Australian Government

Department of Health, Disability and Ageing

Australian Industrial Chemicals Introduction Scheme

Cement copper

Assessment statement (CA10020)

08 July 2025

Table of contents

AICIS assessment (CA10020)

Chemical in this assessment

Name	CAS registry number
Cement copper	67711-88-0

Reason for the assessment

An application for an assessment certificate under section 31 of the *Industrial Chemicals Act 2019* (the Act).

Certificate application type

AICIS received the application in a Health and Environment Focus type.

Defined scope of assessment

The chemical has been assessed:

- as imported as a solid powder into Australia at up to 3,900 tonnes/year
- for manufacture of metal extraction solutions and end use of these solutions in industrial mining settings by professional workers
- with no direct release to natural waterways, municipal water supplies, or municipal sewerage systems.

Summary of assessment

Summary of introduction, use and end use

The assessed chemical will not be manufactured in Australia. It will be imported into Australia as a solid powder, packaged in bags for the manufacture of metal extraction solutions, which will then be used as an activator to recover zinc and zinc sulphide minerals via floatation processes. The imported assessed chemical will be mixed with water in a slurry tank, followed by treatment in sealed, vacuum-operated reactors. Acid emissions during the process are expected to be neutralised by sodium hydroxide scrubbers. The resulting copper sulphate solution will be transferred from the reactors to a thickener and a clarified solution will then be collected from the thickener overflow. Solid lead concentrate will be removed from the thickener underflow, dewatered and bagged. The clarified solution will be stored in storage tanks and pumped into the day tank. The copper sulphate solution will be injected into flotation cells via submerged sparges or pump discharges from the day tank. After flotation, residual copper traces remain in zinc concentrate or are disposed of in onsite tailing dams with no further release to environmental waters.

Human health

Summary of health hazards

The assessed chemical is a substance of unknown or variable composition, complex reaction products or biological materials (UVCB), containing elemental metals including copper, zinc, cadmium, cobalt, arsenic, antimony, magnesium, calcium, iron, lead, nickel and manganese, and/or their compounds, with variations in composition between batches and manufacturers. Consequently, a worst-case approach that aggregates the hazard classifications of all components has been used to estimate the overall hazard profile of the assessed chemical.

Based on the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) classifications on the components of the assessed chemical and using the *Globally Harmonized System of Classification and Labelling of Chemicals (GHS)* mixture rules (UNECE, 2017) (see **Supporting information**), the assessed chemical is likely to:

- be toxic if swallowed
- be fatal if inhaled
- cause serious eye damage
- be a skin and respiratory sensitiser
- have potential to damage organs through repeated exposure
- have genotoxic potential
- be carcinogenic
- cause specific adverse effects on fertility/sexual function or foetal development.

The hazards of the assessed chemical will depend on the composition. Although certain effects, for example sensitisation (see **supporting information**), may not be present at typical composition levels, effects such as genotoxicity, carcinogenicity, and reproductive and developmental effects are expected for all likely compositions.

Hazard classifications relevant for worker health and safety

Based on publicly available hazard classifications on the components of the assessed chemical, the assessed chemical satisfies the criteria for classification according to the GHS (UNECE, 2017) for hazard classes relevant for worker health and safety as adopted for industrial chemicals in Australia.

The chemical is a UVCB. The hazards of the assessed chemical will depend on the composition. The proposed hazard classifications are based on read across principles, the available composition data and the assumption that hazardous components are present at the maximum concentrations as provided by the applicant. The following classifications should be used as a default for the assessed chemical. If empirical or composition data are available for a specific batch of the assessed chemical, that data could be used to amend the default classifications.

Health hazards	Hazard category	Hazard statement
Acute toxicity, oral	Acute Tox. 3	H301: Toxic if swallowed
Acute toxicity, inhalation	Acute Tox. 1	H330: Fatal if inhaled
Serious eye damage/eye irritation	Eye Dam. 1	H318: Causes serious eye damage

Sensitisation, skin	Skin Sens. 1	H317: May cause an allergic skin reaction
Sensitisation, respiratory	Resp. Sens. 1	H334: May cause allergy or asthma symptoms or breathing difficulties if inhaled
Specific target organ toxicity, repeated exposure	STOT Rep. Exp. 1	H372: Causes damage to organs through prolonged or repeated exposure
Germ cell mutagenicity	Muta. 1B	H340: May cause genetic defects
Carcinogenicity	Carc. 1A	H350: May cause cancer
Reproductive toxicity	Repr. 1A	H360FD: May damage fertility; May damage the unborn child

Summary of health risk

Public

When introduced and used in the proposed manner, it is unlikely that the public will be exposed to the assessed chemical. No risks are identified for public health during this assessment that require specific risk management measures if the assessed chemical is introduced and used in accordance with the terms of the assessment certificate.

Workers

Potential exposure of workers to the assessed chemical at up to 100% concentration may occur during transfer, mixing, dilution and equipment maintenance activities. Considering the expected adverse health effects of the assessed chemical, control measures to minimise dermal, ocular and inhalation exposure are needed to manage the risk to workers (see **Means for managing risk** section).

Environment

Summary of environmental hazard characteristics

As the assessed chemical is inorganic, it is excluded from categorisation under the *Australian Environmental Criteria for Persistent, Bioaccumulative and/or Toxic Chemicals* (DCCEEW, 2022).

Environmental hazard classification

Dissolution tests conducted on the assessed chemical by following OECD TG 105 and OECD Guidance Document 29 methods detected soluble copper. Therefore, the hazard classification for the assessed chemical is based on soluble copper data. Accordingly, the assessed chemical satisfies the criteria for environmental hazard classification according to the GHS (UNECE, 2017) as follows.

Environmental Hazard	Hazard Category	Hazard Statement
Hazardous to the aquatic environment (acute / short-term)	Aquatic Acute 1	H400: Very toxic to aquatic life

Hazardous to the aquatic environment (long-term)	Aquatic Chronic 1	H410: Very toxic to aquatic life with long lasting effects

Summary of environmental risk

No environmental exposures of the assessed chemical are expected during manufacture of metal extraction solutions, recovery processes, re-packaging, use or end of life disposals.

As the assessed chemical is inorganic, it is excluded from categorisation under the *Australian Environmental Criteria for Persistent, Bioaccumulative and/or Toxic Chemicals* (DCCEEW, 2022).

However, copper shows significant toxicity to all trophic levels, under environmental conditions. Furthermore, the assessed chemical is a UVCB mixture containing other metals, such as lead, cadmium and arsenic, which have concerns for their bioaccumulation potential and toxicity (UNEP, 2010; 2014).

Consequently, the assessed chemical is considered to pose a high environmental hazard.

A Risk Quotient (PEC/PNEC) for the aquatic compartment was not calculated as the currently available information indicates the assessed chemical will not be released to the environment. Therefore, it is expected that the environmental risk from the introduction of the assessed chemical can be managed.

Means for managing risk

Workers

Recommendation to Safe Work Australia

It is recommended that Safe Work Australia (SWA) update the *Hazardous Chemical Information System* (HCIS) to include classifications relevant to work health and safety (see **Hazard classifications relevant for worker health and safety**).

The recommended classification and labelling entry should have the following note appended. Note 10: The chemical is a substance of unknown or variable composition, complex reaction product, or biological material (UVCB). The hazards of the chemical may depend on the composition. For more information refer to the assessment report published on the website of the Australian Industrial Chemicals Introduction Scheme.

Information relating to safe introduction and use

The information in this statement, including recommended hazard classifications, should be used by a person conducting a business or undertaking at a workplace (such as an employer) to determine the appropriate controls under the relevant jurisdiction Work Health and Safety laws.

The following control measures could be implemented to manage the risk arising from exposure to the assessed chemical during manufacture of metal extraction solutions, end use and clean-up activities:

- Use of engineering controls such as
    - Enclosed and automated systems where possible
    - Adequate workplace ventilation e.g. local exhaust to avoid accumulation of dusts, mists or aerosols and prevent the chemical from entering the breathing zone of any worker
- Use of safe work practices to
    - Avoid contact with skin and eyes
    - Avoid inhalation of dusts, mists or aerosols
- Use of personal protective equipment (PPE)
    - Impervious gloves
    - Chemical resistant footwear
    - Protective clothing
    - Full-face mask with appropriate respiratory protection

- The storage of the assessed chemical should be in accordance with the Safe Work Australia *Code of Practice for Managing Risks of Hazardous Chemicals in the Workplace* (SWA 2023) or relevant State or Territory Code of Practice.
- The control measures may need to be supplemented with conducting health monitoring for any worker who is at significant risk of exposure to the chemical, if valid techniques are available to monitor the effect on the worker's health.
- A copy of the Safety Data Sheet (SDS) should be easily accessible to workers.

Conclusions

The Executive Director is satisfied that the risks to human health or the environment associated with the introduction and use of the industrial chemical can be managed.

Note:

1. Obligations to report additional information about hazards under s 100 of the *Industrial Chemicals Act 2019* apply.
2. You should be aware of your obligations under environmental, workplace health and safety and poisons legislation as adopted by the relevant state or territory.

Supporting information

Chemical identity

CAS number	67711-88-0
CAS name	Cement copper
Molecular formula	Unspecified

Additional chemical identity information

The CAS notes describe the identity as "Formed when pregnant solution is applied to metallic iron which is taken into solution and copper and other metals precipitated."

Relevant physical and chemical properties

Physical form	Dark brown powder
Density	3,910 kg/m^3 at 22 °C
Water solubility	4.6 mg/L at 20 °C, pH 12
Particle Size	Inhalable fraction (< 100 µm): 51% Respirable fraction (< 10 µm): Not determined
Ionisable in the environment	Yes
log K_d	2.68 (calc)

Human exposure

Workers

Transport, storage and warehouse workers are not expected to be exposed to the assessed chemical, except in the event of an accidental rupture of containers.

There is a potential for worker exposure to the assessed chemical at up to 100% concentration during processes for manufacture of metal extraction solutions including transfer, mixing and equipment maintenance activities. The extraction plant is expected to use automated closed systems where possible, limiting the potential exposure of workers. According to the applicant, workers are expected to wear appropriate personal protective equipment (PPE) to reduce potential dermal, ocular and inhalation exposure.

Mine workers may experience dermal and ocular exposure to extraction solutions containing the assessed chemical during addition of extraction solutions and equipment maintenance activities, especially if using manual processes. However, according to the applicant, workers are expected to wear appropriate PPE to reduce potential dermal and ocular exposure.

Inhalation exposure is not expected in end use activities given vapours, mists and aerosols are not expected to form.

Public

No public exposure to the assessed chemical is expected as the assessed chemical will only be used by professional workers in industrial settings, where manufacture of metal extraction solutions and mining extraction processes are carried out.

Health hazard information

No toxicological studies on the assessed chemical were provided by the applicant. The assessed chemical is a UVCB containing other elemental metal compounds in addition to copper. This includes:

- soluble compounds of zinc, cadmium and lead
- oxides of antimony, cobalt and nickel
- arsenic compounds such as tricopper arsenide
- manganese

These classes of chemicals have previously been assessed under the NICNAS framework (NICNAS, 2013; NICNAS, 2014a; NICNAS, 2014b; NICNAS, 2014c; NICNAS, 2014d; NICNAS, 2014e; NICNAS, 2015; NICNAS, 2018). Copper II oxide, which is the major component of the assessed chemical, has no hazard classifications (NICNAS, 2014f; SWA, n.d.). The hazard profile of the assessed chemical was determined based on the human health hazards of other relevant elemental compounds.

The hazards of the assessed chemical will depend on the composition of the UVCB, which may differ between batches and manufacturers. For this reason, it has been classified according to the GHS criteria for mixtures (UNECE, 2017). The applicant provided the potential typical and maximum concentrations for each component of the assessed chemical.

High level information on hazard classifications according to the GHS (UNECE, 2017) is provided below based on typical and maximum concentrations provided by the applicant. Further information on the hazards of these metal components can be found in previous NICNAS assessment reports (NICNAS, 2013; NICNAS, 2014a; NICNAS, 2014b; NICNAS, 2014c; NICNAS, 2014d; NICNAS, 2014e; NICNAS, 2018).

Acute toxicity

Oral

Several metal compounds potentially present in the assessed chemical are classified according to the GHS for acute oral toxicity. Of these, soluble cadmium compounds, oxides of cobalt and arsenic compounds have the highest classification with a classification of Category 3 - toxic if swallowed (H301) (NICNAS, 2013; NICNAS, 2014a; NICNAS, 2014b; SWA, n.d.). Soluble zinc and sparingly soluble lead compounds are classified as Category 4 – harmful if swallowed (H302) (NICNAS, 2014c; NICNAS, 2014d; SWA, n.d.)

The hazards of the assessed chemical will depend on the composition, which may differ between batches and manufacturers. Based on maximum reported levels of these compounds using acute toxicity estimate (ATE) calculations for a mixture (UNECE, 2017), an ATE of 100 was calculated. Therefore, the classification of the assessed chemical would be Category 3 - toxic if swallowed (H301). Based on typical reported concentrations, an ATE of 683 was calculated and therefore a classification of Category 4 – harmful if swallowed (H302) would apply.

Dermal

Soluble cadmium compounds are classified as harmful in contact with skin - Category 4 (H312) (NICNAS, 2014a; SWA, n.d.):

The hazards of the assessed chemical will depend on the composition, which may differ between batches and manufacturers. Based on maximum reported levels of these compounds using ATE calculations for a mixture (UNECE, 2017), the assessed chemical is expected to have low acute dermal toxicity (ATE value > 2000 mg/kg bw/day).

Inhalation

Several metal compounds potentially present in the assessed chemical are classified according to the GHS for acute inhalation toxicity (NICNAS, 2013; NICNAS, 2014a; NICNAS, 2014c; NICNAS, 2014d; SWA, n.d.). This includes:

- soluble cadmium compounds: Category 1 – Fatal if inhaled (H330)
- oxides of cobalt: Category 2 – Fatal if inhaled (H330)
- arsenic compounds: Category 3 - Toxic if inhaled (H331)
- sparingly soluble lead compounds: Category 4 – Harmful if inhaled (H332)

The hazards of the assessed chemical will depend on the composition, which may differ between batches and manufacturers. Based on maximum reported levels of these compounds using ATE calculations for a mixture (UNECE, 2017) an ATE (dust/mist) of 0.012 was calculated. Therefore, the classification of the assessed chemical would be Category 1 - Fatal if inhaled (H330). Based on typical reported concentrations an ATE (dust/mist) of 0.37 was calculated and a classification of Category 2 – Fatal if inhaled (H330) would apply.

Corrosion/Irritation

Eye irritation

Soluble zinc compounds such as zinc sulfate are classified for eye irritation as Category 1 - H318: Causes serious eye damage (NICNAS, 2014c; SWA, n.d.)

As both the typical and maximum concentrations of soluble zinc compounds in the assessed chemical are > 3%, the assessed chemical is classified as Category 1 – Causes serious eye damage (H318) according to GHS criteria for mixture classification.

Sensitisation

Skin sensitisation

Oxides of nickel and cobalt are classified as for skin sensitisation as Category 1 - May cause an allergic skin reaction (H317) (NICNAS, 2014b; NICNAS, 2014e; SWA, n.d.).

Based on potential maximum concentrations of these compounds in the assessed chemical (> 1%) and using the GHS classification mixture rules, the assessed chemical is classified as Category 1 - May cause an allergic skin reaction (H317). Using the typical concentrations provided by the applicant (< 1%) the assessed chemical would not require classification for this endpoint.

Respiratory sensitisation

Oxides of cobalt are classified as respiratory sensitisation Category 1 (H334: May cause allergy or asthma symptoms or breathing difficulties if inhaled) (NICNAS, 2014b; SWA, n.d.).

Based on potential maximum concentrations of these compounds in the assessed chemical (> 1%), the assessed chemical is classified as Category 1 (H334: May cause allergy or asthma symptoms or breathing difficulties if inhaled) according to GHS criteria for mixture classification. Using the typical concentrations provided by the applicant (< 1%), the assessed chemical would not require classification for this end point.

Repeat dose toxicity

A number of metal compounds potentially present in the assessed chemical are classified for repeated dose toxicity. Of these. the following are classified as Category 1 (H372: Causes damage to organs through prolonged or repeated exposure) (NICNAS, 2014a; NICNAS, 2014b; NICNAS, 2014d; NICNAS, 2014e; NICNAS, 2018; SWA, n.d.):

- soluble compounds of cadmium
- sparingly soluble lead compounds
- oxides of cobalt and nickel
- manganese

Based on potential maximum concentrations of these compounds (> 10%), the assessed chemical is classified as Category 1 (H372: Causes damage to organs through prolonged or repeated exposure) according to GHS criteria for mixture classification. Based on typical reported concentrations (between 1% and 10%), the assessed chemical is classified as Category 2 (H373: May cause damage to organs through prolonged or repeated exposure).

Genotoxicity

A number of metal compounds potentially present in the assessed chemical are classified for genotoxicity. Of these, soluble cadmium compounds have the highest classification - Category 1B (H340: May cause genetic defects) (NICNAS, 2014a; SWA, n.d.).

As both the typical and maximum concentrations of soluble cadmium compounds are > 0.1%, the assessed chemical is classified as Category 1B (H340: May cause genetic defects) according to GHS criteria for mixture classification.

Carcinogenicity

A number of metal compounds potentially present in the assessed chemical are classified for carcinogenicity. Of these, nickel and arsenic compounds have the highest classification. Nickel oxides are classified as carcinogenicity Category 1A by inhalation (H350i: May cause cancer by inhalation) (NICNAS, 2014e; SWA, n.d.). Arsenic compounds are classified as category 1A (H350: May cause cancer) (NICNAS, 2013; SWA, n.d.)

As both the typical and maximum concentrations of these compounds are > 0.1%, the assessed chemical is classified as Category 1A - May cause cancer (H350) according to GHS criteria for mixture classification.

Reproductive and development toxicity

A number of metal compounds potentially present in the assessed chemical are classified for reproductive and developmental toxicity. Of these, soluble cadmium, lead compounds and oxides of cobalt have the highest classification (NICNAS, 2014a; NICNAS, 2014b; NICNAS, 2014d; SWA, n.d.):

- sparingly soluble lead compounds: reproductive toxicity 1A (H360Df: May damage the unborn child. Suspected of damaging fertility)
- soluble cadmium compounds: reproductive toxicity 1B (H360FD: May damage fertility. May damage the unborn child)
- oxides of cobalt: reproductive toxicity 1B (H360F: May damage fertility)

As both the typical and maximum concentrations of these compounds are > 0.3%, the assessed chemical is classified as Category 1A - May damage fertility or the unborn child (H360FD) according to GHS criteria for mixture classification.

Environmental exposure

The assessed chemical will not be manufactured in Australia and will be imported as a solid cement powder. The assessed chemical will be used for manufacture of metal extraction solutions which will be used in the recovery of zinc minerals. These floatation processes will occur at one site, domestically.

Once received on site, the assessed chemical will be removed from containers with a forklift and fed to slurry tanks to be reacted to manufacture metal extraction solutions. The process water from the manufacturing processes is pumped to and retained in tailing dams.

The activities for extraction solution manufacture utilise engineering controls to prevent release including bunds and gas scrubbing systems. Any accidental spills from the process will be captured and recycled and any packaging containing residues of the assessed chemical will be disposed of as designated hazardous waste.

Residual solid waste containing lead which is generated during extraction solution manufacture is treated onsite prior to transportation to an appropriate lead smelter for further treatment.

The resulting extraction solutions are used to recover the zinc mineral and zinc sulphide via floatation processes. Dosing the extraction solution into floatation circuits is done via enclosed systems. Thus, any environmental releases during these processes are expected to be minimal.

The remaining slurry solution from floatation processes can contain trace amounts of copper sulphate and other trace elements of the UVCB. This remaining slurry solution will also be disposed of in the tailings dam. Thus, exposures to the environment from extraction solution manufacture processes and end-use of the solutions are not expected.

In the unlikely event of accidental spills or leaks during storage, transport, and loading, the assessed chemical is expected to be collected and disposed of according to Local, State, Territory and Federal regulations.

Environmental fate

Dissolution, speciation and partitioning

The assessed chemical is a UVCB containing other elemental metals including zinc, cadmium, cobalt, arsenic and magnesium in addition to copper. A water solubility dissolution test conducted according to OECD 105 method, demonstrated a solubility of 4.6 mg/L at pH 12.3-12.4 at 20°C for the assessed chemical. This result indicates the assessed chemical is slightly soluble in water under above conditions. However, under environmental pH conditions (pH 4-9), the assessed chemical is expected to have negligible solubility, remaining largely insoluble.

Another dissolution test conducted according to OECD Guidance Document 29 method provided additional information on the water solubility of cadmium, lead and zinc present in the assessed chemical. For cadmium, lead and zinc the water solubility ranged from very slightly soluble to slightly soluble with reported concentrations of 4.36 µg/L, 1.2 µg/L, 110 µg/L respectively.

Based on above supplied information, the assessed chemical is expected to be insoluble under environmental pH conditions. However, some dissolution into ionic forms such as Cu^{2+} can occur depending on the pH levels in the environment.

In natural waters, copper, zinc and arsenic are largely complexed by natural dissolved organic matter (DOM) such as humic, fulvic and tannic acids, or adsorbed to colloidal, humic-coated iron and/or manganese oxide particles (ANZECC & ARMCANZ, 2000; ATSDR, 2005; Eisler, 1993; Barral-Fraga et al., 2020; McCleskey et al., 2004; Pothier et al., 2020). Most copper in natural waters is present as copper-DOM complexes (ANZECC & ARMCANZ, 2000).

Partitioning of copper in natural waters is controlled by active biological processes as much as by chemical equilibria. Organisms such as algae and fish release dissolved organic ligands, which bind copper and control its uptake and bioavailability (ANZECC & ARMCANZ, 2000).

Additionally, based on supplied information, the assessed chemical has a high soil distribution coefficient (log K_d = 2.68). If released to environment, the assessed chemical is expected to strongly adsorb on to soil, organic matter, sediment particles and suspended solids in water because of its high affinity to negatively charged surfaces/molecules.

Degradation

No information on the degradation of the assessed chemical was provided. The assessed chemical is inorganic and therefore excluded from persistence classification. However, the assessed chemical is expected to be stable and long lived in the environment.

Bioaccumulation

Conventional measures of bioaccumulation as applied to organic chemicals are not appropriate for metal ions. The assessed chemical primarily contains copper that can be accumulated in organisms. However, copper is considered an essential element and is commonly bio-regulated by organisms. (ANZECC & ARMCANZ, 2000). Furthermore, the assessed chemical is a UVCB substance containing other metals, such as lead, cadmium and arsenic, which are known to have bioaccumulation concerns (UNEP, 2010; 2014; Madhusudan et, al., 2003).

Predicted environmental concentration (PEC)

The predicted environmental concentration (PEC) has not been calculated as release of the assessed chemical to the aquatic environment is not expected based on its assessed use pattern.

Environmental effects

Effects on aquatic Life

Acute toxicity

The following median lethal concentration (LC50), effect concentration (EC50) and inhibitory concentration (IC50) values for model organisms were supplied for dissolvable Cu in solution.

Taxon	Endpoint	Method
Fish	96 hr LC50 = 2.8 µg Cu/L at 11 mg/L CaCO3 hardness level, pH 7.0	*Salmo gairdineri* (steelhead trout) Mortality Unspecified test method Flow-through conditions Measured concentration
Invertebrate	48 hr EC50 = 3.52 µg C/L at 0.5 mg C/L dissolved organic carbon, pH 7.82- 7.95	*Mytilus edulis* (blue mussel) Embryo larval development Unspecified test method Static conditions Measured concentration
Algae	72 hr ErC10 = 0.047 µg /L dissolved Cu at pH 6.2	*Chlamidomonas reinhardtil* (green algae) Growth rate OECD TG 201 method Flow through conditions Geometric mean measured concentration
Microorganisms	48 h IC50 = 0.1 mg dissolved Cu/L	*Tetrahymena pyriformis* (ciliated protozoa) Synthesis determination assay Unspecified test method Semi-static conditions Measured concentration

Chronic toxicity

The following no observed effect concentration (NOEC) values for model organisms were supplied for dissolvable Cu in solution.

Taxon	Endpoint	Method
Fish	60 day NOErC = 2.2 µg dissolved Cu/L	*Oncorhynchus mykiss* (rainbow trout) Growth rate Unspecified test method Flow through conditions Arithmetic mean measured concentration
Invertebrates	42 d NOEC = 4.2 µg dissolved Cu/L at 57.5 mg/L CaCO3 hardness level, pH 8.6	*Daphnia pulex* (water flea) Mortality Unspecified test method Flow through conditions Arithmetic mean measured concentration

Effects on terrestrial Life

The following measured effect concentration (EC50) and no effect concentration (NOEC) values for model organisms were supplied for dissolvable copper in solution:

Taxon	Endpoint	Method
Soil macroorganisms except arthropods	6 wk EC50 = 51.5 g dissolved Cu/L	*Aporrectodea caligninosa* (grey worm) Mortality Unspecified test method Measured concentration
Soil arthropods	28 d NOEC = 48.2 mg/kg soil dw	*Eisenia fetida* (red wiggler worm) Reproduction ISO 1996 method Measured concentration
Terrestrial plants	45 d NOEC = 50 mg/kg soil dw	*Vigna mungo* (black gram) Yield stem with no bioavailability correction Unspecified test method Measured concentration
Soil microorganisms	28 d NOEC = 83 mg/kg soil dw	*Soil microbials* Maize respiration Unspecified test method Arithmetic mean measured concentration

Effects on sediment dwelling life

The following measured effect concentration (EC50) value for model organisms was supplied for dissolvable copper in solution:

Taxon	Endpoint	Method
Sediment toxicity	28 d EC50 = 59.2 mg Cu/kg dry wt	*Chironomus riparius* (earthworm) Emergence OECD TG 218 method Unspecified conditions Measured concentration

Predicted no-effect concentration (PNEC)

Copper was determined to be the component of the assessed chemical most relevant to environmental toxicity based on its dissolution and available ecotoxicity endpoints. Default guideline values are published for copper in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality. These values represent thresholds above which further assessment of potential toxicity may be required to ensure environmental quality and have been normalised using a water hardness of 30 mg $CaCO_3$/L. For marine ecosystem, a high reliability guideline value for protection of 95% of marine species has been determined to be 1.3 µg Cu/L (ANZECC, 2000b).

Categorisation of environmental hazard

As the assessed chemical is inorganic, it is excluded from categorisation under the *Australian Environmental Criteria for Persistent, Bioaccumulative and/or Toxic Chemicals* (DCCEEW, 2022).

Environmental risk characterisation

The assessed chemical is inorganic and excluded from Persistent, Bioaccumulative and Toxic categorisation (DCCEEW, 2022). These criteria were developed for organic chemicals and do not take into consideration the unique properties of inorganic substances and their behaviour in the environment (UNECE, 2017).

Copper is an essential trace element, and its accumulation is typically regulated by physiological mechanisms in organisms. However, copper shows significant toxicity to all trophic levels, under environmental conditions. Furthermore, the assessed chemical is a UVCB substance containing other metals, such as lead, cadmium and arsenic, which have concerns for their bioaccumulation potential and toxicity (UNEP, 2010; 2014). Consequently, the assessed chemical is considered to pose a high environmental hazard.

A Risk Quotient (PEC/PNEC) for the aquatic compartment was not calculated as the currently available information indicates the assessed chemical will not be released to the environment, untreated. Therefore, the risk from the assessed chemical can be managed.

References

ANZECC & ARMCANZ (2000). Australia and New Zealand Environment and Conservation Council Conservation Council & Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra (2000), 'Detailed descriptions of chemicals' (Section 8.3.7). Accessed 03 April 2025 at https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/toxicants/copper 2000#:~:text=The%20current%20analytical%20practical%20quantitation,water%20(NSW%20EPA%202000).

ATSDR (Agency for Toxic Substances and Disease Registry) (2005) *Toxicological Profile for Zinc*, U.S. Department of Health and Human Services, accessed 05 May 2025.

Barral-Fraga L, Barral MT, MacNeill KL, Martiñá-Prieto D, Morin S, Rodríguez-Castro MC, Tuulaikhuu BA and Guasch H (2020) 'Biotic and Abiotic Factors Influencing Arsenic Biogeochemistry and Toxicity in Fluvial Ecosystems: A Review', *International Journal of Environmental Research and Public Health,* 17(7), doi:10.3390/ijerph17072331.

DCCEEW (2022) Australian Environmental Criteria for Persistent, Bioaccumulative and/or Toxic Chemicals, DCCEEW, accessed 05 May 2025.

Eisler R (U.S. Department of the Interior) (1993) *Zinc Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review*, accessed 05 May 2025.

Madhusudan S, Liyaquat, Fatima and Nadim C (2003) 'Bioaccumulation of zinc and cadmium in freshwater fishes', *Indian Journal of Fisheries,* 50(1), pp 53-65.

McCleskey RB, Nordstrom DK and Maest AS (2004) 'Preservation of water samples for arsenic(III/V) determinations: an evaluation of the literature and new analytical results', *Applied Geochemistry,* 19(7), pp 995-1009, doi:10.1016/j.apgeochem.2004.01.003.

NICNAS (National Industrial Chemicals Notification and Assessment Scheme) (2013) *IMAP Group Assessment Report – Arsenic: Human health tier II assessment*, NICNAS, accessed 03 June 2025.

NICNAS (National Industrial Chemicals Notification and Assessment Scheme) (2014a) *IMAP Group Assessment Report – Soluble cadmium salts: Human health tier II assessment*, NICNAS, accessed 03 June 2025.

NICNAS (National Industrial Chemicals Notification and Assessment Scheme) (2014b) *IMAP Group Assessment Report – Cobalt oxide: Human health tier II assessment*, NICNAS, accessed 03 June 2025.

NICNAS (National Industrial Chemicals Notification and Assessment Scheme) (2014c) *IMAP Group Assessment Report – Soluble zinc salts: Human health tier II assessment*, NICNAS, accessed 03 June 2025.

NICNAS (National Industrial Chemicals Notification and Assessment Scheme) (2014d) *IMAP Group Assessment Report – Sparingly-soluble lead salts: Human health tier II assessment*, NICNAS, accessed 03 June 2025.

NICNAS (National Industrial Chemicals Notification and Assessment Scheme) (2014e) *IMAP Group Assessment Report – Nickel oxide: Human health tier II assessment*, NICNAS, accessed 03 June 2025.

NICNAS (National Industrial Chemicals Notification and Assessment Scheme) (2014f) *IMAP Group Assessment Report – Copper oxide: Human health tier II assessment*, NICNAS, accessed 03 June 2025.

NICNAS (National Industrial Chemicals Notification and Assessment Scheme) (2015*)* *IMAP Group Assessment Report – Antimony oxide: Human health tier II assessment*, NICNAS, accessed 03 June 2025.

NICNAS (National Industrial Chemicals Notification and Assessment Scheme) (2018)) *IMAP Group Assessment Report – Manganese: Human health tier II assessment*, NICNAS, accessed 03 June 2025.

Pothier MP, Lenoble V, Garnier C, Misson B, Rentmeister C and Poulain AJ (2020) 'Dissolved organic matter controls of arsenic bioavailability to bacteria', *Science of The Total Environment,* 716, pp 137118, doi:10.1016/j.scitotenv.2020.137118.

Rahman MA, Hasegawa H and Peter Lim R (2012) 'Bioaccumulation, biotransformation and trophic transfer of arsenic in the aquatic food chain', *Environmental Research,* 116, pp 118-135, doi:10.1016/j.envres.2012.03.014.

SWA (Safe Work Australia) (n.d.) *Hazardous Chemical Information System*, SWA website, Accessed 20 March 2025.

SWA (Safe Work Australia) (2023), Code of Practice: Managing Risks of Hazardous Chemicals in the Workplace, Safe Work Australia, Accessed 20 March 2025.

UNEP (2010). Final review of scientific information on lead. United Nations Environment Programme, Nairobi, Kenya. Accessed May 2025 at http://www.unep.org.

UNEP (2014). Lead and Cadmium, United Nations Environment Programme, Nairobi, Kenya. Accessed May 2025 at http://www.unep.org.

UNECE (United Nations Economic Commission for Europe) (2017). Globally Harmonized System of Classification and Labelling of Chemicals (GHS), Seventh Revised Edition. Accessed 05 May 2025.