Hydrochloric acid: Human health tier II assessment

04 July 2014

CAS Number: 7647-01-0

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	muriatic acid hydrogen chloride aqueous hydrogen chloride chlorohydric acid
Structural Formula	
Molecular Formula	ClH
Molecular Weight (g/mol)	36.46
Appearance and Odour (where available)	Clear, colourless liquid
SMILES	Cl

Import, Manufacture and Use

Australian

The chemical is listed on the 2006 High Volume Industrial Chemicals List (HVICL) with a total reported volume of 10000–99999 tonnes.

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

The chemical has reported cosmetic use:

- as a buffering agent/pH adjuster.

The chemical has reported domestic use including:

- in cleaning/washing agents.

The chemical has reported commercial or site-limited use including:

- as a pH regulating agent;
- in water treatment (e.g. flocculant and precipitant);
- as a metal treating agent;
- in scale/dust removers;
- in electroplating;
- in photographic development;
- as an odour agent;
- in manufacturing domestic/cleaning products;
- in sugar refining;
- in rubber industries;
- in leather tanning;
- as a laboratory reagent;
- in mining and metal extraction industry; and
- in manufacturing other chemicals and dyes.

The following non-industrial uses have been identified in Australia:

- as a bactericide, fungicide and virucide (for disinfection); and
- as an additive and a starch modifier in food processing.

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 eChemPortal: OECD High Production Volume chemical program (OECD HPV), the US Environmental Protection Agency's 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 buffering agent/pH adjuster.

The chemical has reported domestic use including in:

- cleaning/washing agents; and
- disinfectants.

The chemical has reported commercial or site-limited use including:

- as a pH regulating agent;
- in water treatment (e.g. flocculant and backwashing filter beds);
- as a precipitant;
- in regenerating ion-exchange resins;
- as a descaling agent/rust removal;
- as an odour agent;
- in coal seam gas extraction;
- in manufacturing textiles, leather and fur; and
- in producing chemicals and articles.

Restrictions

Australian

This chemical is listed in the Poisons Standard (Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP)) in Schedules 5 and 6.

- Schedule 6:

'HYDROCHLORIC ACID (excluding its salts and derivatives) **except**:

(a) when included in Schedule 5;

(b) in preparations for therapeutic use; or

(c) in preparations containing 0.5 per cent or less of hydrochloric acid (HCl)'.

Schedule 6 chemicals are labelled with 'Poison'. 'Substances with a moderate potential for causing harm, the extent of which can be reduced through the use of distinctive packaging with strong warnings and safety directions on the label'.

- Schedule 5:

'HYDROCHLORIC ACID (excluding its salts and derivatives) in preparations containing 10 per cent or less of hydrochloric acid (HCl) **except**:

(a) in preparations containing 0.5 per cent or less of hydrochloric acid (HCl); or

(b) for therapeutic use'.

Schedule 5 chemicals are labelled with 'Caution'. 'Substances with a low potential for causing harm, the extent of which can be reduced through the use of appropriate packaging with simple warnings and safety directions on the label'.

International

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

- China (Hong Kong) Pharmacy and Poisons Regulations—Special exemptions: Exempted substance or article—substances containing less than 9 %, w/w of hydrochloric acid (HCl).

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).

There are two entries in the HSIS relevant for the chemical.

Hydrogen chloride (CAS No. 7647-01-0):

T; R23 (acute toxicity)

C; R35 (corrosive)

Hydrochloric acid % (aqueous form):

C; R34 (corrosive) (cut offs to R 36/37/38 are non-standard)

Xi; R37 (irritant)

Exposure Standards

Australian

The chemical has an exposure standard (peak limitation) of 7.5 mg/m^3 (5 ppm) time weighted average (TWA).

International

The following exposure standards are identified (Galleria Chemica).

TWA:

- 7–8 mg/m^3 (5 ppm) in different countries such as Austria, Belgium, Canada (Yukon), Denmark, Europe (EU), Hungary, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Sweden and Turkey.

STEL (short-term exposure limits):

- 15 mg/m^3 (10 ppm) in Austria, Belgium, EU and Hungary.
- 7.6–8 mg/m^3 (5 ppm) in Finland, Iceland and the United Kingdom (UK).

Health Hazard Information

Hydrogen chloride is highly acidic and concentrated aqueous solutions may have pH <0.14. It is a direct-acting corrosive and adverse effects are caused at the site of contact due to the very low pH rather than the effects of the chloride ion. As hydrogen ions and chloride ions are normal constituents in the body fluid of animals, low concentrations of hydrogen chloride gas/mist or solution do not seem to cause adverse effects in animals. As the constituent ions of hydrochloric acid are ubiquitous in the human body, systemic effects are not expected. There are sufficient data on long-term effects of hydrochloric acid exposure in animals and humans to confirm that adverse effects are not expected.

Toxicokinetics

The adult human secretes hydrochloric acid into the stomach at a concentration of 0.05–0.10 N and uptake is buffered by the simultaneous endogenous production of bicarbonate (OECD, 2005).

Following absorption, hydrogen chloride will be rapidly dissociated and the chloride ions enter the body's electrolyte pool. The hydrogen ions react with various buffering components to form water. Apart from this, the constituents are not metabolised. The body pool of chloride anions is large and is regulated by well-known human physiological processes. Inhaled hydrogen chloride gas or mist is partially neutralised by naturally occurring ammonia gas in the respiratory system, before it reaches the lower respiratory tract (OECD, 2005).

Following intravenous infusion of 0.15 M hydrochloric acid into rats (50 mL/kg bw/h) and dogs (20 mL/kg bw/h), urinary excretion of the chloride ion was increased in both species (OECD, 2005). With regard to hydrogen ions, changes in the pH of the body fluids are buffered and regulated within a narrow range to maintain homeostasis, which ultimately depends on respiratory excretion of carbon dioxide and bicarbonate regeneration through proton secretion in the urine (OECD, 2005).

Acute Toxicity

Oral

Due to the corrosive nature of the chemical, it is not possible to conduct acute oral toxicity studies in animals to derive a median lethal dose (LD50) for the chemical.

The LD50 for a 3.3 % concentration of the chemical falls withing the hazard classification range to classify it as 'harmful'. However, acute lethal effects are expected due to the corrosive nature of the chemical. The chemical is classified for its corrosive effects and, therefore, an additional hazard classification for acute oral toxicity is not required.

In female rats that received the chemical at 3.3 % orally, the LD50 was reported as 238–277 mg/kg bw (details not available) (OECD, 2005).

Dermal

No data are available. Due to the corrosive nature of the chemical, it is not possible to conduct acute dermal toxicity studies in animals.

Inhalation

The chemical (hydrogen chloride) is classified as hazardous with the risk phrase ‘Toxic by inhalation’ (T; R23) in HSIS (Safe Work Australia). The available median lethal concentration (LC50) values are for a shorter exposure duration (30 minutes), compared with the four-hour exposure duration required to derive an LC50 value for hazard classification. Considering that three (out of four) LC50 values available fall within the classification range to classify the chemical as 'harmful' (for exposure duration eight times less than the standard exposure duration), the existing classification is supported.

The LC50 values of 8.3 mg/L (aerosol) and 6.9 mg/L (gas) were reported for rats, and 3.2 mg/L (aerosol) and 3.9 mg/L (gas) for mice, after a 30-minute inhalation exposure to hydrochloric acid. Sublethal clinical signs observed were irritation and corrosion to the eyes, skin and respiratory tract, with animals succumbing to respiratory failure shortly after exposure (OECD, 2005; REACH).

In a non-guideline study, a single exposure to a very high dose of the chemical vapour (450 mg/m^3), either before or during pregnancy, resulted in deaths of female rats (1/3 of the group) (OECD, 2005).

Observation in humans

Mortality has been observed following ingestion of the chemical. A woman died 29 hours after ingesting 60 mL of a 35 % w/v hydrochloric acid solution (OECD, 2005).

A 29-year-old man was admitted to hospital after ingesting approximately 200 mL of a cleaning solution containing 36 % w/v hydrochloric acid. Initial clinical effects included mucosal injury in the middle part of the pharynx in the area above the vocal cords and oesophagus. Further examination after two days revealed gastric necrosis and perforation and the patient died shortly thereafter (OECD, 2005).

Corrosion / Irritation

Corrosivity

The chemical is classified as hazardous with the risk phrase ‘Causes severe burns’ (C; R35) for hydrogen chloride or 'Causes burns' (C; R34) for hydrochloric acid % (aqueous form) in HSIS (Safe Work Australia). The available data support these classifications. However, due to the lack of test data for durations less than one hour, the available information is not sufficient to differentiate the degree of severity of burns to confirm the classification as R35 or R34. In addition, the results seen in dermal testing bring the concentration cut off values listed on HSIS for hydrochloric acid into question (see **Recommendations**).

In a skin irritation test (OECD Test Guideline (TG) 404), 37 % w/v hydrochloric acid (0.5 mL) was applied (under semi-occlusive and occlusive conditions) to rabbits. The chemical was found to be corrosive under both conditions following a one-hour exposure (OECD, 2005).

Several studies in animals indicated that the chemical at concentrations above 3.3 % causes irritation and at concentrations above 17 % causes corrosion (OECD, 2005).

In a Draize test (OECD TG 405), eye instillation of a 10 % hydrochloric acid solution (0.1 mL) in rabbits produced severe irritation with conjunctivitis, chemosis, iritis and corneal opacity from 4–96 hours following instillation, with the severity of effects increasing over time (OECD, 2005). The effects were not reversible (REACH).

An eye irritation study (comparable to OECD TG 405) in rabbits with 3.3 % of the chemical produced very slight to slight reddening and opaque swelling of the conjunctivae with slight corneal opacity, over 28 hours. No eye irritation was observed in rabbits that received the chemical at 0.33 % (OECD, 2005).

Observations in humans

Diluted solutions of the chemical caused skin irritation in humans.

Patch testing of 30 individuals with 10 % hydrochloric acid was conducted in a clinic. Based on the reactions in six volunteers that scored as milder than that of the positive control (20 % sodium dodecyl sulfate), the chemical at 10 % concentration was

determined to be ‘irritating to skin’ (OECD, 2005).

Occlusive patches of 4 % hydrochloric acid that were applied to the skin of 20 individuals for four days resulted in slight irritation in 14/20, with very weak to weak erythema (OECD, 2005).

Sensitisation

Skin Sensitisation

Only limited data are available due to the corrosive nature of the chemical. The chemical is not expected to be a skin sensitiser at 1 % concentration.

Two studies are available using low concentrations of the chemical. A guinea pig maximisation test (OECD TG 406) (which used 1 % hydrochloric acid (HCl) in both induction and challenge phases) and a mouse ear swelling test (which used 1 % HCl in the induction phase and 5 % HCl for the challenge phase), showed negative results for sensitisation (OECD, 2005; REACH).

Observation in humans

The chemical (37 % in water) did not produce skin sensitisation in humans.

In a human repeated patch test, subjects (n = 128) were exposed to nine induction patches containing the chemical (0.5 mL) for 24 hours (occlusive) on three alternating days per week for three weeks. After a two-week rest period, subjects were challenged with the chemical (0.5 mL) for 24 hours (occlusive) and observed at 48 and 96 hours. No response indicative of skin sensitisation was observed (REACH).

Repeated Dose Toxicity

Oral

Only limited data are available. However, the constituent ions are present in the human body at high concentrations, particularly in the stomach, and only short-term local effects are expected.

In a repeated dose study (non-guideline), rats were fed diets containing the chemical at 312, 625, 937 or 1250 millimoles/kg diet (180, 349, 366 or 466 mg/animal/day) for nine weeks. Water intake was high in all treatment groups. A no observed adverse effect level (NOAEL) of 625 mmol/kg diet (349 mg/kg bw) was determined based on mortalities (100 %) at 937 mmol/kg diet and above. The other effects reported include decreased body weight and food consumption, changes to blood pH and femur length at 937 mmol/kg diet and above (OECD, 2005).

Dermal

No data are available.

Inhalation

Based on the available data, the chemical is not considered to cause serious damage to health from repeated inhalation exposure. However, local irritation effects are expected due to the corrosivity of the chemical.

Studies reporting exposure to hydrogen chloride gas are available. Rats and mice were exposed to the chemical gas (equivalent to OECD TG 413) at concentrations of 0, 10, 20 or 50 ppm (0, 15, 30 or 75 mg/m^3), six hours/day, five days/week for 90 days.

Mice showed decreased body weight gain, food consumption and liver weight (in males only) at 50 ppm. Decreased body weight gain was observed in male rats at 50 ppm and food consumption was reduced in both sexes at 20 and 50 ppm. Inflammatory histopathological changes in lips or the nasal cavity were observed in mice and rats above 10 ppm. The no observed adverse effect concentration (NOAEC) for systemic toxicity was determined to be 20 ppm for rats and mice based on the reduction in body weight gain and liver weight (in male mice) (OECD, 2005).

Observation in humans

Repeated exposure to the chemical fumes at 15 % concentration (or 7 mg/m^3 in air) caused severe irritation of the front teeth in humans.

A 15 % hydrochloric acid solution was used in a pickling process at a zinc galvanizing plant in the Netherlands. An atmospheric concentration of 1.8–12.4 mg/m^3 (geometric mean) was observed at six sites within the plant, with the workers exposed to a hydrochloric acid concentration above 7 mg/m^3 for 27 % of their work (details not available). Erosion in more than one incisor (front teeth) was observed in the 34/38 workers examined (OECD, 2005).

Genotoxicity

Based on the in vitro data available, the chemical is not considered to be genotoxic. The OECD (2005) concluded that positive results obtained in the non-bacterial systems 'were considered to be artifacts due to low pH' of the test media.

The chemical gave negative results in several in vitro tests for gene mutation and clastogenicity (OECD, 2005; REACH):

- a bacterial reverse mutation assay using *Salmonella typhimurium* strains TA98, TA100, TA1535, TA1537 and TA1538 with or without metabolic activation;
- a reverse mutation assay in *Escherichia coli* strains W3110 (pol A+) and P3078 (pol A-) or *Bacillus subtilis* repair deficient strains;
- a mitotic recombination test (compliant with OECD TG 481) using *Saccharomyces cerevisiae* (D4);
- a chromosome aberration test using Fischer L5178Y mouse lymphoma cells, at dose levels ≤ 1.6 µL/mL;
- a sister chromatid exchange assay using Fischer L5178Y mouse lymphoma cells, at dose levels ≤ 1.6 µL/mL; and
- a mammalian cell gene mutation assay using Fischer L5178Y mouse lymphoma cells, at dose levels ≤ 1.6 µL/mL.

At high concentrations (not specified), the chemical gave positive results in two in vitro tests for gene mutation and clastogenicity (OECD, 2005):

- a chromosome aberration test (equivalent to OECD TG 473) in Chinese hamster ovary (CHO) cells (pH 5.3), with and without metabolic activation; and
- in a mammalian cell gene mutation assay using mouse lymphoma L5178Y cells, at cytotoxic conditions (pH <6.3).

Carcinogenicity

Based on the information available, the chemical is not considered to be carcinogenic.

After reviewing the epidemiological studies, the IARC concluded that there is inadequate evidence for carcinogenicity of the chemical in humans and in experimental animals, and 'classified hydrochloric acid as Group 3 (not classifiable as to its carcinogenicity to humans)' (IARC, 1992).

In a 128-week inhalation study, male Sprague Dawley (SD) rats (n = 100) were exposed to the chemical at a concentration of 10 ppm, six hours/day for five days/week. No pre-neoplastic or neoplastic nasal lesions were observed. A negative result was also

obtained in an 84-week study of comparable design using the same dose level (OECD, 2005; REACH).

In a poorly conducted dermal carcinogenicity study in mice administered 3–5 % hydrochloric acid for 25–46 weeks, no incidence of malignant tumours was observed (OECD, 2005).

Several case-control studies of US industry-based workers have been undertaken. No association was found between exposure to hydrogen chloride and lung cancer, intracranial neoplasms or renal cancer. In a study of 1165 male workers employed in 1940–64 in three US steel-pickling operations for at least six months, a subset of 189 workers had been exposed to mists of acids other than sulfuric, which were primarily hydrochloric acid (exposure levels not available). An excess risk for lung cancer was seen, but the effect of confounding factors such as exposure to other acids or life-style factors such as smoking could not be excluded (OECD, 2005).

Reproductive and Developmental Toxicity

Only limited data are available. However, the constituent ions are present in the human body at high concentrations, particularly in the stomach, and only short-term local effects are expected.

In a 90-day inhalation study, SD and Fischer 344 rats and B6C3F1 mice were exposed to the chemical vapour at concentrations up to 50 ppm (75 mg/m^3), six hours/day for five days/week. No exposure-related effects were observed in the reproductive organs (testis, epididymis, prostate and seminal vesicles, nor ovary, uterus, oviduct and mammary glands) (OECD, 2005).

In a non-guideline study a single exposure to a very high dose of the chemical vapour (450 mg/m^3), either before or during pregnancy, caused severe adverse effects, including deaths in female rats. In this reproductive and developmental toxicity study, groups of female Wistar rats (n = 8–15) were exposed to the chemical vapours at 450 mg/m^3 for one hour, either 12 days before mating or on day nine of gestation. Offspring were examined for growth and viability after birth and also underwent pulmonary, hepatic and renal tests at two to three months of age. The treatment was lethal to one-third of the dams, and functional disorders of the lungs, kidneys and liver were observed in surviving dams and offspring. In addition, treatment altered the oestrus cycles. In rats mated post-exposure, fewer live foetuses, decreased foetal weights and increased relative lung weights of the foetuses were observed. In rats exposed during pregnancy on gestation day 9, postnatal mortality was increased in the litters (31.9 % versus 5.6 % in the group exposed before mating, relative to the control group). The study was considered unreliable 'due to the lack of methodology details and limited reporting of results' (OECD, 2005). The reproductive effects observed in the study were considered to be secondary to maternal toxicity (REACH).

Risk Characterisation

Critical Health Effects

The critical health effects for risk characterisation include:

- local effects (corrosivity); and
- systemic acute effect (acute toxicity by the inhalation route of exposure).

The critical health effects are different for gaseous hydrogen chloride, for which respiratory irritation and corrosion are critical, and aqueous solutions (hydrochloric acid) where dermal corrosion is the key effect.

Due to corrosive nature of the chemical, even low concentrations of the chemical will also cause irritation to the eyes, skin and the respiratory tract.

Public Risk Characterisation

Cosmetic use of the chemical is expected to be limited to use as a buffering agent, with the final pH of the cosmetic product not strongly acidic. Domestic cleaning products may contain the chemical at concentrations that could cause irritant effects.

The chemical is listed on Schedules 5 and 6 of the SUSMP. At concentrations greater than 0.5 %, a number of warning statements, first aid instructions and safety directions apply.

Occupational Risk Characterisation

Given the critical health effects (corrosivity and acute toxicity), 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.

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.

A Tier III assessment may be required to consider any changes to the concentration cut offs for aqueous hydrogen chloride.

Regulatory Control

Public Health

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

Work Health and Safety

The chemical (hydrogen chloride) is recommended for classification and labelling under the current approved criteria and adopted GHS as below. The existing classification seperates gaseous hydrogen chloride and aqueous solutions (hydrochloric acid) on practical grounds and it is recommended that this practice continue. This assessment does not consider classification of physical hazards and environmental hazards.

Aqueous hydrogen chloride should be classified under the existing entry hydrochloric acid (%) R34 (GHS cat 1B).

The basis of the concentration cut off values listed in HSIS is not clear. If these are read as % HCl in solution, hydrochloric acid at <25 % HCl content is classified as irritant. Data assessed in the section **corrosivity** indicate that hydrochloric acid containing 17 % HCl is corrosive. Therefore, a Tier III assessment may be required to consider any changes to the existing concentration cut offs for aqueous hydrogen chloride.

Hazard	Approved Criteria (HSIS)[a]	GHS Classification (HCIS)[b]
Acute Toxicity	Toxic by inhalation (T; R23)*	Toxic if inhaled - Cat. 3 (H331)
Irritation / Corrosivity	Causes severe burns (C; R35)*	Causes severe skin burns and eye damage - Cat. 1A (H314)

[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, 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.

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