



CHEMICAL UPDATE WORKSHEET

Chemical Name:	Cadmium
CAS #:	7440-43-9
Revised By:	RRD Toxicology Unit
Revision Date:	December 4, 2015

(A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)	112.411	112.4	PP	EXP
Physical State at ambient temp	Inorganic	Inorganic	MDEQ	
Melting Point (°C)	---	321	PP	EXP
Boiling Point (°C)	765	765	PP	EXP
Solubility (ug/L)	NA	NA	NA	NA
Vapor Pressure (mmHg at 25°C)	NA	NR	NA	NA
HLC (atm-m³/mol at 25°C)	NR	NR	NA	NA
Log Kow (log P; octanol-water)	NR	NR	NA	NA
Koc (organic carbon; L/Kg)	NR	NR	NA	NA
Ionizing Koc (L/kg)		NR	NA	NA
Diffusivity in Air (Di; cm²/s)	NR	NR	NA	NA
Diffusivity in Water (Dw; cm²/s)	NR	NR	NA	NA
Soil Water Partition Coefficient (Kd; inorganics)	75	7.5E+01	SSG	EST

	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)		NR	NA	NA
Enthalpy of Vaporization (cal/mol)		NR	NA	NA
Density (g/mL, g/cm ³)		NR	NA	NA
EMSOFT Flux Residential 2 m (mg/day/cm ²)	NA	NR	EMSOFT	NA
EMSOFT Flux Residential 5 m (mg/day/cm ²)	NA	NR	EMSOFT	NA
EMSOFT Flux Nonresidential 2 m (mg/day/cm ²)	NA	NR	EMSOFT	NA
EMSOFT Flux Nonresidential 5 m (mg/day/cm ²)	NA	NR	EMSOFT	NA

(B) Toxicity Values/Benchmarks

	Part 201 Value	Updated Value	Source*/Reference /Date	Comments/Notes /Issues
Reference Dose (RfD) (mg/kg/day)	1.0E-3	1.0E-4	ATSDR, 2012	
RfD details	<p>Chronic human exposure studies (VS EPA, 1985), NOAEL = 0.005 mg/kg-day; UF=10. Critical effect = significant proteinuria. The RfD is based on the absorbed dose which would result in 200 ug Cd/gm wet human renal cortex. The RfD is calculated using a toxicokinetic model which accounts for daily elimination rates as well as absorption by media of exposure (drinking water and food). The RfD for drinking water is 5.0E-4, however, since</p>	<p>Tier 2 Source: ATSDR: Basis: ATSDR MRL selected over the IRIS value because it is based on more recent data and a more recent, scientifically sound toxicity assessment. ATSDR MRL = 0.0001 (1.0E-4) mg/kg-day based on renal effects. Critical Studies: Buchet et al. 1990. Lancet 336:699-702. Jarup et al. 2000. Occup Environ Med 57(10):668-672. Suwazono et al. 2006. Environ Health Perspect 114:1072-1076. Methods: ATSDR conducted a meta-analysis of select environmental exposure dose-response studies examining the relationship between urinary cadmium and the prevalence of elevated levels of biomarkers of renal function. Individual dose-response functions from each study were implemented to arrive at estimates of the internal dose corresponding to probabilities of 10% excess risk of low molecular weight proteinuria. Critical effect: decreased renal function. POD: The lowest urinary cadmium dose (UCD₁₀) of 1.34 µg/g creatinine was estimated from the European database; and the 95% LCL on this UCD₁₀ (UCDL10) of 0.5 µg/g creatinine was considered as the POD for the MRL. UF: 3 for human variability. Source: ATSDR Toxicological Profile, September, 2012.</p> <p>Tier 1 and 2 Sources: IRIS, 2/1/1994: 5E-4 (water) and 1E-3 (food). Critical Studies: Human studies involving chronic exposures cited in U.S. EPA. 1985. Drinking Water Criteria Document on Cadmium. Office of Drinking Water, Washington, DC. Final draft. Methods: Human studies involving chronic exposures to cadmium in drinking water showed that a concentration of 200 µg cadmium (Cd)/gm wet human renal cortex is the highest renal level not associated with significant proteinuria. Using</p>		Complete

	Part 201 Value	Updated Value	Source*/Reference /Date	Comments/Notes /Issues
	the DW values are based on the State standard, the RfD for cadmium in food of 1.0E-3 is used to calculate soil DCVs.	<p>toxicokinetic modeling, which assumes 0.01% elimination of the Cd body burden per day, 2.5% absorption of Cd from food or 5% from water, the predicted NOAEL for chronic exposure which would result in 200 µg Cd/gm wet weight human renal cortex is 0.01 and 0.005 mg Cd/kg/day for food and water, respectively.</p> <p>Critical effect: Significant proteinuria</p> <p>End point or Point of Departure (POD): NOAEL (drinking water) = 0.0005 mg/kg-day for Cd in drinking water NOAEL (food) = 0.001 mg/kg-day for Cd in food</p> <p>Uncertainty Factors: UF = 10 (for intraspecies variability)</p> <p>Source and date: IRIS, Last revision - 2/1/1994</p> <p>PPRTV: No PPRTV record available at this time.</p> <p>Tier 3 Source: MDEQ: Per MDEQ-CCD, RRD adopted the 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: B1, probable human carcinogen</p> <p>IRIS WOE Basis: Limited evidence from occupational epidemiologic studies, which is consistent across investigators and study populations.</p> <p>Source and Date: IRIS, Last revision date: 6/01/1992</p> <p>Tier 1 and 2 Sources: IRIS: Per IRIS (6/01/1992), 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 Source: MDEQ: Per DEQ-CCD, no value at this time.</p>		Complete
Reference Concentration (RfC) or Initial	--	NA	MDEQ, 2015	



	Part 201 Value	Updated Value	Source*/Reference /Date	Comments/Notes /Issues
Threshold Screening Level (ITSL) ($\mu\text{g}/\text{m}^3$)				
RfC/ITSL details	NA	<p>Tier 1 and 2 Sources: IRIS: Per IRIS (6/01/1992), no value at this time. PPRTV: No PPRTV record available at this time. MRL: No MRL record available at this time.</p> <p>Tier 3 Source: MDEQ: Per DEQ-CCD, no value at this time.</p>		Complete
Inhalation Unit Risk Factor (IURF) ($(\mu\text{g}/\text{m}^3)^{-1}$)	1.8E-3	1.8E-3	IRIS, 1992	
IURF details	<p>Potency is based on EPA IRIS's assessment of Thun et al 1985 epidemiology study. Increases in lung, tracheal, bronchus cancer following occupational exposure. Source: AQD/EPA Entry date: 6/4/1992</p>	<p>Tier 1 Source: IRIS: Basis: Tier 1 IURF is the only available information. Critical Study: Thun, M.J., T.M. Schnorr, A.B. Smith and W.E. Halperin. 1985. Mortality among a cohort of U.S. cadmium production workers: An update. J. Natl. Cancer Inst. 74(2): 325-333. Method(s):</p> <ol style="list-style-type: none"> 1) <i>Dose response data:</i> Tumor Type - lung, trachea, bronchus cancer deaths; <i>Test Species</i> - human/white male; <i>Route</i> - inhalation, occupational exposure 2) <i>Extrapolation method:</i> Two stage; only first affected by exposure; extra risk. <p>Carcinogen Weight-of-Evidence (WOE) Class: B1; probable human carcinogen IRIS WOE Basis: Limited evidence from occupational epidemiologic studies of cadmium is consistent across investigators and study populations. There is sufficient evidence of carcinogenicity in rats and mice by inhalation and intramuscular and subcutaneous injection. Source and Date: IRIS, Last Revision - 6/01/1992</p> <p>Tier 1 and 2 Sources:</p>		Complete



	Part 201 Value	Updated Value	Source*/Reference /Date	Comments/Notes /Issues
		PPRTV: No PPRTV record available at this time. MRL: NA; MRLs are for non-cancer effects only. Tier 3 Source: MDEQ: AQD adopted the IRIS IURF 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 is not based on a reproductive-developmental effect.	MDEQ, 2015	
Developmental or Reproductive Toxicity Details	NA	NA		
State Drinking Water Standard (SDWS) (ug/L)	5.0	5.0	SDWA, 1976	
SDWS details	SDWA, 1976	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, 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		

	Part 201 Value	Updated Value	Source*/Reference /Date	Comments/Notes /Issues
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)	---	0.001	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)	(G,X)
Updated GSI value (µg/L)	(G,X)
Rule 57 Drinking Water Value (µg/L)	2.5

	Rule 57 Value (µg/L)	Verification Date
Human Non-cancer Values- Drinking water source (HNV-drink)	2.5	6/1997
Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)	130	6/1997
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)	$(EXP(0.7852(LnH)-2.715))*CFb$ CFb = 1.101672-[(LnH)(0.04184)]	7/1997
Aquatic maximum value (AMV)	$(EXP(1.128(LnH)-3.6867))*CFa$ CFa = 1.136672-[(LnH)(0.04184)]	7/1997
Final Acute Value (FAV)	$(EXP(1.128(LnH)-3.6867))*CFa*2$ CFa = 1.136672-[(LnH)(0.04184)]	7/1997

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 ($\mu\text{g}/\text{kg}$)	200	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