



CHEMICAL UPDATE WORKSHEET

Chemical Name:	Barium
CAS #:	7440-39-3
Revised By:	RRD Toxicology Unit
Revision Date:	September 24, 2015

(A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)	137.327	137.33	EPI	EXP
Physical State at ambient temp	Inorganic	Inorganic	MDEQ	
Melting Point (°C)	---	710	PP	EXP
Boiling Point (°C)	1640	1600	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)	41	4.1E+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	EST
EMSOFT Flux Residential 5 m (mg/day/cm ²)	NA	NR	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm ²)	NA	NR	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm ²)	NA	NR	EMSOFT	EST

(B) Toxicity Values/Benchmarks

	Part 201 Value	Updated Value	Source*/Reference /Date	Comments/Notes /Issues
Reference Dose (RfD) (mg/kg/day)	7.0E-2	2.0E-1	IRIS, 2005	
RfD details	Subchronic to chronic human drinking water studies (Wones et al., 1990) & (Brenniman & Levy), 1984); NOAEL=0.21 mg/kg/day; UF=3; Critical effect = increased blood pressure.	<p>Tier 1 Source: IRIS: Basis: IRIS is the Tier 1 source. IRIS RfD = 2.0E-1 mg/kg-day. Critical Study: National Toxicology Program (NTP), Public Health Service, U.S. Department of Health and Human Services. (1994) NTP technical report on the toxicology and carcinogenesis studies of barium chloride dihydrate (CAS no. 10326-27-9) in F344/N rats and B6C3F1 mice (drinking water studies). NTP TR 432. Research Triangle Park, NC. NIH pub. No. 94-3163. NTIS pub PB94-214178. Method(s): F344/N rats and B6C3F1 mice (60 animals/sex/group) received 0, 500, 1250, and 2500 ppm barium chloride dihydrate in drinking water for 13 weeks or 2 years. Doses were estimated based on water consumption and body weight data. Critical effect: Nephropathy or renal lesions in mice. End point or Point of Departure (POD): BMDL05 = 63 mg/kg/day Uncertainty Factors: UF = 300 (10 each for interspecies extrapolation and intraspecies variability and 3 for database deficiency) Source and date: IRIS, Last revision date - 7/11/2005</p> <p>Tier 2 Sources: PPRTV: No PPRTV record available at this time. MRL: Per ATSDR (8/2007), chronic oral MRL = 0.2 mg/kg/day. From 12/2014 MRL list.</p> <p>Tier 3 Source: MDEQ: Per CCD/RRD, RfD = 7.0E-2 mg/kg-day. Refer to Part 201 Value RfD details.</p>		Complete
Oral Cancer Slope Factor (CSF) (mg/kg-day) ⁻¹	--	NA	MDEQ, 2015	



	Part 201 Value	Updated Value	Source*/Reference /Date	Comments/Notes /Issues
CSF details	NA	<p>Barium is classified as Group D, “not classifiable as to human carcinogenicity”. Chronic oral exposure studies in rats and mice have not demonstrated carcinogenic effects; however, the lack of adequate inhalation studies precludes assessing the carcinogenic potential of inhaled barium. (IRIS, 2005)</p> <p>Tier 1 and 2 values: IRIS: Per IRIS (7/05/2005), 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 Threshold Screening Level (ITSL) (µg/m³)	5.0E+0	5.0E+0	MDEQ, 2015	
RfC/ITSL details	Insufficient quality data to base ITSL on data other than TLV. Not appropriate to convert oral RfD to ITSL due to known lung effects. CCD/AQD date = 3/9/1992	<p>Tier 3 Source: MDEQ: Basis: HEAST value was ruled out due to the methodology used (see below). MDEQ-AQD methodology/justification best available. See details below.</p> <p>Tier 1 and 2 Sources: IRIS: Per IRIS (7/05/2005), no value at this time. The available data do not meet the minimum database requirements according to the current IRIS methods document for RfCs. PPRTV: No PPRTV record available at this time. MRL: Per ATSDR List (12/2014), no value at this time.</p> <p>Tier 3 Sources: MDEQ: Per CCD/AQD (3/26/15), ITSL = 5.0E+0. Averaging time = 8 hours. Basis: Insufficient quality data to base ITSL on data other than TLV. Not</p>		Complete.

	Part 201 Value	Updated Value	Source*/Reference /Date	Comments/Notes /Issues
		<p>appropriate to convert oral RfD to ITSL due to known lung effects. Updated file to include soluble barium compounds, which have the same TLV according to ACGIH. Note: The combined ambient impact of all barium and soluble barium compounds with the CAS# 543-80-6, 1304-28-5, 10022-31-8, 10361-37-2, 10553-31-8, 13477-00-4, 13718-50-8, 17194-00-2, and 21109-95-5 cannot exceed 5 µg/m³ (8-hour averaging time).</p> <p>Source and date: MDEQ-CCD/AQD, 3/26/2015</p> <p>HEAST: RfC= Subchronic 5E-3, Chronic 5E-4 µg/m³ based on an inhalation reproduction study however, and HEAST 1997 Table 2 states: The subchronic and chronic inhalation values were derived from methodology that is not current with the interim inhalation methodology used by the RfD/RfC Work Group.</p> <p>New Jersey DEP: RfC= 0.5 µg/m³ based on HEAST 1997.</p> <p>New York DEC: RfC= 0.5 µg/m³ based on HEAST 1997.</p> <p>Other Tier 3: No value is available at this time from these Tier 3 sources/databases: NTP ROC, health and environmental agencies of California, Massachusetts, Minnesota and Texas, WHO (IARC), WHO (IPCS/INCHEM), Canada, ECHA (REACH) and OECD HPV.</p>		
Inhalation Unit Risk Factor (IURF) ((µg/m³)⁻¹)	--	NA	MDEQ, 2015	
IURF details	NA	<p>Barium is classified as Group D, “not classifiable as to human carcinogenicity”. (IRIS, 2005)</p> <p>Tier 1 and 2 Sources: IRIS: Per IRIS (7/05/2005), 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:</p>		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, 2014	
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, 2014	
Developmental or Reproductive Toxicity Details	NA	NA		
State Drinking Water Standard (SDWS) (ug/L)	2.0E+3	2.0E+3	SDWA, 1976	
SDWS details	NA	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	
Aesthetic Value details		NA		
Phytotoxicity Value? (Y/N)	NO	Not evaluated.	NA	
Phytotoxicity details	NA	NA		

	Part 201 Value	Updated Value	Source*/Reference /Date	Comments/Notes /Issues
Others	--	--	NA	

(C) Chemical-specific Absorption Factors

	Part 201 Value	Update	Source/Reference/ Dates	Comments/Notes /Issues
Gastrointestinal absorption efficiency value (AEi)	---	1.0	MDEQ, 2015/USEPA RAGS-E, 2004	
ABSgi details		MDEQ, 2015/USEPA RAGS-E, 2004		
Gastrointestinal absorption efficiency value (ABSgi) ABSgi details	---	0.01	MDEQ, 2015	
Skin absorption efficiency value (AE _d)				
AE _d details		0.5	MDEQ, 2015	
Ingestion Absorption Efficiency (AEi)				
AEi Details		1.0	MDEQ, 2015	
Relative Source Contribution for Water (RSC _w)		1.0	MDEQ, 2015	
Relative Source Contribution for Soil (RSC _s)		1.0	MDEQ, 2015	
Others				

(D) Rule 57 Water Quality Values and GSI Criteria

Current GSI value (µg/L)	(G)
Updated GSI value (µg/L)	(G)
Rule 57 Drinking Water Value (µg/L)	1,900

	Rule 57 Value (µg/L)	Verification Date
Human Non-cancer Values- Drinking water source (HNV-drink)	1,900	5/1997
Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)	160,000	5/1997
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)	$EXP(1.0629*(LnH)+1.1869)$	5/2009
Aquatic maximum value (AMV)	$EXP(1.0629*(LnH)+2.2354)$	5/2009
Final Acute Value (FAV)	$EXP(1.0629*(LnH)+2.9285)$	5/2009

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 ($\mu\text{g}/\text{kg}$)	1,000	MDEQ, 2015
Target Detection Limit – Water ($\mu\text{g}/\text{L}$)	100	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