



CHEMICAL UPDATE WORKSHEET

Chemical Name:	Chlordane
CAS #:	57-74-9
Revised By:	RRD Toxicology Unit
Revision Date:	August 14, 2105

(A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)	409.8	409.78	EPI	EXP
Physical State at ambient temp	Solid	Solid	MDEQ	
Melting Point (°C)	379	106.00	EPI	EXP
Boiling Point (°C)	---	NA	NA	
Solubility (ug/L)	56	5.6E+01	EPI	EXP
Vapor Pressure (mmHg at 25°C)	0.0000266	9.75E-06	EPI	EXP
HLC (atm-m ³ /mol at 25°C)	4.86E-5	4.86E-05	EPI	EXP
Log Kow (log P; octanol-water)	6.32	6.16	EPI	EXP
Koc (organic carbon; L/Kg)	1.21E+5	6.754E+04	EPI	EST
Ionizing Koc (L/kg)		NR	NA	NA
Diffusivity in Air (Di; cm ² /s)	0.0118	2.15E-02	W9	EST
Diffusivity in Water (Dw; cm ² /s)	4.37E-6	5.4477E-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	55.6	PC	EXP
Lower Explosivity Level (LEL; unit less)	NA	NA	NA	NA
Critical Temperature (K)		885.73	EPA2001	EXP
Enthalpy of Vaporization (cal/mol)		1.40E+04	EPA2001	EST
Density (g/mL, g/cm ³)		1.6	CRC	EXP
EMSOFT Flux Residential 2 m (mg/day/cm ²)	1.73E-07	6.20E-07	EMSOFT	EST
EMSOFT Flux Residential 5 m (mg/day/cm ²)	1.73E-07	6.20E-07	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm ²)	2.05E-07	7.82E-07	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm ²)	2.05E-07	7.82E-07	EMSOFT	EST

(B) Toxicity Values/Benchmarks

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
Reference Dose (RfD) (mg/kg/day)	1.5E-3	5.0E-4	IRIS, 1998	
RfD details	<p>Mouse 104-week oral study (Khasawinah and Grutsch, 1989). NOAEL=0.15 mg/kg/day; UF=100 (adjusted from IRIS UF = 300. Critical effect = hepatic necrosis. Calculation date: 11/3/1997</p>	<p>Tier 1 Source: IRIS: Basis: IRIS is a Tier 1 source. Critical Study(ies): 1) Khasawinah, A.M. and J.F. Grutsch. 1989a. Chlordane: 24-month tumorigenicity and chronic toxicity test in mice. Reg. Toxicol. Pharmacol. 10: 244-254. 2) Velsicol Chemical Corporation. 1983. Twenty-four month chronic toxicity and tumorigenicity test in mice by chlordane technical. Unpublished study by Research Institute for Animal Science in Biochemistry and Toxicology, Japan. MRID No. 00144312, 00132566. Available from U.S. EPA. Method(s): ICR mice (80/sex/group) were given 0, 1, 5, or 12.5 ppm (0, 0.15, 0.75, and 1.875 mg/kg-day) chlordane in the diet for 104 weeks. Critical effect: Hepatic necrosis End point or Point of Departure (POD): NOAEL = 0.15 mg/kg-day Uncertainty Factors: UF = 300, (10 each for interspecies variability and interspecies extrapolation, and 3 for lack of any reproductive studies) Source and date: IRIS, Last revision date - 2/07/1998</p> <p>Tier 2 Sources: PPRTV: No PPRTV record available at this time. MRL: Per ATSDR, chronic oral MRL = 6.0E-4 mg/kg-day (see below). An MRL for intermediate-duration oral MRL = 0.0006 mg/kg/day is available based on the same studies used for deriving the chronic value. An acute MRL = 0.001 mg/kg/day is available based on a LOAEL of 1 mg/kg/day for developmental effects (depressed conditioned avoidance response acquisition, increased exploratory activity in open field test, and increased seizure threshold) in the offspring of mice exposed to chlordane during the last trimester (Al-Hachim and Al-Baker 1973). Chronic MRL basis:</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p>Critical Study (ies): Khasawinah and Grutsch (1989a) and Velsicol Chemical Co. (1983a). Method(s): 30-month dietary study Critical effect: hepatocellular hypertrophy was found in female rats End point or Point of Departure (POD): NOAEL = 0.055 mg/kg/day Uncertainty Factors: UF = 100 (10 each for interspecies variability and interspecies extrapolation) Source and date: ATSDR Tox Profile, 5/1994; ATSDR Addendum December 2013.</p> <p>Tier 3 Source: MDEQ: RfD = 1.5E-3 mg/kg/day. Per RRD Toxicological Assessment (7/2009), the RfD value is based on the Chlordane (Technical) IRIS assessment (2/07/1998); however, the RRD number differs as a total UF of 100 was used. RRD did not support the use of an UF of 3 for lack of reproductive studies.</p>		
Oral Cancer Slope Factor (CSF) (mg/kg-day)⁻¹	3.5E-1	3.5E-1	IRIS, 1998	
CSF details	The slope factor was developed based on the Chlordane (Technical) IRIS record; CAS #12789-03-6. Per IRIS, the slope factor was derived from geometric mean of five chronic carcinogenicity assays conducted in mice that demonstrated an	<p>Tier 1 Source: IRIS: Basis: IRIS is a Tier 1 source. Critical Study(ies): 1) Khasawinah, A.M. and J.F. Grutsch. 1989a. Chlordane: 24-month tumorigenicity and chronic toxicity test in mice. Reg. Toxicol. Pharmacol. 10: 244-254. 2) Velsicol Chemical Corporation. 1983. Twenty-four month chronic toxicity and tumorigenicity test in mice by chlordane technical. Unpublished study by Research Institute for Animal Science in Biochemistry and Toxicology, Japan. MRID No. 00144312, 00132566. Available from U.S. EPA. Method(s): ICR mice (80/sex/group) were given 0, 1, 5, or 12.5 ppm (0, 0.15, 0.75, and 1.875 mg/kg-day) chlordane in the diet for 104 weeks. 1) <i>Dose response data: Tumor Type</i> - hepatocellular carcinoma; <i>Test Species</i> - mouse/CD-1 (IRDC), mouse/B6C3F1 (NCI), mouse/ICR (Khasawinah and Grutsch); <i>Route</i> - diet 2) <i>Extrapolation method:</i> Linearized multistage procedure, extra risk</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
	increased incidence of hepatocellular carcinoma. See IRIS record for full details of each study.	<p>Carcinogen Weight-of-Evidence (WOE) Class: B2; probable human carcinogen</p> <p>IRIS WOE Basis: Human carcinogenicity data: inadequate. Animal carcinogenicity data: sufficient</p> <p>Source and Date: IRIS, Last revision date: 2/07/1998. IRIS literature review in November, 2001 did not identify any significant new studies</p> <p>Other values:</p> <p>PPRTV: No PPRTV record available at this time.</p> <p>MRL: NA; MRLs are for non-cancer effects only.</p> <p>Tier 3 sources:</p> <p>MDEQ: RRD adopted the IRIS value (RRD Toxicological Assessment, 2009).</p>		
Reference Concentration (RfC) or Initial Threshold Screening Level (ITSL) ($\mu\text{g}/\text{m}^3$)	7.0E-1	7.0E-1	IRIS, 1998	
RfC/ITSL details	ITSL based on EPA's 2/7/98 RfC. RfC based on rat sub chronic inhalation study hepatic effects NOAEL of 5.8 mg/m ³ (LOAEL of 28.2 mg/m ³) reported in Khasawinah et al 1989. An UF of 1000 was applied to NOAEL (HEC) of 0.65 mg/m ³ .	<p>Tier 1 Source:</p> <p>IRIS:</p> <p>Basis: IRIS RfC = 7.0E-4 mg/m³. IRIS is a Tier 1 source.</p> <p>Critical Study: Khasawinah, A., C. Hardy, and G. Clark. 1989b. Comparative inhalation toxicity of technical chlordane in rats and monkeys. J. Toxicol. Environ. Health 28(3): 327-347. (The 90-day rat study.)</p> <p>Method(s): Wistar rats (35 47/sex/group) were exposed to 0, 0.1, 1.0, or 10 mg/cu.m technical chlordane, 8 hours/day, 5 days/week, for 13 weeks, followed by a 13-week recovery period.</p> <p>Critical effect: hepatic effects</p> <p>End point or Point of Departure (POD): NOAEL = 1.0 mg/m³; NOAEL_{HEC} = 0.65 mg/m³.</p> <p>Uncertainty Factors: UF = 1,000 (10 each for interspecies variability, interspecies extrapolation, and use of a sub chronic study)</p> <p>Source and date: IRIS, Last revision date - 2/07/1998</p>		Complete

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
	FINAL. AQD calculation date: 3/17/98.	<p>Tier 2 Sources: PPRTV: No PPRTV record available at this time. MRL: Per ATSDR (5/1994), chronic inhalation MRL = 2.0E-5 mg/m³. An intermediate-duration inhalation MRL = 2.0E-4 mg/m³ is available based on the same studies used for the chronic MRL. Critical Study: Khasawinah, A., C. Hardy, and G. Clark. 1989a. Comparative inhalation toxicity of technical chlordane in rats and monkeys. J. Toxicol. Environ. Health 28(3): 327-347. (The 90-day rat study.) Method(s): Wistar rats (35 47/sex/group) were exposed to 0, 0.1, 1.0, or 10 mg/m³ technical chlordane, 8 hours/day, 5 days/week, for 13 weeks (90 days), followed by a 13-week recovery period. Critical effect: hepatic effects (hepatocellular hypertrophy and increased cytochrome P-450) End point or Point of Departure (POD): NOAEL = 0.1 mg/m³ Uncertainty Factors: UF = 1,000 (10 each for interspecies variability, interspecies extrapolation, and use of a sub chronic study) Source and date: ATSDR, 5/1994 (Tox Profile); ATSDR Addendum 12/2013.</p> <p>Tier 3 Source: MDEQ: AQD adopted IRIS value.</p>		
Inhalation Unit Risk Factor (IURF) ((µg/m³)⁻¹)	1.0E-4	1.0E-4	IRIS, 1998	
IURF details	EPA based the inhalation slope factor on the oral slope factor (3.5 per mg/kg), increased incidences of hepatocellular carcinomas in	<p>Tier 1 Source: IRIS: Basis: IRIS used the oral slope factor to estimate an IURF as no chronic inhalation bioassays are available. The estimation assumed 100% absorption of inhaled chlordane and a breathing rate of 20 m³/day. IRIS is the only available value. Carcinogen Weight-of-Evidence (WOE) Class: B2; probable human carcinogen IRIS WOE Basis: Human carcinogenicity data: inadequate. Animal carcinogenicity data: sufficient Source and Date: IRIS, Last revision date: 2/07/1998. IRIS literature review in 2001</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
	mice. See 2/7/98 IRIS printout. AQD calculation date: 11/3/97.	did not identify any significant new studies. Tier 2 Sources: PPRTV: No PPRTV record available at this time. MRL: NA; MRLs are for non-cancer effects only. Tier 3 Source: MDEQ: AQD adopted IRIS value.		
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.		
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)	--	2	SDWA, 1976	
SDWS details	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399		
Secondary Maximum Contaminant Level (SMCL) (ug/L)	--	NA	SDWA, 1976 and USEPA SMCL List, 2015	
SMCL details	NA	NA		
Is there an aesthetic value for drinking water? (Y/N)	NO	Not evaluated.	NA	
Aesthetic value (ug/L)	NA	NA	NA	

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
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)	---	0.04	MDEQ, 2015	
AE _d details				
Ingestion Absorption Efficiency (AE _i)		0.5	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)	2.0 (M); 0.00025
Updated GSI value (µg/L)	2 (M); 0.00025
Rule 57 Drinking Water Value (µg/L)	2 (M); 0.00025

	Rule 57 Value (µg/L)	Verification Date
Human Non-cancer Values- Drinking water source (HNV-drink)	0.0014	7/1997
Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)	0.0014	7/1997
Wildlife Value (WV)	NLS	NA
Human Cancer Values for Drinking Water Source (HCV-drink)	0.00025	7/1997
Human Cancer values for non-drinking water source (HCV-Non-drink)	0.00025	7/1997
Final Chronic Value (FCV)	0.029	5/1997
Aquatic maximum value (AMV)	0.27	5/1997
Final Acute Value (FAV)	0.53	5/1997

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 ($\mu\text{g}/\text{kg}$)	30	MDEQ, 2015
Target Detection Limit – Water ($\mu\text{g}/\text{L}$)	0.05	MDEQ, 2015
Target Detection Limit – Air (ppbv)	1.50E-02	MDEQ, 2015
Target Detection Limit – Soil Gas (ppbv)	5.10E-01	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
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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