Australian Government
Department of Health and Aged Care
Australian Industrial Chemicals Introduction Scheme

Acrylic acid and its salts and acyl derivatives

Evaluation statement (EVA00160)

31 March 2025

Draft

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Reason for the evaluation

Evaluation Selection Analysis indicated a potential environmental risk.

Parameters of evaluation

This evaluation considers the environmental risks associated with the industrial uses of acrylic acid, its acyl derivative and five salts of acrylic acid that are listed on the Australian Inventory of Industrial Chemicals (the Inventory).

Chemicals in this group have been assessed for their risks to the environment according to the following parameters:

- total domestic introduction volume of up to 9,999 tonnes/year
- industrial uses listed in the 'Summary of Use' section
- expected emission into sewage treatment plants (STPs) and air due to industrial use.

The evaluation of these substances has been conducted as a group as they have similar use patterns, are structurally similar and expected to dissociate or hydrolyse to form the acrylate anion in environmental waters and moist soils.

In this evaluation these chemicals will be referred to as

- acrylic acid (CAS RN 79-10-7)
- acryloyl chloride (CAS RN 814-68-6)
- magnesium acrylate (CAS RN 5698-98-6)

- calcium acrylate (CAS RN 6292-01-9)
- sodium acrylate (CAS RN 7446-81-3)
- ammonium acrylate (CAS RN 10604-69-0)
- zinc acrylate (CAS RN 14643-87-9).

Summary of evaluation

Summary of introduction, use and end use

The chemicals in this group mainly have site-limited applications with functional use as intermediates and monomers in the manufacture of polymers and other chemicals such as:

- acrylic acid esters
- polyacrylic acid
- polyacrylates
- other polymers
- co-polymers.

The manufactured products have a wide range of end uses including in:

- water treatment products, personal care products (cosmetics)
- adhesives and sealants
- paints and coatings
- leather
- textile
- paper processing
- cleaning products
- construction materials.

Typical residual contents of acrylic acid in these products are below 0.2%. Some adhesive and sealants products may contain up to 10% acrylic acid.

Available Australian data indicate that acrylic acid and its salts are introduced as neat chemicals or in solution for the manufacture of polymers, and as residues or ingredients within imported products. These chemicals are cumulatively used in high volumes (in the range of 1,000–9,999 tonnes). There is currently no specific information about the introduction of acryloyl chloride in Australia. Internationally, the use volumes exceed:

- 1,000,000 tonnes for acrylic acid
- 1,000 tonnes for magnesium and sodium acrylate
- 100 tonnes for calcium and zinc acrylate
- 10 tonnes for acryloyl chloride and ammonium acrylate.

Environment

Summary of environmental hazard characteristics

Based on the information presented in this evaluation and according to the environmental hazard thresholds stated in the Australian Environmental Criteria for Persistent, Bioaccumulative and/or Toxic Chemicals (DCCEEW n.d.-c), the organic components of chemicals in this group are:

- Not Persistent (Not P)
- Not Bioaccumulative (Not B)
- Toxic (T)

Environmental hazard classification

Chemicals in this group satisfy the criteria for classification according to the Globally Harmonised System of Classification and Labelling of Chemicals (GHS) for environmental hazards as follows (UNECE 2017). This evaluation does not consider classification of physical and health hazards.

Magnesium acrylate is:

Environmental Hazard	Hazard Category	Hazard Statement
Hazardous to the aquatic environment (acute / short-term)	Aquatic Acute 2	H401: Toxic to aquatic life
Hazardous to the aquatic environment (long-term)	Aquatic Chronic 3	H412: Harmful to aquatic life with long lasting effects

Acrylic acid, acryloyl chloride, calcium acrylate, sodium acrylate and ammonium acrylate are:

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 2	H411: Toxic to aquatic life with long lasting effects

Zinc acrylate is:

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

Chemicals in this group are widely used as intermediates and monomers to manufacture polymers and acrylate esters and are present as residues in manufactured products for a range of end uses. These chemicals are expected to be released to sewage treatment plants (STPs) through point source emissions from manufacturing sites and diffuse emissions from residual contents in end products. Chemicals remaining in STP effluents are released to surface waters. Acrylic acid and acryloyl chloride may also be emitted to air.

The organic components of these chemicals are not persistent in the environment and have a low potential for bioaccumulation. They are very toxic to freshwater algae.

Based on estimated concentrations in STP effluent, the substances are expected to be present in Australian surface waters at concentrations below levels of concern. The estimated risk quotient (RQ) for surface waters is less than 1. Therefore, current use of these chemicals is not expected to pose a significant risk to the environment.

Conclusions

The Executive Director proposes to be satisfied that the identified risks to the environment from the introduction and use of the industrial chemical can be managed.

Note:

1. Obligations to report additional information about hazards under Section 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

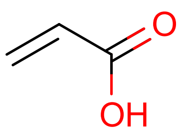
Grouping rationale

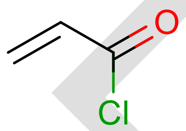
2-Propenoic acid, commonly known as acrylic acid, is a discrete chemical. It is part of a large group of chemicals containing the 2-propenoate or ‘acrylate’ structure, that are widely used as monomers for a broad range of applications. Acrylic acid is grouped with its acyl chloride and with its magnesium, calcium, sodium, ammonium, and zinc salts.

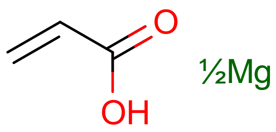
The acyl chloride of acrylic acid is 2-Propenoyl chloride or acryloyl chloride is. The other chemicals in the group are salts of acrylic acid where the counter cation is not expected to contribute to the environmental risk from industrial use of these chemicals. Magnesium, calcium, sodium, ammonium are ubiquitous to the environment. Zinc has been previously evaluated for environmental risk (AICIS 2024). Based on use patterns zinc acrylate is not expected to significantly contribute to the total zinc levels detected in the environment (see **Predicted environmental concentration (PEC)**).

The chemicals in this group are expected to dissociate or hydrolyse to form the acrylate anion in environmental waters and moist soils. Their fate and hazard characteristics are expected to be similar to acrylic acid. They also have similar uses to acrylic acid, mostly as intermediates or monomers in the production of acrylic ester monomers and polyacrylate polymers for various end products, including adhesives, sealants, paints and coatings.

Chemical identity

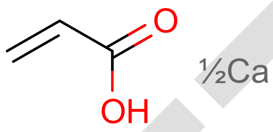
CAS number	79-10-7
CAS name	2-Propenoic acid
Molecular formula	$C_3H_4O_2$
Associated names	Acrylic acid Acroleic acid Vinylformic acid
Molecular weight (g/mol)	72.06
SMILES (canonical)	O=C(O)C=C
Structural formula	

CAS number	814-68-6
CAS name	2-Propenoyl chloride
Molecular formula	C_3H_3ClO
Associated names	Acryloyl chloride Acrylic acid chloride Acrylyl chloride
Molecular weight (g/mol)	90.51
SMILES (canonical)	O=C(Cl)C=C
Structural formula	

CAS number	5698-98-6
CAS name	2-Propenoic acid, magnesium salt (2:1)
Molecular formula*	$C_3H_4O_2$.½Mg
Associated names	Magnesium acrylate Acrylic acid, magnesium salt
Molecular weight (g/mol)*	168.43
SMILES (canonical)*	[Mg].O=C(O)C=C
Representative structure	

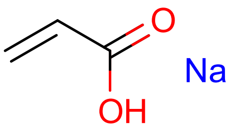
Additional chemical identity information

* This chemical is a salt and has been represented according to CAS nomenclature/identity conventions.

CAS number	6292-01-9
CAS name	2-Propenoic acid, calcium salt (2:1)
Molecular formula*	$C_3H_4O_2$.½Ca
Associated names	Calcium acrylate Acrylic acid, calcium salt
Molecular weight (g/mol)*	184.20
SMILES (canonical)*	[Ca].O=C(O)C=C
Representative structure*	

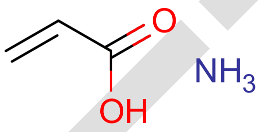
Additional chemical identity information

* This chemical is a salt and has been represented according to CAS nomenclature/identity conventions.

CAS number	7446-81-3
CAS name	2-Propenoic acid, sodium salt (1:1)
Molecular formula*	$C_3H_4O_2$.Na
Associated names	Sodium acrylate Acrylic acid, sodium salt
Molecular weight (g/mol)*	95.05
SMILES (canonical)*	[Na].O=C(O)C=C
Representative structure*	

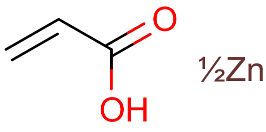
Additional chemical identity information

* This chemical is a salt and has been represented according to CAS nomenclature/identity conventions.

CAS number	10604-69-0
CAS name	2-Propenoic acid, ammonium salt (1:1)
Molecular formula*	$C_3H_4O_2.H_3N$
Associated names	Ammonium acrylate Acrylic acid, ammonium salt
Molecular weight (g/mol)*	89.09
SMILES (canonical)*	O=C(O)C=C.N
Representative structure*	

Additional chemical identity information

* This chemical is a salt and has been represented according to CAS nomenclature/identity conventions.

CAS number	14643-87-9
CAS name	2-Propenoic acid, zinc salt (2:1)
Molecular formula*	$C_3H_4O_2.½Zn$
Associated names	Zinc acrylate Acrylic acid, zinc salt
Molecular weight (g/mol)*	209.52
SMILES (canonical)*	[Zn].O=C(O)C=C
Representative structure*	

Additional chemical identity information

* This chemical is a salt and has been represented according to CAS nomenclature/identity conventions.

Relevant physical and chemical properties

Measured physical and chemical property data were retrieved from the registration dossiers for chemicals in this group under the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) legislation in the European Union (EU) (REACH n.d.-a; n.d.-c; n.d.-d; n.d.-e), the PubChem database (NCBI n.d.-c) and the EPI Suite experimental database (US EPA 2017). Estimated values were obtained through calculations using EPI Suite (US EPA 2017). Information for representative chemicals is tabulated below:

Chemical name	Acrylic acid	Acryloyl chloride	Magnesium acrylate
Physical form	Liquid	Liquid	Solid
Melting point	13°C	-69°C (calc.)	> 300°C
Boiling point	141°C	75°C	N/A
Vapour pressure	430 Pa (20 °C)	1,2 x 10^4 Pa	Negligible
Water solubility	1,000 g/L (miscible)	N/A**	964 g/L (21°C)
Henry's law constant	0.031 Pa.m^3/mol* (20 °C)	N/A**	Negligible
Ionisable in the environment?	Yes	Yes	Yes
pK_a	4.26	N/A**	4.26 (read across from acrylic acid)
log K_{OW}	0.46	N/A**	-1.87 (pH 6.9)
K_{OC}	6–137 (pH 5.2–7.5)	N/A**	6–137 (read-across from acrylic acid)

* The Henry's Law constant for acrylic acid was calculated from measured water solubility and vapour pressure data. Dissociation of acrylic acid to acrylate anions in water at environmentally relevant pH is expected to result in a lower effective Henry's law constant and low volatility from water and moist soils.

** Acryloyl chloride hydrolyses rapidly to acrylic acid in water and moist environments.

The salts of acrylic acid are expected to have very low vapour pressures because of their ionic nature. They are expected to be non-volatile and have negligible partitioning to air from water (Henry's Law constant).

The pH for the measurement of the log K_{OW} for acrylic acid was not reported. The log K_{OW} is; however, expected to be low for both the neutral and ionised forms.

Introduction and use

Australia

Acrylic acid has reported Australian uses as a binding agent in adhesives and as an intermediate in chemical and polymer manufacture (DCCEEW n.d.-a; NICNAS 2006). In a 2002 call for information, uses of acrylic acid in other industry sectors were reported, including in water treatment, plastics industry, paints and coatings industry, textile and leather processing, and cleaners industry. These reports most likely relate to the end uses of the manufactured chemicals or polymers rather than acrylic acid. Small amounts of residual monomeric acrylic acid may be present in polyacrylic acid and acrylate polymers. Concentrations up to 0.03% in coating products have been reported through a call for information.

The annual introduction volume of acrylic acid in Australia is in the range of 1,000–9,999 tonnes per year (t/year) based on information reported to the former National Industrial Chemicals Notification and Assessment Scheme (NICNAS) under previous calls for information (NICNAS 2006). This is expected to be made up of imports only as manufacture of acrylic acid in Australia has not been reported. Available Australian data indicate that acrylic acid and its salts are introduced as neat chemicals or in solution for the manufacture of polymers, and as residues or ingredients within imported products. Acrylic acid is listed on the National Pollutant Inventory (NPI) in threshold category 1, meaning that facilities using at least 10 t/year of acrylic acid are required to report to the NPI (DCCEEW n.d.-b). Aggregated usage data reported to the NPI are consistent with the volume range above.

World trade data suggest that the Australian import volume of acrylic acid and its salts was between 4,004 and 5,673 t/year for the years 2021–2023 (WITS n.d.-a; n.d.-b; WTO n.d.).

Information provided to AICIS under a call for information indicates that sodium acrylate and ammonium acrylate are manufactured from acrylic acid in Australia and are further used in the manufacture of related products. No other specific Australian use, import or manufacturing information has been identified for the remaining chemicals in this group.

International

Available information indicates that chemicals in this group are used worldwide mainly as intermediates and monomers in the manufacture of other substances such as acrylic esters (acrylates), polyacrylic acid, polyacrylates, and other polymers (NCBI n.d.-c; n.d.-d; n.d.-e; n.d.-f; Ohara et al. 2020; REACH n.d.-a; n.d.-b; n.d.-d; US EPA 2020).

Acrylate esters and polymers of acrylic acid are used to make plastic items, polymer emulsions and solutions for applications in construction, water treatment products, absorptive hygiene products, coatings, adhesives, printing inks, detergents, polishes (NCBI n.d.-a; OECD 2001) and cosmetics (Fiume 2002). Acrylic acid and its salts may be present as residual monomers in these products. Typical concentrations of residual acrylic acid are small: reported contents in polymeric products are generally in the range 0.0002–0.2% (OECD 2001).

Residual contents of acrylic acid ranging from 0.026 to 0.40%, with an average of 0.16%, have also been reported in polymeric products (EC Joint Research Centre 2002). In polymers used for cosmetic formulations, typical levels of residual acrylic acid are in the range 0.001–0.1%, and the highest content of 3.3% was found in a sodium polyacrylate polymer (Fiume 2002). Higher acrylic acid contents (up to 10%) are present in some adhesives and sealants (CPID n.d.; Sverdrup et al. 2000).

There may be other uses of acrylic acid, but these are expected to be minor. As in Australia, some use information is attributed to acrylic acid, but it more likely relates to the functional and end uses of the manufactured chemicals and polymers. In 2004, the end use pattern of acrylic acid in the USA consisted in 56% manufacture of acrylate esters, 41% manufacture of polyacrylic aid and polyacrylates, and 3% other end uses (NCBI n.d.-b).

As detailed above, the acrylate salts and acyl chloride in this group are used mainly as intermediates and monomers. In addition, sodium acrylate may have minor uses in paints and coatings, construction and building materials, and personal care and cleaning products (CPID n.d.; NCBI n.d.-f). Magnesium acrylate has reported uses in adhesives and sealants (REACH n.d.-c) and as a grouting agent in the construction industry (EC Joint Research Centre 2002; OECD 2001), although another source indicates that the grouting agent contains acrylic acid (Sverdrup et al. 2000). Zinc acrylate is used in the manufacture of rubber, resins, and plastic products (NCBI n.d.-g; REACH n.d.-e; US EPA 2020).

Global acrylic acid use was estimated at 5.75 million tonnes (t) in 2014 (Chen et al. 2019). In Europe the chemical is registered for use at 1,000,000–10,000,000 t/year (ECHA n.d.), and the reported annual use volumes are 454,000–2,270,000 t/year for the US (US EPA 2020), more than 1,000 t/year for Canada (OECD n.d.) and 273,347 t in 2022 for Japan (NITE n.d.).

The remaining chemicals in this group have lower reported use volumes. In Europe, REACH registration volumes are 1,000–10,000 t/year are for magnesium acrylate, 100,000–1,000,000 t/year for sodium acrylate and 100–1,000 t/year for zinc acrylate (REACH n.d.-c; n.d.-d; n.d.-e). In the USA, reported use volumes are 42.8 t/year for acryloyl chloride, less than 454 t/year for magnesium acrylate, 454–4,128 t/year for calcium acrylate, 454–9,072 t/year for sodium and zinc acrylate, and 17–31.8 t/year for ammonium acrylate (US EPA 2020). Use volumes for Japan are 1–1,000 t/year for acryloyl chloride and 1,000–2,000 t/year for acrylate salts (NITE n.d.).

Existing Australian regulatory controls

AICIS

No known restrictions have been identified.

Environment

Acrylic acid is listed on the National Pollutant Inventory (NPI) (DCCEEW n.d.-c) in threshold category 1, meaning that facilities using at least 10 t/year of acrylic acid are required to report to the NPI (DCCEEW n.d.-b).

The industrial use of the remaining chemicals in this group is not subject to any specific national environmental regulations.

International regulatory status

United Nations

This group of chemicals is not currently identified as a Persistent Organic Pollutant (POP) (UNEP 2001), ozone depleting substance (UNEP 1987), or hazardous substance for the purpose of international trade (UNEP & FAO 1998).

OECD

Acrylic acid was sponsored by Germany under the Cooperative Chemicals Assessment Programme (CoCAP). A Screening Information Data Set (SIDS) Initial Meeting Assessment (SIAM 13) in 2001 agreed that the chemical was a candidate for further work, with the conclusion that there is a need for limiting the risks and that risk reduction measures which are already being applied shall be considered (OECD, 2001). A Summary Risk Assessment Report for acrylic acid was published by the EU in 2002 (EC Joint Research Centre 2002).

Sodium acrylate and zinc acrylate are OECD HPV chemicals (OECD, n.d.) but are not yet sponsored for assessment.

Environmental exposure

Site-limited and commercial uses of chemicals in this group have the potential to result in both diffuse and point source emissions to the environment.

Chemicals in this group are expected to be used mainly as monomers and intermediates in the manufacture of polymers and acrylate esters. The manufactured polymers and chemicals are in turn used in various applications (for example polyacrylic acid for water treatment), further transformed into other chemicals and polymers, or formulated into end products including adhesives, paints, coatings and personal care products.

The main potential point sources of emissions to the environment are manufacturing sites where chemicals in this group are used as reagents and monomers. Facilities that use acrylic acid in tonnages exceeding 10 t/year are required to report to the NPI emissions to air, water, and land, as well as transfers to STPs (DCCEEW n.d.-b). Consequently, environmental exposure information for the main manufacturing sites that use acrylic acid is available on the NPI database (DCCEEW n.d.-a). Additionally, emissions information was obtained through a call for information and from operating site licences. 8 facilities have been reporting acrylic acid emissions to the NPI in recent years. Their main activities are the manufacture of water treatment chemicals (flocculants and corrosion inhibitors) and the manufacture of polymers, resins and coatings. Total emissions to air of 260–304 kg/year were reported to the NPI in 2020–2023 across these facilities. Limits to total volatile organic compounds (VOCs) emissions of < 475 t/year and < 428 mg/m^3 apply to some of these facilities under their operating licences with the relevant state Environment Protection Agency (EPA NSW n.d.; EPA Victoria n.d.; Queensland Government n.d.). No direct emissions of acrylic acid to land or water on facility sites have been reported to the NPI.

Liquid waste containing acrylic acid is often reused on site. One facility reported transfers of 8.6–55 kg/year to off-site sewerage in 2020–2023 (DCCEEW n.d.-a). Another facility reported discharge of reactor washings to a local STP through a tradewaste agreement, with concentrations of acrylic acid and acrylate salts estimated to be below 1.8 µg/L in the wastewater. Based on comparative volume information from different sources, the facilities discussed above are expected to be the main potential point sources of environmental exposure.

Diffuse emissions of chemicals in this group to the environment may occur from the use of products containing these chemicals as ingredients or residues.

Environmental exposure from uses in adhesives and sealants is expected to be insignificant, as components of these products are designed to be bound in a matrix once the product is cured. Cleaning of equipment and improper disposal of product residues may lead to the release of small amounts of these chemicals to wastewaters, which are expected to be treated in municipal STPs.

Other products containing acrylic acid residues, such as cosmetics and personal care products, may be disposed of down the drain. Low residual contents of acrylic acid in these products limit the extent of release to the environment. A high proportion of the introduction volume of chemicals in this group is expected to be chemically transformed, resulting in a significantly reduced volume of acrylic acid and salts available for potential release to the environment.

Mitigation of acrylic acid in STPs through degradation processes is estimated to reach 87% (Struijs 1996). The remaining material will be released in STP effluents.

While acrylic acid occurs naturally in certain algae, and free acrylic acid contents of up to 7.4% dry weight (dw) have been measured in the marine alga *Phaecystis* (REACH n.d.-a), the highest environmental concentrations of acrylic acid are expected to be in locations affected by anthropogenic releases.

Environmental fate

Dissolution, speciation and partitioning

Chemicals in this group are expected to be released into the water compartment where they will dissociate into an acrylate anion and a positive counter ion. Acrylic acid and acryloyl chloride can also be released to the air compartment from which they may be removed through rain.

Acrylic acid and acryloyl chloride are neutral organic chemicals that are highly volatile. Salts of acrylic acid have very low volatility due to their ionic nature. All chemicals in this group are readily soluble in water. Acryloyl chloride is an acyl halide, a class of compounds that hydrolyses rapidly in water to yield the parent acid and hydrogen halide (NCBI n.d.-c). Chemicals in this group dissociate into the acrylate anion and respective counter cations at environmentally relevant pH. Dissociation is expected to result in low volatility from water and moist soil. These chemicals have low lipophilicity, with log K_{OW} values of ≤ 0.46 and soil adsorption coefficients (K_{OC}) of ≤ 137, indicating they will have high to very high mobility in soil.

Following release to surface waters in STP effluent, calculations with a fugacity model (Level III approach) with sole release to the water compartment predict that acrylic acid will remain in water, with negligible amounts partitioning to air, sediment and soil (< 0.02%) (US EPA 2017). Predominant dissociation into the anionic form of acrylic acid at environmentally relevant pH is expected to further increase the affinity of the chemical for the water compartment.

When released to the air compartment, acrylic acid and acryloyl chloride are expected to predominantly remain in air (71–95%), with some partitioning to soil (0.4–16%) and water (4.5–13%) (US EPA 2017).

Degradation

Based on available evidence, the organic components of this chemical group are not persistent in the environment.

Acrylic acid is readily biodegradable in water. A closed bottle degradation study according to OECD TG 301 D monitoring O_2 consumption resulted in 81% degradation of acrylic acid within 28 d and met the 14 day window (REACH n.d.-a). This result is supported by multiple other tests that show rapid ready and inherent biodegradation of acrylic acid in water (REACH n.d.-a).

The remaining chemicals in the group are expected to dissociate or hydrolyse to the acrylate anion in water and their organic components are therefore also expected to be readily biodegradable. This is supported by a biodegradation study of magnesium acrylate according to OECD TG 301 A that resulted in 99% degradation (DOC removal) after 11 d, fulfilling the 10 day window (REACH n.d.-c).

Acrylic acid biodegrades rapidly in soils. In a soil degradation study monitoring CO_2 evolution in sandy loam (U.S. EPA Pesticide Assessment Guidelines, Subdivision N, § 162-1), acrylic acid mineralised to 73% in 3 days (REACH n.d.-a). The DT50 of the degradation process was determined to be < 1 day.

Abiotic processes are not expected to contribute significantly to the degradation of acrylic acid in water and moist soils. The chemical does not contain any hydrolysable groups and was observed to be stable to hydrolysis at pH 3, 7, and 11 at 25°C for 28 days, with DT50s estimated at over a year (REACH n.d.-a).

As acryloyl chloride hydrolyses to acrylic acid in water, it is expected to share the degradation fate of acrylic acid and be readily biodegradable. Hydrolysis is expected to be rapid, with a half-life of seconds to minutes (NCBI n.d.-c).

Similarly, due to dissociation into the acrylate anion in water, the acrylate salts are expected to share the degradation fate of acrylic acid in water.

Acrylic acid and acryloyl chloride are expected to degrade in the atmosphere through reaction with photogenerated hydroxyl radicals. Calculations performed assuming a typical hydroxyl radical concentration of 1.5×10^6 molecules/cm^3 resulted in half-lives of 13.2–13.9 h (US EPA 2017). Calculations based on reaction of the substances with atmospheric ozone (7×10^{11} molecules/cm^3) returned half-lives of 6.55 d (US EPA 2017).

Bioaccumulation

Organic components of chemicals in this group have a low potential to bioconcentrate in aquatic organisms. Calculated bioconcentration factors (BCFs) are below the Australian categorisation threshold for bioaccumulation hazards in aquatic organisms (DCCEEW n.d.-d), and experimentally determined and calculated log K_{OW} values are below the threshold of 4.2 (EPHC n.d.).

No measured BCF values are available for chemicals in this group. Calculations show BCFs in a range of 0.90–3.16 L/kg (US EPA 2017).

Environmental transport

Chemicals in this group are not expected to undergo long range transport based on their short half-lives in the environment.

Predicted environmental concentration (PEC)

A total PEC of 0.81 µg/L for acrylic acid and acrylate anions is estimated using standard exposure modelling for the release of these chemicals from STPs to surface waters. This PEC represents the worst case scenario, considering releases from both diffuse and point sources.

For point sources emissions, a PEC of 0.23 µg/L is estimated for surface waters from release of wastewaters to STPs. This PEC estimation is based on the maximum concentration of acrylic acid and salts in wastewater of 1.8 µg/L reported at one facility, a removal rate of 87% in STP, and no dilution of STP effluents in rivers (Struijs 1996). Another facility in a coastal area reported transfers of 8.6–55 kg/year of acrylic acid to off-site sewerage (DCCEEW n.d.-a). Final concentrations of acrylic acid after treatment are unknown, but they are unlikely to be of concern considering expected dilution and removal in STP, along with significant dilution at the STP outfall in the ocean. Other facilities using large volumes of acrylic acid are assumed not to release the chemical to wastewaters based on reported information (DCCEEW n.d.-a).

For diffuse emissions, a PEC of 0.81 µg/L is estimated for surface waters after treatment in STPs. This PEC is based on the volume of acrylic acid and salts estimated to remain in end products after manufacture of polymers and other products. A total introduction volume of 5,773 t/year for chemicals in this group is considered, composed of the maximum trade volume of 5,673 tonnes for acrylic acid and its salts and a default volume of 100 tonnes for acryloyl chloride. Based on available information on residual acrylic acid, an average content of 0.2% in end products is considered, leading to an estimated volume of 11.5 tonnes of acrylic acid and salts remaining in end products. These end products are used in a range of applications, from low to high release uses, for example paints and coating products and personal care products. The residual volume is conservatively assumed to be entirely released to sewers across Australia and treated in STPs. A PEC of 0.81 µg/L is calculated based on release of 11.5 t/year, 87% removal in STP, and no dilution of the STP effluent (Struijs 1996). Adhesives and sealants with higher acrylic acid contents of up to 10% were not considered in this PEC estimation, as these end uses are not expected to result in significant release to the environment once the products are cured.

A PEC for emissions to air was not estimated.

No Australian environmental monitoring data are available. International monitoring data are scarce. Concentrations of acrylic acid reaching up to 5 mg/L were measured in drainage water from a tunnel construction site in Norway. The high concentrations resulted from the use of an acrylic acid-containing grouting agent in suboptimal conditions, with a high flow of water impeding the sealing process (Sverdrup et al. 2000). This case is not expected to be representative of typical use scenarios of acrylic acid in Australia.

The use of zinc acrylate is not expected to contribute significantly to background level of zinc(2+) ions in the environment or elevated levels of zinc that have been detected in some areas in Australia. The use volume of zinc acrylate in Australia is expected to be less than

100 tonnes and is significantly lower than other zinc-containing industrial chemicals (AICIS 2024). The end use of zinc acrylate in polymeric and rubber products is also expected to result in limited release to the environment.

Environmental effects

Effects on aquatic life

Based on the fact that all chemicals in this group form an acrylate ion once dissolved in water, available acute and chronic toxicity endpoints for acrylic acid have been used for read across to all seven chemicals in this evaluation.

Available ecotoxicity endpoints for magnesium acrylate are higher than acrylic acid under laboratory test conditions. However, these results may not be reflective of the toxicity of magnesium acrylate under environmental conditions. Ion exchange and dissociation processes, as well as environmental parameters such as water hardness, pH, and mineral composition, may alter the toxicity of magnesium acrylate in environmental waters (Mount et al. 2016). In some environmental conditions it is expected that the toxicity of the acrylate anion will drive the toxicity of magnesium acrylate in solution, as measured for acrylic acid. Consequently, the endpoints for acrylic acid are conservatively assumed to be representative of the toxicity of the acrylate component of all chemicals in this group. Measured ecotoxicity endpoints for magnesium acrylate are reported below for GHS classification purposes.

The ecotoxicity of zinc(2+) ions has been previously assessed. They are expected to be more toxic than the acrylate anion at all trophic levels (AICIS 2024).

As all other counter cations are ubiquitous in the environment, the environmental effects assessment focuses on the toxicity of the acrylate component.

Acute toxicity

The following measured median lethal concentration (LC50) and effective concentration (EC50) values were retrieved from the registration dossiers for acrylic acid (AA) and magnesium acrylate (MA) submitted to ECHA under REACH legislation (REACH n.d.-a; n.d.-c):

Taxon	Endpoint	Method
Fish	AA: 96h LC50 = 27 mg/L	*Oncorhynchus mykiss* (rainbow trout) Flow-through conditions, measured concentrations EPA OTS 797.1400
Fish	MA: 96h LC50 > 97 mg/L	*Danio rerio* (zebrafish) Static conditions, measured concentrations OECD TG 203
Invertebrate	AA: 48h EC50 = 47 mg/L	*Daphnia magna* (water flea) Immobilisation Static conditions, nominal concentrations EU Method C.2
Invertebrate	MA: 48h EC50 > 110 mg/L	*D. magna* (water flea) Mobility Static conditions, measured concentrations OECD TG 202
Algae	AA: 72h EC50 = 0.13 mg/L	*Desmodesmus subspicatus* (green alga) Growth Static conditions, nominal concentrations EU Method C.3
Algae	MA: 72h EC50 = 2.37 mg/L	*Raphidocelis subcapitata* (green alga) Growth Static conditions, measured concentrations OECD TG 201

Acrylic acid is more acutely toxic to freshwater algae than to freshwater fish and invertebrates by over two orders of magnitude. This difference has been observed in multiple freshwater species and through independent studies (EC Joint Research Centre 2002; REACH n.d.-a).

Two independent studies on the toxicity of acrylic acid to the green alga *Desmodesmus subspicatus* found comparable EC50 and EC10 values. The pH of the test media varied from 4.5 to 10 in one of the studies, while it was in the range of 7.5 to 9.4 in the other study, indicating that the toxicity was not due to the acidification of the test medium (EC Joint Research Centre 2002; REACH n.d.-a).

Marine species are less sensitive to acrylic acid than freshwater species. A 96h LC50 of 236 mg/L, a 48h LC50 of 115 mg/L and a 72h EC50 of 105 mg/L have been measured in standard tests for marine fish, invertebrate and algae, respectively (REACH n.d.-a; Sverdrup et al. 2001). Additional screening tests with 10 species of marine algae resulted in 2 day to 5 day EC50 values of 50 to > 320 mg/L (Sverdrup et al. 2001). The higher toxicity of acrylic acid to freshwater algae compared to other trophic levels does not extend to marine species.

Acrylic acid has not demonstrated toxic effects towards amphibians. In a toxicity study with the African Clawed Frog (*Xenopus laevis*) under semi-static conditions, a 4 d LC50 of 5,488 mg/L was determined (Dawson et al. 1996).

Chronic toxicity

The following measured no-observed effect concentration (NOEC) and 10% effective concentration (EC10) values were retrieved from the registration dossiers for acrylic acid (AA) and magnesium acrylate (MA) submitted to ECHA under REACH legislation (REACH n.d.-a; n.d.-c):

Taxon	Endpoint	Method
Fish	AA: 45d NOEC ≥ 10.1 mg/L	*Oryzias latipes* (medaka) Mortality Flow-through conditions, measured concentrations OECD TG 210
Invertebrates	AA: 21d NOEC = 3.8 mg/L	*D. magna* (water flea) Immobilisation Flow-through conditions, measured concentrations EPA OTS 797.1330
Algae	AA: 72h EC = 0.03 mg/L	*D. subspicatus* (green alga) Growth Static conditions, nominal concentrations EU Method C.3
Algae	MA: 72h EC10 = 0.5 mg/L	*R. subcapitata* (green alga) Growth Static conditions, measured concentrations OECD TG 201

As observed with acute effects, the chronic toxicity of acrylic acid to algae is two orders of magnitude higher than its toxicity to fish and invertebrates.

Effects on terrestrial life

A 14 d study with acrylic acid following guideline EU Method C.8 (nominal concentrations) reported an LC50 of > 1,000 mg/kg soil dw for the earthworm *Eisenia fetida* (REACH n.d.-a).

In a study of wild caught redwing blackbirds (*Agelaius phoeniceus*) that were exposed to acrylic acid through gavage, a 7 d LD50 of ≥ 98 mg/kg body weight (bw) was observed (REACH n.d.-a).

Predicted no-effect concentration (PNEC)

A PNEC for acrylic acid of 3 µg/L was derived from the measured algae chronic ecotoxicity endpoint (72 h EC10 = 30 µg/L) using an assessment factor of 10. This assessment factor was selected as reliable chronic ecotoxicity data are available over 3 trophic levels. The PNEC of 3 µg/L is also used for the acryloyl chloride and acrylate salts, as it is representative of no-effect concentrations for the acrylic acid and acrylate components in all chemicals in this group.

Categorisation of environmental hazard

It is not currently possible to categorise the environmental hazards of metals and other inorganic chemicals according to standard persistence, bioaccumulation, and toxicity (PBT) hazard criteria. 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 and biota (UNECE 2017). Therefore, environmental hazard categorisation according to domestic PBT criteria has only been performed for the organic components (acrylic acid and acrylate anion) of the salts in this group. The categorisation of the environmental hazards of the organic components of chemicals in this group according to domestic environmental hazard thresholds (DCCEEW n.d.-d) is presented below:

Persistence

Not Persistent (Not P). Based on measured degradation studies on acrylic acid, the organic components of all chemicals in this group are categorised as Not Persistent.

Bioaccumulation

Not Bioaccumulative (Not B). Based on low calculated bioconcentration factors (BCF) in fish and low measured log K_{OW} values, the organic components of all chemicals in this group are categorised as Not Bioaccumulative.

Toxicity

Toxic (T). Based on algal acute ecotoxicity values below 1 mg/L and algal chronic ecotoxicity values below 0.1 mg/L for acrylic acid, the organic components of all chemicals in this group are categorised as Toxic.

GHS classification of environmental hazard

Suitable aquatic toxicity information for classification purposes is available for acrylic acid and magnesium acrylate. These chemicals are classified based on the information reported in the ‘Effects on aquatic life’ section above.

No aquatic toxicity data are available for acryloyl chloride, calcium acrylate, sodium acrylate and ammonium acrylate. These chemicals are expected to hydrolyse or dissociate into acrylate anions and the respective calcium, sodium, or ammonium counterions. As these cations are ubiquitous in the environment and less toxic to aquatic life than acrylic acid, the toxicity of these chemicals is expected to be driven by the acrylate component. Based on available endpoints, magnesium acrylate is less toxic than acrylic acid. However, the toxicity of salts is affected by background water chemistry, including hardness and pH (Mount et al. 2016).
The toxicity endpoints measured for the magnesium salt may not be representative of all environmental conditions, and their relevance to other salts of acrylic acid is unknown. Consequently, in the absence of specific toxicity data for calcium, sodium and ammonium acrylates, their GHS classification is conservatively based on read across from acrylic acid rather than magnesium acrylate.

The aquatic hazards of zinc acrylate are based on the ecotoxicity values for zinc(2+) as identified in the published AICIS evaluation Environmental Fate and Effects of Zinc Ions (AICIS 2024). This was in accordance with the classification procedure for metals and metal compounds under the GHS (UNECE 2017). The lowest median effective concentration (EC50) of the dissolved zinc(2+) ion is 1.8 µg/L The classifications for zinc acrylate were made after correcting the dissolved zinc(2+) ion endpoints for the molecular weight of the zinc acrylate salt. In this case the toxicity of the chemical is expected to be driven by the zinc ion as it is more toxic to aquatic life than acrylic acid.

Environmental risk characterisation

Based on the PEC and PNEC values determined above, the following Risk Quotient (RQ = PEC ÷ PNEC) has been calculated for the total release of acrylic acid and salts from industrial uses of chemicals in this group to surface waters:

Compartment	PEC	PNEC	RQ
Surface water	0.81 µg/L	3 µg/L	0.27

Given that the calculated RQ value is less than 1, these chemicals are not expected to pose a significant risk to the aquatic environment. Estimated environmental concentrations are below levels likely to cause harmful effects to aquatic life in typical environmental conditions.

The RQ above is calculated for release to rivers. The RQ for release to marine waters is expected to be significantly lower due to higher dilution in ocean water and lower toxicity of acrylic acid to saltwater species.

While acrylic acid and acryloyl chloride are emitted to air, it is not possible to calculate a PNEC for air. As a result, no RQ for the release of these chemicals to air has been calculated.

The risk for the soil compartment is low as no significant exposure through this compartment is expected and no adverse effects to earthworms have been observed.

Magnesium, calcium, sodium, ammonium, and zinc(2+) are ubiquitous cations in the environment. Industrial uses of acrylate salts are not expected to significantly contribute to levels of the corresponding cations in the environment.

Uncertainty

This evaluation was conducted based on a set of information that may be incomplete or limited in scope. Some relatively common data limitations can be addressed through use of conservative assumptions (OECD 2019) or quantitative adjustments such as assessment factors (OECD 1995). Others must be addressed qualitatively, or on a case-by-case basis (OECD 2019).

The most consequential areas of uncertainty for this evaluation are:

- Incomplete information is available on the end uses and use volumes of these chemicals in Australia. Some end uses reported in Australia and internationally are expected to be end uses of the transformation products of acrylic acid (acrylate esters and polymers) and were assumed to be wrongly attributed to acrylic acid. Acrylic acid is expected to be present only as a residual monomer in these products.

- Available data indicates that manufacturing facilities using these chemicals in this evaluation result in limited emissions to air and low concentrations of acrylic acid and its salts in wastewaters transferred to STPs. The environmental exposure may need to be re-assessed basis if new information becomes available suggesting that releases from facilities are higher than expected
- The PEC for diffuse emissions has been calculated based on introduction volumes of neat chemical into Australia. This means that the introduction volume of acrylic acid within products has not been considered. Re-evaluation may be required if releases from imported products results in significant releases to the environment.
- No use volume is available for acryloyl chloride. A default volume of 100 t/year was assumed for this chemical
- No relevant Australian environmental monitoring data are available. The outcomes of this evaluation may change if information shows that environmental concentrations exceed the estimates in this evaluation.
- Use volumes for zinc acrylate are not available. Although zinc(2+) ions are very toxic to aquatic life, industrial uses of zinc acrylate are assumed not to significantly increase background levels of zinc in the environment. The risk related to the release of zinc ions may need to be reassessed if information on use volumes and release of zinc acrylate becomes available.

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