



CHEMICAL UPDATE WORKSHEET

Chemical Name:	Endosulfan
CAS #:	115-29-7
Revised By:	RRD Toxicology Unit
Revision Date:	August 19, 2015

(A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)	406.9	406.92	EPI	EXP
Physical State at ambient temp	Solid	Solid	MDEQ	
Melting Point (°C)	358	106.00	EPI	EXP
Boiling Point (°C)	---	NA	NA	
Solubility (ug/L)	510	325	EPI	EXP
Vapor Pressure (mmHg at 25°C)	0.00000988	1.73E-07	EPI	EXP
HLC (atm-m³/mol at 25°C)	1.12E-5	6.50E-05	EPI	EXP
Log Kow (log P; octanol-water)	4.1	3.83	EPI	EXP
Koc (organic carbon; L/Kg)	2110	6761	EPI	EST
Ionizing Koc (L/kg)		NR	NA	NA
Diffusivity in Air (Di; cm²/s)	0.0115	2.25E-02	W9	EST
Diffusivity in Water (Dw; cm²/s)	4.55E-6	5.7629E-06	W9	EST
Soil Water Partition Coefficient (Kd; inorganics)	NR	NR	NA	NA

	Part 201 Value	Updated Value	Reference Source	Comments
Flash Point (°C)	NA	NA	NA	NA
Lower Explosivity Level (LEL; unit less)	NA	NA	NA	NA
Critical Temperature (K)		9.43E+02	EPA2004	EXP
Enthalpy of Vaporization (cal/mol)		1.40E+04	EPA2004	EST
Density (g/mL, g/cm ³)		1.745	CRC	EXP
EMSOFT Flux Residential 2 m (mg/day/cm ²)	NA	2.34E-06	EMSOFT	EST
EMSOFT Flux Residential 5 m (mg/day/cm ²)	NA	2.34E-06	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm ²)	NA	2.96E-06	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm ²)	NA	2.96E-06	EMSOFT	EST

(B) Toxicity Values/Benchmarks

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
Reference Dose (RfD) (mg/kg/day)	0.006	5.0E-3	ATSDR, 2013	
RfD details	<p>2-year rat feeding study, NOAEL = 0.6mg/kg-d in males UF = 100; Critical effect = reduced body weight gain in males and females, and blood vessel aneurysms in males (Hoechst Celanese Corp., 1989a). SUBCHRONIC RfD: The chronic oral RfD was adopted as the sub chronic oral RfD. Based on co-critical rat and dog studies. CCD/RRD date: 3/31/1993</p>	<p>Tier 2 Source: ATSDR: Basis: The ATSDR RfD was selected because it is based on benchmark dose modeling. The ATSDR calculated a chronic oral MRL = 0.006 mg/kg-day based on BMDL10 = 0.56 mg/kg/day for critical effect = marked progressive glomerulonephrosis in male rats (Hoechst, 1989 2-year study) and total UF = 100. Since the intermediate-duration oral MRL of 0.005 mg/kg/day derived for endosulfan is lower than the chronic MRL, ATSDR adopted the intermediate-duration oral MRL value for the chronic MRL for endosulfan. Critical Study (for intermediate MRL): Banerjee BD, Hussain QZ. 1986. Effect of sub-chronic endosulfan exposure on humoral and cell-mediated immune responses in albino rats. Arch Toxicol 59:279-284. Method(s): Male Wistar rats (10–12/group) were exposed to endosulfan (α-and β-endosulfan in the ratio of 7:3) in their diets at dietary levels of 0, 5, 10, or 20 ppm (0, 0.45, 0.9, and 1.8 mg/kg/day, using the EPA [1988d] food factor for male Wistar rats). At weeks 8, 12, 18, and 22, 10-12 rats from each group were sacrificed. Twenty days before sacrifice, the rats were immunized by injecting 0.2 mL of tetanus toxin and adjuvant subcutaneously. Groups of 10–12 rats per dose that were not immunized were sacrificed at the same time periods indicated. Critical effect: depressed immune response. End point or Point of Departure (POD): Offspring NOAEL = 0.45 mg/kg/day Uncertainty Factors: UF = 100 (10 each for interspecies variability and interspecies extrapolation) Source and date: ATSDR, Draft 5/2013</p> <p>Tier 1 and 2 Sources: IRIS: Per IRIS (10/1/1994), RfD = 6.0E-3 mg/kg-day Critical Study: 1) Hoechst Celanese Corporation. 1989a. Endosulfan—substance technical (Code:</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p>HOE 002671 OI ZD97 0003). Combined chronic toxicity/carcinogenicity study: 104-week feeding in rats. Performed by Huntingdon Research Center Ltd. HST 289/881067. Submitted by Hoechst Celanese Corporation, North Somerville, NJ. EPA MRID No. 41099502. HED Doc. No. 007937. Available from the U.S. EPA.</p> <p>2) Hoechst Celanese Corporation. 1989b. Endosulfan—substance technical (code HOE 02671 OI ZD96 0002): Testing for toxicity by repeated oral administration (1-year feeding study) to Beagle dogs. Conducted for Hoechst Aktiengesellschaft,</p> <p>Critical effect: reduced body weight gain and marked progressive glomerulonephrosis in rats and decreased weight gain and neurologic effects in dogs.</p> <p>End point or Point of Departure (POD): NOAEL = 15 ppm (0.6 mg/kg-day in male rats); 10 ppm (0.57 mg/kg-day in female dogs)</p> <p>Uncertainty Factors: UF = 100 (10 each for interspecies variability and interspecies extrapolation)</p> <p>Source and date: IRIS, Last revision date - 10/01/1994. An EPA screening-level review in 2002 did not identify any critical new studies.</p> <p>EPA-OPP: Chronic RfD = 0.006 mg/kg/day.</p> <p>Critical Study: MRID# 41099502. Ruckman, S.; Waterson, L.; Crook, D.; et al. (1989) Endosulfan—Substance Technical: Combined Chronic Toxicity/Carcinogenicity Study: 104-Week Feeding in Rats: Project ID HST 289/881076. Unpublished study prepared by Huntingdon Research Centre Ltd. 1601 p.</p> <p>Methods: Combined chronic toxicity/carcinogenicity study in rats. Male and female rats were fed 0, 3, 7.5, 15, and 75 ppm for 104 weeks. Male doses = 0, 0.1, 0.3, 0.6, and 2.9 mg/kg/d and female doses = 0, 0.1, 0.4, 0.7, and 3.8 mg/kg/d.</p> <p>Critical effects: Reduced body weight gain, enlarged kidneys, and increased incidences of marked progressive glomerulonephrosis & blood vessel aneurysms in male rats.</p> <p>POD: NOAEL = 0.6 mg/kg/day. (LOAEL = 2.9 mg/kg/day).</p> <p>UF: 100 (10 each for intra- and inter-species variation).</p> <p>Source: OPP-RED Memo dated May 30, 2002. Subject: Endosulfan: Reevaluation</p>		



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p>of the HED Risk Assessment for the Endosulfan Reregistration Eligibility Decision (RED) Document.</p> <p>PPRTV: PPRTV (9/30/2009) refers to the IRIS RfD.</p> <p>Tier 3 Source: MDEQ: Per DEQ-CCD, RRD (3/31/1993) and WRD (3/2001) adopted IRIS RfD. See Part 201 Value RfD details.</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” of endosulfan. Source and Date: PPRTV, 9/30/2009</p> <p>Tier 1 and 2 Sources: IRIS: Per IRIS (10/01/1994), no value at this time. PPRTV: Per PPRTV (9/30/2009), no value 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 Threshold Screening Level (ITSL) (µg/m³)	--	NA	MDEQ, 2015	
RfC/ITSL details	NA	<p>Tier 1 and 2 Sources: IRIS: Per IRIS (10/01/1994), no value at this time. PPRTV: Per PPRTV (9/30/2009), no value at this time. MRL: Per ATSDR (12/2014), no inhalation chronic MRL at this time.</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		Tier 3 Source: MDEQ: Per DEQ-CCD, no value at this time.		
Inhalation Unit Risk Factor (IURF) (($\mu\text{g}/\text{m}^3$)⁻¹)	--	NA	MDEQ, 2015	
IURF details	NA	Carcinogen Weight-of-Evidence (WOE) Class: "inadequate information to assess the carcinogenic potential" of endosulfan. Source and Date: PPRTV, 9/30/2009 Tier 1 and 2 Sources: IRIS: Per IRIS (10/01/1994), no value at this time. PPRTV: Per PPRTV (9/30/2009), no value at this time. MRL: NA; MRLs are for non-cancer effects only. Tier 3 source: MDEQ: Per DEQ-CCD, no value at this time.		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 and RfC/ITSL are not based on a reproductive-developmental effect.	MDEQ, 2015	
Developmental or Reproductive Toxicity Details	NA	NA		
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	--	NO	SDWA, 1976 and US-EPA SMCL List	

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
(SMCL) (ug/L)				
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)	0.03 (M); 0.029
Updated GSI value (µg/L)	0.03 (M); 0.029
Rule 57 Drinking Water Value (µg/L)	85

	Rule 57 Value (µg/L)	Verification Date
Human Non-cancer Values- Drinking water source (HNV-drink)	85	3/2001
Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)	170	3/2001
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)	0.029	7/2001
Aquatic maximum value (AMV)	0.13	7/2001
Final Acute Value (FAV)	0.27	7/2001

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	MDEQ, 2015
Target Detection Limit – Water ($\mu\text{g}/\text{L}$)	0.03	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