.3-100%. Note initial concentrations were about 50% of the nominal values. Thus the EC_{50} was determined using geometric mean concentrations.

CONCLUSION The notified chemical is considered to be very toxic to *Daphnia.*

TEST FACILITY Arkema (2007b)

C.2.3. Algal growth inhibition test

TEST SUBSTANCE Notified chemical

METHOD OECD TG 201 Alga, Growth Inhibition Test.
EC Directive 92/69/EEC C.3 Algal Inhibition Test.

Species	Freshwater algae (*Selenastrum capricornutum*)	
Exposure Period	72 hours	
Concentration Range	Nominal:	0.02, 0.04, 0.07, 0.14, 0.26 and 0.5 mg/L
	Geometric mean:	0.006, 0.008, 0.01, 0.027, 0.061 and 0.168 mg/L
Auxiliary Solvent	None	
Water Hardness	Not stated	
Analytical Monitoring	LCMS	
Remarks - Method	No significant protocol deviations.	

RESULTS

Biomass		*Growth*	
EbC_{50} (µg/L at 72 h)	*NOEbC (µg/L)*	*ErC_{50} (µg/L at 72 h)*	*NOErC (µg/L)*
5.9	ND*	10 (7.5-13)	ND*

*Not determined

Remarks - Results Microscopic observation confirmed that the algae appeared normal at the end of the test. The test solutions were clear, uncoloured and no precipitation was observed at the end of the test. Dissolved oxygen and pH were within acceptable limits. The results of the analyses showed that the final concentrations have not been maintained within the limits of

	80% of the initial concentrations as the values ranged from 26.9-59.3%. Thus the EC_{50}s were determined using geometric mean concentrations.
CONCLUSION	The notified chemical is considered to be very toxic to algae.
TEST FACILITY	Arkema (2007c)

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