



CHEMICAL UPDATE WORKSHEET

Chemical Name:	Atrazine
CAS #:	1912-24-9
Revised By:	RRD Toxicology Unit
Revision Date:	January 5, 2015

(A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)	215.72	215.69	EPI	EXP
Physical State at ambient temp	Solid	Solid	MDEQ	
Melting Point (°C)	---	173.00	EPI	EXP
Boiling Point (°C)	---	NA	NA	
Solubility (ug/L)	70000	3.447E+05	EPI	EXP
Vapor Pressure (mmHg at 25°C)	0.0000003	2.89E-07	EPI	EXP
HLC (atm-m ³ /mol at 25°C)	2.63E-9	2.60E-09	HSDB	EXP
Log Kow (log P; octanol-water)	2.7	2.61	EPI	EXP
Koc (organic carbon; L/Kg)	451	224.5	EPI	EST
Ionizing Koc (L/kg)		NR	NA	NA
Diffusivity in Air (Di; cm ² /s)	0.08	2.65E-02	W9	EST
Diffusivity in Water (Dw; cm ² /s)	8.0E-6	6.8378E-06	W9	EST
Soil Water Partition Coefficient (Kd; inorganics)	NR	NR	NA	NA

	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)		NA	NA	NA
Enthalpy of Vaporization (cal/mol)		NA	NA	NA
Density (g/mL, g/cm ³)		1.23	PC	EXP
EMSOFT Flux Residential 2 m (mg/day/cm ²)	NA	2.05E-07	EMSOFT	EST
EMSOFT Flux Residential 5 m (mg/day/cm ²)	NA	2.05E-07	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm ²)	NA	2.36E-07	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm ²)	NA	2.36E-07	EMSOFT	EST

(B) Toxicity Values/Benchmarks

	Part 201 Value	Updated Value	Source*/Reference /Date	Comments/Notes /Issues
Reference Dose (RfD) (mg/kg/day)	3.5E-2	1.8E-2	OPP, 2013	
RfD details	<p>(***NOTE*** These details are inconsistent with RfD value used; the rationale is unclear).</p> <p>2-Generation rat reproduction study (Ciba-Geigy, 1987) NOAEL = 10 ppm (0.5 mg/kg/day converted by 1 ppm = 0.05 mg/kg/day assumed rat food consumption; UF=100; Critical effect = decreased body weights of F2 generation pups.</p>	<p>Tier 1 Source: EPA-OPP: Basis: OPP is the more current than IRIS and ATSDR. OPP is a Tier 1 source. OPP (2013) derived a chronic RfD = 1.8E-2 mg/kg-day. The OPP document also provides a chronic population adjusted dose (PAD) of 0.0018 mg/kg/day. The cPAD value included an additional FQPA Safety factor (SF) of 10 applied to the chronic RfD of 0.018 mg/kg-day to account for residual hazard-based and exposure-based uncertainties. This 10x FQPA SF was not included in MDEQ's RfD evaluation.</p> <p>Critical Study: Morseth, S. (1996) Evaluation of the Luteinizing Hormone (LH) Surge in Atrazine-Exposed Female Sprague-Dawley Rats--(Final) 6-Month Interim Report: Lab Project Number: CHV 2386-111: 2386-111: 6791E. Unpublished study prepared by Corning Hazleton Inc. 727 p.</p> <p>Method(s): six-month luteinizing hormone (LH) surge study in rats. Atrazine was administered to 360 female Sprague Dawley rats in the diet for 26 weeks (approximately six months). Dose levels were 0 (negative control), 25, 50, and 400 parts per million (ppm) (0, 1.80, 3.65, 29.44 mg/kg/day).</p> <p>Critical effect: estrous cycle alterations and LH surge suppression (a biomarker indicative of hypothalamic function disruption)</p> <p>End point or Point of Departure (POD): NOAEL = 1.8 mg/kg-day</p> <p>Uncertainty Factors: standard UF = 100 (10 each for intraspecies variability and interspecies extrapolation)</p> <p>Source and date: USEPA OPP 6/4/2013. (Memorandum: Atrazine, Propazine, and Simazine. Human Health Risk Scoping Document in Support of Registration Review. (6/04/2013). EPA-HQ-OPP-2013-0266-0073)</p> <p>Note: Per IRIS (2015), the Program does not currently develop updated assessments for registered pesticides unless the registered pesticides also have non-pesticide uses. The IRIS user should consult the OPP Reregistration Eligibility</p>		Complete



	Part 201 Value	Updated Value	Source*/Reference /Date	Comments/Notes /Issues
		<p>Decision (RED) documents prepared by the Office of Pesticide Programs.</p> <p>Tier 1 and 2 Sources: IRIS: Per IRIS 1993, RfD = 3.5E-2 mg/kg-day. Critical Studies: 1) Ciba-Geigy Corporation. 1986. MRID No. 00141874, 00157875, 00158930, 40629302. HED Doc. No. 005940, 006937. Available from EPA. (unpublished) 2) Ciba-Geigy Corporation, Agricultural Division. 1987a. MRID No. 40431301, 41293801. HED Doc. No. 006718, 006937, 007647. Available from EPA. (unpublished) Methods: 1) Sprague-Dawley rats (20/sex/dose for the chronic study, 50/sex/dose for the oncogenicity study) received 0, 10, 70, 500, and 1000 ppm (0, 0.5, 3.5, 25 and 50 mg/kg-day) atrazine in the diet for 2 years. . (Ciba-Geigy 1986). 2) 5-month-old beagle dogs (6/sex control, 4/sex low- and mid-dose, and 6/sex high-dose) received 0, 15, 150 and 1000 ppm atrazine for 1 year. (Ciba-Geigy 1987a) Critical effect: decreased body weight gain; cardiac toxicity and moderate-to-severe dilation of the right atrium <i>End point or Point of Departure (POD):</i> NOAEL = 3.5 mg/kg-day Uncertainty Factors: UF = 100 (10 each for intraspecies variability and interspecies extrapolation) Source and date: IRIS; Last revision date - 10/01/1993. Per IRIS, as of February, 2004 this substance is no longer being reassessed under the IRIS program.</p> <p>PPRTV: No PPRTV record available at this time.</p> <p>MRL: Per ATSDR (9/2003), no oral chronic MRL value at this time. An oral Intermediate MRL = 0.003 (3.0E-3) mg/kg-day is derived based on reproductive effect: Critical Study (ies): Gojmerac T, Uremovic M, Uremovic S, et al. 1999. Reproduction disturbance caused by an atrazine herbicide in pigs. Acta</p>		

	Part 201 Value	Updated Value	Source*/Reference /Date	Comments/Notes /Issues
		<p>Veterinaria Hungarica 47(1):129-135. Method(s): Groups of nine female Swedish Landrace/Large Yorkshire cross pigs (6–7-monthold gilts) were exposed to 0 or 1 mg/kg/day atrazine in the feed for 19 days beginning with the onset of estrus (day 0). Critical effect: delayed onset of estrus End point or Point of Departure (POD): LOAEL = 1 mg/kg/day Uncertainty Factors: UF = 300 (3 for intraspecies variability and 10 each for interspecies extrapolation and use of a LOAEL.) Source and date: ATSDR, 09/2003</p> <p>Tier 3 Source: MDEQ: Per DEQ-CCD (date), RRD adopted IRIS RfD = 0.035 mg/kg/day.</p>		
Oral Cancer Slope Factor (CSF) (mg/kg-day)⁻¹	7.4E-2	NA	MDEQ, 2015	
CSF details	<p>An increase in mammary gland tumors was found in female Sprague-Dawley rats in a 2 year study conducted by Ciba-Geigy (1986). Revised species scaling factor of (BWh/BWa) to the 0.25 power used for q* calculation. See WRD (former WB) HCV justification. Source and date:</p>	<p>Basis: Based on the most recent review of the cancer data for atrazine, the conclusion of the EPA OPP, 6/4/2013 was adopted i.e., atrazine is not likely to cause cancer in humans.</p> <p>Carcinogen Weight-of-Evidence (WOE) Class: “not likely to be carcinogenic to humans.” IRIS WOE Basis: joint consideration of the available animal cancer and mode of action data and epidemiological studies, does not indicate that atrazine is likely to cause cancer in humans. Results in the St. Gabriel study and other recent epidemiological studies regarding atrazine’s potential link to cancer do not alter that conclusion. Further, any weight attributable to these data is weakened by the data in animals that fail to reveal any mechanism of action for atrazine consistent with the cancers observed in the studies. Source and date: EPA OPP, 6/4/2013. (Memorandum: Atrazine, Propazine, and Simazine. Human Health Risk Scoping Document in Support of Registration Review. (6/04/2013). EPA-HQ-OPP-20 13-0266-0073)</p> <p>Tier 1 and 2 Sources:</p>		Complete.



	Part 201 Value	Updated Value	Source*/Reference /Date	Comments/Notes /Issues
	<p>CCD/RRD. 1/10/2000</p>	<p>IRIS: Per IRIS (10/01/1993), no value at this time. IRIS refers to EPA-OPP RED documents.</p> <p>PPRTV: No PPRTV record available at this time.</p> <p>MRL: NA; MRLs are for non-cancer effects only.</p> <p>Tier 3 Sources:</p> <p>MDEQ: Per DEQ-CCD/RRD (1/10/2000), CSF = 7.4E-2 (mg/kg-day)⁻¹. See Part 201 Value CSF details.</p> <p>Per CCD/WRD, no value at this time. WRD (9/10/2003): A special review of atrazine and other triazines was initiated by EPA in 1994 due to concerns about cancer risks to humans. The Cancer Assessment Review Committee (CARC) of the Office of Pesticide Programs and the FIFRA Science Advisory Panel (SAP) concluded that the mode of action for atrazine in female Sprague-Dawley rats is unlikely to be expressed in humans (EPA, 2002). They also concluded that the epidemiological studies do not make a strong case for an association between exposure of humans to atrazine and cancer formation. EPA (2002) concluded that atrazine should be classified as a "Not Likely to be Carcinogenic to Humans." IARC (1999) concluded that there is strong evidence that the mechanism by which atrazine increases the incidence of mammary gland tumors in Sprague-Dawley rats is not relevant to humans. IARC also concluded that atrazine is not classifiable as to its carcinogenicity. <u>Based on EPA's assessment, a Human Cancer Value will not be derived for atrazine.</u></p> <p>CA OEHHA 1999, Public Health Goal for Atrazine in Drinking Water: OEHHA used a CSF of 2.3E-1 (mg/kg-day)⁻¹ to calculate the DW PHG. The CSF was calculated from the mammary tumor data in rats from the 2 year dietary cancer bioassay by Ciba Geigy (1986).</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 Massachusetts, Minnesota, New Jersey, New York, and Texas, WHO (IARC), WHO (IPCS/INCHEM), Canada, The Netherlands (RIVM), ECHA (REACH) and OECD HPV.</p>		
<p>Reference Concentration</p>	<p>--</p>	<p>2.1E+1</p>	<p>OPP, 2013/MDEQ,</p>	



	Part 201 Value	Updated Value	Source*/Reference /Date	Comments/Notes /Issues
(RfC) or Initial Threshold Screening Level (ITSL) ($\mu\text{g}/\text{m}^3$)			2015	
RfC/ITSL details	NA	<p>Tier 1 Source: EPA-OPP Basis: OPP is the only data available. Per OPP, a Level of Concern (LOC) represented by Margin of Exposure (MOE) values are derived for residential exposure (MOE = 300) and MOE = 100 for occupational exposure. Based on the NOAEL (1.8 mg/kg-day) and UF (300) values, MDEQ derived an RfC = 0.021 (2.1E-2) mg/m^3 assuming 70 kg body weight and 20 m^3/day inhalation rate. An inhalation toxicity endpoint is not estimated for atrazine. MOE basis: Critical Study: Morseth, S. (1996) Evaluation of the Luteinizing Hormone (LH) Surge in Atrazine-Exposed Female Sprague-Dawley Rats--(Final) 6-Month Interim Report: Lab Project Number: CHV 2386-111: 2386-111: 6791E. Unpublished study prepared by Corning Hazleton Inc. 727 p. Method(s): six-month luteinizing hormone (LH) surge study in rats. Critical effect: estrous cycle alterations and LH surge suppression (a biomarker indicative of hypothalamic function disruption) End point or Point of Departure (POD): NOAEL = 1.8 mg/kg-day Uncertainty Factors: standard UF = 100 (10 each for intraspecies variability and interspecies extrapolation) and FQPA Safety Factor (SF) = 3 for residual hazard-based uncertainties. Source and date: USEPA OPP, 6/4/2013. (Memorandum: Atrazine, Propazine, and Simazine. Human Health Risk Scoping Document in Support of Registration Review. (6/04/2013). EPA-HQ-OPP-20 13-0266-0073</p> <p>Tier 1 and 2 Sources: IRIS: Per IRIS (10/01/1993), no value at this time. PPRTV: No PPRTV record available at this time. MRL: Per ATSDR (7/2013), no value at this time.</p>		Complete



	Part 201 Value	Updated Value	Source*/Reference /Date	Comments/Notes /Issues
		Tier 3 Source: MDEQ: Per DEQ-CCD-AQD, no value at this time.		
Inhalation Unit Risk Factor (IURF) (($\mu\text{g}/\text{m}^3$)⁻¹)	--	NA	MDEQ, 2015	
IURF details	NA	<p>Carcinogen Weight-of-Evidence (WOE) Class: “not likely to be carcinogenic to humans.”</p> <p>IRIS WOE Basis: joint consideration of the available animal cancer and mode of action data and epidemiological studies, does not indicate that atrazine is likely to cause cancer in humans. Results in the St. Gabriel study and other recent epidemiological studies regarding atrazine’s potential link to cancer do not alter that conclusion. Further, any weight attributable to these data is weakened by the data in animals that fail to reveal any mechanism of action for atrazine consistent with the cancers observed in the studies.</p> <p>Source and Date: IRIS refers to EPA-OPPT Finalization of Atrazine Interim Reregistration Eligibility Document (IRED), April 6, 2006.</p> <p>Tier 1 and 2 Sources: IRIS: Per IRIS (10/01/1993), 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
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-oral NO-inhalation, the RfD or RfC is not based on a reproductive-developmental effect.	MDEQ, 2015	



	Part 201 Value	Updated Value	Source*/Reference /Date	Comments/Notes /Issues
Developmental or Reproductive Toxicity Details	NA	<p>RfD: Critical Study: Morseth, S. (1996) Evaluation of the Luteinizing Hormone (LH) Surge in Atrazine-Exposed Female Sprague-Dawley Rats--(Final) 6-Month Interim Report: Lab Project Number: CHV 2386-111: 2386-111: 6791E. Unpublished study prepared by Corning Hazleton Inc. 727 p. Method(s): six-month luteinizing hormone (LH) surge study in rats. Critical effect: estrous cycle alterations and LH surge suppression (a biomarker indicative of hypothalamic function disruption).</p> <p>RfC: Critical Study: Morseth, S. (1996) Evaluation of the Luteinizing Hormone (LH) Surge in Atrazine-Exposed Female Sprague-Dawley Rats--(Final) 6-Month Interim Report: Lab Project Number: CHV 2386-111: 2386-111: 6791E. Unpublished study prepared by Corning Hazleton Inc. 727 p. Method(s): six-month luteinizing hormone (LH) surge study in rats. Critical effect: estrous cycle alterations and LH surge suppression (a biomarker indicative of hypothalamic function disruption)</p>		
State Drinking Water Standard (SDWS) (ug/L)	3.0	3.0	SDWA, 1976	
SDWS details	MI Safe Drinking Water Act (SDWA) 1976 PA 399	MI Safe Drinking Water Act (SDWA) 1976 PA 399		
Secondary Maximum Contaminant Level (SMCL) (ug/L)	--	NA	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	



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

(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		MDEQ, 2015/USEPA RAGS-E, 2004		
Skin absorption efficiency value (AE _d)	---	0.1	MDEQ, 2015	
AE _d details				
Ingestion Absorption Efficiency (AE _i)		1.0	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)	7.3
Updated GSI value (µg/L)	7.3
Rule 57 Drinking Water Value (µg/L)	880

	Rule 57 Value (µg/L)	Verification Date
Human Non-cancer Values- Drinking water source (HNV-drink)	880	9/2003
Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)	8,600	9/2003
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)	7.3	12/1997
Aquatic maximum value (AMV)	50	12/1997
Final Acute Value (FAV)	100	12/1997

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 ($\mu\text{g}/\text{kg}$)	50	MDEQ, 2015
Target Detection Limit – Water ($\mu\text{g}/\text{L}$)	3	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 OEHHHA	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