1,4-Benzenediol: Human health tier II assessment

04 July 2014

CAS Number: 123-31-9

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.

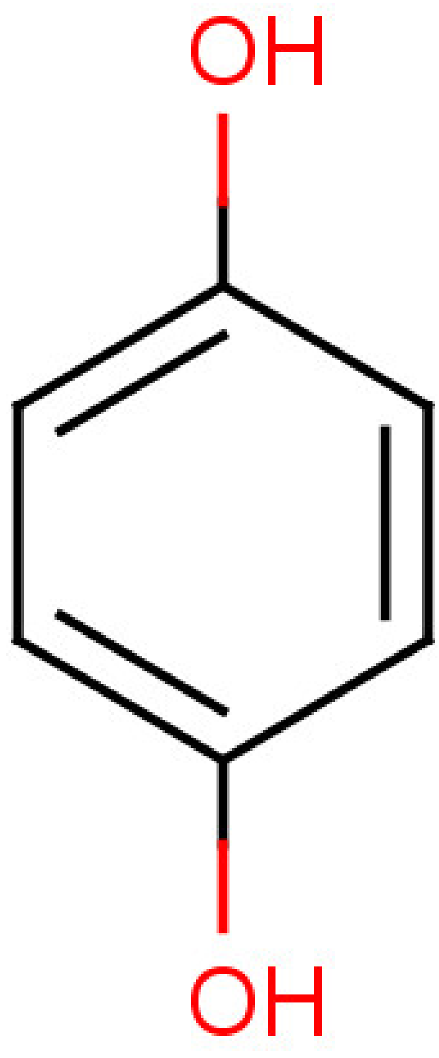
This chemical or group of chemicals are being assessed at Tier II because the Tier I assessment indicated that it needed further investigation.

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

Disclaimer

Acronyms & Abbreviations

Chemical Identity

Synonyms	1,4-dihydroxybenzene hydroquinone p-dihydroxybenzene
Structural Formula	
Molecular Formula	C6H6O2
Molecular Weight (g/mol)	110.11
Appearance and Odour (where available)	Colourless, light tan, light grey or white crystalline solid that can be found as needles, prisms and monoclinic prisms, with no odour.
SMILES	c1(O)ccc(O)cc1

Import, Manufacture and Use

Australian

The chemical is on the 'List of chemicals used as dyes in permanent and semi-permanent hair dyes in Australia' (NICNAS, 2007).

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

The chemical has reported cosmetic use including as a component of permanent hair dye preparations.

The chemical has reported commercial uses including:

- as a component of photochemical reagents; and
- in photographic processing.

The chemical has reported site-limited uses including:

- in resin and polymer manufacturing;
- as a stabiliser for resins in the fibreglass industry;
- in adhesive manufacturing; and
- as a laboratory reagent.

The total volume introduced into Australia was reported to be between 100 and 1000 tonnes.

The chemical has reported non-industrial use including:

- as a depigmenting agent in topical therapeutic products.

International

The following international uses have been identified through European Union Registration, Evaluation and Authorisation of Chemicals (EU REACH) dossiers; the Organisation for Economic Cooperation and Development Screening information data set International Assessment Report (OECD SIAR); 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 Household Products Database and US Department of Health and Human Services (HSDB).

The chemical has reported cosmetic uses including as a:

- depigmenting agent in cosmetic products;
- coupler in oxidative hair dye products;
- stabiliser or inhibitor in the liquid component of artificial nail systems; and
- fragrance ingredient.

The chemical has reported domestic use including as a component in adhesives (e.g. super glue).

The chemical has reported commercial uses including as:

- a reducing agent in photographic developers for black and white film;
- a stabiliser in paints, varnishes, motor fuels & oils;
- an antioxidant and antiozonant in rubber manufacturing; and
- a corrosion inhibitor in water cooling towers.

The chemical has reported site-limited uses including as a:

- chemical intermediate for producing performance polymers; and
- polymerisation inhibitor in polyester and methacrylate resin monomers.

The following non-industrial uses have been identified internationally:

- as an antibiotic in feeds;
- as an intermediate in manufacturing agrochemicals; and

- as a depigmenting agent in topical therapeutic products.

Restrictions

Australian

The chemical is listed in the *Poisons Standard* (the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP)) in Schedules 2, 4 and 6.

- Schedule 2:

'HYDROQUINONE (excluding monobenzone and other alkyl ethers of hydroquinone included in Schedule 4) in preparations for human external therapeutic or cosmetic use containing 2 per cent or less of hydroquinone, except in hair preparations containing 0.3 per cent or less of hydroquinone' (SUSMP, 2013).

Schedule 2 chemicals are pharmacy medicines, 'which may require advice from a pharmacist and which should be available from a pharmacy or a licensed person' (SUSMP, 2013).

- Schedule 4:

'HYDROQUINONE (other than its alkyl ethers separately specified in this Schedule) in preparations for human therapeutic or cosmetic use except:

(a) when included in Schedule 2; or

(b) in hair preparations containing 0.3 per cent or less of hydroquinone' (SUSMP, 2013).

Schedule 4 chemicals are prescription only medicines or a prescription animal remedy.

- Schedule 6:

'HYDROQUINONE except:

(a) when included in Schedule 2 or 4; or

(b) in preparations containing 10 per cent or less of hydroquinone' (SUSMP, 2013).

Schedule 6 chemicals are labelled with 'Poison'. These are 'substances with a moderate potential for causing harm, the extent of which can be reduced by using distinctive packaging with strong warnings and safety directions on the label' (SUSMP, 2013).

The cumulative effect of these schedule restrictions for industrial use is that hydroquinone used in cosmetic products, except in hair preparations containing 0.3 % or less of hydroquinone, is not allowed. In non-cosmetic domestic products, a labelling requirement with the single word 'Poison' applies at greater than 10 % hydroquinone.

International

The chemical is listed on the following (Galleria Chemica):

- EU Cosmetics Regulation 1223/2009 Annex III—List of substances which cosmetic products must not contain except subject to the restrictions laid down; The maximum authorised concentration in the finished cosmetic product allowed is 0.02 % after mixing for use in artificial nail systems.
- New Zealand Cosmetic Products Group Standard—Schedule 5—Table 1: Components cosmetic products must not contain except subject to the restrictions and conditions laid down; The maximum authorised concentration in the finished cosmetic product allowed is 0.02 % after mixing for use in artificial nail systems.
- Health Canada List of prohibited and restricted cosmetic ingredients (The Cosmetic Ingredient "Hotlist"). Permitted at concentrations equal to or less than 0.3 % as an oxidising colouring agent for hair dyes. Permitted at concentrations equal to or less than 0.1 % in cyanoacrylate adhesive products.

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):

R40 Carc. Cat 3 (carcinogenicity)

R68 Mut. Cat 3 (mutagenicity)

Xn; R22 (acute toxicity)

Xi; R41 (eye irritation)

Xi; R43 (sensitisation)

Exposure Standards

Australian

The chemical has an exposure standard of 2 mg/m³ time weighted average (TWA).

International

The following exposure standards are identified (Galleria Chemica).

An exposure limit of 2 mg/m³ TWA and/or 4 mg/m³ short-term exposure limit (STEL) in different countries such as the USA (Washington, Hawaii), Canada (Saskatchewan), Greece and South Africa.

An exposure limit of 0.5 mg/m³ TWA in different countries such as Estonia, Iceland, Ireland, Norway, and Sweden.

Health Hazard Information

Toxicokinetics

The chemical is rapidly absorbed, distributed, metabolised and excreted (EHC, 1994; OECD, 2002). Absorption occurs via the gastrointestinal tract, lungs, and skin of animals, but the dermal absorption is slow. The chemical, administered orally, was distributed to many animal tissues, mainly the kidneys and the liver (Government of Canada, 2008).

The main metabolites are hydroquinone monoglucuronide and hydroquinone monosulfate conjugates, and, to a lesser extent glutathione conjugates. Excretion of the chemical is rapid and mainly in the form of metabolites (90 %) via the urine (EHC, 1994).

Acute Toxicity

Oral

The chemical is classified as hazardous with the risk phrase 'Harmful if swallowed' (Xn; R22) in HSIS (Safe Work Australia). The data available support this classification.

The median lethal dose (LD50) in Sprague Dawley (SD) rats is 367 mg/kg bw in females and >375 mg/kg bw in males (OECD test guideline (TG) 401). Reported signs of toxicity include minor tremors or convulsions immediately after dosing (REACH).

In another acute oral toxicity study, male Wistar rats administered the chemical via oral gavage displayed mortality rates of 0 % and 100 % at doses of 300 and 600 mg/kg bw, respectively. At 300 mg/kg bw, convulsions appeared within 15 minutes, whereas at 600 mg/kg bw, convulsions appeared within five minutes, and death occurred within 19–28 mins after dosing (REACH).

A range of oral LD50 values from 298 mg/kg bw to 680 mg/kg bw, in rats and mice of various strains, has been reported (OECD, 2002).

Dermal

The chemical has low acute dermal toxicity.

The LD50 in rats was >2000 mg/kg bw. In an acute dermal toxicity study (OECD TG 402), New Zealand White rabbits (n = 5/sex) were administered the chemical using an occlusive patch (at 2000 mg/kg bw dose) and observed for 14 days. No deaths, abnormal clinical signs or necropsy finding were reported (REACH).

Inhalation

No data are available.

Observation in humans

In a controlled human volunteer study, daily ingestion of 300–500 mg of the chemical for three to five months did not produce any observable pathological changes in the blood or urine. In cases of poisoning from oral ingestion, dark urine, vomiting, abdominal pain, tachycardia, tremors, convulsions, coma and death were reported in humans (IPCS,1996).

Negligible effects in male volunteers were observed after dermal application of the chemical at less than 3 % concentration. However, there have been case reports of leukoderma (localised loss of pigmentation of the skin) and ochronosis (bluish black discolouration of tissues) from using skin lightening creams containing 2 % of the chemical, and irritation (erythema or staining) from using an aqueous solution containing 1 % or creams containing 5 % of the chemical. Allergic contact dermatitis has been diagnosed due to the chemical (IPCS, 1996).

Corrosion / Irritation

Skin Irritation

The chemical is not considered to be a skin irritant.

There are no skin irritation studies available for the chemical. However, it produced no skin irritation in animals during acute dermal toxicity testing. In acute dermal toxicity studies, no local skin effects were observed in CD rats exposed to the chemical (via an open collar) at doses of 125 or 875 mg/kg bw for 24 hours, or New Zealand White rabbits exposed to the chemical at 2000 mg/kg bw (REACH).

Eye Irritation

The chemical is classified as hazardous with the risk phrase 'Risk of serious damage to eyes' (Xi; R41) in HSIS (Safe Work Australia). The available data support this classification.

There are no eye irritation studies available for the chemical. However, there were a few repeated dose studies that administered the chemical in the eyes of dogs and guinea pigs over nine weeks, and rabbits over four months. These studies indicated severe eye effects including irritation (all species) and opacity of the cornea (dogs and guinea pigs), which resolved within two and three days after exposure, respectively. Additionally, corneal ulceration was observed in guinea pigs, which resolved within three days after exposure (ECH, 1994). However, a single injection (0.1 mL) of a solution of the chemical (0.012–0.05 mol/L) into the cornea of rabbits (strain not specified) resulted in an irritation score of 5/100 (ECH, 1994).

Sensitisation

Skin Sensitisation

The chemical is classified as hazardous with the risk phrase ‘May cause sensitisation by skin contact’ (R43) in HSIS (Safe Work Australia). The positive results reported in a guinea pig maximisation test and a mouse local lymph node assay (LLNA) support this classification.

In a guinea pig maximisation test (n = 10/sex), animals were induced with the chemical at 2 % using an intradermal injection (REACH). After seven days, animals were induced again using an epicutaneous patch containing the chemical at 10 % over the injected sites, for 48 hours. After an interval of 14 days, the animals were challenged with an epicutaneous, occlusive patch containing the chemical at 5 % for 24 hours. A high sensitisation rate of 70 % was reported (REACH).

In a mouse LLNA (comparable to OECD TG 429), CBA mice (four females/dose) were administered the chemical at 0.05, 0.1, 0.25, 0.5, 1.0, 2.5, 5.0 and 10 % using different vehicles (no control identified). The vehicles used were acetone/olive oil (4:1), methylethylketone, dimethyl formamide, propylene glycol, dimethyl sulfoxide, and acetone/physiological saline (1:1). Sensitising potential was reported to be dependent on the vehicle used. The effective concentration needed to produce a three-fold increase in lymphocyte proliferation (EC3) was calculated to range from 0.08 % to up to 1–2 %. The chemical produced a stronger sensitisation reaction when dissolved in acetone (EC3 = 0.08 %), compared with propylene glycol (EC3 = 1–2 %) (CIR, 2014; REACH).

Repeated Dose Toxicity

Oral

Based on the available data, the chemical is not considered to cause serious damage to health from repeated oral exposure. The kidney effects in rats are not considered to be sufficiently irreversible at 100 mg/kg bw/d to consider classifying the chemical using the Globally Harmonized System of Classification (GHS) criteria.

In a 13-week study, B6C3F1 mice and Fischer 344 (F344) rats (10 animals/sex/dose) were administered the chemical via oral gavage doses of 0, 25, 50, 100, 200 or 400 mg/kg bw/d for five days per week. A no observed adverse effect level (NOAEL) of 50 mg/kg bw/d was reported in mice and rats. The effects observed at 100 mg/kg bw/d and above included lethargy and toxic nephropathy in the renal cortex in rats, and increased liver weights and lethargy in mice. In the highest dose group, observations in mice and rats included tremors followed by convulsions. At this dose, 8/10 mice and 10/10 rats died within the first seven weeks (REACH).

In reference to the 13-week rat study, the OECD (2002) report states that, 'Toxic nephropathy was observed in 7/10 male and 6/10 female rats at 200 mg/kg and 1/10 females at 100 mg/kg. The severity ranged from moderate to marked in males and was less severe in females. Tubular cell degeneration and regeneration in the cortex was evident'.

Dermal

Based on the available data, the chemical is not considered to cause serious damage to health from repeated dermal exposure.

The no observed effect levels (NOELs) from two 14-day studies using F344 rats and B6C3F1 mice were 1920 and 4800 mg/kg bw/d, respectively. The NOAEL from a 13-week study in F344 rats was 73.9 mg/kg bw/d in males and 109.6 mg/kg bw/d in females. There were no toxicity effects in rats or mice (OECD, 2002; Government of Canada, 2008). As no further details are available, it implies that these were the highest doses tested in these studies.

In a study in black guinea pigs (n = 5/sex), the chemical was administered topically (0.1 mL in an ointment) at concentrations of 0.1, 1.0 and 5.0 % on an epilated area of the back, five days/week for 13 weeks. The 0.1 % dose caused marginal irritation without depigmentation, while the 1.0 % dose resulted in a slight to marginal irritation in 30 % of the animals (mainly females) and to weak depigmentation in females. At the highest concentration, moderate to severe ulcerative inflammatory responses occurred (IPCS, 1994). No systemic toxicity effects were reported.

Inhalation

No data are available.

Genotoxicity

The chemical is classified as hazardous (a Category 3 mutagenic substance) with the risk phrase 'Possible risk of irreversible effect' (R68) in HSIS (Safe Work Australia). The available data support this classification. The negative results observed for mutagenicity in the in vivo dominant lethal assay in SD rats, confirm that the Category 3 hazard classification for the chemical is appropriate.

Negative results were reported for one in vitro point mutation assay (Ames test) in *Salmonella typhimurium* strains TA97, 98, 100, 1535, 1537 and 1538, with or without metabolic activation. Positive results were observed in several other in vitro assays with the chemical (OECD, 2002; Government of Canada, 2008):

- gene mutation in human lymphocytes and Chinese hamster lung cells;
- chromosome aberration in Chinese hamster ovary cells;
- sister chromatid exchange in V79 Chinese hamster cells and human lymphocytes; and
- DNA damage in HeLa cells.

Although the in vivo assays with the chemical for gene mutation and clastogenicity in somatic cells produced positive results (chromosome aberrations and c-mitotic effects in mouse bone marrow cells following intraperitoneal injection), negative results were reported for the in vivo germ cell mutagenicity assay (dominant lethal mutation assay in male SD rats received the chemical via gavage dosing) (OECD, 2002; Government of Canada, 2008).

Carcinogenicity

The chemical is classified as hazardous (a Category 3 carcinogenic substance) with the risk phrase 'Limited evidence of carcinogenic effect' (Xn; R40 in HSIS (Safe Work Australia). The available data support this classification.

In a carcinogenicity study, F344 rats (n = 55/sex/dose) were administered the chemical via oral gavage doses of 0, 25 or 50 mg/kg bw/d for five days/week for 103 weeks (IARC, 1999). Survival was reduced in exposed animals. Exposed males had lower mean body weights and, for the high-dose males, higher relative kidney weights were observed compared with controls. Exposed males developed renal tubule cell adenomas (4/55 in the low dose group and 8/55 in the high dose group) compared with controls (0/55) (IARC, 1999).

In another study, F344 rats (n = 30/sex/dose) were administered the chemical at 0 or 0.8 % for 104 weeks. Body weight gain was decreased in exposed animals. Exposed male rats had 100 % incidence of renal tubule hyperplasia and 14/30 had renal tubule cell adenomas compared with 1/30 and 0/30, respectively in unexposed control groups (IARC, 1999).

Mice (B6C3F1; n = 55/sex/dose) were administered the chemical via oral gavage doses of 0, 50 or 100 mg/kg bw for five days/week for 103 weeks (IARC, 1999). Exposed males and high dose females had increased relative liver weights and the high-dose mice had lower mean body weights compared with controls. Exposed females developed hepatocellular adenomas (15/55 in the low dose group and 12/55 in the high dose group) compared with 2/55 in controls (IARC, 1999).

In another study, B6C3F1 mice (n = 30/sex/dose) were administered the chemical at 0 or 0.8 % for 96 weeks. Body weight gain was decreased in exposed female animals. Exposed male rats had an increased incidence (14/30) of hepatocellular adenoma compared with 6/28 in the control group (IARC, 1999).

In a cohort of 879 workers in a plant where the chemical was manufactured and used, with defined and lengthy exposure, low cancer rates were observed compared with two other comparison populations. In another cohort of 837 lithographic workers, five cases of malignant melanoma were recorded, although only two of the cases had reported exposure to the chemical (IARC, 1999).

According to the IARC monograph (1999), there is inadequate evidence in humans for the carcinogenicity of the chemical. However, there is limited evidence in laboratory animals. The IARC conclusion was that the chemical 'is not classifiable as to its carcinogenicity to humans (Group 3)'.

Reproductive and Developmental Toxicity

The chemical is not considered to have reproductive or developmental toxicity.

In a two-generation reproductive toxicity study (OECD TG 416), male and female SD rats received the chemical orally by gavage at doses of 15, 50 or 150 mg/kg bw/d (no details on the timing of exposure). Tremors were observed at the highest dose in several parent rats of both sexes. A single parent male developed tumours at 50 mg/kg/day. A parental NOEL of 15 mg/kg bw/day and a F1 generation reproductive NOEL of 150 mg/kg bw/day were reported (OECD, 2002; Government of Canada, 2008). No adverse effects were observed on survival, reproductive parameters, pup weight, gross lesions or histopathology (IARC, 1999).

In a developmental toxicity study, COBS-CD-BR rats were administered the chemical via oral gavage doses of 30, 100 or 300 mg/kg bw/day on gestation days (GD) 6–15. There were no observations of malformation, gross variations or skeletal variations (except an increase in the incidence of total common vertebral variations at 300 mg/kg bw/day). At the highest dose, slight reductions of mean foetal body weight and maternal body weight gain were reported (IARC, 1999).

In another study (OECD TG 414), New Zealand White female rabbits were administered the chemical by oral gavage with doses 25–150 mg/kg bw/day on GD 6–18. Maternal microphthalmia (small eyes) and decreased maternal weight gain were observed at the highest dose (IARC, 1999). The maternal NOEL was reported to be 25 mg/kg bw/d and the NOEL for offspring was 75 mg/kg bw/d (OECD, 2002).

Other Health Effects

Neurotoxicity

At high acute oral exposure to the chemical (dose not available) non-specific effects on the nervous system of animals were observed. Neurotoxic effects observed included hyperexcitability, hyperactive reflexes, sensitivity to light and sound, tremor and convulsions in various animal species (EHC 157, 1994).

Risk Characterisation

Critical Health Effects

The critical health effects for risk characterisation include:

- local effects (skin sensitisation and serious eye damage);
- systemic acute effects (acute toxicity by the oral route of exposure); and
- systemic long-term effects (carcinogenicity, mutagenicity).

Out of these critical health effects, skin sensitisation is more important for risk characterisation as it can occur even at low concentrations of short-term exposure.

Public Risk Characterisation

The chemical is used in permanent hair dye preparations in Australia with a concentration up to a maximum of 0.3 %. There are both Australian and international uses which indicate the chemical to be used in skin depigmenting creams. However, use in depigmenting creams in Australia is only allowed for therapeutic purposes under the current schedule restrictions. Other international uses indicate the chemical is also used in fragrances and artifical nails.

The chemical is considered safe at concentrations of ≤1 % in aqueous cosmetic formulations designed for discontinuous and brief use with rinsing from the skin and hair after use (CIR, 2014). At low concentrations, it is expected to be used in hair preparations and, considering the specific uses (e.g. for discontinuous and brief use with rinsing), eye irritation effects are not expected. However, skin sensitisation could be expected even at low concentrations, depending on the product formulation type (see mouse LLNA results under **Skin sensitisation**). No information about the prevalence of hydroquinone sensitisation in Australia was found.

The chemical could also have specific domestic uses such as for photographic processing by photo hobbyists and as a component in adhesives, with potential risks associated through dermal exposure. The concentration of the chemical in these products is unknown, but these are uses of the chemical where dermal exposure would be restricted to only occasional splashes and spills.

The existing scheduling requirements are considered adequate to mitigate any risks to public health from the industrial uses identified.

Occupational Risk Characterisation

During product formulation, dermal and ocular exposure of workers to the chemical could occur, particularly where manual or open processes are used. Worker exposure to the chemical at lower concentrations could also occur while formulating products containing the chemical. The level and route of exposure will vary depending on the work practices employed.

Given the critical health effects including carcinogenicity, mutagenicity, skin sensitisation and serious eye damage, the chemical might pose an unreasonable risk to workers unless adequate control measures to minimise dermal and ocular 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.

Based on the available data, the hazard classification in HSIS is considered appropriate.

NICNAS Recommendation

Current risk management measures are considered adequate to protect public and workers' health and safety, provided that all requirements are met under workplace health and safety and poisons legislation as adopted by the relevant state or territory. No further assessment is required.

Regulatory Control

Public Health

Products containing the chemical should be labelled in accordance with state and territory legislation (SUSMP, 2013).

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 if swallowed (Xn; R22)*	Harmful if swallowed - Cat. 4 (H302)
Irritation / Corrosivity	Risk of serious eye damage (Xi; R41)*	Causes serious eye damage - Cat. 1 (H318)
Sensitisation	May cause sensitisation by skin contact (Xi; R43)*	May cause an allergic skin reaction - Cat. 1 (H317)

Hazard	Approved Criteria (HSIS)[a]	GHS Classification (HCIS)[b]
Genotoxicity	Muta. Cat 3 - Possible risk of irreversible effects (Xn; R68)*	Suspected of causing genetic defects - Cat. 2 (H341)
Carcinogenicity	Carc. Cat 3 - Limited evidence of a carcinogenic effect (Xn; R40)*	Suspected of causing cancer - Cat. 2 (H351)

[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 instruction on the label.

Advice for industry

Control measures

Control measures to minimise the risk from oral, dermal and ocular 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 can minimise the risk include, but are not limited to:

- using closed systems or isolating operations;
- 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 04 July 2014

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