CHEMICAL UPDATE WORKSHEET

Chemical Name:	**Mercury, inorganic (as mercuric chloride)**
CAS #:	**7487-94-7**
Revised By:	RRD Toxicology Unit
Revision Date:	August 26, 2015

(A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)		271.50	EPI	EXP
Physical State at ambient temp		Inorganic	MDEQ	
Melting Point (˚C)		277.00	EPI	EXP
Boiling Point (˚C)		302	HSDB	EXP
Solubility (ug/L)		69000000	EPI	EXP
Vapor Pressure (mmHg at 25˚C)		NR	NA	NA
HLC (atm-m^3/mol at 25˚C)		NR	NA	NA
Log Kow (log P; octanol-water)		NR	NA	NA
Koc (organic carbon; L/Kg)		NR	NA	NA
Ionizing Koc (L/kg)		NR	NA	NA
Diffusivity in Air (Di; cm^2/s)		NR	NA	NA
Diffusivity in Water (Dw; cm^2/s)		NR	NA	NA
Soil Water Partition Coefficient (Kd; inorganics)		5.2E+01	SSG	EST

	Part 201 Value	Updated Value	Reference Source	Comments
Flash Point (˚C)		NA	NA	NA
Lower Explosivity Level (LEL; unitless)		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)		3.0E-4	IRIS, 1995	
RfD details		**Tier 1 Source:** **IRIS:** **Basis:** IRIS is a Tier 1 source. **Critical Study**: U.S. EPA. 1987. Peer Review Workshop on Mercury Issues. Summary Report. Environmental Criteria and Assessment Office, Cincinnati, OH. October 26-27. **Method(s)**: On October 26-27, 1987, a panel of mercury experts met at a Peer Review Workshop on Mercury Issues in Cincinnati, Ohio, and reviewed outstanding issues concerning the health effects and risk assessment of inorganic mercury (U.S. EPA, 1987). The following five consensus conclusions and recommendations were agreed to as a result of this workshop: 1) The most sensitive adverse effect for mercury risk assessment is formation of mercuric-mercury-induced autoimmune glomerulonephritis. The production and deposition of IgG antibodies to the glomerular basement membrane can be considered the first step in the formation of this mercuric-mercury-induced autoimmune glomerulonephritis. 2) The Brown Norway rat should be used for mercury risk assessment. The Brown Norway rat is a good test species for the study of Hg2+-induced autoimmune glomerulonephritis. The Brown Norway rat is not unique in this regard (this effect has also been observed in rabbits). 3) The Brown Norway rat is a good surrogate for the study of mercury-induced kidney damage in sensitive humans. For this reason, the uncertainty factor used to calculate criteria and health advisories (based on risk assessments using the Brown Norway rat) should be reduced by 10-fold. 4) Hg2+ absorption values of 7% from the oral route and 100% from the s.c. route should be used to calculate criteria and health advisories. 5) A DWEL of 0.010 mg/L was recommended based on the weight-of-evidence from the studies using Brown Norway rats and limited human tissue data. See IRIS for details.		Complete

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		Critical effect: Autoimmune effects. **End point or Point of Departure (POD):** NOAEL: none. LOAEL: 0.226; 0.317; 0.633 mg/kg-day. **Uncertainty Factors**: An uncertainty factor of 1000 was applied to the animal studies using Brown Norway rats as recommended in U.S. EPA (1987). An uncertainty factor was applied for LOAEL to NOAEL conversion: 10 for use of subchronic studies and a combined 10 for both animals to human and sensitive human populations. **Source and date:** IRIS, 05/01/1995 **Tier 2 Sources:** **PPRTV:** Per PPRTV 09/25/2002 for mercuric sulfide: data are inadequate for mercuric sulfide for derivation of a p-RfD. Based on the limited available pharmacokinetic data for mercuric sulfide, the RfD for mercuric chloride (0.0003 mg/kg-day) could be considered protective for mercuric sulfide. It is likely that the actual RfD for mercuric sulfide would be higher by a factor of at least 10 when compared to that of mercuric chloride based on their relative bioavailability. **MRL:** Oral intermediate MRL = 0.002 mg/kg-day. **Critical Study:** NTP. 1993. NTP technical report on the toxicology and carcinogenesis studies of mercuric chloride (CAS no. 7487-94-7) in F344/N rats and B6C3F1 mice (gavage studies). NTP TR408. **Method:** Fischer 344 rats (10/sex/group) were administered 0, 0.23, 0.46, 0.93, 1.9, or 3.7 mg Hg/kg/day as mercuric chloride in deionized water by oral gavage once daily 5 days per week for 26 weeks. **Critical effect:** no renal effects **End point or Point of Departure (POD):** NOAEL = 0.23 mg Hg/kg/day **Uncertainty Factors:** UF = 100; 10 for each animal to human extrapolation and human variability **Source and date:** ATSDR, March 1999.		

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		MRL: Oral acute MRL for inorganic mercury = 0.007 mg/kg-day. (ATSDR 3/1999) **Tier 3 Source:** **MDEQ:** Per DEQ-CCD-RRD, 01/16/1988, RfD = 0.0003 mg/kg-day based on IRIS file for mercuric chloride. RfD is back-calculated from DWEL = 0.010 mg/L x 2 L/day/70 kg. Critical effect = autoimmune glomerulonephritis. EPA 1987.		
Oral Cancer Slope Factor (CSF) (mg/kg-day)$^{-1}$)		NA	MDEQ, 2015	
CSF details		**Weight of Evidence Characterization:** Cancer classification is C; possible human carcinogen. **IRIS Basis:** Based on the absence of data in humans and limited evidence of carcinogenicity in rats and mice. Focal papillary hyperplasia and squamous cell papilloma in the forestomach as well as thyroid follicular cell adenomas and carcinomas were observed in male rats gavaged with mercuric chloride for 2 years. The relevance of the forestomach papilloma to assessment of cancer in humans is questionable because no evidence indicated that the papilloma progressed to malignancy. The relevance of the increase in thyroid tumors has also been questioned because these tumors are generally considered to be secondary to hyperplasia; this effect was not observed in the high-dose males. It should also be noted that the authors considered the doses used in the study to exceed the MTD for male rats. In the same study, evidence for increases in squamous cell papilloma in the forestomach of female rats was equivocal. In a second study, equivocal evidence for renal adenomas and adenocarcinomas was observed in male mice; there was a significant positive trend. This tumor type is rare in mice, and the increase in incidence was statistically significant when compared with historic controls. Two other nonpositive lifetime rodent studies were considered inadequate. Mercuric chloride showed mixed results in a number of genotoxicity assays. Source and Date: IRIS 06/01/1995. **Tier 1 and 2 Sources:** **IRIS:** Per IRIS (6/1/1995), no CSF value at this time.		Complete

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		PPRTV: Per PPRTV for mercuric sulfide (09/25/2002), no data were located regarding the carcinogenicity of mercuric sulfide i.e., the data are inadequate for an assessment. No PPRTV document for mercuric chloride. **MRL:** NA; MRLs are for non-cancer effects only. **Tier 3 Source**: **MDEQ:** Per DEQ-CCD, no value at this time.		
Reference Concentration (RfC) or Initial Threshold Screening Level (ITSL) (µg/m³)		NA	MDEQ, 2015	
RfC/ITSL details		**Tier 1 and 2 Sources:** **IRIS:** Per IRIS 04/01/1994, RfC not available at this time. **PPRTV:** Per PPRTV 09/25/2002, no toxicity studies of mercuric sulfide or other inorganic mercury salts in humans or animals. The lack of data precludes derivation of a provision RfC for mercuric sulfide. **MRL:** Per ATSDR (3/1999), no inhalation value at this time. **Tier 3 Source:** **MDEQ:** Per DEQ-CCD no value at this time. Values available for Hg vapors.		Complete
Inhalation Unit Risk Factor (IURF) $((\mu g/m^3)^{-1})$		NA	MDEQ, 2015	
IURF details		**Tier 1 and 2 Sources:** **IRIS:** Per IRIS (06/01/1995) no IURF value available at this time. **PPRTV:** Per PPRTV for mercuric sulfide (09/25/2002), no data were located regarding the carcinogenicity of mercuric sulfide i.e., the data are inadequate for an assessment. No PPRTV document for mercuric chloride. **MRL:** NA; MRLs are for non-cancer effects only. **Tier 3 Source:**		Complete

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		MDEQ: Per DEQ-CCD no value at this time.		
Mutagenic Mode of Action (MMOA)? (Y/N)	--	No	USEPA, 2015	
MMOA Details	--	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	--		
State Drinking Water Standard (SDWS) (µg/L)	--	2.0E+0	SDWA, 1976 (for inorganic Hg)	
SDWS details	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399		
Secondary Maximum Contaminant Level (SMCL) (µg/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? (Y/N)	NO	Not evaluated.	NA	
Aesthetic value details	NA	NA		
Is there a Phytotoxicity Value? (Y/N)	NO	Not evaluated.	NA	
Phytotoxicity details	NA	NA		
Others:				

(C) Chemical-specific Absorption Factors

	Part 201 Value	Update	Source/Reference/ Dates	Comments/Notes /Issues
Gastrointestinal absorption efficiency value (ABSgi)	---	1.0	MDEQ, 2015/USEPA RAGS-E, 2004	
ABSgi details		RAGS E (USEPA, 2004) Default Value		
Skin absorption efficiency value (AEd)	---	NA	MDEQ, 2015	
AEd details				
Ingestion Absorption Efficiency (AEi)		NA	MDEQ, 2015	
AEi Details				
Relative Source Contribution for Water (RSC_W)		NA	MDEQ, 2015	
Relative Source Contribution for Soil (RSC_S)		NA	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)	0.0013
Updated GSI value (µg/L)	0.0013
Rule 57 Drinking Water Value (µg/L)	0.0018

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	Rule 57 Value (µg/L)	Verification Date
Human Non-cancer Values- Drinking water source (HNV-drink)	0.0018	7/1997
Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)	0.0018	7/1997
Wildlife Value (WV)	0.0013	7/1997
Human Cancer Values for Drinking Water Source (HCV-drink)	NA	
Human Cancer values for non-drinking water source (HCV-Non-drink)	NA	
Final Chronic Value (FCV)	0.77^{D} D = value is expressed as dissolved	7/1997
Aquatic maximum value (AMV)	1.4^{D} D = value is expressed as dissolved	7/1997
Final Acute Value (FAV)	2.8^{D} D = value is expressed as dissolved	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 (μg/kg)	50	MDEQ Op Memo 2 Att. 1, 2004
Target Detection Limit – Water (μg/L)	0.001	MDEQ Op Memo 2 Att. 1, 2004

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