



CHEMICAL UPDATE WORKSHEET

Chemical Name:	2,4-Dichlorophenol(DD)
CAS #:	120-83-2
Revised By:	RRD Toxicology Unit
Revision Date:	September 24, 2015

(A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)	163	163.00	EPI	EXP
Physical State at ambient temp	Liquid	Solid	MDEQ	
Melting Point (°C)	318	45.00	EPI	EXP
Boiling Point (°C)	210	210.00	EPI	EXP
Solubility (ug/L)	4.50E+6	5.550E+06	EPI	EXP
Vapor Pressure (mmHg at 25°C)	0.005472	9.00E-02	EPI	EXP
HLC (atm-m³/mol at 25°C)	3.16E-6	3.48E-06	PP	EST
Log Kow (log P; octanol-water)	3.08	3.06	EPI	EXP
Koc (organic carbon; L/Kg)	147	491.8	EPI	EST
Ionizing Koc (L/kg)		147	SSG	EST
Diffusivity in Air (Di; cm²/s)	0.0346	4.88E-02	W9	EST
Diffusivity in Water (Dw; cm²/s)	8.77E-6	8.7425E-06	W9	EST

	Part 201 Value	Updated Value	Reference Source	Comments
Soil Water Partition Coefficient (Kd; inorganics)	NR	NR	NA	NA
Flash Point (°C)	NA	114	CRC	EXP
Lower Explosivity Level (LEL; unit less)	NA	NA	NA	NA
Critical Temperature (K)		708.17	EPA2001	EXP
Enthalpy of Vaporization (cal/mol)		1.50E+04	EPA2001	EST
Density (g/mL, g/cm³)		1.4	PC	EXP
EMSOFT Flux Residential 2 m (mg/day/cm²)	8.58E-07	2.93E-06	EMSOFT	EST
EMSOFT Flux Residential 5 m (mg/day/cm²)	8.58E-07	2.93E-06	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm²)	1.02E-06	3.71E-06	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm²)	1.02E-06	3.71E-06	EMSOFT	EST

(B) Toxicity Values/Benchmarks

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
Reference Dose (RfD) (mg/kg/day)	1.0E-2	2.0E-2	PPRTV, 2007/MDEQ, 2015	
RfD details	<p>Rat 21 - week DW 2- generation reproduction study (Exon & Koller, 1985). Critical effect = increased organ weights and antibody levels. NOAEL = 30 mg/kg/l (3 mg/kg/day per authors); UF - 300 (3x for subchronic to chronic extrapolation).). Staff personal communication with Dr. Exon (1987) indicated that 30 ppm was a NOAEL rather than a LOAEL, although EPA (IRIS) considered 30 ppm a LOAEL with a NOAEL at 3 ppm. RfD is based</p>	<p>Tier 2 Source: PPRTV: Basis: The PPRTV assessment is more current than those conducted by IRIS (1988) and ATSDR (1999) and used BMD modeling to derive the RfD. MDEQ applied a UF = 1 for subchronic to chronic exposure extrapolation because the endpoint is an immunological reaction and the study exposure duration included prenatal and lactational exposure. Therefore, no additional adjustment to the total UF to derive the chronic p-RfD was applied. PPRTV subchronic p-RfD of 0.02 mg/kg-day. Critical Study: Exon J.H., G.M. Henningsen, C.A. Osborne and L.D. Koller. 1984. Toxicologic, pathologic, and immunotoxic effects of 2,4-dichlorophenol in rats. J. Toxicol. Environ. Health. 14:723-730. Methods: Male and female Sprague-Dawley rats were exposed prenatally or both pre- and postnatally. All animals were offspring (10/group) of dams exposed via drinking water to concentrations of 0, 3, 30 or 300 ppm 2,4-DCP from 3 weeks of age through breeding (at 90 days) and parturition. Upon weaning, the prenatal-only groups were maintained untreated until 6 weeks of age. Dams of the pre- and postnatal groups were treated throughout the lactation period and, after weaning, offspring were given the treatment compound in the drinking water at the same concentrations until 13 weeks of age. Critical effect: decreased cell-mediated immunity, as measured by decreased footpad swelling End point or Point of Departure (POD): BMDL = 2 mg/kg-day Uncertainty Factors: UF = 100 (10 each for intraspecies variability and interspecies extrapolation) and MDEQ UF= 1. Source and date: PPRTV, 7/30/2007</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
	<p>on this information. CCD/SWQD date: 10/14/1994</p>	<p>Tier 1 and 2 Sources: IRIS: RfD = 3.0E-3 mg/kg-day. Critical Study: Exon, J.H. and L.D. Koller. 1985. Toxicity of 2-chlorophenol, 2,4-dichlorophenol and 2,4,6-trichlorophenol. In: Water Chlorination: Chemistry, Environmental Impact and Health Effects, Jolley et al., Ed. Vol. 5. Method(s): Female rats were exposed to 3, 30, or 300 ppm 2,4-dichlorophenol in drinking water from weaning age through breeding at 90 days, parturition, and weaning of pups. Ten randomly selected pups/group were weaned at 3 weeks and administered 2,4-dichlorophenol for an additional 15 weeks. The authors estimated the exposure to be approximately 0.3, 3.0, and 30.0 mg/kg-day. Critical effect: decreased delayed hypersensitivity in rats. End point or Point of Departure (POD): NOEL = 3 ppm (0.3 mg/kg-day) Uncertainty Factors: UF = 100 (10 each for intraspecies variability and interspecies extrapolation) Source and date: IRIS, Last revision date - 6/30/1988.</p> <p>MRL: Per ATSDR (7/1999), no oral chronic MRL at this time. An intermediate oral MRL = 3.0E-3 mg/kg-day is available: based on immunological effects (Exon and Koller, 1985); UF = 100; Date - 7/1999. Critical Study: Exon, J.H. and L.D. Koller. 1985. Toxicity of 2-chlorophenol, 2,4-dichlorophenol and 2,4,6-trichlorophenol. In: Water Chlorination: Chemistry, Environmental Impact and Health Effects, Jolley et al., Ed. Vol. 5.. Methods: Groups of 10 female Sprague-Dawley rats were exposed to 2,4-DCP (99% pure) in the drinking water at 0,3, 30, or 300 ppm from weaning through breeding at 90 days, parturition, and weaning of pups. Ten randomly selected offspring/groups were then continued on the same treatment regimen as the dams for an additional 10 weeks. IRIS (1994) indicates that doses were calculated by the authors, but the doses are not presented in the papers. To be consistent with IRIS, a 10% drinking water intake factor was used so that estimated 2,4- DCP intakes were 0,0.3,3, and 30 mg/kg/day, at 0,3,30, and 300 ppm, respectively.</p>		

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p>Critical effect: decrease in delayed type hypersensitivity</p> <p>End point or Point of Departure (POD): NOAEL = 0.3 mg/kg-day</p> <p>Uncertainty Factors: UF = 100 (10 each for intraspecies variability and interspecies extrapolation)</p> <p>Source and date: ATSDR, 7/1999</p> <p>MRL: An acute MRL for 4-chlorophenols and other chlorophenols is derived, acute MRL = 0.01 mg/kg-day based on a NOAEL = 1.28 mg/kg-day for electron microscopic changes in hepatocytes (Phornchirasilp et al. 1989) and UF = 100.</p> <p>Tier 3 Source:</p> <p>MDEQ: Per DEQ-CCD/WRD (2/19/2002), RRD (10/14/1994), RfD = 1.0E-2 mg/kg-day. 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: not likely to be carcinogenic to humans via oral exposure.</p> <p>IRIS WOE Basis: inadequate information to assess the carcinogenic potential of 2,4-DCP to humans via inhalation exposure. There are no human data addressing the potential carcinogenicity of 2,4-DCP alone, either via oral or inhalation exposure. 2,4-DCP tested negative in adequate 2-year NTP dietary bioassays using both rats and mice. A second chronic study in rats found no increase in tumor formation with chronic 2,4-DCP exposure (Exon and Koller, 1985).</p> <p>Source and Date: PPRTV, 7/30/2007</p> <p>Tier 1 and 2 Sources:</p> <p>IRIS: Per IRIS (6/30/1988), no value at this time.</p> <p>PPRTV: Per PPRTV (7/30/2007), 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

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
Reference Concentration (RfC) or Initial Threshold Screening Level (ITSL) ($\mu\text{g}/\text{m}^3$)	7.7E+1	1.1E+1	MDEQ, 2015	
RfC/ITSL details	Based on Kobayashi et al. 1972 six month feeding study in male mice at doses of 0, 45, 100 or 230 mg/kg. Entry date: 6/18/1986	<p>Tier 3 Source: MDEQ: Basis: MDEQ was the only value identified in the Tier 3 search. See details below.</p> <p>Tier 1 and 2 Sources: IRIS: Per IRIS (6/30/1988), no value at this time. PPRTV: Per PPRTV (7/30/2007), no value at this time. MRL: Per ATSDR (April 2015 list), no inhalation MRL at this time.</p> <p>Tier 3 Sources: MDEQ: Per MDEQ-AQD justification file for 2,4-dichlorophenol, ITSL = 1.1E+1 $\mu\text{g}/\text{m}^3$. Annual averaging time. Based on IRIS RfD = 0.003 mg/kg/day (1988). Critical Study: Exon, J.H. and L.D. Koller. 1985. Toxicity of 2-chlorophenol, 2,4-dichlorophenol and 2,4,6-trichlorophenol. In: Water Chlorination: Chemistry, Environmental Impact and Health Effects, Jolley et al., Ed. Vol. 5. Method(s): Sprague-Dawley rat dams were exposed to be 0, 3, 30 or 300 ppm 2,4-DCP in drinking water from the age of 3 weeks old to parturition and lactation. EPA has noted that this exposure can be calculated to 0, 0.3, 3, or 30 mg/kg per day. Randomly-selected 3 week old rat pups from each respective dosing group (N=10 per group) were likewise given 0, 0.3, 3 or 30 mg/kg per day of 2,4-DCP in drinking water for 15 weeks Critical effect: significant decrease in the delayed-type hypersensitivity (DTH) response (An alteration in cell-mediated immunity was evaluated via the delayed-type hypersensitivity (DTH) response of footpad swelling after bovine serum albumin sensitization and challenge) End point or Point of Departure (POD): NOAEL = 0.3 mg/kg/day Uncertainty Factors: EPA IRIS RfD UF = 100 (10 each for intraspecies variability</p>	Complete	

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		and interspecies extrapolation). AQD did not apply UF in the RfC derivation. Source and date: MDEQ- AQD, 5/5/2015 Other Tier 3 Sources. There were no values from the following Sources: HEAST 1997, NTP ROC, the Health or Environmental Departments of California, Massachusetts, Minnesota, New Jersey, New York, or Texas, Environment Canada, RIVM, ECHA (REACH) or the OECD HPV Program.		
Inhalation Unit Risk Factor (IURF) (($\mu\text{g}/\text{m}^3$)⁻¹)	--	NA	MDEQ, 2015	
IURF details	NA	Carcinogen Weight-of-Evidence (WOE) Class: not likely to be carcinogenic to humans via oral exposure. IRIS WOE Basis: inadequate information to assess the carcinogenic potential of 2,4-DCP to humans via inhalation exposure. There are no human data addressing the potential carcinogenicity of 2,4-DCP alone, either via oral or inhalation exposure. 2,4-DCP tested negative in adequate 2-year NTP dietary bioassays using both rats and mice. A second chronic study in rats found no increase in tumor formation with chronic 2,4-DCP exposure (Exon and Koller, 1985). Source and Date: PPRTV, 7/30/2007 Tier 1 and 2 Sources: IRIS: Per IRIS (6/30/1988), no value at this time. PPRTV: Per PPRTV (7/30/2007), 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	--	NA Not listed as a carcinogen with mutagenic MOA in the USEPA OSWER List.		



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
Developmental or Reproductive Effector? (Y/N)	No	YES-oral The RfD is based on a reproductive-developmental study and immunotoxicity effect. Oral Exposure Pathways- Single Exposure NO-inhalation. The 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 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		
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	
ABS_{gi} details		RAGS E (EPA, 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)	11
Updated GSI value (µg/L)	11
Rule 57 Drinking Water Value (µg/L)	220

	Rule 57 Value (µg/L)	Verification Date
Human Non-cancer Values- Drinking water source (HNV-drink)	220	9/2006
Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)	1,100	9/2006
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)	11	7/2008
Aquatic maximum value (AMV)	92	7/2008
Final Acute Value (FAV)	180	7/2008

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 ($\mu\text{g}/\text{kg}$)	330	MDEQ, 2015
Target Detection Limit – Water ($\mu\text{g}/\text{L}$)	10	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