File No: LTD/1689

April 2014

NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME (NICNAS)

PUBLIC REPORT

Benzene, ethenyl-, polymer with 1,3-butadiene, brominated

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.

For the purposes of subsection 78(1) of the Act, this Public Report may be inspected at our NICNAS office by appointment only at Level 7, 260 Elizabeth Street, Surry Hills NSW 2010.

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

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Director
NICNAS

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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
LTD/1689	Chemtura Australia Pty Ltd	Benzene, ethenyl-, polymer with 1,3-butadiene, brominated	ND*	≤ 500 tonnes per annum	A component of polystyrene foam-based wall insulation products

*ND = not determined

CONCLUSIONS AND REGULATORY OBLIGATIONS

Hazard classification
Based on the available information, the notified polymer is not recommended for classification according to the *Globally Harmonised System for the Classification and Labelling of Chemicals* (GHS)*,* as adopted for industrial chemicals in Australia, or the *Approved Criteria for Classifying Hazardous Substances* (NOHSC, 2004).

Human health risk assessment
Provided that adequate control measures are in place to minimise worker exposure, including the use of automated processes and PPE, and measures to reduce the formation of degradation products, the notified polymer is not considered to pose an unreasonable risk to workers.

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

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

Recommendations

(Material) Safety Data Sheet

- The (M)SDS provided by the notifier should be amended as follows:
  - Section 7 of the MSDS (Handling and Storage) should contain the following warning: “Avoid exposure to direct sunlight”

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 polymer as introduced:
  - Enclosed, automated processes, where possible

- 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 polymer as introduced:
  - Avoid contact with skin and eyes
  - Avoid inhaling dust
  - Avoiding exposing the notified polymer and products containing the notified polymer to sunlight

- 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 polymer as introduced:
  - Goggles
  - Impervious gloves
  - Coveralls
  - Respiratory protection where dust and/or small particles are encountered.

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

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

- As photodegradation of the notified polymer may occur, foam products containing the notified polymer should contain warnings regarding exposure to sunlight.

- Precautions should be taken during processing and storage of the notified polymer and products containing it, in order to avoid high temperatures that may cause degradation.

- If products and mixtures containing the notified polymer are classified as hazardous to health in accordance with the *Globally Harmonised System for the 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.

Public Health

- The following measures should be taken to minimise public exposure to the notified polymer:
  - Avoid inhaling dust
  - Foam products containing the notified polymer and available to the public should contain warnings regarding exposure to sunlight.

Disposal

- The notified polymer should be disposed of to landfill.

Storage

- The following precautions should be taken regarding storage of the notified polymer:
  - Exposure of products containing the notified polymer to sunlight should be avoided.

Emergency procedures

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

Transport and Packaging

- The following precautions should be taken regarding transport and packaging of the notified polymer:
  - Exposure of products containing the notified polymer to sunlight should be avoided.

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 polymer is listed on the Australian Inventory of Chemical Substances (AICS).

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

(1) Under Section 64(1) of the Act; if
  - the polymer has a number-average molecular weight of less than 1000 Da;
  - the concentration of respirable particles in the notified polymer exceeds 5%;

or

(2) Under Section 64(2) of the Act; if
  - the function or use of the polymer has changed from a component of polystyrene foam-based wall insulation products, or is likely to change significantly;
  - the amount of polymer being introduced has increased, or is likely to increase, significantly;
  - the polymer has begun to be manufactured in Australia;
  - additional information has become available to the person as to an adverse effect of the polymer 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.

(Material) Safety Data Sheet
The (M)SDS of the notified polymer provided by the notifier was reviewed by NICNAS. The accuracy of the information on the (M)SDS remains the responsibility of the applicant.

ASSESSMENT DETAILS

1. APPLICANT AND NOTIFICATION DETAILS

This notification has been conducted under the cooperative arrangement with Canada. The health and environmental hazard assessment components of the Canadian report were provided to NICNAS and, where appropriate, used in this assessment report. The other elements of the risk assessment and recommendations on safe use of the notified chemical were carried out by NICNAS.

APPLICANT(S)
Chemtura Australia Pty Ltd (ABN: 18 005 225 507)
Level 7, 435 King William Street
ADELAIDE SA 5000

NOTIFICATION CATEGORY
Limited (Reduced fee notification): Synthetic polymer with Mn ≥ 1000 Da – Polymer has been assessed by a competent authority under a comparable category.

EXEMPT INFORMATION (SECTION 75 OF THE ACT)
Data items and details claimed exempt from publication: other names, molecular and structural formulae, molecular weight, analytical data, degree of purity, polymer constituents, residual monomers, impurities, additives/adjuvants, use details, manufacture/import volume, site of manufacture/reformulation and identity of manufacturer/recipients.

VARIATION OF DATA REQUIREMENTS (SECTION 24 OF THE ACT)
Variation to the schedule of data requirements is claimed as follows: vapour pressure, hydrolysis as a function of pH, partition co-efficient, adsorption/desorption, dissociation constant, flash point, flammability limits, autoignition temperature, explosive properties and oxidising properties.

PREVIOUS NOTIFICATION IN AUSTRALIA BY APPLICANT(S)
None

NOTIFICATION IN OTHER COUNTRIES
Canada (2012)
USA (2010)
China (2012)
South Korea (2012)

2. IDENTITY OF CHEMICAL

MARKETING NAME(S)
Emerald Innovation™ 3000

CAS NUMBER
1195978-93-8

CHEMICAL NAME
Benzene, ethenyl-, polymer with 1,3-butadiene, brominated

MOLECULAR WEIGHT
> 10,000 Da

ANALYTICAL DATA
Reference IR, and GPC spectra were provided.

3. COMPOSITION

None

4. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AT 20 °C AND 101.3 kPa: White powder

Property	Value	Data Source/Justification
Melting Point/Freezing Point	116.8 °C	Measured
Boiling Point	Approximately 250 °C at 101.3 kPa (decomposition)	Measured
Density	1900 kg/m^3	Measured
Vapour Pressure	Not determined	Not expected to exhibit a measureable vapour pressure at 25 °C
Water extractability	< 0.001 g/L at 20°C	Measured
Hydrolysis as a Function of pH	$t_{½}$ > 1 year at 25°C	Measured
Partition Coefficient (n-octanol/water)	Not determined	The notified polymer is not considered to have bioaccumulation potential
Adsorption/Desorption	Not determined	The notified polymer is insoluble in water, and therefore, is expected to adsorb to sludge/sediment.
Dissociation Constant	Not determined	Contains no acid or base functional groups
Particle Size	42.7% ≥ 150 µm (Plant dried) 55.5% ≥ 150 µm (Lab dried) 51.7% < 125 µm (Plant dried) 38.8% < 125 µm (Lab dried) 0.30% < 38 µm (Plant dried) 0.11% < 38 µm (Lab dried)	Measured (Chemtura, 2010)
Flash Point	Not determined	Not applicable as the notified polymer is a solid at room temperature
Flammability	Not determined	Not anticipated to be flammable, based on the polymer's use as a flame retardant.
Autoignition Temperature	Not determined	Not anticipated to undergo autoignition under conditions of use.
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

Water extractability

The solution and extraction behaviour of the notified polymer in water adjusted to pH 2, 7, and 9 at 20ºC and pH 7 at 37ºC was determined following the OECD Method 120 guideline. No detectable dissolved organic carbon (DOC) was measured in the test mixtures, indicating that the notified polymer did not release any detectable organic compounds into aqueous solution under the conditions of the OECD 120 test guideline.

Hydrolysis as a Function of pH

The hydrolysis of the notified polymer was evaluated in buffered solutions (pH 1.2, 4, 7, and 9) at 49.9 ºC for five days following the OECD 111 guidelines. Dissolved organic carbon (DOC) concentrations in the aqueous phase of the reaction mixtures were measured on days 0, 1, and 5 in order to monitor whether hydrolytic degradation of the notified polymer occurred over the course of the study. The notified polymer was not susceptible to hydrolysis under the conditions of the test based on the release of DOC.

Partition Coefficient (n-octanol/water)

The octanol/water partition coefficient (Kow) values for organic compounds present in the water accommodated fraction (WAF) prepared from the notified polymer were estimated using OECD Method 117 "Partition Coefficient (n-octanol/water), High Performance Liquid Chromatography (HPLC) Method". The method compares the retention times of the test material in a defined HPLC assay to the retention times of a series of reference compounds with known Kow values. In the HPLC assay for the WAF sample, one chromatographic peak was measured separate from the solvent front peak. The estimated log Kow for the unknown compound eluting in this chromatographic peak was approximately 2. The dissolved organic carbon (DOC) concentration in the WAF sample was 1.9 mg/L. However, this unknown compound is not expected to represent the polymeric material but some sort of unknown soluble compound.

Reactivity
The notified polymer is expected to be stable under normal conditions of use; however it may photolytically degrade under prolonged exposure to direct sunlight. Its susceptibility to heat degradation is not known.

Physical hazard classification
Based on the submitted physico-chemical data depicted in the above table, the notified polymer is not recommended for hazard classification according to the *Globally Harmonised System for the Classification and Labelling of Chemicals (GHS),* as adopted for industrial chemicals in Australia.

5. INTRODUCTION AND USE INFORMATION

MODE OF INTRODUCTION OF NOTIFIED CHEMICAL (100%) OVER NEXT 5 YEARS
The notified polymer will be imported in powder form (compacted) at > 99% concentration.

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

Year	*1*	*2*	*3*	*4*	*5*
Tonnes	30-100	100-200	200-500	200-500	200-500

PORT OF ENTRY
Anticipated to be Melbourne and Adelaide

IDENTITY OF MANUFACTURER/RECIPIENTS
Chemtura Australia Pty Ltd

TRANSPORTATION AND PACKAGING
The notified polymer will be imported into Australia by ship in 25 kg paper bags or in 500 kg super-sacks and will be transported by road to end-user sites.

USE
The notified polymer will be used as a flame retardant in polystyrene foam-based wall insulation products at <5% concentration. These products will be used for either commercial or residential construction, and may also be made available to the general public through DIY home improvement stores.

OPERATION DESCRIPTION
The processes involved in the production of foam insulation products containing the notified polymer are:
a) incorporation of the notified polymer in powder form into a polystyrene matrix and b) fabrication into insulation board as either expanded polystyrene (EPS) or extruded polystyrene (XPS) foams containing < 5% of the notified polymer.

In the production of XPS insulation foam, the notified polymer (> 99% concentration) will be mixed with other additives and compounded into a polystyrene master-batch (containing 50% or more of the notified polymer) via an extrusion process. This process will typically occur at a specialised master-batch manufacturer. At the sites where XPS foam board panels are produced, the master-batch in the form of non-dusting plastic pellets will be incorporated at approximately 2 to 5% with neat polystyrene pellets and a blowing agent in an extrusion process to make foam board. The boards are then cut to size, and production waste is reprocessed (US EPA, 2011).

The notified polymer may also be used in the production of EPS insulation foam. The notified polymer (> 99% concentration) will be dissolved into the polystyrene beads prior to polymerisation. Through a suspension polymerisation process, the produced polystyrene beads will be isolated, dried and pre-expanded. Using steam, the pre-expanded beads will then be moulded into large blocks.

Both the EPS and XPS insulation boards will be cut into size before delivery to a distributor, retailer or construction site.

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)*
Warehouse: off-loading of bags	0.5	50
Warehouse: bulk storage of bags	0.5	50
Reformulation: feeder	0.5	50
Reformulation: empty bag disposal	0.5	25

EXPOSURE DETAILS

Transport and storage
Transport and warehouse workers will transport and store the imported product containing the notified polymer at > 99% concentration. Workers will also be involved in packaging and transporting of finished products. However, it is expected that workers will only be exposed to the notified polymer in the unlikely event of an accident or packaging breach, in which case dermal, ocular, and inhalation exposure could occur.

Manufacturing of polystyrene beads and pellets
During the manufacture of polystyrene beads and pellets workers may be exposed to the imported product containing the notified polymer at > 99% concentration during the transfer of the imported product in powder form from 25 kg paper bags or 500 kg super-sacks into vessels. Other manual operations such as weighing, packing and cleaning may also be involved.

Fabrication into foam insulation boards
During the moulding of pre-expanded beads (EPS foam production) and the extrusion of polymer pellets (XPS foam production) the notified polymer will be incorporated into foam sheets. The notified polymer (at more than 50% concentration in master-batch pellets and at an unknown concentration in beads) will be incorporated into the matrix of the polystyrene beads/pellets and will not be bioavailable.

Workers may be exposed to dust containing the notified polymer at < 5% concentration during the handling of semi-finished products such as in cutting and sawing of foam sheets into insulation boards.

End-user
The finished products (foam sheets) containing the notified polymer at < 5% concentration will be used in industrial applications. The notified polymer (< 5% concentration) will be incorporated into the matrix of the polystyrene beads/pellets. Some exposure to the notified polymer may occur in situations where products containing the notified polymer crumble or where dust and/or small particles are formed.

6.1.2. Public Exposure

The notified polymer itself will not be sold to the public; however the finished polystyrene foam-based wall insulation products containing the notified polymer at < 5% concentration may be available to the general public through DIY home improvement stores. The wall insulation products may also be installed in homes. Some exposure to the notified polymer may occur in situations where products containing the notified polymer crumble or where dust and/or small particles are formed from these products, i.e. inside packaging or for example as a result of the finished products being cut to size.

6.2. Human Health Effects Assessment

The results from toxicological investigations conducted on the notified polymer are summarised in the following table.

Endpoint	*Result and Assessment Conclusion*
Rat, acute oral toxicity	LD50 > 2,000 mg/kg bw; low toxicity
Rabbit, skin irritation	slightly irritating
Rabbit, eye irritation	slightly irritating
Guinea pig, skin sensitisation – non-adjuvant test	no evidence of sensitisation
Rat, combined repeat dose oral with reproductive /developmental toxicity screen	NOEL = 1,000 mg/kg bw/day

Mutagenicity – bacterial reverse mutation	non mutagenic
Genotoxicity – *in vitro* chromosomal aberration	non genotoxic
Rat, reproductive and developmental toxicity*	NOEL = 1,000 mg/kg bw/day

Toxicokinetics, metabolism and distribution.
Based on the high molecular weight (Mn > 10,000 Da), low water solubility and expected high lipophilicity, absorption across biological membranes is expected to be low. Systemic toxicity after dermal exposure to the notified polymer is therefore expected to be low.

Acute toxicity.
The notified substance was tested using a method based on OECD TG 425 Acute Oral Toxicity Up and Down Procedure in rats. The notified polymer, in corn oil at 20% concentration, was given as a single dose by gavage to female rats. No mortalities occurred and no gross toxicity, adverse clinical signs, or abnormal behaviour was observed. The test authors concluded that the notified polymer has a low acute oral toxicity in female rats with an LD_{50} > 2000 mg/kg bw.

Irritation and sensitisation.
The notified substance was tested using a method based on OECD TG 405 Acute Eye Irritation/Corrosion. The notified polymer was applied as a single instillation of solid sample at 100% concentration to the eyes of New Zealand white albino rabbits. All subject animals exhibited iritis for up to 24 hours post-distillation, whilst conjunctivitis persisted for up to 48 hours post-distillation. The study authors concluded that the notified polymer is a mild eye irritant with a Mean Average Score (MAS) of 6.5 (1-72 hours) when tested in rabbit eyes.

The notified substance was tested using a method based on OECD TG 404 Acute Dermal Irritation/Corrosion. The notified polymer was applied as a dry paste at 30% concentration in mineral oil to the skin of New Zealand white albino rabbits. All test animals exhibited very slight erythema one hour post patch removal, but all were free of dermal irritation by 24 hours. One out of three test animals experienced a very slight reduction in body weight over the 72 hour observation period. The test authors concluded that the notified polymer is a barely perceptible irritant when tested on rabbit skin.

The notified substance was tested using a method that was in accordance with OECD TG 406 Skin Sensitisation. The notified polymer in mineral oil was applied to guinea pigs at 30% concentration during the induction phase. Very faint non-confluent erythema was observed for 24 hours in 9/20 test subjects and for 48 hours in 5/20 test animals. However, the test authors concluded that the notified polymer was not a dermal sensitiser when tested in guinea pigs using a Buehler assay.

Repeated Dose Toxicity.
The notified substance was tested using a method based on OECD TG 422 (Combined Repeated Dose Toxicity Study with the Reproduction/Developmental Toxicity Screening Test). The molecular weight of the tested polymer varied significantly from the notified polymer; however both were greater than 10,000 Da. The notified polymer was administered by gavage at dose levels up to and including 1000 mg/kg/day.

One mid-dose male and one mid-dose female died on days 3 and 16 respectively but their deaths were associated with a gavage accident and were not the result of the notified substance. There were no treatment related effects on behaviour or demeanor or clinical signs of systemic toxicity in any of the treated animals as compared to control animals. There were no treatment related changes in any of the functional tests performed which included sensory evaluations, rectal temperature, grip performance and motor activity. There were no significant differences in body weight or body weight gains observed among males at any dose level. Similarly, there were no treatment related differences in the body weights or body weight gains in females during pre-mating, gestation or lactation periods.

Food consumption was not different between treated and control groups during the treatment period. There were no differences in the reproductive functions, which included reproductive indices, pup survival, sex ratios, time to mating and gestation length, at any dose level. There were no treatment related observations in the offspring or changes in the litter size and pup body weights at any dose level. There were no treatment related changes in the hematological parameters, including prothrombin times in males or females at any dose. There were no treatment related changes in clinical chemistry parameters in either males or females. The blood glucose of high dose females was higher than controls but was only slightly above historical controls and no histopathological effects were associated with the change. The cholesterol levels of all treated males were higher than control animals and statistically significant at the low and mid-dose but did not show a dose-dependent change.

Urinalysis parameters were similar between treated and control animals with the exception that two low dose and two high dose males had hematuria. This change was not anticipated to be treatment related as it was not dose dependent and no histopathological changes in the kidneys were observed. There were no treatment related differences in organ weights in males or females. High dose males did have increased testes weights, however this finding was neither accompanied by any histological changes or changes in reproductive performance. In addition, the absolute testes weights of this group were within historical control range and the concurrent controls were outside the existing historical control range. There were no gross pathological changes or histopathological changes observed in males or females at any dose tested.

Since no treatment-related toxicity or indications of neurological or reproductive toxicity was reported at any dose level, the study authors concluded that the notified polymer has a low subchronic and developmental toxicity with a No-Observed-Effect Level (NOEL) of 1000 mg/kg bw/day.

Mutagenicity/Genotoxicity.

The molecular weight of the tested polymer varied from the notified polymer; however, both were greater than 10,000 Da. The test material was extracted into either phosphate buffered saline or 95% ethanol before being used in the tests. The concentration of the test substance in the extracts was not determined. The test authors concluded that the extracts containing the notified polymer were negative in the bacterial reverse mutation screening assay employed.

The notified substance was tested using a method following the guidelines for OECD TG 473 In vitro Mammalian Chromosome Aberration Test. However, only a single concentration of each extract was evaluated for aberrations. The molecular weight of the tested polymer varied from the notified polymer; however both were greater than 10,000 Da. The test material was extracted into either RPMI 1640 medium or 95% ethanol before being used in the tests. The concentration of the test substance in the extracts was not determined. The test author concluded that the extracts containing the notified polymer were non-genotoxic in the *in vitro* chromosomal aberration test employed.

Neither of the two available *in vitro* studies indicate a concern for genotoxicity.

Degradation products

Photolytic degradation of the notified polymer has been observed on or near the surface of the foam after exposure to sunlight. (see Section 7.1.2 for details). Degradation is expected to result in release of bromine, which is a hazardous substance at concentrations ≥ 0.1% (effects at low concentrations are acute toxicity and irritation). The bromine will likely react with other constituent groups within the polymer. Some aromatic degradation products have been identified; however, their health effects are not known.

Health hazard classification

Based on the available information, the notified polymer is not recommended for classification according to the *Globally Harmonised System for the Classification and Labelling of Chemicals (GHS),* as adopted for industrial chemicals in Australia, or the *Approved Criteria for Classifying Hazardous Substances* (NOHSC, 2004).

6.3. Human Health Risk Characterisation

6.3.1. Occupational Health and Safety

The notified polymer is slightly irritating to skin and eyes. It was of low hazard in other health endpoints tested. Because of the high molecular weight of the polymer and the absence of low molecular weight species, it is not expected to be bioavailable. Workers with the highest potential exposure to the notified polymer (at > 99% concentration) include those involved in the transport, storage and reformulation of the imported product. Workers may experience dermal, ocular and inhalation exposure to the notified polymer (at > 99% concentration) during the reformulation processes. The use of enclosed, automated processes, where possible, and use of PPE (impervious gloves, goggles, coveralls and respiratory protection, if significant inhalation exposure is expected) would minimise the potential for exposure to the notified polymer. No inhalation toxicity data was provided. However the low level of respirable particles (< 1%) in the polymer itself would reduce exposure and risk from inhalation.

Once the notified polymer has been incorporated into polystyrene beads/pellets the notified polymer will be incorporated within the polymer matrix at < 5%, although it is not chemically bound. In situations where products containing the notified polymer crumble or where dust and/or small particles are formed from these products (i.e. inside packaging or for example as a result of the finished products being cut to size), dermal, ocular and inhalation exposure to the notified polymer may occur. In such situations use of PPE (impervious gloves, goggles, coveralls and respiratory protection, if significant inhalation exposure is expected) would minimise the potential for exposure to the notified polymer.

Worker exposure to potentially hazardous degradation products may occur if foam products have been exposed to sunlight. The conditions causing degradation should be avoided and appropriate PPE should be worn during the handling of finished products that have been exposed to sunlight. The notifier advised that some commercial foam board products are marketed with storage instructions to minimise degradation due to light. Once installed, further photodegradation is not expected. It is not known whether degradation due to heat during processing and storage may also occur. Therefore precautions against this occurrence are recommended.

Provided that adequate control measures are in place to minimise worker exposure, including the use of automated processes and PPE, and measures to reduce the formation of degradation products, the risk to workers from the use of the notified polymer is not considered to be unreasonable.

6.3.2. Public Health

The notified polymer is a slight skin and eye irritant, and of low hazard in other health endpoints tested. Consumers may be exposed to foam products containing the notified polymer at < 5% during the occasional DIY home improvement operations. Public exposure to potentially hazardous degradation products of the notified chemical in insulation boards may occur during handling and installation, if storage conditions have been suboptimal. Therefore exposure of foam products to sunlight should be avoided. Following product labelling instructions will reduce the potential for such exposure to occur. Once installed within the walls, further photodegradation is not expected.

Due to the low systemic hazard of the notified polymer and the expected infrequent exposure, the notified polymer 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 polymer will be imported for use as a flame retardant in polystyrene foam-based wall insulation products. Environmental release of the notified polymer during importation, storage and transportation is not expected except in the event of accidental spills or leaks. Spills are expected to be collected and disposed of to landfill. It will be reformulated into polystyrene polymer pellets at industrial sites in Australia. Release of the notified polymer to the environment from spills, equipment washing, and container residues during this process is not expected to be significant.

RELEASE OF CHEMICAL FROM USE

The pellet products containing the notified polymer are anticipated to be extruded into foam insulation sheets and other products for use in foam-based wall insulation. Therefore, the notified polymer will be bound in the polymer matrix and its release to the environment is not expected.

RELEASE OF CHEMICAL FROM DISPOSAL

The notified polymer is a solid and will be sold in neat form for industrial applications. Any waste generated during the industrial application process is expected to be collected for disposal to landfill. Empty containers are expected to be collected by an approved waste management company for recycling or disposal to landfill. Any accidental release is expected to be contained and collected for proper disposal, which is most likely landfill.

7.1.2. Environmental Fate

Biodegradation

No data for aerobic biodegradability was provided. The anaerobic biodegradation of the notified polymer was determined in municipal digester sludge following OECD 311 guideline test "Anaerobic Biodegradability of Organic Compounds in Digested Sludge: Method by Measurement of Gas Production." The test material was added to digester sludge reaction mixtures at a concentration of 208 mg/L (100 mg/L-dissolved organic carbon) and incubated in the dark at 34.9 ºC for 62 days. The results from this study indicated that no anaerobic mineralization of the notified polymer was observed in the digester sludge reaction mixtures over the 62 days incubation period.

Photodegradation

The photodegradation of the notified polymer in a typical extruded polystyrene (XPS foam) matrix was evaluated through an experimental study of the stability of the notified polymer to artificial sunlight. XPS foam samples with or without the notified polymer additive package were exposed to artificial sunlight at a temperature range of 40ºC for approximately 30 days. Identical foam samples wrapped in aluminium foil were also included to serve as "dark controls". After exposure there was a distinct discoloration (i.e. yellowing) of the light-exposed foam samples. This discoloration was identical for foam samples either with or without the notified polymer additive package. The light exposed and dark control foam samples containing the notified polymer were analysed for water extractable bromide ion using Ion Chromatography (IC)/Mass Spectrometry (MS). Bromide ion levels in the discoloured surface layers of the foam with the notified polymer package increased approximately 30-65% over those in the dark control, indicating photolytic degradation of the notified polymer on or near the surface of the foam. Bromide ion levels in the foam layers taken below the discoloured areas were very similar to those in the dark controls, indicating the stability of the notified polymer under the exposed surface area. Additional analyses were conducted to identify any low molecular weight organic materials which may have originated from the photolysis of the notified polymer. Four unique photolytic degradation products were identified from the Electrospray Ionization Liquid Chromatography Mass Spectrometry (ESVLC/I\4S) and by Gas Chromatography Mass Spectrometry (GC-MS) analyses of the light-exposed foam samples containing the notified polymer additive package. The mass spectra of these components were consistent with the proposed structures.

The degradation products were only detected in the surface layer samples of the light exposed foam containing the notified polymer package.

Based on the result of the experimental anaerobic biodegradation and hydrolysis of the notified polymer and the chemical composition, size and structure, the notified polymer is not anticipated to be subjected to significant environmental degradation processes. Photodegradation of the notified polymer may occur in case of exposure to sunlight, e.g. in landfill. These degradation products were only detected in the surface layer samples of the light exposed foam containing the notified polymer package. In addition, these degradates are expected to be hydrophilic or water soluble based on the structural information. Therefore, they are not expected to be bioaccumulative in aquatic organisms. Predictive modelling conducted by the notifier using the US EPA EPI Suite and the OASIS CATABOL software also indicated that these materials should be neither persistent nor bioaccumulative in the aquatic environment.

Bioaccumulation

The notified polymer has a molecular weight greater than 1,000 Daltons and no significant percentage of low molecular weight constituents. Due to molecular size it is thus not expected to be able to cross biological membranes, therefore making bioaccumulation unlikely.

Final fate

A small amount of the notified polymer may be directly disposed of to landfill as spills and container residues.

Most of the notified polymer is expected to be bound in the polystyrene matrix for use as foam-based wall insulation, and therefore, will share the fate of the insulation materials. In the case of exposure to flames, the notified polymer will be thermally decomposed into water, oxides of carbon and brominated species. At the end of these materials' useful life, they may be sent to landfill. In landfill, the notified polymer is expected to undergo biotic or abiotic degradation processes, eventually forming water, oxides of carbon, and brominated species.

7.1.3. Predicted Environmental Concentration (PEC)

Since no significant release of the notified polymer to the aquatic environment is expected based on its proposed use pattern, the calculation of the predicted Environmental Concentration (PEC) is not considered necessary.

7.2. Environmental Effects Assessment

The notifier provided an acute toxicity study with daphnid (*Daphnia magna*) of the test substance (contains >99% notified substance by weight). The test performed in compliance with the principles of Good Laboratory Practice (GLP) showed the absence of adverse effects to daphnia. The test was based on OECD Guideline 202. Neonate (< 24-hours old) daphnids were added to each test substance treatment containing aqueous solution of the test item at 0 (control) and 1,000 mg of the test substance/L for a period of 48 hours at a temperature of about 19°C to 21°C under static test conditions. The daphnids were observed for immobility and sublethal effects at approximately 24 and 48 hours after test initiation. The median effect concentration (EL50) at 48 h (nominal concentration) was >1,000 mg/L (the limit loading rate tested).

Endpoint	*Result*	*Assessment Conclusion*
Daphnia Toxicity	48 h EL50 > 1000 mg/L (WAF[*])	Not harmful up to the limit of solubility in water

[*] Water accommodated fraction

The notified polymer is considered to be not harmful to aquatic organisms up to the limit of its water solubility. Based on the toxicity to aquatic daphnids, the notified polymer is not classified under the Globally Harmonised System of Classification and Labelling of Chemicals (GHS; United Nations, 2009) for acute and chronic classification.

7.2.1. Predicted No-Effect Concentration

Since no significant release of the notified polymer to the aquatic environment is expected based on its proposed use pattern, the calculation of the Predicted No-Effect Concentration (PNEC) is not considered necessary.

7.3. Environmental Risk Assessment

The Risk Quotient (RQ = PEC/PNEC) has not been calculated since neither the PEC nor the PNEC have been calculated. Based on the reported low ecotoxicity and low release based on the assessed use pattern, the notified polymer is not expected to pose an unacceptable risk to the environment.

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