



CHEMICAL UPDATE WORKSHEET

Chemical Name:	Epichlorohydrin
CAS #:	106-89-8
Revised By:	RRD Toxicology Unit
Revision Date:	August 17, 2015

(A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)	92.53	92.53	EPI	EXP
Physical State at ambient temp	Liquid	Liquid	MDEQ	
Melting Point (°C)	216	-57.20	EPI	EXP
Boiling Point (°C)	117.9	116.11	EPI	EXP
Solubility (ug/L)	6.60E+7	6.5900E+07	EPI	EXP
Vapor Pressure (mmHg at 25°C)	16.72	1.64E+01	EPI	EXP
HLC (atm-m ³ /mol at 25°C)	3.00E-5	2.96E-05	CRC	EXP
Log Kow (log P; octanol-water)	0.26	0.45	EPI	EXP
Koc (organic carbon; L/Kg)	1.92	9.907	EPI	EST
Ionizing Koc (L/kg)		NR	NA	NA
Diffusivity in Air (Di; cm ² /s)	0.086	8.88E-02	W9	EST
Diffusivity in Water (Dw; cm ² /s)	9.8E-6	1.1089E-05	W9	EST
Soil Water Partition Coefficient (Kd; inorganics)	NR	NR	NA	NA

	Part 201 Value	Updated Value	Reference Source	Comments
Flash Point (°C)	93 F	31	CRC	EXP
Lower Explosivity Level (LEL; unit less)	0.038	0.038	CRC	EXP
Critical Temperature (K)		NA	NA	NA
Enthalpy of Vaporization (cal/mol)		9.06E+03	HSDB	EXP
Density (g/mL, g/cm ³)		1.1812	CRC	EXP
EMSOFT Flux Residential 2 m (mg/day/cm ²)	2.11E-05	2.34E-05	EMSOFT	EST
EMSOFT Flux Residential 5 m (mg/day/cm ²)	3.41E-05	4.23E-05	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm ²)	2.85E-05	3.55E-05	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm ²)	4.25E-05	5.85E-05	EMSOFT	EST

(B) Toxicity Values/Benchmarks

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
Reference Dose (RfD) (mg/kg/day)	1.0E-3	6.0E-3	PPRTV, 2006	
RfD details	90-day oral study (gavage) in rats, NOAEL = 1 mg/kg/d; UF=1,000. Critical effect: increase in relative liver weight in male rats (Daniel et al., 1996). Entry date: 10/07/1999.	<p>Tier 2 Source: PPRTV: Basis: PPRTV is a Tier 2 source, no Tier 1 available. PPRTV chronic oral RfD = 6.0E-3 mg/kg-day: Critical Study: Toth, G.P., H. Zenick and M.K. Smith. 1989. Effects of epichlorohydrin on male and female reproduction in Long-Evans rats. Fund. Appl. Toxicol. 13:16-25. Methods: Long-Evans rats (20/sex/dose) were exposed to 0, 12.5, 25, or 50 mg/kg-day epichlorohydrin by gavage for 21 days (males) or 0, 25, 50, or 100 mg/kg-day for 14 days (females) prior to mating trials with untreated animals. Treated females were dosed until delivery. Critical effect: reduced sperm motility (velocity) End point or Point of Departure (POD): LOAEL = 6.25 mg/kg-day Uncertainty Factors: UF = 1,000 (10 each for interspecies variability and interspecies extrapolation and 10^{0.5} each for LOAEL to NOAEL extrapolation and database deficiencies) Source and date: PPRTV, 8/15/2006</p> <p>Tier 1 and 2 Sources: IRIS: Per IRIS (4/01/1992), no value at this time. The IRIS 1987 RfD value was withdrawn.</p> <p>MRL: No MRL record is available at this time.</p> <p>Tier 3 Sources: MDEQ: Per DEQ-CCD/RRD (10/07/1999), RfD = 1.0E-3 mg/kg-day. See Part 201 Value RfD</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p>details.</p> <p>Per DEQ-CCD/WRD (6/3/1987) RfD = 1.7E-2 mg/kg-day based on NOAEL of 5 ppm (1.7 mg/kg/d) in reproduction study in rats exposed via inhalation for 6 hours/day, 5 days/week for 10 weeks (John, 1983). Inhalation rate was 0.244 m3/day and the absorption factor was 0.8 (UF=1000).</p>		
Oral Cancer Slope Factor (CSF) (mg/kg-day)⁻¹	5.9E-1	9.9E-3	IRIS, 1994	
CSF details	<p>The study used by SWQD to develop the SF was a study by Wester, 1985. In this study squamous cell carcinomas of the forestomach were reported in male Wistar rats dosed via gavage for 2 years. The Revised species scaling factor of (BWh/BWa) to the 0.25 power was used for q* calculation. Source: SWQD CCD date: 10/07/1999</p>	<p>Tier 1 Source: IRIS: Basis: IRIS is a Tier 1 source. IRIS (1994) CSF = 9.9E-3 (mg/kg-day)⁻¹: Critical Study: Konishi, Y., A. Kawabata, A. Denda et al. 1980. Forestomach tumors induced by orally administered epichlorohydrin in male Wistar rats. Gann 71:922-923. Methods: male Wistar rats (18 animals/dose) were exposed to 0, 375, 750, or 1500 ppm epichlorohydrin in drinking water daily for 81 weeks. Dosing was stopped intermittently between weeks 60 and 81 as a result of the poor health of the treated animals; the total duration of dosing interruption was not reported.</p> <ol style="list-style-type: none"> 1) <i>Dose response data: Tumor Type</i> - papilloma and carcinomas of the forestomach; <i>Test Species</i> - rat/Wistar, male; <i>Route</i> - drinking water 2) <i>Extrapolation method:</i> Linearized multistage procedure, extra risk <p>Carcinogen Weight-of-Evidence (WOE) Class: B2; probable human carcinogen IRIS WOE Basis: Multiple studies in rats and mice administered epichlorohydrin by various routes were positive. Epichlorohydrin as a strong alkylating agent produced tumors are at the site of application. Human data are inadequate. Source and Date: IRIS, Last revision date - 2/1/1994</p> <p>Tier 2 Sources: PPRTV: PPRTV (8/15/2006) refers to the IRIS CSF. MRL: NA; MRLs are for non-cancer effects only.</p> <p>Tier 3 Source: MDEQ: Per DEQ-CCD/RRD (1999), CSF = 5.9E-1 mg/kg-day:</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p>Critical Study: Wester, P.W., C.A. Van Der Heijden, A. Bisschop and G.J. Van Esch. 1985. Carcinogenicity study with epichlorohydrin (CEP) by gavage in rats. Toxicology 36:325-339.</p> <p>Methods: Wistar rats (50/sex/dose) by gavage with 0, 2, or 10 mg/kg-day, 5 days/week for two years.</p> <p>1) <i>Dose response data: Tumor Type</i> - squamous cell carcinomas of the forestomach; <i>Test Species</i> – male rats; <i>Route</i> - oral (gavage)</p> <p>2) <i>Extrapolation method:</i> Linear; Revised species scaling factor of (BWh/BWa) to the 0.25 power was used for q* calculation</p> <p>Source and Date: MDEQ/RRD, 10/07/1999</p>		
Reference Concentration (RfC) or Initial Threshold Screening Level (ITSL) (µg/m³)	1.0E+0	1.0E+0	IRIS, 1992	
RfC/ITSL details	<p>RfC based on EPA's RfC of 1 µg/m³ from Quast et al 1979 - 90d rat and mouse inhalation NOAEL of 5 ppm, lesions of the nasal turbinates.</p> <p>CCD/AQD date: 12/12/1991</p>	<p>Tier 1 Source:</p> <p>IRIS:</p> <p>Basis: IRIS is a Tier 1 source. IRIS (1992) RfC = 1.0E-3 mg/m³:</p> <p>Critical Study: Quast, J.F., J.W. Henck, B.J. Postma, D.J. Schuetz and M.J. McKenna. 1979a. Epichlorohydrin subchronic studies I. A 90-Day Inhalation Study in Laboratory Rodents. 8D Submission. Microfiche No. 206200.</p> <p>Methods: B6C3F1 mice, Fischer 344 rats, and Sprague-Dawley rats (10/sex/concentration/strain) were exposed to 0, 5, 25, or 50 ppm epichlorohydrin (0, 19, 95, or 189 mg/m³) for 6 hours/day, 5 days/week (duration-adjusted to 3.4, 17, and 34 mg/m³, respectively), for 61-62 exposures (3 months).</p> <p>Critical effect: changes in the nasal turbinates</p> <p>End point or Point of Departure (POD): NOAEL = 19 mg/m³ (5 ppm); NOAEL_{ADJ} = 3.4 mg/m³; NOAEL_{HEC} = 0.36 mg/m³</p> <p>Uncertainty Factors: UF = 300 (10 each for interspecies variability and use of a sub chronic study, and 3 for interspecies extrapolation)</p> <p>Source and date: IRIS, Last revision date - 4/01/1992</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p>Tier 2 Sources: PPRTV: PPRTV (8/15/2006), refers to the IRIS RfC. PPRTV sub chronic p-RfC = 1.0E-2 mg/m³ is available: Critical Study: Quast, J.F., J.W. Henck, B.J. Postma, D.J. Schuetz and M.J. McKenna. 1979a. Epichlorohydrin - sub chronic studies I. A 90-Day Inhalation Study in Laboratory Rodents. 8D Submission. Microfiche No. 206200. Methods: B6C3F1 mice, Fischer 344 rats, and Sprague- Dawley rats (10/sex/concentration/strain) were exposed to 0, 5, 25, or 50 ppm epichlorohydrin (0, 19, 95, or 189 mg/m³) for 6 hours/day, 5 days/week (duration-adjusted to 3.4, 17, and 34 mg/m³, respectively), for 61-62 exposures (3 months). Critical effect: changes in the nasal turbinates End point or Point of Departure (POD): NOAEL = 19 mg/m³ (5 ppm); NOAEL_{HEC} = 0.32 mg/m³ Uncertainty Factors: UF = 30 (10 for interspecies variability and 3 for interspecies extrapolation) Source and date: PPRTV, 8/15/2006</p> <p>MRL: No MRL record is available at this time.</p> <p>Tier 3 Source: MDEQ: Per DEQ-CCD (12/12/1991), AQD adopted IRIS RfC of 1 ug/m³. See Part 201 Value CSF details.</p>		
Inhalation Unit Risk Factor (IURF) ((µg/m³)⁻¹)	1.2E-6	1.2E-6	IRIS, 1994	
IURF details	Potency was calculated by EPA IRIS based on Laskin et al 1980 male Sprague-Dawley inhalation study with observed	<p>Tier 1 Source: IRIS: Basis: IRIS is the only available information. Critical Study: Laskin, S., A.R. Sellakumar, M. Kushner, et al. 1980. Inhalation carcinogenicity of epichlorohydrin in non-inbred Sprague-Dawley rats. J. Natl. Cancer Inst. 65(4): 751-757. Methods: 3) <i>Dose response data: Tumor Type - nasal cavity tumors; Test Species -</i></p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
	increased nasal squamous cell carcinomas. CCD/AQD date: 10/29/1986.	Rat/Sprague-Dawley, male; <i>Route</i> - inhalation 4) <i>Extrapolation method</i> : linearized multistage procedure, extra risk Carcinogen Weight-of-Evidence (WOE) Class : B2; probable human carcinogen IRIS WOE Basis : Multiple studies in rats and mice administered epichlorohydrin by various routes were positive. Epichlorohydrin, a strong alkylating agent, produced tumors at the site of application. Human data are inadequate. Source and Date : IRIS, Last revision date - 2/1/1994 Tier 2 Sources : PPRTV : PPRTV (8/15/2006), refers to the IRIS IURF. MRL : NA; MRLs are for non-cancer effects only. Tier 3 Source : MDEQ : Per DEQ-CCD (10/29/1986) AQD adopted IRIS IURF. See Part 201 Value IURF details.		
Mutagenic Mode of Action (MMOA)? (Y/N)	--	NO	USEPA, 2015	
MMOA Details	--	NA Not listed as a carcinogen with mutagenic MOA in the EPA OSWER List.		
Developmental or Reproductive Effector? (Y/N)	No	No. The RfD is based on a reproductive effect. MDEQ does not consider this substance a developmental toxicant at this time.	MDEQ, 2015	
Developmental or Reproductive Toxicity Details	NA	DR effects by oral: Critical effect : reduced sperm motility (velocity) Critical Study : Toth, G.P., H. Zenick and M.K. Smith. 1989. Effects of epichlorohydrin on male and female reproduction in Long-Evans rats. <i>Fund. Appl. Toxicol.</i> 13:16-25. Method(s) : Long-Evans rats (20/sex/dose) were exposed to 0, 12.5, 25, or 50 mg/kg-day epichlorohydrin by gavage for 21 days (males) or 0, 25, 50, or 100 mg/kg-day for 14 days (females) prior to mating trials with untreated animals. Treated females were dosed until delivery.		

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		DR effects by inhalation is inconclusive: Per PPRTV (2006), the occupation studies of reproductive function in humans exposed to epichlorohydrin (Milby et al., 1981; Milby and Whorton, 1980; Venable et al., 1980) have shown no evidence of reduced sperm count in the exposed groups, with approximate 8-hr inhalation exposure levels in the range of 0.1 to greater than 1 ppm (0.4 - 4 mg/m ³). However, the occupational studies did not examine sperm morphology or motility, which were the principal findings in Toth et al. (1991), and exposure quantification was inadequate. Sperm count was unaffected in rats orally exposed to epichlorohydrin (Toth et al. 1989, 1991); therefore, "negative evidence for humans is inconclusive."		
State Drinking Water Standard (SDWS) (ug/L)	2.0	TT ²	SDWA, 1976	
SDWS details	NA	When epichlorohydrin is used in drinking water systems, the combination (or product) of dose and monomer level shall not exceed that equivalent to an epichlorohydrin-based polymer containing 0.01% monomer dosed at 20 mg/L. The MCLG = zero. 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	

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
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)	NA
Updated GSI value (µg/L)	NA
Rule 57 Drinking Water Value (µg/L)	NA

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

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 ($\mu\text{g}/\text{kg}$)	100	MDEQ, 2015
Target Detection Limit – Water ($\mu\text{g}/\text{L}$)	5	MDEQ, 2015
Target Detection Limit – Air (ppbv)	2.60E-01	MDEQ, 2015
Target Detection Limit – Soil Gas (ppbv)	8.70E+00	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 OEHHHA	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