



CHEMICAL UPDATE WORKSHEET

Chemical Name:	Formic acid
CAS #:	64-18-6
Revised By:	RRD Toxicology Unit
Revision Date:	August 25, 2015

(A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)	46.03	46.03	EPI	EXP
Physical State at ambient temp	Liquid	Liquid	MDEQ	
Melting Point (°C)	282	8.30	EPI	EXP
Boiling Point (°C)	101	101.00	EPI	EXP
Solubility (ug/L)	1.0E+9	1000000000	EPI	EXP
Vapor Pressure (mmHg at 25°C)	41.04	4.26E+01	EPI	EXP
HLC (atm-m ³ /mol at 25°C)	2.50E-6	1.67E-07	EPI	EXP
Log Kow (log P; octanol-water)	-0.538	-0.54	EPI	EXP
Koc (organic carbon; L/Kg)	0.449	1	EPI	EST
Ionizing Koc (L/kg)		NR	NA	NA
Diffusivity in Air (Di; cm ² /s)	0.079	1.48E-01	W9	EST
Diffusivity in Water (Dw; cm ² /s)	1.4E-6	1.72E-05	W9	EST

	Part 201 Value	Updated Value	Reference Source	Comments
Soil Water Partition Coefficient (Kd; inorganics)	NR	NR	NA	NA
Flash Point (°C)	122 F	50	CRC	EXP
Lower Explosivity Level (LEL; unitless)	0.18	0.18	CRC	EXP
Critical Temperature (K)		588	CRC	EXP
Enthalpy of Vaporization (cal/mol)		5.42E+03	CRC	EXP
Density (g/mL, g/cm ³)		1.22	CRC	EXP
EMSOFT Flux Residential 2 m (mg/day/cm ²)	1.07E-05	5.66E-06	EMSOFT	EST
EMSOFT Flux Residential 5 m (mg/day/cm ²)	1.09E-05	5.66E-06	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm ²)	1.29E-05	7.16E-06	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm ²)	1.30E-05	7.16E-06	EMSOFT	EST

(B) Toxicity Values/Benchmarks

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
Reference Dose (RfD) (mg/kg/day)	1.4E+0	9.9E-1	PPRTV, 2010	
RfD details	NOAEL of 0.2% calcium formate (138mg formate/kg/day) in drinking water in a multi-operation study using male & female Wistar rats. Critical effect = no observable effects. UF = 100 (Malorny, 1969). HEAST value corrected to 2 significant figures. CCD/RRD date: 6/3/1992	<p>Tier 2 Source: PPRTV: Basis: PPRTV is a Tier 2 source, no Tier 1 available PPRTV (2010) RfD = 9.0E-1 mg/kg/day Critical Study: Malorny, G. (1969) Acute and chronic toxicity of formic acid and formate. Z Ernahrungswiss 9(4):332-339. (English translation of German article). Method(s): 2 year multigenerational-reproduction/chronic toxicity studies; A series of three studies. In the first study, 8 males and 24 females were exposed to 0.2% calcium formate in the drinking water daily to doses of 150-200 mg/kg (equivalent to 104-138 mg formate/kg), based on fluid intake and body weight measurements. A control group of 8 animals (gender not specified) was used. Exposure of the F1 offspring was continued through 5 generations over a 3-year period. The second study was identical to the first, except the drinking water concentration was increased to 0.4% and the data were reported for two generations over a 2-year period. Estimated daily doses were 300-400 mg/kg (approximately 208-277 mg formate/kg). In the third study, the same numbers of rats were exposed to 1% sodium formate in drinking water for 1-1.5 years and estimated the daily intake as 730 mg /kg (equivalent to 450 mg formate/kg). Critical effect: No chronic, developmental, and reproductive toxicity End point or Point of Departure (POD): NOAEL = 277 mg/kg/day Uncertainty Factors: UF = 300 (10 each for interspecies variability and interspecies extrapolation, and 3 for database deficiencies) Source and date: PPRTV, 10/01/2010</p> <p>Tier 1 and 2 Sources: IRIS (02/01/1996): Per IRIS, the RfD for formic acid was withdrawn on 12/01/1990 pending review by the RfD Work Group. The RfD status was last revised on 2/01/1996. EPA screening-level review on September 2002 did not identify any critical new studies.</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p>MRL: No MRL record for formic acid is available at this time.</p> <p>Tier 3 Source: MDEQ/RRD: Per DEQ-CCD (6/3/1992), RfD = 1.4 mg/kg/day was based on NOAEL of 0.2% calcium formate (138mg formate/kg/day) in drinking water in a multi-operation study using male & female WISTAR rats (Malorny, 1969). Critical effect = no observable effects. UF = 100. HEAST value corrected to 2 significant figures.</p>		
Oral Cancer Slope Factor (CSF) (mg/kg-day)⁻¹	--	NA	MDEQ, 2015	
CSF details	NA	<p>Carcinogen Weight-of-Evidence (WOE) Class: "Inadequate Information to Assess the Carcinogenic Potential"</p> <p>PPRTV WOE Basis: 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. Cancer bioassays for formic acid have not been conducted in animals with inhalation exposure.</p> <p>Source and Date: PPRTV, 10/01/2010</p> <p>Tier 1 and 2 Sources: IRIS: Per IRIS (10/1/1991), no value at this time. PPRTV (10/01/2010): Per PPRTV, no value for formic acid is available at this time. MRL: NA; MRLs are for non-cancer effects only.</p> <p>Tier 3 Source: MDEQ: Per DEQ-CCD, no value at this time.</p>		Complete
Reference Concentration (RfC) or Initial	2.0E+0	3.0E-1	PPRTV, 2010	



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
Threshold Screening Level (ITSL) ($\mu\text{g}/\text{m}^3$)				
RfC/ITSL details	<p>RfC based on critical effect of nasal olfactory epithelial degeneration in male F344/N rats exposed by vapor inhalation for 13 weeks (NOAEL=32 ppm, UF=1000) (NTP, 1992). CCD/AQD date: 2/23/1995</p>	<p>Tier 3 Source: PPRTV Screening Value: Basis: PPRTV developed a <i>screening</i> chronic p-RfC value = $3.0\text{E-}4 \text{ mg}/\text{m}^3$ ($3\text{E-}1 \mu\text{g}/\text{m}^3$). EPA considers PPRTV screening values as a Tier 3 source so a Tier 3 search was conducted. PPRTV information represents the best available information since the information is transparent and easy to follow. See details below.</p> <p>Tier 1 and 2 Sources: IRIS: Per IRIS (01/31/1987), no value at this time. MRL: No MRL record available at this time.</p> <p>Tier 3 Source: PPRTV (10/01/2010): Screening chronic p-RfC = $3\text{E-}1 \mu\text{g}/\text{m}^3$ Critical Study: NTP (National Toxicology Program). (1992) NTP technical report of toxicity studies of formic acid (CAS No: 64-18-6) administered by inhalation to F344/N rats and B6C3F1 mice. U.S. Dept. of Health and Human Services, Public Health Service, National Institutes of Health. Toxicity Report Series, No. 19. Method(s): In 2-week and 13-week range-finding studies, F344/N rats and B6C3F1 mice, (5/sex/group/specie) were exposed, whole body, to 0, 31, 62.5, 125, 250, or 500 ppm (0, 58, 118, 235, 470, or $941 \text{ mg}/\text{m}^3$) formic acid vapor for 6 hours per day, 5 days per week. Critical effect: Neutropenia and increased serum alkaline phosphatase in rats. End point or Point of Departure (POD): $\text{LOAEL}_{[\text{HEC}]} = 2.7 \text{ mg}/\text{m}^3$ Uncertainty Factors: UF = 10,000 (10 each for interspecies variability, lack of a NOAEL, database deficiencies, and use of a sub chronic study, and 3 for toxic dynamic difference between mice and human. The total UF of 30,000 was reduced to 10,000, by convention, for screening levels). Source and date: PPRTV, 10/01/2010</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		MDEQ/AQD: Per DEQ-CCD, ITSL = 2.0E+3 $\mu\text{g}/\text{m}^3$. Per AQD, RfC based on critical effect of nasal olfactory epithelial degeneration in male F344/N rats exposed by vapor inhalation for 13 weeks (NOAEL=32 ppm, UF=1,000) (NTP, 1992).		
Inhalation Unit Risk Factor (IURF) ($\mu\text{g}/\text{m}^3$)⁻¹	--	NA	MDEQ, 2015	
IURF details	NA	<p>Carcinogen Weight-of-Evidence (WOE) Class: "Inadequate Information to Assess the Carcinogenic Potential"</p> <p>PPRTV WOE Basis: Cancer bioassays for formic acid have not been conducted in animals with inhalation exposure.</p> <p>Source and Date: PPRTV, 10/01/2010</p> <p>Tier 1 and 2 Sources:</p> <p>IRIS: Per IRIS (10/1/1991), no value at this time.</p> <p>PPRTV: Per PPRTV (10/01/2010, no value at this time.</p> <p>MRL: NA; MRLs are for non-cancer effects only.</p> <p>Tier 3 Source:</p> <p>MDEQ: Per DEQ-CCD, no value at this time.</p>		Complete
Mutagenic Mode of Action (MMOA)? (Y/N)	--	NO	USEPA, 2015	
MMOA Details	--	Not listed as a carcinogen with mutagenic MOA in the USEPA OSWER List.		
Developmental or Reproductive Effector? (Y/N)	No	No , the RfD is not based on a reproductive-developmental effect.	MDEQ, 2015	
Developmental or Reproductive Toxicity Details	NA	<p>Critical effect: no chronic, developmental, and reproductive toxicity</p> <p>Critical Study: Malorny, G. (1969) Acute and chronic toxicity of formic acid and formate. Z Ernahrungswiss 9(4):332-339. (English translation of German article). Method(s): 2 year multigenerational-reproduction/chronic toxicity studies; A series of three studies. In the first study, 8 males and 24 females were exposed to 0.2% calcium formate in the drinking water daily to doses of 150-200 mg/kg</p>		

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		(equivalent to 104–138 mg formate/kg), based on fluid intake and body weight measurements. A control group of 8 animals (gender not specified) was used. Exposure of the F1 offspring was continued through 5 generations over a 3-year period. The second study was identical to the first, except the drinking water concentration was increased to 0.4% and the data were reported for two generations over a 2-year period. Estimated daily doses were 300–400 mg/kg (approximately 208–277 mg formate/kg). In the third study, the same numbers of rats were exposed to 1% sodium formate in drinking water for 1–1.5 years and estimated the daily intake as 730 mg /kg (equivalent to 450 mg formate/kg).		
State Drinking Water Standard (SDWS) (ug/L)	--	NO	SDWA, 1976	
SDWS details	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399		
Secondary Maximum Contaminant Level (SMCL) (ug/L)	--	NO	SDWA, 1976 and USEPA SMCL List	
SMCL details	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399 and USEPA SMCL List, 2015		
Is there an aesthetic value for drinking water? (Y/N)	NO	Not evaluated.	NA	
Aesthetic value (ug/L)	NA	NA	NA	
Aesthetic Value details	NA	NA		
Phytotoxicity Value? (Y/N)	NO	Not evaluated.	NA	
Phytotoxicity details	NA	NA	NA	
Others				

(C) Chemical-specific Absorption Factors

	Part 201 Value	Update	Source/Reference/ Dates	Comments/Notes /Issues
Gastrointestinal absorption efficiency value (ABS _{gi})	---	1.0	MDEQ, 2015/USEPA RAGS-E, 2004	
ABS _{gi} details		RAGS E (USEPA, 2004) Default Value		
Skin absorption efficiency value (AE _d)	---	0.1	MDEQ, 2015	
AE _d details				
Ingestion Absorption Efficiency (AE _i)		1.0	MDEQ, 2015	
AE _i Details				
Relative Source Contribution for Water (RSC _w)		0.2	MDEQ, 2015	
Relative Source Contribution for Soil (RSC _s)		1.0	MDEQ, 2015	
Relative Source Contribution for Air (RSC _A)		1.0	MDEQ, 2015	
Others				

(D) Rule 57 Water Quality Values and GSI Criteria

Current GSI value (µg/L)	ID
Updated GSI value (µg/L)	ID
Rule 57 Drinking Water Value (µg/L)	38,000

	Rule 57 Value (µg/L)	Verification Date
Human Non-cancer Values- Drinking water source (HNV-drink)	38,000	5/1999
Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)	3,100,000	5/1999
Wildlife Value (WV)	NA	NA
Human Cancer Values for Drinking Water Source (HCV-drink)	NA	NA
Human Cancer values for non-drinking water source (HCV-Non-drink)	NA	NA
Final Chronic Value (FCV)	ID	5/1999
Aquatic maximum value (AMV)	ID	5/1999
Final Acute Value (FAV)	ID	5/1999

Sources:

1. MDEQ Surface Water Assessment Section Rule 57 [website](#)
2. MDEQ Rule 57 [table](#)

(E) Target Detection Limits (TDL)

	Value	Source
Target Detection Limit – Soil ($\mu\text{g}/\text{kg}$)	20,000	MDEQ, 2015
Target Detection Limit – Water ($\mu\text{g}/\text{L}$)	50	MDEQ, 2015
Target Detection Limit – Air (ppbv)	NA	MDEQ, 2015
Target Detection Limit – Soil Gas (ppbv)	NA	MDEQ, 2015

CHEMICAL UPDATE WORKSHEET ABBREVIATIONS:

CAS # - Chemical Abstract Service Number.

Section (A) Chemical-Physical Properties**Reference Source(s):**

CRC	Chemical Rubber Company Handbook of Chemistry and Physics, 95th edition, 2014-2015
EMSOFT	USEPA Exposure Model for Soil-Organic Fate and Transport (EMSOFT) (EPA, 2002)
EPA2001	USEPA (2001) Fact Sheet, Correcting the Henry's Law Constant for Soil Temperature. Office of Solid Waste and Emergency Response, Washington, D.C.
EPA4	USEPA (2004) User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings. February 22, 2004.
EPI	USEPA's Estimation Programs Interface SUITE 4.1, Copyright 2000-2012
HSDB	Hazardous Substances Data Bank
MDEQ	Michigan Department of Environmental Quality
NPG	National Institute for Occupational Safety and Health Pocket Guide to Chemical Hazards
PC	National Center for Biotechnology Information's PubChem database
PP	Syracuse Research Corporation's PhysProp database
SCDM	USEPA's Superfund Chemical Data Matrix
SSG	USEPA's Soil Screening Guidance: Technical Background Document, Second Edition, 1996
USEPA/EPA	United States environmental protection agency's Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). July, 2004.

W9 USEPA's User Guide for Water9 Software, Version 2.0.0, 2001

Basis/Comments:

EST	estimated
EXP	experimental
EXT	extrapolated
NA	not available or not applicable
NR	not relevant

Section (B) Toxicity Values/Benchmarks**Sources/References:**

ATSDR	Agency for Toxic Substances and Disease Registry
CALEPA	California Environmental Protection Agency
CAL DTSC	California Department of Toxic Substances Control
CAL OEHHA	CAEPA Office of Environmental Health Hazard Assessment
CCD	MDEQ Chemical Criteria Database
ECHA	European Chemicals Agency (REACH)
OECD HPV	Organization for Economic Cooperation and Development HPV Database
HEAST	USEPA's Health Effects Assessment Summary Tables
IRIS	USEPA's Integrated Risk Information System
MADEP	Massachusetts Department of Environmental Protection
MDEQ/DEQ	Michigan Department of Environmental Quality
DEQ-CCD/AQD	MDEQ Air Quality Division
DEQ-CCD/RRD	MDEQ Remediation and Redevelopment Division
DEQ-CCD/WRD	MDEQ Water Resources Division
MNDOH	Minnesota Department of Health

NJDEP	New Jersey Department of Environmental Protection
NYDEC	New York State Department of Environmental Conservation
OPP/OPPT	USEPA's Office of Pesticide Programs
PPRTV	USEPA's Provisional Peer Reviewed Toxicity Values
RIVM	The Netherlands National Institute of Public Health and the Environment
TCEQ	Texas Commission on Environmental Quality
USEPA	United States Environmental Protection Agency
USEPA OSWER	USEPA Office of Solid Waste and Emergency Response
USEPA MCL	USEPA Maximum Contaminant Level
WHO	World Health Organization
WHO IPCS	International Programme on Chemical Safety (IPCS/INCHEM)
WHO IARC	International Agency for Research on Cancers
NA	Not Available.
NR	Not Relevant.

Toxicity terms:

BMC	Benchmark concentration
BMCL	Lower bound confidence limit on the BMC
BMD	benchmark dose
BMDL	Lower bound confidence limit on the BMD
CSF	Cancer slope Factor
CNS	Central nervous system
IURF or IUR	Inhalation unit risk factor
LOAEL	Lowest observed adverse effect level
LOEL	Lowest observed effect level
MRL	Minimal risk level (ATSDR)
NOAEL	No observed adverse effect level
NOEL	No observed effect level

RfC	Reference concentration
RfD	Reference dose
p-RfD	Provisional RfD
aRfD	Acute RfD
UF	Uncertainty factor
WOE	Weight of evidence

Section (C) Chemical-specific Absorption Factors

MDEQ	Michigan Department of Environmental Quality
USEPA RAGS-E	United States Environmental Protection Agency's Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). July, 2004.

Section (D) Rule 57 Water Quality Values and GSI Criteria

GSI	Groundwater-surface water interface
NA	A value is not available or not applicable.
ID	Insufficient data to derive value
NLS	No literature search has been conducted