## 4. CHEMICAL AND PHYSICAL INFORMATION

## 4.1 CHEMICAL IDENTITY

Information regarding the chemical identity of malathion is located in Table 4-1.

Malathion is manufactured in the United States as a technical-grade concentrate that is >90% pure malathion and contains approximately 5% of impurities consisting largely of reaction byproducts and degradation products. As many as 14 impurities have been identified in technical-grade malathion. The identities of the impurities and their percent (w/w) in technical grade malathion were found to be as follows: S-1,2-ethyl-*O*,*S*-dimethyl phosphorodithioate (isomalathion; 0.2%), S-1,2-bis(ethoxycarbonyl)-ethyl-*O*,*O*-dimethyl phosphorothioate (malaxon; 0.1%), diethylfumarate (DEF; 0.9%), *O*,*S*,*S*-trimethyl phosphorodithioate (0.003–1.2%), *O*,*O*,*S*-trimethyl phosphorothioate (0.04%), *O*,*O*,*S*-trimethyl phosphorodithioate (1.2%), *O*,*O*,*O*-trimethyl phosphorothioate (0.45%), diethylhydroxysuccinate (0.05%), ethyl nitrite (0.03%), diethyl mercaptosuccinate (0.15%), diethyl methylthiosuccinate (1.0%), *O*,*O*-dimethylphosphorothioate (0.05%), diethyl ethylthiosuccinate (0.1%), and sulfuric acid (0.05%). Malathion is formulated as an emulsifiable concentrate (EC), a dust (D), a wettable powder (WP), a ready-to-use (RTU) liquid, and a pressurized liquid. The quantity of active ingredient (ai) in EC and RTU formulations is variable and can contain up to 82 and 95%, respectively (Brown et al. 1993b; EPA 2001a).

## 4.2 PHYSICAL AND CHEMICAL PROPERTIES

Information regarding the physical and chemical properties of malathion is located in Table 4-2.

Table 4-1. Chemical Identity of Malathion

Characteristic Information		Reference	
CAS Nomenclature	Diethyl[(dimethoxyphosphino -thioyl)thio]butanedioate	CAS 2001	
Common name	Malathion	Howard and Neal 1992	
Synonym(s)	1,2-Di(ethoxycarbonyl)ethyl O,O-dimethyl phosphorodithioate	Howard and Neal 1992	
Registered trade name(s)	Cekumal Fyfanon <sup>®</sup> Malixol <sup>®</sup> Maltox <sup>®</sup>	Farm Chemicals Handbook 2000 Howard and Neal 1992 Farm Chemicals Handbook 2000 Howard and Neal 1992	
Chemical formula	$C_{10}H_{19}O_6PS_2$	Howard and Neal 1992	
Chemical structure	Butanedioic acid, [(dimethoxyphosphinothioyl) thio]-, diethyl ester (malathion)		
Identification numbers: CAS registry NIOSH RTECS EPA hazardous waste OHM/TADS	000121-75-5 WM8400000	Howard and Neal 1992 HSDB 2001	
DOT/UN/NA/IMCO shipping HSDB NCI	NA 2783; Malathion 665	HSDB 2001 HSDB 2001	

CAS = Chemical Abstracts Services; DOT/UN/NA/IMCO = Department of Transportation/United Nations/North America/International Maritime Dangerous Goods Code; EPA = Environmental Protection Agency; HSDB = Hazardous Substances Data Bank; NCI = National Cancer Institute; NIOSH = National Institute for Occupational Safety and Health; OHM/TADS = Oil Hazardous Materials/Technical Assistance Data System; RTECS = Registry of Toxic Effects of Chemical Substance

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**Table 4-2. Physical and Chemical Properties of Malathion** 

Molecular weight Color Colorless liquid (pure form) Deep brown to yellow Physical state Liquid Melting point Soliting point Boiling point Density: at 25 °C Odor Garlic-like Mercaptan Odor threshold: Water 60 °C Air Corganic solvent(s) Miscible with alcohols, esters, aromatics, and vegetable oil; limited solubility in paraffin hydrocarbons  Partition coefficients: Log K <sub>ow</sub> Colorless liquid (pure form) Matsumura 1985 Budavari 1996 Matsumura 1985 Budavari 1996 Budavari 1996 Budavari 1996 NIOSH 1997 Farm Chemicals Handbook 1999 Fazzalari 1978 Ruth 1986 Tomlin 1978 Budavari 1978 Fazzalari 1978 Futition coefficients: Log K <sub>ow</sub> Log Kow Log Kow Cord Deventor Matsumura 1985 Budavari 1996 Budavari 1996  Matsumura 1985 Budavari 1996 Budavari 1996  Fazzalari 1978 Ruth 1986  Tomlin 1997 Budavari 1996 Hansch et al. 1995 Chiou et al. 1977; Freed et al.	Property	Information	Reference	
Deep brown to yellow		330.36		
Physical state Melting point 2.9 °C Boiling point Boiling point pressure Density: at 25 °C Odor Garlic-like Water 60 °C Air  Vater at 20 °C  Organic solvent(s)  Partition coefficients: Log K <sub>ow</sub> Log Charles Log K <sub>ow</sub> Log Charles Log K <sub>ow</sub> Log Charles Log K <sub>ow</sub> Log Charles L	Color	Colorless liquid (pure form)	Matsumura 1985	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		Deep brown to yellow	Budavari 1996; NIOSH 1997	
Boiling point pressure 0.7 torr  Density: at 25 °C 1.23 g/cm³ Budavari 1996  Odor Garlic-like NIOSH 1997 Mercaptan Farm Chemicals Handbook 1999  Odor threshold: Water 60 °C 1.0 mg/L Fazzalari 1978 Air 13.5 mg/m³ (low) and 13.5 mg/m³ (high)  Solubility: Water at 20 °C 145 mg/L Organic solvent(s) Miscible with alcohols, esters, ketones, ethers, aromatics, and vegetable oil; limited solubility in paraffin hydrocarbons  Partition coefficients: Log Kow Log Kow 2.36 Hansch et al. 1995 Chiou et al. 1977; Freed et al.	Physical state	Liquid	Matsumura 1985	
Boiling point pressure Density: at 25 °C  1.23 g/cm³  Budavari 1996  Odor  Garlic-like MIOSH 1997  Mercaptan  Farm Chemicals Handbook 1999  Odor threshold: Water 60 °C Air  13.5 mg/m³ (low) and 13.5 mg/m³ (high)  Solubility: Water at 20 °C Organic solvent(s)  Miscible with alcohols, esters, ketones, ethers, aromatics, and vegetable oil; limited solubility in paraffin hydrocarbons  Partition coefficients: Log Kow Log Kow Log Kow  2.36  Hansch et al. 1995 Chiou et al. 1977; Freed et al.	Melting point	2.9 °C	Budavari 1996	
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at 25 °C  Odor  Garlic-like MIOSH 1997  Mercaptan  Odor threshold: Water 60 °C  Air  1.0 mg/L  Air  13.5 mg/m³ (low) and 13.5 mg/m³ (high)  Solubility: Water at 20 °C  Organic solvent(s)  Miscible with alcohols, esters, ketones, ethers, aromatics, and vegetable oil; limited solubility in paraffin hydrocarbons  Partition coefficients: Log K <sub>ow</sub> Log K <sub>ow</sub> 2.36  Log K <sub>ow</sub> Log K <sub>ow</sub> 2.89  Budavari 1996  NIOSH 1997  Fazzalari 1978  Ruth 1986  Tomlin 1997  Tomlin 1997  Budavari 1996  Hansch et al. 1995  Chiou et al. 1977; Freed et al.	Boiling point pressure	0.7 torr		
Odor threshold: Water 60 °C Air  Vater at 20 °C Organic solvent(s)  Partition coefficients: Log K <sub>ow</sub> Log K <sub>ow</sub> Log K <sub>ow</sub> Log C  Air  Garlic-like Mercaptan  NIOSH 1997 Farm Chemicals Handbook 1999  Fazzalari 1978 Ruth 1986 Ruth 1986  Fazzalari 1978 Ruth 1986  Fatzalari 1978 Ruth 1986  Fazzalari 1978 Ruth 1986  Fatzalari 1978 Ruth 1986  Fazzalari 1978 Ruth 1986  Fatzalari 1978 Ruth 1986  Fatzalari 1978 Ruth 1986  Fazzalari 1978 Ruth 1986  Fatzalari 1978 Fatzalari 1978  Fatzalari 197		•		
Odor threshold: Water 60 °C Air 1.0 mg/L Nater at 20 °C Organic solvent(s)  Partition coefficients: Log K <sub>ow</sub> Log K <sub>ow</sub> Log K <sub>ow</sub> Mercaptan  Farm Chemicals Handbook 1999  Fazzalari 1978 Fazzalari 1978 Ruth 1986  Fazzalari 1978 Fauth 1986  Tomlin 1997 Budavari 1996  Hansch et al. 1995 Chiou et al. 1977; Freed et al.				
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$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Organic solveni(s)			
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Log K <sub>ow</sub> 2.89 Chiou et al. 1977; Freed et al.		2.36	Hansch et al. 1995	
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$Log K_{oc}$ 3.25 1978	Log K <sub>oc</sub>	3.25	1978	
Buyuksonmez 1999	<b>3</b>		Buyuksonmez 1999	
Vapor pressure	Vapor pressure		•	
at 25 °C 5.03x10 <sup>-6</sup> torr Watanabe 1993	at 25 °C		Watanabe 1993	
at 30 °C 3.38x10 <sup>-6</sup> torr SRC 2000	at 30 °C		SRC 2000	
at 25 °C 7.9x10 <sup>-6</sup> torr Kim et al. 1984	at 25 °C	7.9x10 <sup>-6</sup> torr	Kim et al. 1984	
Henry's law constant (25 4.9x10 <sup>-9</sup> atm m <sup>3</sup> /mol Fendinger et al. 1990	Henry's law constant (25	4.9x10 <sup>-9</sup> atm m <sup>3</sup> /mol	Fendinger et al. 1990	
°C)	,		•	
Autoignition temperature No data	Autoignition temperature	No data		
Flashpoint 163 °C <sup>a</sup> Farm Chemicals Handbook 1989	Flashpoint	163 °C²	Farm Chemicals Handbook 1989	
Flammability limits No data		No data		
Conversion factors <sup>b</sup> No data	Conversion factors <sup>b</sup>	No data		
Explosive limits Containers of malathion may U.S. Coast Guard 1984–1985	Explosive limits	Containers of malathion may	U.S. Coast Guard 1984–1985	
explode in a fire		explode in a fire		

<sup>&</sup>lt;sup>a</sup>Pensky-Martens closed cup test <sup>b</sup>The conversion factor for ppm to mg/m³ is: ppm = (mg/m³) (24.45 L/mole)/(g/mole).