Ammonium Bifluoride (CAS# 1341-49-7) Certified GreenScreen® Assessment

Prepared for
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GreenScreen® Assessment for Ammonium Bifluoride (CAS# 1341-49-7)

Method Version: GreenScreen Version 1.3[1]

Assessment Type:[2] **Certified**

Chemical Name: Ammonium Bifluoride

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Confirm Application of the Disclosure and Assessment Rules and Best Practice:[3] N/A

Chemical Name (CAS#): Ammonium Bifluoride (CAS# 1341-49-7)

Also Called:

Ammonium hydrogen fluoride, Ammonium hydrogen difluoride, Ammonium acid fluoride

Chemical Structure: $[NH_4][HF_2]$

[1] Use GreenScreen Assessment Procedure (Guidance) v1.3 (March 2016).
[2] GreenScreen reports are either "UNACCREDITED" (by unaccredited person), "AUTHORIZED" (by Authorized GreenScreen Practitioner), "CERTIFIED" (by Licensed GreenScreen Profiler or equivalent), or "CERTIFIED WITH VERIFICATION" (Certified or Authorized assessment that has passed GreenScreen Verification Program)
[3] See GreenScreen Guidance v1.3.

Suitable Analogs or Moieties Used in This Assessment (CAS #s):

Ammonium sulfate (Chemistry Abstracts Service [CAS]# 7783-20-2), ammonium chloride (CAS# 12125-02-9), sodium fluoride (CAS# 7681-49-4), potassium bifluoride (CAS# 7789-29-9), sodium bifluoride (CAS# 1333-83-1), ammonium fluoride (CAS# 12125-01-8), and hydrofluoric acid (CAS# 7664-39-3). Information about fluorides in general was also used.

Several surrogates were identified to assist in filling data gaps for multiple endpoints, as indicated in Table 1. These compounds are considered appropriate and relevant surrogates because they yield similar dissociation products as ammonium bifluoride in solution. As discussed below, ammonium bifluoride dissociates into multiple ionic species in solution, including ammonium, bifluoride, and fluoride. Each of the surrogates accounts for at least one of these ionic species. Ammonium sulfate, ammonium chloride, and ammonium fluoride yield ammonium; sodium fluoride, ammonium fluoride, and hydrofluoric acid yield fluoride; and potassium bifluoride and sodium bifluoride yield bifluoride and fluoride.

Chemical Structure(s)

Table 1 Chemical Structures of Surrogates Used in the GreenScreen Assessment of Ammonium Bifluoride (CAS# 1341-49-7)

Surrogate Name (CAS#)	Structure	Endpoint(s) Assessed
Ammonium Sulfate (CAS# 7783-20-2)	$[NH_4][SO_4]$	Carcinogenicity, Mutagenicity/Genotoxicity, Reproductive Toxicity, Systemic Toxicity/Organ Effects (repeated dose), Acute Aquatic Toxicity, Chronic Aquatic Toxicity, Persistence, Bioaccumulation
Ammonium Chloride (CAS# 12125-02-9)	$[NH_4][Cl]$	Mutagenicity/Genotoxicity, Developmental Toxicity, Acute Aquatic Toxicity, Chronic Aquatic Toxicity, Persistence
Sodium Fluoride (CAS# 7681-49-4)	NaF	Carcinogenicity, Mutagenicity/Genotoxicity, Reproductive Toxicity, Developmental Toxicity, Endocrine Activity, Systemic Toxicity/Organ Effects (repeated dose), Neurotoxicity (repeated dose), Skin Sensitization, Acute Aquatic Toxicity, Chronic Aquatic Toxicity, Persistence
Potassium Bifluoride (CAS# 7789-29-9)	$[K][HF_2]$	Systemic Toxicity/Organ Effects (repeated dose), Persistence
Sodium Bifluoride (CAS# 1333-83-1)	$[Na][HF_2]$	Mutagenicity/Genotoxicity, Systemic Toxicity/Organ Effects (single dose), Systemic Toxicity/Organ Effects (repeated dose), Neurotoxicity (repeated dose), Persistence
Ammonium Fluoride (CAS# 12125-01-8)	$[NH_4][F]$	Acute Aquatic Toxicity, Chronic Aquatic Toxicity, Persistence
Hydrofluoric Acid (CAS# 7664-39-3)	HF	Acute Aquatic Toxicity, Persistence, Bioaccumulation
Fluorides (no CAS#)	F^-	Endocrine activity, Systemic Toxicity/Organ Effects (repeated dose), Neurotoxicity (repeated dose)

Note:
CAS = Chemistry Abstracts Service.

Notes Related to Production-Specific Attributes:[4] Not Applicable

For Inorganic Chemicals and Relevant Particulate Organics

Define Properties:

1. **Particle Size:** Unknown, variable
2. **Structure:** Crystalline (Papcun, 2000)
3. **Mobility (*e.g.*, water solubility, volatility):** Readily soluble in water (Papcun, 2000; NLM, 2006)
4. **Bioavailability:** Bioavailable (dose unknown)[5]

Identify Applications/Functional Uses:

1. Additive for acidizing oil wells (Papcun, 2000; Solvay America, Inc., 2013)
2. Etching agent for silicon wafers and glass (Papcun, 2000; Solvay America, Inc., 2013)
3. Neutralizer for alkalis and remover of iron stains in commercial laundries and textile pants (Papcun, 2000; Solvay America, Inc., 2013)
4. Cleaning and etching agent for metals (Solvay America, Inc., 2013)
5. Agent in other metal treatments: additive in metal pickling solutions, acid dips for steel, activator solution for nickel plating, and formulations for anodizing aluminum; corrosion resistance treatment for magnesium and its alloys (Papcun, 2000)
6. Cleaning agent for brick and ceramics (Solvay America, Inc., 2013)
7. Preservative for wood (Papcun, 2000)
8. Fungicide (Spectrum Chemical Mfg. Corp., 2015)

[4] Note any composition or hazard attributes of the chemical product relevant to how it is manufactured. For example, certain synthetic pathways or processes result in typical contaminants, by-products or transformation products. Explain any differences between the manufactured chemical product and the GreenScreen assessment of the generic chemical by CAS#.

[5] No information was located regarding the bioavailability of ammonium bifluoride. Fluorides are absorbed by humans following exposure by inhalation, ingestion, and dermal contact, but the bioavailable dose *via* these routes is unknown (NLM, 2006; ATSDR, 2003, p. 258). The ammonium ion is also expected to be bioavailable, as it plays an important role in the nitrogen cycle and can be transported across biological membranes (Kleiner, 1981).

GreenScreen Benchmark Score and Hazard Summary Table[6-9]

Ammonium bifluoride is assigned a **Benchmark Score of 1** based on high repeated exposure systemic toxicity and neurotoxicity in combination with very high persistence. Although data gaps were evident for neurotoxicity – single exposure and respiratory sensitization, all data requirements were met for Benchmark 1 classification.

If we consider the worst case benchmarking scenario based on the reported data gaps, neurotoxicity – single exposure would be designated a Very High Hazard (vH), and respiratory sensitization would be designated a High Hazard (H). Even under this worst case scenario, ammonium bifluoride would still receive a Benchmark 1 classification.

Table 2 GreenScreen (v.1.3) Hazard Profile Summary Table – Ammonium Bifluoride (CAS# 1341-49-7)

Group I Human					Group II and II* Human									Ecotox		Fate		Phys.	
C	M	R	D	E	A	ST		N		SnS*	SnR*	IrS	IrE	AA	CA	P	B	Rx	F
						sgl	rpt*	sgl	rpt*										
L	*M*	*M*	*L*	*M*	**H**	**M**	*H*	Dg	*H*	*L*	Dg	**vH**	**vH**	*M*	*M*	**vH**	*vL*	*M*	*L*

Notes:
CAS = Chemistry Abstracts Service.
Hazard levels (Very High [vH], High [H], Moderate [M], Low [L], Very Low [vL]) in *italics* reflect estimated values, authoritative B lists, screening lists, weak analogues, and lower confidence.
Hazard levels in **bold** font are used with good quality data, authoritative A lists, or strong analogues.
Group II Human Health endpoints differ from Group II* Human Health endpoints in that they have four hazard scores (*i.e.*, vH, H, M, and L) instead of three (*i.e.*, H, M, and L) and are based on single exposures instead of repeated exposures.

[6] See Appendix A for a glossary of hazard endpoint acronyms.
[7] See Appendix B for the PHAROS results for ammonium bifluoride and its transformation products.
[8] For inorganic chemicals only, see GreenScreen Guidance v1.3 Section 13. (Exceptions for Persistence).
[9] For Systemic Toxicity and Neurotoxicity, repeated exposure data are preferred. Lack of single exposure data is not a Data Gap when repeated exposure data are available. In that case, lack of single exposure data may be represented as NA instead of DG. See GreenScreen Guidance v1.3 Section 8.2.1.

Environmental Transformation Products and Ratings[10]

Identify feasible and relevant environmental transformation products (*i.e.*, dissociation products, transformation products, valence states) and/or moieties of concern.[11]

Table 3 Environmental Transformation Products and Ratings

Functional Use	Life Cycle Stage	Transformation Pathway	Environmental Transformation Products	CAS#	Feasible and Relevant?	GreenScreen List Translator Score
N/A	Use, End	Dissolution in Aqueous Media	$Ammonium_{(aq)}$	14798-03-9	Yes	Not listed
N/A	Use, End	Dissolution in Aqueous Media	$Bifluoride_{(aq)}$	18130-74-0	Yes	Not listed
N/A	Use, End	Dissolution in Aqueous Media	$Fluoride_{(aq)}$	16984-48-8	Yes	LT-P1
N/A	Use, End	Dissolution in Aqueous Media	Ammonium $Fluoride_{(aq)}$	12125-01-8	Yes	LT-UNK
N/A	Use, End	Dissolution in Aqueous Media	Hydrofluoric $Acid_{(aq)}$	7664-39-3	Yes	LT-P1/LT-UNK[a]
N/A	Use, End	Dissolution in Aqueous Media, Followed by Precipitation	Calcium Fluoride	7789-75-5	Yes	LT-UNK
N/A	Use, End	Dissolution in Aqueous Media, Followed by Precipitation	Magnesium Fluoride	7783-40-6	Yes	LT-UNK

Notes:
CAS = Chemistry Abstracts Service; N/A = Not Applicable.
(a) The Pharos List Translator provides a GreenScreen score of "LT-P1" to hydrofluoric acid, but solutions of hydrofluoric acid (40%, 50%, and 70%) are listed as "LT-UNK."

In addition to being readily soluble in water (Papcun, 2000; NLM, 2006), ammonium bifluoride is deliquescent: it tends to absorb moisture from the air and form a solution (NLM, 2006). When dissolved in aqueous media, ammonium bifluoride dissociates to the ammonium cation (NH_4^+) and the bifluoride anion (H_2F^-). The bifluoride anion is weakly acidic, and will to some extent yield fluoride (F^-) and hydrofluoric acid (HF) (Papcun, 2000). Hydrofluoric acid is also weakly acidic in solution, yielding fluoride (F^-) and protons (H^+) (Genuino *et al.*, 2012). If certain metal ions are present in solution, insoluble fluoride salts may form; such salts include calcium fluoride and magnesium fluoride (ATSDR, 2003, p. 188). Table 3 lists these transformation products identified for ammonium bifluoride.

Summary

Multiple ammonium bifluoride transformation products have been identified (see Table 3 above). Of these products, fluoride and hydrofluoric acid are listed in the Pharos List Translator as LT-P1; the others are either unlisted or listed as LT-UNK. As discussed above, this assessment uses surrogates that yield

[10] See GreenScreen Guidance v1.3 Section 12.
[11] A moiety is a discrete chemical entity that is a constituent part or component of a substance. A moiety of concern is often the parent substance itself for organic compounds. For inorganic compounds, the moiety of concern is typically a dissociated component of the substance or a transformation product.

fluoride and/or hydrofluoric acid. Thus, the toxicity posed by these transformation products has been accounted for, and their associated LT-P1 scores have not influenced ammonium bifluoride's Benchmark 1 score. Nevertheless, full GreenScreen assessments of these transformation products would be needed to better understand their hazards and potential impact on ammonium bifluoride's Benchmark 1 score.

Introduction

Ammonium bifluoride is an industrial chemical that has multiple applications. It is used, for example, as a preservative, an etching agent for glass and metals, a cleaning agent for ceramics, and an acidifier for oil wells. Table 4 summarizes the physical and chemical properties obtained for ammonium bifluoride:

Table 4 Physical and Chemical Properties of Ammonium Bifluoride (CAS# 1341-49-7)

Property	Value	Reference
Molecular Formula	$[NH_4][HF_2]$	
SMILES Notation	[N+].[F-].F	
Molecular Weight	57.04 g/mol	
Physical State	Solid	Papcun (2000)
Appearance	Colorless Crystal	Papcun (2000)
Melting Point	126.1°C	Papcun (2000)
Vapor Pressure	Not Volatile at Ambient Temperatures	Papcun (2000)
Water Solubility	41.5 wt% at 25°C 602 g/L at 20°C	Papcun (2000); NLM (2006)
Dissociation Constant	Unknown[a]	
Density/Specific Gravity	1.50	Papcun (2000)
Partition Coefficient, Log K_{ow}	Unknown[b]	

Notes:
NLM = National Library of Medicine; SMILES = Simplified Molecular-input Line-entry System.
Gradient assessed ammonium bifluoride against GreenScreen version 1.3 (CPA, 2016).
(a) No dissociation constant for ammonium bifluoride was located in the literature. The dissociation constant of hydrofluoric acid, a transformation product of ammonium bifluoride, is 6.7×10^{-4} (pKa 3.17) (Genuino *et al.*, 2012).
(b) No partition coefficients were located for ammonium, bifluoride, fluoride, or hydrofluoric acid.

Hazard Classification Summary Section

Hazard classifications for the GreenScreen endpoints evaluated are provided below.

Group I Human Health Effects (Group I Human)

Carcinogenicity (C) Score (H, M, or L): *L*

Ammonium bifluoride is assigned a score of *Low (L)* for carcinogenicity based on lack of carcinogenic effects for ammonium sulfate in rats and equivocal findings in rats, but not mice, for sodium fluoride. There is low confidence in this score because equivocal carcinogenic findings were reported in a National Toxicology Program (NTP) rat study for sodium fluoride. However, the incidence of osteosarcoma observed was lower than two of the historical control groups. Ammonium bifluoride and its surrogates (potassium bifluoride [CAS# 7789-29-9], sodium bifluoride [CAS# 1333-83-1], ammonium sulfate [CAS# 7783-20-2], and sodium fluoride [CAS# 7681-49-4]) are not listed by any GreenScreen-specified authoritative or screening list as a carcinogen.

Authoritative and Screening Lists

Ammonium bifluoride (CAS# 1341-49-7) and surrogates:

- *Authoritative*: Not listed
- *Screening*: Not listed

Surrogate ammonium sulfate (CAS# 7783-20-2):

- ECHA (2016a)
  - In a 2006 Organisation for Economic Cooperation and Development (OECD) Guideline 453 Combined Chronic Toxicity/Carcinogenicity study in rats (Klimisch score of 2), ammonium sulfate (CAS# 7783-20-2) was administered at dietary concentrations of 0, 0.1, 0.6, and 3.0% in the 52-week toxicity study and 0, 1.5, and 3.0% in the 104-week carcinogenicity study. In the carcinogenicity study, 50 rats/sex/dose were exposed to feed. Under carcinogenicity, the highest dose tested 3% (or 1,288 mg/kg-bw for males and 1,371 mg/kg-bw for females) was established as the No Observed Adverse Effect Level (NOAEL). Neoplastic lesions in the form of adrenal malignant pheochromocytoma were observed in the highest dose tested in males. However, these tumors are not thought to be treatment related as they are known to occur spontaneously in rats of this strain and age. No other effects on carcinogenicity were observed in this study.

Surrogate sodium fluoride (CAS# 7681-49-4):

- ECHA (2016b)
  - In a 1990 NTP study in Fischer 344 rats (Klimisch score of 2 and Good Laboratory Practice [GLP] compliant), 0, 25, 100 or 175 ppm sodium fluoride (equivalent to 0, 11, 45 or 79 ppm fluoride) were administered over the course of 103 weeks. Osteosarcoma of the bone occurred in 1 out of 50 male rats (2%) at 100 parts per million (ppm) sodium fluoride (45 ppm fluoride) and 3 out of 80 male rats (3.75%) at 175 ppm sodium fluoride (79 ppm fluoride). Of the three male rats receiving 175 ppm sodium fluoride, two had osteosarcomas involving vertebrae, and the third had an intramedullary neoplasm in the proximal portion of the humerus. For all treatment groups, dose-related fluoride concentrations in bone were significantly increased over control values. The NOAELs were established to be 25 and 175 ppm in male and female rats, respectively. Thus, the Lowest Observed Adverse Effect Level (LOAEL) was established to be 100 ppm in males due to incidence of osteosarcoma. However, it should be noted that one of the groups of control male rats in the NTP historical control database had 3 osteosarcomas in a group of 50 animals (6% incidence) and another control group had two osteosarcomas (4% incidence). These osteosarcoma incidences in the historical controls were higher than those found in the treated groups.
  - Another 1990 NTP study (Klimisch score of 2 and GLP compliant) of the same dosage and study duration found no evidence of carcinogenicity in B6C3F1 mice. No osteosarcomas were observed in the treated groups.

Summary

Ammonium bifluoride is assigned a score of *Low (L)* for carcinogenicity based on lack of carcinogenic findings in ammonium sulfate in rats and equivocal findings in rats, but not mice, in sodium sulfate. There is low confidence in this score because equivocal carcinogenic findings were reported in an NTP rat study. However, the incidence of osteosarcoma observed was lower than two of the historical control groups.

No relevant data were identified for this endpoint for ammonium bifluoride and its primary surrogates potassium bifluoride (CAS# 7789-29-9) and sodium bifluoride (CAS# 1333-83-1). Thus, ammonium sulfate (CAS# 7783-20-2) and sodium fluoride (CAS# 7681-49-4) were used to inform this endpoint. These surrogates were selected because they yield the same dissociation products in solution as ammonium bifluoride. No evidence of carcinogenicity was found in ammonium sulfate in rats (OECD guideline study) and sodium fluoride in mice (NTP guideline study). However, osteosarcomas were observed in an NTP guideline study in rats for sodium fluoride, albeit the incidences observed were lower than that of the historical controls. The study authors also opined that the sodium fluoride and fluoride concentrations in this study are considered extremely high when compared to the concentration range used to fluoridate human drinking water.

Ammonium bifluoride and surrogates (potassium bifluoride [CAS# 7789-29-9], sodium bifluoride [CAS# 1333-83-1], ammonium sulfate [CAS# 7783-20-2], and sodium fluoride [CAS# 7681-49-4]) are not listed by any GreenScreen-specified authoritative or screening list as a carcinogen.

Mutagenicity/Genotoxicity (M) Score (H, M or L): *M*

Ammonium bifluoride is assigned a score of *Moderate (M)* for mutagenicity/genotoxicity based on some positive mutagenic effects observed in *in vitro* assays of sodium fluoride and sodium bifluoride. Additionally, sodium fluoride is present on two screening lists as a Potential Mutagen Category 2, which translates to a Moderate GreenScreen score. There is low confidence in this score because *in vivo* studies on sodium fluoride did not agree with the positive *in vitro* findings and no studies are available for ammonium bifluoride itself.

Authoritative and Screening Lists

Ammonium bifluoride (CAS# 1341-49-7), and surrogates potassium bifluoride (CAS# 7789-29-9), sodium bifluoride (CAS# 1333-83-1), ammonium sulfate (CAS# 7783-20-2), and ammonium chloride (CAS# 12125-02-9):

- *Authoritative*: Not listed
- *Screening*: Not listed

Surrogate sodium fluoride (CAS# 7681-49-4):

- *Authoritative*: Not listed
- *Screening*:
  - New Zealand – Globally Harmonized System (GHS) - 6.6B - Suspected human mutagens
  - Japan - GHS - Germ cell mutagenicity - Category 2

Table 5 *In Vitro* Studies on Ammonium Bifluoride and Surrogates

Name	CAS#	Study Details	Results	Reference
Ammonium bifluoride	1341-49-7	OECD test guideline 471 (Ames), Klimisch score = 1	No mutagenic effects observed in *S. typhimurium* strains (TA 1535, TA 1537, TA 98, and TA 100) with or without metabolic activation.	ECHA (2016c)
30% Sodium fluoride; 70% Sodium bifluoride	7681-49-4; 1333-83-1	Mammalian cell gene mutation assay, Klimisch score = 2	30% sodium fluoride - 70% sodium bifluoride is mutagenic and toxic to mouse lymphoma cells. Test substance induced approximately three-fold increases in mutant frequency.	ECHA (2016c)
Ammonium sulfate	7783-20-2	OECD test guideline 471 (Ames), Klimisch score = 1	No mutagenic effects observed in *S. typhimurium* strains (TA 1535, TA 1537, TA 98, and TA 100) with or without metabolic activation.	ECHA (2016a)
Sodium fluoride	7681-49-4	Ames, Klimisch score = 1	No mutagenic effects observed in *S. typhimurium* strains (TA 1535, TA 1537, TA 98, and TA 100) with or without metabolic activation.	ECHA (2016b)
Sodium fluoride	7681-49-4	Mammalian cell gene mutation assay, Klimisch score = 2	No mutagenic effects observed in Chinese hamster V79 cells.	ECHA (2016b)
Sodium fluoride	7681-49-4	OECD Guideline 473 (*In vitro* Mammalian Chromosome Aberration Test), Klimisch score = 2	Sodium fluoride, at concentrations of 0.1, 1, 10, or 100 µM, induced statistically significant increases in chromosome aberrations in rat bone marrow cells at different exposure times (12, 24, and 36 hours) when compared to control.	ECHA (2016b)

Note:
CAS = Chemistry Abstracts Service.

Table 6 *In Vivo* Studies on Surrogates of Ammonium Bifluoride

Name	CAS#	Study Details	Results	Reference
Ammonium chloride	12125-02-9	OECD Guideline 474 (Mammalian Erythrocyte Micronucleus Test), Klimisch score = 2	No genotoxic effects observed in mouse micronucleus assay.	ECHA (2016a)
Sodium fluoride	7681-49-4	EPA OPPTS 870.5385 (chromosome aberration), Klimisch score = 1	No effects on micronuclei or chromosomal aberration observed up to 400 ppm in mice.	ECHA (2016b)
Sodium fluoride	7681-49-4	Sister chromatid exchange, Klimisch score = 2	No effects on sister chromatid exchange frequencies observed up to 130 mg/kg-bw in hamsters.	ECHA (2016b)

Note:
CAS = Chemistry Abstracts Service.

Summary

Ammonium bifluoride is assigned a score of *Moderate (M)* for mutagenicity/genotoxicity based on some positive mutagenic effects observed in *in vitro* assays of sodium fluoride and sodium bifluoride. Additionally, sodium fluoride is present on two screening lists as Potential Mutagens Category 2. There is low confidence in this score because none of the 14 *in vivo* mutagenicity studies on sodium fluoride in the ECHA Dossier (ECHA, 2016b) agreed with the limited number of positive *in vitro* findings.

These surrogates were selected because they yield the same dissociation products in solution as ammonium bifluoride. All *in vivo* studies on ammonium chloride and sodium fluoride were negative for genotoxic effects (Table 6), while a few of the *in vitro* studies on sodium fluoride were positive for mutagenic effects (Table 5). Sodium fluoride was negative in Ames and mammalian gene cell mutation assays, but positive in mammalian chromosome aberration tests.

Ammonium bifluoride and the surrogate (potassium bifluoride [CAS# 7789-29-9], sodium bifluoride [CAS# 1333-83-1], ammonium sulfate [CAS# 7783-20-2]) are not listed by any GreenScreen-specified list as a mutagen. Sodium fluoride (CAS# 7681-49-4) is listed on two screening lists, New Zealand and Japan, as Category 2 mutagen, translating into a Moderate GreenScreen score.

Reproductive Toxicity (R) Score (H, M, or L): *M*

Ammonium bifluoride is assigned a *Moderate (M)* score for reproductive toxicity based on the surrogate sodium fluoride's equivocal effects on the sperm and screening list Category 2 classification. Confidence in this score is low because no reproductive effects were observed in a GLP guideline three-generation rat study of sodium fluoride. Additionally, no study was located on ammonium bifluoride (CAS# 1341-49-7) itself.

Authoritative and Screening Lists

Ammonium bifluoride (CAS# 1341-49-7), and surrogates potassium bifluoride (CAS# 7789-29-9), sodium bifluoride (CAS# 1333-83-1), ammonium sulfate (CAS# 7783-20-2), and ammonium chloride (CAS# 12125-02-9):

- *Authoritative*: Not listed
- *Screening*: Not listed

Surrogate sodium fluoride (CAS# 7681-49-4):

- *Authoritative*: Not listed
- *Screening*:
  - New Zealand - GHS - 6.8B - Suspected human reproductive or developmental toxicants
  - Japan - GHS - Toxic to reproduction - Category 2

Surrogate ammonium sulfate (CAS# 7783-20-2):

- OECD (2004)
  - In a one-generation mouse study (Klimisch score of 2), female mice (n = 10/dose) were given 0, 625, 1,250, 2,500, and 5,000 mg sulfate/L drinking water as ammonium sulfate from one week prior to mating until day 21 post-partum of the second parity. No differences in litter size, litter weaning weights, or gestational or lactational weight gain of the dams among sulfate treatments was observed.

Surrogate sodium fluoride (CAS# 7681-49-4):

- ECHA (2016b)
  - In a three-generation rat study (Klimisch score of 2, GLP-compliant), parental (P) and first generation (F1) male and female rats were exposed to 0, 25, 100, 175, or 250 ppm sodium fluoride in drinking water for 10 weeks before mating. For the P and F1 generation, the reproductive No Observed Effect Concentration (NOEC) for both male and female rats is the highest dose tested 250 ppm (equivalent to 28.4 mg sodium fluoride/kg bw-d). In both P and F1 generations, no effects on offspring viability, body weight, sexual maturation, organ weight, pathology and histopathology were observed. Sperm measures were not examined. No adverse effects on reproduction throughout three generations. No cumulative toxic effects were observed in the three generations.
- ECHA (2016c)
  - In a non-guideline, World Health Organization (WHO) protocol MB-50 study, Klimisch score of 2, sodium fluoride was administered orally to adult male rats daily for 30 days at either 5 or 10 mg/kg bw. Sodium fluoride caused reversible changes to the sperm. Sperm motility and count decreased at 10 mg/kg-bw compared to controls, but was partially restored following the 70-day recovery period. Sperm morphology was also adversely affected. No information was given regarding the fertility rate.

Summary

Ammonium bifluoride is assigned a *Moderate (M)* score for reproductive toxicity based on the surrogate sodium fluoride's equivocal effects on the sperm and screening list Category 2 classification. Confidence in this score is low because no reproductive effects were observed in a GLP-compliant, Klimisch score 2, three-generation rat study of sodium fluoride.

Sodium fluoride and ammonium sulfate were selected as the surrogates for this endpoint because in combination they yield the same dissociation products in solution as ammonium bifluoride. While a non-guideline study with limited details reported decreased sperm motility and count in rats following ingestion of sodium fluoride, a guideline three-generation study in rats did not report reproductive effects (though sperm measures were not examined). No adverse effects were observed for the surrogate ammonium sulfate.

Ammonium bifluoride and its surrogates were not listed on any GreenScreen authoritative or screening lists for this endpoint.

Developmental Toxicity Incl. Developmental Neurotoxicity (D) Score (H, M or L): *L*

Ammonium bifluoride is assigned a *Low (L)* score for developmental toxicity based on toxicity data on surrogate sodium fluoride (CAS# 7681-49-4) and ammonium chloride (CAS# 12125-02-9). Confidence in this score is low because there is conflicting information between the toxicological data and screening list classifications for the surrogate sodium fluoride, and no study was located for ammonium bifluoride (CAS# 1341-49-7) itself.

Authoritative and Screening Lists

Ammonium bifluoride (CAS# 1341-49-7), and surrogates potassium bifluoride (CAS# 7789-29-9), sodium bifluoride (CAS# 1333-83-1), ammonium sulfate (CAS# 7783-20-2), and ammonium chloride (CAS# 12125-02-9):

- *Authoritative*: Not listed
- *Screening*: Not listed

Surrogate sodium fluoride (CAS# 7681-49-4):

- *Authoritative*: Not listed
- *Screening*:
  - New Zealand - GHS - 6.8B - Suspected human reproductive or developmental toxicants
  - Japan - GHS - Toxic to reproduction - Category 2

Surrogate ammonium chloride (CAS# 12125-02-9):

- ECHA (2016a)
  - A non guideline, 1964, Klimisch score 2, study on ammonium chloride in drinking water was located. Pregnant Sprague-Dawley rats were exposed to drinking water containing 0 and 0.17

mol/L ammonium chloride (or 3,060 mg NH4+/L) from gestation day 7. There were ten dams per dose. Decreased detail weight and crown-rump lengths were observed compared to control. No skeletal or gross pathology abnormalities were located. The study did not include an examination of maternal toxicity parameters.

Surrogate sodium fluoride (CAS# 7681-49-4):

- ECHA (2016b)
  - In a prenatal Developmental Toxicity study (EPA OPPTS 870.3700 Klimisch score of 1), pregnant Sprague Dawley rats were exposed to 0, 50, 150, and 300 ppm of sodium fluoride (CAS# 7681-49-40). No embryotoxic or teratogenic effects related to exposure to sodium fluoride in drinking water was observed at any dose concentration. Maternal exposure to sodium fluoride at concentrations up to 300 ppm (approximately 27 mg/kg/day) during organogenesis (gestation days 6 to 15) did not significantly affect the frequency of post-implantation loss, mean fetal body weight/litter, or external, visceral or skeletal malformations in the rat. The NOEC for developmental toxicity was the highest dose tested.
  - In another prenatal Developmental Toxicity study (EPA OPPTS 870.3700 Klimisch score of 1), pregnant New Zealand rabbits were exposed to 0, 100, 200, and 400 ppm of sodium fluoride (CAS# 7681-49-40). No embryotoxic or teratogenic effects related to exposure to sodium fluoride in drinking water was observed at any dose concentration. Maternal exposure to sodium fluoride at concentrations up to 300 ppm (approximately 29 mg/kg/day) during organogenesis (gestation days 6 to 19) did not significantly affect the frequency of post-implantation loss, mean fetal body weight/litter, or external, visceral or skeletal malformations in rabbits. The no observed effect concentration (NOEC) for developmental toxicity was the highest dose tested.

Summary

Ammonium bifluoride is assigned a *Low (L)* score for developmental toxicity based on toxicity data for the surrogate sodium fluoride (CAS# 7681-49-4). Confidence in this score is low because two GreenScreen screening lists include sodium fluoride as a Category 2 reproductive or developmental toxicant. However, it is our opinion that quality toxicological data should supersede screening list classification in this scenario.

No studies were identified for ammonium bifluoride, thus, studies for suitable surrogates were reviewed for this endpoint. Two studies were located for this endpoint for sodium fluoride and one for ammonium chloride. These surrogates were selected because they yield the same dissociation products in solution as ammonium bifluoride. No embryotoxic or teratogenic effects related to exposure to sodium fluoride in drinking water were observed at any dose concentration in both EPA OPPTS 870.3700 method studies in rats and rabbits. A non-guideline study on ammonium chloride was also reported. Decreased detail weight and crown-rump lengths were observed compared to control. However, the study did not include an examination of maternal toxicity parameters. Due to the high dose administered (3,060 mg NH4+/L), it is unclear whether the observed effects are attributable to ammonium or maternal toxicity or both. No data were located on ammonium sulphate on this endpoint.

Ammonium bifluoride and the other surrogates were not listed on any GreenScreen lists for this endpoint.

Endocrine Activity (E) Score (H, M or L): *M*

Ammonium bifluoride is assigned a *Moderate (M)* score for endocrine activity based on evidence that fluorides may have effects on the thyroid with unknown clinical significance. Additionally, one of the surrogates (sodium fluoride CAS# 7681-49-4) is listed on a screening list as a potential endocrine disruptor. While this screening list spans the GreenScreen classification of Moderate to High, based on professional judgment, a Moderate score is assigned because toxicological data showing endocrine activity (but not necessary disruption) would outweigh screening list classification in this scenario. Confidence in this score is low because the human studies are limited in details and there are no studies specifically for ammonium bifluoride for this endpoint.

Authoritative and Screening Lists

Ammonium bifluoride (CAS# 1341-49-7), and surrogates potassium bifluoride (CAS# 7789-29-9), sodium bifluoride (CAS# 1333-83-1), ammonium sulfate (CAS# 7783-20-2), and ammonium chloride (CAS# 12125-02-9):

- *Authoritative*: Not listed
- *Screening*: Not listed

Surrogate sodium fluoride (CAS# 7681-49-4):

- *Authoritative*: Not listed
- *Screening*:
  - The Endocrine Disruption Exchange (TEDX) - Potential Endocrine Disruptors - Potential Endocrine Disruptor

Surrogate fluorides:

- ATSDR (2003)
  - There are some data that suggest fluorides induce effects on the thyroid with unknown clinical significance. An increase in serum thyronine levels was observed in residents in areas of India where high fluoride levels are present in drinking water. It is unclear if nutritional deficiencies played a role to the observed effects. Conversely, in animals, a decrease in thyronine levels were observed in rats exposed to fluorides in drinking water for 2 months. In another study, decreased serum testosterone was observed in rats exposed to sodium fluoride for 50 to 60 days.

Summary

Ammonium bifluoride is assigned a *Moderate (M)* score for endocrine activity based on evidence that fluorides may have effects on the thyroid with unknown clinical significance. Confidence in this score is low because the human studies are limited in details and there are no studies for ammonium bifluoride or the selected surrogates ammonium sulfate or ammonium chloride on this endpoint.

Because there were no studies identified for ammonium bifluoride, studies for "fluorides" (as a class) were reviewed because ammonium bifluoride is expected to yield fluoride ions in solution. While increases in serum thyronine levels were observed in human fluoride studies, the opposite effect was observed in animals following fluoride exposure in drinking water. One of the surrogates (sodium fluoride [CAS# 7681-49-4]) is listed on a screening list as a potential endocrine disruptor. While this screening list spans the GreenScreen classification of Moderate to High, it is our opinion that actual toxicological data in human showing endocrine activity of uncertain biological significance (consistent with a Moderate score) would support the Moderate score assigned for this endpoint.

Group II and II* Human Health Effects (Group II and II* Human)

Note: *Group II and Group II* endpoints are distinguished in the v1.3 Benchmark system (the asterisk indicates repeated exposure). For Systemic Toxicity and Neurotoxicity, Group II and II* are considered sub-endpoints. When classifying hazard for Systemic Toxicity/Organ Effects and Neurotoxicity endpoints, repeated exposure results are required and preferred. Lacking repeated exposure results in a data gap. Lacking single exposure data does not result in a data gap when repeated exposure data are present (shade out the cell in the hazard table and make a note). If data are available for both single and repeated exposures, then the more conservative value is used.*

Acute Mammalian Toxicity (AT) Group II Score (vH, H, M or L): H

Ammonium bifluoride is assigned a score of **High (H)** based on an acute oral toxicity study in rats and concordant classification of Category 3 acute toxicity according to GreenScreen authoritative (EU) and screening (Taiwan, Australia, Korean, New Zealand, China) lists for ammonium bifluoride. The level of confidence in this score is high because of the high study quality (OECD 401, Klimisch score = 2) of the acute oral toxicity study in rats for ammonium bifluoride itself.

Authoritative and Screening Lists

Ammonium bifluoride (CAS# 1341-49-7):

- Acute Oral Toxicity
  - *Authoritative*:
    - European Union (EU) - GHS – Standardized View (SV) – Classification, Labelling and Packaging of Substances and Mixtures (CLP) (1272/2008) - Acute Toxicity - Oral Category 3
  - *Screening*:
    - Taiwan - GHS - SV - Acute Toxicity - Oral Category 3
    - Australia - GHS - SV - Acute Toxicity - Oral Category 3
    - Korea - MOE - GHS - Acute Toxicity - Oral Category 3
    - New Zealand - GHS - SV - Acute Toxicity - Oral Category 3
- Acute Dermal Toxicity
  - *Authoritative*: Not listed
  - *Screening*: Not listed

- Acute Inhalation Toxicity
  - *Authoritative*: Not listed
  - *Screening*:
    - Taiwan - GHS - SV - Acute Toxicity - Inhalation Category 4

- ECHA (2016c); European Commission (EC), European Chemicals Bureau (ECB) (2000); NLM (2016)
  - A singe acute toxicity oral study was located for ammonium bifluoride. A 1990 OECD Guideline 401 study, Klimisch score = 2 (reliable with restriction), reported LD_{50} of 130 mg/kg-bw in rats. There were ten rats per sex per dose. Mortality was observed in the two highest dose groups of 100 mg/kg-bw (1/20 died) and 147 mg/kg-bw (14/20 died). No mortality was observed at 0, 21.5, and 46.4 mg/kg-bw. Starting at 46.4 mg/kg-bw and above, symptoms included dyspnea, ataxia, reduced circulation, and decreased spontaneous motility
  - No acute toxicity dermal or inhalation studies were located for ammonium bifluoride and surrogates.

Summary

Ammonium bifluoride is assigned a score of **High (H)** based on an acute oral toxicity study in rats and concordant classification of Category 3 according to GreenScreen authoritative (EU) and screening (Taiwan, Australia, Korean, New Zealand, China) lists. The level of confidence in the score is high because of the high study quality (OECD 401, Klimisch score = 2) of the acute oral toxicity study in rats of ammonium bifluoride itself.

The singular acute oral toxicity study we reviewed reported an LD_{50} of 130 mg/kg-bw, which falls into GHS Category 3, translating to a High GreenScreen score. No acute toxicity dermal or inhalation studies were located for ammonium bifluoride or surrogates likely due to the corrosive nature of ammonium bifluoride and similar substances.

Ammonium bifluoride was classified on a GreenScreen screening list (Taiwan) as Acute Inhalation Category 4, which would translate to a GreenScreen Moderate score.

Systemic Toxicity/Organ Effects incl. Immunotoxicity (ST)

(ST-Single) Group II Score (vH, H, M or L): M

Ammonium bifluoride is assigned a score of **Moderate (M)** for single exposure systemic toxicity/organ effects *via* inhalation using professional judgment based on the corrosive nature of ammonium bifluoride itself (*i.e.*, score of Very High [vH] for the GreenScreen Skin Irritation/Corrosivity endpoint). The confidence in this score is high because the hazard score for skin irritation is based on ammonium bifluoride data.

Authoritative and Screening Lists

Ammonium bifluoride (CAS# 1341-49-7), and surrogates potassium bifluoride (CAS# 7789-29-9), sodium bifluoride (CAS# 1333-83-1), ammonium sulfate (CAS# 7783-20-2), and ammonium chloride (CAS# 12125-02-9):

- *Authoritative*: Not listed
- *Screening*: Not listed

Surrogate sodium bifluoride (CAS# 1333-83-1):

- *Authoritative*: Not listed
- *Screening*:
    - Japan - GHS - Specific target organs following single exposure - Category 1

Summary

Ammonium bifluoride is assigned a score of **Moderate (M)** for single exposure systemic toxicity/organ effects *via* inhalation using professional judgment based on the corrosive nature of ammonium bifluoride itself. As noted above, ammonium bifluoride was assigned a score of Very High (vH) for skin irritation based on low pH (3.5 at 5% solution [Kirk-Othmer, 2000, as cited in NLM, 2006] and < 1 at 29% solution [Solvay America, Inc., 2013]) and Category 1 classification on GreenScreen authoritative (EU) and screening (Taiwan, Australia, Korea, New Zealand, Japan, China) lists for the skin irritation endpoint. Additionally, ammonium bifluoride is listed as severely irritating to the nose, throat, and lungs, causing nosebleeds, cough, wheezing and shortness of breath (NJDHSS, 2002). Based on the cited classifications of ammonium bifluoride as corrosive to skin, its low pH, and additional information from the New Jersey Department of Health and Senior Services (NJDHSS, 2002), we conclude that ammonium bifluoride will likely irritate the respiratory system when inhaled. This translates to GHS Category 3 "irritating to the respiratory tract" and a GreenScreen Moderate (M) score. Confidence in the Moderate score is high, because the classification is based on ammonium bifluoride data for this endpoint and related endpoints.

A surrogate, sodium fluoride, is listed on a screening list (Japan) as "Category 1 GHS Specific target organs following single exposure," translating into a Very High GreenScreen score. However, no data were located to support this classification. Therefore, we relied on the ammonium bifluoride data to inform this endpoint, and maintain the Moderate score.

(ST-Repeated) Group II* Score (H, M, L): *H*

Ammonium bifluoride is assigned a *High (H)* score for systemic toxicity *via* repeated oral exposure based on human studies on fluorides in general and classification of several surrogates on GreenScreen screening lists as Category 1 target organ toxicants. There is low confidence in this score as surrogate data were relied upon and no studies are available for ammonium bifluoride itself.

Authoritative and Screening Lists

Ammonium bifluoride (CAS# 1341-49-7), and surrogates ammonium sulfate (CAS# 7783-20-2) and ammonium chloride (CAS# 12125-02-9):

- *Authoritative*: Not listed
- *Screening*: Not listed

Surrogate sodium bifluoride (CAS# 1333-83-1):

- *Authoritative*: Not listed
- *Screening*:
  - Japan - GHS - Specific target organs following repeated exposure - Category 1

Surrogate potassium bifluoride (CAS# 7789-29-9):

- *Authoritative*: Not listed
- *Screening*:
  - New Zealand - GHS - 6.9A (oral) - Toxic to human target organs or systems (Cat. 1)

Surrogate sodium fluoride (CAS# 7681-49-4):

- *Authoritative*: Not listed
- *Screening*:
  - Japan - GHS - Specific target organs following repeated exposure - Category 1
  - New Zealand - GHS - 6.9A (oral) - Toxic to human target organs or systems (Cat. 1)

Surrogate ammonium sulfate (CAS# 7783-20-2):

- ECHA (2016a)
  - In a 2006 OECD Guideline 453 Combined Chronic Toxicity/Carcinogenicity Studies in rats, Klimisch score of 2, ammonium sulfate (CAS# 7783-20-2) was administered at dietary concentrations of 0, 0.1, 0.6 and 3.0% in the 52-week toxicity study and 0, 1.5, and 3.0% in the 104-week carcinogenicity study. No mortality was observed in the duration of this study. No obvious clinical signs, changes on body weight or food intake, changes on hematology, serum chemistry, or histopathology were observed. There were some changes observed in the white blood cell parameters, however, the effects were not dose-dependent and the study authors did not consider it to be treatment-related. Kidney and liver weights increased, while spleen weight decreased in the 3% dose group (1,288 mg/kg-bw for males and 1371 mg/kg-bw for females). For chronic oral toxicity, the study established a NOAEL 0.6% (284 mg/kg-bw male and 256 mg/kg-bw females) and LOAEL of 3% (or 1,288 mg/kg-bw for males and 1371 mg/kg-bw for females) based on organ weight changes. However, without adverse clinical significance, organ weight changes are not considered to be classifiable under GHS for chronic toxicity studies.

Surrogate fluorides, primarily in the form of sodium fluoride (CAS# 7681-49-4):

- ATSDR (2003)
  - In humans and animals, the skeletal system is the primary site of fluoride deposit. At low dosages, fluorides can prevent cavity formation. At high doses, fluoride can cause dental fluorosis characterized by increased porosity.
  - In humans, fluoride is used as a treatment for osteoporosis due to its ability to stimulate bone formation and increase bone mass at low dosages. However, high levels of fluoride can also lead to increased risk of non-vertebral fractures and skeletal fluorosis characterized by brittle bone and decreased tensile strength.
  - No repeated exposure dermal or inhalation studies were located for fluorides.

Summary

Ammonium bifluoride is assigned a *High (H)* score in systemic toxicity *via* repeated oral exposure based on human studies on fluorides in general and classification of several surrogates on GreenScreen screening lists as Category 1 target organ toxicants. There is low confidence in this assignment as no studies are available for ammonium bifluoride itself.

Because there were no studies identified for ammonium bifluoride, studies for "fluorides" (as a class) were reviewed because ammonium bifluoride is expected to yield fluoride ions in solution. In humans, high levels of fluorides can cause dental and skeletal fluorosis (brittle teeth and bones) leading to increased risk of fractures.

Multiple surrogates, including sodium bifluoride (CAS# 1333-83-1), potassium bifluoride (CAS# 7789-29-9), and sodium fluoride (CAS# 7681-49-4), are listed on GreenScreen screening level lists under this endpoint as Category 1 toxicants.

Neurotoxicity (N)

Neurotoxicity (N) Group II Score (Single Exposure: vH, H, M or L): dg

Ammonium bifluoride is assigned a score of data gap (dg) for neurotoxicity following acute exposure. No studies were located for ammonium bifluorides or its surrogates following acute exposure. While ammonium bifluoride and surrogates sodium bifluoride and sodium fluoride are listed as a GreenScreen screening list as a potential neurotoxicant, it is unclear if this classification is for repeated or acute exposure. The screening list placement is used to inform the neurotoxicity repeated dose endpoint.

Authoritative and Screening Lists

Ammonium bifluoride (CAS# 1341-49-7), and surrogates sodium bifluoride (CAS# 1333-83-1) and sodium fluoride (CAS# 7681-49-4):

- *Authoritative*: Not listed
- *Screening*:
  - Developmental neurotoxicity of industrial chemicals, List of 201 Chemicals known to be neurotoxic in man (G&L - Neurotoxic chemicals)

Surrogates potassium bifluoride (CAS# 7789-29-9) and ammonium sulfate (CAS# 7783-20-2):

- *Authoritative*: Not listed
- *Screening*: Not listed

Neurotoxicity (N) Group II* Score (Repeated Exposure: H, M or L): *H*

Ammonium bifluoride is assigned a score of *High* (*H)* for neurotoxicity based on inclusion on a GreenScreen screening list for ammonium bifluoride (CAS# 1341-49-7) and its surrogates sodium bifluoride (CAS# 1333-83-1) and sodium fluoride (CAS# 7681-49-4), as well as convulsions observed following oral ingestion of high levels of fluorides in humans. The level of confidence in this score is low because of the lack of toxicological data on ammonium bifluoride itself and the listing on a screening, and not authoritative, list.

Authoritative and Screening Lists

Ammonium bifluoride (CAS# 1341-49-7), and surrogates sodium bifluoride (CAS# 1333-83-1) and sodium fluoride (CAS# 7681-49-4):

- *Authoritative*: Not listed
- *Screening*:
  - G&L - Neurotoxic chemicals

Surrogates potassium bifluoride (CAS# 7789-29-9) and ammonium sulfate (CAS# 7783-20-2):

- *Authoritative*: Not listed
- *Screening*: Not listed

Surrogate fluorides, primarily in form of sodium fluoride (CAS# 7681-49-4):

- ATSDR (2003)
  - In humans, very oral high exposure to fluorides following ingestion can lead to neuromuscular effects such as tetany, paresthesia, paresis, convulsions. These effects are

likely due to the hypocalcemia caused by fluoride's affinity for calcium. There are limited studies in animals on this endpoint.

Summary

Ammonium bifluoride is assigned a score of *High* (*H)* for neurotoxicity based on its presence on a GreenScreen screening list for ammonium bifluoride (CAS# 1341-49-7) and its surrogates sodium bifluoride (CAS# 1333-83-1) and sodium fluoride (CAS# 7681-49-4). This score is also based on evidence of convulsions observed following oral ingestion of high levels of fluorides in humans. The level of confidence in this score is low because of the lack of toxicological data on ammonium bifluoride itself and the listing on a screening, not authoritative, list.

Sodium bifluoride and sodium fluoride were selected as surrogates because they yield the same dissociation products in solution as ammonium bifluoride.

Skin Sensitization (SnS) Group II* Score (H, M or L): *L*

Ammonium bifluoride is assigned a *Low (L)* score for dermal sensitization based on a singular dermal sensitization study of surrogate sodium fluoride (CAS# 7681-49-4) reporting no effects. Confidence in this score is low because only one study was available and no study was located for ammonium bifluoride itself.

Authoritative and Screening Lists

Ammonium bifluoride (CAS# 1341-49-7), and surrogates potassium bifluoride (CAS# 7789-29-9), sodium bifluoride (CAS# 1333-83-1), ammonium sulfate (CAS# 7783-20-2), ammonium chloride (CAS# 12125-02-9), and sodium fluoride (CAS# 7681-49-4):

- *Authoritative*: Not listed
- *Screening*: Not listed

Surrogate sodium fluoride (CAS# 7681-49-4):

- ECHA (2016b)
  - In a 1995 EPA OPP 81-6 skin sensitization (Klimisch score = 1), sodium fluoride was not sensitizing in guinea pigs. None of the readings following initial induction or challenge yielded positive results.

Summary

Ammonium bifluoride has been assigned a *Low (L)* score for dermal sensitization based on a singular dermal sensitization study of surrogate sodium fluoride (CAS# 7681-49-4) reporting no effects. Confidence in this assignment is low, because only one study was available and no study was located for ammonium bifluoride itself.

No data were identified for this endpoint for ammonium bifluoride or the other surrogates (potassium bifluoride, sodium bifluoride, ammonium sulfate (CAS# 7783-20-2), ammonium chloride (CAS# 12125-

02-9). The single sodium fluoride study reviewed followed an EPA protocol and has a Klimisch score of 1 (reliable without restriction). Ammonium bifluoride and its surrogates are not listed by any GreenScreen-specified list as a dermal sensitizer.

Respiratory Sensitization (SnR) Group II* Score (H, M or L): dg

Ammonium bifluoride is assigned a data gap (dg) for respiratory sensitization because no relevant data were identified for this endpoint for ammonium bifluoride and surrogates potassium bifluoride (CAS# 7789-29-9), sodium bifluoride (CAS# 1333-83-1), sodium fluoride (CAS# 7681-49-4), ammonium sulfate (CAS# 7783-20-2), ammonium chloride (CAS# 12125-02-9). Ammonium bifluoride and surrogates are not listed by any GreenScreen-specified list as a respiratory sensitizer.

Skin Irritation/Corrosivity (IrS) Group II Score (vH, H, M or L): vH

Ammonium bifluoride is assigned a score of **Very High (vH)** for skin irritation based on low pH and Category 1 classification on GreenScreen authoritative (EU) and screening (Taiwan, Australia, Korean, New Zealand, Japan, China) lists. The level of confidence in this score is high due to the low pH and multiple listings as a Category 1 irritant on GreenScreen authoritative and screening lists.

Authoritative and Screening Lists

Ammonium bifluoride (CAS# 1341-49-7):

- *Authoritative*:
  - EU - GHS - SV - CLP (1272/2008) - Skin Corrosion/Irritation - Category 1B
- *Screening*:
  - Taiwan - GHS - SV - Skin Corrosion/Irritation - Category 1
  - Australia - GHS - SV - Skin Corrosion/Irritation - Category 1B
  - Korea - MOE - GHS - SV - Skin Corrosion/Irritation - Category 1
  - New Zealand - GHS - SV - Skin Corrosion/Irritation - Category 1C
  - Japan - GHS - Skin Corrosion/Irritation - Category 1

Studies

No skin irritation studies were located on ammonium bifluoride.

Summary

Ammonium bifluoride is assigned a score of **Very High (vH)** for skin irritation based on low pH and Category 1 classification on GreenScreen authoritative (EU) and screening (Taiwan, Australia, Korea, New Zealand, Japan, China) lists. The level of confidence in this score is high due to the low pH and ammonium bifluoride's presence on an authoritative GreenScreen list.

No skin irritation studies were located on ammonium bifluoride. The lack of animal tests is likely due to its ability to etch glass and cause tissue damage as reported in the National Library of Medicine's (NLM)

Hazardous Substance Data Bank (HSDB), Merck Safety Data Sheet (SDS), and New Jersey Department of Health and Senior Services Hazardous Substance Fact Sheet (NLM, 2006; Merck KGaA, 2013; NJDHSS, 2002). Additionally, the pH of ammonium bifluoride has been reported to be 3.5 at 5% solution (Kirk-Othmer, 2000, as cited in NLM, 2006) and < 1 at 29% solution (Solvay America, Inc., 2013). According to GHS (UN, 2015), pH ≤ 2 or ≥ 11.5 would automatically warrant a classification Category 1 translating into a GreenScreen score of Very High.

Eye Irritation/Corrosivity (IrE) Group II Score (vH, H, M or L): vH

Ammonium bifluoride is assigned a score of **Very High (vH)** for eye irritation based on low pH and Category 1 classification on multiple GreenScreen screening lists (Taiwan, Korea, New Zealand, Japan, China, Canada). The level of confidence in this score is high based on its low pH, ability to etch glass, and its classification as a Category 1 eye irritant on several screening lists.

Authoritative and Screening Lists

Ammonium bifluoride (CAS# 1341-49-7):

- *Authoritative*: Not listed
- *Screening*:
  - Taiwan - GHS - SV - Serious Eye Damage/Irritation - Category 1
  - Korea - MOE - GHS - SV - Serious Eye Damage/Irritation - Category 1
  - New Zealand - GHS - SV - Serious Eye Damage/Irritation - Category 1
  - Japan - GHS - Serious Eye Damage/Irritation - Category 1
  - Canada - Workplace Hazardous Materials Information System (WHMIS) - GHS - Suggested Classifications - Serious Eye Damage/Eye Irritation - Category 1

Studies

No eye irritation studies were located on ammonium bifluoride.

Summary

Ammonium bifluoride is assigned a score of **Very High (vH)** for eye irritation based on low pH and classification as a Category 1 eye irritant on multiple GreenScreen screening lists (Taiwan, Korea, New Zealand, Japan, China, Canada). The level of confidence in this score is high based on the low pH.

No eye irritation studies were located on ammonium bifluoride. The lack of animal tests is likely due to its ability to etch glass and cause eye damage as reported in the HSDB, Merck SDS, and NJDHSS Hazardous Substance Fact Sheet (NLM, 2006; Merck KGaA, 2013; NJDHSS, 2002). Additionally, the pH of ammonium bifluoride has been reported to be 3.5 at 5% solution (Kirk-Othmer, 2000, as cited in NLM, 2006) and < 1 at 29% solution (Solvay America, Inc., 2013). According to GHS (UN, 2015), pH ≤ 2 or ≥ 11.5 would automatically warrant a classification as a Category 1 eye irritant, which translates to a GreenScreen score of Very High.

Ecotoxicity (Ecotox)

Acute Aquatic Toxicity (AA) Score (vH, H, M or L): *M*

Ammonium bifluoride is assigned a score of *Moderate (M)* for acute aquatic toxicity, with low confidence, based on experimental fish toxicity data for ammonium bifluoride and several of its surrogates (Table 7). Ammonium bifluoride is not present on any authoritative or screening lists, nor are there any acute aquatic toxicity data for any trophic levels other than fish. However, several surrogates are present on screening lists indicating that ammonium bifluoride would exhibit moderate acute aquatic toxicity. Because the majority of the experimental data indicating low toxicity disagree with the lists and the most sensitive toxicity data, which indicate moderate toxicity, the conservative score of Moderate for acute aquatic toxicity is given low confidence.

Authoritative and Screening Lists

Ammonium bifluoride (CAS# 1341-49-7):

- *Authoritative*: Not listed
- *Screening*: Not listed

Surrogate ammonium fluoride (CAS# 12125-01-8):

- *Authoritative*: Not listed
- *Screening*:
  - Japan - GHS - Hazardous to the aquatic environment (acute) - Category 3

Surrogate ammonium sulfate (CAS# 7783-20-2):

- *Authoritative*: Not listed
- *Screening*:
  - New Zealand - GHS - Hazardous to the aquatic environment (acute) - Category 3

Surrogate ammonium chloride (CAS# 12125-02-9):

- *Authoritative*: Not listed
- *Screening*:
  - Japan - GHS - Hazardous to the aquatic environment (acute) - Category 3

Surrogate sodium fluoride (CAS# 7783-20-2):

- *Authoritative*: Not listed
- *Screening*:
  - New Zealand - GHS - Hazardous to the aquatic environment (acute) - Category 3
  - Japan - GHS - Hazardous to the aquatic environment (acute) - Category 3

Surrogate hydrofluoric acid (CAS# 7664-39-3):

- *Authoritative*: Not listed
- *Screening*:
  - Japan - GHS - Hazardous to the aquatic environment (acute) - Category 3

Table 7 Acute Ecotoxicity Data for Ammonium Bifluoride and Surrogates

Trophic Level	Test Species	Endpoint	Value (mg/L)[a]	Method	Source
Test Material: Ammonium Bifluoride (CAS# 1341-49-7)					
Fish	Zebrafish (*Brachydanio rerio*)	96h LC_{50}	421.4	OECD 209	ECHA (2016c)
Test Material: Ammonium Sulfate (CAS# 7783-20-2)					
Fish	Zebrafish (*Brachydanio rerio*)	96h LC_{50}	250	ISO/TC 147/SC 5/WG 3 (1976)	ECHA (2016a)
	Fathead minnow (*Pimephales promelas*)		>100	No guideline followed	
	Pogge (*Agonus cataphractus*)		130-210	No guideline followed	
	Zebrafish (*Brachydanio rerio*)		480	ISO/TC 147/SC 5/WG (1976)	
	Guppy (*Lebistes reticulates*)		592	Not reported	
	Ide (*Leuciscus idus*)		681	OECD 203	
	Zebrafish (*Brachydanio rerio*)		420	Not reported	
	Common bleak (*Alburnus alburnus*)		310	Not reported	
	Rainbow trout (*Salmo gairdneri*)		141-165	Not reported	
	Rainbow trout (*Oncorhynchus mykiss*)		53 (measured)	Not reported	
	Mountain whitefish (*Prosopium williamsoni*)		57.2 (measured)	Not reported	
Invertebrate	Freshwater isopod (*Asellus intermedius*)	96h LC_{50}	>100	Not reported	ECHA (2016a)
	Freshwater shrimp (*Gammarus fasciatus*)		>100	Not reported	

Trophic Level	Test Species	Endpoint	Value (mg/L)[a]	Method	Source
Invertebrate	Freshwater flatworm (*Dugesia tigrina*)	96h LC_{50}	>100	Not reported	ECHA (2016a)
	Brown shrimp (*Crangon crangon*)		380-600	Not reported	
	Water flea (*Daphnia magna*)		>100	No guideline followed	
	Water flea (*Daphnia magna*)	48h EC_{50}	73.05	Not reported	
	Water flea (*Daphnia magna*)		169 (measured)	Not reported	
	Water flea (*Ceriodaphnia acanthine*)		121.7 (measured)	Not reported	
Test Material: Ammonium Chloride (CAS# 12125-02-9)					
Fish	Common carp (*Cyprinus carpio*)	96h LC_{50}	209	E03-05: APHA, AWWA & WPCF (1960)	ECHA (2016d)
Invertebrate	Water flea (*Daphnia magna*)	48h LC_{50}	101	ASTM E729-80	
Algae	Green algae (*Chlorella vulgaris*)	120h EC_{50}	1,300	Not reported	ECHA (2016d)
Test Material: Sodium Fluoride (CAS# 7681-49-4)[b]					
Fish	Brown trout (*Salmo trutta*)	192h LC_{50}	164.5 ppm	EPA 600/3-75-009	ECHA (2016b)
	Rainbow trout (*Salmo gairdneri*)	192h LC_{50}	107.5 ppm	EPA 600/3-75-009	
	Rainbow trout (*Oncorhynchus mykiss*)	96h LC_{50}	51 (measured)	Not reported	
	Three-spined stickleback (*Gasterosteus aculeatus*)	96h LC_{50}	340	Not reported	
	Ide (*Leuciscus idus*)	48h LC_{50}	299	Not reported	
Invertebrate	Benthic trichoptera larvae	96h EC_{50}	26-48	No guideline followed	
	Water flea (*Daphnia magna*)	24-48h EC_{50}	97-352		
	Mysid shrimp (*Mysidopsis bahia*)	96h EC_{50}	10.5		
Algae	Green algae (*Scenedesmus sp.*)	96h EC_{50}	43	No guideline followed	
	Green algae (*Selenastrum capricornutum*)		122		
	Marine diatom (*Skeletonema costatum*)		81		

Notes:
CAS = Chemistry Abstracts Service; LC_{50} = Median Lethal Concentration; EC_{50} = Median Effect Concentration; ppm = Parts Per Million
(a) Nominal concentration, unless otherwise noted.
(b) Concentrations based on fluoride ion (mg F- ion/L).

Although ammonium bifluoride lacks robust acute aquatic toxicity data, several data values are available for its surrogates (Table 7). Nominal Median Lethal/Effect Concentration (L/EC_{50}) values between 10 and 100 mg/L indicate that ammonium bifluoride exhibits moderate acute aquatic toxicity in accordance

with the GreenScreen guidance for the acute aquatic toxicity endpoint. Although the toxicity data exceed 100 mg/L for several of the surrogates, a conservative assignment of Moderate for acute aquatic toxicity is in alignment with the surrogate screening list results. However, because a majority of the surrogate data indicate low acute aquatic toxicity, our score of Moderate is given low confidence.

Chronic Aquatic Toxicity (CA) Score (vH, H, M or L): *M*

Ammonium bifluoride is assigned a score of *Moderate (M)* for chronic aquatic toxicity, with low confidence, based on experimental fish toxicity data for several surrogates of ammonium bifluoride (Table 8). Ammonium bifluoride is not present on any authoritative or screening lists, nor are there any chronic aquatic toxicity data available. Surrogates of ammonium bifluoride are present on screening lists for chronic aquatic toxicity, assigned to GHS Category 3, which does not translate into a GreenScreen assignment for chronic aquatic toxicity. Because the only experimental data available are for the surrogates, this chronic aquatic toxicity score is assigned with low confidence.

Authoritative and Screening Lists

Ammonium bifluoride (CAS# 1341-49-7):

- *Authoritative*: Not listed
- *Screening*: Not listed

Surrogate ammonium fluoride (CAS# 12125-01-8):

- *Authoritative*: Not listed
- *Screening*:
  - Japan - GHS - Hazardous to the aquatic environment (chronic) - Category 3

Surrogate ammonium chloride (CAS# 12125-02-9):

- *Authoritative*: Not listed
- *Screening*:
  - New Zealand - GHS - Hazardous to the aquatic environment (chronic) - Category 3

Surrogate sodium fluoride (CAS# 7783-20-2):

- *Authoritative*: Not listed
- *Screening*:
  - Japan - GHS - Hazardous to the aquatic environment (chronic) - Category 3

Table 8 Chronic Aquatic Toxicity Data for Surrogates of Ammonium Bifluoride

Trophic Level	Test Species	Endpoint	Value (mg/L)[a]	Method	Source
Test Material: Ammonium Sulfate (CAS# 7783-20-2)					
Fish	Pink Salmon (*Oncorhynchus gorbuscha*)	61d NOEC	11	No guideline followed	ECHA (2016a)
	Walking Catfish (*Clarias batrachus*)	12mo LOEC	100		
	Snakehead Fish (*Channa punctatus*)	6mo LOEC	100		
Algae	Green Algae (*Chlorella vulgaris*)	18d EC_{50}	2,700		
Test Material: Ammonium Chloride (CAS# 12125-02-9)					
Invertebrate	Water Flea (*Daphnia magna*)	21d NOEC	14.6 (measured)	Not reported	ECHA (2016d)
Algae	Green algae (*Navicula sp.*)	10d NOEC	26.8	No guideline followed	
Test Material: Sodium Fluoride (CAS# 7681-49-4)					
Fish	Rainbow Trout (*Oncorhynchus mykiss*)	21d NOEC	4 (measured)	Not reported	ECHA (2016b)
Invertebrate	Water flea (*Daphnia magna*)	21d NOEC	3.7 (measured)	Not reported	ECHA (2016b)
Algae	Various Species: *Ankistridesmus braunii, Cyclotella menghiniana, Oscillatoria limnetica, Scenedesmus quadricauda, Stephanodiscus minutus, Synechococcus leopoldiensis*	7d NOEC	50[2]	No guideline followed	
	Green Algae (*Scenedesmus quadricauda*)	8d NOEC	249[b]		
	Various Species: *Amphidnium carteri, Chaetoceros gracilis, Dunaliella tertiolecta, Pvlova lutheri*	14-21d NOEC	≥50 to ≤200[b]		

Notes:
CAS = Chemistry Abstracts Service; EC_{50} = Median Effect Concentration; LOEC = Lowest Observed Effect Concentration; NOEC = No Observed Effect Concentration.
(a) Nominal concentration, unless otherwise noted.
(b) Concentrations based on fluoride ion (mg F- ion/L).

Ammonium bifluoride lacks chronic aquatic toxicity data, nor is it present on any authoritative or screening lists. However, several data values are available for its surrogates (Table 8). Nominal No/Lowest Observed Effect Concentrations (N/LOEC) values between 1 and 10 mg/L indicate that ammonium bifluoride exhibits moderate chronic aquatic toxicity in accordance with the GreenScreen guidance for the chronic aquatic toxicity endpoint. While several of the data values exceed 10 mg/L for the surrogates, a conservative score of Moderate accounts for the more sensitive species. The score for chronic aquatic toxicity is given low confidence because it is based on surrogate data only.

Environmental Fate (Fate)

Persistence (P) Score (vH, H, M, L, or vL): vH

Ammonium bifluoride is assigned a score of **Very High (vH)** for persistence due to its presence on a screening list and because it is an inorganic chemical. Several of ammonium bifluoride's surrogates were also present on the same screening list. This score is assigned high confidence, even though no experimental data are available, because ammonium bifluoride is inorganic, and therefore not expected to biodegrade. Ammonium bifluoride was not present on any authoritative lists for persistence in the environment, nor are any experimental half-life or percent biodegradation data available for it or any of its surrogates.

Authoritative and Screening Lists

Ammonium bifluoride (CAS# 1341-49-7), and surrogates ammonium fluoride (CAS# 12125-01-8), Ammonium sulfate (CAS# 7783-20-2), ammonium chloride (CAS# 12125-02-9), potassium bifluoride (CAS# 7789-29-9), sodium bifluoride (CAS# 1333-83-1), sodium fluoride (CAS# 7681-49-4), and hydrofluoric acid (CAS# 7664-39-3):

- *Authoritative*: Not listed
- *Screening*:
  - EC - CEPA DSL - Persistent

There are no available experimental half-life or percent biodegradation data for ammonium bifluoride, nor is it present on any authoritative lists regarding its environmental persistence. However, it is present on one screening list, which indicates that ammonium bifluoride is persistent. Additionally, because ammonium bifluoride is inorganic, it is not expected to biodegrade. Therefore, ammonium bifluoride is assigned a score of Very High for persistence.

Bioaccumulation (B) Score (vH, H, M, L, or vL): *vL*

Ammonium bifluoride is assigned a score of *Very Low* (*vL)* for bioaccumulation based on a modeled partition coefficient value for ammonium bifluoride and additional surrogate bioaccumulation data (Table 9). This score is assigned low confidence because it is based on modeled data and surrogate data without information regarding the guidelines that were followed during data collection. Ammonium bifluoride and its surrogates were not listed on any authoritative or screening lists.

Authoritative and Screening Lists

Ammonium bifluoride (CAS# 1341-49-7) and surrogates:

- *Authoritative*: Not listed
- *Screening*: Not listed

Table 9 Bioaccumulation Data for Ammonium Bifluoride and Surrogates

Parameter	Test Species	Endpoint	Value	Method	Source
Test Material: Ammonium Bifluoride (CAS# 1341-49-7)					
Partition Coefficient	Not Applicable	Log K_{ow}	-4.371	Modeled (ECOSAR)	ECHA (2016c)
Test Material: Ammonium Sulfate (CAS# 7783-20-2)					
Partition Coefficient	Not Applicable	Log K_{ow}	0.48	Modeled (ECOSAR)	ECHA (2016a)
Test Material: Hydrofluoric acid (CAS# 7664-39-3)					
Bioconcentration Factor	Freshwater fish	BCF	<2 (whole body d.w.); 53-58 (whole body w.w.)	No guideline followed	ECHA (2016e)
	Freshwater Mollusk		3.2 (whole body w.w.)		
	Freshwater Aquatic Microphyta		7.5 (whole body w.w.)		
	Marine Crustacean		27-62 (whole body w.w.)		
	Marine Fish		30 (whole body w.w.)		

Notes:
BCF = Bioconcentration Factor; CAS = Chemistry Abstracts Service; d.w. = Dry Weight; ECOSAR = United States Environmental Protection Agency's Ecological Structure Activity Relationships Predictive Model (v1.1); w.w. = Wet Weight.

Table 9 presents the modeled partition coefficient data and measured bioconcentration factor data available for ammonium bifluoride and two of its surrogates. Log K_{ow} values of less than or equal to 4.0 and bioconcentration factor (BCF) values of less than or equal to 100 indicate that ammonium bifluoride exhibits very low bioaccumulative potential, in accordance with the GreenScreen guidance for bioaccumulation. However, because these bioaccumulation data are modeled or of unknown quality, this score is assigned with low confidence.

Physical Hazards (Physical)

Reactivity (Rx) Score (vH, H, M or L): *M*

Ammonium bifluoride is assigned a score of *Medium (M)* for reactivity based on professional judgment, using the information below. Low confidence has been assigned to this score due to the lack of supporting data.

Authoritative and Screening Lists

Ammonium bifluoride (CAS# 1341-49-7):

- *Authoritative*: Not listed
- *Screening*: Not listed

- NLM (2006)
  - In the presence of moisture, ammonium bifluoride is capable of corroding glass, cement, and most metals. Ammonium bifluoride is deliquescent; it tends to absorb moisture from the air and form a solution.

- Solvay America, Inc. (2013)
  - Ammonium bifluoride can corrode most metals. It reacts with water to form hydrofluoric acid.

Summary

While no specific data were identified regarding reactivity of ammonium bifluoride, available qualitative information suggests that ammonium bifluoride forms corrosive solutions upon reaction with water, including with moisture from the air. It is unknown whether ammonium bifluoride's corrosivity toward metals is sufficient for classification under GHS;[12] none of the SDSs consulted for ammonium bifluoride listed corrosivity to metals as a GHS hazard. Nonetheless, ammonium bifluoride has been assigned a score of *Medium* (*M*) due to its potential to form corrosive solutions. Low confidence has been assigned to this score due to the lack of supporting data.

Flammability (F) Score (vH, H, M or L): *L*

Ammonium bifluoride is assigned a score of *Low (L)* for flammability based on professional judgment, using the information below. Low confidence has been assigned to this score due to the lack of supporting data.

Authoritative and Screening Lists

Ammonium bifluoride (CAS# 1341-49-7):

- *Authoritative*: Not listed
- *Screening*: Not listed

- Solvay America, Inc. (2013)
  - Ammonium bifluoride is non-flammable.
- Merck KGaA (2013)
  - Ammonium bifluoride is not flammable and decomposes at temperatures > 230°C.
- Spectrum Chemical Mfg. Corp. (2015)
  - Ammonium bifluoride is non-flammable and decomposes at 240°C.

Summary

Ammonium bifluoride is assigned a score of *Low (L)* for flammability based on professional judgment, using the information described above. Low confidence has been assigned to this score due to the lack of supporting data.

[12] Under GHS, the criterion for classification as a metal-corrosive substance is a "corrosion rate on either steel or aluminium surfaces exceeding 6.25 mm per year at a test temperature of 55 °C when tested on both materials" (UN, 2015, p. 105).

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Appendix A

Hazard Benchmark Acronyms

Hazard Benchmark Acronyms

AA	Acute Aquatic Toxicity
AT	Acute Mammalian Toxicity
B	Bioaccumulation
C	Carcinogenicity
CA	Chronic Aquatic Toxicity
Cr	Corrosion/ Irritation (Skin/Eye)
D	Developmental Toxicity
E	Endocrine Activity
F	Flammability
IrE	Eye Irritation/Corrosivity
IrS	Skin Irritation/Corrosivity
M	Mutagenicity and Genotoxicity
N	Neurotoxicity
P	Persistence
R	Reproductive Toxicity
Rx	Reactivity
SnS	Sensitization – Skin
SnR	Sensitization – Respiratory
ST	Systemic/Organ Toxicity

Appendix B

PHAROS Results – Ammonium Bifluoride and Associated Transformation Products

Toggle navigation

- Building Products
- Chemicals and Materials
- Certifications
- CompAIR
- Dashboard
- Logout

1. Dashboard
2. Chemicals and Materials
3. [1341-49-7] AMMONIUM BIFLUORIDE

[1341-49-7] AMMONIUM BIFLUORIDE

- General Information
- Hazards
- Compound Groups
- Process Chemistry Research
- GreenScreen
- C2C

CAS RN: 1341-49-7

Description: *Not provided*

Website (if applicable): *Not provided*

- View products containing this material

My Project Lists

No project lists available. Lists can be added to existing projects on your account. Visit your dashboard for more information.

Direct Hazards:

EYE IRRITATION	New Zealand - GHS - 8.3A - Corrosive to ocular tissue (Cat. 1) Japan - GHS - Serious eye damage / eye irritation - Category 1	+ 1
SKIN IRRITATION	EU - GHS (H-Statements) - H314 - Causes severe skin burns and eye damage EU - R-phrases - R34 - Causes burns	+ 5

	Korea - GHS - Skin corrosion/irritation - Category 1 [H314 - Causes severe skin burns and eye damage] New Zealand - GHS - 8.2C - Corrosive to dermal tissue (Cat. 1C) Japan - GHS - Skin corrosion / irritation - Category 1 Australia - GHS - H314 - Causes severe skin burns and eye damage EU - R-phrases - R25 - Toxic if Swallowed	
MAMMALIAN	Japan - GHS - Specific target organs/systemic toxicity following repeated exposure - Category 2 EU - GHS (H-Statements) - H301 - Toxic if swallowed Korea - GHS - Acute toxicity (oral) - Category 3 [H301 - Toxic if swallowed] New Zealand - GHS - 6.1C (oral) - Acutely toxic Japan - GHS - Specific target organs/systemic toxicity following single exposure - Category 2 Australia - GHS - H301 - Toxic if swallowed	+ 6
TERRESTRIAL	New Zealand - GHS - 9.3B - Ecotoxic to terrestrial vertebrates	
REACTIVE	Québec CSST - WHMIS 1998 - Class E - Corrosive materials	
NEUROTOXICITY	G&L - Neurotoxic Chemicals - Neurotoxic	
MULTIPLE	German FEA - Substances Hazardous to Waters - Class 1 - Low Hazard to Waters EC - CEPA DSL - Inherently Toxic in the Environment EC - CEPA Toxic Substances (Sched 1) - CEPA Toxic	+ 2
PERSISTENT	EC - CEPA DSL - Persistent	

Potential Residual Hazards:

See Process Chemistry Research tab for details on residuals and other substances used in manufacture.

None identified

Compound Groups (1):

- Fluoride compounds, Inorganic

Process Chemistry Research Status: No life cycle research started

GreenScreen for Safer Chemicals Full Assessment: *None available*

Highest concern GreenScreen score : LT-UNK (Benchmark Unknown)

Cradle to Cradle Certified™ List Hazards

What are C2C hazards and what do these colors mean?

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What are C2C hazards and what do these colors mean?

What are the C2C Hazards? The Cradle to Cradle Certified Product Standard establishes a Material Health Assessment Methodology which assigns hazard ratings to 24 individual human and environmental health endpoints. Roll your cursor over the abbreviations (C, M, R+D, etc) in the table to see the full name of each endpoint (Carcinogenicity, Mutagenicity, Reproductive Toxicity, etc). Organohalogen and Toxic Metal are classes of chemicals generally associated with significant human and environmental health issues and are specially treated in the C2C Standard.

The hazard rating is a Green-Yellow-Red-Grey color scheme based upon available toxicity and fate information:

- Green: no hazard identified for the endpoint
- Red: hazard identified for the endpoint
- Yellow: borderline
- Grey: no data available for the endpoint

This tab shows the preliminary hazard ratings based upon hazard lists tracked in the Pharos Chemical & Material Library. During full assessment for certification purposes, Grey hazards must be filled by an accredited assessor and other list-based hazards may be overridden.

Why are these rating colors sometimes different from the GreenScreen or Pharos rating colors? The C2C hazard rating colors are similar to those used in the GreenScreen system and in Pharos, with some distinctions. Pharos has two additional rating colors - orange and purple - not used in the C2C or GreenScreen systems. Pharos orange, red and purple ratings generally encompass the C2C & GreenScreen red ranges. There are some distinctions between the GreenScreen and C2C thresholds that result in different color assignments that are under consideration for harmonization. See the Material Health Evaluation Programs Harmonization Opportunities Report for details. For substances that have been fully assessed under the GreenScreen protocol, there may be different colors due to the application of data from studies that provide information beyond that in the hazard lists.

If interested in assessing the chemicals in a product, please also review the link below describing "How to Use These Scores in a C2C Assessment".

How to Use These Scores in a C2C Assessment

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How to Use These Scores in a C2C Assessment

The top table displays preliminary hazard ratings for individual endpoints based on the hazard lists a given chemical appears on. During the assessment, an accredited Cradle to Cradle Certified Material Health Assessor may override these list-based hazard ratings based on information from other sources. Additionally, a red hazard rating in any one endpoint does not automatically mean that a substance will be x-assessed and targeted for phase-out, as exposure relevant to the endpoint may be deemed non-plausible for the substance depending on the material and product context in which it is being assessed.

The bottom table (Full Hazard List by Endpoint) includes all warnings associated with the substance from each of the authoritative hazard lists used by C2C, as well as additional lists in the Pharos Chemical and Material Library. C2C lists are labeled with their C2C hazard rating (Red, Yellow, or Green), while non-C2C lists are labeled as "not rated".

The ratings for the hazard lists used in this tool are based on Table 9 in the Material Assessment Methodology, Cradle to Cradle Certified Version 3.0 with a few minor adjustments/additions to allow for direct mapping from GreenScreen list translator results for a subset of the covered lists. The v3.0 Material Assessment Methdology document can be found on the C2C Resources page at http://www.c2ccertified.org/resources/collection-page/cradle-to-cradle-certified-resources.

Key
R: Red hazard level
Y: Yellow hazard level
G: Green hazard level
?: On a hazard list that has not been rated by C2C
-: Not listed on any C2C or Pharos hazard lists

				Acute and Chronic Tox.							Acute Aquatic Tox.				Chronic Aquatic Tox.							
C	**M**	**R+D**	**E**	**O**	**D**	**I**	**O/D/I**	**N**	**IrS+IrE**	**SnS+SnR**	**Fish**	**Inv.**	**Alg.**	**Any**	**Fish**	**Inv.**	**Alg.**	**Any**	**T**	**P**	**B**	**C**
-	-	-	-	R	-	-	Y	R/Y	R	-	-	-	-	-	-	-	-	-	?	R/Y	-	(

Full Hazard List By Endpoint:

Carcinogenicity	not listed
Mutagenicity	not listed
Reproductive Toxicity (Repro + Dev)	not listed
Endocrine Disruption	not listed
Oral Toxicity	Australia - GHS - H301 - Toxic if swallowed: Red EU - GHS (H-Statements) - H301 - Toxic if swallowed: Red EU - R-phrases - R25 - Toxic if Swallowed: Red Korea - GHS - Acute toxicity (oral) - Category 3 [H301 - Toxic if swallowed]: Red New Zealand - GHS - 6.1C (oral) - Acutely toxic: Not rated
Dermal Toxicity	not listed

Inhalative Toxicity	not listed
Oral, Dermal, and/or Inhalative Toxicity	Japan - GHS - Specific target organs/systemic toxicity following repeated exposure - Category 2: Yellow Japan - GHS - Specific target organs/systemic toxicity following single exposure - Category 2: Yellow
Neurotoxicity	G&L - Neurotoxic Chemicals - Neurotoxic: Red or Yellow
Skin, Eye, and Respiratory Corrosion/Irritation	Australia - GHS - H314 - Causes severe skin burns and eye damage: Red EU - GHS (H-Statements) - H314 - Causes severe skin burns and eye damage: Red EU - R-phrases - R34 - Causes burns: Red Japan - GHS - Serious eye damage / eye irritation - Category 1: Red Japan - GHS - Skin corrosion / irritation - Category 1: Red Korea - GHS - Skin corrosion/irritation - Category 1 [H314 - Causes severe skin burns and eye damage]: Red New Zealand - GHS - 8.2C - Corrosive to dermal tissue (Cat. 1C): Not rated New Zealand - GHS - 8.3A - Corrosive to ocular tissue (Cat. 1): Not rated
Skin and Respiratory Sensitization	not listed
Acute Aquatic Toxicity (Fish)	not listed
Acute Aquatic Toxicity (Invertibrates)	not listed
Acute Aquatic Toxicity (Algae)	not listed
Acute Aquatic Toxicity (Fish, Invertibrates, and/or Algae)	not listed
Chronic Aquatic Toxicity (Fish)	not listed
Chronic Aquatic Toxicity (Invertibrates)	not listed
Chronic Aquatic Toxicity (Algae)	not listed
Chronic Aquatic Toxicity (Fish, Invertibrates, and/or Algae)	not listed
Terrestrial	New Zealand - GHS - 9.3B - Ecotoxic to terrestrial vertebrates: Not rated
Persistence	EC - CEPA DSL - Persistent: Red or Yellow
Bioaccumulation	not listed
Climatic Relevance	not listed
Organohalogen	not listed - *This chemical is not on the Pharos list of organohalogens, but we may have missed a few. Please double-check*

	the chemical structure to confirm there are no carbon-halogen bonds.
Toxic Metal	not listed - *This chemical is not on the Pharos list of toxic metals, but we may have missed a few. Please double-check the chemical structure to confirm there are no toxic metals.*
Other (Human Health)	not listed
Multiple Endpoints	EC - CEPA DSL - Inherently Toxic in the Environment: Red German FEA - Substances Hazardous to Waters - Class 1 - Low Hazard to Waters: Red Québec CSST - WHMIS 1998 - Class E - Corrosive materials: Red EC - CEPA Toxic Substances (Sched 1) - CEPA Toxic: Red

×

Substance Hazard

This color reflects the highest hazard associated directly with this substance by an authoritative hazard list.

The colors represent the relative level of hazard, ranging from **purple** (highest concern) through **red**, **orange**, and **yellow** to **green** (lowest concern).

Grey indicates that the authoritative hazard listing is ambiguous and covers a wide range of possible hazard levels.

Blue indicates that the substance is referenced on a restricted substance list (RSL) rather than an authoritative hazard list.

For a full description of authoritative hazard lists used in Pharos and of the derivation of the hazard level indicators, see the complete Pharos Chemical and Material Library Description.

For the authoritative hazard list that is the source of this hazard color, see the "Hazard" tab on the chemical / material's page.

×

Residual Hazard

This color reflects the highest hazard associated with residual chemicals that our research indicates may be present with the chemical. These residuals consist of all process chemicals in the following categories:

- Monomers
- Catalysts
- Non-reactive Additives
- Pollutants and Contaminants
- Other known residuals

Hazards are drawn from process chemicals far upstream in the manufacturing process as well as the immediate precursors to this chemical.

The colors represent the relative level of hazard, ranging from **purple** (highest concern) through **red**, **orange**, and **yellow** to **green** (lowest concern).

Grey indicates that the authoritative hazard listing is ambiguous and covers a wide range of possible hazard levels.

Blue indicates that the substance is referenced on a restricted substance list (RSL) rather than an authoritative hazard list.

For a full description of authoritative hazard lists used in Pharos and of the derivation of the hazard level indicators, see the complete Pharos Chemical and Material Library Description.

For the source of this hazard, see the "Process Chemistry Research" tab on the chemical's page.

×

Manufacturing Hazard

This color reflects the highest hazard associated with chemicals that our research categorizes as “frequent” or “integral” to the production of a chemical. The manufacturing score is included to surface potential hazards upstream in the manufacturing process that may or may not be present as residuals. Hazards are drawn from process chemicals far upstream in the manufacturing process as well as the immediate precursors to this chemical.

The colors represent the relative level of hazard, ranging from **purple** (highest concern) through **red**, **orange**, and **yellow** to **green** (lowest concern).

Grey indicates that the authoritative hazard listing is ambiguous and covers a wide range of possible hazard levels.

Blue indicates that the substance is referenced on a restricted substance list (RSL) rather than an authoritative hazard list.

For a full description of authoritative hazard lists used in Pharos and of the derivation of the hazard level indicators, see the complete Pharos Chemical and Material Library Description.

For the source of this hazard, see the "Process Chemistry Research" tab on the chemical's page.

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GreenScreen

The Pharos scoring system is informed by the GreenScreen® for Safer Chemicals, a benchmarking system to rank the safety of chemicals on a 4 point hazard scale and encourage progress toward safer alternatives. Chemicals that have undergone a full GreenScreen assessment by Licensed GreenScreen Profilers are given a Benchmark score, which is the most authoritative. Chemicals that have been

assessed using an automated comparison to hazard lists are given a List Translator score, which is less authoritative. Full GreenScreen assessments trump results from List Translator scoring.

GreenScreen Scores in order from highest concern to lowest concern are:

- Benchmark 1
- LT-1 - List Translator Likely Benchmark 1
- LT-P1 - List Translator Possible Benchmark 1
- LT-UNK - List Translator Benchmark Unknown
- Benchmark U
- Benchmark 2
- Benchmark 3
- Benchmark 4

For more information, see the "GreenScreen" tab on the chemical's page or visit www.greenscreenchemicals.org.

Toggle navigation

- Building Products
- Chemicals and Materials
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- Dashboard
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1. Dashboard
2. Chemicals and Materials
3. [14798-03-9] Ammonium Ion

[14798-03-9] Ammonium Ion

- General Information
- Hazards
- Process Chemistry Research
- GreenScreen
- C2C

CAS RN: 14798-03-9

Description: *Not provided*

Website (if applicable): *Not provided*

- View products containing this material

My Project Lists

No project lists available. Lists can be added to existing projects on your account. Visit your dashboard for more information.

Direct Hazards:

None identified

Potential Residual Hazards:

See Process Chemistry Research tab for details on residuals and other substances used in manufacture.

None identified

Process Chemistry Research Status: No life cycle research started

This material is used in the process chemistry of:

Material	Hazard			Type	Frequency	Percentage	Notes
	Substance	Residual	Manufacturing				
[28214-57-5] 2-							

Propenoic acid, ammonium salt (1:1), homopolymer [68989-03-7]	Reactant	Integral	Unknown
Quaternary ammonium compounds, cocoalkyl bis (hydroxyethyl)methyl, ethoxylated, methyl sulfate	Reactant	Frequent	Unknown

GreenScreen for Safer Chemicals Full Assessment: *None available*

Highest concern GreenScreen score : *Unknown*

Cradle to Cradle Certified™ List Hazards

What are C2C hazards and what do these colors mean?

×

What are C2C hazards and what do these colors mean?

What are the C2C Hazards? The Cradle to Cradle Certified Product Standard establishes a Material Health Assessment Methodology which assigns hazard ratings to 24 individual human and environmental health endpoints. Roll your cursor over the abbreviations (C, M, R+D, etc) in the table to see the full name of each endpoint (Carcinogenicity, Mutagenicity, Reproductive Toxicity, etc). Organohalogen and Toxic Metal are classes of chemicals generally associated with significant human and environmental health issues and are specially treated in the C2C Standard.

The hazard rating is a Green-Yellow-Red-Grey color scheme based upon available toxicity and fate information:

- Green: no hazard identified for the endpoint
- Red: hazard identified for the endpoint
- Yellow: borderline
- Grey: no data available for the endpoint

This tab shows the preliminary hazard ratings based upon hazard lists tracked in the Pharos Chemical & Material Library. During full assessment for certification purposes, Grey hazards must be filled by an accredited assessor and other list-based hazards may be overridden.

Why are these rating colors sometimes different from the GreenScreen or Pharos rating colors? The C2C hazard rating colors are similar to those used in the GreenScreen system and in Pharos, with some distinctions. Pharos has two additional rating colors - orange and purple - not used in the C2C or GreenScreen systems. Pharos orange, red and purple ratings generally encompass the C2C & GreenScreen red ranges. There are some distinctions between the GreenScreen and C2C thresholds that result in different color assignments that are under consideration for harmonization. See the Material Health Evaluation Programs Harmonization Opportunities Report for details. For substances that have been fully assessed under the GreenScreen protocol, there may be different colors due to the application of data from studies that provide information beyond that in the hazard lists.

If interested in assessing the chemicals in a product, please also review the link below describing "How to Use These Scores in a C2C Assessment".

How to Use These Scores in a C2C Assessment

×

How to Use These Scores in a C2C Assessment

The top table displays preliminary hazard ratings for individual endpoints based on the hazard lists a given chemical appears on. During the assessment, an accredited Cradle to Cradle Certified Material Health Assessor may override these list-based hazard ratings based on information from other sources. Additionally, a red hazard rating in any one endpoint does not automatically mean that a substance will be x-assessed and targeted for phase-out, as exposure relevant to the endpoint may be deemed non-plausible for the substance depending on the material and product context in which it is being assessed.

The bottom table (Full Hazard List by Endpoint) includes all warnings associated with the substance from each of the authoritative hazard lists used by C2C, as well as additional lists in the Pharos Chemical and Material Library. C2C lists are labeled with their C2C hazard rating (Red, Yellow, or Green), while non-C2C lists are labeled as "not rated".

The ratings for the hazard lists used in this tool are based on Table 9 in the Material Assessment Methodology, Cradle to Cradle Certified Version 3.0 with a few minor adjustments/additions to allow for direct mapping from GreenScreen list translator results for a subset of the covered lists. The v3.0 Material Assessment Methdology document can be found on the C2C Resources page at http://www.c2ccertified.org/resources/collection-page/cradle-to-cradle-certified-resources.

Key
R: Red hazard level
Y: Yellow hazard level
G: Green hazard level
?: On a hazard list that has not been rated by C2C
-: Not listed on any C2C or Pharos hazard lists

Acute and Chronic Tox.											Acute Aquatic Tox.				Chronic Aquatic Tox.								
C	M	R+D	E	O	D	I	O/D/I	N	IrS+IrE	SnS+SnR	Fish	Inv.	Alg.	Any	Fish	Inv.	Alg.	Any	T	P	B	Climate	Orga
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	G	NL

Full Hazard List By Endpoint:

Carcinogenicity	not listed
Mutagenicity	not listed
Reproductive Toxicity (Repro + Dev)	not listed
Endocrine Disruption	not listed
Oral Toxicity	not listed
Dermal Toxicity	not listed
Inhalative Toxicity	not listed

Oral, Dermal, and/or Inhalative Toxicity	not listed
Neurotoxicity	not listed
Skin, Eye, and Respiratory Corrosion/Irritation	not listed
Skin and Respiratory Sensitization	not listed
Acute Aquatic Toxicity (Fish)	not listed
Acute Aquatic Toxicity (Invertibrates)	not listed
Acute Aquatic Toxicity (Algae)	not listed
Acute Aquatic Toxicity (Fish, Invertibrates, and/or Algae)	not listed
Chronic Aquatic Toxicity (Fish)	not listed
Chronic Aquatic Toxicity (Invertibrates)	not listed
Chronic Aquatic Toxicity (Algae)	not listed
Chronic Aquatic Toxicity (Fish, Invertibrates, and/or Algae)	not listed
Terrestrial	not listed
Persistence	not listed
Bioaccumulation	not listed
Climatic Relevance	not listed
Organohalogen	not listed - *This chemical is not on the Pharos list of organohalogens, but we may have missed a few. Please double-check the chemical structure to confirm there are no carbon-halogen bonds.*
Toxic Metal	not listed - *This chemical is not on the Pharos list of toxic metals, but we may have missed a few. Please double-check the chemical structure to confirm there are no toxic metals.*
Other (Human Health)	not listed
Multiple Endpoints	not listed

×

Substance Hazard

This color reflects the highest hazard associated directly with this substance by an authoritative hazard list.

The colors represent the relative level of hazard, ranging from **purple** (highest concern) through **red**, **orange**, and **yellow** to **green** (lowest concern).

Grey indicates that the authoritative hazard listing is ambiguous and covers a wide range of possible hazard levels.

Blue indicates that the substance is referenced on a restricted substance list (RSL) rather than an authoritative hazard list.

For a full description of authoritative hazard lists used in Pharos and of the derivation of the hazard level indicators, see the complete Pharos Chemical and Material Library Description.

For the authoritative hazard list that is the source of this hazard color, see the "Hazard" tab on the chemical / material's page.

×

Residual Hazard

This color reflects the highest hazard associated with residual chemicals that our research indicates may be present with the chemical. These residuals consist of all process chemicals in the following categories:

- Monomers
- Catalysts
- Non-reactive Additives
- Pollutants and Contaminants
- Other known residuals

Hazards are drawn from process chemicals far upstream in the manufacturing process as well as the immediate precursors to this chemical.

The colors represent the relative level of hazard, ranging from **purple** (highest concern) through **red**, **orange**, and **yellow** to **green** (lowest concern).

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For a full description of authoritative hazard lists used in Pharos and of the derivation of the hazard level indicators, see the complete Pharos Chemical and Material Library Description.

For the source of this hazard, see the "Process Chemistry Research" tab on the chemical's page.

×

Manufacturing Hazard

This color reflects the highest hazard associated with chemicals that our research categorizes as “frequent” or “integral” to the production of a chemical. The manufacturing score is included to surface potential hazards upstream in the manufacturing process that may or may not be present as residuals. Hazards are drawn from process chemicals far upstream in the manufacturing process as well as the immediate precursors to this chemical.

The colors represent the relative level of hazard, ranging from **purple** (highest concern) through **red**, **orange**, and **yellow** to **green** (lowest concern).

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For the source of this hazard, see the "Process Chemistry Research" tab on the chemical's page.

×

GreenScreen

The Pharos scoring system is informed by the GreenScreen® for Safer Chemicals, a benchmarking system to rank the safety of chemicals on a 4 point hazard scale and encourage progress toward safer alternatives. Chemicals that have undergone a full GreenScreen assessment by Licensed GreenScreen Profilers are given a Benchmark score, which is the most authoritative. Chemicals that have been assessed using an automated comparison to hazard lists are given a List Translator score, which is less authoritative. Full GreenScreen assessments trump results from List Translator scoring.

GreenScreen Scores in order from highest concern to lowest concern are:

- Benchmark 1
- LT-1 - List Translator Likely Benchmark 1
- LT-P1 - List Translator Possible Benchmark 1
- LT-UNK - List Translator Benchmark Unknown
- Benchmark U
- Benchmark 2
- Benchmark 3
- Benchmark 4

For more information, see the "GreenScreen" tab on the chemical's page or visit www.greenscreenchemicals.org.

Toggle navigation

- Building Products
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1. Dashboard
2. Chemicals and Materials
3. [16984-48-8] FLUORIDE

[16984-48-8] FLUORIDE

- General Information
- Hazards
- Compound Groups
- Process Chemistry Research
- GreenScreen
- C2C

CAS RN: 16984-48-8

PubChem CID: 28179

Description: *Not provided*

Website (if applicable): *Not provided*

- View products containing this material

My Project Lists

No project lists available. Lists can be added to existing projects on your account. Visit your dashboard for more information.

Direct Hazards:

DEVELOPMENTAL	G&L - Neurotoxic Chemicals - Developmental neurotoxicant (2014)
NEUROTOXICITY	G&L - Neurotoxic Chemicals - Emerging neurotoxicant G&L - Neurotoxic Chemicals - Neurotoxic + 1
RESTRICTED LIST	CA SCP - Candidate Chemicals - Candidate Chemical List
MULTIPLE	EC - CEPA Toxic Substances (Sched 1) - CEPA Toxic

Potential Residual Hazards:

See Process Chemistry Research tab for details on residuals and other substances used in manufacture.

None identified

Compound Groups (2):

- Fluoride compounds, Inorganic
- Fluorides

Process Chemistry Research Status: No life cycle research started

This material is used in the process chemistry of:

Material	Hazard			Type	Frequency	Percentage	Notes
	Substance	Residual	Manufacturing				
[75-21-8] ETHYLENE OXIDE				Byproduct	Unknown	Unknown	
Phosphogypsum				Pollutant/ Contaminant	Occasional/Rare (known)	Unknown	

GreenScreen for Safer Chemicals Full Assessment: *None available*

Highest concern GreenScreen score : LT-P1 (Possible Benchmark 1)

Cradle to Cradle Certified™ List Hazards

What are C2C hazards and what do these colors mean?

×

What are C2C hazards and what do these colors mean?

What are the C2C Hazards? The Cradle to Cradle Certified Product Standard establishes a Material Health Assessment Methodology which assigns hazard ratings to 24 individual human and environmental health endpoints. Roll your cursor over the abbreviations (C, M, R+D, etc) in the table to see the full name of each endpoint (Carcinogenicity, Mutagenicity, Reproductive Toxicity, etc). Organohalogen and Toxic Metal are classes of chemicals generally associated with significant human and environmental health issues and are specially treated in the C2C Standard.

The hazard rating is a Green-Yellow-Red-Grey color scheme based upon available toxicity and fate information:

- Green: no hazard identified for the endpoint
- Red: hazard identified for the endpoint
- Yellow: borderline
- Grey: no data available for the endpoint

This tab shows the preliminary hazard ratings based upon hazard lists tracked in the Pharos Chemical & Material Library. During full assessment for certification purposes, Grey hazards must be filled by an accredited assessor and other list-based hazards may be overridden.

Why are these rating colors sometimes different from the GreenScreen or Pharos rating colors? The C2C hazard rating colors are similar to those used in the GreenScreen system and in Pharos, with some distinctions.

Pharos has two additional rating colors - orange and purple - not used in the C2C or GreenScreen systems. Pharos orange, red and purple ratings generally encompass the C2C & GreenScreen red ranges. There are some distinctions between the GreenScreen and C2C thresholds that result in different color assignments that are under consideration for harmonization. See the [Material Health Evaluation Programs Harmonization Opportunities Report] for details. For substances that have been fully assessed under the GreenScreen protocol, there may be different colors due to the application of data from studies that provide information beyond that in the hazard lists.

If interested in assessing the chemicals in a product, please also review the link below describing "How to Use These Scores in a C2C Assessment".

How to Use These Scores in a C2C Assessment

×

How to Use These Scores in a C2C Assessment

The top table displays preliminary hazard ratings for individual endpoints based on the hazard lists a given chemical appears on. During the assessment, an accredited Cradle to Cradle Certified Material Health Assessor may override these list-based hazard ratings based on information from other sources. Additionally, a red hazard rating in any one endpoint does not automatically mean that a substance will be x-assessed and targeted for phase-out, as exposure relevant to the endpoint may be deemed non-plausible for the substance depending on the material and product context in which it is being assessed.

The bottom table (Full Hazard List by Endpoint) includes all warnings associated with the substance from each of the authoritative hazard lists used by C2C, as well as additional lists in the Pharos Chemical and Material Library. C2C lists are labeled with their C2C hazard rating (Red, Yellow, or Green), while non-C2C lists are labeled as "not rated".

The ratings for the hazard lists used in this tool are based on Table 9 in the Material Assessment Methodology, Cradle to Cradle Certified Version 3.0 with a few minor adjustments/additions to allow for direct mapping from GreenScreen list translator results for a subset of the covered lists. The v3.0 Material Assessment Methdology document can be found on the C2C Resources page at http://www.c2ccertified.org/resources/collection-page/cradle-to-cradle-certified-resources.

Key
R: Red hazard level
Y: Yellow hazard level
G: Green hazard level
?: On a hazard list that has not been rated by C2C
-: Not listed on any C2C or Pharos hazard lists

			Acute and Chronic Tox.								**Acute Aquatic Tox.**				**Chronic Aquatic Tox.**								
C	**M**	**R+D**	**E**	**O**	**D**	**I**	**O/D/I**	**N**	**IrS+IrE**	**SnS+SnR**	**Fish**	**Inv.**	**Alg.**	**Any**	**Fish**	**Inv.**	**Alg.**	**Any**	**T**	**P**	**B**	**Climate**	**Or**
-	-	?	-	-	-	-	-	Y/G	-	-	-	-	-	-	-	-	-	-	-	-	-	G	NL

Full Hazard List By Endpoint:

Carcinogenicity	not listed

Mutagenicity	not listed
Reproductive Toxicity (Repro + Dev)	G&L - Neurotoxic Chemicals - Developmental neurotoxicant (2014): Not rated
Endocrine Disruption	not listed
Oral Toxicity	not listed
Dermal Toxicity	not listed
Inhalative Toxicity	not listed
Oral, Dermal, and/or Inhalative Toxicity	not listed
Neurotoxicity	G&L - Neurotoxic Chemicals - Emerging neurotoxicant: Yellow or Green G&L - Neurotoxic Chemicals - Neurotoxic: Red or Yellow
Skin, Eye, and Respiratory Corrosion/Irritation	not listed
Skin and Respiratory Sensitization	not listed
Acute Aquatic Toxicity (Fish)	not listed
Acute Aquatic Toxicity (Invertibrates)	not listed
Acute Aquatic Toxicity (Algae)	not listed
Acute Aquatic Toxicity (Fish, Invertibrates, and/or Algae)	not listed
Chronic Aquatic Toxicity (Fish)	not listed
Chronic Aquatic Toxicity (Invertibrates)	not listed
Chronic Aquatic Toxicity (Algae)	not listed
Chronic Aquatic Toxicity (Fish, Invertibrates, and/or Algae)	not listed
Terrestrial	not listed
Persistence	not listed
Bioaccumulation	not listed
Climatic Relevance	not listed
Organohalogen	not listed - *This chemical is not on the Pharos list of organohalogens, but we may have missed a few. Please double-check the chemical structure to confirm there are no carbon-halogen bonds.*
Toxic Metal	not listed - *This chemical is not on the Pharos list of toxic metals, but we may have missed a few. Please double-check the chemical structure to confirm there are no toxic metals.*
Other (Human Health)	not listed
Multiple Endpoints	EC - CEPA Toxic Substances (Sched 1) - CEPA Toxic: Red

×

Substance Hazard

This color reflects the highest hazard associated directly with this substance by an authoritative hazard list.

The colors represent the relative level of hazard, ranging from **purple** (highest concern) through **red**, **orange**, and **yellow** to **green** (lowest concern).

Grey indicates that the authoritative hazard listing is ambiguous and covers a wide range of possible hazard levels.

Blue indicates that the substance is referenced on a restricted substance list (RSL) rather than an authoritative hazard list.

For a full description of authoritative hazard lists used in Pharos and of the derivation of the hazard level indicators, see the complete Pharos Chemical and Material Library Description.

For the authoritative hazard list that is the source of this hazard color, see the "Hazard" tab on the chemical / material's page.

×

Residual Hazard

This color reflects the highest hazard associated with residual chemicals that our research indicates may be present with the chemical. These residuals consist of all process chemicals in the following categories:

- Monomers
- Catalysts
- Non-reactive Additives
- Pollutants and Contaminants
- Other known residuals

Hazards are drawn from process chemicals far upstream in the manufacturing process as well as the immediate precursors to this chemical.

The colors represent the relative level of hazard, ranging from **purple** (highest concern) through **red**, **orange**, and **yellow** to **green** (lowest concern).

Grey indicates that the authoritative hazard listing is ambiguous and covers a wide range of possible hazard levels.

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For a full description of authoritative hazard lists used in Pharos and of the derivation of the hazard level indicators, see the complete Pharos Chemical and Material Library Description.

For the source of this hazard, see the "Process Chemistry Research" tab on the chemical's page.

×

Manufacturing Hazard

This color reflects the highest hazard associated with chemicals that our research categorizes as “frequent” or “integral” to the production of a chemical. The manufacturing score is included to surface potential hazards upstream in the manufacturing process that may or may not be present as residuals. Hazards are drawn from process chemicals far upstream in the manufacturing process as well as the immediate precursors to this chemical.

The colors represent the relative level of hazard, ranging from **purple** (highest concern) through **red**, **orange**, and **yellow** to **green** (lowest concern).

Grey indicates that the authoritative hazard listing is ambiguous and covers a wide range of possible hazard levels.

Blue indicates that the substance is referenced on a restricted substance list (RSL) rather than an authoritative hazard list.

For a full description of authoritative hazard lists used in Pharos and of the derivation of the hazard level indicators, see the complete Pharos Chemical and Material Library Description.

For the source of this hazard, see the "Process Chemistry Research" tab on the chemical's page.

×

GreenScreen

The Pharos scoring system is informed by the GreenScreen® for Safer Chemicals, a benchmarking system to rank the safety of chemicals on a 4 point hazard scale and encourage progress toward safer alternatives. Chemicals that have undergone a full GreenScreen assessment by Licensed GreenScreen Profilers are given a Benchmark score, which is the most authoritative. Chemicals that have been assessed using an automated comparison to hazard lists are given a List Translator score, which is less authoritative. Full GreenScreen assessments trump results from List Translator scoring.

GreenScreen Scores in order from highest concern to lowest concern are:

- Benchmark 1
- LT-1 - List Translator Likely Benchmark 1
- LT-P1 - List Translator Possible Benchmark 1
- LT-UNK - List Translator Benchmark Unknown
- Benchmark U
- Benchmark 2
- Benchmark 3
- Benchmark 4

For more information, see the "GreenScreen" tab on the chemical's page or visit www.greenscreenchemicals.org.

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1. Dashboard
2. Chemicals and Materials
3. [12125-01-8] AMMONIUM FLUORIDE

[12125-01-8] AMMONIUM FLUORIDE

- General Information
- Hazards
- Compound Groups
- Process Chemistry Research
- GreenScreen
- C2C

CAS RN: 12125-01-8

PubChem CID: 25516

Description: *Not provided*

Website (if applicable): *Not provided*

- View products containing this material

My Project Lists

No project lists available. Lists can be added to existing projects on your account. Visit your dashboard for more information.

Direct Hazards:

EU - GHS (H-Statements) - H311 - Toxic in contact with skin

Québec CSST - WHMIS 1998 - Class D1B - Toxic material causing immediate and serious toxic effects

Québec CSST - WHMIS 1998 - Class D2A - Very toxic material causing other toxic effects

EU - R-phrases - R25 - Toxic if Swallowed

EU - R-phrases - R24 - Toxic in Contact with Skin

EU - R-phrases - R23 - Toxic by Inhalation (gas, vapour, dust/mist)

MAMMALIAN ± 13

	EU - GHS (H-Statements) - H301 - Toxic if swallowed	
	EU - GHS (H-Statements) - H331 - Toxic if inhaled	
	New Zealand - GHS - 6.1C (dermal) - Acutely toxic	
	New Zealand - GHS - 6.1C (oral) - Acutely toxic	
	Korea - GHS - Acute toxicity (oral) - Category 3 [H301 - Toxic if swallowed]	
	Australia - GHS - H331 - Toxic if inhaled	
	Australia - GHS - H311 - Toxic in contact with skin	
	Australia - GHS - H301 - Toxic if swallowed	
EYE IRRITATION	New Zealand - GHS - 8.3A - Corrosive to ocular tissue (Cat. 1)	+ 1
	Japan - GHS - Serious eye damage / eye irritation - Category 2	
SKIN IRRITATION	New Zealand - GHS - 8.2C - Corrosive to dermal tissue (Cat. 1C)	
ORGAN TOXICANT	Japan - GHS - Specific target organs/systemic toxicity following repeated exposure - Category 1	+ 2
ACUTE AQUATIC	Japan - GHS - Hazardous to the aquatic environment (acute) - Category 3	
CHRON AQUATIC	Japan - GHS - Hazardous to the aquatic environment (chronic) - Category 3	
TERRESTRIAL	New Zealand - GHS - 9.3B - Ecotoxic to terrestrial vertebrates	
NEUROTOXICITY	G&L - Neurotoxic Chemicals - Neurotoxic	
	German FEA - Substances Hazardous to Waters - Class 1 - Low Hazard to Waters	
MULTIPLE	EC - CEPA DSL - Inherently Toxic in the Environment	+ 2
	EC - CEPA Toxic Substances (Sched 1) - CEPA Toxic	
PERSISTENT	EC - CEPA DSL - Persistent	

Potential Residual Hazards:

See Process Chemistry Research tab for details on residuals and other substances used in manufacture.

None identified

Compound Groups (1):

- Fluoride compounds, Inorganic

Process Chemistry Research Status: No life cycle research started

This material is used in the process chemistry of:

Material	Hazard			Type	Frequency	Percentage	Notes
	Substance	Residual	Manufacturing				
[7440-41-7] BERYLLIUM				Reactant	Occasional/Rare	Unknown	

GreenScreen for Safer Chemicals Full Assessment: *None available*

Highest concern GreenScreen score : LT-UNK (Benchmark Unknown)

Cradle to Cradle Certified™ List Hazards

What are C2C hazards and what do these colors mean?

×

What are C2C hazards and what do these colors mean?

What are the C2C Hazards? The Cradle to Cradle Certified Product Standard establishes a Material Health Assessment Methodology which assigns hazard ratings to 24 individual human and environmental health endpoints. Roll your cursor over the abbreviations (C, M, R+D, etc) in the table to see the full name of each endpoint (Carcinogenicity, Mutagenicity, Reproductive Toxicity, etc). Organohalogen and Toxic Metal are classes of chemicals generally associated with significant human and environmental health issues and are specially treated in the C2C Standard.

The hazard rating is a Green-Yellow-Red-Grey color scheme based upon available toxicity and fate information:

- Green: no hazard identified for the endpoint
- Red: hazard identified for the endpoint
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- Grey: no data available for the endpoint

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How to Use These Scores in a C2C Assessment

×

How to Use These Scores in a C2C Assessment

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Key
R: Red hazard level
Y: Yellow hazard level
G: Green hazard level
?: On a hazard list that has not been rated by C2C
-: Not listed on any C2C or Pharos hazard lists

Acute and Chronic Tox.										Acute Aquatic Tox.				Chronic Aquatic Tox.							
C	**M**	**R+D**	**E**	**O**	**D**	**I**	**O/D/I**	**N**	**IrS+IrE**	**SnS+SnR**	**Fish**	**Inv.**	**Alg.**	**Any**	**Fish**	**Inv.**	**Alg.**	**Any**	**T**	**P**	**B**	**Climate**
-	-	-	-	R	R	R	R	R/Y	Y/G	-	-	-	-	Y	-	-	-	?	?	R/Y	-	G

Full Hazard List By Endpoint:

Carcinogenicity	not listed
Mutagenicity	not listed
Reproductive Toxicity (Repro + Dev)	not listed
Endocrine Disruption	not listed
Oral Toxicity	Australia - GHS - H301 - Toxic if swallowed: Red EU - GHS (H-Statements) - H301 - Toxic if swallowed: Red EU - R-phrases - R25 - Toxic if Swallowed: Red Korea - GHS - Acute toxicity (oral) - Category 3 [H301 - Toxic if swallowed]: Red New Zealand - GHS - 6.1C (oral) - Acutely toxic: Not rated
Dermal Toxicity	Australia - GHS - H311 - Toxic in contact with skin: Red EU - GHS (H-Statements) - H311 - Toxic in contact with skin: Red EU - R-phrases - R24 - Toxic in Contact with Skin: Red New Zealand - GHS - 6.1C (dermal) - Acutely toxic: Not rated
Inhalative Toxicity	Australia - GHS - H331 - Toxic if inhaled: Red EU - GHS (H-Statements) - H331 - Toxic if inhaled: Red EU - R-phrases - R23 - Toxic by Inhalation (gas, vapour, dust/mist): Red
Oral, Dermal, and/or	Japan - GHS - Specific target organs/systemic toxicity following repeated exposure - Category 1: Red Québec CSST - WHMIS 1998 - Class D1B - Toxic material causing immediate and serious toxic effects: Red or Yellow

Inhalative Toxicity	Japan - GHS - Specific target organs/systemic toxicity following repeated exposure - Category 2: Yellow Japan - GHS - Specific target organs/systemic toxicity following single exposure - Category 3: Green
Neurotoxicity	G&L - Neurotoxic Chemicals - Neurotoxic: Red or Yellow
Skin, Eye, and Respiratory Corrosion/Irritation	Japan - GHS - Serious eye damage / eye irritation - Category 2: Yellow or Green New Zealand - GHS - 8.2C - Corrosive to dermal tissue (Cat. 1C): Not rated New Zealand - GHS - 8.3A - Corrosive to ocular tissue (Cat. 1): Not rated
Skin and Respiratory Sensitization	not listed
Acute Aquatic Toxicity (Fish)	not listed
Acute Aquatic Toxicity (Invertibrates)	not listed
Acute Aquatic Toxicity (Algae)	not listed
Acute Aquatic Toxicity (Fish, Invertibrates, and/or Algae)	Japan - GHS - Hazardous to the aquatic environment (acute) - Category 3: Yellow
Chronic Aquatic Toxicity (Fish)	not listed
Chronic Aquatic Toxicity (Invertibrates)	not listed
Chronic Aquatic Toxicity (Algae)	not listed
Chronic Aquatic Toxicity (Fish, Invertibrates, and/or Algae)	Japan - GHS - Hazardous to the aquatic environment (chronic) - Category 3: Not rated
Terrestrial	New Zealand - GHS - 9.3B - Ecotoxic to terrestrial vertebrates: Not rated
Persistence	EC - CEPA DSL - Persistent: Red or Yellow
Bioaccumulation	not listed
Climatic Relevance	not listed
Organohalogen	not listed - *This chemical is not on the Pharos list of organohalogens, but we may have missed a few. Please double-check the chemical structure to confirm there are no carbon-halogen bonds.*
Toxic Metal	not listed - *This chemical is not on the Pharos list of toxic metals, but we may have missed a few. Please double-check the chemical structure to confirm there are no toxic metals.*
Other (Human Health)	not listed
Multiple Endpoints	EC - CEPA DSL - Inherently Toxic in the Environment: Red German FEA - Substances Hazardous to Waters - Class 1 - Low Hazard to Waters: Red Québec CSST - WHMIS 1998 - Class D2A - Very toxic material causing other toxic effects: Red EC - CEPA Toxic Substances (Sched 1) - CEPA Toxic: Red

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Substance Hazard

This color reflects the highest hazard associated directly with this substance by an authoritative hazard list.

The colors represent the relative level of hazard, ranging from **purple** (highest concern) through **red**, **orange**, and **yellow** to **green** (lowest concern).

Grey indicates that the authoritative hazard listing is ambiguous and covers a wide range of possible hazard levels.

Blue indicates that the substance is referenced on a restricted substance list (RSL) rather than an authoritative hazard list.

For a full description of authoritative hazard lists used in Pharos and of the derivation of the hazard level indicators, see the complete Pharos Chemical and Material Library Description.

For the authoritative hazard list that is the source of this hazard color, see the "Hazard" tab on the chemical / material's page.

×

Residual Hazard

This color reflects the highest hazard associated with residual chemicals that our research indicates may be present with the chemical. These residuals consist of all process chemicals in the following categories:

- Monomers
- Catalysts
- Non-reactive Additives
- Pollutants and Contaminants
- Other known residuals

Hazards are drawn from process chemicals far upstream in the manufacturing process as well as the immediate precursors to this chemical.

The colors represent the relative level of hazard, ranging from **purple** (highest concern) through **red**, **orange**, and **yellow** to **green** (lowest concern).

Grey indicates that the authoritative hazard listing is ambiguous and covers a wide range of possible hazard levels.

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For a full description of authoritative hazard lists used in Pharos and of the derivation of the hazard level indicators, see the complete Pharos Chemical and Material Library Description.

For the source of this hazard, see the "Process Chemistry Research" tab on the chemical's page.

×

Manufacturing Hazard

This color reflects the highest hazard associated with chemicals that our research categorizes as “frequent” or “integral” to the production of a chemical. The manufacturing score is included to surface potential hazards upstream in the manufacturing process that may or may not be present as residuals. Hazards are drawn from

process chemicals far upstream in the manufacturing process as well as the immediate precursors to this chemical.

The colors represent the relative level of hazard, ranging from **purple** (highest concern) through **red**, **orange**, and **yellow** to **green** (lowest concern).

Grey indicates that the authoritative hazard listing is ambiguous and covers a wide range of possible hazard levels.

Blue indicates that the substance is referenced on a restricted substance list (RSL) rather than an authoritative hazard list.

For a full description of authoritative hazard lists used in Pharos and of the derivation of the hazard level indicators, see the complete Pharos Chemical and Material Library Description.

For the source of this hazard, see the "Process Chemistry Research" tab on the chemical's page.

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GreenScreen

The Pharos scoring system is informed by the GreenScreen® for Safer Chemicals, a benchmarking system to rank the safety of chemicals on a 4 point hazard scale and encourage progress toward safer alternatives. Chemicals that have undergone a full GreenScreen assessment by Licensed GreenScreen Profilers are given a Benchmark score, which is the most authoritative. Chemicals that have been assessed using an automated comparison to hazard lists are given a List Translator score, which is less authoritative. Full GreenScreen assessments trump results from List Translator scoring.

GreenScreen Scores in order from highest concern to lowest concern are:

- Benchmark 1
- LT-1 - List Translator Likely Benchmark 1
- LT-P1 - List Translator Possible Benchmark 1
- LT-UNK - List Translator Benchmark Unknown
- Benchmark U
- Benchmark 2
- Benchmark 3
- Benchmark 4

For more information, see the "GreenScreen" tab on the chemical's page or visit www.greenscreenchemicals.org.

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1. Dashboard
2. Chemicals and Materials
3. [7664-39-3] HYDROFLUORIC ACID

[7664-39-3] HYDROFLUORIC ACID

- General Information
- Hazards
- Compound Groups
- Process Chemistry Research
- GreenScreen
- C2C
- Variants

CAS RN: 7664-39-3

Synonyms: HYDROGEN FLUORIDE

Description: *Not provided*

Website (if applicable): *Not provided*

VOC designation: VVOC (Boiling point: 19 degrees Celsius)

- View products containing this material

My Project Lists

No project lists available. Lists can be added to existing projects on your account. Visit your dashboard for more information.

Direct Hazards:

DEVELOPMENTAL MAK - Pregnancy Risk Group C

GENE MUTATION Japan - GHS - Germ cell mutagenicity - Category 2

EU - R-phrases - R26 - Very Toxic by Inhalation

Québec CSST - WHMIS 1998 - Class D1B - Toxic material causing immediate and serious toxic effects

	Québec CSST - WHMIS 1998 - Class D2A - Very toxic material causing other toxic effects Québec CSST - WHMIS 1998 - Class D1A - Very toxic material causing immediate and serious toxic effects Japan - GHS - Acute toxicity (inhalation: vapor) - Category 3 EU - GHS (H-Statements) - H300 - Fatal if swallowed EU - GHS (H-Statements) - H310 - Fatal in contact with skin EU - GHS (H-Statements) - H330 - Fatal if inhaled	
MAMMALIAN	US EPA - EPCRA Extremely Hazardous Substances - Extremely Hazardous Substances EU - R-phrases - R27 - Very Toxic in Contact with Skin EU - R-phrases - R28 - Very Toxic if Swallowed Korea - GHS - Acute toxicity (oral) - Category 1 [H300 - Fatal if swallowed] Korea - GHS - Acute toxicity (dermal) - Category 1 [H310 - Fatal in contact with skin] Korea - GHS - Acute toxicity (inhalation) - Category 1 [H330 - Fatal if inhaled] Malaysia - GHS - H300 - Fatal if swallowed Malaysia - GHS - H310 - Fatal in contact with skin Malaysia - GHS - H330 - Fatal if inhaled Australia - GHS - H330 - Fatal if inhaled Australia - GHS - H310 - Fatal in contact with skin Australia - GHS - H300 - Fatal if swallowed US EPA - OPP - Registered Pesticides - FIFRA Registered Pesticide	+ 20
EYE IRRITATION	Japan - GHS - Serious eye damage / eye irritation - Category 1 Malaysia - GHS - H318 - Causes serious eye damage EU - GHS (H-Statements) - H314 - Causes severe skin burns and eye damage	+ 1
SKIN IRRITATION	Japan - GHS - Skin corrosion / irritation - Category 1 EU - R-phrases - R35 - Causes severe burns Korea - GHS - Skin corrosion/irritation - Category 1 [H314 - Causes severe skin burns and eye damage] Malaysia - GHS - H314 - Causes severe skin burns and eye damage Australia - GHS - H314 - Causes severe skin burns and eye damage	+ 5
SKIN SENSITIZE	Japan - GHS - Skin sensitizer - Category 1	
ORGAN TOXICANT	Japan - GHS - Specific target organs/systemic toxicity following single exposure - Category 1 Japan - GHS - Specific target organs/systemic toxicity following repeated exposure - Category 1	+ 1
ACUTE AQUATIC	Japan - GHS - Hazardous to the aquatic environment (acute) - Category 3	
	Québec CSST - WHMIS 1998 - Class E - Corrosive materials	

REACTIVE	Korea - GHS - H290: May be corrosive to metals	+ 1
RESTRICTED LIST	US EPA - Hazardous Air Pollutants - Hazardous Air Pollutant subject to the Clean Air Act CA SCP - Candidate Chemicals - Candidate Chemical List	+ 1
NEUROTOXICITY	G&L - Neurotoxic Chemicals - Neurotoxic Boyes - Neurotoxicants - Neurotoxic	+ 1
MULTIPLE	German FEA - Substances Hazardous to Waters - Class 2 - Hazard to Waters	+ 1
PERSISTENT	EC - CEPA Toxic Substances (Sched 1) - CEPA Toxic EC - CEPA DSL - Persistent	

Potential Residual Hazards:

See Process Chemistry Research tab for details on residuals and other substances used in manufacture.

None identified

Compound Groups (2):

- Fluoride compounds, Inorganic
- Fluorides

Process Chemistry Research Status: No life cycle research started

This material is used in the process chemistry of:

Material	Hazard	Type	Frequency	Percentage	Notes
	Substance Residual Manufacturing				
[75-37-6] 1,1-DIFLUOROETHANE		Reactant	Integral	Unknown	
[420-46-2] 1,1,1-TRIFLUOROETHANE		Reactant	Integral	Unknown	
[811-97-2] 1,1,1,2-TETRAFLUOROETHANE (HFC-134A)		Reactant	Integral	Unknown	
[460-73-1] 1,1,1,3,3-Pentafluoropropane		Reactant	Integral	Unknown	
[75-45-6] CHLORODIFLUOROMETHANE (HCFC-22)		Reactant	Frequent	Unknown	
[75-68-3] MONOCHLORODIFLUOROETHANE (HCFC-142B)		Reactant	Frequent	Unknown	
[98-56-6] PARACHLOROBENZOTRIFLUORIDE (PCBTF)		Reactant	Integral	Unknown	
[375-73-5] PERFLUOROBUTANE SULFONATE (PFBS C-4)		Reactant	Integral	Unknown	

[375-22-4] PERFLUOROBUTANOIC ACID (PFBA, C-4)	Reactant	Integral	Unknown
[65545-80-4] Poly(oxy-1,2-ethanediyl), _-hydro-_-hydroxy-, ether with _-fluoro-_-(2-hydroxyethyl)poly(difluoromethylene) (1:1)	Process Aid	Frequent	Unknown

GreenScreen for Safer Chemicals Full Assessment: *None available*

Highest concern GreenScreen score : LT-P1 (Possible Benchmark 1)

Cradle to Cradle Certified™ List Hazards

What are C2C hazards and what do these colors mean?

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What are C2C hazards and what do these colors mean?

What are the C2C Hazards? The Cradle to Cradle Certified Product Standard establishes a Material Health Assessment Methodology which assigns hazard ratings to 24 individual human and environmental health endpoints. Roll your cursor over the abbreviations (C, M, R+D, etc) in the table to see the full name of each endpoint (Carcinogenicity, Mutagenicity, Reproductive Toxicity, etc). Organohalogen and Toxic Metal are classes of chemicals generally associated with significant human and environmental health issues and are specially treated in the C2C Standard.

The hazard rating is a Green-Yellow-Red-Grey color scheme based upon available toxicity and fate information:

- Green: no hazard identified for the endpoint
- Red: hazard identified for the endpoint
- Yellow: borderline
- Grey: no data available for the endpoint

This tab shows the preliminary hazard ratings based upon hazard lists tracked in the Pharos Chemical & Material Library. During full assessment for certification purposes, Grey hazards must be filled by an accredited assessor and other list-based hazards may be overridden.

Why are these rating colors sometimes different from the GreenScreen or Pharos rating colors? The C2C hazard rating colors are similar to those used in the GreenScreen system and in Pharos, with some distinctions. Pharos has two additional rating colors - orange and purple - not used in the C2C or GreenScreen systems. Pharos orange, red and purple ratings generally encompass the C2C & GreenScreen red ranges. There are some distinctions between the GreenScreen and C2C thresholds that result in different color assignments that are under consideration for harmonization. See the Material Health Evaluation Programs Harmonization Opportunities Report for details. For substances that have been fully assessed under the GreenScreen protocol, there may be different colors due to the application of data from studies that provide information beyond that in the hazard lists.

If interested in assessing the chemicals in a product, please also review the link below describing "How to Use These Scores in a C2C Assessment".

How to Use These Scores in a C2C Assessment

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How to Use These Scores in a C2C Assessment

The top table displays preliminary hazard ratings for individual endpoints based on the hazard lists a given chemical appears on. During the assessment, an accredited Cradle to Cradle Certified Material Health Assessor may override these list-based hazard ratings based on information from other sources. Additionally, a red hazard rating in any one endpoint does not automatically mean that a substance will be x-assessed and targeted for phase-out, as exposure relevant to the endpoint may be deemed non-plausible for the substance depending on the material and product context in which it is being assessed.

The bottom table (Full Hazard List by Endpoint) includes all warnings associated with the substance from each of the authoritative hazard lists used by C2C, as well as additional lists in the Pharos Chemical and Material Library. C2C lists are labeled with their C2C hazard rating (Red, Yellow, or Green), while non-C2C lists are labeled as "not rated".

The ratings for the hazard lists used in this tool are based on Table 9 in the Material Assessment Methodology, Cradle to Cradle Certified Version 3.0 with a few minor adjustments/additions to allow for direct mapping from GreenScreen list translator results for a subset of the covered lists. The v3.0 Material Assessment Methdology document can be found on the C2C Resources page at http://www.c2ccertified.org/resources/collection-page/cradle-to-cradle-certified-resources.

Key
R: Red hazard level
Y: Yellow hazard level
G: Green hazard level
?: On a hazard list that has not been rated by C2C
-: Not listed on any C2C or Pharos hazard lists

	Acute and Chronic Tox.										Acute Aquatic Tox.				Chronic Aquatic Tox.								
C	**M**	**R+D**	**E**	**O**	**D**	**I**	**O/D/I**	**N**	**IrS+IrE**	**SnS+SnR**	**Fish**	**Inv.**	**Alg.**	**Any**	**Fish**	**Inv.**	**Alg.**	**Any**	**T**	**P**	**B**	**Climate**	
-	R	R/Y/G	-	R	R	R	R	R/Y	R	R	-	-	-	Y	-	-	-	-	-	R/Y	-	G	

Full Hazard List By Endpoint:

Carcinogenicity	not listed
Mutagenicity	Japan - GHS - Germ cell mutagenicity - Category 2: Red
Reproductive Toxicity (Repro + Dev)	MAK - Pregnancy Risk Group C: Red, Yellow, or Green
Endocrine Disruption	not listed
Oral Toxicity	Australia - GHS - H300 - Fatal if swallowed: Red EU - GHS (H-Statements) - H300 - Fatal if swallowed: Red EU - R-phrases - R28 - Very Toxic if Swallowed: Red Korea - GHS - Acute toxicity (oral) - Category 1 [H300 - Fatal if swallowed]: Red Malaysia - GHS - H300 - Fatal if swallowed: Red
Dermal Toxicity	Australia - GHS - H310 - Fatal in contact with skin: Red EU - GHS (H-Statements) - H310 - Fatal in contact with skin: Red EU - R-phrases - R27 - Very Toxic in Contact with Skin: Red Korea - GHS - Acute toxicity (dermal) - Category 1 [H310 - Fatal in contact with skin]: Red Malaysia - GHS - H310 - Fatal in contact with skin: Red

Inhalative Toxicity	Australia - GHS - H330 - Fatal if inhaled: Red EU - GHS (H-Statements) - H330 - Fatal if inhaled: Red EU - R-phrases - R26 - Very Toxic by Inhalation: Red Japan - GHS - Acute toxicity (inhalation: vapor) - Category 3: Red Korea - GHS - Acute toxicity (inhalation) - Category 1 [H330 - Fatal if inhaled]: Red Malaysia - GHS - H330 - Fatal if inhaled: Red
Oral, Dermal, and/or Inhalative Toxicity	Japan - GHS - Specific target organs/systemic toxicity following repeated exposure - Category 1: Red Japan - GHS - Specific target organs/systemic toxicity following single exposure - Category 1: Red Québec CSST - WHMIS 1998 - Class D1A - Very toxic material causing immediate and serious toxic effects: Red US EPA - EPCRA Extremely Hazardous Substances - Extremely Hazardous Substances: Red Québec CSST - WHMIS 1998 - Class D1B - Toxic material causing immediate and serious toxic effects: Red or Yellow
Neurotoxicity	Boyes - Neurotoxicants - Neurotoxic: Red, Yellow, or Green G&L - Neurotoxic Chemicals - Neurotoxic: Red or Yellow
Skin, Eye, and Respiratory Corrosion/Irritation	Australia - GHS - H314 - Causes severe skin burns and eye damage: Red EU - GHS (H-Statements) - H314 - Causes severe skin burns and eye damage: Red EU - R-phrases - R35 - Causes severe burns: Red Japan - GHS - Serious eye damage / eye irritation - Category 1: Red Japan - GHS - Skin corrosion / irritation - Category 1: Red Korea - GHS - Skin corrosion/irritation - Category 1 [H314 - Causes severe skin burns and eye damage]: Red Malaysia - GHS - H314 - Causes severe skin burns and eye damage: Red Malaysia - GHS - H318 - Causes serious eye damage: Red
Skin and Respiratory Sensitization	Japan - GHS - Skin sensitizer - Category 1: Red
Acute Aquatic Toxicity (Fish)	not listed
Acute Aquatic Toxicity (Invertibrates)	not listed
Acute Aquatic Toxicity (Algae)	not listed
Acute Aquatic Toxicity (Fish, Invertibrates, and/or Algae)	Japan - GHS - Hazardous to the aquatic environment (acute) - Category 3: Yellow
Chronic Aquatic Toxicity (Fish)	not listed
Chronic Aquatic Toxicity (Invertibrates)	not listed
Chronic Aquatic Toxicity (Algae)	not listed
Chronic Aquatic Toxicity (Fish, Invertibrates, and/or Algae)	not listed
Terrestrial	not listed
Persistence	EC - CEPA DSL - Persistent: Red or Yellow
Bioaccumulation	not listed
Climatic Relevance	not listed

Organohalogen	not listed - *This chemical is not on the Pharos list of organohalogens, but we may have missed a few. Please double-check the chemical structure to confirm there are no carbon-halogen bonds.*
Toxic Metal	not listed - *This chemical is not on the Pharos list of toxic metals, but we may have missed a few. Please double-check the chemical structure to confirm there are no toxic metals.*
Other (Human Health)	not listed
Multiple Endpoints	German FEA - Substances Hazardous to Waters - Class 2 - Hazard to Waters: Red Québec CSST - WHMIS 1998 - Class D2A - Very toxic material causing other toxic effects: Red Québec CSST - WHMIS 1998 - Class E - Corrosive materials: Red EC - CEPA Toxic Substances (Sched 1) - CEPA Toxic: Red

Variants:

- Hydrofluoric acid 40 %
- Hydrofluoric acid 50%
- Hydrofluoric acid 70%

×

Substance Hazard

This color reflects the highest hazard associated directly with this substance by an authoritative hazard list.

The colors represent the relative level of hazard, ranging from **purple** (highest concern) through **red**, **orange**, and **yellow** to **green** (lowest concern).

Grey indicates that the authoritative hazard listing is ambiguous and covers a wide range of possible hazard levels.

Blue indicates that the substance is referenced on a restricted substance list (RSL) rather than an authoritative hazard list.

For a full description of authoritative hazard lists used in Pharos and of the derivation of the hazard level indicators, see the complete Pharos Chemical and Material Library Description.

For the authoritative hazard list that is the source of this hazard color, see the "Hazard" tab on the chemical / material's page.

×

Residual Hazard

This color reflects the highest hazard associated with residual chemicals that our research indicates may be present with the chemical. These residuals consist of all process chemicals in the following categories:

- Monomers
- Catalysts
- Non-reactive Additives
- Pollutants and Contaminants
- Other known residuals

Hazards are drawn from process chemicals far upstream in the manufacturing process as well as the immediate precursors to this chemical.

The colors represent the relative level of hazard, ranging from **purple** (highest concern) through **red**, **orange**, and **yellow** to **green** (lowest concern).

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For the source of this hazard, see the "Process Chemistry Research" tab on the chemical's page.

×

Manufacturing Hazard

This color reflects the highest hazard associated with chemicals that our research categorizes as “frequent” or “integral” to the production of a chemical. The manufacturing score is included to surface potential hazards upstream in the manufacturing process that may or may not be present as residuals. Hazards are drawn from process chemicals far upstream in the manufacturing process as well as the immediate precursors to this chemical.

The colors represent the relative level of hazard, ranging from **purple** (highest concern) through **red**, **orange**, and **yellow** to **green** (lowest concern).

Grey indicates that the authoritative hazard listing is ambiguous and covers a wide range of possible hazard levels.

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For the source of this hazard, see the "Process Chemistry Research" tab on the chemical's page.

×

GreenScreen

The Pharos scoring system is informed by the GreenScreen® for Safer Chemicals, a benchmarking system to rank the safety of chemicals on a 4 point hazard scale and encourage progress toward safer alternatives. Chemicals that have undergone a full GreenScreen assessment by Licensed GreenScreen Profilers are given a Benchmark score, which is the most authoritative. Chemicals that have been assessed using an automated comparison to hazard lists are given a List Translator score, which is less authoritative. Full GreenScreen assessments trump results from List Translator scoring.

GreenScreen Scores in order from highest concern to lowest concern are:

- Benchmark 1
- LT-1 - List Translator Likely Benchmark 1
- LT-P1 - List Translator Possible Benchmark 1
- LT-UNK - List Translator Benchmark Unknown
- Benchmark U
- Benchmark 2
- Benchmark 3

- Benchmark 4

For more information, see the "GreenScreen" tab on the chemical's page or visit www.greenscreenchemicals.org.

Toggle navigation Pharos

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1. Dashboard
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3. [7789-75-5] CALCIUM FLUORIDE

[7789-75-5] CALCIUM FLUORIDE

- General Information
- Hazards
- Compound Groups
- Process Chemistry Research
- GreenScreen
- C2C

CAS RN: 7789-75-5

Description: *Not provided*

Website (if applicable): *Not provided*

- View products containing this material

My Project Lists

No project lists available. Lists can be added to existing projects on your account. Visit your dashboard for more information.

Direct Hazards:

ORGAN TOXICANT	New Zealand - GHS - 6.9A (inhalation) - Toxic to human target organs or systems (Cat. 1)	
NEUROTOXICITY	G&L - Neurotoxic Chemicals - Neurotoxic	
MULTIPLE	German FEA - Substances Hazardous to Waters - Class 1 - Low Hazard to Waters	+ 1
	EC - CEPA Toxic Substances (Sched 1) - CEPA Toxic	
PERSISTENT	EC - CEPA DSL - Persistent	

Potential Residual Hazards:

See Process Chemistry Research tab for details on residuals and other substances used in manufacture.

None identified

Compound Groups (1):

- Fluoride compounds, Inorganic

Process Chemistry Research Status: No life cycle research started

GreenScreen for Safer Chemicals Full Assessment: *None available*

Highest concern GreenScreen score : LT-UNK (Benchmark Unknown)

Cradle to Cradle Certified™ List Hazards

What are C2C hazards and what do these colors mean?

×

What are C2C hazards and what do these colors mean?

What are the C2C Hazards? The Cradle to Cradle Certified Product Standard establishes a Material Health Assessment Methodology which assigns hazard ratings to 24 individual human and environmental health endpoints. Roll your cursor over the abbreviations (C, M, R+D, etc) in the table to see the full name of each endpoint (Carcinogenicity, Mutagenicity, Reproductive Toxicity, etc). Organohalogen and Toxic Metal are classes of chemicals generally associated with significant human and environmental health issues and are specially treated in the C2C Standard.

The hazard rating is a Green-Yellow-Red-Grey color scheme based upon available toxicity and fate information:

- Green: no hazard identified for the endpoint
- Red: hazard identified for the endpoint
- Yellow: borderline
- Grey: no data available for the endpoint

This tab shows the preliminary hazard ratings based upon hazard lists tracked in the Pharos Chemical & Material Library. During full assessment for certification purposes, Grey hazards must be filled by an accredited assessor and other list-based hazards may be overridden.

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How to Use These Scores in a C2C Assessment

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How to Use These Scores in a C2C Assessment

The top table displays preliminary hazard ratings for individual endpoints based on the hazard lists a given chemical appears on. During the assessment, an accredited Cradle to Cradle Certified Material Health Assessor may override these list-based hazard ratings based on information from other sources. Additionally, a red hazard rating in any one endpoint does not automatically mean that a substance will be x-assessed and targeted for phase-out, as exposure relevant to the endpoint may be deemed non-plausible for the substance depending on the material and product context in which it is being assessed.

The bottom table (Full Hazard List by Endpoint) includes all warnings associated with the substance from each of the authoritative hazard lists used by C2C, as well as additional lists in the Pharos Chemical and Material Library. C2C lists are labeled with their C2C hazard rating (Red, Yellow, or Green), while non-C2C lists are labeled as "not rated".

The ratings for the hazard lists used in this tool are based on Table 9 in the Material Assessment Methodology, Cradle to Cradle Certified Version 3.0 with a few minor adjustments/additions to allow for direct mapping from GreenScreen list translator results for a subset of the covered lists. The v3.0 Material Assessment Methdology document can be found on the C2C Resources page at http://www.c2ccertified.org/resources/collection-page/cradle-to-cradle-certified-resources.

Key
R: Red hazard level
Y: Yellow hazard level
G: Green hazard level
?: On a hazard list that has not been rated by C2C
-: Not listed on any C2C or Pharos hazard lists

				Acute and Chronic Tox.							Acute Aquatic Tox.				Chronic Aquatic Tox.						
C	**M**	**R+D**	**E**	**O**	**D**	**I**	**O/D/I**	**N**	**IrS+IrE**	**SnS+SnR**	**Fish**	**Inv.**	**Alg.**	**Any**	**Fish**	**Inv.**	**Alg.**	**Any**	**T**	**P**	**B**	**Climate**
-	-	-	-	-	-	?	-	R/Y	-	-	-	-	-	-	-	-	-	-	-	R/Y	-	G

Full Hazard List By Endpoint:

Carcinogenicity	not listed
Mutagenicity	not listed
Reproductive Toxicity (Repro + Dev)	not listed
Endocrine Disruption	not listed
Oral Toxicity	not listed
Dermal Toxicity	not listed
Inhalative Toxicity	New Zealand - GHS - 6.9A (inhalation) - Toxic to human target organs or systems (Cat. 1): Not rated
Oral, Dermal, and/or Inhalative Toxicity	not listed

Neurotoxicity	G&L - Neurotoxic Chemicals - Neurotoxic: Red or Yellow
Skin, Eye, and Respiratory Corrosion/Irritation	not listed
Skin and Respiratory Sensitization	not listed
Acute Aquatic Toxicity (Fish)	not listed
Acute Aquatic Toxicity (Invertibrates)	not listed
Acute Aquatic Toxicity (Algae)	not listed
Acute Aquatic Toxicity (Fish, Invertibrates, and/or Algae)	not listed
Chronic Aquatic Toxicity (Fish)	not listed
Chronic Aquatic Toxicity (Invertibrates)	not listed
Chronic Aquatic Toxicity (Algae)	not listed
Chronic Aquatic Toxicity (Fish, Invertibrates, and/or Algae)	not listed
Terrestrial	not listed
Persistence	EC - CEPA DSL - Persistent: Red or Yellow
Bioaccumulation	not listed
Climatic Relevance	not listed
Organohalogen	not listed - *This chemical is not on the Pharos list of organohalogens, but we may have missed a few. Please double-check the chemical structure to confirm there are no carbon-halogen bonds.*
Toxic Metal	not listed - *This chemical is not on the Pharos list of toxic metals, but we may have missed a few. Please double-check the chemical structure to confirm there are no toxic metals.*
Other (Human Health)	not listed
Multiple Endpoints	German FEA - Substances Hazardous to Waters - Class 1 - Low Hazard to Waters: Red EC - CEPA Toxic Substances (Sched 1) - CEPA Toxic: Red

×

Substance Hazard

This color reflects the highest hazard associated directly with this substance by an authoritative hazard list.

The colors represent the relative level of hazard, ranging from **purple** (highest concern) through **red**, **orange**, and **yellow** to **green** (lowest concern).

Grey indicates that the authoritative hazard listing is ambiguous and covers a wide range of possible hazard levels.

Blue indicates that the substance is referenced on a restricted substance list (RSL) rather than an authoritative hazard list.

For a full description of authoritative hazard lists used in Pharos and of the derivation of the hazard level indicators, see the complete Pharos Chemical and Material Library Description.

For the authoritative hazard list that is the source of this hazard color, see the "Hazard" tab on the chemical / material's page.

×

Residual Hazard

This color reflects the highest hazard associated with residual chemicals that our research indicates may be present with the chemical. These residuals consist of all process chemicals in the following categories:

- Monomers
- Catalysts
- Non-reactive Additives
- Pollutants and Contaminants
- Other known residuals

Hazards are drawn from process chemicals far upstream in the manufacturing process as well as the immediate precursors to this chemical.

The colors represent the relative level of hazard, ranging from **purple** (highest concern) through **red**, **orange**, and **yellow** to **green** (lowest concern).

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For the source of this hazard, see the "Process Chemistry Research" tab on the chemical's page.

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Manufacturing Hazard

This color reflects the highest hazard associated with chemicals that our research categorizes as “frequent” or “integral” to the production of a chemical. The manufacturing score is included to surface potential hazards upstream in the manufacturing process that may or may not be present as residuals. Hazards are drawn from process chemicals far upstream in the manufacturing process as well as the immediate precursors to this chemical.

The colors represent the relative level of hazard, ranging from **purple** (highest concern) through **red**, **orange**, and **yellow** to **green** (lowest concern).

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GreenScreen

The Pharos scoring system is informed by the GreenScreen® for Safer Chemicals, a benchmarking system to rank the safety of chemicals on a 4 point hazard scale and encourage progress toward safer alternatives. Chemicals that have undergone a full GreenScreen assessment by Licensed GreenScreen Profilers are given a Benchmark score, which is the most authoritative. Chemicals that have been assessed using an automated comparison to hazard lists are given a List Translator score, which is less authoritative. Full GreenScreen assessments trump results from List Translator scoring.

GreenScreen Scores in order from highest concern to lowest concern are:

- Benchmark 1
- LT-1 - List Translator Likely Benchmark 1
- LT-P1 - List Translator Possible Benchmark 1
- LT-UNK - List Translator Benchmark Unknown
- Benchmark U
- Benchmark 2
- Benchmark 3
- Benchmark 4

For more information, see the "GreenScreen" tab on the chemical's page or visit www.greenscreenchemicals.org.

Toggle navigation

- Building Products
- Chemicals and Materials
- Certifications
- CompAIR
- Dashboard
- Logout

1. Dashboard
2. Chemicals and Materials
3. [7783-40-6] Magnesium fluoride

[7783-40-6] Magnesium fluoride

- General Information
- Hazards
- Process Chemistry Research
- GreenScreen
- C2C

CAS RN: 7783-40-6

Description: *Not provided*

Website (if applicable): *Not provided*

- View products containing this material

My Project Lists

No project lists available. Lists can be added to existing projects on your account. Visit your dashboard for more information.

Direct Hazards:

REACTIVE	Québec CSST - WHMIS 1998 - Class E - Corrosive materials
MULTIPLE	German FEA - Substances Hazardous to Waters - Class 1 - Low Hazard to Waters
PERSISTENT	EC - CEPA DSL - Persistent

Potential Residual Hazards:

See Process Chemistry Research tab for details on residuals and other substances used in manufacture.

None identified

Process Chemistry Research Status: No life cycle research started

This material is used in the process chemistry of:

Material	Hazard			Type	Frequency	Percentage	Notes
	Substance	Residual	Manufacturing				
[7440-41-7] BERYLLIUM				Byproduct	Frequent	Unknown	

GreenScreen for Safer Chemicals Full Assessment: *None available*

Highest concern GreenScreen score : LT-UNK (Benchmark Unknown)

Cradle to Cradle Certified™ List Hazards

What are C2C hazards and what do these colors mean?

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What are C2C hazards and what do these colors mean?

What are the C2C Hazards? The Cradle to Cradle Certified Product Standard establishes a Material Health Assessment Methodology which assigns hazard ratings to 24 individual human and environmental health endpoints. Roll your cursor over the abbreviations (C, M, R+D, etc) in the table to see the full name of each endpoint (Carcinogenicity, Mutagenicity, Reproductive Toxicity, etc). Organohalogen and Toxic Metal are classes of chemicals generally associated with significant human and environmental health issues and are specially treated in the C2C Standard.

The hazard rating is a Green-Yellow-Red-Grey color scheme based upon available toxicity and fate information:

- Green: no hazard identified for the endpoint
- Red: hazard identified for the endpoint
- Yellow: borderline
- Grey: no data available for the endpoint

This tab shows the preliminary hazard ratings based upon hazard lists tracked in the Pharos Chemical & Material Library. During full assessment for certification purposes, Grey hazards must be filled by an accredited assessor and other list-based hazards may be overridden.

Why are these rating colors sometimes different from the GreenScreen or Pharos rating colors? The C2C hazard rating colors are similar to those used in the GreenScreen system and in Pharos, with some distinctions. Pharos has two additional rating colors - orange and purple - not used in the C2C or GreenScreen systems. Pharos orange, red and purple ratings generally encompass the C2C & GreenScreen red ranges. There are some distinctions between the GreenScreen and C2C thresholds that result in different color assignments that are under consideration for harmonization. See the Material Health Evaluation Programs Harmonization Opportunities Report for details. For substances that have been fully assessed under the GreenScreen protocol, there may be different colors due to the application of data from studies that provide information beyond that in the hazard lists.

If interested in assessing the chemicals in a product, please also review the link below describing "How to Use These Scores in a C2C Assessment".

How to Use These Scores in a C2C Assessment

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How to Use These Scores in a C2C Assessment

The top table displays preliminary hazard ratings for individual endpoints based on the hazard lists a given chemical appears on. During the assessment, an accredited Cradle to Cradle Certified Material Health Assessor may override these list-based hazard ratings based on information from other sources. Additionally, a red hazard rating in any one endpoint does not automatically mean that a substance will be x-assessed and targeted for phase-out, as exposure relevant to the endpoint may be deemed non-plausible for the substance depending on the material and product context in which it is being assessed.

The bottom table (Full Hazard List by Endpoint) includes all warnings associated with the substance from each of the authoritative hazard lists used by C2C, as well as additional lists in the Pharos Chemical and Material Library. C2C lists are labeled with their C2C hazard rating (Red, Yellow, or Green), while non-C2C lists are labeled as "not rated".

The ratings for the hazard lists used in this tool are based on Table 9 in the Material Assessment Methodology, Cradle to Cradle Certified Version 3.0 with a few minor adjustments/additions to allow for direct mapping from GreenScreen list translator results for a subset of the covered lists. The v3.0 Material Assessment Methdology document can be found on the C2C Resources page at http://www.c2ccertified.org/resources/collection-page/cradle-to-cradle-certified-resources.

Key
R: Red hazard level
Y: Yellow hazard level
G: Green hazard level
?: On a hazard list that has not been rated by C2C
-: Not listed on any C2C or Pharos hazard lists

Acute and Chronic Tox.												Acute Aquatic Tox.				Chronic Aquatic Tox.								
C	M	R+D	E	O	D	I	O/D/I	N	IrS+IrE	SnS+SnR	Fish	Inv.	Alg.	Any	Fish	Inv.	Alg.	Any	T	P	B	Climate	Or
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R/Y	-	G	NI

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