



## CHEMICAL UPDATE WORKSHEET

<b>Chemical Name:</b>	<b>Carbaryl (DD)</b>
<b>CAS #:</b>	<b>63-25-2</b>
<b>Revised By:</b>	RRD Toxicology Unit
<b>Revision Date:</b>	August 17, 2015

### (A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
<b>Molecular Weight (g/mol)</b>	201.24	201.23	EPI	EXP
<b>Physical State at ambient temp</b>	Solid	Solid	MDEQ	
<b>Melting Point (°C)</b>	---	145.00	EPI	EXP
<b>Boiling Point (°C)</b>	315	315.00	EPI	EXP
<b>Solubility (ug/L)</b>	1.26E+5	1.10E+05	EPI	EXP
<b>Vapor Pressure (mmHg at 25°C)</b>	0.00004	1.36E-06	EPI	EXP
<b>HLC (atm-m<sup>3</sup>/mol at 25°C)</b>	6.80E-4	2.80E-09	HSDB	EXP
<b>Log Kow (log P; octanol-water)</b>	2.4	2.36	EPI	EXP
<b>Koc (organic carbon; L/Kg)</b>	229	354.8	EPI	EST
<b>Ionizing Koc (L/kg)</b>		NR	NA	NA
<b>Diffusivity in Air (Di; cm<sup>2</sup>/s)</b>	0.08	2.74E-02	W9	EST
<b>Diffusivity in Water (Dw; cm<sup>2</sup>/s)</b>	8.0E-6	7.1216E-06	W9	EST
<b>Soil Water Partition Coefficient (Kd; inorganics)</b>	NR	NR	NA	NA

	Part 201 Value	Updated Value	Reference Source	Comments
Flash Point (°C)	NA	193	PC	EXP
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 <sup>3</sup> )		1.228	CRC	EXP
EMSOFT Flux Residential 2 m (mg/day/cm <sup>2</sup> )	NA	1.60E-07	EMSOFT	EST
EMSOFT Flux Residential 5 m (mg/day/cm <sup>2</sup> )	NA	1.60E-07	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm <sup>2</sup> )	NA	1.83E-07	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm <sup>2</sup> )	NA	1.83E-07	EMSOFT	EST

**(B) Toxicity Values/Benchmarks**

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
<b>Reference Dose (RfD) (mg/kg/day)</b>	9.6E-2	1.0E-2 (oral); 1.0E+2 (dermal)	OPP, 2010	
<b>RfD details</b>	<p>2-year rat chronic feeding study, NOAEL=9.6 mg/kg/day, UF = 100; Critical effect = kidney and liver toxicity. RfD adjusted to 2 significant figures (IRIS reports 1E-1 mg/kg/day).</p> <p>Entry date: 5/31/1985</p>	<p><b>Tier 1 Source:</b>  <b>EPA-OPP:</b>  <b>Basis:</b> OPP is the most current information available. OPP is a Tier 1 source. Per OPP, acute oral aPAD/RfD = 1.0E-2 mg/kg-day. OPP concluded that a chronic assessment is not appropriate for carbaryl because acute exposure from carbaryl is the main exposure duration of concern due to the rapid recovery of cholinesterase (ChE) inhibition.  <b>Critical Study:</b> Moser, G. (2006) Report on Cholinesterase Comparative Sensitivity Study of Carbaryl. Unpublished study prepared by U.S. Environmental Protection Agency, ORD, NHEERL. 35 p. (MRID No. 47007001)  <b>Methods:</b>  <b>Critical effect:</b> brain ChE inhibition in post-natal day 11 (PND 11) pups  <b>End point or Point of Departure (POD):</b> BMDL10 = 1.1 mg/kg bw/day  <b>Uncertainty Factors:</b> UF = 100 (10 each for interspecies variability and interspecies extrapolation)  <b>Source and date:</b> USEPA/Office of Chemical Safety and Pollution Prevention (OPP), Reregistration Eligibility Decision (RED) for Carbaryl (9/2007), Amended Reregistration Eligibility Decision (RED) for Carbaryl (8/2008), Memorandum: Carbaryl: Human Health Scoping Document in Support of Registration Review (8/26/2010)</p> <p><b>INFORMATION ON DERMAL ENDPOINT:</b>  <b>EPA-OPP derived a Dermal Margin of Exposure (MOE) = 100 for adults and MOE = 180 for children:</b>  <b>Basis:</b> Per EPA/OPP, acute oral aPAD/RfD = 1.0E-2 mg/kg-day. OPP concluded that a chronic assessment is not appropriate for carbaryl because acute exposure from carbaryl is the main exposure duration of concern due to the rapid recovery of cholinesterase (ChE) activity.  <b>Critical Study:</b> Rat Adult Dermal Study (MRID 45630601),</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p><b>Method(s):</b> Rat 4-week dermal toxicity study  <b>Critical effect:</b> brain ChE inhibition  <b>End point or Point of Departure (POD):</b> BMDL10 = 30.56 mg/kg (Adjusted to POD = 86 mg/kg-day using 2.8x dermal penetration factor (rat skin permeability compared to human skin) (MRID 47151902)  <b>Uncertainty Factors:</b> UF = 100 (10 each for interspecies variability and interspecies extrapolation). An FQPA safety factor of 1.8x was used for the dermal endpoint since the endpoint was selected from a dermal toxicity study in adult rats.                      Juvenile rats are 1.8x more sensitive than adults based on the oral comparative cholinesterase study in rats.  <b>Source and date:</b> EPA/Office of Chemical Safety and Pollution Prevention (OPP), Reregistration Eligibility Decision (RED) for Carbaryl (9/2007), Amended Reregistration Eligibility Decision (RED) for Carbaryl (8/2008), Memorandum: Carbaryl: Human Health Scoping Document in Support of Registration Review (8/26/2010)</p> <p><b>Tier 1 and 2 Sources:</b>  <b>IRIS:</b> RfD = 1.0E-1 mg/kg-day:  <b>Critical Study:</b> Carpenter, C.P., C.W. Weil, P.E. Polin, et al. 1961. Mammalian toxicity of 1-naphthyl-N-methylcarbamate (Sevin insecticide). J. Agric. Food Chem. 9: 30-39.  <b>Method(s):</b> CF-N rats (20/sex/dose) were fed 50, 100, 200, or 400 ppm carbaryl in the diet for 2 years.  <b>Critical effect:</b> histopathologic changes in the kidneys and liver  <b>End point or Point of Departure (POD):</b> NOAEL = 9.6 mg/kg bw/day  <b>Uncertainty Factors:</b> UF = 100 (10 each for interspecies variability and interspecies extrapolation).  <b>Source and date:</b> IRIS, Last revision date - 3/01/1988</p> <p><b>PPRTV:</b> No PPRTV record available at this time.  <b>MRL:</b> No MRL record available at this time.</p>		



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p><b>Tier 3 Source:</b>  <b>MDEQ:</b> Per DEQ-CCD, RRD adopted the IRIS RfD. The RRD value differs because the number is rounded up to 2 significant figures</p>		
<b>Oral Cancer Slope Factor (CSF) (mg/kg-day)<sup>-1</sup></b>	--	8.7E-4	OPP, 2010	
<b>CSF details</b>	NA	<p><b>Tier 1 Source:</b>  <b>EPA-OPP:</b>  <b>Basis:</b> . OPP is the only available data.  <b>OPP Cancer SF</b> = 8.7 x10<sup>-4</sup> (mg/kg/day)<sup>-1</sup>  <b>Carcinogen Weight-of-Evidence (WOE) Class:</b> Likely to be carcinogenic in humans  <b>IRIS WOE Basis:</b> based on incidence of hemangiosarcomas in mice  <b>Source and Date:</b> EPA/Office of Chemical Safety and Pollution Prevention (OPP), Reregistration Eligibility Decision (RED) for Carbaryl (9/2007), Amended Reregistration Eligibility Decision (RED) for Carbaryl (8/2008), Memorandum: Carbaryl: Human Health Scoping Document in Support of Registration Review (8/26/2010)</p> <p><b>Tier 1 and 2 Sources:</b>  <b>IRIS:</b> Per IRIS (11/01/1991), no value at this time.  <b>PPRTV:</b> No PPRTV record available at this time.  <b>MRL:</b> NA; MRLs are for non-cancer effects only.</p> <p><b>Tier 3 Source:</b>  <b>MDEQ:</b> Per DEQ-CCD, no value at this time.</p>		Complete
<b>Reference Concentration (RfC) or Initial Threshold Screening Level (ITSL) (µg/m³)</b>	--	NA	MDEQ, 2015	
<b>RfC/ITSL details</b>	NA			



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p><b>Tier 1 Sources:</b>  <b>EPA-OPP:</b> Per EPA/OPP, inhalation MOE = 100. OPP concluded that a chronic assessment is not appropriate for carbaryl due to rapid recovery of cholinesterase (ChE) inhibition.  <b>Critical Study:</b> Comparative Cholinesterase Study- (MRID 47143001)  <b>Methods:</b>  <b>Critical effect:</b> brain ChE inhibition in post-natal day I (PND I I) pups  <b>End point or Point of Departure (POD):</b> BMDL10 = 1.1 mg/kg; POD = 1.1 mg/kg-day  <b>Uncertainty Factors:</b> UF = 100 (10 each for interspecies variability and interspecies extrapolation)  <b>Source and date:</b> EPA/Office of Chemical Safety and Pollution Prevention (OPP), Reregistration Eligibility Decision (RED) for Carbaryl (9/2007), Amended Reregistration Eligibility Decision (RED) for Carbaryl (8/2008), Memorandum: Carbaryl: Human Health Scoping Document in Support of Registration Review (8/26/2010)</p> <p><b>IRIS:</b> Per IRIS (8/15/1991), no value at this time. The health effects data for carbaryl were reviewed by the U.S. EPA RfD/RfC Work Group and determined to be inadequate for derivation of an inhalation RfC.</p> <p><b>Tier 2 Sources:</b>  <b>PPRTV:</b> No PPRTV record available at this time.  <b>MRL:</b> No MRL record available at this time.</p> <p><b>Tier 3 Source:</b>  <b>MDEQ:</b> Per DEQ-CCD, no value at this time.</p>		Complete
Inhalation Unit Risk Factor (IURF) (( $\mu\text{g}/\text{m}^3$ ) <sup>-1</sup> )	--	NA	MDEQ,2015	
IURF details	NA	<p><b>Carcinogen Weight-of-Evidence (WOE) Class:</b> Likely to be carcinogenic in humans  <b>IRIS WOE Basis:</b> based on incidence of hemangiosarcomas in mice  <b>Source and Date:</b> Amended Reregistration Eligibility Decision (RED) for Carbaryl</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		(8/2008), Memorandum: Carbaryl: Human Health Scoping Document in Support of Registration Review (8/26/2010)  <b>Tier 1 and 2 Sources:</b> <b>IRIS:</b> Per IRIS (11/01/1991), no value at this time. <b>EPA-OPP:</b> Per EPA/OPP (8/26/2010), no inhalation cancer value at this time. <b>PPRTV:</b> No PPRTV record available at this time. <b>MRL:</b> NA; MRLs are for non-cancer effects only.  <b>Tier 3 Source:</b> <b>MDEQ:</b> Per DEQ-CCD, no value at this time.		
<b>Mutagenic Mode of Action (MMOA)? (Y/N)</b>	--	NO	USEPA, 2015	
<b>MMOA Details</b>	--	NA Not listed as a carcinogen with mutagenic MOA in the USEPA OSWER List.		
<b>Developmental or Reproductive Effector? (Y/N)</b>	No	YES-oral No-inhalation, the RfD is based on a reproductive-developmental effect. Oral Exposure Pathways- Single Exposure	MDEQ, 2015	
<b>Developmental or Reproductive Toxicity Details</b>	NA	NA		
<b>State Drinking Water Standard (SDWS) (ug/L)</b>	--	NO	SDWA, 1976	
<b>SDWS details</b>	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399		
<b>Secondary Maximum Contaminant Level (SMCL) (ug/L)</b>	--	NO	SDWA, 1976 and USEPA SMCL List	
<b>SMCL details</b>	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399 and USEPA SMCL List, 2015		
<b>Is there an aesthetic value for</b>	NO	Not evaluated.	NA	



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
drinking water? (Y/N)				
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: Dermal RfD				

**(C) Chemical-specific Absorption Factors**

	Part 201 Value	Update	Source/Reference/ Dates	Comments/Notes /Issues
Gastrointestinal absorption efficiency value (ABS <sub>gi</sub> )	---	1.0	MDEQ, 2015/USEPA RAGS-E, 2004	
ABS <sub>gi</sub> details		RAGS E (USEPA, 2004) Default Value		
Skin absorption efficiency value (AE <sub>d</sub> )	---	0.1	MDEQ, 2015	
AE <sub>d</sub> details				
Ingestion Absorption Efficiency (AE <sub>i</sub> )		1.0	MDEQ, 2015	
AE <sub>i</sub> Details				
Relative Source Contribution for Water (RSC <sub>w</sub> )		0.2	MDEQ, 2015	
Relative Source Contribution for Soil (RSC <sub>s</sub> )		1.0	MDEQ, 2015	
Relative Source Contribution for Air (RSC <sub>A</sub> )		1.0	MDEQ, 2015	
Others				

**(D) Rule 57 Water Quality Values and GSI Criteria**

<b>Current GSI value (µg/L)</b>	NA
<b>Updated GSI value (µg/L)</b>	NA
<b>Rule 57 Drinking Water Value (µg/L)</b>	NA

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

Sources:

1. MDEQ Surface Water Assessment Section Rule 57 [website](#)
2. MDEQ Rule 57 [table](#)



**(E) Target Detection Limits (TDL)**

	<b>Value</b>	<b>Source</b>
<b>Target Detection Limit – Soil (<math>\mu\text{g}/\text{kg}</math>)</b>	200	MDEQ, 2015
<b>Target Detection Limit – Water (<math>\mu\text{g}/\text{L}</math>)</b>	20	MDEQ, 2015
<b>Target Detection Limit – Air (ppbv)</b>	NA	MDEQ, 2015
<b>Target Detection Limit – Soil Gas (ppbv)</b>	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