GreenScreen® Chemical Assessment

Calcium Formate (544-17-2)

Method Version: GreenScreen® for Safer Chemicals v1.4

Assessment Details:

Assessment Type:	Certified
Assessment Prepared By:	WAP Sustainability Consulting, LLC (Eric Rosenblum Ph.D. DABT Donald K. Ward, NSF International)
Assessment Prepared For:	Tile Council of North America (TCNA)
Date Assessment Completed:	January 31st, 2021
Assessment Expiration Date:	January 31st, 2026
Assessor Type:	Licensed GreenScreen® Profiler

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GREENSCREEN BENCHMARK™ SUMMARY:

This chemical assessment report includes a GreenScreen Benchmark™ score and results for Calcium formate (544-17-2) only. No marketing claims can be made without licensing through Clean Production Action.

GreenScreen Benchmark Score: BM-3

Calcium formate (544-17-2) was assigned a GreenScreen® Benchmark Score of 3 ("Use but Still Opportunity for Improvement") as it has Moderate Human Group II (single dose systemic toxicity, single dose neurotoxicity, and eye irritation). This corresponds to GreenScreen® benchmark classification 3c in CPA 2018. Data gaps (DG) exist for endocrine activity, repeat dose neurotoxicity, and respiratory sensitization. As outlined in CPA (2018) Annex 5 (Conduct a Data Gap Analysis to assign a final Benchmark score), Calcium formate meets the requirements for a GreenScreen® Benchmark Score of 3. In a worst-case scenario, if Calcium formate were assigned a High score for data gap endocrine activity it would be categorized as a Benchmark 1 Chemical.

HAZARD CLASSIFICATION SUMMARY

Table 1. GreenScreen Hazard Summary Table:

GreenScreen Hazard Summary Table for Calcium Carbonate – BM-3																			
Group I Human					Group II and II* Human									Ecotox		Fate		Physical	
Carcinogenicity	Genotoxicity/Mutagenicity	Reproductive Toxicity	Developmental Toxicity	Endocrine Activity	Acute Toxicity	Systemic Toxicity		Neurotoxicity		Skin Sensitization*	Respiratory Sensitization*	Skin Irritation	Eye Irritation	Acute Aquatic Toxicity	Chronic Aquatic Toxicity	Persistence	Bioaccumulation	Reactivity	Flammability
						single	repeat*	Single	repeat*	*	*								
L	L	L	L	DG	L	*M*	L	*M*	DG	L	DG	L	M	L	*L*	vL	*vL*	L	L

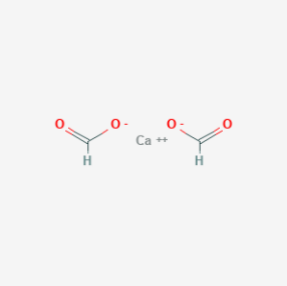
Note: Hazard levels (Very High (vH), High (H), Moderate (M), Low (L), Very Low (vL)) in italics reflect lower confidence in the hazard classification while hazard levels in BOLD font reflect higher confidence in the hazard classification. Group II Human Health endpoints differ from Group II* Human Health endpoints in that Group II Human Health endpoints 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. Group II* Human Health endpoints are indicated by an * after the name of the hazard endpoint or after "repeat" for repeated exposure sub-endpoints.

SCOPE OF ASSESSMENT

Calcium formate (544-17-2):

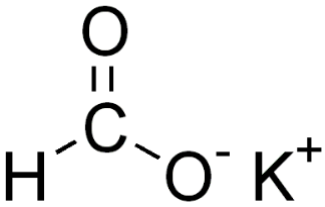
Also Called: Calcium diformate; Calcoform; Aluminum formate; Ammonium formate; Ammonium tetraformate; Calcium formate; Chromic formate; Cobalt(II) formate dihydrate; Cobaltous formate; Cupric formate; Formate; Formic acid; Lead formate; Lithium formate; Magnesium formate; Methanoic acid; Nickel formate; Nickel formate dihydrate; Potassium formate; Sodium formate; Strontium formate; Zinc formate (PubChem 2019)

Chemical Structure:

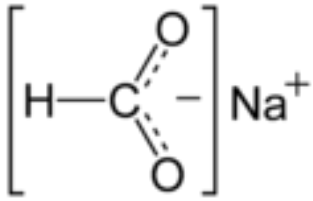


Suitable analogs or moieties of chemicals used in this assessment (CASRN(s)):

Chemical Structure(s) of suitable analog(s) and/or moieties:



Potassium formate (CAS# 590-29-4)



Sodium formate (CAS# 141-53-7)

For Inorganic Chemicals and relevant particulate organics (if not relevant, list NA)

Define Properties:

1. Particle size (e.g., silica of respirable size): N/A
2. Structure (e.g., amorphous vs. crystalline): N/A
3. Mobility (e.g., water solubility, volatility): N/A
4. Bioavailability: N/A

Identify potential applications/functional uses of the chemical:

1. Used in laundry and dishwashing products
2. Used as an input in anti-freeze and de-icing products
3. Used as an adhesive/sealant in both consumer and industrial products
4. Used as an accelerator for concrete grout
5. Used as a paint and coating additive
6. Used in fuels and related products (PubChem 2019)

Table 2. Environmental Transformation Products Summary

Life Cycle Stage	Transformation Pathway	Environmental Transformation Product	CAS #	Feasible (Yes or No)	Relevant (Yes or No)	GreenScreen List Translator Score or GreenScreen Benchmark Score
		Calcium	7440-70-2	No	No	
		Formate	71-47-6	No	No	

HAZARD CLASSIFICATION SUMMARY

GROUP I HUMAN HEALTH EFFECTS (GROUP I HUMAN)

Carcinogenicity (C): L

Calcium formate was assigned a hazard classification level of Low for carcinogenicity based on no significant increase in the incidence of any specific tumors following oral exposures to calcium formate or other high-quality analogs. The hazard classification is based on studies in both rats and mice which report no evidence of carcinogenicity and therefore is reported as high confidence.

Lists

- Authoritative: not included on any authoritative lists
- Screening: not included on any screening lists

Measured Data

ECHA 2019a

The repeated dose toxicity and oncogenicity of potassium diformate(1:2) was examined in a combined chronic toxicity and 104-week oral feed oncogenicity study in the rat similar to the OECD guideline 453 and under GLP conditions. Local effects are attributable to the formic acid formed and can be neglected because these are not expected with neutral salts (sodium, potassium, ammonium, calcium formate). Read across can therefore be limited to systemic effects. The oral dietary administration of potassium formate (1:2) in a combined chronic toxicity/carcinogenicity study (equivalent to OECD guideline 453 and under GLP) to male and female Wistar rats (50 animals/dose/sex) for 104 weeks to rats at dose levels of 50, 400, and 2000 mg/kg bw/d was well tolerated without effects on clinical condition or survival. Treatment-related findings were noted at 2000 mg/kg bw/d and included a statistically significant depression of body weight gain (by 27% in males and 19% in females; no effect at the low and intermediate dose levels) and, at terminal kill, a thickening of the stomach confirmed as basal cell hyperplasia or foveolar epithelium hyperplasia in the majority of the high dose animals. These changes were less pronounced than in a previous 90-day rat study. There was no evidence of systemic target organ toxicity due to test substance administration, including the eyes. The spectrum of tumours was generally consistent with that expected in rats of this strain. There were no tumours of unusual nature or incidence indicative of specific target organ carcinogenicity in the stomach or any other tissue (Covance Laboratories, 2002). Overall, the local toxicity NOAEL for 52 and 104 weeks of treatment was considered to be 400 mg/kg bw/d, based on the local effects in the stomach and reduced body weight of the high dose rats. As no signs of systemic effects were noted, the NOAEL (rat, 104 week) for systemic toxicity is considered to be 2000 mg/kg bw/d. Taking stoichiometry and formula weights into consideration, the systemic toxicity NOAEL (rat, oral, 104-week) was 2092 mg sodium formate/kg bw/d.

US EPA 2010

No evidence of carcinogenesis was observed in rats exposed by drinking water to 0.2% calcium formate (104−138 mg formate/kg-day) for 3 years, 0.4% calcium formate (208−277 mg formate/kg-

day) for 2 years, or 1% sodium formate (450 mg formate/kg-day) for 1 to 1.5 years (Malorny, 1969). However, the Malorny (1969) study was poorly reported and did not provide sufficient information to determine if comprehensive tissues were examined for nonmalignant and malignant lesions.

SIDS 2008

The dietary administration of potassium formate (1:2) to the mouse at up to 2000 mg/kg bw and day for 80 weeks was well tolerated and did not adversely affect clinical conditions or survival, or the pattern or incidence of neoplastic lesions. Treatment related changes were limited to high dose males and included minor disturbances of body weight (decrease) and food consumption (increase), and an increased incidence of limiting ridge hyperplasia in the forestomach. The test substance was not carcinogenic.

Estimated Data- None

Mutagenicity/Genotoxicity (M): L

Calcium formate was assigned a hazard classification level of Low for mutagenicity based on negative results reported in numerous in vitro assays for the substance, and for high quality analogs of the substance. A negative result was also reported for a single in vivo study. The hazard score is based on in vitro and in vivo studies for the compound and high quality analogs. Therefore, the hazard score is reported as high confidence.

Lists

- Authoritative: not included on any authoritative lists
- Screening: not included on any screening lists

Measured Data

EHCA 2019a

Calcium diformate (10-12500 µg/plate) was negative in a valid Ames test (2 independet experiments; 4 replicates; conducted according to OECD guideline 471 and under GLP conditions) using Salmonella typhimurium strains TA1535, TA100, TA1537, and TA98, both in the presence and absence of metabolic activation (S9 liver fraction from Aroclor induced male Sprague Dawley rats). Cytotoxicity was seen at 4000 µg/plate and above. Positive and solvent controls performed as expected (Bayer, 1989).

Formic acid was tested in an in-vitro genotoxicity test using bacteria (TA97, TA98, TA100, and TA1535) with and without metabolic activation (supernatant from induced male rat and Syrian hamster liver) at concentrations of 0, 10, 33, 100, 333, 1000, and 3333 µg/plate in accordance with OECD Guideline No. 471. Solvent and positive controls were included and performed as expected. Tests were conducted in triplicate, and two independent experiments were conducted. The number of revertants was not increased in any strain with or without metabolic activation up to and including the top dose of formic acid. Bacteriotoxicity was seen at 1000 µg/plate and above (Zeiger, 1992).

In a mammalian cell gene mutation assay (HPRT locus), Chinese Hamster ovary cells cultured in vitro were exposed to formic acid (85.3%) at concentrations of 0, 31.25, 62.5, 125, 250, and 500 µg/mL in the presence, and of 0, 25, 50, 100, 200, and 400µg/mL in the absence of mammalian metabolic activation. Formic acid was tested up to cytotoxic concentrations (i.e., 200 to 400 µg/mL

in the absence, and 400 to 500 µg/mL in the presence of metabolic activation) without increasing mutation frequency at any concentration. The positive controls did induce the appropriate response as did the vehicle control. There was no evidence of induced mutant colonies over background This study is classified as acceptable because it meets the requirements of GLP and current test guidelines. This study satisfies the requirement for Test Guideline OECD 476 and EEC Directive 2000/32, B.17 for in vitro mutagenicity (mammalian forward gene mutation) data.

In a mammalian cell cytogenetics assay (Chromosome aberration, conducted similar to OECD Test Guideline No. 473) CHO cell cultures were exposed to formic acid dissolved in F12 cell culture medium at concentrations of 6 to 14 mM, i.e. 0, 276, 368, 460, 552, and 644 µg/mL with and without metabolic activation. In a series of subsequent experiments, the influence of confounding factors, i.e. pH and osmolality) on the incidence of aberrant cells (%) was examined at concentrations of 20, 25, 27.5, and 30 mM, i.e. at 920, 1150, 1266, and 1380 µg/mL. Formic acid was tested up to cytotoxic concentrations. Overt cytotoxicity and increased numbers of aberrant cells were seen when the initial pH of the incubation medium was approximately 6 or less. The number of aberrant cells was not increased by formic acid up to 14 mM, i.e. 644 mg/mL, if the initial pH was adequate (pH 7.2). Moreover, no positive response was seen with concentrations up to 20 mM (920 µg/mL) with two different buffer systems as long as the buffer capacity was not exhausted. At 25 to 30 mM formic acid an increasing positive response and cytotoxicity were both seen. It was concluded that this results from the combined inadequately low pH and high osmolarity of the incubation medium. Positive controls were not included. There was no evidence of Chromosome aberration induced over background by formic acid. Pseudo-positive reactions attributable to non-physiological pH could be eliminated by either neutralisation of the treatment medium or enhancing the buffer capacity (Morita, 1990).

Formic acid was tested for genetic toxicity in a multigenerational test in Drosophila melanogaster similar to the OECD Guideline No. 477 (Genetic Toxicology: Sex-linked Recessive Lethal Test in Drosophila melanogaster). Following exposure to 0.1% formic acid vapour, the number of mutants was significantly increased compared to historical controls ($p<0.001$). An increase was also seen with 0.1% formic acid in a subsequent feeding experiment, but without gaining statistical significance. Sodium formate (produced by neutralization of formic acid) at the same molar concentration in the feed was negative in the Drosophila SLRL test. The authors concluded that the mutations observed with formic acid were related to the acidic pH, rather than to the acid or the formate molecule itself (Stumm-Tegethoff, 1969).

Estimated Data- None

Reproductive Toxicity (R): L

Calcium formate was assigned a hazard classification level of Low for reproductive toxicity based on no reproductive effects observed at the highest concentrations tested in multiple species. The hazard score is based on well reported study data for the compound and high-quality analogs and therefore is reported as high confidence.

Lists

- Authoritative: not included on any authoritative lists
- Screening: not included on any screening lists

Measured Data

ECHA 2019a

The reproductive toxicity potential of sodium formate was examined in a 2-Generation feed study using male and female Wistar rats (25/sex and dose) at dose levels of 0, 100, 300, and 1000 mg/kg bw/d. The study was conducted in accordance with current test guidelines including OECD guideline No. 416, and under GLP conditions There were no clinical signs of toxicity or mortalities in any of the F0 or F1 parental dose groups. Food consumption and body weights were comparable to that of the concurrent controls. Necropsy and pathology revealed no gross findings or organ weight changes that could be treatment-related. Reproduction parameters in F0 and F1 parental animals There were no indications that sodium formate adversely affected fertility or reproductive performance of the F0 and F1 parental animals at dose levels as high as 1000 mg/kg bw/d. Mating behaviour, conception, gestation, parturition, lactation and weaning as well as sexual organ weights and gross findings of these organs were comparable between the rats of the test substance-treated test groups and the corresponding controls, and ranged within the historical control data of the test facility. There were no effects on male and female reproduction organs. Sperm parameters and oestrous cycle were not affected. Clinical and/or gross necropsy examinations of the F1 and F2 pups revealed only findings which were considered to be spontaneous in nature. The type and incidence of findings was within the range of the concurrent and/or the historical controls. (BASF SE, 2008). Based on the above, the NOAEL values were as follows: NOAEL 1000 mg/kg bw/d for general systemic toxicity for F0 and F1 parental animals. NOAEL 1000 mg/kg bw/d for fertility and reproductive performance for the F0 and F1 parental rats

Calcium diformate was repeatedly administered in a pre-guideline study to male and female rats with drinking water (0.2 and 0.4% in water; 7 days/week) in multigenerational experiments that lasted for 36 and 24 months (F0 to F4 and F2 generation, respectively). Regarding toxicity to reproduction, the authors reported that there were no signs of toxicity to reproduction, and some data were presented which support the statement that no adverse effect on reproduction was noted in any of the 4 generations born from dams exposed to 0.2% CaF (i.e. ca. 200 mg/kg bw/day). The NOAEL for reproduction toxicity was therefore 200 mg calcium diformate/kg bw/day under the conditions of this study (Malorny, 1969). This early study is not comparable with current study protocols, but the review is well-documented and meets basic scientific principles. Poor documentation, low number of animals and the very poor examination compared to current guideline should be noted. The study is acceptable for assessment and provides some weight of evidence

ECHA 2019b

In an OECD guideline No. 413 test conducted under GLP conditions, 10 Fischer rats per sex and dose were exposed to formic acid vapor at 0, 0.015, 0.030, 0.062, 0.122, or 0.244 mg/L (0, 8, 16, 32, 64, or 128 ppm; dose selection based on results of a range finding study) via whole-body inhalation 6 hours/day, 5 days/week for 13 weeks. Sperm motility and morphology was examined at termination in all males, or estrous cycle of all females was examined during the last two weeks of exposure. Male and female reproductive organs were weighed and subjected to histopathology. There were no findings that would indicate adverse effects on male and female reproductive organs at any dose in this 13-week inhalation study (Thomson, 1992)

Estimated Data- None

Developmental Toxicity incl. Developmental Neurotoxicity (D): L

Calcium formate was assigned a hazard classification level of Low for developmental toxicity based on no developmental effects observed at the highest concentrations tested in multiple species. The hazard score is based on well reported study data for the compound and high-quality analogs and therefore is reported as high confidence.

Lists

- Authoritative: not included on any authoritative lists
- Screening: not included on any screening lists

Measured Data

ECHA 2019a

In a developmental toxicity study performed according to OECD test guideline No. 414 and under GLP conditions, sodium formate (in water) was administered to 25 female Himalayan rabbits by gavage at dose levels of 0, 100, 300, and 1000 mg/kg bw/day from days 6 through 28 of gestation. There were no treatment-related effects in mortality, clinical signs, body weight, food consumption, cesarean parameters, and terminal necropsy in the does. The maternal NOAEL is therefore 1000 mg sodium formate/kg bw/day. There were no treatment-related effects in developmental parameters. Fetal weight at birth, sex distribution, placenta weight, pre- and postimplantation loss were not affected. There were no unusual or increased incidences of external, soft tissue or skeletal malformations attributable to the treatment. The developmental NOAEL is therefore 1000 sodium formate mg/kg bw/day. The NOAEL for teratogenicity is also 1000 sodium formate mg/kg bw/day, the highest dose tested (BASF, 2008). The developmental toxicity study in the rabbit is classified as acceptable and satisfies the guideline requirement for a developmental toxicity study (OECD 414) in rabbits.

In a developmental toxicity study, time-mated female rats (25/dose, OECD TG 414; study conducted under GLP conditions) received sodium formate via oral gavage at 0, 59, 236, and 945 mg/kg bw/day during gestation days 6 to 19. Maternal toxicity was not seen. Maternal toxicity was not seen. Gestational parameters were not influenced and there were no effects on the developing fetuses. No malformations or skeletal variations were seen. The NOAEL for maternal and

developmental toxicity was 945 mg sodium formate/kg bw/day, the highest dose tested (BASF AG, 2005).

Calcium diformate was repeatedly administered in a pre-guideline study to male and female rats with drinking water (0.2 and 0.4% in water; 7 days/week) in multigenerational experiments that lasted for 36 and 24 months (F0 to F4 and F2 generation, respectively). The subchronic NOAEL was therefore 150-200 and 200 mg calcium diformate/kg bw/day under the conditions of this study. The authors reported that there were no signs of maternal toxicity, developmental toxicity or teratogenicity in rats exposed to 200 mg calcium diformate/kg bw/day and their progeny. Fertility, gestation, litter size, fetal development, and the development of the progeny were unaffected in 3 generations. The NOAEL for developmental toxicity was therefore 200 mg calcium diformate/kg bw/day under the conditions of this study (Malorny, 1969). This early study is not comparable with current study protocols, but the review is well-documented and meets basic scientific principles. Poor documentation, low number of animals and the very poor examination compared to current guideline should be noted. The study is acceptable for assessment and provides some weight of evidence.

Estimated Data- None

Endocrine Activity (E): DG

Calcium formate was assigned a hazard classification level of Data Gap for endocrine activity based on the lack of available studies that directly address endocrine activity effects following exposures to the compound. No analog data was available to fill the data gap.

Lists

- Authoritative: not included on any authoritative lists
- Screening: not included on any screening lists

Measured Data- None

Estimated Data- None

GROUP II AND II* HUMAN HEALTH EFFECTS (GROUP II AND II* HUMAN)

Note: Group II and Group II* endpoints are distinguished in the v1.4 Benchmark system (the asterisk indicates repeated exposure). For Systemic Toxicity and Neurotoxicity, Group II and II* are considered sub-endpoints. See GreenScreen Guidance v1.4, Annex 2 for more details.

Acute Mammalian Toxicity (AT): L

Calcium formate was assigned a hazard classification level of Low for acute mammalian toxicity based on weight of evidence which indicates LD50 values for oral and dermal exposures >2000 mg/kg. One study indicated an oral LD50 of 1920 mg/kg for calcium diformate. This study however was poorly reported, and the only available study that indicated an LD50 <2000 mg/kg. Inhalation LC50 were greater than the highest concentrations tested. The hazard score is based on test data using the compound and in high quality analogs and therefore reported as high confidence.

Lists

- Authoritative: not included on any authoritative lists
- Screening:
    - GHS - New Zealand - 6.1D (oral) - Acutely toxic

Measured Data

ECHA 2019a

The acute oral toxicity of formic acid and several of its salts was examined in male and female mice in a pre-guideline study. The aim was to establish LD_{50} values and elucidate the mode of action. Sodium formate was tested in a total of 45 mice. The oral LD_{50} was 11200 mg/kg bw (range: 9600-12800) in mice. The acute oral toxicity was therefore low (Malorny, 1969). This pre-guideline publication reviews the results of a variety of studies including metabolism and excretion, acute and repeated toxicity, and toxicity to reproduction. These results were used in the course of an early MAK-assessment. Though formal requirements for modern studies are not met, the published results are valuable for the assessment of formic acid and its salts. The study is considered to be valid (low reliability of 4 is assigned for formal reasons) and is used in a Weight of Evidence approach.

The acute oral toxicity of formic acid and several of its salts was examined in male and female mice in a pre-guideline study. The aim was to establish LD_{50}values and elucidate the mode of action. Calcium diformate was tested in a total of 45 mice. The oral LD_{50} was 1920 mg/kg bw (range: 1280-2560) in male and female mice. The acute oral toxicity was therefore low (Malorny, 1969). This pre-guideline publication reviews the results of a variety of studies including metabolism and excretion, acute and repeated toxicity, and toxicity to reproduction. These results were used in the course of an early MAK-assessment. Though formal requirements for modern studies are not met, the published results are valuable for the assessment of formic acid and its salts. The study is considered to be useful in a Weight of Evidence approach.

The acute oral toxicity of formic acid and several of its salts was examined in male and female mice in a pre-guideline study. The aim was to establish LD_{50} values and elucidate the mode of action. Potassium formate was tested in a total of 50 mice.The oral $LD_{50}$was 1in the range 5000 to 6000

mg/kg bw in mice. The acute oral toxicity was therefore low (Malorny, 1969). This pre-guideline publication reviews the results of a variety of studies including metabolism and excretion, acute and repeated toxicity, and toxicity to reproduction. These results were used in the course of an early MAK-assessment. Though formal requirements for modern studies are not met, the published results are valuable for the assessment of formic acid and its salts. The study is considered to be valid (low reliability of 4 is assigned for formal reasons) and is used in a Weight of Evidence approach

In an acute inhalation toxicity test, five Sprague Dawley rats of either sex were exposed to an atmosphere containing ground sodium formate dust (4 hours whole body exposure). The study was conducted according to the US EPA guideline EPA OTS 798.1150 (similar to OECD guideline 403) and under GLP conditions. The target concentration was 10 mg/L, the observation period 14 days. The mean gravimetric particle concentration was 0.67 mg/L under the conditions of this study. The average mass median aerodynamic diameter was 5.4 µm with an average geometric standard deviation of 2.4 µm. There were no mortalities. Signs of treatment were minimal and included nasal discharge and lacrimation after treatment with recovery within one week, and a transient reduction of body weight gain. No treatment-related changes were seen at the terminal necropsy (Biodynamics, 1990). Overall, exposure of rats to the highest practical aerosol concentration of test material, with a large portion in the respirable range, was not associated with adverse effects other than eye and nasal irritation. The acute inhalation LC50 is greater than 0.67 mg/L for a 4-hour inhalation exposure.

In an OECD TG 402 study Wistar rats (5/sex) were administered sodium formate on the fur-clipped dorsal skin at 2000 mg/kg bw under semi-occlusive conditions for 24 hours and observed for 14 days. The study was conducted under GLP conditions. No mortality or clinical signs of toxicity, skin reactions and no effects on body weights were seen, and no changes were seen in any organs during necropsy. The LD50 was > 2000 mg/kg bw (BASF AG, 2007).

The acute oral toxicity of calcium diformate (1000, 2000, 3100, 3500, 3800, 4000 mg/kg bw; dissolved in water, oral gavage) was examined in male Wistar rats (10 per dose). The method was similar to OECD test guideline 401, observation period was 14 days.There were no clinical signs or mortality in animals at 1000 mg/kg bw. Mortality, sedation, increased diuresis, and reduced general state were noted in the dose groups at 2000 mg/kg bw and above. The LD_{50} was 3050 (95% confidence range 2540 – 3390) mg/kg bw (Bayer, 1978).

The acute oral toxicity of calcium diformate (2000, 2520, 3180, 3980, 5000 mg/kg bw; dissolved in water, oral gavage) was examined in male and female Wistar rats (5/sex/dose). The method was similar to OECD test guideline 401, the observation period was 14 days. Mortality was noted in the dose groups at 2000 mg/kg bw and above. The $LD_{50}$was 2560 mg/kg bw in rats (Degussa, 1979). The study is considered to be of low reliability (4) because of the study report is not yet available. The calculated LD_{50}value does, however, indicate low oral toxicity and may be used in a weight of evidence approach for assessment.

SIDS 2008

An LC50 of > 5.16 mg/L was determined for KHFo in a study conducted according to OECD TG 403.

An LD50 of 3050 mg/kg bw was determined for CaFo in a study that was similar to OECD TG 401;

An LD50 > 2000 mg/kg bw in rats was determined for KHFo in an OECD TG 401 study;

Studies using rats were not available for NaFo or KFo, but mouse LD50 s were 11200 mg/kg bw and 5500 mg/kg bw, respectively. Overall, category members exhibit low acute toxicity via inhalation, dermal and oral routes.

Estimated Data- None

Systemic Toxicity/Organ Effects incl. Immunotoxicity (ST-single): M

Calcium formate was assigned a hazard classification level of Moderate for single dose systemic toxicity/organ effects based on no clinical signs of significant systemic toxicity following oral and dermal exposures to doses up to 2000. One study indicates effects (i.e. Mortality, sedation, increased diuresis, and reduced general state) occurred following oral exposures to 2000 mg/kg, however, the reported effects do not fulfill GHS category 1 or 2 classification for Systemic Toxicity/Organ Effects incl. Immunotoxicity (ST-single). Therefore, based on professional judgement calcium formate has been classified as GHS category 3 for Systemic Toxicity/Organ Effects incl. Immunotoxicity (ST-single). The hazard score is based on study data that is not specific to systemic toxicity and was developed using professional judgement and therefore reported as low confidence.

Lists

- Authoritative: not included on any authoritative lists
- Screening: not included on any screening lists

Measured Data

ECHA 2019a

In an acute inhalation toxicity test, five Sprague Dawley rats of either sex were exposed to an atmosphere containing ground sodium formate dust (4 hours whole body exposure). The study was conducted according to the US EPA guideline EPA OTS 798.1150 (similar to OECD guideline 403) and under GLP conditions. The target concentration was 10 mg/L, the observation period 14 days. The mean gravimetric particle concentration was 0.67 mg/L under the conditions of this study. The average mass median aerodynamic diameter was 5.4 µm with an average geometric standard deviation of 2.4 µm. There were no mortalities. Signs of treatment were minimal and included nasal discharge and lacrimation after treatment with recovery within one week, and a transient reduction of body weight gain. No treatment-related changes were seen at the terminal necropsy (Biodynamics, 1990). Overall, exposure of rats to the highest practical aerosol concentration of test material, with a large portion in the respirable range, was not associated with adverse effects other than eye and nasal irritation.

In an OECD TG 402 study Wistar rats (5/sex) were administered sodium formate on the fur-clipped dorsal skin at 2000 mg/kg bw under semi-occlusive conditions for 24 hours and observed for 14 days. The study was conducted under GLP conditions. No mortality or clinical signs of toxicity, skin reactions and no effects on body weights were seen, and no changes were seen in any organs during necropsy

ECHA 2019b

The acute oral toxicity of calcium diformate (1000, 2000, 3100, 3500, 3800, 4000 mg/kg bw; dissolved in water, oral gavage) was examined in male Wistar rats (10 per dose). The method was similar to OECD test guideline 401, observation period was 14 days. There were no clinical signs or mortality in animals at 1000 mg/kg bw. Mortality, sedation, increased diuresis, and reduced general state were noted in the dose groups at 2000 mg/kg bw and above.

SIDS 2008

An LC50 of > 5.16 mg/L was determined for KHFo in a study conducted according to OECD TG 403. Clinical signs included strongly decreased breathing rates in all rats throughout exposure, piloerection, moderate sluggishness in all animals, rales, and blepharospasms. Lower body weight gain and changes in lungs (bleeding/discoloration) and intestines were seen.

LD50 of > 2000 mg/kg bw was obtained following 24-hour dermal exposure of rats to NaFo under semi-occlusive conditions (OECD TG 402). No mortality, clinical signs of toxicity, skin reactions or effects on body weight were noted. No changes in any organs were noted during necropsy.

An LD50 of 3050 mg/kg bw was determined for CaFo in a study that was similar to OECD TG 401; clinical signs included sedation, increased diuresis, and reduced general state.

An LD50 > 2000 mg/kg bw in rats was determined for KHFo in an OECD TG 401 study; clinical signs included lethargy, piloerection and tachypnea.

Studies using rats were not available for NaFo or KFo, but mouse LD50 s were 11200 mg/kg bw and 5500 mg/kg bw, respectively. Overall, category members exhibit low acute toxicity via inhalation, dermal and oral routes.

There were no mortalities with 14 days following a 4-h inhalation exposure of rats to 5.16 mg/l potassium formate (1:2). At 5 mg/l: severely depressed breathing rates during exposure. After exposure: red colored nose, blepharospasms, dyspnea, immobility decreased breathing rate were noted. The test substance was dissolved in water and nebulized. The particle size (Mass Median Aerodynamic Diameter, MMAD) was 3.25 µm. Clinical signs noted included severe respiratory depression during the exposure, irritation of the eyes and the respiratory tract. Necropsy findings included discoloration and petechiae in lungs and air-filled Cecum in most animals.

Estimated Data- None

Systemic Toxicity/Organ Effects incl. Immunotoxicity (ST-repeat) (Group II*): L

Calcium formate was assigned a hazard classification level of Low for repeated dose systemic toxicity/organ effects based on repeat dose oral studies using high quality analogs which showed NOAEL at concentrations >100 mg/kg. Inhalation studies using formic acid have shown NOAECs <0.2 mg/L based on irritation of the upper respiratory tract along with degeneration of the olfactory epithelium and squamous metaplasia of the respiratory epithelium. These effects associated with formic acid however have not been considered in the hazard score as local effects of the formic acid formed can be discounted because these are not expected with neutral salts (sodium, potassium, ammonium, calcium formate). These results are reported in high-quality guideline studies using a high-quality analog. Therefore, the hazard score is reported as high confidence.

Lists

- Authoritative: not included on any authoritative lists
- Screening: not included on any screening lists

Measured Data

ECHA 2019a

The repeated dose of potassium diformate(1:2) was examined in a subchronic rat study according to the OECD guideline 408 and under GLP conditions. A read across from potassium diformate is justified because potassium diformate decomposes in aqueous solution into one molecule of each formate and formic acid, and the potassium ion. Thus, potassium diformate gives two formate anions on a molar basis. Local effects of the formic acid formed can be neglected because these are not expected with neutral salts (sodium, potassium, ammonium, calcium formate). Read across can therefore be limited to systemic effects.

In the 13-week oral fed study potassium diformate (1:2) was administered in the diet at dose levels of 0, 600, 1200, and 3000 mg/kg bw/day to 10 rats/sex/dose. The doses were selected based on the results of a 7 day range finding study. Additional animals were used in satellite studies, i.e. a 4-week recovery study (0 and 3000 mg/kg bw/day, 10 rats/sex/dose), and in an absorption study (3000 mg/kg bw/day, 10 rats/sex/dose). No mortality or clinical signs of toxicity were seen. Male body weight gain was significantly decreased in all treated groups, whereas in females body weight reduction gained a level of significance only in the high dose group animals. A slightly reduced food consumption was seen in groups with reduced body weights. Test substance consumption was close to the nominal doses, i.e. 0, 590, 1180, and 2880 (males) and 2950 (females) mg/kg bw/day, respectively. Reduced body weight gain and food consumption resulted possibly from a reduced palability of the diet, and from the local irritation. There were no effects in ophthalmology. No clear effects were seen in hematology and clinical chemistry. Some parameters gained a level of statistical significance, but this was of no biological or toxicological relevance. Organ weights of male and female rats were similar to those of the controls. Pathology revealed no remarkable finding except from local irritation, evidenced by the observation of a thickening of the limiting ridge in the stomach in all male groups and in the female high dose group at the end of the 13-week period. Histopathology revealed a dose-related increase in the incidence and severity of squamous cell hyperplasia in the forestomach of male and female rats. This effect was largely reversible in the 4-week recovery group. Overall, there was no overt systemic toxicity or target organ in this study. A dose-related body weight decrease was seen in all treated males and in the high dose female group, possibly as a result of the reduced palability of the diet. The small but statistically significant changes in hematology and clinical chemistry parameters in the high dose animals were not of toxicological significance, due to the small changes and the lack of target organ toxicity. A specific target organ was the stomach, based on local irritation in the forestomach which caused a dose-related thickening of the stomach at all dose levels, and was confirmed to be squamous cell hyperplasia. This was considered to be a response to minor irritation by the test substance, rather than a toxic effect (Covance, 1998). Overall, dietary administration of potassium diformate (1:2) to rats at 600, 1200, and 3000 mg/kg bw and day for 13 weeks did not produce any overt systemic toxicity. Minor local irritation had occurred in the forestomach of both sexes, with effects being seen in the males at all dose levels. Recovery was not complete in all animals after the 4-week treatment-free period. The authors did not derive NOAEL values, but they may be considered as follows: Local irritation: NOAEL below 600 mg/kg bw/day, based on the irritation of the forestomach and the squamous cell

hyperplasia seen at 600 mg/kg bw and day in both sexes. Systemic toxicity: NOAEL(rat, 90 day study) 3000 mg/kg bw/day, as no adverse effect was seen at the highest dose tested. Taking stoichiometry and formula weights into consideration, this is equivalent to 3138 mg sodium formate/kg bw/d.

The repeated dose toxicity and oncogenicity of potassium diformate(1:2) was examined in a combined chronic toxicity and 104-week oral feed oncogenicity study in the rat similar to the OECD guideline 453 and under GLP conditions. Local effects are attributable to the formic acid formed and can be neglected because these are not expected with neutral salts (sodium, potassium, ammonium, calcium formate). Read across can therefore be limited to systemic effects. The oral dietary administration of potassium formate (1:2) in a combined chronic toxicity/carcinogenicity study (equivalent to OECD guideline 453 and under GLP) to male and female Wistar rats (50 animals/dose/sex) for 104 weeks to rats at dose levels of 50, 400, and 2000 mg/kg bw/d was well tolerated without effects on clinical condition or survival. Treatment-related findings were noted at 2000 mg/kg bw/d and included a statistically significant depression of body weight gain (by 27% in males and 19% in females; no effect at the low and intermediate dose levels) and, at terminal kill, a thickening of the stomach confirmed as basal cell hyperplasia or foveolar epithelium hyperplasia in the majority of the high dose animals. These changes were less pronounced than in a previous 90-day rat study. There was no evidence of systemic target organ toxicity due to test substance administration, including the eyes. The spectrum of tumours was generally consistent with that expected in rats of this strain. There were no tumours of unusual nature or incidence indicative of specific target organ carcinogenicity in the stomach or any other tissue (Covance Laboratories, 2002). Overall, the local toxicity NOAEL for 52 and 104 weeks of treatment was considered to be 400 mg/kg bw/d, based on the local effects in the stomach and reduced body weight of the high dose rats. As no signs of systemic effects were noted, the NOAEL (rat, 104 week) for systemic toxicity is considered to be 2000 mg/kg bw/d. Taking stoichiometry and formula weights into consideration, the systemic toxicity NOAEL (rat, oral, 104-week) was 2092 mg sodium formate/kg bw/d.

SIDS 2008

In an OECD TG 413 test, rats were exposed to FoA vapor at 0, 0.015, 0.030, 0.062, 0.122, or 0.244 mg/L (0, 8, 16, 32, 64, or 128 ppm) via whole-body inhalation 6 hours/day, 5 days/week for 13 weeks. Increased absolute or relative liver weights and decreased lung weights were seen without histopathological correlation. Irritation of the upper respiratory tract was seen at 128 ppm (0.244 mg/L) along with degeneration of the olfactory epithelium and squamous metaplasia of the respiratory epithelium. The NOAEC and LOAEC were 0.122 mg/(L*d) (i.e. 64 ppm) and 0.244 mg/(L*d) (i.e. 128 ppm) based on respiratory effects.

A 13-week study (OECD TG 413) in B6C3F1 mice with FoA using the same protocol and concentration as those used in the rat study, resulted in decreased body weights and increased liver weights in males at all doses. Mild degeneration of the olfactory epithelium was seen at the two highest concentrations. Based on the changes in olfactory epithelium, the NOAEC and LOAEC were determined to be 0.062 mg/(L*d) (32 ppm) and 0.122 mg/(L*d) (64 ppm), respectively.

Estimated Data- None

Neurotoxicity (N-single): M

Calcium formate was assigned a hazard classification level of Moderate for single dose neurotoxicity based on reported sluggishness, lethargy, piloerection and tachypnea following oral exposures to 2000 mg/kg/day. No information was provided regarding the reversibility of these effects. In addition, while the results were reported from high quality studies using high quality analogs, the studies were not specific to neurotoxicity and it is unclear if the reported effects are caused by direct neurotoxicity or are the result of general toxicity. Therefore, the hazard score is reported as low confidence.

Lists

- Authoritative: not included on any authoritative lists
- Screening: not included on any screening lists

Measured Data

ECHA 2019a

In an acute inhalation toxicity test, five Sprague Dawley rats of either sex were exposed to an atmosphere containing ground sodium formate dust (4 hours whole body exposure). The study was conducted according to the US EPA guideline EPA OTS 798.1150 (similar to OECD guideline 403) and under GLP conditions. The target concentration was 10 mg/L, the observation period 14 days. The mean gravimetric particle concentration was 0.67 mg/L under the conditions of this study. The average mass median aerodynamic diameter was 5.4 µm with an average geometric standard deviation of 2.4 µm. There were no mortalities. Signs of treatment were minimal and included nasal discharge and lacrimation after treatment with recovery within one week, and a transient reduction of body weight gain. No treatment-related changes were seen at the terminal necropsy (Biodynamics, 1990). Overall, exposure of rats to the highest practical aerosol concentration of test material, with a large portion in the respirable range, was not associated with adverse effects other than eye and nasal irritation.

In an OECD TG 402 study Wistar rats (5/sex) were administered sodium formate on the fur-clipped dorsal skin at 2000 mg/kg bw under semi-occlusive conditions for 24 hours and observed for 14 days. The study was conducted under GLP conditions. No mortality or clinical signs of toxicity, skin reactions and no effects on body weights were seen, and no changes were seen in any organs during necropsy

The acute oral toxicity of calcium diformate (1000, 2000, 3100, 3500, 3800, 4000 mg/kg bw; dissolved in water, oral gavage) was examined in male Wistar rats (10 per dose). The method was similar to OECD test guideline 401, observation period was 14 days. There were no clinical signs or mortality in animals at 1000 mg/kg bw. Mortality, sedation, increased diuresis, and reduced general state were noted in the dose groups at 2000 mg/kg bw and above.

SIDS 2008

An LC50 of > 5.16 mg/L was determined for KHFo in a study conducted according to OECD TG 403. Clinical signs included strongly decreased breathing rates in all rats throughout exposure, piloerection, moderate sluggishness in all animals, rales, and blepharospasms. Lower body weight gain and changes in lungs (bleeding/discoloration) and intestines were seen.

LD50 of > 2000 mg/kg bw was obtained following 24-hour dermal exposure of rats to NaFo under semi-occlusive conditions (OECD TG 402). No mortality, clinical signs of toxicity, skin reactions or effects on body weight were noted. No changes in any organs were noted during necropsy.

An LD50 > 2000 mg/kg bw in rats was determined for KHFo in an OECD TG 401 study; clinical signs included lethargy, piloerection and tachypnea.

Studies using rats were not available for NaFo or KFo, but mouse LD50 s were 11200 mg/kg bw and 5500 mg/kg bw, respectively. Overall, category members exhibit low acute toxicity via inhalation, dermal and oral routes.

Estimated Data- None

Neurotoxicity (N-repeated) (Group II*): DG

Calcium formate was assigned a hazard classification level of Data Gap for repeated dose neurotoxicity based on the lack of available studies that directly address neurotoxic effects following inhalation, oral or dermal exposures to the compound. No analog data was available to fill the data gap.

Lists

- Authoritative: not included on any authoritative lists
- Screening: not included on any screening lists

Measured Data- None

Estimated Data- None

Skin Sensitization (SnS) (Group II*): L

Calcium formate was assigned a hazard classification level of Low for skin sensitization based on no sensitization reported in an OECD Guideline 406 Guinea pig maximization test. The hazard score is based on a high-quality analog and therefore, the hazard conclusion is reported as high confidence.

Lists

- Authoritative: not included on any authoritative lists
- Screening: not included on any screening lists

Measured Data

ECHA 2019a

Potassium diformate (1:2) was not sensitizing in a Guinea pig maximization test (10 controls, 20 test animals) that was conducted according to OECD 406 and under GLP. The concentration of the test substance was 0.5 and 15% dissolved in purified water during induction and 10% at challenge; the test concentrations were selected following preliminary studies. No skin reactions were seen in the 20 test and 10 control animals at 24 or 48 hours after challenge. Potassium diformate, therefore, is not a skin sensitiser (Covance Laboratories, 1998).

Estimated Data- None

Respiratory Sensitization (SnR) (Group II*): DG

Calcium formate was assigned a hazard classification level of Data Gap for respiratory sensitization based on the lack of available studies that directly address respiratory sensitization following inhalation exposures to the compound. No analog data was available to fill the data gap.

Lists

- Authoritative: not included on any authoritative lists
- Screening: not included on any screening lists

Measured Data- None

Estimated Data- None

Skin Irritation/Corrosivity (IrS): L

Calcium formate was assigned a hazard classification level of Low for skin irritation/corrosivity based on no skin reaction reported in a GLP OECD guideline No. 404 study using three male Himalayan rabbits. This finding is supported by a study using high quality analogs. The hazard score is based on well reported study data and therefore is reported as high confidence.

Lists

- Authoritative: not included on any authoritative lists
- Screening:
    - GHS - New Zealand - 6.3B - Mildly irritating to the skin

Measured Data

ECHA 2019a

The potential of CaFo for skin irritation was examined in a GLP OECD guideline No. 404 study using three male Himalayan rabbits. A dose of 500 mg/animal as a paste with water was applied to the shaved and intact dorsal skin. The test area was then covered with a gauze patch which was held in contact by means of semi-occlusive dressing. The skin sites were evaluated according to the table contained in the test guideline (adopted in 1992) immediately before the application of the test substance and after the 4-hour exposure. The scores were taken 60 min, 24, 48 and 72 hours after patch removal. There was no skin reaction in any animal at any reading, i.e. the mean erythema and edema scores were 0 at all readings, and there were no pathological changes noted. Therefore, CaFo was not irritating to the skin (LPT, 1999). The study is considered to be fully valid for assessment.

ECHA 2019c

In an OECD guideline 404 study, sodium formate was tested for its skin irritating properties under GLP conditions in three rabbits. Skin reactions were scored at 24, 48, and 72 hours after treatment according to the table contained in the guideline. There were no skin reactions noted except from a slight (Grade 1) Oedema in one of 3 animals at 24 hours after application. This reaction was fully reversible within one day.

CIR 2013

Two groups of 8 female Fischer 344/N rats were treated with formic acid (pH 5.5) and sodium formate, respectively. During a 2-week daily application period, each test substance (volume not stated) was applied topically to a 2 cm x 2 cm area of skin above the tail area.28 A control group of 8 rats was treated with saline according to the same procedure. Neither redness nor swelling at the application site was observed in test or control groups.

Estimated Data- None

Eye Irritation/Corrosivity (IrE): M

Calcium formate was assigned a hazard classification level of Moderate for eye irritation/corrosivity based on eye irritation that was reversible within a 14-day observation period. Reversible corresponding to the GHS Category 2B criteria for eye irritation. The hazard score is based on well reported study data and therefore is reported as high confidence.

Lists

- Authoritative: not included on any authoritative lists
- Screening:
    - GHS - New Zealand 6.4A - Irritating to the eye (Cat. 2A)

Measured Data

ECHA 2019a

The eye irritating properties of calcium diformate (100 mg) was examined in rabbits (Himalayan, 3 males) according to OECD guideline No. 405 and under GLP conditions. Marked corneal opacity (mean score 2.0), severe iritis (mean score 2.0), and marked conjunctival reactions (mean scores redness and chemosis 2.0) were seen during days 1 to 3. All reactions were reversible within the 14 day observation period. Corneal opacity and iritis were absent on day 7, conjunctival effects on day 14. Induration of the lower lid was seen in all animals on days 3 through 13 after treatment. Overall, calcium diformate was irritating to the rabbit's eyes. Results require labeling (R41: risk of serious eye damage) and classification (risk of serious damage to eyes) (LPT, 1999). The study is considered to be valid and acceptable for assessment.

ECHA 2019c

The eye irritation potential of sodium formate was investigated in a GLP- and guideline (OECD 405)-compliant rabbit study. 0.1 g of the unchanged test material was instilled into one (left) eye of three male New Zealand White rabbits. The untreated (right) eye of each animal acted as a control. Ocular reactions were scored at up to 72 hours using the Draize scale. There were no corneal or iridic effects in any rabbit. There were no corneal or iridic effects in any rabbit. Initial conjunctival erythema (Grade 2 or 3) was seen in all animals but had resolved or decreased in severity to Grade 1 by 24 hours. Findings had resolved in all animals by 72 hours. Initial conjunctival chemosis (Grade 1 or 2) was seen in all animals but had resolved or decreased in severity to Grade 1 by 24 hours. Findings had resolved in all animals by 48 hours. Slight ocular secretion was also noted in all animals at the 1-hour observation. The results of this study indicate that sodium formate causes moderate transient eye irritation and is not classified for eye irritation according to the CLP criteria.

In a study of eye irritating properties, 0.1 mL sodium formate was instilled into one eye of six rabbits. The study is equivalent to a guideline study (an OECD 405) and was conducted under GLP conditions. Eye reactions were evaluated according to the provisions of the OECD guideline No. 405. The observation period of up to 17 days allowed effects to subside. Following treatment, all six animals showed moderate to severe conjunctival irritation (redness, chemosis, and reversible changes) that was fully reversible. Chemosis was absent after 3 and redness after 7 days. The mean redness score was 1.89 across all animals and readings at 24, 48, and 72 hours, although four animals showed a mean score of grading at 24, 48 and 72 hours of at least 2.0. Changes of the nictitating membrane and conjunctivae subsided within 7 days in five and were absent in all animals on day 17 after treatment. There were no effects on cornea or iris noted at any time after dosing (Biodynamics, 1990).

Estimated Data- None

ECOTOXICITY (ECOTOX)

Acute Aquatic Toxicity (AA): L

Calcium formate was assigned a hazard classification level of Low for acute aquatic toxicity based on reported LC50 and EC50 that are >100 mg/L. The aquatic toxicity of the compound is reported for three trophic levels in guideline studies for the compound and/or using the high-quality analogs. Therefore, the hazard score is reported as high confidence.

Lists

- Authoritative: not included on any authoritative lists
- Screening: not included on any screening lists

Measured Data

ECHA 2019a

Draft guideline "Lethal effects towards zebrafish Brachydanio rerio (LC0, LC50, LC100; 48-96 h) of the German Federal Environmental Agency (UBA) (May 1984). No mortality was observed in any concentration at any time point during the exposure period. In the 1000 mg/L calcium formate concentration, one fish was observed to exhibit sluggish swimming behavior after 48 hours and thereafter.

In a Guideline study under GLP conditions, but test item concentrations not verified analytically After 96 h, 1 Scophthalmus maximus (turbot) fish each was moribund in the 1800 mg/L Potassium formate concentration. At all other test concentrations and time intervals no abnormalities were detected.

Guideline study under GLP conditions, but test item concentrations not verified analytically with Brown shrimp 96h LC50 of 1308 mg/L

Pseudokirchneriella subcapitata (previous names: Raphidocelis subcapitata, Selenastrum capricornutum) EC50> 1000 mg/L Validity criteria according to OECD 201

ECHA 2019c

The acute toxicity of sodium formate to rainbow trout was determined. The study was carried out according to EPA OTS test guideline 797/1400 (Acute toxicity to fish). In this study rainbow trout were exposed to sodium formate over a test period of 96 hours under flow-through. Nominal exposure concentrations were 0 (control), 63, 125, 250, 500 and 1000 mg/L, the mean measured concentrations were < 5 (control), 54, 105, 215, 443, and 887 mg/L. The results of the study were based on the nominal concentrations. The 96 hour LC50 of sodium formate to rainbow trout was observed to be >1000 mg/L and the corresponding NOEC was 1000 mg/L.

The acute toxicity of sodium formate to fathead minnow was determined. The study was carried out according to EPA OTS test guideline 797/1400 (Acute toxicity to fish). In this study fathead minnows were exposed to sodium formate over a test period of 96 hours under flow-through. Nominal exposure concentrations were 0 (control), 63, 125, 250, 500 and 1000 mg/L, the mean measured concentrations were < 5 (control), 58, 116, 223, 461, and 954mg/L. The results of the study were

based on the nominal concentrations. The 96 hour LC50 of sodium formate to fathead minnow was observed to be >1000 mg/L and the corresponding NOEC was 1000 mg/L.

The acute toxicity of sodium formate to Daphnia magna was determined. The study was carried out according to US EPA (1975) Methods for acute toxicity tests with fish, macroinvertebrates and amphibians, EPA 660/3-75-009. In this study Daphnia were exposed to sodium formate over a test period of 48 hours under flow-through test conditions. Nominal exposure concentrations were 0 (control), 60, 120, 250, 500 and 1000 mg/L, the mean measured concentrations were < 5 (control), 74, 122, 247, 447, and 1070 mg/L. The results of the study were based on the nominal concentrations. The 48 hour EC50 of sodium formate to Daphnia magna was observed to be >1000 mg/L and the corresponding NOEC was 120 mg/L.

The inhibition of growth of sodium formate to the green algae Pseudokirchneriella subcapitata was determined. The study was carried out according to the following guidelines, 1) Miller et al. (1978). The Selenastrum capricornutum Printz Algal Assay Bottle Test. Experimental Design, Application and Data Interpretation Research Laboratory, Corvallis, Oregon 97330. EPA-600/9-78-018, 2) OTS Algal Acute Toxicity Test, August, 1982. EG-8, ES-5 and 3) ASTM (1983). Proposed Standard Practice for Conducting Short-Term Toxicity Tests with Freshwater and Saltwater Algae. E-47.01, Draft No. 5. These guidelines. The test material was tested using nominal exposure concentrations were 0 (control), 63, 125, 250, 500 and 1000 mg/L, the overall (0 and 72 h) mean measured concentrations were <5 (control), 58, 121, 243, 498 and 1001 mg/L. The results of the study were therefore based on the nominal concentrations. The 72 h EC20 and EC50 for growth rate were 807 and >1000 mg/L based on nominal exposure concentrations.

Estimated Data- None

Chronic Aquatic Toxicity (CA): L

Calcium formate was assigned a hazard classification level of Low for chronic aquatic toxicity based on NOEC values >10 mg/L in aquatic invertebrates and algae reported in guideline studies. No data was located for chronic toxicity in fish. Due to the lack of fish data the hazard score is reported as low confidence.

Lists

- Authoritative: not included on any authoritative lists
- Screening: not included on any screening lists

Measured Data

ECHA 2019a

The inhibition of growth of sodium formate to the green algae Pseudokirchneriella subcapitata was determined. The study was carried out according to the following guidelines, 1) Miller et al. (1978). The Selenastrum capricornutum Printz Algal Assay Bottle Test. Experimental Design, Application and Data Interpretation Research Laboratory, Corvallis, Oregon 97330. EPA-600/9-78-018, 2) OTS Algal Acute Toxicity Test, August, 1982. EG-8, ES-5 and 3) ASTM (1983). Proposed Standard Practice for Conducting Short-Term Toxicity Tests with Freshwater and Saltwater Algae. E-47.01, Draft No. 5. These guidelines. The test material was tested using nominal exposure concentrations were 0 (control), 63, 125, 250, 500 and 1000 mg/L, the overall (0 and 72 h) mean measured

concentrations were <5 (control), 58, 121, 243, 498 and 1001 mg/L. The results of the study were therefore based on the nominal concentrations. The 72 h NOEC for growth rate was 500 mg/L based on nominal exposure concentrations.

ECHA 2019b

No data are available for calcium diformate. Therefore, a read-across was performed to formic acid. To determine chronic effects of formic acid to aquatic invertebrates, a semi-static GLP study according to OECD guideline 211 using Daphnia magna was performed. The calculated NOEC value (21d) in this study was 100 mg/L, related to the nominal concentrations which were verified analytically (BASF SE 2007). It can be concluded with high probability that formic acid and hence calcium diformate is not chronically toxic to aquatic invertebrates.

Estimated Data- None

ENVIRONMENTAL FATE (FATE)

Persistence (P): vL

Calcium formate was assigned a hazard classification level of Very Low for persistence based on reported results of rapid biodegradability of sodium formate in a Biodegradability in Seawater test (OECD 306). The hazard score is based on a guideline study using a high-quality analog and therefore is reported with high confidence.

Lists

- Authoritative: not included on any authoritative lists
- Screening: not included on any screening lists

Measured Data

ECHA 2019a

The biodegradability of sodium formate in seawater was investigated via a 'Biodegradability in Seawater (closed bottle)' study (OECD Guideline 306), which showed 86% degradation (ThOD) over 28 days (KM Lab, 1998). According to OECD Guidance, when a chemical attains more than 60% ThOD or more than 70% DOC removal in a Biodegradability in Seawater test (OECD 306) it can also be expected to fulfil the criteria for ready biodegradability, given that the degradation potential in seawater is normally lower than in freshwater tests (OECD, 2002). Sodium formate can therefore be regarded as readily biodegradable.

Estimated Data- None

Bioaccumulation (B): vL

Calcium formate was assigned a hazard classification level of Very Low for bioaccumulation based on a reported Log Pow for sodium formate. The hazard score is estimated based on the chemical properties of the compound and therefore is reported as low confidence.

Lists

- Authoritative: not included on any authoritative lists
- Screening: not included on any screening lists

Measured Data

ECHA 2019a

In accordance with column 2 of Annex IX, the study does not need to be conducted if the 1-octanol/water partition coefficient is <3. Due to the low logPow of below -1.8 (Na formate; Perstorp, 2009), accumulation in organisms is not expected.

Estimated Data- None

PHYSICAL HAZARDS (PHYSICAL)

Reactivity (Rx): L

Calcium formate was assigned a hazard classification level of Low for reactivity based on the structural composition of the compound, which is not reactive, explosive or oxidizing. The NFPA rating is 0 for instability. The hazard score is based on the physical properties of the compound and therefore reported as high confidence.

Lists

- Authoritative: not included on any authoritative lists
- Screening: not included on any screening lists

Measured Data

ECHA 2019a

- Examination of the structure indicates that there are no groups associated with explosive properties.
- Due to the structural composition of the substance it is not considered to be oxidising

Fishersci 2008

Hazardous Polymerization: Will not occur.

NOAA

Reactivity Alters: none

Estimated Data- None

Flammability (F): L

Calcium formate was assigned a hazard classification level of Low for flammability based on several sources reporting that calcium formate is stable and has a low risk for flammability with an NFPA rating of 0 for flammability. The hazard score is based on the physical properties of the compound and therefore reported as high confidence.

Lists

- Authoritative: not included on any authoritative lists
- Screening: not included on any screening lists

Measured Data

Fishersci 2008

NFPA Rating: Flammability: 0

ECHA 2019a

The self-ignition temperature of calcium diformate was determined according to the EU method A.16 (Test A16 of Annex V of 67/548/EEC) to be 292 °C (Perstorp, 2009).

EU Method A.10 (Flammability (Solids)): non flammable

Estimated Data- None

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APPENDIX A: HAZARD CLASSIFICATION ACRONYMS

(AA) Acute Aquatic Toxicity

(AT) Acute Mammalian Toxicity

(B) Bioaccumulation

(C) Carcinogenicity

(CA) Chronic Aquatic Toxicity

(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 OUTPUT FOR CALCIUM FORMATE (544-17-2)

ENDPOINT	HAZARD LEVEL	GS SCORE	LIST NAME	HAZARD DESCRIPTION	OTHER LISTS
Acute Mammalian Toxicity	M	LT-UNK	GHS - New Zealand	6.1D (oral) - Acutely toxic	
Skin Irritation/Corrosivity	M	LT-UNK	GHS - New Zealand	6.3B - Mildly irritating to the skin	
Eye Irritation/Corrosivity	H	LT-UNK	GHS - New Zealand	6.4A - Irritating to the eye (Cat. 2A)	+2
	pC	NoGS	EU - Manufacturer REACH hazard submissions	H318 - Causes serious eye damage (unverified)	
	pC	NoGS	EU - Manufacturer REACH hazard submissions	H319 - Causes serious eye irritation (unverified)	
Terrestrial Ecotoxicity	M	NoGS	GHS - New Zealand	9.3C - Harmful to terrestrial vertebrates	
Human and/or Aquatic toxicity and/or Persistence and/or Bioaccumulation	U	LT-UNK	German FEA - Substances Hazardous to Waters	Class 1 - Low Hazard to Waters	