Acetic acid, mercapto-: Human health tier II assessment

28 June 2013

CAS Number: 68-11-1

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.

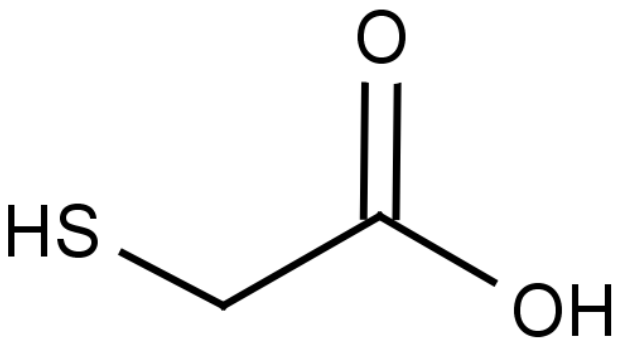
This chemical or group of chemicals are being assessed at Tier II because the Tier I assessment indicated that it needed further investigation.

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

Disclaimer

Acronyms & Abbreviations

Chemical Identity

Synonyms	Mercaptoacetic acid Thioglycolic acid Thiovanic acid 2-Mercaptoacetate 2-Sulfanylacetic acid
Structural Formula	
Molecular Formula	C2H4O2S
Molecular Weight (g/mol)	92.12
Appearance and Odour (where available)	Clear, colourless liquid with a strong, unpleasant, sulfide odour
SMILES	C(=O)(O)CS

Import, Manufacture and Use

Australian

No specific Australian use, import, or manufacturing information has been identified.

International

The following international uses have been identified through the review article of Burnett et al. (2009): European Union Registration, Evaluation and Authorisation of Chemicals (EU REACH) dossiers, the Organisation for Economic Cooperation and Development Screening Information Dataset Initial Assessment Report (OECD SIAR), Galleria Chemica, Substances in preparations in Nordic countries (SPIN) database, the European Commission Cosmetic Substances and Ingredients (CosIng) database, United States (US) Personal Care Products Council International Nomenclature Cosmetic Ingredients (INCI) Dictionary, US Household Products Database and other data sources via eChemPortal including the US Environmental Protection Agency (EPA) Aggregated Computational Toxicology Resource (ACToR), and the US National Library of Medicine's Hazardous Substances Data Bank (HSDB).

The chemical has reported cosmetic use as a component of salts used in hair perming, straightening and removal products.

The chemical has reported site-limited use including:

- as an intermediate for production of mercaptoacetate salts;
- in the synthesis of esters used in manufacturing tin stabilisers (used in producing polyvinyl chloride);
- in leather processing (depilatory);
- in manufacturing pharmaceuticals;
- in sensitive detection reagents for iron, molybdenum, silver and tin; and
- in corrosive inhibitors.

Restrictions

Australian

No known restrictions have been identified.

International

Mercaptoacetic acid and its salts appear on the following:

- EU Cosmetic Directive 88/233/EEC Annex III: List of substances which cosmetic ingredients must not contain except subject to the restrictions laid down (reference 2a; thioglycolic acid and its salts);
- Canada: List of Prohibited and Restricted Cosmetic Ingredients (The Cosmetic Ingredient Hotlist);
- New Zealand: Cosmetic Products Group Standard—Schedule 5: Components cosmetic products must not contain except subject to the restrictions and conditions laid down; and
- Association of Southeast Asian Nations (ASEAN): Cosmetic Directive Annex III, part 1—List of substances which cosmetic products must not contain except subject to restrictions and conditions.

In these directives the maximum concentration of the mercaptoacetate in preparations is limited according to the type of cosmetic product:

- Hair products for waving or straightening:

  (a) General use (≤ 8 %; pH 7 to 9.5)

  (b) Professional use (≤ 11 %; pH 7 to 9.5);

- Depilatories (≤ 5 %; pH 7 to 12.7); and
- Hair rinse-off products (≤ 2 %; pH 7 to 9.5).

The concentration specified is measured as mercaptoacetic acid. Labelling requirements are specified.

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):

T; R23/24/25 (acute toxicity)

C; R34 (corrosive)

Exposure Standards

Australian

The chemical has an exposure standard of 3.8 mg/m³ (1 ppm) time weighted average (TWA).

International

The following exposure standards have been identified for the chemical (Galleria Chemica):

TWA: 2.0–5 mg/m³ (1 ppm) in different countries such as USA (California, Hawaii, Tennessee), Canada (Alberta, Quebec), Norway and Switzerland.

STEL: 8–10 mg/m³ (2–3 ppm) in different countries such as Canada (Saskatchewan, Yukon), Poland, Sweden and USA (Washington).

Health Hazard Information

Wherever possible this assessment has used toxicity information on this specific chemical, mercaptoacetic acid. However, where data on the chemical are not available for a specific health endpoint, or where further weight of evidence is desirable, reliable data on the salts of this acid have been used. A number of salts of this chemical, the mercaptoacetates, have been assessed separately as a group. Any systemic toxic effects of these salts is expected to result from the presence of the mercaptoacetate anion (see corresponding report by NICNAS).

Toxicokinetics

No data are available on the systemic availability of the chemical (or its salts) through oral, dermal or inhalation routes. Physical chemistry parameters (small, ionisable and water-soluble molecules with a very low log K_{ow}), and results from toxicological studies suggest ready absorption from oral and inhalation routes (OECD, 2009). Cosmetic formulations containing the salts of this chemical have shown low dermal penetration (≤ 1 %) (OECD, 2009; REACH a).

Dermal absorption of ^{14}C-labelled ammonium mercaptoacetate (CAS No. 5421-46-5; 11 % solution) was tested in Sprague Dawley rats (skin exposed for 30 minutes, washed off and followed with a neutralisation step). Radiolabelled ^{14}C was detected in the wash solution at 96.1–96.8 %. Mean absorption was 0.24–0.27 % of the dose (Burnett et al., 2009; REACH b). A study on excised pig skin found that a 30 minute exposure to ammonium mercaptoacetate (13 % in a hair product formulation) resulted in dermal absorption of only 0.8 % (REACH b).

Dermal absorption of ^{35}S-labelled sodium mercaptoacetate (CAS No. 367-51-1) was tested in male rabbits. A 25 % solution (330 mg/kg bw) was applied to the skin. After one hour, 5–8 % of ^{35}S was detected in the urine. This increased to 30–40 % after five hours. At a higher dose (660 mg/kg bw), similar excretion as a percentage of dose was observed (Burnett et al., 2009; REACH a,b).

In a study investigating urinary excretion of ammonium mercaptoacetate (CAS No. 5421-46-5) in rabbits, 22.7 % and 23.5 % of oral doses 65 or 131 mg/kg bw, respectively had been excreted by 72 hours (REACH a). When ^{35}S-labelled sodium mercaptoacetate was administered by intraperitoneal injection to rats or rabbits in a number of studies at doses ranging from 70 to 200 mg/kg bw, 59–95 % of the chemical was excreted in the first 24 hours (REACH a,b).

Acute Toxicity

Oral

The chemical is classified as hazardous with the risk phrase ‘Toxic if swallowed’ (T; R25) in HSIS (Safe Work Australia). The data available support this classification.

The oral LD50 for the chemical is 73 mg/kg bw, based on a study which used similar methodology to OECD Test Guidelines (TG) 401 (REACH a). At doses of 40, 64, 80 and 200 mg/kg bw the mortalities were 0/10, 1/10, 8/10 and 10/10, respectively. Sublethal signs of toxicity included lethargy, piloerection, ptosis (drooping of the eyelid) and prostration (REACH a).

Dermal

The chemical is classified as hazardous with the risk phrase 'Toxic in contact with skin' (T; R24) in HSIS (Safe Work Australia). The data available from animal studies suggest that this hazard classification should be downgraded and amended to 'Harmful in contact with skin' (Xn; R21).

The dermal LD50 for the chemical was established as 848 mg/kg bw in rabbits in a test which used similar methodology to OECD TG 402 (OECD, 2009; REACH a). Clinical signs of toxicity included erythema and oedema at the site of application. Other non-guideline studies established LD50s of 926 and 1210 mg/kg bw, for mice and rats, respectively (REACH a).

Inhalation

The chemical is classified as hazardous with the risk phrase ‘Toxic by inhalation’ (T; R23) in HSIS (Safe Work Australia). The data available support this classification.

The LC50 for the chemical as a vapour was established as 1094 mg/m^3/4-h (1.09 mg/L/4-h) in female rats and 1981 mg/m^3/4-h (1.98 mg/L/4-h) in male rats, in a test conducted according to OECD TG 403 (OECD, 2009; REACH a). Clinical signs of toxicity included irregular and laboured breathing, irritation of the respiratory tract, ruffled coat, reduced mobility, leg tremors and paralysis.

Another inhalation toxicity study of seven hours in rats resulted in no mortalities at a concentration of 2.4 mg/L (600 ppm) (OECD, 2009; REACH a).

Corrosion / Irritation

Corrosivity

The chemical is classified as hazardous with the risk phrase ‘Causes burns' (C; R34) in HSIS (Safe Work Australia). The data available support this classification.

A study conducted according to Directive 2000/33/EC B.27 (EpiDerm Skin Model) found the chemical to be corrosive to EpiDerm tissues (mean viability score of 4.96 % at three minutes) (Burnett et al., 2009; OECD, 2009; REACH a). A second study conducted according to OECD TG 404 found necrosis of rabbit skin after only five minutes of exposure to the chemical (REACH a).

Corrosive chemicals are also considered to cause irreversible effects on the eyes. This is supported by the available eye irritation data for the chemical. A study in accordance with Directive 85/449/EEC B.5 reported that the chemical was corrosive to the eyes of six rabbits. A study with one rabbit (using similar methodology to OECD TG 405) reported that the chemical was corrosive. Even in a 10 % solution, the acid caused irreversible eye damage (at 96 hours based on conjunctival redness) in six rabbits with mean (24, 48 and 72 hour) eye irritation scores of 2.11, 1.0, 2.8 and 1.2 for corneal opacity, iritis, redness of the conjunctivae and chemosis, respectively (REACH a).

Irritation of the respiratory tract was observed in rats exposed to mercaptoacetic acid vapour (REACH a).

Sensitisation

Skin Sensitisation

Considering that mercaptoacetate salts are suspected skin sensitisers in humans and toxicity of the mercaptoacetate salts is attributed to the mercaptoacetate anion, a hazard classification for skin sensitisation is warranted for mercaptoacetic acid.

Because the chemical is corrosive to skin, no reliable sensitisation studies have been conducted with this chemical at non-neutralised pH values (OECD, 2009).

Mercaptoacetate salts are suspected skin sensitisers in humans (OECD, 2009; NICNAS; REACH b).

Repeated Dose Toxicity

Oral

No data are available for the chemical. Liver effects were reported at concentrations as low as 40 mg/kg bw/d for the sodium salt of mercaptoacetic acid (CAS No. 367-51-1). Based on 60 or 80 mg/kg bw/d lowest observed adverse effect level (LOAEL) for the sodium salt of mercaptoacetic acid, mercaptoacetic acid will have LOAELs of < 50 or < 70 mg/kg bw/d. Therefore, a hazard classification is warranted under the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) to indicate specific target organ toxicity from repeated oral exposure. However, according to the Approved Criteria for Classifying Hazardous Substances (Approved Criteria), a hazard classification is not warranted.

A 90-day oral gavage repeated dose toxicity study (OECD TG 408) exposed rats to sodium mercaptoacetate (CAS No. 367-51-1) daily (7 and 20 mg/kg bw/d, n = 10 animals of each sex/dose; 60 mg/kg bw/d, n = 16 animals of each sex). The no observed adverse effect level (NOAEL) was 20 mg/kg bw/d based on mortalities at 60 mg/kg bw/day (1/16 males died, 1/16 females had to be euthanised). The liver of each of these animals was discoloured. Other signs of toxicity at the highest dose included higher mean absolute and relative liver weights (accompanied by histopathological changes, particularly microscopic vacuolation in the area near the portal vein of the liver), microscopic vacuolation of the heart and kidneys, excessive salivation and piloerection (erection of the hair of the skin) (OECD, 2009; REACH a,b). In blood plasma, there were dose-related increases in the

concentration of fatty acids (36–178 % increase), urea (60–70 % increase) and lactate (80–107 % increase), and dose-related decreases in both glucose (17–32 % decrease) and β−hydroxybutyrate (78–80 % decrease). Changes were significant in blood plasma at 60 mg/kg bw/day in male rats and from 20 mg/kg bw/day in female rats. These observations of blood biochemistry, in conjunction with microscopic histopathological changes in the liver, are consistent with a mode of toxic action where β−oxidation of fatty acids is inhibited, leading to higher concentrations of triglycerides in the liver (REACH a,b).

In an oral gavage study, rats were dosed with sodium mercaptoacetate during the 10-week premating phase of a reproductive toxicity study. No effects were seen for male or female adult rats at doses of 10 and 20 mg/kg bw/d (n = 25 of each sex). The lowest observed effect level (LOEL) was 40 mg/kg bw/day based on microscopic observation of vacuolation in the liver in 2/25 males and 6/25 females. Observations of biochemistry showed significant decreases in urea in males and decreases in fatty acids in females at this dose. As the reproductive test continued, 4/6 (pregnant) females with the microvacuolation of the liver were found dead and 2/6 had to be euthanised (REACH a,b).

In a similar oral gavage test (premating phase of a reproductive toxicity test) rats were administered doses of 20, 40 and 80 mg/kg bw/d (14 animals/sex/dose). A NOAEL of 40 mg/kg bw/d and a LOAEL of 80 mg/kg bw/d were established based on mortalities at 80 mg/kg bw/day (1/14 female, 2/14 male) in this 10-week period (OECD, 2009; REACH a,b).

Dermal

No data are available for the chemical. Based on the data available for the sodium salt of mercaptoacetic acid (CAS No. 36751-1, NOAEL > 180 mg/kg bw/d), the chemical is not considered to cause serious damage to health from repeated dermal exposure.

In 13-week studies (similar to OECD TG 411), sodium mercaptoacetate was applied to the skin of rats (Fischer) and mice (B6C3F1) (five days/week, five dose levels, 10 animals/sex/dose). NOAELs for systemic toxicity were established as > 180 mg/kg bw/d and > 360 mg/kg bw/d for rats and mice, respectively, which was the highest dose tested in each case. No mortalities occurred. The studies resulted in either no weight or histopathological changes in major organs (rats), or these changes were only observed in a few animals at the highest dose (mice). However, local effects were observed at the site of application. Skin irritation was noted for all rats at all treatment levels, including the lowest dose of 11.25 mg/kg bw/d. Skin thickening and ulceration were also observed, but were only prevalent at higher doses. In mice, microscopic changes at the treatment site resulted in hyperplasia at concentrations ≥ 45 mg/kg bw/d (OECD, 2009; REACH a,b).

Inhalation

No data are available for the chemical or its salts.

Genotoxicity

Based on the data available from well-conducted in vitro and in vivo genotoxicity studies with mercaptoacetic acid, and some of its salts (ammonium mercaptoacetate CAS No. 5421-46-5; and sodium mercaptoacetate, CAS No. 367-51-1), the chemical is not considered genotoxic.

Negative results were reported for the chemical in an in vitro mammalian chromosome aberration test (OECD TG 473) with human lymphocytes. Some positive cytotoxic results were observed in this test, without a dose-response relationship. Additionally, negative results were reported for an in vivo chromosome aberration study up to and including 1000 mg/kg bw/d in male mice and 500 mg/kg bw/d in female mice (micronucleus assay on mouse bone marrow; OECD TG 474) (OECD, 2009; REACH a).

Negative results were reported for the ammonium salt of mercaptoacetic acid (CAS No. 5421-46-5) in a number of in vitro tests (bacterial reverse mutation assay—Ames test; and mammalian cell gene mutation assay with mouse lymphoma cells) (OECD, 2009; REACH b).

Negative results were also reported for the sodium salt of mercaptoacetic acid (CAS No. 367-51-1), in an in vitro test (bacterial reverse mutation assay—Ames test) and in some in vivo tests (micronucleus assay on mouse bone marrow (OECD TG 474); and sex-linked recessive lethal mutation test with *Drosophila melanogaster*) (OECD, 2009; REACH a,b).

Carcinogenicity

No data are available for the chemical.

Limited data are available for the sodium salt of mercaptoacetic acid (CAS No. 367-51-1). Sodium mercaptoacetate was not carcinogenic in mice when their skin was treated with 1 % or 2 % solutions in acetone twice weekly from seven weeks until death. Average lifespan and the incidence of tumours was similar for control and treated groups (50 mice/sex/dose) (OECD, 2009; REACH a,b).

Reproductive and Developmental Toxicity

No data are available for the chemical. Based on the data available for the sodium salt of mercaptoacetic acid (CAS No. 367-51-1) and the ammonium salt of mercaptoacetic acid (CAS No. 5421-46-5), the chemical is not considered to cause reproductive or developmental toxicity.

In a two-generation reproductive study (OECD TG 416) in rats using the sodium salt of mercaptoacetic acid, the no observed effect level (NOEL) for F0 parental toxicity was 20 mg/kg bw/d, based on microscopic vacuolation of the liver in the region of the portal vein in 2/25 male and 6/25 female rats at the highest dose of 40 mg/kg bw/d. Four of these females died. Fatty acid concentrations in the blood were also significantly lower in females in this highest dose group (40 mg/kg bw/d). It is stated that 'sodium thioglycolate is known to induce fatty liver via an inhibition of the β-oxidation of fatty acids' (REACH a,b). The NOELs for fertility and gestation were 20 mg/kg bw/d in females. The NOELs for male fertility and mating were ≥ 40 mg/kg bw/d (no effects were observed at the highest dose). The NOEL for developmental toxicity was 20 mg/kg bw/d. At the higher dose, the pregnant female rats did not nest or nurse properly, which may have caused pups to die (REACH a,b).

In another reproductive study in rats using sodium mercaptoacetate (OECD TG 421: single generation), the NOEL for parental toxicity (F0) was 20 mg/kg bw/d based on deaths of pregnant rats in the gestation phase (due to late delivery) at 40 mg/kg bw/d and above. At the highest dose of 80 mg/kg bw/d, 2/12 males died during the prebreeding phase; and 7/12 females died or had to be sacrificed early in prebreeding, late gestation and early lactation stages. The NOEL for male reproductive toxicity (F0) was = 80 mg/kg bw/d (no effects were observed even at the highest dose). The NOEL for pups (F1 generation) was 40 mg/kg bw/d, based on the death of an entire litter of pups at 80 mg/kg bw/d, which may or may not have been related to adverse maternal effects (REACH a,b).

In a developmental toxicity study (OECD TG 414), the ammonium salt of mercaptoacetic acid was administered to pregnant rats at concentrations of 3, 15 and 75 mg/kg bw/d (gestation days 6–15). The NOAEL for maternal toxicity was 15 mg/kg bw/d based on two mortalities on gestation day 20 at the highest dose. The NOAEL for developmental toxicity was 75 mg/kg bw/d based on no teratogenic effects in pups, even at maternotoxic doses (OECD, 2009; REACH a,b).

Risk Characterisation

Critical Health Effects

The critical health effects for risk characterisation of the chemical include acute toxicity through oral and inhalation exposure, corrosivity and skin sensitisation. The chemical may also cause damage to the liver following repeated oral exposure.

Public Risk Characterisation

Although the use of the chemical in cosmetic/domestic products in Australia is not known, it is reported to be used in cosmetic/domestic products overseas at concentrations up to 11 %. Canada, New Zealand and the European Union have restricted the use concentration of this chemical in various cosmetic product types.

Currently, there are no restrictions on using this chemical in Australia. Considering the range of cosmetic products that may contain the chemical, the main route of public exposure is expected to be through the skin. In the absence of any regulatory

controls, the characterised critical health effects have the potential to pose an unreasonable risk under the uses identified. The risks could be mitigated by implementing concentration limits and restricting uses to limit exposure.

Occupational Risk Characterisation

During product formulation, dermal, ocular and inhalation 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 cleaning and maintenance of equipment. 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 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 the HSIS (refer to the **Recommendation** section).

NICNAS Recommendation

Further risk management is required. Sufficient information is available to recommend that risks to public health and safety from the potential use of the chemical in cosmetic products be managed through scheduling, and risks for workplace health and safety be managed through changes to classification and labelling.

Assessment of the chemical is considered to be sufficient provided that risk management recommendations are implemented and all requirements are met under workplace health and safety and poisons legislation as adopted by the relevant state or territory.

Regulatory Control

Public Health

Given the risk characterisation, it is recommended that the concentration of the chemical in cosmetic products be restricted by appropriate scheduling to mitigate risks. Maximum concentrations allowed in the EU are provided under the **Restrictions** section.

Matters to be taken into consideration include acute toxicity, corrosivity, skin sensitisation (at non-corrosive concentrations) and harmful effects from repeated oral exposure. Exemptions to scheduling may be applicable at low concentrations.

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	Toxic if swallowed (T; R25)* Harmful in contact with skin (Xn; R21) Toxic by inhalation (T; R23)*	Toxic if swallowed - Cat. 3 (H301) Harmful in contact with skin - Cat. 4 (H312) Fatal if inhaled - Cat. 2 (H330)

Hazard	Approved Criteria (HSIS)[a]	GHS Classification (HCIS)[b]
Irritation / Corrosivity	Causes burns (C; R34)*	Causes severe skin burns and eye damage - Cat. 1 (H314)
Sensitisation	May cause sensitisation by skin contact (Xi; R43)	May cause an allergic skin reaction - Cat. 1 (H317)
Repeat Dose Toxicity		May cause damage to organs through prolonged or repeated exposure - Cat. 2 (H373)

[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;
- health monitoring for any worker who is at risk of exposure to the chemical if valid techniques are available to monitor the effect on the worker's health;
- 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.

References

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Last update 28 June 2013

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