



## CHEMICAL UPDATE WORKSHEET

<b>Chemical Name:</b>	<b>Ammonia</b>
<b>CAS #:</b>	<b>7664-41-7</b>
<b>Revised By:</b>	RRD Toxicology Unit
<b>Revision Date:</b>	November 16, 2015

### (A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)	17.04	17.03	EPI	EXP
Physical State at ambient temp	Liquid	Gas	MDEQ	
Melting Point (°C)	---	-77.7	EPI	EXP
Boiling Point (°C)	-33.35	-33.35	EPI	EXP
Solubility (ug/L)	5.30E+8	4.82E+08	EPI	EXP
Vapor Pressure (mmHg at 25°C)	7600	7.51E+03	EPI	EXP
HLC (atm-m <sup>3</sup> /mol at 25°C)	3.20E-4	1.61E-05	EPI	EXP
Log Kow (log P; octanol-water)	NA	0.23	PP	EST
Koc (organic carbon; L/Kg)	NA	NA	NA	NA
Ionizing Koc (L/kg)		NR	NA	NA
Diffusivity in Air (Di; cm <sup>2</sup> /s)	0.08	2.87E-01	W9	EST
Diffusivity in Water (Dw; cm <sup>2</sup> /s)	8.0E-6	3.3538E-05	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)	0.15	0.15	PC	EXP
Critical Temperature (K)		405.55	HSDB	EXP
Enthalpy of Vaporization (cal/mol)		5.58E+03	CRC	EXP
Density (g/mL, g/cm <sup>3</sup> )		NA	NA	NA
EMSOFT Flux Residential 2 m (mg/day/cm <sup>2</sup> )	NA	NA	EMSOFT	NA
EMSOFT Flux Residential 5 m (mg/day/cm <sup>2</sup> )	NA	NA	EMSOFT	NA
EMSOFT Flux Nonresidential 2 m (mg/day/cm <sup>2</sup> )	NA	NA	EMSOFT	NA
EMSOFT Flux Nonresidential 5 m (mg/day/cm <sup>2</sup> )	NA	NA	EMSOFT	NA

**(B) Toxicity Values/Benchmarks**

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
Reference Dose (RfD) (mg/kg/day)	--	NA	MDEQ, 2015	
RfD details	NA	<p><b>Tier 1 and 2 Sources:</b>  <b>IRIS:</b> Per IRIS (5/1/91), no value at this time.  <b>PPRTV:</b> Per PPRTV (2/02/2005), no value at this time.  <b>MRL:</b> Per ATSDR (10/2004), no value at this time.</p> <p><b>Tier 3 Source:</b>  <b>MDEQ:</b> Per DEQ-CCD, no value at this time.</p>		Complete
Oral Cancer Slope Factor (CSF) (mg/kg-day <sup>-1</sup> )	--	NA	MDEQ, 2015	
CSF details	NA	<p><b>Carcinogen Weight-of-Evidence (WOE) Class:</b> inadequate for an assessment of human carcinogenic potential  <b>IRIS WOE Basis:</b> Human data are not available. Among animals, no evidence for carcinogenicity was observed in two strains of mice administered ammonium hydroxide in drinking water for two years or in a urethane-sensitive strain of mice administered ammonia in water by gavage for 4 weeks. There is some indication that ammonia contributes to the development of cancer when coadministered with DEPC (via formation of urethane) or MNNG (via stimulation of cell proliferation in the gastric mucosa). Limited genotoxicity testing has produced mixed results.  <b>Source and Date:</b> PPRTV, 2/02/2005</p> <p><b>Tier 1 and 2 Sources:</b>  <b>IRIS:</b> Per IRIS (5/1/1991), no value at this time.  <b>PPRTV:</b> Per PPRTV (2/02/2005), no value at this time.  <b>MRL:</b> Per ATSDR (10/2004), no value at this time.</p> <p><b>Tier 3 Source:</b>  <b>MDEQ:</b> Per DEQ-CCD, no value at this time.</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
<b>Reference Concentration (RfC) or Initial Threshold Screening Level (ITSL) (<math>\mu\text{g}/\text{m}^3</math>)</b>	1.0E+2	7.0+1	ATSDR, 2004	
<b>RfC/ITSL details</b>	Based on EPAs RfC, from Holness et al 1989 and Broderson et al 1976. CCD/AQD date: 2/20/1990	<p><b>Tier 2 Source:</b>  <b>ATSDR:</b>  <b>Basis:</b> ATSDR RfC = <math>0.07 \text{ mg}/\text{m}^3</math>. ATSDR is a more recent assessment of ammonia than IRIS. PPRTV (2005) refers to IRIS for the chronic RfC and generates only a subchronic RfC.  <b>MRL:</b> Per ATSDR, chronic inhalation MRL = <math>0.1 \text{ ppm} = 0.07 \text{ mg}/\text{m}^3 = 70 \mu\text{g}/\text{m}^3</math> based on respiratory effect. An acute MRL = <math>1.7 \text{ ppm}</math> has also been derived.  <b>Critical Study:</b> Holness DL, Purdham JT, Nethercott JR. 1989. Acute and chronic respiratory effects of occupational exposure to ammonia. Am Ind Hyg Assoc J 50:646-650.  <b>Method(s):</b> Workers exposed for an average of 12.2 years in a soda ash plant were evaluated for sense of smell, prevalence of respiratory symptoms (cough, bronchitis, wheeze, dyspnea, and others), eye and throat irritation, and lung function parameters (FVC, FEV1, FEV1/FVC, FEF50, and FEF75). The cohort consisted of 52 workers and 35 controls. The subjects were assessed on two workdays: on the first workday of their workweek and on the last workday of their workweek; the average sample collection period was 8.4 hours. All of the participants in the study were males  <b>Critical effect:</b> no significant alterations in lung function in chronically exposed workers  <b>End point or Point of Departure (POD):</b> NOAEL = <math>9.2 \text{ ppm}</math> (mean TWA exposure concentration); adjusted for continuous exposure (<math>9.2 \times 8/24 \text{ hours} \times 5/7 \text{ days}</math>)  <b>Uncertainty Factors:</b> UF = 30 for intraspecies variability and 3 for database deficiencies – lack of reproductive and developmental studies)  <b>Source and date:</b> ATSDR, 10/2004. From April 2015 MRL list.</p> <p><b>Tier 1 and 2 Sources:</b></p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p><b>IRIS:</b> RfC = 1E-1 mg/cu.m = 1E+2 ug/m<sup>3</sup>. (RfC developed in 1991.)</p> <p><b>Critical Studies:</b></p> <p>1) Holness, D.L., J.T. Purdham and J.R. Nethercott. 1989. Acute and chronic respiratory effects of occupational exposure to ammonia. Am. Ind. Hyg. Assoc. J. 50: 646-650.</p> <p>2) Broderson, J.R., J.R. Lindsey and J.E. Crawford. 1976. The role of environmental ammonia in respiratory mycoplasmosis of rats. Am. J. Pathol. 85: 115-130.</p> <p><b>Method(s):</b></p> <p>1) Workers exposed to ammonia in a sodium carbonate production plant. Fifty-two of the 64 available workers participated in the study. The control group consisted of 31 office and stores workers without previous exposure to ammonia.</p> <p>2) F344 rats (6 rats/sex/dose) exposed to ammonia concentrations of 25, 50, 150, or 250 ppm for seven days prior to inoculation with Mycoplasma pulmonaris and for 28 to 42 days following inoculation.</p> <p><b>Critical effect:</b> 1) lack of evidence of decreased pulmonary function in human workers, or 2) increased severity of rhinitis and pneumonia with respiratory lesions in rats.</p> <p><b>End point or Point of Departure (POD):</b></p> <p>1) NOAEL (Holness, 1989) = 9.2 ppm (6.4 mg/m<sup>3</sup>); NOAEL<sub>ADJ</sub> = 2.3 mg/m<sup>3</sup>; NOAEL<sub>HEC</sub> = 2.3 mg/m<sup>3</sup></p> <p>2) LOAEL (Broderson, 1976) = 17.4 mg/m<sup>3</sup>; LOAEL<sub>ADJ</sub> = 17.4 mg/m<sup>3</sup>; LOAEL<sub>HEC</sub> = 1.9 mg/m<sup>3</sup>; Broderson et al., 1976: Assuming 25C and 760 mm Hg, the LOAEL (mg/m<sup>3</sup>) = 25 ppm x 17.03/24.45 = 17.4 mg/m<sup>3</sup>. The LOAEL (HEC) was calculated for a gas: respiratory effect in the Extra Thoracic region. MVa = 0.14m<sup>3</sup>/day, MVh = 20 m<sup>3</sup>/day, Sa(ET) = 11.6 sq. cm, Sh(ET) = 177 sq. cm. RGDR(ET) = (MVa/Sa) / (MVh/Sh) = 0.1068. NOAEL(HEC) = 17.4 x RGDR = 1.9 mg/m<sup>3</sup>.</p> <p><b>Uncertainty Factors:</b> UF = 30; (10 for protection of sensitive individuals and 3 for database deficiencies including the lack of chronic data, the proximity of the LOAEL to the NOAEL and the lack of reproductive and developmental toxicology studies. This factor is not larger than 3, however, since studies in rats (Schaerdel</p>		

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p>et al., 1983) have shown no increases in blood ammonia levels at exposures 32 ppm and only minimal increases at 300-1000 ppm, suggesting that no significant distribution is likely to occur at the HEC level calculated)</p> <p><b>Source and date:</b> IRIS, Last revision date - 2/20/1991. An IRIS screening level review in 2003 identified one or more significant new studies.</p> <p><b>PPRTV:</b> PPRTV (2/02/2005) refers to the RfC IRIS. A subchronic p-RfC = 0.1 mg/m<sup>3</sup> is derived:</p> <p><b>Critical Study:</b> 1) Holness, D.L., J.T. Purdham and J.R. Nethercott. 1989. Acute and chronic respiratory effects of occupational exposure to ammonia. Am. Ind. Hyg. Assoc. J. 50: 646-650.</p> <p><b>Method(s):</b> Workers exposed to ammonia in a sodium carbonate production plant. Fifty-two of the 64 available workers participated in the study. The control group consisted of 31 office and stores workers without previous exposure to ammonia.</p> <p><b>Critical effect:</b> apparent lack of effect on pulmonary function in human workers</p> <p><b>End point or Point of Departure (POD):</b> NOAEL = 9.2 ppm (6.4 mg/m<sup>3</sup>); NOAEL<sub>ADJ</sub> = 4.6 mg/m<sup>3</sup>; NOAEL<sub>HEC</sub> = 2.3 mg/m<sup>3</sup>.</p> <p><b>Uncertainty Factors:</b> UF = 30; (10 for interspecies variability and 3 for proximity of the animal LOAEL to the human NOAEL and database limitations). The animal LOAEL of 1.62 mg/m<sup>3</sup> is in close proximity to the human NOAEL of 2.3 mg/m<sup>3</sup>.</p> <p><b>Source and date:</b> PPRTV, 2/2/2005.</p> <p><b>Tier 3 Source:</b></p> <p><b>MDEQ:</b> Per DEQ-CCD, AQD adopted IRIS value,</p>		
Inhalation Unit Risk Factor (IURF) ((µg/m <sup>3</sup> ) <sup>-1</sup> )	--	NA	MDEQ, 2015	
IURF details	NA	<p><b>Carcinogen Weight-of-Evidence (WOE) Class:</b> inadequate for an assessment of human carcinogenic potential</p> <p><b>IRIS WOE Basis:</b> Human data are not available. Among animals, no evidence for carcinogenicity was observed in two strains of mice administered ammonium hydroxide in drinking water for two years or in a urethane-sensitive strain of mice</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p>administered ammonia in water by gavage for 4 weeks. There is some indication that ammonia contributes to the development of cancer when coadministered with DEPC (via formation of urethane) or MNNG (via stimulation of cell proliferation in the gastric mucosa). Limited genotoxicity testing has produced mixed results.</p> <p><b>Source and Date:</b> PPRTV, 2/02/2005</p> <p><b>Tier 1 and 2 Sources:</b>  <b>IRIS:</b> Per IRIS (5/1/1991), no value at this time.  <b>PPRTV:</b> Per PPRTV (2/02/2005), no value at this time.  <b>MRL:</b> Per ATSDR (7/2013), no value at this time.</p> <p><b>Tier 3 Source:</b>  <b>MDEQ:</b> Per DEQ-CCD, no value at this time.</p>		
<b>Mutagenic Mode of Action (MMOA)? (Y/N)</b>	--	NO	USEPA, 2015	
<b>MMOA Details</b>	--	NA Not listed as a carcinogen with mutagenic MOA in the USEPA OSWER List.		
<b>Developmental or Reproductive Effector? (Y/N)</b>	No	No. The RfD and ITSL are not based on a reproductive-developmental effect.	MDEQ, 2015	
<b>Developmental or Reproductive Toxicity Details</b>	NA	NA		
<b>State Drinking Water Standard (SDWS) (ug/L)</b>	--	NO	SDWA, 1976	
<b>SDWS details</b>	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399		
<b>Secondary Maximum Contaminant Level (SMCL) (ug/L)</b>	--	NO	SDWA, 1976 and USEPA SMCL List	



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
<b>SMCL details</b>	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399 and USEPA SMCL List, 2015		
<b>Is there an aesthetic value for drinking water? (Y/N)</b>	NO	Not evaluated.	NA	
<b>Aesthetic value (ug/L)</b>	NA	NA	NA	
<b>Aesthetic Value details</b>	NA	NA		
<b>Phytotoxicity Value? (Y/N)</b>	NO	Not evaluated.	NA	
<b>Phytotoxicity details</b>	NA	NA	NA	
<b>Others</b>				

**(C) Chemical-specific Absorption Factors**

	Part 201 Value	Update	Source/Reference/ Dates	Comments/Notes /Issues
Gastrointestinal absorption efficiency value (ABS <sub>gi</sub> )	---	1.0	MDEQ, 2015/USEPA RAGS-E, 2004	
ABS <sub>gi</sub> details		MDEQ, 2015/USEPA RAGS-E, 2004		
Skin absorption efficiency value (AE <sub>d</sub> )	---	0.1	MDEQ, 2015	
AE <sub>d</sub> details				
Ingestion Absorption Efficiency (AE <sub>i</sub> )		1.0	MDEQ, 2015	
AE <sub>i</sub> Details				
Relative Source Contribution for Water (RSC <sub>w</sub> )		0.2	MDEQ, 2015	
Relative Source Contribution for Soil (RSC <sub>s</sub> )		1.0	MDEQ, 2015	
Relative Source Contribution for Air (RSC <sub>A</sub> )		1.0	MDEQ, 2015	
Others				

**(D) Rule 57 Water Quality Values and GSI Criteria**

<b>Current GSI value (µg/L)</b>	(CC)
<b>Updated GSI value (µg/L)</b>	(CC)
<b>Rule 57 Drinking Water Value (µg/L)</b>	29 (cold water) 53 (warm water)

	<b>Rule 57 Value (µg/L)</b>	<b>Verification Date</b>
<b>Human Non-cancer Values- Drinking water source (HNV-drink)</b>	ID* (cold water) (29) ID* (warm water) (53)	11/1997 11/1997
<b>Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)</b>	ID* (cold water) (29) ID* (warm water) (53)	11/1997 11/1997
<b>Wildlife Value (WV)</b>	NA (cold water) NA (warm water)	NA NA
<b>Human Cancer Values for Drinking Water Source (HCV-drink)</b>	NA (cold water) NA (warm water)	NA NA
<b>Human Cancer values for non-drinking water source (HCV-Non-drink)</b>	NA (cold water) NA (warm water)	NA NA
<b>Final Chronic Value (FCV)</b>	29 (cold water) 53 (warm water)	10/1997 10/1997
<b>Aquatic maximum value (AMV)</b>	160 (cold water) 210 (warm water)	10/1997 10/1997
<b>Final Acute Value (FAV)</b>	320 (cold water) 420 (warm water)	10/1997 10/1997

Sources:

1. MDEQ Surface Water Assessment Section Rule 57 [website](#)
2. MDEQ Rule 57 [table](#)



**(E) Target Detection Limits (TDL)**

	<b>Value</b>	<b>Source</b>
<b>Target Detection Limit – Soil (<math>\mu\text{g}/\text{kg}</math>)</b>	1,000	MDEQ, 2015
<b>Target Detection Limit – Water (<math>\mu\text{g}/\text{L}</math>)</b>	25	MDEQ, 2015
<b>Target Detection Limit – Air (ppbv)</b>	1.40E+02	MDEQ, 2015
<b>Target Detection Limit – Soil Gas (ppbv)</b>	4.70E+03	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