CHEMICAL UPDATE WORKSHEET

Chemical Name:	**Thallium (metallic Thallium)**
CAS #:	**7440-28-0**
Revised By:	RRD Toxicology Unit
Revision Date:	September 28, 2015

(A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)	204.383	204.38	EPI	EXP
Physical State at ambient temp	Inorganic	Inorganic	MDEQ	
Melting Point (˚C)	---	303.50	Phys Prop	EXP
Boiling Point (˚C)	1457	1473.00	CRC	EXP
Solubility (ug/L)	NA	NA	NA	NA
Vapor Pressure (mmHg at 25˚C)	NA	NR	NA	NA
HLC (atm-m^3/mol at 25˚C)	NR	2.45E-02	PP	EST
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; cm^2/s)	NR	NR	NA	NA
Diffusivity in Water (Dw; cm^2/s)	NR	NR	NA	NA
Soil Water Partition Coefficient (Kd; inorganics)	71	7.1E+01	SSG	EST

	Part 201 Value	Updated Value	Reference Source	Comments
Flash Point (˚C)	NA	216	PC	EXP
Lower Explosivity Level (LEL; unitless)	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	NR	NA
EMSOFT Flux Residential 5 m (mg/day/cm^2)	NA	NR	NR	NA
EMSOFT Flux Nonresidential 2 m (mg/day/cm^2)	NA	NR	NR	NA
EMSOFT Flux Nonresidential 5 m (mg/day/cm^2)	NA	NR	NR	NA

(B) Toxicity Values/Benchmarks

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
Reference Dose (RfD) (mg/kg/day)	6.7E-5	1.0E-5	PPRTV, 2012	
RfD details	90-day rat gavage study. NOAEL = 0.25 mg/kg TLSO4. Dose related increased in alopecia, lacrimation, and exophthalmos (all critical effects), but microscopic evaluations did not reveal histopathologic changes. NOAEL adjusted to the proportion of the dose attributable to thallium alone. In another study (Formigli et al., 1986), testicular effect seen @ 0.7 mg/kg. For this reason, additional 3-fold UF was used. UF = 3000* (US EPA, 1986). *EPA in IRIS used 3-fold modifying	**Tier 3 Source:** **PPRTV Screening Value:** **Basis:** PPRTV (2012) screening chronic p-RfD. California (1999, 2004) developed the same value using the same study, NOAEL, and uncertainty factors. Minnesota adopted the PPRTV value. MDEQ (1988), Massachusetts (1996) and New Jersey (no date) values are the same. See details below. **Tier 1 and 2 Sources**: **IRIS:** Per IRIS (9/30/2009), no value at this time. Per IRIS, the 90-day oral toxicity study of thallium (I) sulfate in Sprague-Dawley rats (MRI, 1988) was identified as a potential principal study; however, the study suffers from certain critical and there are particular difficulties in the selection of appropriate endpoints. Therefore, even though an RfD would generally be derived with a combined uncertainty factor of 3000, an RfD for soluble thallium salts was not derived by IRIS in this case. Refer to the 2009 IRIS Toxicological Review for details. **MRL:** No MRL record is available at this time. **Tier 3 Sources:** **PPRTV Tier 3:** PPRTV (2012) screening chronic p-RfD = 1.0E-5 mg/kg-day. A provisional chronic p-RfD was not derived due to critical limitations of the key study. Note that there is considerably more uncertainty associated with the derivation of a supplemental screening RfD compared to a provisional RfD. This screening value also applies to thallium salts and any of these thallium compounds: Thallium (I) acetate, Thallium (I) carbonate, Thallium (I) chloride, Thallium (I) nitrate, and Thallium (I) sulfate. **Critical Study**: MRI (Midwest Research Institute). (1988) Toxicity of thallium (I) sulfate (CAS No. 7446-18-6) in Sprague-Dawley rats. Vol. 2. Sub chronic (90-day) study [revised final report]. Prepared by Dynamac Corporation, Rockville, MD, for the Office of Solid Waste.		Complete

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
	factor to account for testicular effects. CCD/RRD date: 4/21/1988.	**Method(s)**: male and female Sprague-Dawley rats (20/sex/group) were exposed to 0 (untreated and vehicle controls), 0.01, 0.05, or 0.25 mg/kg-day of an aqueous solution of thallium (I) sulfate (approximately 0, 0.008, 0.04, or 0.20 mg/kg-day T1) by gavage for 90 days. **Critical effect(s)**: hair follicle atrophy in female rats **End point or Point of Departure (POD):** NOAEL = 0.04 mg/kg-day **Uncertainty Factors**: 3,000 (10 each for interspecies variability, interspecies extrapolation and database deficiency, and 3 for use of a sub chronic study) **Source and date:** PPRTV, 10/25/2012 **MDEQ:** Per DEQ-CCD/RRD (4/21/1988), RfD = 6.7E-5 mg/kg-day based on modified EPA (1986) RfD. See Part 201 Value RfD details. **California OEHHA:** RfD = 1.3E-5 mg/kg-day is based on the Public Health Goal (PHG) in Drinking Water; Value established in 1999 and reviewed in 2004 without change: Critical study: Stoltz, ML. Stedman, MA, Brown, LK, Laber, L. El-hawari, AM, 1986. Midwest Research Institute. Final Report. Sub chronic (90-day) Toxicity of Thallium (I) Sulfate (CAS No. 7446-18-6) in Sprague-Dawley Rats. Project No. 8702-L. November 21, 1986. Methods: Thallium sulfate was administered daily by gavage to Sprague-Dawley rats (20/sex/dose) at levels of 0.01, 0.05, or 0.25 mg/kg bw-day for 90 days. Administered doses correspond to 8.1, 40.5 and 202.5 mg Tl/kg bw-day, respectively. Critical effect: alopecia (hair loss) NOAEL: 0.04 mg/kg-day Uncertainty Factors: 3,000 (for use of a sub chronic study (10), interspecies extrapolation (10), interspecies variation (10), and a modifying factor for the steep dose-response curve (3). Sources: OEHHA 1999. Public Health Goal for Thallium and OEHHA 2004. Memorandum: Update of Public Health Goal for Thallium		

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		Massachusetts: RfD = 6.7E-5 mg/kg-day was determined from information used by the U.S. EPA to derive the Drinking Water Equivalent Level (DWEL) for this chemical for the Phase V Rule. This RfD is based on Stoltz et al. (1986) and a total UF of 3,000**.** Source: Massachusetts. Current Regulatory Limit Thallium, 3/1996 **Minnesota PCA:** RfD = 1.0E-5 mg/kg-day is based on PPRTV (2012) and CalEPA (2004). **New Jersey DEP**: RfD = 7.0E-5 mg/kg-day based on IRIS/NJDEP.		
Oral Cancer Slope Factor (CSF) (mg/kg-day)$^{-1}$)	--	NA	MDEQ, 2015	
CSF details	NA	**Carcinogen Weight-of-Evidence (WOE) Class**: "Inadequate Information to Assess Carcinogenic Potential (both oral and inhalation)." **WOE Basis**: no studies on the carcinogenicity of any thallium compound **Source and Date**: IRIS, 9/30/2009; PPRTV, 10/8/2010 **Tier 1 and 2 Sources:** **IRIS:** Per IRIS (9/30/2009), no value at this time. A September 2009 IRIS Toxicological Review is available. **PPRTV:** Per PPRTV (10/8/2010), 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
Reference Concentration (RfC) or Initial Threshold Screening Level (ITSL) (µg/m³)	2.0E-1	2.0E-1	MDEQ, 2009	
RfC/ITSL details	ITSL based on	**Tier 3 Source:**		

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
	R232 (1) (b) and EPA RfD of 8.0E-5 mg/kg from a 90-day rat NOAEL of 0.25 mg/kg thallium sulfate - see IRIS printout. Because this ITSL is for any thallium compound, the ITSL was also adjusted to allow for the difference in molecular weight between thallium and thallium sulfate which the RfD is for. CCD/AQD date: 6/24/09.	**MDEQ:** **Basis:** MDEQ ITSL is based on an extrapolated RfD. No other Tier 3 value is available at this time. See details below. **Tier 1 and 2 Sources:** **IRIS:** Per IRIS (9/30/2009), no value at this time. A September 2009 IRIS Toxicological Review is available. **PPRTV:** Per PPRTV (10/25/2012), no value at this time. **MRL:** No MRL record is available at this time. **Tier 3 Sources:** **MDEQ:** The ITSL was based on RfD =8.0E-5 mg/kg-day: **Critical Study**: MRI (Midwest Research Institute). (1988) Toxicity of thallium (I) sulfate (CAS No. 7446-18-6) in Sprague-Dawley rats. Vol. 2. Sub chronic (90-day) study [revised final report]. Prepared by Dynamac Corporation, Rockville, MD, for the Office of Solid Waste. **Method(s)**: male and female Sprague-Dawley rats (20/sex/group) were exposed to 0 (untreated and vehicle controls), 0.01, 0.05, or 0.25 mg/kg-day of an aqueous solution of thallium (I) sulfate (approximately 0, 0.008, 0.04, or 0.20 mg/kg-day T1) by gavage for 90 days. **Critical effect(s)**: hair follicle atrophy in female rats **End point or Point of Departure (POD):** NOAEL = 0.25 mg/kg-day **Uncertainty Factors**: 3,000 (10 each for interspecies variability, interspecies extrapolation and database deficiency, and 3 for use of a sub chronic study) **Note:** In the Sept 2009 IRIS assessment, the old 90-day rat study used in the old IRIS RfD calculations was considered inadequate in quality to calculate a new RfD; therefore, IRIS did not develop an RfD for thallium. AQD decided to continue to use the old RfD based ITSL to be protective of potential reproductive/developmental effects that are mentioned in the latest IRIS 2009 summary. **Source and date:** MDEQ-CCD/AQD, 6/24/2009		Complete

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		Other Tier 3: No value is available at this time from these Tier 3 sources/databases: HEAST, NTP ROC, health and environmental agencies of California, Massachusetts, Minnesota, New Jersey, New York, and Texas, WHO (IARC), WHO (IPCS/INCHEM), Canada, The Netherlands (RIVM), ECHA (REACH) and OECD HPV.		
Inhalation Unit Risk Factor (IURF) ((µg/m^3)$^{-1}$)	--	NA	MDEQ, 2015	
IURF details	NA	**Carcinogen Weight-of-Evidence (WOE) Class**: "Inadequate Information to Assess Carcinogenic Potential (both oral and inhalation)." **WOE Basis**: no studies on the carcinogenicity of any thallium compound **Source and Date**: IRIS, 9/30/2009; PPRTV, 10/8/2010 **Tier 1 and 2 Sources:** **IRIS:** Per IRIS (9/30/2009), no value at this time. A September 2009 IRIS Toxicological Review is available. **PPRTV:** Per PPRTV (10/8/2010), 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.		
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	2.0	2.0	SDWA, 1976	

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
(SDWS) (ug/L)				
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		
Phytotoxicity Value? (Y/N)	NO	Not evaluated.	NA	
Phytotoxicity details	NA	NA	NA	
Others				

(C) Chemical-specific Exposure 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)	---	0.01	MDEQ, 2015	
AEd details				
Ingestion Absorption Efficiency (AEi)		0.5	MDEQ, 2015	
AEi 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)	3.7 (X)
Updated GSI value (µg/L)	3.7 (X)
Rule 57 Drinking Water Value (µg/L)	2 (M); 1.2

	Rule 57 Value (µg/L)	Verification Date
Human Non-cancer Values- Drinking water source (HNV-drink)	1.2	1/2005
Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)	3.7	1/2005
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)	7.2	7/2014
Aquatic maximum value (AMV)	47	7/2014
Final Acute Value (FAV)	94	7/2014

Sources:

1. MDEQ Surface Water Assessment Section Rule 57 website
2. MDEQ Rule 57 table

(E) Analytical Information

	Value	Source
Target Detection Limit – Soil (µg/kg)	500	MDEQ, 2015
Target Detection Limit – Water (µg/L)	2	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