

Hydrochloric acid: Human health tier III assessment

29 June 2018

CAS Number: 7647-01-0



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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 III because the Tier II assessment indicated that it needed further investigation. The report should be read in conjunction with the Tier II assessment.

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

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Acronyms & Abbreviations

Synopsis

The human health Tier II assessment of hydrochloric acid under the Inventory Multi-tiered Assessment and Prioritisation (IMAP) framework determined that further work is required to consider any changes to the existing classification and concentration cut offs for aqueous hydrogen chloride (NICNAS).

Hydrochloric acid is a strong mineral acid and is classified as Category 1B Skin Corrosive. Other strong mineral acids, such as nitric acid (HNO₃), perchloric acid (HClO₄) and sulfuric acid (H₂SO₄) are classified as Category 1A Skin Corrosives. Considering the severe skin and eye damage effects of hydrochloric acid, the current classification and cut-offs for classification are anomalous to those of other mineral acids.

In this Tier III assessment, an extensive literature search was conducted for toxicity studies on hydrochloric acid. No proper studies, conducted according to international guidelines, were found that could be used to conclusively bring the classification and cut-off concentrations of hydrochloric acid in line with other strong mineral acids, such as nitric and sulfuric acids. This assessment documents the absence of relevant data.

In the absence of adequate skin and eye irritation studies, this assessment recommends that the current classification of hydrochloric acid remain unchanged. Sufficient data are not available to provide additional guidance on suitable concentration cut-offs. This classification may be re-considered, if new studies become available in future.

The human health Tier II IMAP report for the chemical is available online and contains detailed assessment information that remains valid (NICNAS). The Tier II and Tier III reports for this chemical should be read together.

Rationale for Tier III Assessment

The chemical, hydrogen chloride, exists as gaseous as well as aqueous forms (hydrochloric acid). These two forms of the chemical have different hazard classifications. During Tier II assessment it was determined that the existing classifications for the gaseous form were appropriate but for hydrochloric acid, it was noted that:

- 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; and

- the basis of the concentration cut off values listed in Hazardous Substances Information System (HSIS) (the Safe Work Australia online classification database at the time) was not clear

Therefore, a Tier III assessment was recommended (NICNAS).

The scope of the Tier III assessment is to evaluate whether there are sufficient data to reconsider the classification and cut-off concentrations of hydrochloric acid. The classification for the gaseous form is not being considered in this Tier III.

Chemical Identity

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

Health Hazard Information

Hydrogen chloride is a colourless, corrosive gas with a pungent, suffocating odour. Hydrogen chloride can occur in gaseous and aerosol forms in the atmosphere, and its partitioning between the two is dependent on temperature and humidity (Sebacher et al. 1980). It is highly soluble in water, forming hydrochloric acid.

Corrosion / Irritation

Hydrogen chloride is corrosive to the eyes, skin, and mucous membranes. It is highly acidic and concentrated aqueous solutions may have pH < 0.14. Adverse effects are caused at the site of contact due to the very low pH rather than the effects of the chloride ion.

Hazard classification

Hydrochloric acid (aqueous form) is listed in Hazardous Chemicals Information System (HCIS) with the following hazard category and hazard statement (Safe Work Australia):

- Skin corrosion – category 1B; H314 (Causes severe skin burns and eye damage)
- STOT SE 3; H335 (May cause respiratory irritation)

The chemical was originally classified in accordance with European Union (EU) Dangerous Substances Directive (67/548/EEC) (EU, 1967), and adopted by the Australian National Occupational Health and Safety Commission (NOHSC) and included in the **NOHSC List of Designated Hazardous Substances**, later renamed as Hazardous Substances Information System (HSIS). The HSIS was an online database intended for use with the 1994 Hazardous Substances Regulatory Framework. In 2012 the Hazardous Substances Regulatory Framework was replaced by the model work health and safety legislation. This legislation references classification in accordance with the Globally Harmonized System of Classification and Labelling of Chemicals (GHS). As such, HSIS was replaced by the Hazardous Chemical Information System (HCIS), which contains classification information in accordance with the GHS. Hydrochloric acid (aqueous form) was previously listed in HSIS with concentration cut offs recommended by the European Union; however, HCIS does not currently recommend any specific concentration cut offs for Hydrochloric acid (aqueous form).

Comparison with other mineral acids

Hydrochloric acid is a strong mineral acid. Other strong mineral acids, such as nitric acid (HNO₃), perchloric acid (HClO₄) and sulfuric acid (H₂SO₄) are classified as corrosives with risk phrase (Skin Corr. Category 1A). Considering severe skin and eye damage effects of hydrochloric acid, the current classification (Skin Corr. Category 1B) is anomalous to that of other mineral acids. Based on concentration cut offs recommended by the European Union, hydrochloric acid at up to 25 % is classified only as irritating to eyes, respiratory system and skin, whereas HNO₃, HClO₄ and H₂SO₄ are classified as causing severe skin burns and eye damage at 5 %, 10 % and 15 %, respectively. The basis for the classification of hydrochloric acid at a lower level is not known.

Comparison of classification and concentration cut-off of four mineral acids

HCl	HNO ₃	HClO ₄	H ₂ SO ₄
Skin Corr. 1B; H314; STOT SE 3; H335	Skin Corr. 1A; H314	Skin Corr. 1A; H314	Skin Corr. 1A; H314
Skin Corr. 1B; H314: C ≥ 25 %	Skin Corr. 1A; H314: C ≥ 20 %	Skin Corr. 1A; H314: C ≥ 50 %	Skin Corr. 1A; H314: C ≥ 15 %
Skin Irrit. 2; H315: 10 % ≤ C < 25 %	Skin Corr. 1B; H314: 5 % ≤ C < 20 %	Skin Corr. 1B; H314: 10 % ≤ C < 50 %	Skin Irrit. 2; H315: 5 % ≤ C < 15 %
Eye Irrit. 2; H319: 10 % ≤ C < 25 %		Skin Irrit. 2; H315: 1 % ≤ C < 10 %	Eye Irrit. 2; H319: 5 % ≤ C < 15 %
STOT SE 3; H335: C ≥ 10 %		Eye Irrit. 2; H319: 1 % ≤ C < 10 %	

H314 – Causes severe skin burns and eye damage

H335 – May cause respiratory irritation

H315 – causes skin irritation

H319 – Causes serious eye irritation

Review of available data

Several studies in laboratory animals indicated that hydrochloric acid at concentrations above 3.3 % causes irritation and at concentrations above 17 % causes corrosion (NICNAS). These studies strongly indicate the corrosive nature of hydrochloric acid.

For the current assessment, an extensive literature search was conducted for toxicity studies on hydrochloric acid. The following study in addition to those previously reviewed was found.

In this preliminary eye irritation study (Griffith et. Al., 1980), several chemical substances (acids, alkalis, detergents) were tested for their eye irritation effects in New Zealand White rabbits. Dilute mineral acids (5 % hydrochloric acid and 10 % nitric acid) were severely irritating or corrosive at doses of 0.1 and 0.03 mL. At the 0.1 mL dose, persistent (≥ 14 days to clear) or permanent damage was produced by these chemicals. In the follow-up detailed study, hydrochloric acid and other acids were not included.

No proper studies, conducted according to international guidelines, were found that could be used to conclusively bring the classification and cut-off concentrations of hydrochloric acid, in line with other strong mineral acids, such as nitric and sulfuric acids. Due to the lack of test data for durations of less than one hour, the available information is not sufficient to differentiate the degree of severity of burns to confirm the classification as Skin Corr. 1A or Skin Corr. 1B.

NICNAS Recommendation

Due to a lack of adequate skin and eye irritation studies required to revise the classification and cut-off concentrations of hydrochloric acid to bring them in line with those of other strong mineral acids, it is recommended that the current classification of hydrochloric acid remain unchanged. Sufficient data are not available to provide additional guidance on suitable concentration cut-offs. This classification may be re-considered, if new studies become available in future.

Other recommendations provided in the Tier II report remain unchanged.

Regulatory Control

Work Health and Safety

The chemical is recommended for classification and labelling aligned with the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) as below. This does not consider classification of physical hazards and environmental hazards. This classification may be re-considered, if new studies become available in future. Sufficient data are not available to provide additional guidance on suitable concentration cut-offs.

From 1 January 2017, under the model Work Health and Safety Regulations, chemicals are no longer to be classified under the Approved Criteria for Classifying Hazardous Substances system.

Hazard	Approved Criteria (HSIS) ^a	GHS Classification (HCIS) ^b
Irritation / Corrosivity	Not Applicable	Causes severe skin burns and eye damage - Cat. 1B (H314)* May cause respiratory irritation - Specific target organ tox, single exp Cat. 3 (H335)*

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

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

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

References

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Last update 29 June 2018

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