2-Propanol, 2-methyl-: Human health tier II assessment

22 November 2013

CAS Number: 75-65-0

Preface

This assessment was carried out by staff of the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) using the Inventory Multi-tiered Assessment and Prioritisation (IMAP) framework.

The IMAP framework addresses the human health and environmental impacts of previously unassessed industrial chemicals listed on the Australian Inventory of Chemical Substances (the Inventory).

The framework was developed with significant input from stakeholders and provides a more rapid, flexible and transparent approach for the assessment of chemicals listed on the Inventory.

Stage One of the implementation of this framework, which lasted four years from 1 July 2012, examined 3000 chemicals meeting characteristics identified by stakeholders as needing priority assessment. This included chemicals for which NICNAS already held exposure information, chemicals identified as a concern or for which regulatory action had been taken overseas, and chemicals detected in international studies analysing chemicals present in babies' umbilical cord blood.

Stage Two of IMAP began in July 2016. We are continuing to assess chemicals on the Inventory, including chemicals identified as a concern for which action has been taken overseas and chemicals that can be rapidly identified and assessed by using Stage One information. We are also continuing to publish information for chemicals on the Inventory that pose a low risk to human health or the environment or both. This work provides efficiencies and enables us to identify higher risk chemicals requiring assessment.

The IMAP framework is a science and risk-based model designed to align the assessment effort with the human health and environmental impacts of chemicals. It has three tiers of assessment, with the assessment effort increasing with each tier. The Tier I assessment is a high throughput approach using tabulated electronic data. The Tier II assessment is an evaluation of risk on a substance-by-substance or chemical category-by-category basis. Tier III assessments are conducted to address specific concerns that could not be resolved during the Tier II assessment.

These assessments are carried out by staff employed by the Australian Government Department of Health and the Australian Government Department of the Environment and Energy. The human health and environment risk assessments are conducted and published separately, using information available at the time, and may be undertaken at different tiers.

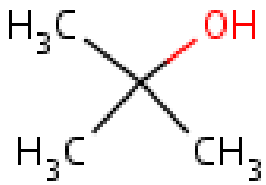
This chemical or group of chemicals are being assessed at Tier II because the Tier I assessment indicated that it needed further investigation.

For more detail on this program please visit:www.nicnas.gov.au

Disclaimer

Acronyms & Abbreviations

Chemical Identity

Synonyms	tert-Butanol tert-Butyl alcohol Trimethyl Carbinol Trimethylmethanol 2-methyl-2-propanol
Structural Formula	
Molecular Formula	C4H10O
Molecular Weight (g/mol)	74.12
Appearance and Odour (where available)	Colourless liquid or solid (below 26 deg C) with a camphor-like odour
SMILES	C(C)(C)(C)O

Import, Manufacture and Use

Australian

The following Australian industrial uses were reported under previous mandatory and/or voluntary calls for information.

The chemical has reported cosmetic use including in unspecified cosmetics, deodorants, hair sprays, colognes, aftershaves, and antiperspirants.

The chemical has reported potential domestic use including in aerosols.

The chemical has reported commercial use including in resins and polymer products.

The chemical has reported site-limited use including as a laboratory reagent.

The total volume introduced into Australia, reported under previous mandatory and/or voluntary calls for information, was 100–1000 tonnes.

International

The following international uses have been identified through European Union Registration, Evaluation and Authorisation of Chemicals (EU REACH) dossiers; Galleria Chemica; Substances and Preparations in the Nordic countries (SPIN) database; the European Commission Cosmetic Ingredients and Substances (CosIng) database; United States (US) Personal Care Product Council International Nomenclature of Cosmetic Ingredients (INCI) Dictionary; and eChemPortal: OECD High Production Volume chemical program (OECD HPV), US EPA HPV challenge program (US EPA HV); US Household Products Database; and the US National Library of Medicine's Hazardous Substances Data Bank (HSDB).

The chemical has reported cosmetic use including as a:

- denaturant and solvent in cosmetic products; and
- fragrance ingredient.

The US cosmetic ingredient review (CIR) reported the use of chemical, as a solvent or an alcohol denaturant, in 32 formulations of eye makeup, fragrance, and shaving preparations, at concentrations ranging from 0.0001 % to 0.5 % (CIR, 2005). The US Household Products Database shows concentrations of up to 2.5 % (aerosol) for use in personal care products.

The chemical has reported domestic use including in:

- adhesives and binding agents;
- cleaning/washing agents;
- flame retardants and extinguishing agents;
- fillers;
- paints, lacquers and varnishes, and in paint removers;
- the manufacture of coatings for paper and paperboard, and for metallic articles for holding food; and
- surface treatment.

The chemical has reported domestic use which is specified in the SPIN database. However, it should be noted that SPIN does not distinguish between direct use of the chemical or using materials produced from chemical reactions using the chemical. The US Household Products Database states a concentration of up to 5 % (liquid) for inside the home use such as cleaning products.

The chemical has reported commercial use including in:

- anti-freezing agents;
- conductive agents;
- construction materials;
- fuels and fuel additives;
- impregnation materials;
- process regulators;
- flotation agent;
- reprographic agents; and
- as a solvent.

The chemical has reported site-limited use including in:

- laboratory chemicals;
- chemical analyses;
- heat transfer agents; and
- as an intermediate for oil soluble polyester resins, methyl t-butyl ether (a gasoline oxygenate) isobutylene, tertiary butyl chloride, tertiary butyl phenol, artificial musk, and flotation agent.

The chemical has reported non-industrial use including:

- as a solvent in pharmaceuticals; and
- in non-agricultural pesticides and preservatives.

Restrictions

Australian

No known restrictions have been identified.

International

No known restrictions have been identified.

Existing Work Health and Safety Controls

Hazard Classification

The chemical is classified as hazardous, with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia):

Xn; R20 (Harmful by inhalation)

Xi; R36/37 (Irritating to eyes and respiratory system)

Exposure Standards

Australian

The chemical has an exposure standard of 303 mg/m³ (100 ppm) time weighted average (TWA) and 455 mg/m³ (150 ppm) short-term exposure limit (STEL).

International

The following exposure standards are identified (Galleria Chemica):

An exposure limit (TWA) of 150–308 mg/m³ (50–100 ppm) in countries such as Canada, Denmark, France, Japan, Sweden, Spain, South Africa, UK, and USA.

An exposure limit (STEL) of 240–462 mg/m³ (75–150 ppm) in countries such as Canada, Denmark, Spain, Sweden, South Africa, Switzerland, UK, and USA.

Health Hazard Information

Toxicokinetics

Although the chemical has been reported to be rapidly absorbed from the gastrointestinal tract and the lungs, absorption through the skin is limited (less than 1.5 % absorbed over a 72-hour period). The chemical is rapidly distributed into the tissues following absorption. The chemical is slowly metabolised due to tertiary alcohol functionality of the chemical resulting in lack of metabolism by alcohol dehydrogenase.

Following an oral dose (2000 mg/kg bw) administered to rats, the maximum blood concentration of the chemical (1240 mg/L) was achieved at two hours and slowly decreased to 1100 mg/L after eight hours. The chemical has also been detected in the blood of rabbits 70 hours after an oral dose of 2 mL/kg bw.

Elimination from the blood is slower and the half-life increases with the dose. The chemical is mainly eliminated in the urine as glucuronide (up to 24 % of the dose) and can also be excreted in the breath (up to 10 % of the dose) as acetone or carbon dioxide. It has also been demonstrated that, following intraperitoneal administration of the chemical to rats (1 or 2 mg/kg bw), blood levels of acetone were approximately proportional to the dose of the chemical (WHO, 1987a; CIR, 2005; McGregor, 2010).

Acute Toxicity

Oral

The chemical had low acute toxicity in animal tests following oral exposure. The median lethal dose (LD50) in rats is greater than 2000 mg/kg bw. Observed sub-lethal effects included lacrimation, wakefulness, ataxia, and respiratory depression (EC, 2000; US EPA, 2004; McGregor, 2010; RTECS).

Dermal

The chemical had low acute toxicity in animal tests following dermal exposure. The median lethal dose (LD50) in rabbits is greater than 2000 mg/kg bw. Observed sub-lethal effects included weight loss or decreased weight gain, injected iris (red eyes), and ataxia (EC, 2000; US EPA, 2004; RTECS).

Inhalation

The chemical is classified as hazardous with the risk phrase ‘Harmful by inhalation’ (Xn; R20) in HSIS (Safe Work Australia). While the available data do not support this classification (LC50 >10000 ppm/4 hours), in the absence of more comprehensive information, there is insufficient evidence to support a recommendation to amend this classification. Reported effects following acute inhalation exposure included nasal/ocular discharge, excessive weakness, dyspnoea (shortness of breath), ataxia, and prostration. Red foci were observed on the lungs at necropsy (EC, 2000; US EPA, 2004; CIR, 2005; RTECS).

Corrosion / Irritation

Respiratory Irritation

The chemical is classified as hazardous with the risk phrase 'Irritating to respiratory system' (Xi; R37) in the HSIS (Safe Work Australia). Although there is limited evidence of respiratory irritation in acute and repeated dose inhalation studies (see **Acute toxicity** and **Repeat dose toxicity)**, irritation of the nose and throat have been observed in humans (see **Irritation: observation in humans**).

Skin Irritation

The chemical is reported to be minimally irritating to the skin in animal studies. The effects were not sufficient to warrant a hazard classification.

In a skin irritation study, two groups of three male and three female rabbits (strain not specified) received 0.5 mL of the chemical on two intact and two abraded sites for 2–4 hours. The chemical was found to be minimally irritating to the skin, with an irritation index of 0.4/8. The chemical was also found to be minimally irritating (very slight erythema) in another similar study, where the chemical (0.5 mL) was applied to two groups of three male and three female New Zealand White rabbits at two intact and two abraded sites for 24 hours (EC, 2000; CIR, 2005).

Eye Irritation

The chemical is classified as hazardous with the risk phrase 'Irritating to eyes' (Xi; R36) in HSIS (Safe Work Australia). Although individual score data to allow comparison with classification criteria was not available, the presence of ocular effects at the end of the observation period and reported corneal damage support an amendment to this classification (refer to the **Recommendation** section).

In an eye irritation study, 0.1 mL of the chemical was applied to the conjunctival sac of one eye of five male and four female New Zealand White rabbits. The treated eyes of one group (two males, one female) were washed for approximately one minute after 30 seconds of exposure to the chemical. The eye irritation was assessed by Draize scoring. The average Draize scores for the unwashed group were 40.6 at 72 hours (maximum), 13.9 at day 10, 4.1 at day 25, and 4.4 at day 34. The average Draize scores for the washed group were 33.2 at 72 hours (maximum), 1.7 at day 10, and 0 at day 25. Purulent discharge, corneal epithelial damage, petechial haemorrhage (small discrete haemorrhage under the skin), and blanching (whiteness) were noted for 96 hours after exposure. The chemical was classified as severely irritating for the unwashed group and moderately irritating for the washed group (EC, 2000; CIR, 2005; McGregor, 2010).

In another eye irritation study, 0.1 mL of gasoline-grade chemical was applied to the conjunctival sac of one eye of four male and five female New Zealand White rabbits. The treated eyes of one group (one male, two females) were washed for approximately one minute after 30 seconds of exposure to the chemical. The average Draize scores for the unwashed group

were 41 at 24 hours (maximum), 0.4 at day seven, 5.4 at day 10, and 0 at day 15. The average Draize scores for the washed group were 30.3 at 24 hours (maximum), 0.4 at day seven, 5.4 at day 10, 0 at day 22, 2.1 at day 25, and 0.8 at day 34. The chemical was classified as moderately irritating for both test groups (EC, 2000; CIR, 2005).

Observation in humans

Vapours of the chemical have been reported to be irritating to the eyes, nose and throat in humans. Following application of the chemical to the skin of five human volunteers, only slight erythema and hyperaemia were observed (WHO, 1987a; HSDB).

Sensitisation

Skin Sensitisation

The chemical was not found to induce dermal sensitisation when tested according to OECD Test Guideline (TG) 406.

In a guinea pig maximisation study (OECD TG 406), animals were initially induced intradermally on day zero with 0.1 % of the chemical and topically with 100 % of the chemical on day seven. A challenge with 100 % of the chemical on day 21 did not cause a sensitisation reaction (EC, 2000; McGregor, 2010).

Observation in humans

No dermal reactions were observed following a repeat-insult patch test on 99 human volunteers using 60 % ethanol and 0.125 % of the chemical. It was concluded that the chemical demonstrated no potential for either dermal irritation or sensitisation. A negative reaction to the chemical was also observed in a woman who had a positive patch test reaction to ethanol. The chemical was applied for 48 hours and the reactions were read up to 48 hours after removal of the patch. Four female patients did not show any reaction to the chemical at 1 % and 10 % concentration when tested on their upper back for 24 hours. The reactions were read up to 48 hours after removal of the patch (CIR, 2005).

However, an allergic skin reaction to the chemical has been described in a patient who used a commercial sunscreen preparation containing the chemical (WHO, 1987a; CIR, 2005). Dermatitis, including irritation, moderate hyperaemia and erythema, dryness, and vesiculation (formation of vesicles), has also been reported in a man following patch testing with the chemical at 70 % concentration. This person used a variety of sunscreens, had widespread, pruritic, red, vesicular eruptions on his face, neck, arms, and chest (EC, 2000; CIR, 2005).

Repeated Dose Toxicity

Oral

Considering the lowest observed adverse effect levels (LOAELs) available from 13-week rat studies (1599 mg/kg bw/day), and based on the treatment-related effects reported in various repeated dose toxicity studies, the chemical is not considered to cause serious damage to health from repeated oral exposure.

Fischer 344 (F344) rats and B6C3F$_1$ mice were administered the chemical in drinking water at 0, 0.25, 0.5, 1, 2, and 4 % (w/v) for approximately 13 weeks. The calculated mean chemical consumption (based on water consumption) was 235.4/260.7, 495.7/503.3, 803.7/758.4, 1598.9/1451.5, and 3588.5/3500.1 mg/kg bw/day for male/female rats. For mice, the calculated mean chemical consumption was 319.3/568.3, 726.3/941.7, 1565.8/1731.8, 2838.8/4362.9, 6247.2/7475.8 mg/kg bw/day. Lesser weight gain occurred at all dose levels in male rats; at 4 % in female rats; at 1, 2, and 4 % in male mice; and at 2 and 4 % in female mice. Reported clinical signs included emaciation, ataxia, and hypoactivity for both sexes of rats and mice. Blood was noticed in the urine of male rats and female rats exhibited urine staining on the fur. Treatment-related mortalities were common at the highest concentration in male and female rats and mice.

Gross lesions at necropsy were urinary tract calculi (stones), renal pelvic and urethral dilatation, and thickening of the urinary bladder mucosa. The principal treatment-related pathology findings were in the urinary bladder of rats and mice and in the kidneys of rats. The incidence and severity of the urinary bladder lesions were higher in male than female rats and mice. Calculi in the urinary bladder were observed only in rats but not in mice. Histological changes in the urinary bladder included hyperplasia of transitional epithelia and inflammation of the urinary bladder. Microscopic renal changes in male rats were suggestive of a-2µ-globulin nephropathy. The urinary tract was identified as the target organ for the chemical toxicity in rodents, and males were stated to be more sensitive than females. Based on the urinary tract lesions, a no observed adverse effect level (NOAEL) of 1 % in male rats and mice (803.7/1565.8 mg/kg/day) and 2 % in female rats and mice (1451.5/4362.9 mg/kg/day), was established (EC, 2000; CIR, 2005).

Other studies have also reported similar findings, where the chemical was administered in drinking water to F344 rats and $B6C3F_1$ mice at 0, 0.25, 0.5, 1, 2, and 4 % or at 0, 2.5, 5, 10, 20, or 40 mg/mL for approximately 13 weeks (CIR, 2005; NTP, 1995).

Dermal

No data are available.

Inhalation

As no significant adverse systemic effects were reported in subchronic inhalation toxicity studies in animals, the chemical is likely to be of minimal toxicity from inhalation exposure.

Groups of F344 rats and $B6C3F_1$ mice were exposed (whole body) to the chemical by inhalation at concentrations of 0, 450, 900, 1750, 3500, and 7000 ppm for six hours/day, five days/week, for 12 exposure days. All animals exposed to 7000 ppm were sacrificed moribund following a single six-hour exposure on day two. Ataxia, hyperactivity, and hypoactivity were reported in rats exposed to 900 ppm and higher. Hypoactivity, ataxia, and rapid respiration were reported in mice at 3500 ppm, hyperactivity, and urogenital wetness were also noted in mice exposed to 1750 ppm. Mean body weight gains were significantly lower than those of controls for the male and female rats exposed to 3500 ppm (14 % and 1 3 % less, respectively). Gross or microscopic treatment related lesions were not present in rats or mice (NTP, 1997).

Groups of F344 rats and $B6C3F_1$ mice were exposed to the chemical by inhalation at concentrations of 0, 135, 270, 540, 1080, and 2100 ppm (0, 415, 831, 1662, 3324, and 6464 mg/m³) for six hours/day, five days/week, for 13 weeks. Only one male mouse in the 2100 ppm group died during the study. While the treatment had no effect on body weights of rats at any dose level, reductions in body weight gain of female mice in the 1080 and 2100 ppm groups were significantly lower compared with 94 % and 92 % of the controls, respectively. Clinical signs were noted at one observation time only and included emaciation and hypoactivity in female rats exposed to 2100 ppm.

The most notable evidence of toxicity was limited to male rats and consisted of increased kidney weights, which correlated microscopically to increased severity of chronic nephropathy. Regenerative foci were characterised by tubules with cytoplasmic basophilia, increased nuclear/cytoplasmic ratio, and occasionally thickened basement membranes and intraluminal protein casts. The severity of nephropathy was increased in the exposed group as evidenced by an increased number of foci (NTP, 1997).

Genotoxicity

The chemical is not considered to have mutagenic or genotoxic potential.

The chemical tested negative in a number of tests for genotoxicity. These included two Ames assays on *Salmonella typhimurium* (TA 98, TA 100, TA 1535, TA 1537) and two mouse lymphoma assays using L5178Y mouse lymphoma cells. The chemical tested positive in an in vitro sister chromatid exchange assay using Chinese hamster ovary cells without activation at the highest tested dose of 20 µl/mL, while the assay was negative with activation. Another in vitro sister chromatid exchange assay using Chinese hamster ovary cells also tested negative at lower doses of 5000 µg/mL, with and without metabolic activation. The chemical also tested negative in an in vivo mouse micronucleus induction assay (EC, 2000; CIR, 2005; US EPA, 2004; McGregor, 2010).

Carcinogenicity

Based on the limited data available, the chemical is not likely to be a carcinogen. Although there is some evidence of carcinogenic activity in animals, either the mode of action was not considered to be relevant for humans or the effects were not consistently observed and observed only at high doses in particular species and strains of animals.

In a carcinogenicity study, the chemical was administered in drinking water to male F344 rats at 1.25, 2.5, or 5 mg/mL (90, 200, 420 mg/kg bw/day) and to female F344 rats at 2.5, 5, or 10 mg/mL (180, 330, 650 mg/kg bw/day) for two years. In the same study, the chemical was also administered in drinking water to male and female B6C3F$_1$ mice at 5, 10, or 20 mg/mL (corresponding to 540, 1040, or 2070 mg/kg bw/day in males and 510, 1020, or 2110 mg/kg bw/day in females) for two years (NTP, 2005).

The survival rates of male and female rats were significantly lower than those of the controls only at the highest tested dose of 5 mg/mL. The survival of male mice was also significantly lower than that of the controls at the highest tested dose of 20 mg/mL. While the final mean body weights of male rats were 15 % to 24 % lower than that of the controls at all doses, only female rats of the highest dose group had 21 % lower final mean body weight. Similarly, the mean body weights of female mice given the highest dose of 20 mg/mL were 10 % to 15 % lower than those of the controls from week 13 to the end of the study.

The principal effects were noted in the kidney of male and female rats and the thyroid gland and the urinary bladder of male and female mice.

Dose related increased incidence of mineralisation in the kidney of rats was noted and was significantly greater than that of the controls in males of 5 mg/mL group. Exposed males also demonstrated dose-related increased incidence of focal renal tubule hyperplasia and of renal tubule adenoma. Renal tubule carcinoma was noted in two males of 1.25 mg/mL group and in one male each from 2.5 mg/mL and 5 mg/mL groups. The severity of nephropathy and the incidence and severity of transitional cell hyperplasia of the kidney were increased in exposed male and female rats.

The incidence of follicular cell hyperplasia of the thyroid gland was significantly increased in all exposed male and in female mice at the top two doses (10 and 20 mg/mL). While the incidence of thyroid follicular cell adenoma was significantly increased in females of 20 mg/mL group, only one male in the 20 mg/mL group had thyroid follicular cell carcinoma. The data do not support an important function for hyperplasia in the thyroid neoplasia. Increased incidences of chronic inflammation and transitional epithelial hyperplasia of the urinary bladder were noted in males and to a lesser extent in females which received 20 mg/mL.

It was concluded that there was: some evidence of carcinogenic activity of the chemical in male rats, based on increased incidences of renal tubule adenoma or carcinoma (combined); no evidence of carcinogenic activity in female rats receiving the chemical; equivocal evidence of carcinogenic activity of the chemical in male mice, based on the marginally increased incidences of follicular cell adenoma or carcinoma (combined) of the thyroid gland; and some evidence of carcinogenic activity of the chemical in female mice, based on increased incidences of follicular cell adenoma of the thyroid gland.

The mode of carcinogenic action of the chemical with respect to the increased incidences of renal tubule cell adenomas and thyroid follicular cell adenomas in the above study and its relevance to humans has recently been discussed (McGregor, 2010). The chemical is not considered to have mutagenic or genotoxic potential (see **Genotoxicity**). It was concluded that the development of renal adenomas was mediated by a primary mode of action of *a*-2u-globulin nephropathy (male rat specific) and also by a secondary mode of action of exacerbation of chronic progressive nephropathy (rat specific). These modes of action have no relevance in humans. Although a strain-specific response cannot be ruled out with respect to increased thyroid adenomas in mice, the role of the chemical is not certain. The induction of thyroid tumours in rodents by the chemical, delivered either as the chemical or as an endogenously formed metabolite, has not been consistently shown and there are few data to support any of the known modes of action for thyroid follicular cell neoplasia. In addition, there is no evidence that the chemical is directly toxic to the thyroid (McGregor, 2010).

Reproductive and Developmental Toxicity

The chemical does not show specific reproductive or developmental toxicity. Any reproductive and developmental effects were only observed secondary to maternal toxicity (CIR, 2005; US EPA, 2004; McGregor, 2010).

Groups of F344 rats and B6C3F$_1$ mice were exposed to the chemical by inhalation for six hours/day, five day/per week, at concentrations of 135, 270, 540,1080, and 2100 ppm, for 13 weeks. The treatment had no significant effect on the weights of male reproductive organs or sperm, and on female estrous cycle (CIR, 2005).

In a reproductive/developmental toxicity study (OECD TG 421), Sprague Dawley (SD) rats (F0) were treated orally by gavage for four weeks premating at doses of 0, 64, 160, 400, or 1000 mg/kg bw/day. While treatment for males was continued for a total of nine weeks, females were treated until postnatal day 21. Transient signs of mild to moderate toxicity, including lethargy and ataxia in the 400 and 1000 mg/ kg bw/day groups, were observed in the parental (F0) rats. Statistically significant increased absolute kidney weights in the paternal animals were also observed in the 400 and 1000 mg/kg bw/day groups by about 13 % and 19 %, respectively. The NOAEL for paternal and maternal toxicity was established as 160 mg/kg bw/day. The NOAEL for reproductive/development toxicity was determined as 400 mg/kg bw/day, based on a significant reduction in the number of live born pups, increased number of still born pups, decreased body weight of pups, and decreased mean litter size of offspring at 1000 mg/kg bw/day (F1) (US EPA, 2004; McGregor, 2010).

In a developmental toxicity study, pregnant SD rats were administered the chemical by inhalation at 0, 2000, 3500, or 5000 ppm (0, 6669, 10640, 15248 mg/m^3), seven hours/day, from gestation day 1–19. A maternal NOAEL of 2000 ppm was determined, based on decreased weight gain, decreased feed consumption, and unsteady gait at the two higher doses. Although foetal weights were significantly reduced at all exposure levels, it was concluded that this effect is associated with maternal toxicity. A developmental NOAEL of >5000 ppm was determined (EC, 2000; CIR, 2005; US EPA, 2004; McGregor, 2010).

Risk Characterisation

Critical Health Effects

The critical health effects for risk characterisation are local effects (eye and respiratory irritation).

The chemical is unlikely to have significant carcinogenic potential for the industrial uses identified.

Public Risk Characterisation

Considering the range of cosmetic and domestic products that may contain this chemical, the main route of public exposure is expected to be through dermal, ocular, and inhalational exposure from products applied as cosmetics and from using domestic products.

Based on the available use information (see **Import, manufacture and use)**, the concentration of the chemical in cosmetic and domestic products is not considered to be sufficiently high (up to 5 %) to cause any significant human health effects. Spray application of products containing the chemical may result in eye and respiratory irritation, although the likelihood is low. The effects are likely to be slight and reversible.

Therefore, the risk to public health is not considered to be unreasonable and further risk management is not considered necessary for public safety.

Occupational Risk Characterisation

During product formulation, dermal, ocular and inhalational exposure of workers to the chemical may occur, particularly where manual or open processes are used. These may include transfer and blending activities, quality control analysis, and equipment cleaning and maintenance. Worker exposure to the chemical at lower concentrations may also occur while using formulated products containing the chemical. The level and route of exposure will vary depending on the method of application and work practices employed.

Given the critical health effects, the chemical may pose an unreasonable risk to workers, particularly at high concentrations, unless adequate control measures to minimise dermal, ocular and inhalation exposure to the chemical are implemented. The chemical should be appropriately classified and labelled to ensure that a person conducting a business or undertaking (PCBU) at a workplace (such as an employer) has adequate information to determine appropriate controls.

The data available support an amendment to the hazard classification in HSIS (refer to the **Recommendation section**).

NICNAS Recommendation

Assessment of the chemical is considered to be sufficient, provided that the recommended amendment to the classification is adopted, and labelling and all other requirements are met under workplace health and safety and poisons legislation as adopted by the relevant state or territory.

Regulatory Control

Work Health and Safety

The chemical is recommended for classification and labelling under the current approved criteria and adopted GHS as below. This assessment does not consider classification of physical hazards and environmental hazards.

Hazard	Approved Criteria (HSIS)[a]	GHS Classification (HCIS)[b]
Acute Toxicity	Harmful by inhalation (Xn; R20)*	Harmful if inhaled - Cat. 4 (H332)
Irritation / Corrosivity	Risk of serious eye damage (Xi; R41) Irritating to respiratory system (Xi; R37)*	Causes serious eye damage - Cat. 1 (H318) May cause respiratory irritation - Specific target organ tox, single exp Cat. 3 (H335)

[a] Approved Criteria for Classifying Hazardous Substances [NOHSC:1008(2004)].

[b] Globally Harmonized System of Classification and Labelling of Chemicals (GHS) United Nations, 2009. Third Edition.

[*] Existing Hazard Classification. No change recommended to this classification

Advice for consumers

Products containing the chemical should be used according to the instructions on the label.

Advice for industry

Control measures

Control measures to minimise the risk from dermal, ocular, and inhalation exposure to the chemical should be implemented in accordance with the hierarchy of controls. Approaches to minimise risk include substitution, isolation and engineering controls. Measures required to eliminate or minimise risk arising from storing, handling and using a hazardous chemical depend on the physical form and the manner in which the chemical is used. Examples of control measures which may minimise the risk include, but are not limited to:

- using closed systems or isolating operations;
- using local exhaust ventilation to prevent the chemical from entering the breathing zone of any worker;
- air monitoring to ensure control measures in place are working effectively and continue to do so;

- minimising manual processes and work tasks through automating processes;
- work procedures that minimise splashes and spills;
- regularly cleaning equipment and work areas; and
- using protective equipment that is designed, constructed, and operated to ensure that the worker does not come into contact with the chemical.

Guidance on managing risks from hazardous chemicals are provided in the *Managing risks of hazardous chemicals in the workplace—Code of practice* available on the Safe Work Australia website.

Personal protective equipment should not solely be relied upon to control risk and should only be used when all other reasonably practicable control measures do not eliminate or sufficiently minimise risk. Guidance in selecting personal protective equipment can be obtained from Australian, Australian/New Zealand or other approved standards.

Obligations under workplace health and safety legislation

Information in this report should be taken into account to assist with meeting obligations under workplace health and safety legislation as adopted by the relevant state or territory. This includes, but is not limited to:

- ensuring that hazardous chemicals are correctly classified and labelled;
- ensuring that (material) safety data sheets ((m)SDS) containing accurate information about the hazards (relating to both health hazards and physicochemical (physical) hazards) of the chemical are prepared; and
- managing risks arising from storing, handling and using a hazardous chemical.

Your work health and safety regulator should be contacted for information on the work health and safety laws in your jurisdiction.

Information on how to prepare an (m)SDS and how to label containers of hazardous chemicals are provided in relevant codes of practice such as the *Preparation of safety data sheets for hazardous chemicals— Code of practice* and *Labelling of workplace hazardous chemicals—Code of practice*, respectively. These codes of practice are available from the Safe Work Australia website.

A review of the physical hazards of the chemical has not been undertaken as part of this assessment.

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