



CHEMICAL UPDATE WORKSHEET

Chemical Name:	Dichlorvos
CAS #:	62-73-7
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)	220.98	220.98	EPI	EXP
Physical State at ambient temp	Liquid	Liquid	MDEQ	
Melting Point (°C)	---	-60.00	EPI	EXP
Boiling Point (°C)	---	234.10	EPI	EXP
Solubility (ug/L)	1.60E+7	8.000E+06	EPI	EXP
Vapor Pressure (mmHg at 25°C)	0.0527	1.58E-02	EPI	EXP
HLC (atm-m ³ /mol at 25°C)	9.58E-7	5.74E-07	PP	EST
Log Kow (log P; octanol-water)	1.4	1.43	EPI	EXP
Koc (organic carbon; L/Kg)	15.4	53.96	EPI	EST
Ionizing Koc (L/kg)		NR	NA	NA
Diffusivity in Air (Di; cm ² /s)	0.08	2.79E-02	W9	EST
Diffusivity in Water (Dw; cm ² /s)	8.0E-6	7.3302E-06	W9	EST
Soil Water Partition Coefficient (Kd; inorganics)	NR	NR	NA	NA

	Part 201 Value	Updated Value	Reference Source	Comments
Flash Point (°C)	175	NA	NA	NA
Lower Explosivity Level (LEL; unit less)	NA	NA	NA	NA
Critical Temperature (K)		NA	NA	NA
Enthalpy of Vaporization (cal/mol)		NA	NA	NA
Density (g/mL, g/cm ³)		1.415	CRC	EXP
EMSOFT Flux Residential 2 m (mg/day/cm ²)	NA	2.49E-06	EMSOFT	EST
EMSOFT Flux Residential 5 m (mg/day/cm ²)	NA	2.49E-06	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm ²)	NA	3.14E-06	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm ²)	NA	3.14E-06	EMSOFT	EST

(B) Toxicity Values/Benchmarks

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
Reference Dose (RfD) (mg/kg/day)	4.0E-4	5.0E-4	USEPA-OPP, 2009	
RfD details	<p>Previously in IRIS at 8E-4 mg/kg/day; NOEL=0.08 mg/kg/day UF=100. 2-year dog feeding study (Shell Chemical Co. 1967) Critical effect = increased liver weight and enlarged liver cells. Source: IRIS CCD date: 5/27/1992</p>	<p>Tier 1 Source: USEPA-OPP: Basis: OPP is a Tier 1 source that is more current than IRIS. OPP (2009) chronic RfD = 0.0005 (5.0E-4) mg/kg-day. EPA-OPP: best available chronic data Critical Study: Markiewicz, V. 1990. A 52-Week Chronic Toxicity Study on DDVP in Dogs: Lab Project Number: 2534/102. Unpublished study prepared by Hazleton Laboratories America, Inc. 431 p. MRID No. 41593101 Method: 1-year dog study; beagle dogs (4/sex/dose) were exposed to 0, 0.1, 1.0 and 3.0 mg/kg/day dichlorvos by capsule for 52 weeks. The 0.1 mg/kg/day dose was lowered to 0.05 mg/kg/day on day 22 due to the inhibition of plasma cholinesterase noted after 12 days. Critical effect: RBC cholinesterase depression End point or Point of Departure (POD): NOAEL = 0.05 mg/kg-day Uncertainty Factors: UF = 100 (10 each for intraspecies variability and interspecies extrapolation and 1 for FQPA safety factor) Source and date: EPA OPP REDs (Table 4.4), (7/2006); OPP memorandum: Dichlorvos (DDVP). Human health Scoping Document in Support of Registration Review (Table 7), 5/6/2009.</p> <p>Tier 1 and 2 Sources: IRIS: Per IRIS (1993), RfD = 5.0E-4 mg/kg-day. Critical Study: AMVAC Chemical Corp. 1990. MRID No. 41593101; HED Doc. No. 008178) (unpublished) Method(s): Beagle dogs (4/sex/dose) were administered 0, 0.1, 1.0 and 3.0 mg/kg-day dichlorvos by capsule for 52 weeks. The 0.1 mg/kg-day dose level was lowered to 0.05 mg/kg-day on day 22 due to the inhibition of plasma ChE noted after 12 days on test material. Critical effect: plasma ChE inhibition in males and females and brain ChE</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		inhibition in males End point or Point of Departure (POD): NOAEL = 0.05 mg/kg-day Uncertainty Factors: UF = 100 (10 each for intraspecies variability and interspecies extrapolation) Source and date: IRIS, Last revision date - 11/01/1993. An EPA screening-level review in November 2001 identified significant new studies. PPRTV: No PPRTV record available at this time. MRL: Per ATSDR (9/1997), oral chronic MRL = 5.0E-4 mg/kg-day based on neurological effects; Critical Study: AMVAC Chemical Corp. 1990. A 52-Week Chronic Toxicity Study on DDVP in Dogs. Unpublished report dated August 6, 1990 submitted by AMVAC Chemical Corp, Los Angeles, CA. EPA-41593101. Method(s): Beagle dogs (4/sex/dose, approx. 6-7 months old) were exposed to 0, 0.1, 1.0 and 3.0 mg/kg-day dichlorvos by capsule for 52 weeks. The 0.1 mg/kg-day dose level was lowered to 0.05 mg/kg-day on day 22 due to the inhibition of serum ChE noted after 12 days on dichlorvos. Critical effect: RBC and brain ChE inhibition End point or Point of Departure (POD): NOAEL = 0.05 mg/kg-day Uncertainty Factors: UF = 100 (10 each for intraspecies variability and interspecies extrapolation) Source and date: ATSDR, 9/1997 EPA-OPP: Per OPP (2009) acute RfD = 0.008 mg/kg-day based on rat acute cholinesterase studies on RBC and brain ChE and depression. Tier 3 Source: MDEQ: Per DEQ-CCD, RRD (5/27/1992) adopted IRIS value. See Part 201 Value RfD details.		
Oral Cancer Slope Factor (CSF) (mg/kg-day)⁻¹	5.2E-1	2.9E-1	IRIS, 1994	
CSF details	Rat 2-year gavage studies (NTP, 1989). Pancreatic	Tier 1 Source: IRIS: Basis: IRIS is the only available value. IRIS (1994) CSF = 2.9E-1 mg/kg-day ⁻¹ :		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
	<p>acinar adenoma in male rats. SF is based on the 1989 published report that gives incidence rates derived from both cross and horizontal sections of pancreatic tissue. Revised species scaling factor of (BWh/BWa) to the 0.25 power used for q* calculation. Source: IRIS/ERD Entry date: 12/13/1999</p>	<p>Critical Studies: 1) NTP (National Toxicology Program). 1986a. Two-year mouse gavage study. Unpublished report prepared by Southern Research Institute, May 23. Study No. 05049. NTP, Research Triangle Park, NC. 2) NTP (National Toxicology Program). 1986b. Two-year gavage study of dichlorvos in rats. Unpublished report prepared by Southern Research Institute, May 23. Study No. 05049. NTP, Research Triangle Park, NC.</p> <p>Method(s): 1) B6C3F1 mice (60/group) were treated with dichlorvos at 10 and 20 (mg/kg)/day (males) or 20 and 40 (mg/kg)/day (females), 5 days/week for 104 weeks followed by a 1-week observation period. 2) F344 rats (60/group) were treated with 4 or 8 (mg/kg)/day once daily 5 days/week. The incidence of pancreatic acinar adenoma and leukemia were significantly elevated.</p> <p>1) <i>Dose response data: Tumor Type</i> - : forestomach, pancreatic, leukemia; <i>Test Species</i> - mouse and rat; <i>Route</i> – oral (gavage) 2) <i>Extrapolation method</i>: linearized multistage procedure, extra risk</p> <p>Carcinogen Weight-of-Evidence (WOE) Class: B2; probable human carcinogen IRIS WOE Basis: Significant increases in forestomach tumors in female and male B6C3F1 mice and leukemia and pancreatic acinar adenomas in Fischer 344 rats. Supporting evidence included observation of tumors at other sites in the rat and observation of mutagenicity for both dichlorvos and a major metabolite dichloroacetaldehyde.</p> <p>Source and Date: IRIS, Last revision date – 12/01/1994</p> <p>Tier 2 Sources: PPRTV: No PPRTV record 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>		
Reference Concentration	5.0E-1	2.0E+0	OPP, 2009/MDEQ,	



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
(RfC) or Initial Threshold Screening Level (ITSL) ($\mu\text{g}/\text{m}^3$)			2015	
RfC/ITSL details	<p>ITSL based on EPA's 6/94 RfC, rat chronic inhalation NOAEL of 0.05 mg/m³ based on changes of brain cholinesterase activity, Blair et al (1976). EPA applied UF of 100. CCD/AQD date: 6/1/1994.</p>	<p>Tier 1 Source: IRIS: Basis: EPA-OPP is Tier 1 source that is more current than IRIS. OPP (2009) margin of exposure MOE = 30 (described in table 6) and BMDL₁₀ = 0.07 mg/m³; RfC = 2.0 E-3 mg/m³ is derived by dividing the BMDL by the total UF (also MOE). IRIS refers to OPP for toxicity assessment updates of pesticides. EPA-OPP: best available chronic data Critical Study: Blair, D., K.M. Dix, P.F. Hunt, E. Thorpe, D.E. Stevenson, and A.I. Walker. 1976. Dichlorvos: A 2-year inhalation carcinogenesis study. Arch. Toxicol. 35(4): 281-294). MRID No. 0057695, 00632569 (this is the same inhalation study used by IRIS in deriving the RfC for dichlorvos) Method: 2-year rat inhalation study; 50/sex/group Carworth rats were exposed to atmospheres containing dichlorvos vapor for 23 hours/day, 7 days/week at concentrations of 0, 0.05, 0.5, and 5 mg/m³ equivalent to 0.055, 0.5, and 5.0 mg/kg/day for 2 years. Critical effect: RBC cholinesterase depression End point or Point of Departure (POD): BMDL = 0.07 mg/m³ Uncertainty Factors: UF = 30 (10 for intraspecies variability and 3 for interspecies extrapolation; FQPA safety factor is 1x) Source and date: EPA OPP REDs (Table 4.4), (7/2006); OPP memorandum: Dichlorvos (DDVP). Human health Scoping Document in Support of Registration Review (Table 7), 5/6/2009.</p> <p>Tier 1 and 2 Sources: IRIS: IRIS (1994) RfC = 5.0E-4 mg/m³: Critical Study: Blair, D., K.M. Dix, P.F. Hunt, E. Thorpe, D.E. Stevenson, and A.I. Walker. 1976. Dichlorvos: A 2-year inhalation carcinogenesis study. Arch. Toxicol. 35(4): 281-294. Method(s): Carworth Farm E strain (CFE) rats, 50/sex/group, was exposed whole</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p>body to atmospheres containing dichlorvos vapor for at least 23 hours/day, 7 days/week for up to 2 years.</p> <p>Critical effect: Decreased brain cholinesterase activity</p> <p>End point or Point of Departure (POD): NOAEL = 0.05 mg/m³</p> <p>Uncertainty Factors: UF = 100 (10 each for intraspecies variability and interspecies extrapolation)</p> <p>Source and date: IRIS, Last revision date – 6/01/1994</p> <p>PPRTV: No PPRTV record available at this time.</p> <p>MRL: Per ATSDR (9/1997), inhalation chronic MRL = 6.0E-5 ppm (5.4E-4 mg/m³):</p> <p>Critical Study: Blair, D., K.M. Dix, P.F. Hunt, E. Thorpe, D.E. Stevenson, and A.I. Walker. 1976. Dichlorvos: A 2-year inhalation carcinogenesis study. Arch. Toxicol. 35(4): 281-294.</p> <p>Method(s): Carworth Farm E strain (CFE) rats, 50/sex/group, was exposed to atmospheres containing 0, 0.05, 0.5, or 5 mg dichlorvos/m³ (0, 0.006, 0.06, or 0.6 ppm vapor for at least 23 hours/day, 7 days/week for up to 2 years.</p> <p>Critical effect: Decreased brain cholinesterase activity</p> <p>End point or Point of Departure (POD): NOAEL_{HEC} = 0.006 pm</p> <p>Uncertainty Factors: UF = 100 (10 each for intraspecies variability and interspecies extrapolation)</p> <p>Source and date: ATSDR, 9/1997</p> <p>Tier 3 Sources:</p> <p>MDEQ: Per DEQ-CCD, AQD (6/01/1994) ITSL = 0.5 µg/m³/ Averaging time = 24 hours.</p>		
Inhalation Unit Risk Factor (IURF) ((µg/m ³) ⁻¹)	--	NA	MDEQ, 2015	
IURF details	NA	<p>Carcinogen Weight-of-Evidence (WOE) Class: B2; probable human carcinogen</p> <p>IRIS WOE Basis: Significant increases in forestomach tumors in female and male B6C3F1 mice and leukemia and pancreatic acinar adenomas in Fischer 344 rats</p> <p>Source and Date: IRIS, Last revision date – 12/01/1994</p> <p>Tier 1 and 2 Sources:</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p>IRIS: Per IRIS (12/01/1994), no value at this time. PPRTV: No PPRTV record available at this time. MRL: NA; MRLs are for non-cancer effects only.</p> <p>Tier 3 Sources: MDEQ: Per DEQ-CCD, no value at this time.</p>		
Mutagenic Mode of Action (MMOA)? (Y/N)	--	YES	IRIS, 1994; ATSDR, 1997	
MMOA Details	--	<p>Not listed as a carcinogen with mutagenic MOA in the USEPA OSWER List.</p> <p>Per IRIS, considered as a carcinogen with observed mutagenicity. IRIS, 12/1/1994: Supporting evidence included observation of tumors at other sites in the rat and observation of mutagenicity for both dichlorvos and a major metabolite dichloroacetaldehyde.</p> <p>Per ATSDR 9/1997; Dichlorvos is an electrophile and possesses a structural alert for methylating activity. Dichlorvos has been tested for genotoxicity in a number of in vivo and in vitro systems. In general, dichlorvos was not genotoxic in in vivo studies (see Table 2-6) but was generally genotoxic or mutagenic in in vitro tests when metabolizing enzymes (S9 fraction) were not present (see Table 2-7).</p>		
Developmental or Reproductive Effector? (Y/N)	No	No, the RfD or RfC/ITSL is 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	--	NO	SDWA, 1976 and USEPA SMCL List,	



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
Contaminant Level (SMCL) (ug/L)			2015	
SMCL details	NA	SDWA, 1976 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)	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 ($\mu\text{g}/\text{kg}$)	50	MDEQ, 2015
Target Detection Limit – Water ($\mu\text{g}/\text{L}$)	1	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