CHEMICAL UPDATE WORKSHEET

Chemical Name:	**Di(2-ethylhexyl) adipate(DD)**
CAS #:	**103-23-1**
Revised By:	RRD Toxicology Unit
Revision Date:	September 16, 2015

(A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)	370	370.58	EPI	EXP
Physical State at ambient temp	Liquid	Liquid	MDEQ	
Melting Point (˚C)	---	-67.80	EPI	EXP
Boiling Point (˚C)	417	417.00	EPI	EXP
Solubility (ug/L)	471	7.8E+02	EPI	EXP
Vapor Pressure (mmHg at 25˚C)	0.00000085	8.50E-07	EPI	EXP
HLC (atm-m^3/mol at 25˚C)	4.34E-7	4.34E-07	EPI	EXP
Log Kow (log P; octanol-water)	6.11	6.11	PP	EST
Koc (organic carbon; L/Kg)	1.01E+6	3.6E+04	EPI	EST
Ionizing Koc (L/kg)		NR	NA	NA
Diffusivity in Air (Di; cm^2/s)	0.08	1.73E-02	W9	EST
Diffusivity in Water (Dw; cm^2/s)	8.0E-6	4.157E-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	206	CRC	EXP
Lower Explosivity Level (LEL; unit less)	NA	0.004	CRC	EXP
Critical Temperature (K)		845	HSDB	EXP
Enthalpy of Vaporization (cal/mol)		NA	NA	NA
Density (g/mL, g/cm^3)		0.922	CRC	EXP
EMSOFT Flux Residential 2 m (mg/day/cm^2)	NA	6.47E-08	EMSOFT	EST
EMSOFT Flux Residential 5 m (mg/day/cm^2)	NA	6.47E-08	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm^2)	NA	7.88E-08	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm^2)	NA	7.88E-08	EMSOFT	EST

(B) Toxicity Values/Benchmarks

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
Reference Dose (RfD) (mg/kg/day)	1.7E+0	6.0E-1	IRIS, 1992	
RfD details	Rat teratogenicity feeding study, NOAEL=170 mg/kg/day, UF=100; Critical effect = reduced maternal body weight, reduced ossification and slightly dilated ureters in fetuses. Source: IRIS CCD date: 7/16/1991	**Tier 1 Source:** **IRIS:** **Basis:** IRIS selected because it protects for a more sensitive endpoint. IRIS RfD = 6.0E-1 mg/kg-day. IRIS, 07/01/1992. (Per IRIS (01/09/2002) this chemical is being reassessed under the IRIS Program. **Critical Studies**: 1) ICI (ICI Central Toxicology Laboratory). 1988a. Di-(2-ethylhexyl) adipate: Teratogenicity study in the rat. Report CTL/P/2119 (unpublished study); and 2) ICI (ICI Central Toxicology Laboratory). 1988b. Di-(2-ethylhexyl) adipate (DEHA) fertility study in rats. Report CTL/P/2229 (unpublished study). **Methods**: 1) ICI (1988a): Wistar pregnant rats (24/dose) were fed 300, 1800 or 12,000 ppm DEHA (corresponding to doses of 0, 28, 170 or 1080 mg/kg/day) in their diets on gestation days 1 to 22. . 2) ICI (1988b): Wistar- rats (15 males/dose; 30 females/dose) were fed 28, 170, or 1080 mg/kg/day DEHA in their diets. After 10 weeks on the diet, the animals were mated; the one-generation offspring were reared to day 36 post-partum. Test diets were given continuously for approximately 18-19 weeks of exposure. **Critical effects**: For both the ICI, 1988a and ICI, 1988b: changes in body weight and liver weight; increased liver weight of male and female parents; reduced ossification and slightly dilated ureters in fetuses; reduced offspring weight gain, total litter weight, and litter size. **End point or Point of Departure (POD):** NOAEL = 1800 ppm (170 mg/kg/day) **Uncertainty Factors**: UF = 300 (10 each for interspecies extrapolation and interspecies variability and 3 for database deficiencies). **Tier 2 Sources**: **PPRTV:** No PPRTV record is available at this time.		Complete

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		MRL: No MRL record available at this time. **Tier 3 Source:** **MDEQ:** Per DEQ-CCD, RfD = 1.7 mg/kg-day. See Part 201 Value RfD details. WRD (01/20/2001) RfD = 2.7E-1 based on a dietary NOAEL of 1600 ppm (274 mg/kg-day) was found in a 13 week NTP (1982) study in B6C3F1 mice. UF = 1000.		
Oral Cancer Slope Factor (CSF) (mg/kg-day)$^{-1}$)	5.9E-4	1.2E-3	IRIS, 1994	
CSF details	2-year feeding study in B6C3F1 mice, females showed statistically significant increase in combined hepatocellular adenomas and carcinomas (NTP 1982). Source: IRIS-ERD CCD date: 3/14/2000	**Tier 1 Source:** **IRIS:** **Basis:** IRIS is the only available value. **IRIS** CSF = 1.2E-3 (mg/kg-day)$^{-1}$ (12/1/1994). **Critical Study**: NTP (National Toxicology Program). 1982. Carcinogenesis bioassay of di (2- ethylhexyl) adipate (CAS No. 103-23-1) in F344 rats and B6C3F1 mice. NTP-80- 29. NIH Publ. No. 81-1768. **Methods**: 50 B6C3F1 mice/sex/dose were fed 0, 12,000 or 25,000 ppm DEHA in their diet for 104 weeks and observed for 106 weeks. The estimated doses for female mice were 0, 3222 and 8623 mg/kg/day in the control, low- and high-dose groups, respectively, and for male mice were 0, 2659 and 6447 mg/kg/day, respectively. 1) *Dose response data*: *Tumor Type* - combined hepatocellular adenomas and carcinomas; *Test Species* - mouse/B6C3F1, female; *Route* - diet 2) *Extrapolation method*: Linearized multistage procedure, extra risk **Carcinogen Weight-of-Evidence (WOE) Class**: possible human carcinogen (C) **IRIS WOE Basis**: absence of human data and increased incidence of liver tumors in female mice. **Source and Date**: IRIS, Last revision date - 12/1/1994 **Tier 2 Sources**: **PPRTV:** No PPRTV record available at this time. **MRL:** NA; MRLs are for non-cancer effects only.		Complete

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		Tier 3 Source: **MDEQ:** Per DEQ-CCD-RRD (03/14/2000), CSF = 5.9E-4 per mg/kg-day. See Part 201 Value CSF details. WRD CSF = 1.1E-3 per mg/kg-day dated 1/20/2001. (Same NTP study.)		
Reference Concentration (RfC) or Initial Threshold Screening Level (ITSL) (µg/m³)	--	NA	MDEQ, 2015	
RfC/ITSL details	NA	**Tier 1 and 2 Sources**: **IRIS:** Per IRIS (12/01/1992), no value at this time. **PPRTV:** No PPRTV record available at this time. **MRL:** No MRL record available at this time. **Tier 3 Source:** **MDEQ:** Per DEQ-CCD, no value at this time.		Complete
Inhalation Unit Risk Factor (IURF) ((µg/m^3)$^{-1}$)	3.4E-7	3.4E-7	MDEQ, 2000	
IURF details	Based on EPA IRIS Carcinogenicity assessment, in turn based on National Toxicology Program oral bioassay. Critical effect: increased incidence (3/50, 19/50, 18/49 in low, medium and high dose grps.	**Tier 3 Source:** **MDEQ:** **Basis:** MDEQ is the only value returned from the Tier 3 search. See details below. **Tier 1 and 2 Sources**: **IRIS:** Per IRIS (12/01/1994), no value at this time. **PPRTV:** No PPRTV record available at this time. **MRL:** NA; MRLs are for non-cancer effects only. **Tier 3 Source:** **MDEQ:** Per CCD/AQD, IURF = 3.4E-7) (µg/m^3)$^{-1}$. **Basis:** based in IRIS CSF = 1.2E-3 (mg/kg-day)$^{-1}$ derived as follows: **Critical Study**: NTP (National Toxicology Program). 1982. Carcinogenesis bioassay		Complete

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
	resp.) of combined hepatocellular adenomas and carcinomas in female B6C3F1 mice (NTP-TR-212, 1982). CCD/AQD date: 5/12/1999.	of di (2- ethylhexyl) adipate (CAS No. 103-23-1) in F344 rats and B6C3F1 mice. NTP-80- 29. NIH Publ. No. 81-1768. **Methods**: 50 B6C3F1 mice/sex/dose were fed 0, 12,000 or 25,000 ppm DEHA in their diet for 104 weeks and observed for 106 weeks. The estimated doses for female mice were 0, 3222 and 8623 mg/kg/day in the control, low- and high-dose groups, respectively, and for male mice were 0, 2659 and 6447 mg/kg/day, respectively. **Critical effect:** increased incidence (3/50, 19/50, 18/49 in low, medium and high dose grps. resp.) of combined hepatocellular adenomas and carcinomas in female B6C3F1 mice. **Source and Date**: MDEQ-CCD/AQD, 5/12/1999. **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), OECD HPV, and ECHA (REACH).		
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)	YES	YES - oral, the RfD is based on reproductive-developmental effect. Oral Exposure Pathways- Single Exposure No for inhalation exposure.	MDEQ, 2015	
Developmental or Reproductive Toxicity Details	No entry in CCD.	**Critical effects**: Changes in body weight and liver weight and increased liver weight of male and female parents; reduced ossification and slightly dilated ureters in fetuses; reduced offspring weight gain, total litter weight, and litter size. **Critical Studies:** 1) ICI (ICI Central Toxicology Laboratory). 1988a. Di-(2-ethylhexyl) adipate: Teratogenicity study in the rat. Report CTL/P/2119 (unpublished study); and		

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		2) ICI (ICI Central Toxicology Laboratory). 1988b. Di-(2-ethylhexyl) adipate (DEHA) fertility study in rats. Report CTL/P/2229 (unpublished study). **Methods**: 3) ICI (1988a): Wistar pregnant rats (24/dose) were fed 300, 1800 or 12,000 ppm DEHA (corresponding to doses of 0, 28, 170 or 1080 mg/kg/day) in their diets on gestation days 1 to 22. 4) ICI (1988b): Wistar- rats (15 males/dose; 30 females/dose) were fed 28, 170, or 1080 mg/kg/day DEHA in their diets. After 10 weeks on the diet, the animals were mated; the one-generation offspring's were reared to day 36 post-partum. Test diets were given continuously for approximately 18-19 weeks of exposure.		
State Drinking Water Standard (SDWS) (ug/L)	400	400	SDWA, 1976	
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, 2015	
SMCL details	NA	SDWA, 1976 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 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)	---	0.1	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)	ID
Updated GSI value (µg/L)	ID
Rule 57 Drinking Water Value (µg/L)	ID

	Rule 57 Value (µg/L)	Verification Date
Human Non-cancer Values- Drinking water source (HNV-drink)	ID	1/2002
Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)	ID	1/2002
Wildlife Value (WV)	NA	NA
Human Cancer Values for Drinking Water Source (HCV-drink)	ID	1/2002
Human Cancer values for non-drinking water source (HCV-Non-drink)	ID	1/2002
Final Chronic Value (FCV)	4.6	4/2004
Aquatic maximum value (AMV)	41	4/2004
Final Acute Value (FAV)	83	4/2004

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)	330	MDEQ, 2015
Target Detection Limit – Water (μg/L)	5	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