File No: STD/1667

August 2019

NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME (NICNAS)

PUBLIC REPORT

Heptane, branched, cyclic and linear

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 Department of Health, and conducts the risk assessment for public health and occupational health and safety. The assessment of environmental risk is conducted by the Department of the Environment and Energy.

This Public Report is available for viewing and downloading from the NICNAS website or available on request, free of charge, by contacting NICNAS. For requests and enquiries please contact the NICNAS Administration Coordinator at:

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Director
NICNAS

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SUMMARY

The following details will be published in the NICNAS *Chemical Gazette.*

ASSESSMENT REFERENCE	APPLICANT(S)	CHEMICAL OR TRADE NAME	HAZARDOUS CHEMICAL	INTRODUCTION VOLUME	USE
STD/1667	3M Australia Pty Ltd	Heptane, branched, cyclic and linear	Yes	≤ 5 tonne/s per annum	Component of automotive coatings

CONCLUSIONS AND REGULATORY OBLIGATIONS

Hazard classification
Based on the available information, the notified chemical is recommended for hazard classification according to the *Globally Harmonised System of Classification and Labelling of Chemicals (GHS)*, as adopted for industrial chemicals in Australia. The recommended hazard classification is presented in the following table.

Hazard classification	*Hazard statement*
Flammable Liquids (Category 2)	H225 – Highly flammable liquid and vapour
Aspiration Hazard (Category 1)	H304 –May be fatal if swallowed and enters airways
Skin Corrosion/Irritation (Category 2)	H315 - Causes skin irritation
Specific Target Organ Toxicity, Single Exposure; Narcotic Effects (Category 3)	H336 – May cause drowsiness or dizziness

The environmental hazard classification according to the *Globally Harmonised System of Classification and Labelling of Chemicals* (GHS) is presented below. Environmental classification under the GHS is not mandated in Australia and carries no legal status but is presented for information purposes.

Hazard classification	*Hazard statement*
Acute aquatic toxicity (Category 1)	H400: Very toxic to aquatic life
Chronic aquatic toxicity (Category 1)	H410: Very toxic to aquatic life with long lasting effects

Human health risk assessment
Provided that the recommended controls are being adhered to, under the conditions of the occupational settings described, the notified chemical is not considered to pose an unreasonable risk to the health of workers.

When used in the proposed manner, the notified chemical is not considered to pose an unreasonable risk to public health.

Environmental risk assessment
On the basis of the reported use pattern, the notified chemical is not considered to pose an unreasonable risk to the environment.

Recommendations

REGULATORY CONTROLS

Hazard Classification and Labelling

- The notified chemical should be classified as follows:
  - Flammable Liquids (Category 2): H225 – Highly flammable liquid and vapour
  - Aspiration Hazard (Category 1): H304 –May be fatal if swallowed and enters airways
  - Skin Corrosion/Irritation (Category 2): H315 - Causes skin irritation
  - Specific Target Organ Toxicity, Single Exposure; Narcotic Effects (Category 3): H336 – May cause drowsiness or dizziness

The above should be used for products/mixtures containing the notified chemical, if applicable, based on the concentration of the notified chemical present.

Health Surveillance

- As the notified chemical is a respiration hazard, employers should carry out health surveillance for any worker who has been identified in the workplace risk assessment as having a significant risk of impaired pulmonary function.

CONTROL MEASURES

Occupational Health and Safety

- A person conducting a business or undertaking at a workplace should implement the following engineering controls to minimise occupational exposure to the notified chemical as introduced:
  - Enclosed, automated processes where possible
  - Adequate local exhaust ventilation

- A person conducting a business or undertaking at a workplace should implement the following safe work practices to minimise occupational exposure during handling of the notified chemical as introduced:
  - Avoid inhalation

- A person conducting a business or undertaking at a workplace should ensure that the following personal protective equipment is used by workers to minimise occupational exposure to the notified chemical as introduced:
  - Respiratory protection
  - Gloves
  - Coveralls

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

- Spray applications should be carried out in accordance with the Safe Work Australia Code of Practice for *Spray Painting and Powder Coating* (SWA, 2015) or relevant State or Territory Code of Practice.

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

- If products and mixtures containing the notified chemical are classified as hazardous to health in accordance with the *Globally Harmonised System of Classification and Labelling of Chemicals (GHS)* as adopted for industrial chemicals in Australia, workplace practices and control procedures consistent with provisions of State and Territory hazardous substances legislation should be in operation.

Disposal

- Where reuse or recycling are not appropriate, dispose of the notified chemical in an environmentally sound manner in accordance with relevant Commonwealth, state, territory and local government legislation.

Emergency procedures

- Spills or accidental release of the notified chemical should be handled by physical containment, collection and subsequent safe disposal.

Transport and Packaging

- Due to the flammable properties of the notified chemical, introducers of the chemical should consider their obligations under *Australian Code for the Transport of Dangerous Goods by Road and Rail* (ADG code) (NTC, 2017).

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(1) of the Act; if
- The notified chemical is intended for use in end-use products available to the public;

or

(2) Under Section 64(2) of the Act; if
- the function or use of the chemical has changed from component of automotive coatings, or is likely to change significantly;
- the amount of chemical being introduced has increased, or is likely to increase, significantly;
- the chemical has begun to be manufactured in Australia;
- additional information has become available to the person as to an adverse effect of the chemical on occupational health and safety, public health, or the environment.

The Director will then decide whether a reassessment (i.e. a secondary notification and assessment) is required.

Safety Data Sheet
The SDS 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 SDS remains the responsibility of the applicant.

ASSESSMENT DETAILS

1. APPLICANT AND NOTIFICATION DETAILS

APPLICANT(S)
3M Australia Pty Ltd (ABN: 90 000 100 096)
Building A
1 Rivett Road
NORTH RYDE NSW 2113

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

EXEMPT INFORMATION (SECTION 75 OF THE ACT)
Data items and details claimed exempt from publication: other names, molecular and structural formulae, molecular weight, degree of purity, use details, and import volume.

VARIATION OF DATA REQUIREMENTS (SECTION 24 OF THE ACT)
Variation to the schedule of data requirements is claimed as follows: all physico-chemical, human health and ecotoxicity endpoints.

PREVIOUS NOTIFICATION IN AUSTRALIA BY APPLICANT(S)
None

NOTIFICATION IN OTHER COUNTRIES
None

2. IDENTITY OF CHEMICAL

MARKETING NAME(S)
Heptane, branched, cyclic and linear

CAS NUMBER
426260-76-6

CHEMICAL NAME
Heptane, branched, cyclic and linear

MOLECULAR WEIGHT
100.205 g/mol for the weight majority of the isomers present

ANALYTICAL DATA
Reference NMR, IR and MS spectra of the analogue chemcials were provided.

3. COMPOSITION

DEGREE OF PURITY
> 99%

HAZARDOUS IMPURITIES/RESIDUAL MONOMERS
None

NON HAZARDOUS IMPURITIES/RESIDUAL MONOMERS (> 1% BY WEIGHT)
None

ADDITIVES/ADJUVANTS
None

4. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AT 20 °C AND 101.3 kPa: Colorless liquid

Property	Value	Data Source/Justification
Melting Point	Hexane, 3-methyl-: -119 °C Hexane, 2-methyl-: -118 °C Pentane, 2,3-dimethyl-: -107.5 °C Heptane: -91 °C	Commercial website (Chemical Book) Commercial website (Chemical Book) Commercial website (Chemical Book) Commercial website (Chemical Book)
Boiling Point	Notified chemical : 88 °C at 101.3 kPa	SDS
Density	Notified chemical : 693 kg/m^3 at 15.6 °C	SDS
Kinematic Viscosity	Notified chemical : 0.83 mm^2/s at 15.6 °C	SDS
Vapour Pressure	Notified chemical : 15.9 kPa at 37.8 °C	SDS
Water Solubility	Water solubility at 25 °C Hexane, 3-methyl-: 0.0049 g/L Hexane, 2-methyl-: 0.0025 g/L Pentane, 2,3-dimethyl-: 0.0052 g/L Heptane: 0.0034 g/L	Listed on ChemIDplus website
Hydrolysis as a Function of pH	Not determined	Does not contain hydrolysable groups
Partition Coefficient (n-octanol/water)	Log Pow at 25 °C Hexane, 3-methyl-: 3.71 Hexane, 2-methyl-: 3.71 Pentane, 2,3-dimethyl-: 3.63 Heptane: 4.66	Listed on ChemIDplus website
Adsorption/Desorption	log Koc at 25 °C Hexane, 3-methyl-: 3.22 Hexane, 2-methyl-: 3.22 Pentane, 2,3-dimethyl-: 3.58 Heptane: 4.04	Estimated by KOCWIN v2.00 model (US EPA, 2012a)
Dissociation Constant	Not determined	No dissociable functionality
Flash Point	Notified chemical : -9 °C at 101 kPa	SDS
Flammability	Notified chemical: Upper: 6.7% Lower: 1.2%	SDS Explosive limit for Analogues 1 and 3 is given as approximately 7% (Commercial website)
Autoignition Temperature	Heptane: 204 °C	Commercial website (The Engineering ToolBox)
Explosive Properties	Not determined.	Contains no functional groups that would imply explosive properties
Oxidising Properties	Not determined	Contains no functional groups that would imply oxidative properties

DISCUSSION OF PROPERTIES

Reactivity
The notified chemical is expected to be stable under normal conditions of use.

Physical hazard classification
Based on the submitted physico-chemical data depicted in the above table, the notified chemical is recommended for hazard classification according to the *Globally Harmonised System of Classification and Labelling of Chemicals (GHS)*, as adopted for industrial chemicals in Australia. The recommended hazard classification is presented in the following table.

Hazard classification	*Hazard statement*
Flammable Liquids (Category 2)	H225 – Highly flammable liquid and vapour

5. INTRODUCTION AND USE INFORMATION

MODE OF INTRODUCTION OF NOTIFIED CHEMICAL (100%) OVER NEXT 5 YEARS
The notified chemical will not be manufactured in Australia. The notified chemical will be imported as a component of an automotive coating product at a concentration of ≤ 60%.

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

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

PORT OF ENTRY
Sydney

IDENTITY OF MANUFACTURER/RECIPIENTS
3M Australia Pty Ltd

TRANSPORTATION AND PACKAGING
The imported coating products containing the notified chemical (at ≤ 60% concentration) will be available in cans or aerosol containers of volume typically between 0.3 L and 1 L. The imported products will be available for industrial users and professional users. As the notified chemical is a flammable liquid, it has a dangerous goods classification of Class 3. Therefore, the products containing the notified chemical will be transported, packaged and stored in accordance with the Australian Code for the Transport of Dangerous Goods (NTC, 2018).

USE
The notified chemical will be used as a component of primers, adhesives and sealants for automotive aftermarket applications.

OPERATION DESCRIPTION
No reformulation, repackaging or manufacture of the notified chemical will occur in Australia. The products containing the notified chemical will be transported to the notifier's warehouse prior to distribution to end-users.

End-use products containing the notified chemical (at ≤ 60% concentration) may be applied by swab, felt-tipped applicator, spray or roller on a wide range of automotive substrates (including polypropylene, acrylic, polycarbonate, nylon, glass, metal and painted surfaces) by industrial and professional users.

The application process is expected to be largely manual, although spray applications may occur within or outside spray booths. Industrial and professional users will open the containers containing the notified chemical and transfer it to spray equipment, trays, or apply the end-use product direct to the vehicle body.

6. HUMAN HEALTH IMPLICATIONS

6.1. Exposure Assessment

6.1.1. Occupational Exposure

CATEGORY OF WORKERS

Category of Worker	*Exposure Duration (hours/day)*	*Exposure Frequency (days/year)*
Transport and warehousing	0.5 – 2	50
Operators	8	210

EXPOSURE DETAILS
The notified chemical will be imported (at ≤ 60% concentration) in sealed tins or aerosol cans containing the end-use products. No significant exposure to transport, storage, and retail workers is anticipated to occur, unless, in the event of an accident, the containers are breached.

Operators
Workers may be exposed (ocular, dermal and inhalation) to the notified chemical at concentrations ≤ 60% during the transfer, application, and cleaning of coating equipment. According to the notifier, dermal, ocular and inhalation exposure is expected to be minimised through the use of personal protective equipment (PPE) such as coveralls, goggles, impervious gloves, local exhaust ventilation and respirators where ventilation is inadequate.

6.1.2. Public Exposure
The products containing the notified chemical are for industrial and commercial use only and will not be sold to the public for do-it-yourself (DIY) use. The public may come in contact with surfaces coated with products containing the notified chemical. However, once the coatings have dried, the notified chemical is not expected to be available for exposure.

6.2. Human Health Effects Assessment
No toxicity data on the notified chemical was submitted. The results from toxicological investigations conducted on hexane, 3-methyl- (CAS number 589-34-4), hexane, 2-methyl- (CAS number 591-76-4), pentane, 2,3-dimethyl- (CAS number 565-59-3) and heptane (CAS number 142-82-5) along with C_{7-9} aliphatic hydrocarbons are discussed below.

Toxicokinetics, metabolism and distribution
No toxicokinetic data on the notified chemical were submitted. For dermal and gastrointestinal absorption, molecular weights below 100 g/mol are favourable for absorption and molecular weights above 500 g/mol do not favour absorption (ECHA, 2017). Dermal uptake is likely to be low to moderate if the water solubility is between 1-100 mg/L and may be limited if the partition coefficient (log Pow) values are greater than 4 (ECHA, 2017). Gastrointestinal absorption is also likely to be high if the partition coefficient (log Pow) values are greater than 4. Therefore, given the molecular weight of the notified chemical (100.205 g/mol), and its expected low to moderate solubility in water and lipophilicity (based on the water solubility and partition coefficient values of the analogue chemcials), absorption of the notified chemical through the skin and gastrointestinal tract is expected to occur. Additionally, C_{7-9} aliphatic hydrocarbons are expected to be absorbed and distributed through the body, and metabolised and excreted in the urine and as expired carbon dioxide (OECD 2010).

Acute toxicity
No studies on the acute toxicity of the notified chemical were submitted. Information on the acute toxicity is available for heptane, and other C_{7-9} aliphatic hydrocarbons (OECD 2010). In studies conducted on rats, an oral LD_{50} of greater than 15,000 mg/kg bw has been recorded for heptane, and values greater than 5,000 mg/kg bw (greater than 4,000 mg/kg bw in rabbits) have been recorded for other C_{7-9} aliphatic hydrocarbons (OECD 2010). C_{7-9} aliphatic hydrocarbons have been shown to be of low acute dermal toxicity in rabbits (LD_{50} values greater than 2920 mg/kg bw) (OECD 2010).

Heptane, and other C_{7-9} aliphatic hydrocarbons are expected to be of low toxicity via inhalation. In a study conducted in rats (similar to OECD test guideline 403) an LC_{50} of 29.3 mg/L was determined (Hazleton 1982a). Male and female rats were exposed to heptane in a whole body exposure chamber under dynamic airflow conditions. There were no unscheduled deaths or adverse clinical effects observed. All animals exposed to the test substance exhibited a loss in body weight 2 days after exposure. All animals gained weight after this loss. However, by the end of the observation period, male animals gained an appropriate amount of body weight while female animals showed reduced body weight (compared to control animals). At necropsy, one female exhibited an enlarged mandibular lymph node (right side). All other animals appeared normal.

In a separate study studying the potential of heptane to cause respiratory irritation, (similar to OECD test guideline 403), two groups of four male mice were exposed (nose-only) to heptane at a nominal concentration of 29.3 mg/L as a vapour for one minute, followed by room air for 10 minutes, and then a second minute of exposure to the test substance. Three mice exhibited a decrease in respiratory rate following exposure (0 – 25% decrease in 1/4 animals in groups 1 and 2, and 25 – 50% decrease in another animal in group 1). No patterns indicative of respiratory pauses were observed. A slight reduction in male body weights was recorded two days after exposure to the test substance (with full recovery by day 4,) while female weight changes were minimal. At necropsy, one female exhibited an enlarged mandibular lymph node (right side) while all other animals appeared normal (Hazleton 1982b). Subsequently, heptane is not expected to be a respiratory irritant. However, n-heptane has been reported to cause irritation of the respiratory tract following short-term inhalation of high concentrations (TCEQ, 2016) and C_{7-9} aliphatic hydrocarbons may be expected to cause irritation of the respiratory tract (OECD 2010).

Clinical signs of transient central nervous system (CNS) depression after inhalation exposure at relatively high concentrations has been observed in animals exposed to C_{7-9} aliphatic hydrocarbons (OECD 2010). An inhalation study with heptane did not show any clinical evidence of neurotoxicity (OECD 2010).

Therefore, based on the information available for analogue chemicals, the notified chemical may be expected to be of low acute oral, dermal and inhalation toxicity, and may be expected to be a respiratory irritant at high concentrations. As the notified chemical is a hydrocarbon with low viscosity, like other C_{7-9} aliphatic hydrocarbons, the notified chemical may be expected to be an aspiration hazard following exposure by the oral route.

Irritation and sensitisation
In a study on rabbits (conducted similar to OECD test guideline 404), hexane, 3-methyl- was slightly irritating to the skin. Following exposure to the test substance for four hours under semi-occlusive dressing, barely perceptible (3/3 males) to very slight (3/3 females) erythema was observed, with the effects increasing to slight (1/3 males, all females) to well-defined (2/3 males) erythema at the 72 hour observation. Barely perceptible oedema was also observed in four animals (all males, and 1/3 females) 24 hours after exposure, five animals (all males and 2/3 females) 48 hours after exposure and in all animals 72 hours after exposure (very slight oedema in 2/3 males and 1/3 females and barely perceptible in 1/3 males and 2/3 females. All animals had recovered by the end of the observation period (7 days) (Shell 1985).

In a study in rabbits (conducted similar to OECD test guideline 405), following exposure to hexane, 3-methyl-, all animals exhibited slight conjunctival redness at the 1 hour observation. Discharge was also observed in 2/3 males, 1/3 females 1 hour after exposure. Conjunctival redness persisted in two animals (2/3 females) but at a reduced severity to the 24 hour post-exposure observation. All animals had recovered by the 48 hour observation point (7 days) (Shell 1985).

Based on studies in rabbits, C_{7-9} aliphatic hydrocarbons are not expected to be eye irritants, but are expected to be moderate skin irritants. C_{7-9} aliphatic hydrocarbons are not expected to cause skin sensitisation (OECD 2010).

Based on the available information, the notified chemical may be expected to be irritating to the skin, but not to the eye, and is not likely to cause skin sensitisation.

Repeated dose toxicity
Information on repeat dose studies is available for hexane, 2-methyl- and heptane.

Repeated oral exposure to heptane in a 21-day study (Kodak, 1979) did not produce significant adverse clinical signs, neurological or clinical pathology abnormalities at up to 4,000 mg/kg/day. Male rats (Charles River CD, COBS) were exposed to 1,000, 2,000 and 4,000 mg/kg of test substance by oral gavage 5 days/week for three weeks. Only one unscheduled death was recorded, and the study authors attributed this death to accidental instillation of the test substance into the lungs. All animals made the expected body weight gains. In the mid-dose group, platelet and basophil counts were significantly higher than those in the control group, low- and high-dose groups, while leucocyte counts were significantly lower than the other groups. No other significant clinical observations were recorded. Gross pathological and histopathological changes including limited to moderate hyperplasia of gastric non-glandular epithelium were attributed to the test substance by the study authors, but were not considered significant as they weren't seen in all animals, and a dose-dependent relationship was not observed.

Compared to the control group, mean lactic dehydrogenase (LDH) activity was significantly higher in the mid- and high-dose groups compared to the control group, and absolute and relative liver weights were significantly higher in the low-, mid- and high-dose groups. Animals in the low-dose group exhibited the highest increase in absolute and relative liver weights, with values decreasing in a dose-dependent manner in the mid- and high-dose groups (while remaining higher than those in the control group). Animals in the low-dose group exhibited white blood cell counts similar to the control group, while these levels decreased in a dose-dependent manner in the mid- and high-dose groups. While an increase in LDH levels can be indicative of injury to the liver, the small number of animals in the group and the absence of a recovery group limit interpretation of the effects seen.

A report from Yeshiva University (1980), on the pathology examination (whole animal bioassay) following inhalation exposure to heptane at concentrations of 400 ppm and 3,000 ppm for 6 hours per day, 5 days per week for up to 6 months was submitted. The authors of the bioassay report did not attribute the pathological changes observed to the test substance based on the absence of dose response relationships, the observation of the changes in control animals or that the changes were common in rats of the age and strain used in the exposure study.

In a 90-day, repeated oral exposure study (Kodak 1980), male rats (Charles River CD, COBS), were exposed to 4,000 mg/kg of heptane for 5 days/week. Heptane was strongly irritating to the gastric mucosa and the study authors considered that the five unscheduled deaths (1 in weeks 1, 12 and 13 and 2 in week 7) were a result of acute chemically induced pneumonitis following intubation or aspiration of the test substance into the lung as a result of gastric irritation causing reflux into the oesophagus and aspiration into the lungs. The study authors also attributed hepatic enlargement and haematuria in surviving animals to exposure to the test substance. No clinical abnormalities due to systemic toxicity were recorded. Food consumption was low in the first week of the study (23% less than that of controls), and body weight gains were statistically lower than control animals.

A statistically significant reduction in glucose levels was recorded in animals exposed to heptane. However, no other significant changes in haematology or clinical chemistry (lower counts of white blood cells and polymorphonuclear leukocytes (with corresponding higher lymphocyte counts) compared to those observed in control animals were not considered to be related to exposure to the test substance as the changes were not statistically significant.

The study authors indicated that the histopathological changes observed were consistent with the severity of gastric irritation following exposure to heptane. Of the three surviving animals, one did not exhibit any adverse histopathological changes, one exhibited a fibrous adhesion between the liver and non-glandular portion of the stomach, and one exhibited a fibrous adhesion between the left lung and thoracic wall. No signs of neurotoxicity related to the test compound were observed. Relative liver, kidney, and adrenal gland weights were statistically significantly higher than controls in all animals. Absolute heart weight, but not relative heart weight, was statistically lower than controls which the study authors attributed to the heart weight following changes in body weight. Brain, testes and spleen weights were also comparable to those of control animals. The mean liver weight of surviving animals was comparable to those of control animals while animals that died prematurely exhibited grossly enlarged livers.

C_{7-9} aliphatic hydrocarbons are expected to have low systemic toxicity (OECD 2010). While transient CNS depression has been observed, metabolism studies have demonstrated that the potentially neurotoxic 2,5-heptanedione (an heptane metabolite) is present in low concentrations in the urine of rats and humans. In the repeated dose studies available for analogues of the notified chemical, no overt signs of neurotoxicity were observed.

Heptane has been shown to be of low toxicity to rats following repeated inhalation at exposure levels up to ~12,000 mg/m^3 (Mckee *et al*., 2015).

Mutagenicity/Genotoxicity
No data was available on the potential for mutagenicity or genotoxicity of the notified chemical. C_{7-9} aliphatic hydrocarbons are not expected to be mutagenic or genotoxic (OECD 2010). Heptane has been shown to be non-genotoxic (Brooks et al 1988). Therefore, the notified chemical may be expected to also not be mutagenic or genotoxic.

Carcinogenicity
No data was available on the potential for carcinogenicity of the notified chemical or its analogues. Following a screening-level review of heptane, the US EPA (2002) considered that the notified chemical was not classifiable as to human genotoxicity on the basis of the absence of human and animal data.

Observations on Human Exposure
No data was provided on the potential of the notified chemical to have effects on humans following exposure. Central nervous system (CNS) depression effects such as fatigue, nausea, vertigo and loss of coordination have been observed within 30 minutes of exposure to heptane (≥ 0.1% concentration). Irritation of mucous membranes has also been recorded. A narrow margin between the onset of CNS depression or convulsions and cardiac sensitisation and recovery or death following exposure to heptane has also been recorded. Following prolonged exposure to solvent products which contain heptane and its isomers as major components, inflammation of several peripheral nerves (polyneuritis) was recorded. Inhalation of heptane (at 4.8% concentration in air) resulted in respiratory arrest within 3 minutes. Haematological effects including slight anaemia, slight leukopenia and slight neutropenia have been observed in workers exposed to heptane (US EPA 2014).

Health hazard classification
Based on the available information, the notified chemical is recommended for hazard classification according to the *Globally Harmonised System of Classification and Labelling of Chemicals (GHS)*, as adopted for industrial chemicals in Australia. The recommended hazard classification is presented in the following table.

Hazard classification	*Hazard statement*
Aspiration Hazard (Category 1)	H304 –May be fatal if swallowed and enters airways
Skin Corrosion/Irritation (Category 2)	H315 - Causes skin irritation
Specific Target Organ Toxicity, Single Exposure; Narcotic Effects (Category 3)	H336 – May cause drowsiness or dizziness

6.3. Human Health Risk Characterisation

6.3.1. Occupational Health and Safety
Based on the available information from the analogues, the notified chemical is expected to be of low acute toxicity, and is not expected to be an eye or respiratory irritant, or to be a skin sensitiser. The notified chemical is expected to be an aspiration hazard, have potential for skin irritation, and to cause CNS depression effects such as drowsiness or dizziness following inhalation. Absorption of the notified chemical through the skin and gastrointestinal tract is expected to occur based on its solubility in water and low molecular weight. Once absorbed, the notified chemical is expected to be systemically available.

Exposure of workers to the notified chemical at < 60% concentration may occur during transfer, application, and cleaning operations. Based on the high vapour pressure of the notified chemical, inhalation is expected to be the main route of exposure, although ocular and dermal exposure may also occur during these processes. The short term exposure limit (STEL) and time weighted average (TWA) for heptane in Australia is 2,050 mg/m^3 and 1,640 mg/m^3 respectively (Safe work Australia). Provided that the recommended controls (including PPE, and local exhaust ventilation or respirators where ventilation is inadequate), and safe work practices are being adhered to, under the conditions of the occupational settings described, the notified chemical is not considered to pose an unreasonable risk to the health of workers.

6.3.2. Public Exposure
The notified chemical is intended for use in industrial and professional applications only. The public may come into dermal contact with surfaces on which the coatings are applied. However, once the coatings are dried, the notified chemical is not expected to be available for exposure.

When used in the proposed manner, the notified chemical is not considered to pose an unreasonable risk to public health.

7. ENVIRONMENTAL IMPLICATIONS

7.1. Environmental Exposure & Fate Assessment

7.1.1. Environmental Exposure

RELEASE OF CHEMICAL AT SITE
The notified chemical is a volatile liquid and most of the release will be to the atmosphere from evaporation after application to the treated surface. Similarly, any spills and residues on equipment used to apply the substance are expected to evaporate rapidly.

RELEASE OF CHEMICAL FROM USE
Less than 1% of the notified chemical is expected to be released during use. Small amounts will be spilt on the ground during application and will largely evaporate to the atmosphere and disperse.

RELEASE OF CHEMICAL FROM DISPOSAL
The notified chemical is a volatile liquid and most of the release will be to the atmosphere from evaporation after it has been applied to the treated surface. Residues in empty containers will not be significant as the notified chemical will evaporate from opened containers. Thus, there will be no release to landfill.

7.1.2. Environmental Fate

The notified chemical is a mixture of hydrophobic and volatile hydrocarbons, and can therefore be expected to partition mainly to the atmosphere following spillage to soil or water. Spills to water will spread on the surface and evaporate, with limited adsorption to sediment. Residues spilt on land that do not evaporate and remain sorbed to soil will have low mobility and can be expected to degrade. Atmospheric vapours are expected to be susceptible to oxidation, mainly by hydroxyl radicals. The half-life of the notified chemical in air is calculated to be < 2 days based on reactions with hydroxyl radicals (AOPWIN v1.92, US EPA 2012a). Therefore, the notified chemical is not expected to persist in the atmospheric compartment.

No bioaccumulation studies were performed on the notified chemical. As lipophilic substances, the components of the notified chemical have the potential to bioaccumulate, but this potential may not be realised *in vivo* because of their rapid degradation in the atmosphere. In practice, significant bioaccumulation in fish is not expected because the notified chemical is not expected to partition to the aquatic environment. Spills to water are expected to largely partition to the atmosphere, with limited dissolution in the water column.

7.1.3. Predicted Environmental Concentration (PEC)

A PEC in water cannot be calculated, as release to water is expected to be restricted to accidental spills, and such releases will largely partition to the atmosphere.

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 Acute Toxicity	96 h LC50 = 0.97 mg/L (WAF)	Very toxic to fish
Daphnia Acute Toxicity	48h EC50 = 0.97 mg/L (WAF)	Very toxic to aquatic invertebrates
Algal Toxicity	72 h EC50 = 1.8 mg/L (WAF)	Toxic to algae
Northern Bobwhite	LD50 = > 2250 mg/kg	Not toxic to Northern Bobwhite

WAF: Water accommodated fraction

Under the *Globally Harmonised System of Classification and Labelling of Chemicals* (GHS; United Nations, 2009) the notified chemical is considered to be very toxic to fish, aquatic invertebrates and toxic to algae and is formally classified as 'Acute Category 1: Very toxic to aquatic life'. On the basis of lack of ready biodegradability, the notified chemical is classified 'Chronic Category 1: Very toxic to aquatic life with long lasting effects'.

7.2.1. Predicted No-Effect Concentration

A predicted no-effect concentration (PNEC) has not been calculated as no significant aquatic exposure is expected based on the reported use pattern.

7.3. Environmental Risk Assessment

The risk quotient, Q (= PEC/PNEC), of the notified chemical has not been determined due to its low potential for release to the aquatic compartment. The notified chemical is a volatile liquid and most of the release will be to the atmosphere from evaporation after it has been applied to the treated surface. Exposure of the notified chemical to the aquatic compartment is unlikely based on the reported use pattern. The notified chemical is not expected to be toxic to avian species. On the basis of its limited aquatic exposure, low toxicity to avian species and assessed use pattern, the notified chemical is not expected to pose an unreasonable risk to the environment.

APPENDIX A: ENVIRONMENTAL FATE AND ECOTOXICOLOGICAL INVESTIGATIONS

A.1. Ecotoxicological Investigations

A.1.1 Acute toxicity to fish

TEST SUBSTANCE	Notified chemical
METHOD	OECD TG 203 Fish, Acute Toxicity Test Static
Species	Fathead minnow (*Pimephales promelas*)
Exposure Period	96 hours
Auxiliary Solvent	None
Water Hardness	132 mg $CaCO_3$/L
Analytical Monitoring	GC/MS
Remarks – Method	Individual water accommodated fractions (WAFs) were prepared daily for each test concentration. Nominal WAF concentrations were 9.4, 19, 38, 75 and 150 mg/L. The test substance was mixed directly with dilution water (well water). Each WAF was stirred for approximately 21.5 to 25 hours. After mixing, the WAFs were allowed to settle for 1 to 2 hours. The resultant solutions appeared clear and colourless. The test solutions were then drawn from spigots placed near the bottom of the mixing vessels. At each renewal period, the test organisms were transferred to freshly prepared solutions in the test chambers.

RESULTS

Concentration (mg/L)		*Number of Fish*	*Mortality*			
Nominal	*Mean measured*		*24 h*	*48 h*	*72 h*	*96 h*
Control		10	0	0	0	0
9.4	0.16	10	0	0	0	0
19	0.36	10	0	0	0	0
38	0.96	10	0	0	2	3
75	0.99	10	10	10	10	10
150	2.7	10	10	10	10	10

LC50	0.97 mg/L at 96 hours (95% Confidence Interval 0.96 – 0.99 mg/L)
NOEC	0.36 mg/L at 96 hours
Remarks – Results	The validity criteria were satisfied. The dilution water was aerated prior to use in the test, and test solutions were renewed every 24-hours to keep dissolved oxygen levels above 60% of saturation in the closed-bottle system. As the deviation from nominal concentration was greater than 20%, the results are based on the mean measured concentrations. The mortality data were analysed by Probit analysis, with 95% confidence limit The no-mortality concentration and NOEC were determined by visual interpretation of the mortality and observation data.
CONCLUSION	The WAF of the notified chemical is very toxic to fish.
TEST FACILITY	Wildlife International (2003a)

A.1.2 Acute toxicity to aquatic invertebrates

TEST SUBSTANCE	Notified chemical
METHOD	OECD TG 202 Daphnia sp. Acute Immobilisation Test and Reproduction Test - Static
Species	*Daphnia magna*

Exposure Period	48 hours
Auxiliary Solvent	None
Water Hardness	132 mg $CaCO_3$/L
Analytical Monitoring	GC/MS
Remarks - Method	Individual water accommodated fractions (WAFs) were prepared daily for each test concentration. Nominal WAF concentrations were 9.4, 19, 38, 75 and 150 mg/L. The test substance was mixed directly with dilution water (well water). Each WAF was stirred for approximately 21.5 to 25 hours. After mixing, the WAFs were allowed to settle for 1 hour. The resultant solutions appeared clear and colourless. The test solutions were then drawn from spigots placed near the bottom of the mixing vessels.

RESULTS

Concentration (mg/L)		*Number of D. magna*	*Number Immobilised*	
Nominal	*Actual*		*24 h*	*48 h*
Control		20	0	0
9.4	0.25	20	0	0
19	0.57	20	0	0
38	1.3	20	11	17
75	2.3	20	20	20
150	3.6	20	20	20

EC50	0.97 mg/L at 48 hours (95% Confidence Interval 0.57 – 1.3 mg/L)
NOEC	0.57 mg/L at 48 hours
Remarks - Results	The validity criteria were satisfied. The dissolved oxygen concentration at the end of the test was > 3 mg/L. As the deviation from nominal concentration was greater than 20%, the results are based on the mean measured concentrations. The mortality data were analysed by Probit analysis, with 95% confidence limit. The no-mortality/immobility concentration and NOEC were determined by visual interpretation of the observation data.

CONCLUSION The WAF of the notified chemical is very toxic to aquatic invertebrates

TEST FACILITY Wildlife International (2003b)

A.1.3 Algal growth inhibition test

TEST SUBSTANCE Notified chemical

METHOD OECD TG 201 Alga, Growth Inhibition Test
EC Council Regulation No 440/2008 C.3 Algal Inhibition Test

Species	Freshwater Alga (*Selenastrum capricornutum*)
Exposure Period	96 hours
Concentration Range	Nominal: 63, 125, 250, 500 and 1000 mg/L Actual: 0.47, 1.2, 2.6, 4.0 and 7.0 mg/L
Auxiliary Solvent	None
Water Hardness	Not given
Analytical Monitoring	GC/MS
Remarks - Method	Individual water accommodated fractions (WAFs) were prepared daily for each test concentration. Nominal WAF concentrations were 63, 125, 250, 500 and 1000 mg/L. The test substance was mixed directly with dilution water (well water). Each WAF was stirred for approximately 21.5 to 25 hours. After mixing, the WAFs were allowed to settle for 1 hour. The resultant solutions appeared clear and colourless. The test solutions were then drawn from spigots placed near the bottom of the mixing vessels.

RESULTS

Biomass		*Growth*	
EyC50 (mg/L)	*NOEC (mg/L)*	*ErC50 (mg/L)*	*NOEC (mg/L)*
0.83	< 0.47	1.8	< 0.47

Remarks - Results: The validity criteria were satisfied. The biomass in the control culture increased exponentially by a factor of 23 within 72 hour test period. The mean coefficient of variation section-bi-section growth rates in the control culture did not exceed 35%. The coefficient of variations of average growth rates during the whole test period in replicate control cultures did not exceed 7%.

CONCLUSION: The notified chemical is toxic to algae.

TEST FACILITY: Wildlife International (2003c)

A.1.4 An Acute Oral Toxicity Study with the Northern Bobwhite

TEST SUBSTANCE: Notified chemical

METHOD: U.S. Environmental Protection Agency Series 850 - Ecological Effects Test Guidelines OPPTS Number 850.2100 FIFRA Subdivision E, Section 71-1

Species: Northern bobwhite (*Colinus virginianus*)
Exposure Period: 14 days
Concentration Range: Nominal: 0, 292, 486, 810, 1350 and 2250 mg/kg (as a single dose).
Remarks – Method: The test substance was dispersed in deionized water. The concentration of the test substance in the diluent was adjusted to provide a constant volume to body weight dosage for all treatment birds. The dosages were not adjusted to 100% active ingredient. Therefore, all dosages and the LD50 value are reported as milligrams per kilogram of body weight.

The LD50 value was determined to be greater than the highest dosage tested. No statistical analyses were applied to separate mean responses among treatment groups for the endpoints of food consumption and body weight.

RESULTS

LD50: > 2250 mg/kg
NOEC: 2250 mg/kg
Remarks – Results: There were no mortalities in the control group, and all control birds were normal in appearance and behaviour throughout the test. In addition, there were no treatment-related mortalities or overt signs of toxicity in the 292, 486, 810, 1350 and 2250 mg/kg treatment groups.

CONCLUSION: The notified chemical is not toxic to Northern bobwhite.

TEST FACILITY: Wildlife International (2000)

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