

Futures Analysis of Chemicals affecting
Waste Management
Programs

Summary of New Initiatives that
may affect waste management programs

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by

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NOTICE

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FOREWORD

Environmental concern and interest is growing for future analysis of potential environmental problems. EPA's Technology Innovation Office (TIO) provided a grant through the National Network for Environmental Management Studies (NNEMS) to prepare a technology assessment report on a futures analysis of chemicals within the offices of the EPA and their potential effect on waste management programs.

This report was prepared by a third year law student and a second year graduate student from Syracuse University in New York during the summer of 2003. It has been reproduced to help provide federal agencies, states, consulting engineering firms, private industries, and technology developers with information.

About the National Network for Environmental Management Studies (NNEMS)

NNEMS is a comprehensive fellowship program managed by the Environmental Education Division of EPA. The purpose of the NNEMS Program is to provide students with practical research opportunities and experiences.

Each participating headquarters or regional office develops and sponsors projects for student research. The projects are narrow in scope to allow the student to complete the research by working full-time during the summer or part-time during the school year. Research fellowships are available in Environmental Policy, Regulations, and Law; Environmental Management and Administration; Environmental Science; Public Relations and Communications; and Computer Programming and Development.

NNEMS fellows receive a stipend determined by the student's level of education and the duration of the research project. Fellowships are offered to undergraduate and graduate students. Students must meet certain eligibility criteria.

About this Report

This report is intended to provide a basic summary of new initiatives within the EPA . It contains information gathered from a range of currently available sources, including project documents, reports, periodicals, Internet searches, and personal communication with involved parties. No attempts were made to independently confirm the resources used.

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Introduction:

The mission of EPA's Office of Solid Waste and Emergency Response (OSWER) is to provide policy, guidance, and direction for safely managing waste, preparing for, and preventing chemical and oil spills, accidents and emergencies, cleaning up and reusing contaminated property¹. The mission of the Technology Innovation Office (TIO) is to advocate more effective, less costly approaches by government and industry to assess and clean up contaminated waste sites, soil and groundwater through work with other federal agencies, states, consulting engineering firms, responsible parties, technology developers, and the investment community.² This mission includes the responsibility to identify and analyze trends in the private and public sectors that affect programs administered by waste management programs. This paper's focus is on identifying problems that will impact Waste management programs' programs and mission.

This paper reviews regulatory agendas, budgets and programs within the Office of Air and Radiation (OAR), Office of Water (OW), Office of Pollution Prevention and Toxics (OPPT), Office of Pesticides Programs (OPP) to establish a sense of what their priorities are. This compilation of priorities is intended to create a picture of emerging issues for waste management programs in the future by identifying chemicals of concern within OAR, OW, OPPT and OPP.

Approach:

This paper uses information from the EPA's offices of OAR, OW, OPPT and OPP. Within each of these offices, regulatory

agendas, upcoming fiscal year budgets and specific program areas were reviewed and areas that were not regulated, where gaps within the regulations occur or where an office has recently increased emphasis, were all explored for waste management programs implications. For example, the Office of Pesticides is reviewing pesticides that were registered before November 30, 1984 and making a determination as to whether these pesticides meet present registration requirements. OPP has determined that some of these chemicals do not, and some have been voluntarily cancelled by the manufacturer. OPP has not put in place any phase-out program or retrieval mechanism for these now banned pesticides. This gap in the program can leave stockpiles of pesticides unregulated which can be a problem for waste management programs in the future.

Along with these offices, the Agency for Toxic Substances and Disease Registry's (ATSDR), which is a branch of Department of Health and Human Services, website was referred to and their list of chemicals commonly found at Superfund sites was included in this paper.

Scope:

This paper is organized into three sections:

- Section I consists of a matrix and definitions of the items in the matrix.

(The Matrix contains all the chemicals found in the regulatory agendas and new initiatives within each office. High Production Volume is the only category not fully listed because of its immense size; a copy is attached to the end of the paper.)

The matrix includes the following categories of data:

- Symbols indicate whether and where they appear on Resource Conservation and Recovery Act (RCRA) lists.
- Chemical Name: this is the name that was identified on the list, not their scientific name in all cases
- Cancelled Pesticides
- Banned or Severely Restricted Pesticides
- Re- registration 2003/2004: Pesticides that are going through the review process
- Hazardous Air Pollutants (HAP's): this column also includes Urban Air Toxics
- Unregulated Drinking Water Contaminants
- High Production Volume Chemicals
- Persistent, Bioaccumulative Toxic Pollutants
- ATSDR's Top 20 List: 20 most toxic substances found at Superfund sites
- Section II is a more detailed summary of different columns within the matrix and how they can potentially impact Waste management programs in the future.
- Section III is an appendix containing specific elements of each chemical that occurred on more than one list (Examples: Banned Pesticide and Hazardous Air Pollutant or Cancelled Pesticide and Unregulated Drinking Water Contaminant) including commonly used names, molecular formula, molecular mass, common uses, areas of highest concentrations, chemical class,

physical appearance, physical and chemical dangers and physical characteristics.

Methodology:

This paper builds on an analytical foundation begun by a previous TIO effort. An initial consultant-produced paper; "Trends Analysis for the EPA Office of Solid Waste and Emergency Response - Summary of Upcoming Actions Affecting OSWER", viewed specific regulatory actions of the individual offices within EPA and explained how these actions may affect waste management programs.

This paper is also a trends analysis viewed from specific office programs rather than regulatory actions. The offices were chosen by their missions and their roles with chemicals. The offices were viewed to determine if there was any cross-agency interactions that could create unintended consequences for waste management and cleanup.

The paper's focus is specifically on chemicals that OAR, OW, OPP and OPPT recognize as priorities. This was gleaned through their regulatory agendas, budgets and new initiatives.

Section I:

This section contains the matrix; *Identified Chemicals within the EPA Offices*. The Matrix has a total of 10 columns.

- **RCRA Listing:** This column contains symbols that identify if a chemical appears on the RCRA listing of hazardous or characteristic wastes. The following is a list of what each symbol means.

This Font	Chemicals/Groups not on RCRA List
O	40 CFR 261.31
*	40 CFR 261.32
/	40 CFR 261.33 List 1
X	40 CFR 261.33 List 2

- **Chemicals:** This column contains the alphabetical listing of all chemicals found in new initiatives and programs within OAR, OW, OPPT, and OPP. These chemicals have been identified as potential or present problems for these offices and initiatives and regulations have been put into place to control these problems. These initiatives and regulations have the potential to cause unintended consequences on other offices such as Waste management programs. This is the reason that they have been highlighted and written about.
- **Cancelled Pesticides:** This column contains cancelled pesticides in OPP. They can occur due to voluntary cancellation by registrant; cancellation by the EPA because required fees were not paid or cancellation by the EPA because unacceptable risk existed that could not be reduced by other actions
- This column contains Banned, Severely Restricted and SHPF Pesticides within the OPP.
 - **Banned Pesticides:** a chemical where all uses of which within one or more categories have been prohibited by final government action whether it be refusal for approval of use or withdrawal from industry, in order to protect human health or the environment.
 - **Severely Restricted:** a chemical where virtually all uses of which within one or more categories have been prohibited by final government action, in order to protect human health or the environment, but for which certain specific uses remain allowed.
 - **SHPF:** Severely Hazardous Pesticide Formulations are chemicals formulated for pesticidal use that produces severe health or environmental effects observable within a short period of time after single or multiple exposure, under conditions of use.

- This column contained Re-Registration of Pesticides for 2003/2004. These are pesticides that were registered before November 1984 and new regulations require OPP to test and re-register these chemicals. There are three phases to re-registration:
 - **Re-registration Eligibility Decisions (REDs):** EPA has completed review and risk management decision and issues a RED document. This document summarizes the risk assessment conclusions and outlines any risk reduction measures necessary for the pesticide to continue to be registered in the United States.
 - **Interim Re-registration Eligibility Decisions (IREDs):** these are for pesticides that are undergoing reregistration who require a RED document and who still need a cumulative assessment under the Food Quality Protection Act (FQPA). This occurs after the EPA has done their own risk assessment
 - **Reports of FQPA Tolerance Reassessment Progress an Interim Risk Management Decisions (TREDs):** these are pesticides that require tolerance reassessment decisions, but does not require a RED decision at present because the pesticide was registered after November 1984, a RED was done before the FQPA was put in place, August 3,1996 or the pesticide is not registered in the United States.
- **Hazardous Air Pollutants:** This column contains hazardous air pollutants identified by OAR. These are chemicals that are known or suspected to cause a cancer or other serious health effects or adverse environmental effects. There are 188 identified.]
 - **Urban Air Toxics:** 33 HAPs were identified from the list of 188 that pose the greatest threats to public health in urban areas. These pollutants are regulated from their area sources; those that emit less than 10 tons annually of a single HAP or less than 25 tons or more annually of a combination of HAPs; and by risk reduction goals for stationary sources.
 - The words in each column are the area sources that account for the highest release of that particular urban air toxic
- **Drinking Water Contaminants Candidate List:** This column contain contaminants that OW has identified by their known or anticipated occurrence in public water systems. These chemicals are currently under review to determine their cancer causing potential and for determination of what their MCL should be. These particular chemicals were listed because they are not subject to any proposed or promulgated national primary drinking water regulation and may require regulations under Safe Drinking Water Act.
- **High Production Volume Chemicals:** This column contains a voluntary initiative between OPPT and chemical industry. This is part of the chemical right to know program which is a partnership between industry and environmental groups where chemicals are listed and voluntary chemical testing occurs and these results are available to the public

- **PBT Chemicals:** This column contains chemicals that have been identified by OPPT as persistent bioaccumulative and toxic pollutants. The program's goals are to reduce exposure and risk from these pollutants.
- **ATSDR's Top 20 List:** This column contains a list that is a replica of the Top 20 hazardous substances on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Priority List of Hazardous Substances for 2001.

Section II:

This section contains the explanations of the Matrix in greater detail. Each office has their own subsection where the missions and goals of the office are highlighted along with each of the office's programs that appear on the matrix. The programs have a smaller subsection that describes the unintended consequences for waste management programs. The end of each subsection contains a few case studies to highlight the interconnectedness of the offices by showing the unintended consequences that one office's regulations can have on another office within the EPA. Also included in this is a subsection about the Agency for Toxic Substances and Disease Registry (ATSDR) and its connection with the EPA.

Identified Chemicals of the EPA									
RCRA Listing	Chemicals	Cancelled Pesticides	Banned or Severely Restricted	Reregistration 2003/2004	Hazardous Air Pollutants (HAPS) and Urban Air Toxics (see footnote a)	Drinking Water Contaminants Candidate List	High Production Volume	PBT Chemicals	ATSDR's Top 20 List
X	1,1 - Dichloroethane (Ethylidene Dichloride)				X	X - Regulatory Priority *	X		
	1,1 - Dichloropropene					X			
	1,1 - Dimethyl Hydrazine				X				
OX*	1,1,2 - Trichloroethane				X		X		
X	1,1,2,2 - Tetrachloroethane				X - 94% from Municipal Landfills	X - Regulatory Priority	X		
	1,2 - dibromoethane ethylene dibromide (EDB)		X - Banned						
X	1,2 - Diphenylhydrazine				X	X			
	1,2 - Epoxybutane				X				
	1,2 - Propylenimine (2-Methyl Aziridine)				X				
	1,2,4 - Trichlorobenzene				X		X		
	1,2,4 - Trimethyl benzene					X - Regulatory Priority	X		
	1,2-Dibromo -3-chloropropane				X				
X	1,3 - Butadiene				X - 41% from Secondary Lead Smelting		X		
	1,3 - Dichloropropane					X			
X	1,3 - Dichloropropene				X - 82% from Industrial Inorganic Chemical Manufacturing	X - Regulatory Priority			
	1,3 Propane Sul tone				X				
X	1,4 - Dichlorobenzene(p)				X		X		
X	1,4-Dioxane (1,4 - Diethyleneoxide)				X		X		
O	2 - methyl - Phenol (o-cresol)				X	X	X		
OX	2- Nitropropane				X		X		
	2,2 - Dichloropropane					X - Regulatory Priority			
	2,2,4 - Trimethylpentane				X		X		
	2,3,4,5 Bis (2-butylene) tetrahydro - 2 furaldehyde		X - Banned						
	2,3,7,8 - Tetrachlorodibenzo - p - dioxin				X - 73% from Medical Waste Incinerators			X - Priority	
X*	2,4 - D			X - RED '04	X (salts and esters)				

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	2,4 - DB			X- RED '04					
X	2,4 - Dichlorophenol					X	X - Sodium Salt		
/	2,4 - Dinitrophenol				X	X	X		
X*	2,4 - Dinitrotoluene				X	X			
	2,4 - Toluene Diamine				X				
	2,4 - Toluene Diisocyanate				X				
O X	2,4,5 - Trichlorophenol				X				
*	2,4,5 - Trichlorophenoxyacetic Acid (2,4,5 - T)		X - Banned						
X	2,4,6 - Trichlorophenol				X	X			
X	2,6 - Dinitrotoluene					X			
	2-Acetylaminofluorene				X				
	2-Chloroacetophenone				X				
	3,3 - Dichlorobenzidene				X				
	3,3 - Dimethoxybenzidine				X				
	3,3' - Dimethyl Benzidine				X				
	4 - CPA			X - TRED '03					
	4 - Nitrobiphenyl				X				
X*	4 - Nitrophenol				X		X		
	4,4 - Methylene bis (2-chloroaniline)				X				
	4,4 - Methylene dianiline				X				
/	4,6 - Dinitro-o-cresol, and salts				X				
	4-Aminobiphenyl				X				
X*	Acetaldehyde				X - 86% from Stationary Ice		X		
	Acetamide				X				
	Acetochlor					X			
X*	Acetonitrile				X		X		
X	Acetophenone				X				
/	Acrolein				X - 91% from Public Owned Treatment Works				
X	Acrylamide				X				
X	Acrylic Acid				X				
X*	Acrylonitrile				X - 78% from Municipal Landfills				
	Alachlor ESA					X			
/	Aldicarb			X - IRED '04					
/	Aldrin		X - Banned			X - Regulatory Priority		X - Priority	
	Allyl Chloride				X				

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O *	Aluminum					X			
	Americium - 241								
	Amitraz			X - TRED '04					
X *	Aniline				X				
*	Antimony Compounds				X				
	Aroclor 1254 - 1260								X
*	Arsenic				X (Compounds) on both				X
/	Arsenic Trioxide		X - Severely Restricted						
	Asbestos		X - Banned		X				
	Atrazine		X - Severely Restricted	X - IRED '03					
	Azadioxabicyclo-octane			X - RED '04					
X	Bendiocarb	X (9/99)							
	Benfluralin			X - RED '04					
X	Benomyl	X (8/01)							
OX	Benzene				X - 36% from Gas Distributing Stage 1 and 48% from Oil and Natural Gas Production		X		X
	Benzene Hexachloride		X - Banned						
X	Benzidine				X				
	Benzisothiazolin - 3-one (BIT)			X - RED '04					
X	Benzo(a)pyrene							X - Priority	X
	Benzo(b)fluoranthene								X
X	Benzotrichloride				X				
X / *	Benzyl Chloride				X				
(Powder)/	Beryllium Compounds				X (Compounds) - 68% from Institutional Commercial Heating				
	beta - Propiolactone				X				
	Binapacryl		X - Interim Banned						
	Bioban P-1487			X - RED '04					
	Biphenethrin		X - Severely Restricted						
	Biphenyl				X				
	Bis(2-ethylhexyl)phthalate (DEHP)				X				
	Bis(chloromethyl)ether				X				
	Boron					X - Regulatory Priority			

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	Bromobenzene					X - Regulatory Priority			
	Bromoform				X				
	Bromoxynil Butyrate		X - Banned						
	Busan 77			X - RED '04					
X *	Cacodylic Acid			X - RED '04					
	Cadmium		X Compounds - Banned		X (Compounds) on both				X
	Calcium Arsenate		X - Banned						
	Calcium Cyanamide				X				
	Caprolactam				X				
	Captafol		X - Banned						
	Captan				X				
X	Carbaryl			X - IRED '03	X				
	Carbofuran		X (Granular) Severely Restricted	X - IRED '04					
/	Carbon Disulfide				X		X		
O X *	Carbon Tetrachloride		X - Banned		X on both lists				
	Carbonyl Sulfide				X				
	Carboxin			X - RED '04					
	Catechol				X				
	Cesium - 137								
	Chloramben				X				
	Chloranil		X - Banned						
X *	Chlordane		X - Banned		X			X - Priority	X
	Chlordecone (kepone)		X - Banned						
	Chlordimeform		X - Banned						
	Chlorine				X				
	Chloroacetic Acid				X		X - Sodium Salt		
O X *	Chlorobenzene				X		X		
X	Chlorobenzilate		X - Banned		X				
	Chloroform				X - 88% from Public Owned Treatment Works				X
X	Chloromethoxypropylmercuric Acetate (CPMA)		X - Banned						
	Chloromethyl Methyl Ether				X				
	Chlorpicrin		X - Severely Restricted						
	Chloroprene				X				
	Chlorpyrifos - methyl	X (4/01)	X - Severely Restricted						
	Chlorsulfuron			X - RED '03					

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	Chromated Copper Arsenate (CCA)			X - RED '03					
	Chromium Compounds				X - 42% from Hard Chromium Electroplating				X - Hexavalent
	Coal Tar/Creosote			X - RED '03					
	Cobalt Compounds				X				
*	Coke Oven Compounds				X on both lists		X		
	Copper Arsenate		X - Banned						
O X *	Cresols/Cresylic Acid (Isomers & Mixtures)				X				
X *	Cumene				X				
O /	Cyanide Compounds 1				X				
	Cycloate			X - RED '04					
	Cypermethrin			X - RED '04					
	Dacthal (DCPA)			X - TRED '03					
	Daminozide/Alar		X - Severely Restricted						
	DBCP		X - Banned						
	DDE				X	X		X - Priority	
X	DDT		X - Banned					X - Priority	X (p/p)
	Di (phenylmercury) dodeceny succinate (PMDS)		X - Banned						
	Diazinon					X			
	Diazomethane				X				
X	Dibenz(a,h)anthracene								X
	Dibenzofurans				X				
	Dibutyl phthalate				X				
X	Dichloroethyl Ether (Bis(2-Chloroethyl) Ether)				X				
	Dichlorvos			X - IRED '03	X				
/	Dieldrin		X - Banned			X - Regulatory Priority			X
	Diethanolamine				X				
	Diethyl Sulfate				X				
	Dihalomethylhydantoin			X - RED '03					
/	Dimethoate			X - IRED '03					
	Dimethyl Aminoazobenzene				X				
	Dimethyl Carbamoyl Chloride				X				
	Dimethyl Formamide				X				
	Dimethyl Phthalate				X				
	Dimethyl Sulfate				X				
	Dinocap	X ('03)							
/	Dinoseb and Salts		X - Banned						
* /	Disulfoton		X - Severely Restricted			X			
	Diuron			X - RED '03		X			

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	DNOC		X - Banned						
/	Endrin		X - Banned						
X	Epichlorohydrin (1-Chloro-2,3 epoxypropane)				X				
	EPN		X - Banned						
	EPTC (s-ethyl-dipropyl thiocarbamate)					X			
	Ethephon			X - TRED '03					
	Ethion	X (4/01)	X - Severely Restricted						
	Ethoprop		X - Severely Restricted						
	Ethoxyquin			X- RED '03					
X	Ethyl Acrylate				X				
O	Ethyl Benzene				X		X		
X	Ethyl Carbamate (Urethane)				X				
*	Ethyl Chloride (Chloroethane)				X				
	Ethyl Hexyleneglycol (6-12)		X - Banned						
	Ethyl Parathion	X (9/00)							
X *	Ethylene Dibromide (Dibromoethane)				X on both lists				
X *	Ethylene Dichloride (EDC) (1,2-Dichloroethane)		X - Banned		X - 53% from Municipal Landfills		X		
	Ethylene Glycol				X				
	Ethylene Glycol Monobutyl Ether			X - TRED '04					
	Ethylene Imine (Aziridine)				X				
X	Ethylene Oxide		X - Severely Restricted		X - 87% from Hospital Sterilizers				
	Ethylene Thiourea				X				
	Fenamiphos	X (3/02)							
	Fenridazon Potassium			X - TRED '03					
	Fenvalerate			X - RED '04					
	Fine Mineral Fibers				X				
	Fipronal		X - Severely Restricted						
/	Flouroacetamide		X - Banned						
	Fluazifop Butyl			X - TRED '04					
	Fonofos	X (3/99)				X			
X	Formaldehyde			X - RED '04	X - 92% from Stationary Ice		X		
	Formetanate HCL			X- IRED '04					
	Glycol ether				X				
/	Heptachlor		X- Banned		X			X	

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O X	Hexachlorobenzene		X - Banned		X - 99% from Agricultural Chemicals and Pesticides Manufacturing			X - Priority	
X	Hexachlorobutadiene				X	X - Regulatory Priority			X
X	Hexachlorocyclohexane /lindane		X - Severely Restricted		X (Lindane - Isomers)				
X *	Hexachlorocyclopentadiene				X				
X *	Hexachloroethane				X		X		
	Hexamethylene - 1,6 - Diisocyanate				X				
	Hexamethyl phosphoramide				X				
*	Hexane				X		X		
X	Hydrazine				X - 76% from Industrial Inorganic and Organic Chemical Manufacturing				
*	Hydrochloric Acid				X				
X	Hydrogen Flouride (Hydroflouric Acid)				X				
X	Hydrogen Sulfide				X				
	Hydroquinone				X				
	Imazalil			X - RED '03					
	Iodine - 129 & 131								
	Isofenphos	X (3/99)							
	Isophorone				X				
	Lactofen			X - TRED '04					
	Lead				X (Compounds) on both			X	X
	Lead Arsenate		X - Banned						
	Leptophos		X - Banned						
	Linuron					X			
	Malathion			X - IRED '03					
X	Maleic Anhydride				X				
	Mancozeb			X - RED '04					
	Maneb			X - RED '04					
/	Manganese				X (Compounds) on both	X - Regulatory Priority			
	MCPA			X - RED '04					
X /	Mercury		X (Compounds) - Banned		X (Compounds) - 57% from Medical Waste Incinerators			X - Priority	X
	Methamidophos		X - SHPF						
O X *	Methanol				X		X		
X	Methoxychlor				X			X	
X *	Methyl Bromide (Bromomethane)				X	X			

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X	Methyl Chloride (Chloromethane)				X				
X	Methyl Chloroform (1,1,1 - Trichloroethane)				X				
O X	Methyl Ethyl Ketone (2-Butanone)				X				
/	Methyl Hydrazine				X				
X	Methyl Iodide (Iodomethane)				X				
O X	Methyl Isobutyl Ketone (Hexone)				X				
	Methyl Isocyanate				X				
X	Methyl Methacrylate				X				
/	Methyl Parathion		X - SHPF	X - IRED '03					
	Methyl dithiocarbamate (HOCH ₂)	X							
O X	Methylene Chloride (Dichloromethane)				X - 40% from Paint Strippers				
	Methylene Diphenyl Diisocyanate (MDI)				X				
	Metiram			X - RED '04					
	Metolachlor		X - Severely Restricted			X - Regulatory Priority			
	Metribuzin					X - Regulatory Priority			
	Mevinphos		X - Banned						
	MGK - 326			X - RED '03					
	Mirex		X - Banned					X - Priority	
	Molinate			X - RED '03		X			
	Monocrotophos		X - Banned						
	Methyl Tert Butyl Ether				X				
X	N - Nitroso - N - Methylurea				X				
X /	N - Nitrosodimethylamine				X				
	N - Nitrosomorpholine				X				
	N,N - Diethyl Aniline (N,N - Dimethylaniline)				X				
X *	Naphthalene				X	X - Regulatory Priority	X		
	Nickel Compounds				X - 41% from Institutional Commercial Heating		X		
O X *	Nitrobenzene				X	X	X		
	Nitrofen (TOK)		X - Banned						
	o-Toluidine				X				
	o-Anisidine				X				
	OMPA (octamethyl pyrophosphoramide)		X - Banned						
	Organotins					X - Regulatory Priority			

RCRA Listing	Chemicals	Cancelled Pesticides	Banned or Severely Restricted	Reregistration 2003/2004	Hazardous Air Pollutants (HAPS) and Urban Air Toxics (see footnote a)	Drinking Water Contaminants Candidate List	High Production Volume	PBT Chemicals	ATSDR's Top 20 List
	Oryzalin			X - TRED '04					
	Oxadiazon			X - RED '03					
	Oxadixyl	X (9/01)							
	Oxydemeton		X - Severely Restricted						
	Oxythioquinox	X (3/99)							
	p - Phenylenediamine				X				
	Paranitrophenol	X (9/97)							
/	Parathion		X - SHPF		X				
	PCNB			X - RED '04					
X	Pentachloronitrobenzene (Quintobenzene)				X				
O X *	Pentachlorophenol		X - Severely Restricted	X - RED '03	X				
	Perchlorate					X			
O *	Perchloroethylene (Tetrachloroethylene)				X - 94% from Dry Cleaning Facilities				
	Permethrin		X - Severely Restricted						
X *	Phenol				X		X		
	Phenylmercuric Oleate (PMO)		X - Banned						
/	Phenylmercury Acetate (PMA)		X - Banned						
	Phorate		X - Severely Restricted						
/	Phosgene				X				
	Phosphamidon		X						
/	Phosphine				X				
	Phosphorus				X				
*	Phthalic Anhydride				X				
	p-Isopropyl toluene (p-cymene)					X			
	Pival	X (9/97)							
	Plutonium								
	Poly (hexamethyleneguanidine) (PHMB)			X - RED '03					
	Polybrominated Flame Retardants								
	Polychlorinated Biphenyls (PCBs)				X - 65% from Hazardous Waste Incineration			X - Priority	X
	Polychlorinated Dibenzofurans (furans)							X - Priority	
	Polychlorinated Dibenzo-p-dioxins (dioxins)				Only on Urban Air			X - Priority	

RCRA Listing	Chemicals	Cancelled Pesticides	Banned or Severely Restricted	Reregistration 2003/2004	Hazardous Air Pollutants (HAPS) and Urban Air Toxics (see footnote a)	Drinking Water Contaminants Candidate List	High Production Volume	PBT Chemicals	ATSDR's Top 20 List
	Polycyclic Aromatic Hydrocarbons								X
	Polycyclic Organic Matter ⁴				X - on both lists				
	Potassium 2,4,5 trichlorophenate (2,4,5 - TCP)		X - Banned						
	Potassium Bromide			X - TRED '03					
	Prometon					X			
	Propanil			X - RED '03					
	Propionaldehyde				X				
X	Propoxur (Baygon)				X				
	Propylene Dichloride (1,2 - Dichloropropane)				X on both lists				
	Propylene Oxide				X				
	Pyriminil (Vacor)		X - Banned						
	Quinoline								
	Quinone				X				
	Radionuclides (including radon) ⁵				X				
	Radium								
	Radon								
	RDX					X			
	Ryanodine	X (3/99)							
	Safrole		X - Banned						
X	Selenium Compounds				X				
X	Silvex		X - Banned						
	Sodium					X			
	Sodium Acifluorfen			X - RED '04					
	Sodium Arsenate		X - Severely Restricted						
	Sodium Arsenite		X - Banned						
	Sodium Fluoride			X - RED '04					
	Sodium Xylenesulfonate			X - TRED '04					
	Strontium - 90								
	Styrene				X				
	Styrene Oxide				X				
	Sulfate					X - Regulatory Priority			
	Sulfonated Oleic Acid, Sodium Salt			X - TRED '04					
	Sulfotep	X (9/99)							
	Sulprofos	X (4/97)							
	TDE		X - Banned						
	Technetium - 99								
	Terbacil					X			
	Terbufos					X			
	Terpene Polychlorinates (Strobane)		X - Banned						

RCRA Listing	Chemicals	Cancelled Pesticides	Banned or Severely Restricted	Reregistration 2003/2004	Hazardous Air Pollutants (HAPS) and Urban Air Toxics (see footnote a)	Drinking Water Contaminants Candidate List	High Production Volume	PBT Chemicals	ATSDR's Top 20 List
/	Thallium Sulfate		X - Banned						
	Thiophanate - methyl			X - RED '03					
X	Thiram			X - RED '04					
	Thorium								
	Titanium				X				
O X *	Tetrachloride				X				
	Toluene				X				
* /	Toxaphene		X (Chlorinated Campene) - Banned		X (Chlorinated Campene)			X - Priority	
	Triazines					X - Regulatory Priority			
	Tributyl tin Compounds		X - Severely Restricted						
O X *	Trichloroethylene				X - 85% from Halogenated Solvent Cleaners				X
	Trichloromel amine			X - RED '04					
X	Triethylamine				X				
	Triethylene Glycol			X - RED '04					
	Trifluralin			X - TRED '04	X			X	
	Tritium								
	Uranium								
/	Vanadium					X - Regulatory Priority			
	Vernolate	X (3/99)							
	Vinyl Acetate				X				
	Vinyl Bromide				X				
X *	Vinyl Chloride		X - Banned		X - 83% from Municipal Landfills				X
	Vinylidene Chloride (1,1 - Dichloroethylene)				X				
O X	Xylenes (Isomers and Mixtures)				X				
	Zinc Omadine			X - RED '03					
/	Ziram			X - RED '03					
	footnote a	Writing in HAP Column pertains to Urban Air Toxic Program which identifies the main point source for each chemical							
		* Identified as a regulatory priority in 1998, decisions to be made by 2001.							

Pesticides:

OPP regulates the use of all pesticides in the United States and establishes maximum levels for pesticide residues in food, thereby safeguarding the nation's food supply.

“Pesticides include many kinds of ingredients used in products, such as insecticides, fungicides, rodenticides, insect repellents, weed killers, antimicrobials and swimming pool chemicals, which are designed to prevent, destroy, repel, or reduce pests of any sort.”³

Any pesticides that is used on a food crop must be assessed for a maximum residue limit or tolerance, this is the amount of residue allowed to remain in or on each treated food commodity. The limit is usually determined by the standard of “reasonable certainty of no harm.” This is determined by a variety of factors including the toxicity of the pesticide and its breakdown products; how much of the pesticide is applied and how often and how much of the pesticide remains in or on food by the time it is marketed and prepared. A pesticide that is considered safe, does not need a tolerance level.⁴

Statutory Authority for the Office of Pesticides:

- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) which controls the risk assessment and labeling and registration of pesticides before manufacture, sale or transport can occur and the cancellation of registration.
- The Federal Food, Drug and Cosmetic Act (FFDCA) controls the tolerance level assessments by granting the authority to the EPA to set these levels and provide exemptions.
- The Food Quality Protection Act (FQPA) 1996 version established a single standard which includes the cumulative effect of exposure and has provoked the re-registration of many of these pesticides.

5

Cancelled Pesticides:

Cancelled pesticides can occur due to voluntary cancellation by registrant; cancellation by the EPA because required fees were not paid or cancellation by the EPA because unacceptable risk existed that could not be reduced by other actions. During the re-registration process that has occurred since 1997, 16 pesticides have been voluntarily cancelled and only one has been unable for re-registration.⁶

Unintended Consequences for Waste Management Programs:

Once these chemicals are cancelled, they fall off the EPA radar screen because the

pesticide office does not keep track of cancelled pesticides. Since these pesticides are not tracked, there is a potential for stockpiles to occur. The sites where these stockpiles exist are likely to become contaminated with these chemicals which would require cleanup. This cleanup will be directed by waste management programs guidelines and RCRA standards.

Banned, Severely Restricted and Severely Hazardous Pesticide Formulations:

A pesticide that is banned or severely restricted is placed on the Prior Informed Consent (PIC) list. For a pesticide to be included on the PIC list a country must nominate the chemical for inclusion. This can occur by two countries taking regulatory actions banning or restricting the use and sending this action along with health assessments to the PIC Secretariat or a developing country experiences under typical use of a chemical that is banned in most developing countries and this information is sent to the PIC Secretariat. If the Secretariat determines that the criteria for listing the chemical is met then a Decision Guidance Document (DGD) is developed that includes the regulatory actions taken and risk determinations which is sent to the Conference of Parties who decides whether the chemical is to be added to the PIC List. The DGD is then sent to all countries that belong to the Party and the individual country decides what action they want to take with the pesticide.⁷

There are three categories on the PIC: List; banned, severely restricted and severely hazardous pesticide formulation.

- *A Banned pesticide* is a chemical all uses of which within one or more categories have been prohibited by

final government action whether it be refusal for approval of use or withdrawal from industry, in order to protect human health or the environment.

- *A Severely Restricted Pesticide* is a chemical virtually all uses of which within one or more categories have been prohibited by final government action, in order to protect human health or the environment, but for which certain specific uses remain allowed.
- *Severely Hazardous Pesticide Formulations* are chemicals formulated for pesticidal use that produces severe health or environmental effects observable within a short period of time after single or multiple exposure, under conditions of use.
 - This usually applies to developing countries that do not have the same technology to combat the effects of exposure that developed countries have⁸

Unintended Consequences for Waste Management Programs:

These guidance documents are of interest to Waste management programs because the pesticide has the potential to be banned and these documents allow waste management programs to forecast the potential problems or cleanups needed if these pesticides were to be banned.

Banned pesticides or restricted use pesticides have a higher potential for stockpiles since they have not been cancelled, but they cannot be used. The pesticide is no longer in production but it is

still in homes, stores and warehouses. The probable result of this, groups of pesticides lying dormant with a need for proper disposal or cleanup. Again, waste management programs may be needed for cleanup or guidance or direction may need to be issued for proper disposal guidelines.

Restricted Use pesticide may require guidance and direction from waste management programs in how to safely manage and use these pesticides and preparation for accidental spills to meet the tougher standards.

PIC Criteria includes:

- confirmation of regulatory action and risk evaluation
- relevance of the action to other countries
- evidence of current international trade

Re-registration for FY 2003-2004:

Within the pesticide office, there is a division called Special Review and Re-registration Division (SRRD) which is in charge of all re-registration and tolerance assessments for the pesticides registered before November 1984 and evaluated before 1996. This process is begun by submission of studies to Health Effects Division (HED) and Environmental Fate and Effects Division (EFED) for health risk evaluation.

To be eligible for reregistration; a pesticide must have a substantially complete data base and must not cause unreasonable risks to human health or the environment when used in accordance with its approved label

directions and precautions. There must be a conclusion within reasonable certainty that no harm will come to infants, children or other sensitive individuals exposed to these pesticides as directed by the 1996 amendments to FIFRA by FQPA. This harm includes exposure from all possible sources such as food, drinking water and domestic exposure. This is determined by the assessment of the aggregate exposure of the public to pesticide residues from all sources including food, drinking water and residential uses; cumulative effects of pesticides and other substances with common mechanisms of toxicity; special sensitivity of infants and children to pesticides.¹⁰

Risk assessment includes:

- hazardous identification (health effects through oral, dermal and inhalation);
- exposure assessment (from food, water, and residential use through oral, dermal and inhalation routes of exposure);
- dose-response assessment (health effects at different levels of exposure); and
- risk characterization (the added risk of the pesticide in the

RISK = toxicity x exposure

- Acute and Chronic Threshold Effects: Aggregate Exposure/Reference Dose x 100
- Non-threshold Effects: Probability = q_1^* x Aggregate Exposure (in milligrams per kilogram per day) ¹

In determining the approach to the re-registration process, the pesticides were divided into 4 lists from A to D. List A contains food use pesticides which contains 194 chemicals that already went through this process prior to 1996 must be reassessed and are undergoing further testing to see if they meet the stricter safety standard of reasonable certainty of no harm. List B is a higher priority than C which is higher than D. This priority list is determined by the likelihood for residues to be found in food or drinking water and potential for worker exposures.

Once a determination is made as to where the pesticide belongs then the re-registration process begins. There are 5 phases to this process but not all pesticides go through all of the phases. The 5 phases are List of Active Ingredients, Declare Intent and Identify Studies, Summarize Studies, EPA Review and Data Call-In and Re-Registration Decisions.¹³The List A pesticides were able to go through a more abbreviated testing sequence since they have

¹Aggregate Exposure is the combination of dietary exposure from food residues, non-occupational exposure from indoor and outdoor residential pesticide applications and drinking water exposure. q_1^* indicates the relative potency of the chemical as a carcinogen.

been through this testing process before. List B, C and D went through all 5 phases.

- Phase 1 included listing these chemicals and seeking the manufacturers intentions for re-registration.
- Phase 2 was where the manufacturers declared their intentions to re-register and committed to the entire testing process with their first fee installment.
- Phase 3 after the pesticides went through testing, summary reports were required.
- Phase 4 was where the EPA went through these summaries and requested any missing or lacking data.
- Phase 5 is where the determination is made as to whether the pesticides meet all applicable standards and safety standards under FQPA

There are three parts to Phase 5 which include:

- Re-registration Eligibility Decisions (REDs): EPA has completed review and risk management decision and issues a RED document. This document summarizes the risk assessment conclusions and outlines any risk reduction measures necessary for the pesticide to continue to be registered in the United States.
- Interim Re-registration Eligibility Decisions (IREDs): these are for pesticides that are undergoing reregistration who require a RED document and who still need a cumulative assessment under the Food Quality Protection Act (FQPA). This occurs after the EPA has done their own risk assessment

- Reports of FQPA Tolerance Reassessment Progress and Interim Risk Management Decisions (TREDs): these are pesticides that require tolerance reassessment decisions, but does not require a RED decision at present because the pesticide was registered after November 1, 1984, a RED was done before the FQPA was put in place, August 3, 1996 or the pesticide is not registered in the United States. ¹⁴

Unintended Consequences for Waste Management Programs:

Although, pesticides going through re-registration do not pose a present problem, they will cause one if they are to be cancelled or banned as the above paragraphs explain.

Along with the potential of stockpiles is the changing of standards for the use of the pesticides or the amount that can be present in the air, water or land. The pesticides that are going through re-registration are being retested to assure their compliance with today's safety standards. A pesticide has the potential to not meet safety standards in its current state, but would for a different or more limited use. Or a pesticide may be found to have adverse health effects on humans at the level it is currently used at, but a safe level is found. These two scenarios would require land sprayed with these pesticides to meet the new maximum contaminant levels which might require waste management programs involvement in the cleanup to meet these new standards.

Summary of Unintended Consequences for Waste Management Programs:

- Assessment level is determined and chemical can no longer be used
- Assessment level is changed, requiring reopening sites that have been cleaned-up to meet new standards.
- Pesticides are cancelled and stockpiles of these chemicals appear
- May need to issue guidance documents or direction to assure safe management of these pesticides

Case Studies:

The following are examples of how offices within the EPA are interconnected. The actions of one office have unintended consequences on the programs and goals of another. As an example, Methyl Tert Butyl Ether (MTBE) was created as an octane enhancer to replace lead in gasoline in accordance with Clean Air Standards. MTBE has recently been found in drinking water which becomes a problem for the OW because Maximum Contaminant Levels for MTBE need to be determined and also for Waste management programs because the MTBE needs to be cleaned up.

Methyl Bromide:

Methyl Bromide (MeBr) is a fungicide used for soil fumigation in agricultural crops; ornamentals; soil, manure, mulch and compost fumigation; stored commodities

(both raw agricultural commodities and processed foods/feeds); greenhouses; homes; grain elevators; mills; ships and transportation vehicles. The Montreal Protocol and Clean Air Act calls for the phase-out of methyl bromide by 2005. During the Protocol, methyl bromide was identified as a significant ozone depleting compound where import and production, with no exceptions, had to cease by 2001. The ozone depletion level is .38, which is .18 above the .2 level of the Class 1 chemicals that must be eliminated¹⁵

There is strong opposition by mills, farmers and fresh cut flower growers because no cost effective alternative has been found to replace methyl bromide. These growers and mills are currently asking for Critical Use Exemptions if no single alternative is found that can work as well or no economically viable alternative is found. Along with these exemptions, the growers and mills would like to be at 39% of its 1991 consumption level in 2005, which is 9% over what the current 2003 standard is under the Protocol. The critical use exemption states that “a party can seek exemption from the 2005 phase out if it is determined that the absence of MeBR would cause a significant market disruption,... the nominating party has demonstrated that there are no technically or economically viable alternatives for the uses in the context of the application and that the party continues to make efforts to find alternatives for the use and to limit emissions.”¹⁶ These standards and requests are currently under review.

Alternatives for as a soil fumigant involve products containing 1,3 - dichloropropene especially when it is combined with Chloropicrin. Metam sodium, also known

as Vapam, is comparable for weed control. Other fungicides used for vegetables include Halosulfuron (also known as Sandea), Trifloxysulfuron Sodium (also known as Envoke) and Iodimethane (also known as Midas) for nematodes, diseases and weeds. None of these alternatives can work alone and be as effective as methyl bromide. In combination, they are comparable to methyl bromide for strawberries, tomatoes and peppers.¹⁷

Unintended consequences for Waste Management Programs:

Methyl bromide is currently being stockpiled for the purpose of critical use exemptions since production has ceased.¹⁸ If the phase-out was to be complete by 2005 and no exemptions are made because alternatives are found, these stockpiles will still exist with no need for them. This excess methyl bromide would need to be disposed of which will probably involve waste management programs's guidance or directions. If any of these stockpiles were to leak then waste management programs may be needed to assist in the clean-up of the sites.

In addition, part of waste management programs's mission is to provide policy and guidance for safely managing waste and preventing accidents. If critical use exemptions were to be made, waste management programs may need to provide guidance to these users for the proper and safe use of methyl bromide to meet the new standards that were set by the Montreal Protocol.

Atrazine:

Atrazine, is a widely used herbicide for the control of broadleaf and grassy weeds with 76.5 million pounds applied domestically per year. It is also used on corn, sorghum, sugarcane, wheat, guava, macademia nuts, orchard grass, range grasses, and southern turf grasses. Atrazine is also used for non-agricultural uses on lawns, golf courses and sod farms. Growers of corn and sugarcane are the most extensive users of atrazine and the states with the most widespread use are Delaware, Iowa, Illinois, Indiana, Ohio and Nebraska. In areas of high dose use, atrazine is found in 40 parts per billion in precipitation.

Atrazine is currently under Interim Re-registration Eligibility Decision (IREDD) in the EPA's pesticide division which means that it needs a cumulative assessment under Food Quality Protection Act before it can be re-registered. This pesticide is of particular interest because of the 10,000 community water systems fed by surface water, atrazine is used at 3,600 of them and 200 of them are close to or exceed the maximum contaminant level. These systems are found in Alabama, Ohio, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Michigan, Missouri and Texas. This particular pesticide was registered in 1958 and may not need meet current safety standards, although the pesticide is not believed to have any carcinogenic effect on humans. The concern with this pesticide is on the imbalance of hormone levels and disruption of reproductive systems in laboratory animals, particularly frogs. The studies have been criticized because the lower doses produced more of an effect than higher doses but lower doses do not produce inconsistent results. Other studies have

found that this impact is not limited to just frogs, many aquatic organisms show signs of these changes. These criticisms and shortcomings are the reason that atrazine is still under the IRED review system and its fate is unknown.¹⁹

Unintended Consequences for Waste Management Programs:

If this pesticide is found to be harmful to humans or animals, it is probable that the pesticide will be banned or only allowed for restricted uses. If this happens, then the potential problems will exist that exist for all restricted use or banned pesticides. Sites needing clean up from the contamination from atrazine or stockpiles that need to be disposed of where waste management programs guidance or assistance will be needed.

Carbofuran:

Carbofuran is a severely restricted insecticide that can only be used for the control of beetles, nematodes, and rootworms on alfalfa, rice, turf and grapes. It is sprayed directly on soil and the plants after the emergence of the pests. The EPA has set Carbofuran's maximum contaminant level (MCL) at 40 parts per billion in drinking water because of its potential for nervous and reproductive systems damage. Since, the primary cause of the drinking water contamination is runoff from fields or leaching of crops, the use of granular carbofuran has been severely restricted to keep with the MCL since 1992. The same restrictions have not been placed on flowable carbofuran, even though, it is believed to pose the same risks.

The agriculture departments of Louisiana, Oklahoma, and Texas want to be able to use flowable carbofuran on their crops. They are looking for a specific exemption request to treat cotton for cotton aphid. If this exemption is granted, the EPA would have to go through a Special Review Process for flowable carbofuran before they could place any restrictions on it. This process could take years for all the testing to be done where the potential for the MCL in drinking water to rise above 40 parts per billion exists.²⁰

Unintended Consequences for Waste Management Programs:

It is already known that granular carbofuran is dangerous and has the tendency to runoff from fields into drinking water. Once testing is done, the possibility exists that flowable carbofuran will react the same way and it will need to be removed from the water again. Waste management programs would then have to issue guidance or participate in the clean up of the water sources that were contaminated.

Air:

OAR is concerned with pollution prevention, indoor and outdoor air quality, industrial air pollution, pollution from vehicles and engines, radon, acid rain, stratospheric ozone depletion, and radiation protection. One of the ways that OAR meets these goals is by identifying and regulating hazardous air pollutants (HAPs).²¹

Where do HAPs come from?

- Mobile sources (cars, buses)
- Stationary Sources (factories)
- Indoor Sources (cleaning solvents)

HAPs are those pollutants that are known or suspected to cause a cancer or other serious health effects or adverse environmental effects. Presently, the EPA has identified 188 chemicals and placed them in the HAP category. These pollutants are considered cancer causing at sufficient concentrations and durations. EPA defines health effects to include damage to the immune system, as well as neurological, reproductive, developmental, respiratory and other health problems. People are exposed to these pollutants by breathing in contaminated air, eating contaminated food, drinking contaminated water, ingesting contaminated soil or touching contaminated soil or water.

OAR has currently issued 79 air toxic standards covering 123 source categories along with stricter tailpipe emissions. The current initiative that OAR has is the Air Toxics Strategy.²²

Statutory Authority for the Office of Air:

- Clean Air Act

Urban Air Toxics:

In 1999, 33 HAPs were extracted from the 188 listed for the Urban Air Toxics Program. This was in response to Congress' request that the EPA develop a strategy to

address the large number of smaller area sources. These toxics pose serious threats because of the large number of people that are exposed and the variety of sources that they come from such as mobile and stationary. The 33 identified are the HAPs that OAR decided posed the greatest threats to public health in urban areas by highest toxicity, concentrations or most people exposed for major, area and mobile sources. These area sources are identified as those that emit less than 10 tons annually of a single HAP or less than 25 tons of more annually of a combination of HAPs. Along with these 33 pollutants identified have been 70 area sources that represent 90% of the emissions for these pollutants, to date only 14 of them have been regulated (see attached). An example of a major area source is Municipal Landfills and Publicly Owned Treatment Works.

Goals of the Air Toxics Strategy:

- attain a 75% reduction in incidence of cancer attributable to exposure to HAPs emitted by large and small stationary sources nationwide;
- attain a substantial reduction in health risks posed by emissions from these areas sources; and
- address disproportionate impacts of air toxics hazards across urban areas such as geographic hot spots, highly exposed population subgroups, and predominantly minority and low income communities.²³

Urban Air Toxics:

Acetaldehyde
 Acrolein
 Acrylonitrile
 Arsenic Compounds
 Benzene
 Beryllium Compounds
 1,3 - Butadiene
 Cadmium Compounds
 Carbon Tetrachloride
 Chloroform
 Chromium Compounds
 Coke Oven Emissions
 1,3 - Dichloropropene
 Dioxin
 Ethylene Dibromide
 Ethylene Dichloride
 Ethylene Oxide
 Formaldehyde
 Hexachlorobenzene
 Hydrazine
 Lead Compounds
 Manganese Compound
 Mercury Compounds
 Methylene Chloride
 Nickel Compounds
 Perchloroethylene
 PCB's
 Polycyclic Organic Matter
 Propylene Dichloride
 Quinoline
 1,1,2,2 - Tetrachlorethane
 Trichloroethylene
 Vinyl Chloride

How does the Office of Air plan to achieve these goals?

- By developing regulations addressing sources of air toxics at both the national and local levels
- Initiating projects at both the national and local level to address specific pollutants and to identify and address specific community risks
- conduct air toxic assessments
- perform education and outreach to inform and get input into designing and implementing programs

Unintended Consequences for Waste Management Programs:

The Urban Air Toxic Strategy pinpoints and seeks to control area sources that emit these hazardous air pollutants. The control of these sources will usually require modification of facilities or change in practices in order to meet these new standards. The cost may be more than it is worth to keep the facility open and these new standards may force the closure of some of these urban area sources. If the source was to close then the site might need waste management programs guidance or direction for disposal of waste within the facility and for cleanup around the facility so that reuse of the land can occur.

If the area source or facility was to remain open, the areas surrounding these facilities would probably need to be cleaned up to meet new standards. Again, waste management programs guidance may be needed on how the facility can meet these

new standards and cleanup in the safest and most efficient manner.

Summary of Unintended Consequences for Waste Management Programs:

- The land surrounding identified area sources have higher concentrations of these pollutants.
- The new standards for area sources may cause a financial burden that would cause the area source to close leaving a potentially contaminated plot of land.

Case Studies:

MTBE:

Methyl Tertiary Butyl Ether, also known as MTBE, is an oxygenate that is blended into gasoline as an octane enhancer under guidelines of the Clean Air Act to reduce smog. MTBE is a flammable liquid that is created by blending isobutylene and methanol. Although, MTBE meets Clean Air standards, the chemical leaks from underground storage tanks or seeps into the ground and has been found in drinking water where it persists for several years.²⁴ Research has not been conducted in any significant degree for the ingestion of MTBE because the assumption was that human exposure would be through fumes. In 1997, a preliminary standard of 20-40 parts per billion was issued for water was set by the Drinking Water Advisory Panel while the EPA did further research.

In 1998, the Blue Ribbon Panel, under the direction of Administrator Carol Browner,

issued a recommendation to reduce MTBE. In 1999, California released a state phase-out plan of all MTBE by December 31, 2002. In 2002, EPA's Underground Storage Tanks (UST) and TIO issued recommendations for in situ and ex situ treatment of MTBE. Until 2003, there had not been any action passed to definitively reduce MTBE on a nation wide level. The renewable fuel plan is presently being debated in the Senate which calls for the phase-out of MTBE by 2007 and replacement of MTBE by a minimum level of ethanol beginning in 2005. This level will continue to increase until 2012 when an "ethanol mandate" will be issued for 5 billions gallons a year to replace MTBE in gasoline.²⁵

Unintended Consequences for Waste Management Programs:

MTBE is a present problem that is being fixed. The potential problem is in ethanol. MTBE replaced lead in gasoline as a safer alternative that met Clean Air Standards. The consequences of MTBE were not known. Now, ethanol is here as the alternative for MTBE to again meet Clean Air Standards. The consequences of this are not yet known, the same problems caused by MTBE could occur again. In that case, the same cleanup routines that are now in place for MTBE may need to be put in place for ethanol.

Even if ethanol by itself is not be a problem, when it mixes with benzene or the remaining MTBE, problems could occur. The fate of ethanol is not known and there is the potential that it may need waste management programs intervention in the future.

Perchloroethylene:

Perchloroethylene, the chemical commonly known as "perc" is in a 2020 phase-out plan in California, the only state to have taken this step. Other synonyms for perchloroethylene are tetrachloroethylene, tetrachloroethane, ethylene tetrachloride, 1,1,2,2 - tetrachloroethylene, perchlor and carbon dichloride. Perc is a synthetic chemical, which is colorless and non-flammable and is used primarily in the dry cleaning business, accounting for 80-85% of all dry cleaning fluid used. This chemical was used to substitute chlorofluorocarbons (CFCs) for aerosol dry cleaning. It is also used in textile mills, chlorofluorocarbon producers, vapor degreasing, metal cleaning operations and by makers of rubber coatings.²⁶

Perc break downs when exposed to air into other chemicals, respiration of the vapors accounts for the highest exposure pathway for humans. In response to this exposure, California has set its current permissible exposure limit (PEL) to 50 parts of perc per million parts of air or 335 milligrams of perc per cubic meter. There has been a decrease since 1981, when CFCs were still in use and perc was not as widely used, rural areas were at 160 parts per million and areas near emission sources were at 1300 parts per million. California has taken this step because of the likely carcinogenic and cancer-causing effects of this chemical in human exposure, although no definitive link has been found.

Along with this phase-out plan, California has proposed an alternative that has been used in European dry cleaning for over 10 years. This method is called "wet cleaning". Wet cleaning soaks the items in water,

instead of chemicals and then the normal processes of drying and finishing. California's South Coast Air Quality Management District finds this a suitable alternative while the dry cleaners do not agree. The EPA has added N-Propyl Bromide to the list of substitutes for ozone depleting chemicals that are used in solvents and cleaners and in aerosol solvent and adhesive-end uses. This could be another alternative. The debate is ongoing and has spurred other countries such as Canada and Japan to reduce the use of perc as well. ²⁷

Unintended Consequences for Waste Management Programs:

Perchloroethylene is an example of a chemical that was not known to be a problem when it was first put on the market. It was used to replace CFCs in aerosols to meet Clean Air Standards. Now, it is being found in drinking water and it likely to be carcinogenic to humans. The result is the need to remove perc from drinking water systems which will require some level of technical waste management programs guidance. If it is found to be carcinogenic or cancer-causing, there may be a need for direct intervention by waste management programs for immediate removal out of these water sources.

Water:

OW ensures that all Americans will have drinking water that is clean and safe to drink. And to provide effective protection of America's rivers, lakes, wetlands, aquifers, and coastal and ocean waters will sustain fish, plants, and wildlife, as well as recreational, subsistence, and economic activities. Watersheds and their aquatic ecosystems will be restored and protected to

improve human health, enhance water quality, reduce flooding, and provide habitat for wildlife.²⁸ In order to meet this goal, OW regulates common contaminants found in drinking water.

These contaminants are assessed for a Maximum Contaminant Level (MCL) which is the maximum concentration of a chemical that is allowing in public drinking water systems. If a chemical is thought to be non-cancer causing then it goes through a health risk assessment to determine an MCL for the particular contaminant (See Attached List) If the contaminant is believed to cause cancer then the MCL is zero. The Safe Drinking Water Act also requires that the EPA establish a list of contaminants to aid in priority-setting for the Agency's drinking water program, the potential candidates were compiled in 1998. ²⁹

Statutory Authority for the Office of Water:

- Clean Water Act
- Safe Drinking Water Act
- Marine Protection, Research and Sanctuaries Act

Health Risk Assessment: Determining MCLs

- Hazard Identification: types of injuries exposure causes and the conditions of that exposure
- Dose/Response Assessment: Dose of chemical and the magnitude and type of biological response
- Risk Characterization for Non-Carcinogens: $(RfD \times \text{Body Weight}) / (\text{Intake} \times \text{Duration} \times \text{Frequency})$
- Exposure Assessment: $(\text{Concentration} \times \text{Intake} \times \text{Duration} \times \text{Frequency}) / \text{Body Weight}^2$

Drinking Water Contaminants Candidate List:

These chemicals are currently under review to determine their cancer causing potential and for determination of what their MCL should be. These particular chemicals were listed because “they are not subject to any proposed or promulgated national primary drinking water regulation and are known or anticipated to occur in public water systems and may require regulations under Safe Drinking Water Act.” In 1998, these chemicals were prioritized by regulatory and research priorities; research was broken down by health, treatment and analytical. A determination must be have been made by 2001 for those contaminants that were, with proposed rules by 2003 and promulgations by 2005. ³⁰

²RfD is the result of the calculation in the dose-response phase which is the reference dose or safe dose for exposure

1998 Regulatory Determination Priorities:

- 1,1,2,2 - Tetrachloroethane
- 1,1 - Dichloroethane
- 1,2,4 - Trimethylbenzene
- 1,3 - Dimethylpropene
- 2,2 - Dichloropropane
- Aldrin
- Boron
- Bromobenzene
- Dieldrin
- Hexachlorobutadiene
- p - Isopropyltoluene
- Manganese
- Metolachlor
- Metribuzin
- Naphthalene
- Organotins
- Sulfate
- Triazines
- Vanadium

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Unintended Consequences for Waste Management Programs:

If new MCLs are promulgated or old ones are changed in order for Waste management programs to act there would need to be a formal rule-making process done for RCRA or the site may fall under risk based standards under CERCLA. Currently, RCRA has not amended any of their MCLs standards in accordance with any of water’s new regulations.

There is always the chance that an unregulated contaminant is found to be carcinogenic and may need immediate action which would require waste management programs involvement even if no RCRA lists were changed.

Summary of Unintended Consequences for Waste Management Programs:

- MCLs will be established for currently unregulated contaminants and sites will need to be meet these standards
- New and emerging science will change the MCLs for contaminants and sites will need to be reopened to meet these new standards

Case Studies:

Arsenic:

Arsenic is a naturally occurring element in the earth's crust that cannot be destroyed in the environment.(ATSDR) Long-term exposure to arsenic in drinking water has been linked to cancer of the bladder, lungs, skin, kidneys, nasal passages, liver and prostate. There are also non-cancer effects on the cardiovascular, pulmonary, immunological, neurological and endocrine.

The first standard that the EPA set was in 1975 based on 1942 reports at 50 ppb. Further study was done in 1999 and this 50 ppb standard was not ensuring public safety and had to be revised.

The new standard in 2001 was issued at 10 ppb or .010 mg/l, where all public water systems must be in compliance by 2006. This standard was determined to be the level that maximizes health risk reduction benefits at a cost that is justified by its benefits. This corrective action will impact 54,000 community water systems, a system that serves 15 locations or 25 residents year round and 20,000 water systems that serve

at least 25 people for more than 6 months a year.³²

Unintended Consequences for Waste Management Programs:

If RCRA was to change the arsenic MCL standard from the old standard of 50 ppb to 10 ppb, sites would need to meet that higher standard. This might involve reopening sites that were formerly cleaned to the old standard. Or newly contaminated sites would need to be meet the new, more stringent standard and waste management programs guidance would be needed.

Perchlorate:

Perchlorate is a synthetic compound used in industry as an oxidizer for rocket fuel and in missiles and fireworks.. It can also be found in some rare geologic deposits. Pechlorate has been found in drinking water, the salts readily dissolve in water and the components persist. For this reason, perchlorate was listed on the "Drinking Water Contaminants Candidate List" and was reviewed by the EPA. A preliminary standard was advised at 4 - 18 ppb as a safe level for drinking water. California set their standard at the lowest 4 ppb.

Upon further testing, it has been found that even the 4 ppb is too high, and the new standard should be 1 ppb. Perchlorate has been found to cause adverse effect in humans by blocking iodine intake by the thyroid. For adults, this would mean an interference with metabolism. For children, the thyroid assists in development and this blockage can hinder that.^{33,34}

Unintended Consequences for Waste Management Programs:

If RCRA is to adopt the MCL for perchlorate that OW has recommended then normal waste management programs involvement of guidance for disposal and cleanup would be needed.

Since perchlorate has been found to have health effects especially on children, there may be a more immediate need for cleanup of heavily contaminated water systems which would be under CERCLA's risk based standards.

Toxic Substances:

OPPTS promotes the use of safer chemicals, processes, and technologies; promotes life-cycle management of environmental problems such as asbestos; advances pollution prevention through voluntary action by industry; and promotes the public's right to know.³⁵ As part of this goal, the office of toxic substances has created the High Production Volume Challenge Program and The Persistent Bioaccumulative and Toxic Chemical Program.

Statutory Authority for the Office of Pesticides:

- Toxic Substances Control Act
- Pollution Prevention Act
- Emergency Planning and Community Right to Know Act

High Production Volume Chemicals:

A high production volume chemical are those that are manufactured in, or imported into, the United States in amounts equal to or exceeding 1 million pounds per year. This is part of the chemical right to know initiative, this is a partnership between industry and environmental groups where voluntary chemical testing occurs and these results are available to the public.

Since the testing is voluntary there is flexibility in the tests that are conducted on these chemicals and the output is only detailed study summaries. "The intent of EPA's HPV Challenge Program is to gather a basic set of environmental and health effects data for each chemical and make this data publicly available and thereby improve the public's understanding of the toxicity of chemicals most commonly used in this country. This is only considered a risk assessment, there is still the chance that further testing will be done that will prevent any production or use of these chemicals."³⁶

Plan for meeting goals:

- Address problems on multimedia bases
- Coordinate with international efforts and domestic federal programs
- Stress cost-effectiveness
- Involve stakeholders
- Emphasize innovative technology and pollution prevention
- Protect vulnerable sub-populations
- Base decisions on sound science
- Use measurable objectives and assess performance

Unintended Consequences for Waste Management Programs:

This program is voluntary and extensive testing is not needed for the chemicals to be placed onto the list. More testing can be required on chemicals that show adverse human or ecological effect during testing. The more extensive tests have the potential to reveal that these chemicals are dangerous and can no longer be used. If the chemical is now banned from use, there is the problem that this was a high production chemical, manufactured at more than 1 million pounds a year. The sheer volume of production increases the chance that many sites will be contaminated and need waste management programs involvement in disposing and cleaning up their site.

Persistent Bioaccumulative and Toxic Chemicals:

PBT pollutants are chemicals that are toxic, persist in the environment and bioaccumulate in food chains and, thus, pose risks to human health and ecosystems. The biggest concerns about PBTs are that they transfer rather easily among air, water, and land, and span boundaries of programs, geography, and generations. They are associated with a range of adverse health effects including the nervous system, reproductive and developmental problems, cancer, and genetic impacts.

This particular program focuses on coordinating efforts by toxic substances, air and water to draft regulations for the prevention and removal of PBT under a recognition that the actions of one office has an affect on others by identifying and reducing risks to human health. Although the present focus is only on 12 priority

chemicals and not all priorities have been banned from use.³⁷

Unintended Consequences for Waste Management Programs:

The nature of PBT chemicals makes cleanup more difficult since they accumulate in living organisms and persistent in the environment. In addition, to difficulty in getting rid of these chemicals, not all of PBTs have been banned from production. Each additional day that they are produced increases the need for measures to be taken for cleanup and disposal which will involve waste management programs.

States that have issued advisories due to PBT concentrations in water:

- Maine
- Vermont
- New Hampshire
- Massachusetts
- Rhode Island
- Connecticut
- New Jersey
- New York
- Ohio
- Indiana
- Michigan
- Missouri
- North Carolina
- Alabama
- Florida
- Louisiana
- Texas

Summary of Unintended Consequences for Waste Management Programs:

- Clean up of these priority PBT chemicals
- Potential for new PBTs to be identified and guidance or direction will be needed for disposal and cleanup
- Potential will for new chemicals to be created that will be found to be PBT

The Dirty Dozen:

Aldrin
Chlordane
DDT, DDE & DDD
Dieldrin
Endrin
Heptachlor
Hexachlorobenzene
Mirex
Toxaphene
PCBs
Dioxins
Furans

Case Studies:

Persistent Organic Pollutants:

Persistent Organic Pollutants (POPs) are toxic chemicals that adversely affect human health and the environment around the world. They range from intentionally produced chemicals (such as from agriculture or industry processes) to unintentional produced chemicals such as dioxins. These pollutants are of concern because of their toxicity, persistence, long-range transport and bioaccumulation in fatty tissue.

These chemicals were popular during the World War II era of industrial production and were not globally recognized as a problem until 2001 in the Stockholm Convention. At the convention, the United States banned almost all production of these POPs with complete phase-out by 2004. This is only a small step in solving the problem. Although, there will be no more POPs added to the environment, this does not cure all the pollutants that are currently there.³⁸

Unintended Consequences for Waste Management Programs:

POPs are the priority list of PBT chemicals, the nature of these chemicals make disposal and cleanup more difficult and requires waste management programs involvement for proper measures.

C-8:

C-8 is a perfluorooctanoic acid (PFOA) which is a synthetic chemical used in the manufacture of fluoropolymers to create resistance to fire, oil, stain, grease and water repellent in products such as Teflon and Gore-Tex. C-8 also includes ammonium salt or ammonium perfluorooctanoate (APFO). Pathways to human exposure to this product is low and the EPA has established that exposure does not pose any reasonable risk to humans. As a result, no ban has been put on consumer products. Currently, consumer products do not contain PFOA in its pure form, they contain

telomers that can break down into PFOA when exposed to the environment.

There are further studies being done by the EPA, the Food and Drug Administration (FDA) and industry, such as 3-M and DuPont, because C-8 has been shown to cause developmental abnormality in laboratory animals. Studies have shown that C-8 persists in the environment and there is a substantial concern that human exposure through their drinking water may have adverse health effects. The section of the Ohio River in Parkersburg, West Virginia is heavily contaminated with C-8 from the DuPont facility in Pennsylvania, this area is being tested for likely results to human health from exposure.^{39,40}

Unintended Consequences for Waste Management Programs:

PFOAs are a group of chemicals that are not on the High Production Volume list and are not PBTs, but it is an OPPTS and not an OPP chemical. They have been found to cause animal abnormality and are currently being tested for human effects. This increases the potential for production to be ceased or for MCLs in drinking water to be established.

Agency for Toxic Substances and Disease Registry (ATSDR):

The mission of ATSDR as part of the Department of Health and Human Services is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and disease related to toxic substances.⁴¹

ATSDR's Goals:

- Evaluate human health risks from toxic sites and releases and take action in a timely and responsive manner.
- Ascertain the relationship between exposure to toxic substances and diseases
- Develop and provide reliable, understandable information for affected communities, tribes and stakeholders
- Build and enhance effective partnerships

Chemical Fact Sheets; ToxFaqs:

One of the programs of ATSDR is to prepare profiles for certain toxic substances including the type of chemical, where it is found and its reactions in the environment. Along with these fact sheets, ATSDR lists the 20 most toxic substances found at Superfund Sites. These 20 chemicals are listed as part of the matrix in this paper.

Summary of Unintended Consequences for Waste Management Programs:

ATSDR's action do not directly affect waste management programs. Instead they are a tool for waste management programs to identify potential problem chemicals that maybe found at cleanup sites. The top 20 list can be used for waste management programs to continually prepare new and innovative technology for the clean-up of these chemicals.

This governmental agency can be a source of information for all offices within the

EPA. The common goal that the EPA has is to protect the environment. ATSDR's goals views the environment as a whole showing the effect that each chemical has on water, air and land. They recognize that a specific chemical affects every aspect of the environment. If the individual offices within the EPA were to use ATSDR's website as a resource, they could see that their regulations do not only affect their office. This understanding may help to create new initiatives that impact the environment as a whole instead of by the sub-parts that it has been broken down into.

Conclusion:

The environment is a broad term encompassing many areas. It is broken down into sub-parts on paper because it is easier to manage that way. In reality, it is not partitioned that way and must be treated as a whole. The regulations of one office are connected to all other offices and almost all actions taken affect waste management programs. The offices of Air and Water are at the beginning of the continuum because the subjects dealt with are primary components of the actual natural state of the environment. The offices of Pesticides and Toxic Substances are in the middle because the subjects dealt with are human made products that have an affect on the natural state. Waste management programs is at the end of the continuum because the subjects dealt with are human mistakes that have impacted the natural state of the environment and need to be corrected. One office would not be needed, if the others did not exist. The continuum must have a beginning and an end for it to operate correctly.

This paper has attempted to address this issue. Each office within the EPA would like to think that their actions only affect them, but as the case studies prove this is not the case. When a new pesticide is made there is always the chance that runoff will cause the pesticide to appear in drinking water. Or when a chemical is produced at High Volumes that the smokestacks will be new emission sources for HAPs. Or when all of these problems are recognized and waste management programs is needed for disposal and cleanup guidelines.

Each office is taking new initiatives under the direction of the regulations or laws that guide them. These new initiatives have the potential to correct present problems and also to cause new ones in the future. The results are not always known and not all scenarios can be realized when making new standards. The most common contact and uses are the ones that are ordinarily tested. As in the example of C-8, it was originally tested for human health effects in inhalation because that was the most likely exposure route. The producers of this chemical did not foresee C-8 appearing in drinking water and human exposure being ingestion.

Not all consequences can be known or predicted. Future forecasting is an attempt to look at these possibilities and to have the not so obvious to be considered with the known variables. This does not mean that all consequences will be predicted and prevented. It also does not mean that future predictions will come true. It is just a tactic to prevent a surprise like MTBE or to keep abreast so that another arsenic incident does not happen, when an MCL remains at too high a level for human health protection. It is an effort to predict different paths that may be chosen.

Section III:

This section contains the appendix. The appendix contains the definitions of all the chemicals that appear in the matrix on more than one list, such as Hazardous Air Pollutants and Cancelled Pesticides or Banned Pesticides and PBT Chemicals. Each chemical is defined by their molecular formula and mass and chemical class. The chemical's physical characteristics along with their most common uses, reactions in the environment and chemical and physical dangers are also included. Lastly, the regions where high concentrations of the chemicals have been identified has been included.

Appendix:

*1,1 Dichloroethane*⁴²

Commonly Used Names: Vinylidene chloride⁴³

Molecular Formula: C₂H₄Cl₂

Molecular Mass: 99.0

Common Uses: In the past, 1,1-dichloroethane was used as a surgical anesthetic, but it is no longer used this way. Today it is used primarily to make other chemicals, to dissolve substances such as paint, varnish, and finish removers, and to remove grease.⁴⁴

Areas with Highest Concentrations: California, Louisiana, Michigan, and Texas^{45,46}

Reactions in the Environment: 1,1-Dichloroethane is released from industrial processes primarily to the air. 1,1-Dichloroethane evaporates from water rapidly into the air. It can also be found in the air as a breakdown product of another chemical, 1,1,1-trichloroethane.⁴⁷

1,1-Dichloroethane does not dissolve easily in water. Small amounts of 1,1-dichloroethane released to soil can evaporate into the air or move into groundwater. It is not known how long it stays in soil. 1,1-Dichloroethane is not expected to build up in the body tissues of animals.

Chemical Class: Diphatic Halogen Compound^{48,49}

Physical State or Appearance: 1,1-Dichloroethane is an industrial chemical that is not found naturally in the environment. It is a colorless oily liquid with a sweet smell.

Physical Dangers: The vapor is heavier than air and may travel along the ground; distant ignition possible.

Chemical Dangers: The substance decomposes on heating and on burning producing toxic and corrosive fumes including phosgene and hydrogen chloride. It reacts violently with strong oxidants, alkali metals and earth-alkali metals, powdered metals, causing fire and explosion hazard. It attacks aluminum, iron and polyethylene. Contact with strong caustic will cause formation of flammable and toxic acetaldehyde gas.

Physical Characteristics:

Boiling point: 57° C

Melting point: -98° C

Relative density (water = 1): 1.2

Solubility in water, g/100 ml at 20° C: 0.6

Vapor pressure, kPa at 20° C: 24

Relative vapor density (air = 1): 3.4

Flash point: -6° C c.c.

Auto-ignition temperature: 458° C

Explosive limits, vol% in air: 5.6-11.4

Octanol/water partition coefficient as log Pow: 1.8

1,1,2,2-Tetrachloroethane

Commonly Used Names: Acetylene tetrachloride, Symmetrical-tetrachloroethane & S-tetrachloroethane

Molecular Formula: CHCl₂CHCl₂

Molecular Mass: 167.9

Common Uses: In the past, it was used in large amounts to produce other chemicals and as a solvent, to clean and de-grease metals, and in paints and pesticides. Commercial production of 1,1,2,2-Tetrachloroethane for these uses has stopped in the United States. It presently is used only as a chemical intermediate in the production of other chemicals.

Areas with Highest Concentrations: California, Kentucky, Louisiana, Massachusetts, Michigan, New Jersey, New York, Pennsylvania, and Texas

Reaction in the Environment: 1,1,2,2-Tetrachloroethane eventually moves into the air or ground water. It does not attach to soil particles when released to land. When released to surface water, much of it will evaporate to the air while the rest may break down in the water.

Breakdown of the chemical is slow; it takes about 13 months for half of the chemical to disappear in ground water and 2 months in air. 1,1,2,2-Tetrachloroethane does not build up significantly in the bodies of fish or other organisms.

Chemical Class: Halogenated Volatile Organics - Liquid Solvents

Physical State or Appearance: Colorless liquid with characteristic odor

Physical Dangers: Vapor is heavier than air.

Chemical Dangers: The substance decomposes on burning under influence of air, moisture and UV light, producing toxic and corrosive gases including hydrogen chloride and phosgene. It reacts violently with alkali metals, strong bases and many powdered metals producing toxic and explosive gases and attacks plastic and rubber.

Physical Characteristics:

Boiling point: 146° C

Melting point: -44° C

Relative density (water = 1): 1.6

Solubility in water, g/100 ml at 20° C: 0.29

Vapor pressure, kPa at 20° C: 0.647

Vapor pressure, Pa at 25° C: 780

Relative vapor density (air = 1): 5.8

Relative density of the vapor/air-mixture at 20° C (air = 1): 1.031

Octanol/water partition coefficient as log Pow: 2.39

1,2-Diphenylhydrazine

Commonly Used Name: Hydrazobenzene, Diphenylhydrazine, N,N'-Bianiline

Molecular Formula: C₁₂H₁₂N₂ / C₆H₅-NH-NH-C₆H₅

Molecular mass: 184.3

Common Uses: 1,2-Diphenylhydrazine is a man-made chemical that was used in the past to make benzidine which was used to make various fabric dyes. Benzidine dyes are no longer used in the United States, but may still be used in other countries. The only current use of 1,2-diphenylhydrazine in the United States is in the production of medicines to treat inflammation and a type of arthritis.

Areas with Highest Concentrations: N/A

Reaction in the Environment: It does not dissolve easily in water, but when placed in water, it rapidly breaks down into other chemicals. These include the toxic chemicals benzidine and

azobenzene. It does not evaporate easily but may be released to air when attached to dust particles and break down into the same chemicals as it does in water. When released to soil, it will attach to soil particles but is not expected to last very long. It is not likely to filter through the soil to groundwater. There is no information about its biomagnification through the food chain, but it would not be expected to bioaccumulate because it does not persist for long in the environment.

Chemical Class: N/A

Physical State or Appearance: White to yellow crystals, no known odor

Physical Dangers: Combustible.

Chemical Dangers: The substance decomposes on heating or on burning producing toxic fumes including nitrogen oxides. Reacts with mineral acids forming benzidine.

Physical Characteristics:

Melting point: 125-131° C

Relative density (water = 1): 1.16

Solubility in water, g/100 ml at 20° C: <0.1

Octanol/water partition coefficient as log Pow: 2.94

1,2,4 - Trichlorobenzene

Commonly Used Names: unsym-trichlorobenzene, 1,2,4-Trichlorobenzene; 1,2,4-trichlorobenzol; 1,2,5-Trichlorobenzene; 1,3,4-Trichlorobenzene; hostetex L-pec; Trichlorobenzene, 1,2,4- ; Trichlorobenzol; Unsym-trichlorobenzene;

Molecular Formula: C₆H₃Cl₃

Molecular Mass: 181.46

Common Uses: It was formerly used as a soil treatment for termite control. It is currently used as a solvent in chemical manufacturing, dyes & intermediates, dielectric fluid, synthetic transformer oils, lubricants, heat-transfer medium, degreasing agents, septic tank and drain cleaners, wood preservatives, and abrasive formulations. and in insecticides.

Areas with Highest Concentrations: Delaware and West Virginia

Reactions in the Environment: If it is released to the soil it will probably adsorb to the soil and therefore will not leach appreciably through soil. 1,2,4-Trichlorobenzene will not hydrolyze or biodegrade in groundwater, if released to water it will adsorb to the sediments and may bioconcentrate in aquatic organisms. It will not hydrolyze in surface waters but it may be subject to slow biodegradation. It is expected to evaporate from water with half-lives of 11-22 days. Adsorption to sediments or absorption by microorganisms may minimize the rate of evaporation. A half-life of 450 years has been reported for sunlight photolysis in surface waters at 40 deg latitude in summer. If 1,2,4-trichlorobenzene is released to the atmosphere, it may react with photochemically produced hydroxyl radicals with a resulting estimated vapor phase half-life in the atmosphere of 18.5 days.

Chemical Class: Aromatic Hydrocarbon.

Physical State or Appearance: Aromatic colorless liquid or rhombic crystals.

Physical Dangers: N/A

Chemical Dangers: The substance decomposes on heating or on burning, producing toxic and irritating fumes (phosgene, chlorine and hydrogen chloride). Reacts violently with oxidants,

acids, and acid fumes.

Physical Characteristics

Boiling point: 213° C

Melting point: 17° C

Relative density (water = 1): 1.5

Solubility in water: insoluble

Vapor pressure, Pa at 25° C: 40

Relative vapor density (air = 1): 6.26

Relative density of the vapor/air-mixture at 20° C (air = 1): 1.002

Flash point: 105° C

Auto-ignition temperature: 571° C

Explosive limits, vol% in air: 2.5-6.6 (at 150° C)

Octanol/water partition coefficient as log Pow: 4.02

1,2,4 - Trimethylbenzene

Commonly Used Names: Pseudocumene pseudocumol, asymmetrical trimethyl- benzene, TMB

Molecular Formula: 120.19

Molecular Mass: C₉H₁₂

Common Uses: It is a major component (typically 40%) of a petroleum refinery distillation fraction known as the C9 aromatic fraction (or simply the C9 fraction). Most of the C9 fraction is not isolated and refineries pump this "unrecovered" C9 fraction to some other location where it is usually added directly to gasoline. Refineries isolate less than one-half percent of the C9 fraction where it is used for protective surface coatings and cleaners.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Most direct releases of 1,2,4-trimethylbenzene to the environment are to air. It also evaporates from water and soil exposed to air. Once in air, it breaks down to other chemicals. Microorganisms that live in water and in soil can also break it down. Because it is a liquid that does not bind well to soil, 1,2,4-trimethylbenzene that makes its way into the ground can move through the ground and enter groundwater. Plants and animals can store small amounts of the chemical.

Chemical Class: N/A

Physical State or Appearance: It is a color-less, flammable liquid that occurs naturally in coal tar and petroleum crude oil.

Physical Dangers: N/A

Chemical Dangers: N/A

Physical Characteristics

Melting point: -43.8° C

Boiling point: 169° C

Density (g cm⁻³): 0.876

Flash point: 48° C

Water solubility: slightly soluble

1,3-Butadiene

Commonly Used Names: Divinyl, Erythrene, Vinylethylene, or Pyrrolylene

Molecular Formula: $C_4H_6/CH_2=(CH)_2=CH_2$

Molecular Mass: 54.1

Common Uses: 1,3-Butadiene is a chemical made from the processing of petroleum. It is the 36th highest volume chemical produced in the United States. About 75% of the manufactured 1,3-butadiene is used to make synthetic rubber for tires on cars and trucks and a smaller amount is used to make plastics including acrylics.

Areas of Highest Concentration: Arizona, Delaware, Georgia, Illinois, Iowa, Louisiana, Minnesota, Ohio, Santa Fe, New Mexico, Texas, West Virginia, and Western Nevada.

Reactions in the Environment: It quickly evaporates to the air as a gas from leaks during production, use, storage, transport, or disposal. It breaks down quickly in air by sunlight; in sunny weather, half of it breaks down in about 2 hours. When not sunny, it takes a few days for about half of it to break down in the air. It evaporates very quickly from water and soil. Since it evaporates so easily, it is not expected to be found in water or soil, but adequate tests are not available to measure the amounts. 1,3-Butadiene may be broken down by microorganisms in the soil. It is not expected to accumulate in fish.

Chemical Class: N/A

Physical State and Appearance: Colorless compressed liquified gas with a characteristic odor

Physical Dangers: The gas is heavier than air, and may travel along the ground; distant ignition possible. Liquid 1,3-butadiene floats and boils on water.

Chemical Dangers: The substance can under specific circumstances form peroxides, initiating explosive polymerization. The substance may polymerize due to warming with fire or explosion hazard. Shock-sensitive compounds are formed with copper and its alloys. The substance decomposes explosively on rapid heating under pressure. Reacts vigorously with oxidants and many other substances, causing fire and explosion hazard.

Physical Characteristics:

Boiling point: $-4^{\circ}C$

Melting point: $-109^{\circ}C$

Relative density (water = 1): 0.6

Solubility in water: none (<0.1 g/100 ml)

Vapor pressure, kPa at $20^{\circ}C$: 245

Relative vapor density (air = 1): 1.9

Flash point: $-76^{\circ}C$

Auto-ignition temperature: $414^{\circ}C$

Explosive limits, vol% in air: 1.1-16.3

Stable, non-corrosive

1,3 - Dichloropropene

Chemical Name: Dichloropropylene, 1,3 Dichloropropylene, Chloroallyl Chloride

Molecular Formula: $C_3H_4Cl_2$

Molecular Mass: 110.98

Common Uses: 1,3-Dichloropropene is a manufactured chemical that does not occur naturally in the environment. There are two forms of 1,3-dichloropropene: cis-1,3-dichloropropene and trans-1,3-dichloropropene. These forms are very similar to each other and are usually combined in different amounts to form mixtures. It is used mainly in farming to kill nematodes, which are pests that eat the roots of crops. Much smaller amounts are used to dissolve or to make other chemicals.

Areas of Highest Concentration: Coastal Northeast from Massachusetts to Virginia, Florida, Southern California and Southwest Arizona

Reactions in the Environment: 1,3-Dichloropropene rapidly evaporates from water and soil into the air where it is broken down by sunlight. When in soil, it is likely to be broken down by small organisms. It breaks down slowly in water. It may travel deeper into the ground and reach underground water supplies; however, in states where it is often used, very little has been found in the groundwater. Other chemicals often found in hazardous waste sites may slow the breakdown of 1,3-dichloropropene. We do not know if 1,3-dichloropropene accumulates in fish. Studies with animals show that most of it leaves the body within 2 days

Chemical Class: Chlorinated Hydrocarbon

Physical State or Appearance: Colorless liquid with no known odor.

Physical Dangers: Sensitive to heat & light.

Chemical Dangers: It reacts with Magnesium, Aluminum, Acids, and Strong Oxidizing Agents. When it decomposes poisonous gases and toxic fumes are emitted into the air.

Physical Characteristics:

Boiling Point: 233.6° C

Vapor Density: 3.8

Density: 1.224

Solubility in Water: Slight

Relatively Stable

1,4 Dichlorobenzene

Commonly Used Names: PDCB, para-Dichlorobenzene, para-DCB or p-DCB. Trade names include Paramoth, Para crystals, and Paracide

Molecular Formula: C₆H₄Cl₂

Molecular Mass: 147

Common Uses: 1,4-Dichlorobenzene is a chemical used to control moths, molds, and mildew, and to deodorize restrooms and waste containers.

Areas with Highest Concentrations: Georgia, Illinois, Kansas, Missouri, Nebraska, North Carolina, Ohio, Texas, and West Virginia.

Reactions in the Environment: In air, it breaks down to harmless products in about a month. It does not dissolve easily in water. It is not easily broken down by soil organisms. It evaporates easily from water and soil, so most is found in the air. It is taken up and retained by plants and fish.

Chemical Class: Aromatic Halogen Compound

Physical State or Appearance: At room temperature, p-DCB is a white solid with a strong,

pungent odor. When exposed to air, it slowly changes from a solid to a vapor.

Physical Dangers The vapor is heavier than air.

Chemical Dangers: On combustion, forms toxic and corrosive fumes including phosgene, hydrogen chloride. The substance decomposes on contact with acids or acid fumes producing highly toxic fumes. Reacts with strong oxidants.

Physical Characteristics:

Boiling point: 174° C

Melting point: 53° C

Relative density (water = 1): 1.2

Solubility in water: none

Vapor pressure, kPa at 55° C: 1.33

Vapor pressure, Pa at 20° C: 170

Relative vapor density (air = 1): 5.08

Relative density of the vapor/air-mixture at 20° C (air = 1): 1.01

Flash point: 66° C c.c.

Octanol/water partition coefficient as log Pow: 3.37

1,4 Dioxane

Commonly Used Names: 1,4-Diethylene dioxide and 1,4-Diethyleneoxide

Molecular Formula: C₄H₈O₂

Molecular Mass: 88.1

Common Uses: Formerly used as a solvent in spectroscopic and photometric measurements. Used in lacquers, paints, varnishes, paint and varnish removers. Solvent in pulping of wood. Used in dipping, roller coating, tumbling, knifing, and brushing of natural, and synthetic resin-based varnishes, solvents, textile processing, stain and printing compositions, fumigants, lacquers, and paints. Solvent for fats, oils, waxes, and natural and synthetic resins. It can serve as a degreasing agent. Used in purification of drugs. It is reliable only in the absence of oxygen. Used as a stabilizer for chlorinated solvents, particularly, 1,1,1-trichloroethane and in solvent applications. 1,4-Dioxane is used in cosmetic products, such as shampoos and bath preparations.

Areas with Highest Concentrations: Illinois and Louisiana

Reactions in the Environment: When released to water, 1,4-dioxane is not expected to hydrolyze and may volatilize, although its infinite water solubility precludes estimating the volatilization half-life. Based on its infinite water solubility and low estimated soil sorption partition coefficient, 1,4-dioxane released to soil is expected to leach to groundwater.

1,4-Dioxane is not expected to bioconcentrate in fish or biodegrade in soil or water. 1,4-Dioxane which enters the atmosphere is expected to degrade fairly quickly, a half life of 7 hours. The expected products of this reaction are aldehydes and ketones.

Chemical Class: Heterocyclic Compound

Physical State or Appearance: Colorless liquid with characteristic odor.

Physical Dangers: The vapor is heavier than air and may travel along the ground; distant ignition possible. As a result of flow, agitation, etc., electrostatic charges can be generated.

Chemical Dangers: The substance can form explosive peroxides. It reacts vigorously with strong oxidants and concentrated strong acids. Reacts explosively with some catalysts. It attacks

many plastics.

Physical Characteristics:

Boiling point: 101° C

Melting point: 12° C

Relative density (water = 1): 1.03

Solubility in water: Miscible

Vapor pressure, kPa at 20° C: 4.1

Relative vapor density (air = 1): 3.0

Relative density of the vapor/air-mixture at 20° C (air = 1): 1.08

Flash point: 12° C

Auto-ignition temperature: 180° C

Explosive limits, vol% in air: 2-22.5

Octanol/water partition coefficient as log Pow: -0.42

o-CRESOL

Commonly Used Names: *2-methyl-phenol*, 2-Hydroxy-1-methylbenzene, Ortho-hydroxytoluene

Molecular Formula: C₇H₈O/CH₃C₆H₄OH

Molecular Mass: 108.2

Common Uses: There are three forms of cresols that are only slightly different in their chemical structure: ortho-cresol (o-cresol), meta-cresol (m-cresol), and para-cresol (p-cresol). These forms occur separately or as a mixture. They are used to dissolve other chemicals, as disinfectants and deodorizers, and to make certain chemicals that kill insect pests. Cresols are found in many foods and in wood and tobacco smoke, crude oil, coal tar, and in brown mixtures such as creosote and cresylic acids, which are wood preservatives.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Cresols appear everywhere in our environment, but usually at low levels, because they quickly break down. In air, cresols quickly break down into other chemicals. Cresols do not evaporate quickly from water, but they can be removed by bacteria. Cresols may last longer in deep groundwater or water that does not have bacteria. In soil, half the total amount of cresols will break down in about a week. Cresols do not appear to accumulate in fish or meat. Small organisms in soil and water produce cresols when they break down materials in the environment.

Chemical Class: Aromatic Hydroxy Compound

Physical State or Appearance: Cresols are a widely occurring natural and manufactured group of chemicals. In their pure form, they are colorless solids and may be liquids if they are mixtures. Cresols smell like medicine.

Physical Dangers: Combustible.

Chemical Dangers: Reacts violently with strong oxidizing agents, causing fire and explosion hazard.

Physical Characteristics

Boiling point: 191° C

Melting point: 31° C

Relative density (water = 1): 1.05
Solubility in water, g/100 ml at 25° C: 2.5
Vapour pressure, Pa at 25° C: 33
Relative vapour density (air = 1): 3.7
Flash point: 81° C c.c.
Auto-ignition temperature: 599° C
Octanol/water partition coefficient as log Pow: 1.95

2-Nitropropane

Commonly Used Names: Isonitropropane, Dimethylnitromethane, sec-Nitropropane

Molecular Formula: C₃H₇NO₂ / CH₃CHNO₂CH₃

Molecular Mass: 89.1

Common Uses: It is used principally as a solvent and chemical intermediate. As a solvent, it is used in inks, paints, adhesives, varnishes, polymers, and synthetic materials. It is a feedstock for the manufacture of 2-nitro-2-methyl-1-propanol and 2-amino-2-methyl-1-propanol.

Areas with Highest Concentrations: Arkansas, Indiana, Kentucky, Louisiana, New Jersey, Ohio and South Carolina.

Reactions in the Environment: N/A

Chemical Class: Nitro Compound

Physical State or Appearance: A colorless oily liquid with a mild fruity odor.

Physical Dangers: It is flammable when exposed to heat, open flame, or oxidizers; when heated in liquid or vapor form, it may explode.

Chemical Dangers: The substance decomposes on burning producing nitrogen oxides. Shock-sensitive compounds are formed with acids, amines, inorganic bases and heavy metal oxides. It has violent reactions with chlorosulfonic acid and oleum. It is incompatible or reactive with amines, strong acids, alkalis and oxidizers, metal oxides, and combustible materials. Reacts with activated carbon causing fire hazard. May be decomposed by the activated carbon in respirator filters.

Physical Characteristics:

Boiling point: 120° C

Melting point: -93° C

Relative density (water = 1): 0.99

Solubility in water, ml/100 ml at 25° C: 1.7

Vapor pressure, kPa at 20° C: 1.7

Relative vapor density (air = 1): 3.1

Relative density of the vapor/air-mixture at 20° C (air = 1): 1.04

Flash point: 24° C c.c.

Auto-ignition temperature: 428° C

Explosive limits, vol% in air: 2.6-11

Octanol/water partition coefficient as log Pow: 0.93

2,2,4 - Trimethylpentane

Commonly Used Names: Isobutyltrimethylpentane, isooctane

Molecular Formula: $(\text{CH}_3)_3\text{CCH}_2\text{CH}(\text{CH}_3)_2$

Molecular Mass: 114.23

Common Uses: It is used in determining octane numbers of fuels, in spectrophotometric analysis, as a solvent and thinner, and in organic syntheses.

Areas with Highest Concentrations: N/A

Reactions in the Environment: 2,2,4-Trimethylpentane does not break down in water.

Chemical Class: Aliphatic Hydrocarbon

Physical State or Appearance: It is a colorless liquid.

Physical Dangers: N/A

Chemical Dangers: Incompatible with oxidizing agents and reducing agents

Physical Characteristics:

Melting point: -107°C

Boiling point: 98°C

Vapor density: 3.9

Vapor pressure: 41 mm Hg at 21°C

Specific gravity: 0.692

Flash point: -7°C (closed cup)

Explosion limits: 1 - 6%

Autoignition temperature: 396°C

2,4-Dichlorophenoxyacetic acid

Commonly Used Names: 2,4 - D. Trade Names: Plantgard, Weedtime II. Barrage and Aqua-Kleen

Molecular Formula: $\text{C}_8\text{H}_6\text{Cl}_2\text{O}_3$

Molecular Mass: 221.02

Common Uses: 2,4-D was a major component (about 50%) of the product Agent Orange used extensively throughout Vietnam. However most of the problems associated with the use of Agent Orange were associated with a contaminant (dioxin) in the 2,4,5-T component of the defoliant. Currently, this compound is used in cultivated agriculture and in pasture and rangeland applications for broadleaf weeds, forest management, home and garden situations and for the control of aquatic vegetation.

Areas with Highest Concentration: N/A

Reaction in the Environment: Soil microbes are primarily responsible for its disappearance in soil with a half life ranging from a week to 16 days. In aquatic environments microorganisms readily degrade 2,4-D and breakdown by sunlight is not a major reason for loss. Rates of breakdown increase with increased nutrients, sediment load and dissolved organic carbon. 2,4-D interferes with normal plant growth processes. Uptake of the compound is through leaves, stems and roots; however, it is generally non-persistent. Despite its short half-life in soil and in aquatic environments, the compound has been detected in groundwater. It has also been detected in surface waters throughout the United States at very low concentrations.

Chemical Class: Chlorinated Phenoxy Herbicide

Physical State or Appearance: Odorless, colorless crystals or white powder.

Physical Dangers: Not combustible. Liquid formulations containing organic solvents may be flammable.

Chemical Dangers: The substance decomposes on heating producing hydrogen chloride and phosgene. Reacts with strong oxidants causing fire and explosion hazard.

Physical Characteristics:

Melting point: 138°C

Relative density (water = 1): 1.6

Solubility in water: none

Octanol/water partition coefficient as log Pow: 2.81

2,4 Dichlorophenol

Commonly Used Names: 2,4-DCP

Molecular Formula: C₆H₄Cl₂O

Molecular Mass: 163.0

Common Uses: Some chlorophenols are used as pesticides. Others are used in antiseptics. Small amounts are produced when water is disinfected with chlorine. They are also produced while bleaching wood pulp with chlorine to make paper.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Most chlorophenols released into the environment go into the water, few are released into the air. In the air, sunlight destroys them and rain washes them away. They stick to soil and sediments at the bottom of lakes, streams and rivers. They are broken down by microorganisms within a few days to a few weeks.

Chemical Class: Microbiocides

Physical State or Appearance: Colorless crystals with medicine taste.

Physical Dangers: The vapor is heavier than air.

Chemical Dangers: On combustion, forms corrosive gas (hydrogen chloride). Upon heating, toxic fumes are formed. Reacts violently with strong oxidants.

Physical Characteristics

Boiling point: 210.0° C

Melting point: 45.0° C

Solubility in water, g/100 ml at 20° C: 0.5

Vapor pressure, kPa at 53° C: 133

Relative vapor density (air = 1): 5.6

Flash point: 114° C o.c.

Octanol/water partition coefficient as log Pow: 3.06

2,4-Dinitrophenol

Commonly Used Names: 1-Hydroxy-2,4-dinitrobenzene, DNP. Trade Names: Caswell No. 392, Sulfo Black B, and Nitro Kleenup

Molecular Formula: C₆H₄N₂O₅/C₆H₃(OH)(NO₂)₂

Molecular Mass: 184.11

Common Uses: It was formerly used in diet pills in the 1930s but was banned for this use in 1938. Dinitrophenols are a class of manufactured chemicals that do not occur naturally in the environment. It is used in making dyes, wood preservatives, explosives, insect control substances, and other chemicals, and as a photographic developer.

Areas with Highest Concentrations: N/A

Reaction in the Environment: It enters the air, water, and soil during its manufacture and use. It may be formed from reaction of other chemicals in the air or through landfill and storage tank leaks, or accidental spills during manufacture or transport. It dissolves slightly in water, and does not easily evaporate to air. It can be broken down slowly in water and soil by small organisms or by reacting with other chemicals. It sticks to particles in water, which will cause it to eventually settle to the bottom sediment. It also sticks to some types of soil particles, which may prevent it from moving very deep into the soil with rainwater. Dinitrophenol probably does not build up significantly in fish.

Chemical Class: Non-Halogenated Semivolatile Organic - Non-Chlorinated Phenol

Physical State or Appearance: Yellow Crystals.

Physical Dangers: Dust explosion possible if in powder or granular form when mixed with air.

Chemical Dangers: May explosively decompose on shock, friction, or concussion. May explode on heating. Shock-sensitive compounds are formed with alkalis, ammonia and most metals. The substance decomposes on heating producing toxic gases including nitrogen oxides.

Physical Characteristics:

Melting point: 112° C

Relative density (water = 1): 1.68

Solubility in water, g/100 ml at 54.5° C: 0.14

Relative vapor density (air = 1): 6.36

Combustible.

2,4-Dinitrotoluene

Commonly Used Names: 1-Methyl-2,4-dinitrobenzene, 2,4-DNT

Molecular Formula: $C_7H_6N_2O_4$ / $C_6H_3CH_3(NO_2)_2$

Molecular Mass: 182.1

Common Uses: DNT is usually used to make flexible polyurethane foams used in the bedding and furniture industries. DNT is also used to produce explosives, ammunition, and dyes. It is also used in the air bags of automobiles.

Areas with Highest Concentrations: California, Kentucky, Michigan, Mississippi, New Jersey, Ohio, South Carolina,, Texas, Virginia, and West Virginia.

Reactions in the Environment: DNT has been found in the soil, surface and ground water, and air. It has been found at hazardous waste sites that contain buried ammunition wastes. DNT does not usually evaporate; it is found mostly in the air of manufacturing plants. DNT does not stay in the environment because it is broken down by sunlight and by bacteria. In water, DNT tends to be more stable and less likely to break down. DNT can be transferred to plants by root uptake from contaminated water or soil.

Chemical Class: Nitro Compound

Physical State or Appearance: It is a synthetic compound made by mixing toluene with nitric acid. It is usually in the form of yellow crystals with a characteristic odor.

Physical Dangers: Dust explosion possible if in powder or granular form when mixed with air.

Chemical Dangers: May explode on heating. The substance decomposes on heating producing toxic and corrosive fumes including nitrogen oxides even in absence of air. Reacts with strong bases, oxidants and reducing agents.

Physical Characteristics:

Boiling point: 300° C

Melting point: 71° C

Solubility in water: none

Vapor pressure, kPa at 103° C: 0.13

Relative vapor density (air = 1): 6.28

Flash point: 207° C c.c.

Octanol/water partition coefficient as log Pow: 1.98

2,4,6-Trichlorophenol

Commonly Used Names: Trade Names: Collinosol, Dowicide 2

Molecular Formula: C₆H₃Cl₃O/C₆H₂Cl₃OH

Molecular Mass: 197.5

Common Uses: It is no longer used in the United States, production ceased in the 1980's. It was previously used as an antiseptic, a pesticide for wood, leather, and glue preservation and as an anti-mildew treatment

Areas with Highest Concentrations: N/A

Reactions in the Environment: If released in soil, it can biodegrade and its mobility is expected to vary from highly mobile in sandy soil to slightly mobile in muck (due to adsorption to humic acids and other organic matter). Removal by biodegradation apparently limits the extent of leaching, however, and groundwater contamination is likely only by rapid flow through large channels and deep soil cracks. Persistence in soil is reported to vary between 14 to 300 days, but usually does not exceed one full growing season regardless of the application rate.

Chemical Class: Organochlorine Pesticide

Physical State or Appearance: Colorless to light yellow crystals with characteristic odor .

Physical Dangers: N/A

Chemical Dangers: The substance decomposes on heating or on burning producing toxic and corrosive fumes (hydrogen chloride and chlorine). Reacts violently with strong oxidants.

Physical Characteristics:

Boiling point: 246° C

Melting point: 69.5° C

Relative density (water = 1): 1.49

Solubility in water: None

Vapor pressure, Pa at 76.5° C: 133

Relative vapor density (air = 1): 6.8

Relative density of the vapor/air-mixture at 20° C (air = 1): 1.00

Octanol/water partition coefficient as log Pow: 3.87

4- Nitrophenol

Commonly Used Names: P-nitrophenol, 4-Hydroxybenzene

Molecular Formula: $C_6H_5NO_3$

Molecular Mass: 139.1

Common Uses: Nitrophenol is used mainly to make dyes, paint coloring, rubber chemicals, and substances that kill molds.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Most nitrophenols enter the environment during manufacturing and processing. Nitrophenols can be formed in the air as a result of the breakdown of many other manufactured chemicals. Most goes to water and soil; little goes to the air. Very little is known about the fate of nitrophenols in air. They readily break down in surface water. It takes a long time for nitrophenols to break down in deep soil and in groundwater. Nitrophenols have not been found in foods. They are a breakdown product of other pesticides including parathion and fluoridifen. They are also formed in auto exhaust.

Chemical Class: N/A

Physical State or Appearance: Colorless to pale yellow crystals with characteristic odor.

Physical Dangers: Dust explosion possible if in powder or granular form, mixed with air.

Chemical Dangers: May explode on heating. The substance decomposes on heating or on burning producing toxic fumes including nitrogen oxides, causing fire and explosion hazard. The substance is a strong oxidant and reacts violently with combustible and reducing materials. Mixtures with potassium hydroxide are explosive.

Physical Characteristics

Boiling point (decomposes): 279° C

Melting point: 113° C

Relative density (water = 1): 1.48

Solubility in water, g/100 ml at 25° C: 1.6

Vapor pressure, Pa at 20° C: 0.0032

Flash point: 169° C

Octanol/water partition coefficient as log Pow: 1.91

Acetaldehyde

Commonly Used Names: Acetic aldehyde, Ethanal, Ethyl aldehyde

Molecular Formula: C_2H_4O/CH_3CHO

Molecular Mass: 44.1

Common Uses: Used in butanol, perfumes, flavors, aniline dyes, plastics, synthetic rubber, silvering mirrors and hardening gelatin fibers.

Areas with Highest Concentrations: Alabama, Coastal East from Massachusetts to Georgia, Louisiana, Mississippi, Tennessee and Texas.

Reactions in the Environment: Concentrations of acetaldehyde measured in air samples taken

from different locations vary, depending on several conditions, including weather. The chemical has been detected in ice fog, rain, cloud mist, and fog. Trace amounts of acetaldehyde have been detected in the drinking water of several U.S. cities.

Chemical Class: Aliphatic Aldehyde

Physical State or Appearance: Gas or colorless liquid with pungent odor.

Physical Dangers: The vapor is heavier than air and may travel along the ground; distant ignition possible. Extremely flammable.

Chemical Dangers: The substance can form explosive peroxides in contact with air. The substance may polymerize under the influence of acids, alkaline materials, such as sodium hydroxide, in the presence of trace metals (iron) with fire or explosion hazard. The substance is a strong reducing agent and reacts violently with oxidants. Reacts violently with various organic substances, halogens, sulfuric acid and amines, causing fire and explosion hazard.

Physical Characteristics:

Boiling point: 21° C

Melting point: -123° C

Relative density (water = 1): 0.78

Solubility in water: miscible

Vapor pressure, kPa at 20° C: 99

Relative vapor density (air = 1): 1.5

Flash point: -39° C

Auto-ignition temperature: 185° C

Explosive limits, vol% in air: 4-57

Octanol/water partition coefficient as log Pow: 0.43

Acetonitrile

Commonly Used Names: Methyl cyanide, Cyanomethane, Ethanenitrile

Molecular Formula: C₂H₃N/CH₃CN

Molecular Mass: 41.0

Common Uses: It occurs naturally in coal tar and cigarette smoke. The largest users of acetonitrile are companies that use the chemical to extract inorganic and organic chemicals. It is used mainly to extract butadiene. Companies also use acetonitrile to make pesticides.

Areas with Highest Concentrations: Illinois, Indiana, Louisiana, Michigan, New York, Ohio, South Carolina, Tennessee, Texas and Virginia.

Reactions in the Environment: Acetonitrile evaporates when exposed to air. It dissolves completely when mixed with water. Most direct releases of acetonitrile to the environment are to underground sites or to air. It also evaporates from water and soil exposed to air. Once in air, acetonitrile breaks down to other chemicals. Microorganisms that live in water and in soil can also break down acetonitrile. Because it is a liquid that does not bind well to soil, acetonitrile that makes its way into the ground can move through the ground and enter groundwater. Plants and animals are not likely to store acetonitrile.

Chemical Class: Nitrile

Physical State or Appearance: It is a colorless liquid with a characteristic odor.

Physical Dangers. The vapor is heavier than air and may travel along the ground; distant ignition possible. The vapor mixes well with air, explosive mixtures are easily formed. As a result of flow, agitation, etc., electrostatic charges can be generated.

Chemical Dangers: On combustion, forms toxic fumes of hydrogen cyanide and nitrogen oxides. The substance decomposes on contact with acids, water and steam producing toxic fumes and flammable vapor. Reacts with strong oxidants causing fire and explosion hazard. Attacks some forms of plastic, rubber and coating.

Physical Characteristics:

Boiling point: 81° C

Melting point: -45° C

Relative density (water = 1): 0.8

Solubility in water: miscible

Vapor pressure, kPa at 20° C: 9.60

Relative vapor density (air = 1): 1.4

Relative density of the vapor/air-mixture at 20° C (air = 1): 1.04

Flash point: 12.8° C (c.c.)

Auto-ignition temperature: 524° C

Explosive limits, vol% in air: 3.0-16

Octanol/water partition coefficient as log Pow: -0.3

Aldrin

Commonly Used Names: HHDN, 1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro,endo,exo-1,4:5.8-dimethanonaphthalene. Trade Name: Aldrex

Molecular Formula: C₁₂H₈Cl₆

Molecular Mass: 364.9

Common Use: Aldrin and dieldrin are insecticides with similar chemical structures. They are discussed together in this fact sheet because aldrin quickly breaks down to dieldrin in the body and in the environment. From the 1950s until 1970, aldrin and dieldrin were widely used pesticides for crops like corn and cotton. Because of concerns about damage to the environment and potentially to human health, EPA banned all uses of aldrin and dieldrin in 1974, except to control termites. In 1987, EPA banned all uses.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Sunlight and bacteria change aldrin to dieldrin so that we mostly find dieldrin in the environment. They bind tightly to soil and slowly evaporate to the air. Dieldrin in soil and water breaks down very slowly. Plants take in and store aldrin and dieldrin from the soil. Aldrin rapidly changes to dieldrin in plants and animals. Dieldrin is stored in the fat and leaves the body very slowly. Aldrin persists in soils: 50% disappear after 4 to 7 years. This substance may be hazardous to the environment; special attention should be given to fish and birds. In the food chain important to humans, bioaccumulation takes place, specifically in aquatic organisms

Chemical Class: Synthetic Organochlorine Insecticide.

Physical State or Appearance: Pure aldrin and dieldrin are white powders with a mild chemical odor. The less pure commercial powders have a tan color. Neither substance occurs naturally in the environment.

Physical Dangers: N/A

Chemical Dangers: The substance decomposes on heating producing toxic and corrosive fumes (chlorine fumes, hydrogen chloride.) Reacts with acids, oxidants, active metals, phenols, acid catalysts. Can be corrosive due to the slow evolution of hydrogen chloride in storage.

Physical Characteristics:

Boiling point at 0.267 kPa: 145° C

Melting point: 104° C

Relative density (water = 1): 1.54

Solubility in water: none

Vapor pressure, Pa at 20° C: 0.0086

Octanol/water partition coefficient as log Pow: 7.4

Arsenic

Commonly Used Names: Grey arsenic, Metallic arsenic

Molecular Formula: As

Molecular Mass: 74.9

Common Uses: Inorganic arsenic compounds are mainly used to preserve wood. Organic arsenic compounds are used as pesticides, primarily on cotton plants.

Areas with Highest Concentrations: Arizona, Arkansas, Nevada, California, Idaho, Indiana, Louisiana, Maryland, Mississippi, Oregon, South Carolina, South Dakota, and Texas.

Reactions in the Environment: Arsenic cannot be destroyed in the environment. It can only change its form. Arsenic in air will settle to the ground or is washed out of the air by rain. Many arsenic compounds can dissolve in water. Fish and shellfish can accumulate arsenic, but the arsenic in fish is mostly in a form that is not harmful.

Chemical Class: Inorganic.

Physical State or Appearance: Odorless, brittle, grey, metallic-looking crystals. Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds.

Physical Dangers: Combustible

Chemical Dangers: Upon heating, toxic fumes are formed. Reacts violently with strong oxidants and halogens causing fire and explosion hazard. Reacts with nitric acid, hot sulfuric acid. Toxic arsine gas may be formed in contact with acid or acidic substances and certain metals, such as galvanized or light metals.

Physical Characteristics:

Sublimation point: 613° C

Relative density (water = 1): 5.7

Solubility in water: none

Asbestos Chrysotile

Commonly Used Names: *Asbestos*, Serpentine chrysotile, White asbestos

Molecular Formula: $Mg_3Si_4H_8O_{18}$ / $Mg_6(Si_4O_{10})(OH)_8$

Molecular Mass: 554

Common Uses: Asbestos has been used for a wide range of manufactured goods, mostly in building materials (roofing shingles, ceiling and floor tiles, paper products, and asbestos cement products), friction products (automobile clutch, brake, and transmission parts), heat-resistant fabrics, packaging, gaskets, and coatings. Some vermiculite or talc products may contain asbestos.

Areas with Highest Concentrations: Alabama, California, Idaho, Kentucky, Louisiana, New York, Oklahoma, Oregon, Texas, and Utah.

Reactions in the Environment: Asbestos fibers can enter the air or water from the breakdown of natural deposits and manufactured asbestos products. Asbestos fibers do not evaporate into air or dissolve in water. Small diameter fibers and particles may remain suspended in the air for a long time and be carried long distances by wind or water before settling down. Larger diameter fibers and particles tend to settle more quickly. Asbestos fibers are not able to move through soil. Asbestos fibers are generally not broken down to other compounds and will remain virtually unchanged over long periods.

Chemical Class: Fibrous Mineral.

Physical Appearance: It can be white, grey, green or yellow fibrous solid. Asbestos is the name given to a group of six different fibrous minerals (amosite, chrysotile, crocidolite, and the fibrous varieties of tremolite, actinolite, and anthophyllite) that occur naturally in the environment.

Physical Dangers: Asbestos minerals have separable long fibers that are strong and flexible enough to be spun and woven and are heat resistant.

Chemical Dangers: N/A

Physical Characteristics:

Relative density (water = 1): 2.55

Benzene

Commonly Used Names: Cyclohexatriene, Benzol

Molecular Formula: C₆H₆

Molecular Mass: 78.1

Common Uses: Benzene is widely used in the United States; it ranks in the top 20 chemicals for production volume. Some industries use benzene to make other chemicals which are used to make plastics, resins, and nylon and synthetic fibers. Benzene is also used to make some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides. Natural sources of benzene include volcanoes and forest fires. Benzene is also a natural part of crude oil, gasoline, and cigarette smoke. Industrial processes are the main source of benzene in the environment.

Areas with Highest Concentrations: Alabama, Georgia, Illinois, Indiana, Louisiana, Michigan, Ohio, Pennsylvania, Texas and Virginia.

Reactions in the Environment: Benzene can pass into the air from water and soil. It reacts with other chemicals in the air and breaks down within a few days. Benzene in the air can attach to rain or snow and be carried back down to the ground. It breaks down more slowly in water and soil, and can pass through the soil into underground water. Benzene does not build up in plants or animals.

Chemical Class: Aromatic Halogenated Volatile Organic

Physical State or Appearance: Benzene is a colorless liquid with a sweet odor.

Physical Dangers: The vapor is heavier than air and may travel along the ground; distant ignition possible. Highly flammable but stable.

Chemical Dangers: Reacts violently with oxidants and halogens causing fire and explosion hazard

Physical Characteristics:

Boiling point: 80° C

Melting point: 6° C

Relative density (water = 1): 0.9

Solubility in water, g/100 ml at 25° C: 0.18

Vapor pressure, kPa at 20° C: 10

Relative vapor density (air = 1): 2.7

Relative density of the vapor/air-mixture at 20° C (air = 1): 1.2

Flash point: -11° C (c.c.)° C

Auto-ignition temperature: about 500° C

Explosive limits, vol% in air: 1.2-8.0

Octanol/water partition coefficient as log Pow: 2.13

Benzo(a)Pyrene

Commonly Used Names: 6,7-benzopyrene, benzo[a]pyrene, B(a)P, BP, 3,4-benzopyrene, benzo[d,e,f]chrysene, 3,4-benzpyrene, benzpyrene, 3,4-benzylpyrene, 3,4-benz[a]pyrene, 3,4-BP, 3,4-benzopyrene

Molecular Formula: C₂₀H₁₂

Molecular Mass: 252.32

Common Uses: It is found in cigarette smoke, coal tar, fuel exhaust gas and in many other sources. Most PAHs in the environment are from incomplete burning of carbon-containing materials like oil, wood, garbage or coal. Many useful products such as mothballs, blacktop, and creosote wood preservatives contain PAHs. They are also found at low concentrations in some special-purpose skin creams and anti-dandruff shampoos that contain coal tars.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Although environmental concentrations are highest near sources, its presence in places distant from primary sources indicates that it is reasonably stable in the atmosphere and capable of long distance transport. When released to air it may be subject to direct photolysis, although adsorption to particulates apparently can retard this process. If released to water, it will adsorb very strongly to sediments and particulate matter, bioconcentrate in aquatic organisms slightly to moderately, but will not hydrolyze. It may be subject to significant biodegradation, and direct photolysis may be important near the surface of waters. Absorption to sediments and particulates will limit evaporation. If released to soil it will be expected to adsorb very strongly to the soil and will not be expected to appreciably leach to the groundwater, although its presence in groundwater illustrates that it can be transported there. It will not be expected to hydrolyze or significantly evaporate from soils and surfaces. It may be

subject to appreciable biodegradation in soils.

Chemical Class: Polycyclic Aromatic Hydrocarbon.

Physical State or Appearance: Yellow crystals or powder .

Physical Dangers: N/A

Chemical Dangers: N/A

Physical Characteristics

Melting point: 176° C

Boiling point: 495° C

Vapor density: 8.7 (air = 1)

Density (g cm-3): 1.351

Water solubility: slight

Cadmium

Commonly Used Names: N/A

Molecular Formula: Cd

Molecular Mass: 112.4

Common Uses: Cadmium is a natural element in the earth's crust. It is usually found as a mineral combined with other elements such as oxygen (cadmium oxide), chlorine (cadmium chloride), or sulfur (cadmium sulfate, cadmium sulfide). All soils and rocks, including coal and mineral fertilizers, contain some cadmium. Most cadmium used in the United States is extracted during the production of other metals like zinc, lead, and copper. Cadmium does not corrode easily and has many uses, including batteries, pigments, metal coatings, and plastics.

Areas with Highest Concentrations: California, Coastal Massachusetts to Virginia, Idaho, Illinois, Indiana, Missouri, Nevada, Ohio, Oregon, South Carolina and Texas.

Reactions in the Environment: Cadmium enters air from mining, industry, and burning coal and household wastes. Cadmium particles in air can travel long distances before falling to the ground or water. It enters water and soil from waste disposal and spills or leaks at hazardous waste sites. It binds strongly to soil particles. Some cadmium dissolves in water. It doesn't break down in the environment, but can change forms. Fish, plants, and animals take up cadmium from the environment. Cadmium stays in the body a very long time and can build up from many years of exposure to low levels.

Chemical Class: Inorganic

Physical State or Appearance: Soft blue-white metal lumps or grey powder. Malleable turns brittle on exposure to 80 degrees Celsius and tarnishes on exposure to moist air.

Physical Dangers: Dust explosion possible if in powder or granular form, mixed with air. Flammable in powder form.

Chemical Dangers: Reacts with acids giving off flammable hydrogen gas. Dust reacts with oxidants, hydrogen azide, zinc, selenium or tellurium, causing fire and explosion hazard.

Physical Characteristics:

Boiling point: 765° C

Melting point: 321° C

Relative density (water = 1): 8.6

Solubility in water: None

Auto-ignition temperature: 250° C

Carbaryl

Commonly Used Names: 1-Naphthalenol methylcarbamate, 1-Naphthyl methylcarbamate, Methyl carbamic acid 1-naphthyl ester

Molecular Formula: C₁₂H₁₁NO₂

Molecular Mass: 201.2

Common Use: Carbaryl is a broad spectrum insecticide. Forestry uses include control of western spruce budworm, pandora moth, various nursery and seed orchard insects, mountain pine beetle, and western pine beetle. Rangeland uses include control of grasshoppers, black grass bug, mormon cricket, range caterpillar and range crane fly.

Areas with Highest Concentrations: N/A

Reactions in the Environment: The persistence of carbaryl in the soil is moderate to short. The half-life of carbaryl is generally less than 2 months. Carbaryl is degraded or broken down by both chemical and biological means. Carbaryl has been found in surface waters. In water, carbaryl is broken down chemically, by sunlight, and by microorganisms. Carbaryl is not expected to persist in aquatic environment. Carbaryl does not evaporate easily in the air.

Chemical Class: Carbamate Pesticide

Physical State or Appearance: White odorless crystals or solid in various forms.

Physical Dangers: Combustible

Chemical Dangers: The substance decomposes on heating or on burning producing toxic fumes of nitrogen oxides. Reacts violently with strong oxidants causing fire and explosion hazard.

Physical Characteristics:

Melting point: 142° C

Relative density (water = 1): 1.2

Solubility in water, g/100 ml at 30° C: none

Vapor pressure, Pa at 20° C: 0.7

Flash point: 203° C

Octanol/water partition coefficient as log Pow: 2.34

Carbofuran

Commonly Used Names: 2,3-Dihydro-2,2-dimethylbenzofuran-7-yl methylcarbamate, 2,3-Dihydro-2,2-dimethyl-7-benzofuranyl methylcarbamate, 2,2-Dimethyl-2,3-dihydro-7-benzofuranyl-N-methylcarbamate

Molecular Formula: C₁₂H₁₅NO₃

Molecular Mass: 221

Common Use: Insecticide and nematicide for fruit and field crops, vegetables, tobacco, ornamentals and forest trees.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Carbofuran degrades fairly slowly in non-sterile, neutral, or acid aerobic soils, with half-lives ranging from 1-8 weeks. It is more stable in sterile soil, and

unstable under alkaline conditions. Under anaerobic conditions, carbofuran is more stable and may take twice as long to degrade. The major degradates of concern are the 3-hydroxy carbamate and 7-phenol products resulting from hydrolysis. The metabolites of carbofuran are less toxic than the parent compound. Carbofuran is mobile in soil, particularly sandy soil with high percolation rate. It has been found in shallow aquifers under or near treated fields in three states at levels up to 50 ppb.

Chemical Class: Carbamate

Physical State or Appearance: Colorless crystals.

Physical Dangers: N/A

Chemical Dangers: The substance decomposes on heating producing toxic fumes including nitrogen oxides.

Physical Characteristics:

Melting point: 153-154° C

Relative density (water = 1): 1.2

Solubility in water, g/100 ml at 25° C: 0.07

Vapor pressure, Pa at 33° C: 0.0027

Octanol/water partition coefficient as log Pow: 2.32

Carbon Disulfide

Commonly Used Names: Carbon disulphide, CS₂, Carbon bisulfide, Carbon sulfide

Molecular Formula:CS₂

Molecular Mass: 76.1

Common Uses: In nature, small amounts of carbon disulfide are found in gases released to the earth's surface as, for example, in volcanic eruptions or over marshes. Commercial carbon disulfide is made by combining carbon and sulfur at very high temperatures.

Areas with Highest Concentrations: Alabama, Arkansas, Illinois, Kansas, Louisiana, New York, Tennessee, Texas, West Virginia, and Wisconsin.

Reactions in the Environment: The amount of carbon disulfide released into the air through natural processes is difficult to judge because it is so small. Carbon disulfide evaporates rapidly when released to the environment. Most carbon disulfide in the air and surface water is from manufacturing and processing activities. It is found naturally in coastal and ocean waters. Carbon disulfide does not stay dissolved in water very long, and it also moves through soils fairly quickly. Carbon disulfide does not appear to be taken up in significant amounts by the organisms living in water.

Chemical Class: Sulfur Compound

Physical State or Appearance: Pure carbon disulfide is a colorless liquid with a pleasant odor that is like the smell of chloroform. The impure carbon disulfide that is usually used in most industrial processes is a yellowish liquid with an unpleasant odor, like that of rotting radishes.

Physical Dangers: The vapor is heavier than air and may travel along the ground; distant ignition possible. As a result of flow, agitation, etc., electrostatic charges can be generated.

Chemical Dangers: May explosively decompose on shock, friction, or concussion. May explode on heating. The substance may spontaneously ignite on contact with air and on contact with hot

surfaces producing toxic fumes of sulphur dioxide. Reacts violently with oxidants causing fire and explosion hazard. Attacks some forms of plastic, rubber and coating.

Physical Characteristics:

Boiling point: 46.3° C
Melting point: -110.8° C
Relative density (water = 1): 1.26
Solubility in water, g/100 ml at 20° C: 0.2
Vapor pressure, kPa at 25° C: 48
Relative vapor density (air = 1): 2.63
Flash point: -30° C c.c.
Auto-ignition temperature: 90° C
Explosive limits, vol% in air: 1-50
Octanol/water partition coefficient as log Pow: 1.84

Carbon Tetrachloride

Commonly Used Names: Tetrachloromethane, Tetrachlorocarbon, Tetra, carbon chloride, methane tetrachloride, perchloromethane, tetrachloroethane, or benziform.

Trade names include Benzinoform, Freon 10, Halon 104, Tetraform, or Tetrasol.

Molecular Formula: CCl₄

Molecular Mass: 153.8

Common Uses: It was used in the production of refrigeration fluid and propellants for aerosol cans, as a pesticide, as a cleaning fluid and de-greasing agent, in fire extinguishers, and in spot removers. Because of its harmful effects, these uses are now banned and it is only used in some industrial applications.

Areas with Highest Concentrations: California, Illinois, Kansas, Kentucky, Louisiana, Michigan, New York, Ohio, Pennsylvania and Texas.

Reactions in the Environment: It moves very quickly into the air upon release. It evaporates very quickly from soil and surface water. Only a small amount sticks to soil particles; the rest evaporates or moves into the groundwater. It is very stable in air (lifetime of 30-100 years). It can be broken down or transformed in soil and water within several days. When it does break down, it forms chemicals that can destroy ozone in the upper atmosphere. It doesn't build up in animals. Not known if it builds up in plants.

Chemical Class: Aromatic Chlorinated Hydrocarbon - Liquid Solvent

Physical State or Appearance: Carbon tetrachloride is a manufactured compound that does not occur naturally. It's a clear liquid with a sweet smell that can be detected at low levels.

Physical Dangers: The vapor is heavier than air.

Chemical Dangers: On contact with hot surfaces or flames this substance decomposes forming toxic and irritating fumes (hydrogen chloride, chlorine, phosgene). Reacts violently with some metals such as aluminum, barium, magnesium, potassium, sodium, with fluorine and other substances, causing fire and explosion hazard. Attacks copper, lead and zinc.

Physical Characteristics:

Boiling point: 76.5° C
Melting point: -23° C

Relative density (water = 1): 1.59
Solubility in water, g/100 ml at 20° C: 0.1
Vapor pressure, kPa at 20° C: 12.2
Relative vapor density (air = 1): 5.3
Relative density of the vapor/air-mixture at 20° C (air = 1): 1.5
Octanol/water partition coefficient as log Pow: 2.64

Chlordane

Commonly Used Names: 1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene, Trade Names: Octaclor, Chlorkil, Chlortox, Corodane, Gold Cret C-100 & C-50. Kilex, Prentex and Velsicol 1068

Molecular Formula: C₁₀H₆Cl₈

Molecular Mass: 409.8

Common Uses: Chlordane is a manufactured chemical that was used as a pesticide in the United States from 1948 to 1988. Technical chlordane is not a single chemical, but is actually a mixture of pure chlordane mixed with many related chemicals. Until 1983, chlordane was used as a pesticide on crops like corn and citrus and on home lawns and gardens. Because of concern about damage to the environment and harm to human health, the EPA banned all uses of chlordane in 1983 except to control termites. In 1988, EPA banned all uses.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Chlordane entered the environment when it was used as a pesticide on crops, on lawns and gardens, and to control termites. Chlordane sticks strongly to soil particles at the surface and is not likely to enter groundwater. It can stay in the soil for over 20 years. Most chlordane leaves soil by evaporation to the air. It breaks down very slowly. Chlordane doesn't dissolve easily in water. It builds up in the tissues of fish, birds, and mammals.

Chemical Class: Halogenated Semi-Volatile Organic

Physical State or Appearance: Chlordane is a synthetic compound that takes the form of a viscous liquid whose color ranges from colorless to amber with a mild, irritating smell.

Physical Dangers: Combustible

Chemical Dangers: The substance decomposes on heating and/or on burning and on contact with bases producing toxic fumes: chlorine fumes, hydrogen chloride, phosgene. Attacks plastic, rubber and coating.

Physical Characteristics:

Boiling point: 175°C

Relative density (water = 1): 1.59-1.63

Solubility in water: None

Vapor pressure, Pa at 25° C: 0.0013

Octanol/water partition coefficient as log Pow: 2.78

Chloroacetic Acid

Commonly Used Names: Chloroethanoic acid, Monochloroacetic acid, MCA

Molecular Formula: ClCH_2COOH

Molecular Mass: 94.5

Common Uses: Chloroacetic acid is used in the manufacture of cellulose ethers (used mainly for drilling muds, detergents, food, and pharmaceuticals), as a post-emergence contact herbicide and defoliant, and in the manufacture of glycine and thioglycolic acid. It is also used in the manufacture of various dyes, synthetic caffeine, and organic chemicals.

Areas with Highest Concentrations: N/A

Reactions in the Environment: If released into surface water, it will biodegrade in 8-10 days. It will not absorb appreciably to sediment or bioconcentrate in fish. If spilled on land it would biodegrade and leach into the groundwater. Its fate in groundwater is unknown, If released into the air, it will gravitationally settle out and undergo slow photodegradation.

Chemical Class: N/A

Physical State or Appearance: Colorless crystals with pungent odor .

Physical Dangers: Combustible.

Chemical Dangers: The substance decomposes on heating producing toxic and corrosive gases (hydrogen chloride, phosgene). The solution in water is a strong acid, it reacts violently with bases and is corrosive.

Physical Characteristics:

Boiling point: 189° C

Melting point: about 57° C

Relative density (water = 1): 1.6

Solubility in water, g/100 ml at 20° C: 85

Vapor pressure, kPa at 43° C: 0.13

Relative vapor density (air = 1): 3.3

Relative density of the vapor/air-mixture at 20° C (air = 1): 1.00

Flash point: 126° C

Chlorobenzene

Commonly Used Names: Benzene chloride, Chlorobenzol, MCB, Phenyl chloride

Molecular Formula: $\text{C}_6\text{H}_5\text{Cl}$

Molecular Mass: 112.6

Common Uses: Chlorobenzene production in the United States has declined by more than 60% from its peak in 1960. It was used in the past to make other chemicals, such as phenol and DDT. Now chlorobenzene is used as a solvent for some pesticide formulations, to degrease automobile parts, and as a chemical intermediate to make several other chemicals.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Chlorobenzene released to air is slowly broken down by

reactions with other chemicals and sunlight or can be removed by rain. In water, chlorobenzene will rapidly evaporate to the air and/or be broken down by bacteria. When released to soil, it is broken down rapidly by bacteria, but some will evaporate to the air and some may filter into the groundwater. Chlorobenzene does not build up in the food chain.

Chemical Class: Aromatic Hydrogen Compound

Physical State or Appearance: Chlorobenzene is a synthetic compound that is a colorless and flammable liquid with an aromatic, almond-like odor.

Physical Dangers: The vapor is heavier than air and may travel along the ground; distant ignition possible.

Chemical Dangers: The substance decomposes on heating, on burning and on contact with hot surfaces, producing corrosive and toxic fumes including phosgene, hydrogen chloride. Reacts violently with strong oxidants, dimethyl sulfoxide causing fire and explosion hazard. Attacks rubber and some plastics.

Physical Characteristics:

Boiling point: 132° C

Melting point: -45° C

Relative density (water = 1): 1.11

Solubility in water, g/100 ml at 25° C: 0.02

Vapor pressure, kPa at 20° C: 1.17

Relative vapor density (air = 1): 3.88

Flash point: 27° C c.c.

Auto-ignition temperature: 590° C

Explosive limits, vol% in air: 1.3-11

Octanol/water partition coefficient as log Pow: 2.18-2.84

Chlorobenzilate

Commonly Used Names: 4,4'-dichlorobenzilic acid ethy ester, ethyl p,p'-dichlorobenzilate, chlorbenzilate, akar 50, benz-o-chlor, chlorbenzylate,

Trade Names: folbex, acar, acarben 4E, akar, benzilan, G 338, G 23992, Geigy 338, kop-mite, NCI-C00408

Molecular Formula: C₁₆H₁₄Cl₂O₃

Molecular Mass: 325.20

Common Uses: Used primarily as a non-systematic pesticide in spider and mite control, all uses except citrus have been banned

Areas with Highest Concentrations: N/A

Reactions in the Environment: Chlorobenzilate is practically insoluble in water and it adsorbs strongly to soil particles in the upper soil layers, it is expected to exhibit low mobility in soils, and therefore unlikely to leach into groundwater. Chlorobenzilate is not ordinarily found in subsurface drainage waters, nor in surface runoff waters. Chlorobenzilate adsorbs to sediment and suspended particulate material in water. It is practically insoluble in water. It is not expected to volatilize or to bioconcentrate in aquatic organisms, but may be subject to biodegradation. Chlorobenzilate is fairly persistent on plant foliage and may be phytotoxic, or poisonous, to

some plants.

Chemical Class: Organochlorine Compound; Chlorinated Hydrocarbon.

Physical State or Appearance: Viscous yellow liquid or pale yellow crystals.

Physical Dangers: N/A

Chemical Dangers: Chlorobenzilate is stable under normal temperatures and pressures. It may burn, but does not ignite readily. Breakdown of chlorobenzilate by heat may create corrosive fumes of hydrogen chloride and toxic oxides of carbon. Exposure to alkalis or strong acids may cause hydrolysis.

Physical Characteristics:

Melting point: 35 - 37° C

Boiling point: 156° C at 0.07 mm Hg

Water solubility: negligible

Flash point: 104° F (40 °C)

Specific gravity: 1.2816

Vapor Pressure: 20° C/2.2⁻⁶ mm

Chloroform

Commonly Used Names: Trichloromethane, Methane trichloride, Formyl chloride

Molecular Formula: CHCl₃

Molecular Mass: 119.4

Common Uses: In the past, chloroform was used as an inhaled anesthetic during surgery, but it isn't used that way today. Today, chloroform is used to make other chemicals and can also be formed in small amounts when chlorine is added to water.

Areas of Highest Concentration: Alabama, Arkansas, Coast from Massachusetts to Virginia, Florida, Georgia, Louisiana, North Carolina, Wisconsin, South Carolina and Southern California Texas, and Washington.

Reactions in the Environment: Chloroform evaporates easily into the air. Most of the chloroform in air breaks down eventually, but it is a slow process. The breakdown products in air include phosgene and hydrogen chloride, which are both toxic. It doesn't stick to soil very well and can travel through soil to groundwater. Chloroform dissolves easily in water and some of it may break down to other chemicals. Chloroform lasts a long time in groundwater. Chloroform doesn't appear to build up in great amounts in plants and animals.

Chemical Class: Aliphatic Halogen Volatile Organic - Liquid Solvent.

Physical State or Appearance: Chloroform is a volatile colorless liquid with a pleasant, nonirritating odor and a slightly sweet taste.

Physical Dangers: The vapor is heavier than air.

Chemical Dangers: On contact with hot surfaces or flames this substance decomposes forming irritating and toxic fumes (hydrogen chloride, phosgene, chlorine). The substance decomposes slowly under influence of air and light. Reacts violently with strong bases, strong oxidants, some metals, such as aluminum, lithium, magnesium, potassium, sodium and acetone, causing fire and explosion hazard. Attacks plastic, rubber and coatings.

Physical Characteristics:

Boiling point: 62° C
Melting point: -64° C
Relative density (water = 1): 1.48
Solubility in water, g/100 ml at 20° C: 0.8
Vapor pressure, kPa at 20° C: 21.2
Relative vapor density (air = 1): 4.12
Relative density of the vapor/air-mixture at 20° C (air = 1): 1.7
Octanol/water partition coefficient as log Pow: 1.97

Chromium

Commonly Used Names: Chrome (powder)

Molecular Formula: Cr (metal)

Molecular Mass: 52.0

Common Uses: Chromium(VI) and chromium(0) are generally produced by industrial processes. The metal chromium, which is the chromium(0) form, is used for making steel. Chromium(VI) and chromium(III) are used for chrome plating, dyes and pigments, leather tanning, and wood preserving.

Areas with Highest Concentrations: Arizona, California, Idaho, Illinois, Kentucky, Michigan, Montana, Nevada, Ohio, Pennsylvania, South Carolina, Texas and Virginia.

Reactions in the Environment: Chromium enters the air, water, and soil mostly in the chromium(III) and chromium(VI) forms. In air, chromium compounds are present mostly as fine dust particles which eventually settle over land and water. Chromium can strongly attach to soil and only a small amount can dissolve in water and move deeper in the soil to underground water. Fish do not accumulate much chromium in their bodies from water.

Chemical Class: Inorganic

Physical State or Appearance: Steel grey lustrous metal. No taste or odor is associated with chromium compounds. Chromium is a naturally occurring element found in rocks, animals, plants, soil, and in volcanic dust and gases. Chromium is present in the environment in several different forms. The most common forms are chromium(0), chromium(III), and chromium(VI).. Chromium(III) occurs naturally in the environment and is an essential nutrient.

Physical Dangers: Dust explosion possible if in powder or granular form, mixed with air.

Chemical Dangers: Reacts violently with strong oxidants such as hydrogen peroxide, causing fire and explosion hazard. Reacts with diluted hydrochloric and sulfuric acids. Incompatible with alkalis and alkali carbonates.

Physical Characteristics:

Boiling point: 2642° C
Melting point: 1900° C
Relative density (water = 1): 7.14
Solubility in water: None

Coke Oven Compounds

Commonly Used Names: N/A

Molecular Formula: N/A

Molecular Mass: N/A

Common Uses: At coke oven batteries, coal is processed to produce coke (pure carbon) which is a component in manufacturing steel and iron. Chemical recovered from emission are used as a raw material for plastics, solvents, dyes, drugs, waterproofing, paints, coating of pipes, roads, roofing, insulation, and as pesticides and sealants.

Areas with Highest Concentrations: N/A

Reactions in the Environment: N/A

Chemical Class: N/A

Physical State or Appearance: Condensed coke oven emissions are a brownish, thick liquid or semisolid with a naphthalene-like odor, while uncondensed coke oven emissions are vapors that escape when the ovens are changed and emptied.

Physical Dangers: N/A

Chemical Dangers: N/A

Physical Characteristics: N/A

DDE

Commonly Used Names: Dichlorodipenyldichloroethylene

Molecular Formula: C₁₄H₈CL₄

Molecular Mass: 318.029

Common Use: DDE and DDD are chemicals similar to DDT that contaminate commercial DDT preparations. DDE has no commercial use.

Areas of Highest Concentration: N/A

Reactions in the Environment: DDE enters the environment as contaminant or breakdown product of DDT. DDT, DDE, and DDD in air are rapidly broken down by sunlight. DDE, build up in plants and in fatty tissues of fish, birds, and other animals.

Chemical Class: Halogenated Semi-Volatile Organic Pesticide

Physical State or Appearance: N/A

Physical Dangers: Byproduct of DDT, similar dangers.

Chemical Dangers: Byproduct of DDT, similar dangers.

Physical Characteristics: Byproduct of DDT, similar characteristics.

DDT

Commonly Used Names: Dichlorodiphenyltrichloroethane, 1,1,1-Trichloro-2,2-bis(p-chlorophenyl)ethane, 2,2-bis(p-Chlorophenyl)-1,1,1-trichloroethane. Trade Names: Agritan, Gesapon, Gesarex and Gesarol

Molecular Formula: C₁₄H₉Cl₅

Molecular Weight: 354.49

Common Uses: DDT is a pesticide once widely used to control insects in agriculture and insects that carry diseases such as malaria. DDT is a white, crystalline solid with no odor or taste. Its use in the U.S. was banned in 1972 because of damage to wildlife, but is still used in some countries.

Areas of Highest Concentration: N/A

Reactions in the Environment: DDT entered the environment when it was used as a pesticide; it still enters the environment due to current use in other countries. DDT, DDE, and DDD in air are rapidly broken down by sunlight. Half of what's in air breaks down within 2 days. They stick strongly to soil; most DDT in soil is broken down slowly to DDE and DDD by microorganisms; half the DDT in soil will break down in 2-15 years, depending on the type of soil. Only a small amount will go through the soil into groundwater; they do not dissolve easily in water. DDT, and especially DDE, build up in plants and in fatty tissues of fish, birds, and other animals.

Chemical Class: Halogenated Semi-Volatile Organochlorine Compound.

Physical State or Appearance: Colorless solid with a weak, chemical odor.

Physical Dangers: N/A

Chemical Dangers: On combustion, forms toxic and corrosive fumes including hydrogen chloride. Reacts with organic and inorganic bases, aluminum and iron.

Physical Characteristics:

Melting Point: 108.5 ° C

Boiling point: 260 ° C

Slightly Soluble: 0.00000017 g/100 mL

Density (g cm⁻³): 1.56

Flash point: 165° C

Octanol/water partition coefficient as log Pow: 6.36-6.38

Dichlorvos

Commonly Used Names: 2,2-dichloroethenol dimethyl phosphate. Trade Names: Vapona, Vaponite

Molecular Formula: C₄H₇Cl₂O₄P

Molecular Weight: 220.98

Common Uses: Dichlorvos used in pest control is diluted with other chemicals and used as a spray. It can also be incorporated into plastic that slowly releases the chemical. Dichlorvos is used for insect control in food storage areas, green houses, and barns, and control of insects on livestock. It is not generally used on outdoor crops. Dichlorvos is sometimes used for insect control in workplaces and in the home. Veterinarians use it to control parasites on pets.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Dichlorvos enters the environment during its manufacture and use, from landfills, and from accidental spills during transport and leaks from storage containers. It evaporates easily into the air, where it is broken down into less harmful chemicals. It will dissolve in water, where microorganisms can break it down. It takes about 24–36 hours for half of the chemical to be broken down in water. Dichlorvos does not appear to accumulate in plants, fish, or animals.

Chemical Class: Organophosphate Insecticide.

Physical State or Appearances: Colorless to amber liquid with a mild chemical odor.

Dichlorvos is an insecticide that is a dense colorless liquid. It has a sweetish smell and readily mixes with water.

Physical Dangers: N/A

Chemical Dangers: Emits toxic fumes when burned including hydrogen chloride, hydrogen bromide, phosphorus oxides and carbon monoxide.

Physical Characteristics:

Melting Point: -60° C

Boiling Point: 140° C

Density: 1.412

Slightly Soluble

Dieldrin

Commonly Used Names: HEOD, 1,2,3,4,10,10-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro,endo,exo- 1,4:5,8-dimethanonaphthalene. Trade Names: Dieldrite, Dieldrix, Panoram and Octalox.

Molecular Formula: C₁₂H₈Cl₆O

Molecular Mass: 381

Common Use: same as Aldrin.

Areas with Highest Concentrations: N/A

Reactions in the Environment: same as Aldrin.

Chemical Class: Semi-Volatile Halogen - Organochlorine Pesticide.

Physical State or Appearance: Colorless crystals.

Physical Dangers: N/A

Chemical Dangers: The substance decomposes on heating producing toxic and corrosive fumes (chlorine fumes, hydrogen chloride). Reacts with oxidants, concentrated mineral acids, acid acatalysts, metals (copper, iron). Attacks metal due to the slow formation of hydrogen chloride in storage.

Physical Characteristics:

Melting point: 175-176° C

Relative density (water = 1): 1.62

Solubility in water: None

Vapor pressure, Pa at 20° C: 0.0004

Octanol/water partition coefficient as log Pow: 6.2

Diuron

Commonly Used Names: 3-(3,4 - dichlorophenyl) - 1,1 - dimethylurea, ethylene glycol.

Trade Names: Duirex, Karmex, Telvar

Molecular Formula: C₉H₁₀C₁₂N₂O

Molecular Mass: 233.10

Common Uses: Diuron is a substituted urea compound registered for use as a herbicide to

control a wide variety of annual and perennial broadleaf and grassy weeds on both crop and noncrop sites. Diuron is registered for use on numerous crop sites such as forage crops, field crops, fruits, vegetables, nuts, and ornamental crops. In non-crop applications, diuron is used on industrial sites, on rights-of-way, around farm buildings, and on irrigation and drainage ditches.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Degradation is expected in soil environment within one month to a year.

Chemical Class: Substituted Urea Herbicide.

Physical State or Appearance: Brown granules that are odorless. Technical diuron is a white, crystalline, odorless liquid.

Physical Dangers: N/A

Chemical Dangers: Stability altered in extreme temperatures. Reacts with acids and alkalies. When it decomposes it releases toxic oxides of nitrogen and carbon.

Physical Characteristics:

Melting Point: 158-159° F

Boiling Point: 212° F

Vapor Pressure: 50°; 3.1×10^{-6} mm Hg

PH: 6.8

Density: 1.48

Dispersible in Water

Endrin

Commonly Used Names: 3,4,5,6,9,9 - Hexachloro - 1a,2,2a,3,6,6a,7 - 7a- octahydro - 2,7:3m6 - dimethanonaphth - {2,3-b}oxirene, endrin aldehyde and endrin ketone.

Molecular Formula: $C_{12}H_8Cl_6O$

Molecular Mass: 380.93

Common Use: Endrin has not been produced or sold for general use in the United States since 1986. It was used as a pesticide to control insects, rodents, and birds.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Endrin does not dissolve very well in water. It has been found in groundwater and surface water, but only at very low levels. It is more likely to cling to the bottom sediments of rivers, lakes, and other bodies of water. Endrin is generally not found in the air except when it was applied to fields during agricultural applications. The persistence of endrin in the environment depends highly on local conditions. Some estimates indicate that endrin can stay in soil for over 10 years. Endrin may also be broken down by exposure to high temperatures or light to form primarily endrin ketone and endrin aldehyde. It is not known what happens to endrin aldehyde or endrin ketone once they are released to the environment.

However, the amount of endrin broken down to endrin aldehyde or endrin ketone is very small.

Chemical Class: Organochlorine Compound.

Physical State or Appearance: Endrin is a white or colorless crystalline solid with little odor.

Physical Dangers: N/A

Chemical Dangers: Reacts with strong acids and strong oxidizing agents.

Physical Characteristics:

Boiling Point: 493° F
Freezing Point: 226° C
Vapor Pressure: 25°: 2×10^{-7} mm Hg
Insoluble in Water

Ethyl Benzene

Commonly Used Names: Phenylethane, ethylbenzol, EB

Molecular Formula: $C_8H_{10}/C_6H_5-C_2H_5$

Molecular Mass: 106.2

Common Uses: It is found in natural products such as coal tar and petroleum and is also found in manufactured products such as inks, insecticides, and paints. Ethylbenzene is used primarily to make another chemical, styrene. Other uses include as a solvent, in fuels, and to make other chemicals.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Ethylbenzene moves easily into the air from water and soil. It takes about 3 days for ethylbenzene to be broken down in air into other chemicals.

Ethylbenzene may be released to water from industrial discharges or leaking underground storage tanks. In surface water, ethylbenzene breaks down by reacting with other chemicals found naturally in water. In soil, it is broken down by soil bacteria.

Chemical Class: Aromatic Halogen Compound.

Physical State or Appearance: Colorless liquid that smells like gasoline.

Physical Dangers: Flammable liquid and vapor, vapor can cause flash fire. The vapor mixes well with air, explosive mixtures are easily formed.

Chemical Dangers: Reacts with strong oxidants. Attacks plastic and rubber.

Physical Characteristics

Boiling point: 136°C

Melting point: -95° C

Relative density (water = 1): 0.9

Solubility in water, g/100 ml at 20° C: 0.015

Vapor pressure, kPa at 20° C: 0.9

Relative vapor density (air = 1): 3.7

Relative density of the vapor/air-mixture at 20° C (air = 1): 1.02

Flash point: 18° C c.c.

Auto-ignition temperature: 432° C

Explosive limits, vol% in air: 1.0-6.7

Octanol/water partition coefficient as log Pow: 3.2

1,2-DICHLOROETHANE

Commonly Used Names: *Ethylene dichloride*, 1,2-Ethylene dichloride, Ethane dichloride 1,2-bichloroethane, dichloroethylene, ethylene chloride, ethane dichloride, ethylene dichloride, 1,2-

ethylene dichloride, glycol dichloride, EDC, NCI-C00511, sym-dichloroethane, alpha, beta-dichloroethane.

Trade Names: borer sol, brocide, destruxol, dichloremulsion, dutch oil, di-chlor-mulsion, dutch liquid, freon 150, NU-G00511.

Molecular Formula: ClCH₂CH₂Cl / C₂H₄Cl₂

Molecular Mass: 98.96

Common Use: Solvents for fat oils, waxes, gums, resins and particular rubber. Also used as a fumigant.

Areas with Highest Concentrations: California, Coastal East from Massachusetts to Virginia, Louisiana, Michigan, and Southern Texas.

Reaction in the Environment: It turns dark on exposure to air, moisture and light.

Chemical Class: Aliphatic Halogen Compound

Physical State and Appearance: Colorless, viscous liquid, with characteristic odor.

Physical Dangers: The vapor is heavier than air and may travel along the ground; distant ignition possible. As a result of flow, agitation, etc., electrostatic charges can be generated.

Chemical Dangers: The substance decomposes on heating and on burning producing toxic and corrosive fumes including hydrogen chloride and phosgene. Reacts violently with aluminum, alkali metals, alkali amides, ammonia, bases, strong oxidants. Attacks many metals in presence of water. Attacks plastic.

Physical Characteristics:

Boiling point: 83.5° C

Melting point: -35.7° C

Relative density (water = 1): 1.235

Solubility in water, g/100 ml: 0.87

Vapor pressure, kPa at 20° C: 8.7

Relative vapor density (air = 1): 3.42

Relative density of the vapor/air-mixture at 20° C (air = 1): 1.2

Flash point: 13° C c.c.

Auto-ignition temperature: 413° C

Explosive limits, vol% in air: 6.2-16

Octanol/water partition coefficient as log Pow: 1.48

Ethylene Oxide

Commonly Used Names: 1,2-Epoxyethane, Oxirane, Dimethylene oxide (cylinder).

Molecular Formula: C₂H₄O

Molecular Mass: 44.1

Common Uses: Ethylene oxide is a man-made chemical that is used primarily to make ethylene glycol (a chemical used to make antifreeze and polyester). A small amount (less than 1%) is used to control insects in some stored agricultural products and a very small amount is used in hospitals to sterilize medical equipment and supplies.

Areas with Highest Concentrations: Arizona, California, Georgia, Illinois, Louisiana, Michigan, New Jersey, South Carolina, Southern Florida, Texas and West Virginia.

Reactions in the Environment: Ethylene oxide rapidly breaks down when released to the

environment. Because ethylene oxide is a gas, most is expected to be released to the air where it reacts with water vapor and sunlight and breaks down within a few days. Ethylene oxide will dissolve in water, but most of it will quickly evaporate to the air. The ethylene oxide remaining will be broken down by bacteria, or by reacting with water and other chemicals. When released to soil, most will evaporate to air and some may be broken down by bacteria or by reacting with water in the soil. Ethylene oxide does not persist long in the environment and is not expected to build up in the food chain.

Chemical Class: Heterocyclic Compound.

Physical State or Appearance: Colorless compressed liquified gas with a sweet odor.

Physical Dangers: The gas is heavier than air and may travel along the ground; distant ignition possible.

Chemical Dangers: The substance may polymerize due to heating, under the influence of acids, bases, metal chlorides and metal oxides with fire or explosion hazard. The substance decomposes on heating above 500°C, causing fire and explosion hazard. Reacts violently with many compounds. Metal fittings containing silver, copper, mercury, or magnesium should not be used since they may react with impurities in the gas to form explosive compounds.

Physical Characteristics:

Boiling point: 11° C

Melting point: -111° C

Relative density (water = 1): 0.9

Solubility in water: High

Vapor pressure, kPa at 20° C: 146

Relative vapor density (air = 1): 1.5

Auto-ignition temperature: 429° C

Explosive limits, vol% in air: 3-100

Octanol/water partition coefficient as log Pow: -0.3

Fonofos

Commonly Used Names: O-Ethyl S-phenylethylphosphonodithioate

Molecular Formula: C₅H₅SPSCH₂CH₃OCH₂CH₃ / C₁₀H₁₅OPS₂

Molecular Mass: 246.3

Common Uses: Fonofos in a soil applied insecticide used primarily on corn (95%). It is used also on various vegetable crops, ornamentals, home lawns and home vegetable gardens and commercial turf.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Fonofos is immobile in sandy loam and silt loam soils. It is mobile in quartz sand. It decomposes in aerobic soils by microbes in 4-8 weeks. Fonofos is non-volatile from soil but volatile from water. It degrades in aerobic soils with a half life of 3-16 weeks. Fonofos is moderately persistent.

Chemical Class: Organophosphate

Physical State or Appearance: Clear, colorless liquid, with characteristic odor.

Physical Dangers: Combustible. Liquid formulations contain organic solvents which may be flammable.

Chemical Dangers: Substance is hydrolyzed in contact with strong acids and alkalis.

Physical Characteristics:

Boiling point: 130°C

Melting point: 30° C

Relative density (water = 1): 1.16

Solubility in water: None

Vapor pressure, Pa at 25° C: 0.03

Flash point: 94° C c.c.

Octanol/water partition coefficient as log Pow: 3.94

Formaldehyde

Commonly Used Names: Bvf, FA, fannofom, formalith, formalin, formalin 40, formic aldehyde, formol, fyde, hoch, karsan, lysoform, methyl aldehyde, methylene glycol, methylene oxide, methanal, morbicid, oxomethane, oxymethylene, paraform, polyoxymethylene glycols, superlysoform, methylaldehyde

Molecular formula: CH₂O

Molecular Mass: 30.03

Common Uses: It is used in the production of fertilizer, paper, plywood, and urea-formaldehyde resins. It is also used as a preservative in some foods and in many products used around the house, such as antiseptics, medicines, and cosmetics. Formaldehyde is used in the finishing process for textiles and the resulting material must conform to an agreed standard which requires that clothing worn next to the skin must contain less than 75 ppm formaldehyde. Formaldehyde is used to fumigate large storage areas, such as ships and warehouses and to protect plants and vegetables by preventing fungal growths and mildew, as well as killing insects.

Areas with Highest Concentrations: Coastal East and West Coast, Florida, North Carolina, Virginia, and Western Pennsylvania.

Reactions in the Environment: Formaldehyde dissolves easily but does not last a long time in water. Most formaldehyde in the air breaks down during the day. The breakdown products of formaldehyde are formic acid and carbon monoxide. Formaldehyde does not build up in plants and animals.

Chemical Class: Aliphatic Aldehyde

Physical Appearance or State: It is a colorless liquid, typically 37% formaldehyde in water. At room temperature, formaldehyde is a colorless, flammable gas that has a distinct, pungent smell. Formaldehyde is naturally produced in small amounts in our bodies.

Physical Dangers: N/A

Chemical Dangers: Incompatible with oxidizing agents and alkalis. Reacts explosively with nitrogen dioxide at ca. 180°C (356°F). Reacts violently with perchloric acid, perchloric acid-aniline mixtures, and nitromethane. Reaction with hydrochloric acid may form bis-chloromethyl ether, an OSHA regulated carcinogen. Heat, flames, ignition sources and incompatibles.

Physical Characteristics:

Boiling point: 96° C

Specific gravity: 1.083

Vapor pressure: 55 mm Hg at 37° C
Vapor density: 1 (air = 1)
Flash point: 56° C
Explosion limits: 7% - 73%
Autoignition temperature: 572° F
Water solubility: Substantial

Heptachlor

Commonly Used Names: 1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene
Trade names include Heptagran®, Basaklor®, Drinox®, Soleptax®, Termide®, and Velsicol 104®

Molecular Formula: C₁₀H₅Cl₇

Molecular Mass: 373.35

Common Uses: Heptachlor is a manufactured chemical and doesn't occur naturally. Heptachlor was used extensively in the past for killing insects in homes, buildings, and on food crops, especially corn. Use slowed in the 1970s and stopped in 1988.

Areas with Highest Concentrations: New Jersey, South Carolina, and Texas.

Reactions in the Environment: Heptachlor epoxide is also a white powder and is a breakdown product of heptachlor. The epoxide is more likely to be found in the environment than heptachlor. Heptachlor doesn't dissolve easily in water; heptachlor epoxide dissolves more easily. They stick strongly to soil particles and evaporate slowly to air. Heptachlor epoxide can stay in the soil and water for many years. Animals change heptachlor to the epoxide. Plants can take up heptachlor from the soil. Levels build up in the tissues of fish and cattle.

Chemical Class: Organochlorine Pesticide.

Physical State or Appearance: Pure heptachlor is a white powder or crystals that smells like camphor (mothballs). The less pure grade is tan.

Physical Dangers: N/A

Chemical Dangers: The substance decomposes on heating producing toxic fumes. Reacts with strong oxidants.

Physical Characteristics:

Boiling point: 135-145°C

Melting point: 95-96° C

Relative density (water = 1): 1.65-1.67

Solubility in water: None

Vapor pressure, Pa at 25° C: 0.053

Octanol/water partition coefficient as log Pow: 3.87-5.44 (estimated)

Hexane

Commonly Used Names: Normal Hexane; Hexyl Hydride; Hexane 95%

Molecular Formula: $\text{CH}_3(\text{CH}_2)_4\text{CH}_3$ n-hexane

Molecular Mass: 86.18

Common Uses: Pure n-hexane is used in laboratories. Most of the n-hexane used in industry is mixed with similar chemicals called solvents. The major use for solvents containing n-hexane is to extract vegetable oils from crops such as soybeans. These solvents are also used as cleaning agents in the printing, textile, furniture, and shoemaking industries. Certain kinds of special glues used in the roofing and shoe and leather industries also contain n-hexane. Several consumer products contain n-hexane, such as gasoline, quick-drying glues used in various hobbies, and rubber cement.

Areas with Highest Concentrations: N/A

Reactions in the Environment: n-Hexane enters the environment during its manufacture and use. It evaporates very easily into the air where it is broken down in a few days. It dissolves only slightly in water. Most of n-hexane spilled in water will float on the surface where it evaporates into the air. If n-hexane is spilled on the ground, most of it will evaporate before it can soak into the soil. n-Hexane is not concentrated by plants, fish, or animals.

Chemical Class: Aliphatic Hydrocarbon

Physical State or Appearance: n-Hexane is a chemical made from crude oil. Pure n-hexane is a volatile colorless liquid with a slightly disagreeable odor.

Physical Dangers: The vapor is heavier than air and may travel along the ground; distant ignition possible.

Chemical Dangers: Reacts with strong oxidants causing fire and explosion hazard.

Physical Characteristics

Boiling point: 69° C

Melting point: -95° C

Relative density (water = 1): 0.66

Solubility in water: None

Vapor pressure, kPa at 20° C: 16

Relative vapor density (air = 1): 3.0

Relative density of the vapor/air-mixture at 20° C (air = 1): 1.3

Flash point: -22° C (c.c.)

Auto-ignition temperature: 240° C

Explosive limits, vol% in air: 1.1-7.5

Octanol/water partition coefficient as log Pow: 3.9

Hexachlorobenzene

Commonly Used Names: Perchlorobenzene, HCB. Trade Names: Anticarie, Cekie C.B. and No Burt

Molecular Formula: C_6Cl_6

Molecular Mass: 284.80

Common Uses: Hexachlorobenzene was widely used as a pesticide to protect the seeds of onions and sorghum, wheat, and other grains against fungus until 1965. It was also used to make fireworks, ammunition, and synthetic rubber. Currently, hexachlorobenzene is not used commercially in the United States

Areas with Highest Concentrations: California, Massachusetts, and Midwest States.

Reactions in the Environment: Hexachlorobenzene can remain in the environment for a long time. It breaks down very slowly. It sticks strongly to soil. Half of the hexachlorobenzene in soil will disappear in 3-6 years. It does not dissolve easily in water. Once in water, it binds to sediments and settles to the bottom. Half of the hexachlorobenzene in surface water will disappear in 3-6 years. Under ordinary conditions not much evaporates into the air. Once in air, it can be carried out long distances. Hexachlorobenzene can build up in fish and other aquatic animals.

Chemical Class: Aromatic Organochlorine

Physical State or Appearance: Hexachlorobenzene is a colorless to white crystalline solid, that does not occur naturally in the environment.

Physical Dangers: Combustible.

Chemical Dangers: The substance decomposes on heating producing toxic fumes. Reacts violently with dimethyl formamide above 65° C.

Physical Characteristics:

Boiling point: 323-326° C

Melting point: 231° C

Relative density (water = 1): 2.04

Solubility in water: None

Vapor pressure, kPa at 114° C: 0.133

Vapor pressure, Pa at 20° C: <0.1

Relative vapor density (air = 1): 9.8

Flash point: 242° C

Octanol/water partition coefficient as log Pow: 6.2

Hexachlorobutadiene

Commonly Used Names: HCBD, perchlorobutadiene. Trade Name: Dolen-Pur.

Molecular Formula: C₄Cl₆

Molecular Mass: 260.762

Common Uses: Hexachlorobutadiene is a colorless liquid with a turpentine-like odor. It is also called perchlorobutadiene. Hexachlorobutadiene is not found naturally in the environment. It is formed when other chemicals are made. Most hexachlorobutadiene used commercially in the United States is imported from Germany. It is mainly used to make rubber compounds. It is also used as a solvent, and to make lubricants, in gyroscopes, as a heat transfer liquid, and as a hydraulic fluid.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Hexachlorobutadiene is released to the environment mainly from its disposal following industrial uses. In air, half of it may be broken down to other chemicals within 60 days. In water, half of it may be broken down to other chemicals within 30 days. It readily breaks down in soil, but it can accumulate in fish.

Chemical Class: Polyester Polymer

Physical Appearance: Heavy colorless liquid

Physical Dangers: N/A

Chemical Dangers: N/A

Physical Characteristics:

Melting Point: -21° C

Boiling Point: 210° C

Density: 1.68

Insoluble

Lindane

Commonly Used Names: *Hexachlorocyclohexane*, gamma-1,2,3,4,5,6-Hexachlorocyclohexane, gamma-BHC, gamma-HCH. Trade Names: Agrocide, Ambrocide, Benesan, and Gamasan.

Molecular Formula: C₆H₆Cl₆

Molecular Mass: 290.8

Common Uses: HCH are a group of manufactured chemicals that does not occur naturally in the environment. HCH has eight chemical forms (called isomers). The four most common are alpha-, beta-, gamma, and delta-HCH. The most common of these is gamma-HCH (also known as lindane). Lindane was used as an insecticide on fruit and vegetable crops (including greenhouse vegetables and tobacco) and forest crops (including Christmas trees). It is still used in ointments to treat head and body lice, and scabies. Lindane has not been produced in the United States since 1977. It is still imported to and formulated in the United States.

Areas with Highest Concentrations: N/A

Reactions in the Environment: In air, Hexachlorocyclohexanes (HCH) can be present as a vapor or attached to small particles such as soil or dust. Lindane can remain in the air for up to 17 weeks and travel long distances. Particles with attached HCH may be removed from the air by rain. In soil, sediments, and water, it is broken down by algae, fungi, and bacteria to less harmful substances. HCH isomers are broken down quickly in water; lindane does not remain in water longer than 30 days.

The length of time that HCH isomers remain in soil is not known. It can accumulate in the fatty tissue of fish.

Chemical Class: Organochlorine Pesticide

Physical State or Appearance: Lindane is a white solid substance that may evaporate into the air as a colorless vapor with a slightly musty odor.

Physical Dangers: Not combustible. Liquid formulations containing organic solvents may be flammable.

Chemical Dangers: On contact with hot surfaces or flames this substance decomposes forming toxic and corrosive fumes including phosgene and hydrogen chloride. The substance decomposes on contact with alkalis producing trichlorobenzene, or on contact with powdered iron, aluminum and zinc.

Physical Characteristics:

Boiling point: 323° C

Melting point: 113° C

Relative density (water = 1): 1.87

Solubility in water: None

Vapor pressure, Pa at 20° C: 0.0012

Octanol/water partition coefficient as log Pow: 3.61- 3.72

Hexachloroethane

Commonly Used Names: Perchloroethane, Carbon hexachloride, HCE

Molecular Formula: C_2Cl_6/Cl_3CCCl_3

Molecular Mass: 236.7

Common Uses: It is used by the military for smoke-producing devices. It is also used to remove air bubbles in melted aluminum. Hexachloroethane may be present as an ingredient in some fungicides, insecticides, lubricants, and plastics. It is no longer made in the United States, but it is formed as a by-product in the production of some chemicals. Some hexachloroethane can be formed by incinerators when materials containing chlorinated hydrocarbons are burned. Hexachloroethane itself does not catch fire easily. Some hexachloroethane can also be formed when chlorine reacts with carbon compounds in drinking water.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Hexachloroethane can be released to the environment during its production, use, transport, or disposal. In air, hexachloroethane does not break down to other compounds. Some hexachloroethane that is in lakes or streams and surface soils will evaporate into the air. Microscopic organisms can break it down more easily without oxygen than with oxygen. Hexachloroethane does not appear to build up in plants or animals used for food.

Chemical Class: N/A

Physical State or Appearance: Colorless crystals that smells like Camphor.

Physical Dangers: N/A

Chemical Dangers: The substance decomposes on heating above 300° C producing toxic and corrosive fumes, phosgene and hydrogen chloride. Reacts violently with zinc, aluminium powder and sodium. Attacks iron in the presence of moisture.

Physical Characteristics

Sublimation point: 183-185° C

Relative density (water = 1): 2.1

Solubility in water: None

Vapor pressure, Pa at 20° C: 53

Relative vapor density (air = 1): 8.2

Relative density of the vapor/air-mixture at 20° C (air = 1): 1.0

Octanol/water partition coefficient as log Pow: 3.9

Lead

Commonly Used Names: Lead metal, Plumbum (powder)

Molecular Formula: Pb

Molecular Mass: 207.2

Common Uses: Lead can be found in all parts of our environment. Much of it comes from human activities including burning fossil fuels, mining, and manufacturing. Lead has many different uses. It is used in the production of batteries, ammunition, metal products (solder and pipes), and devices to shield X-rays. Because of health concerns, lead from gasoline, paints and ceramic products, caulking, and pipe solder has been dramatically reduced in recent years.

Areas with Highest Concentration: Arizona, Florida, Indiana, Scattered through New York, Ohio and Pennsylvania and in Southern California

Reactions in the Environment: Lead itself does not break down, but lead compounds are changed by sunlight, air, and water. When lead is released to the air, it may travel long distances before settling to the ground. Once lead falls onto soil, it usually sticks to soil particles. Movement of lead from soil into groundwater will depend on the type of lead compound and the characteristics of the soil. Much of the lead in inner-city soils comes from old houses painted with lead-based paint.

Chemical Class: Inorganic

Physical State or Appearance: Lead is a naturally occurring bluish-gray metal found in small amounts in the earth's crust. Tarnishes with exposure to air.

Physical Dangers: Dust explosion possible if in powder or granular form, mixed with air.

Chemical Dangers: Upon heating, toxic fumes are formed. Reacts with hot concentrated nitric acid, boiling concentrated hydrochloric and sulfuric acids. Attacked by pure water and by weak organic acids in the presence of oxygen.

Physical Characteristics:

Boiling point: 1740° C

Melting point: 327.5° C

Relative density (water = 1): 11.34

Solubility in water: None

Manganese (powder)

Commonly Used Names: Methylcyclopentadienyl manganese tricarbonyl (MMT). Trade names: Maneb or mancozeb

Molecular Formula: Mn

Molecular Mass: 54.9

Common Uses: Manganese can also be combined with carbon to make organic manganese compounds. Manganese is an essential trace element and is necessary for good health.

Manganese can be found in several food items, including grains and cereals, and is found in high amounts in other foods, such as tea.

Areas of Highest Concentration: Alabama, Arizona, Illinois, Iowa, Kansas, Michigan, Nevada, Ohio, Pennsylvania, and Southern California.

Reactions in the Environment: Manganese can enter the air from iron, steel, and power plants, coke ovens, and from dust from mining operations. It can enter the water and soil from natural deposits, disposal of wastes, or deposits from airborne sources. Manganese exists naturally in rivers, lakes, and underground water. Plants in the water can take up some of the manganese from water and concentrate it.

Chemical Class: N/A

Physical State or Appearance: Manganese is a naturally occurring metal that is found in many types of rocks. Pure manganese is silver-colored powder, but does not occur naturally. It combines with other substances such as oxygen, sulfur, or chlorine.

Physical Dangers: Dust explosion possible if in powder or granular form, mixed with air.

Chemical Dangers: Upon heating, toxic fumes are formed. Reacts violently with concentrated hydrogen peroxide. Reacts slowly with water more rapidly with steam and acids to produce flammable gas causing fire and explosion hazard. Burns in nitrogen gas above 200° C.

Physical Characteristics:

Boiling point: 1962° C

Melting point: 1244° C

Relative density (water = 1): 7.2-7.4

Solubility in water: None

Mercury

Commonly Used Names: Quicksilver, Liquid silver, Hydrargyrum.

Molecular Formula: Hg

Molecular Mass: 200.6

Common Uses: Mercury also combines with carbon to make organic mercury compounds. The most common one, methylmercury, is produced mainly by microscopic organisms in the water and soil. More mercury in the environment can increase the amounts of methylmercury that these small organisms make. Metallic mercury is used to produce chlorine gas and caustic soda, and is also used in thermometers, dental fillings, and batteries. Mercury salts are sometimes used in skin lightening creams and as antiseptic creams and ointments.

Areas with Highest Concentrations: California, Coastal Massachusetts to Georgia, Kentucky, Louisiana, Nevada, Ohio, Tennessee and West Virginia.

Reactions in the Environment: Inorganic mercury (metallic mercury and inorganic mercury compounds) enters the air from mining ore deposits, burning coal and waste, and from manufacturing plants. It enters the water or soil from natural deposits, disposal of wastes, and volcanic activity. Methylmercury may be formed in water and soil by small organisms called bacteria. Methylmercury builds up in the tissues of fish. Larger and older fish tend to have the highest levels of mercury.

Chemical Class: Inorganic

Physical State or Appearance: Mercury is a naturally occurring metal which has several forms. The metallic mercury is a shiny, silver-white, odorless liquid metal. If heated, it is a colorless, odorless gas. Mercury combines with other elements, such as chlorine, sulfur, or oxygen, to form inorganic mercury compounds or “salts,” which are usually white powders or crystals.

Physical Dangers: Combustible.

Chemical Dangers: Upon heating, toxic fumes are formed. Reacts violently with alkali metals, acetylene, azides, ammonia gas, chlorine, chlorine dioxide, sodium carbide and ethylene oxide. Attacks copper and many other metals forming amalgams.

Physical Characteristics:

Boiling point: 357° C

Melting point: -39° C

Relative density (water = 1): 13.5

Solubility in water: None

Vapor pressure, Pa at 20° C: 0.26

Relative vapor density (air = 1): 6.93

Relative density of the vapor/air-mixture at 20° C (air = 1): 1.009

Methanol

Commonly Used Names: Methyl alcohol, Carbinol, methyl hydroxide, monohydroxymethane, pyroxylic spirit, wood alcohol, wood naphtha, wood spirit.

Molecular Formula:CH₄O/CH₃OH

Molecular Mass:32.0

Common Uses: The largest users of the methanol sold in the US are companies that make methyl t-butyl ether, a gasoline additive. Companies also use methanol to make chemicals such as formaldehyde, acetic acid, chloromethanes, and methyl methacrylate. Companies add methanol to paint strippers, aerosol spray paints, wall paints, carburetor cleaners, and car windshield washer products. Methanol is also a gasoline additive and, in some cases, a gasoline substitute for use in automobiles and other small engines.

Areas with Highest Concentrations: Alabama, Colorado, Delaware, Florida, Georgia, Louisiana, North Carolina, South Carolina, Tennessee, Texas, Virginia and Wyoming.

Reactions in the Environment: Methanol evaporates when exposed to air. It dissolves completely when mixed with water. Most direct releases of methanol to the environment are to air. Methanol also evaporates from water and soil exposed to air. Once in air, it breaks down to other chemicals. Microorganisms that live in water and in soil can also break down methanol. Because it is a liquid that does not bind well to soil, methanol that makes its way into the ground can move through the ground and enter groundwater. Plants and animals are not likely to store methanol.

Chemical Class: Aliphatic Hydroxy Compound.

Physical State or Appearance: Colorless liquid with characteristic odor.

Physical Dangers: The vapor mixes well with air, explosive mixtures are easily formed. Flammable.

Chemical Dangers: Reacts violently with oxidants causing fire and explosion hazard.

Physical Characteristics

Boiling point: 65° C

Melting point: -98° C

Relative density (water = 1): 0.79

Solubility in water: Miscible

Vapor pressure, kPa at 20° C: 12.3

Relative vapor density (air = 1): 1.1

Relative density of the vapor/air-mixture at 20° C (air = 1): 1.01

Flash point: 12° C c.c.

Auto-ignition temperature: 385° C

Explosive limits, vol% in air: 6-35.6

Octanol/water partition coefficient as log Pow: -0.82/-0.66

Methoxychlor

Commonly Used Names: DMDT. Trade Names: Marlata®, or Metox®

Molecular Formula: C₁₆H₁₅Cl₃O₂

Molecular Mass: 345.65

Common Uses: Methoxychlor is used as an insecticide against flies, mosquitoes, cockroaches chiggers, and a wide variety of other insects. It is used on agricultural crops and livestock, and in animal feed, barns, grain storage bins, home garden, and on pets.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Most methoxychlor enters the environment when it is applied to agricultural crops, forests, and farm animals. Methoxychlor released to the air eventually settles to the ground. In the soil it sticks strongly to particles. It does not dissolve easily in water. Once in water, it binds to sediments and settles to the bottom. Methoxychlor breaks down slowly in air, water and soil by sunlight and microscopic organisms. It may take several months. Some breakdown products of methoxychlor can be as harmful as methoxychlor. Methoxychlor does not usually build up in the food chain.

Chemical Class: Synthetic Organic

Physical State or Appearance: Methoxychlor is a manufactured chemical that does not occur naturally in the environment. Pure methoxychlor is a pale-yellow powder with a slight fruity or musty odor.

Physical Dangers: N/A

Chemical Dangers: N/A

Physical Characteristics:

Melting Point: 78-78.2 °

Insoluble

Methyl Bromide

Commonly Used Names: Bromomethane, Monobromomethane (cylinder)

Trade Names: Brom-O-Gas-TM; Celfume-TM; Dowfume-TM; Embafume-TM; Kayafume-TM; Meth-O GasTM; Terr-O-Gas 100TM

Molecular Formula: CH₃Br

Molecular Mass: 94.9

Common Uses: Agricultural crops; ornamentals; soil, manure, mulch and compost fumigation; stored commodities (both raw agricultural commodities and processed foods/feeds); greenhouses; homes; grain elevators; mills; ships and transportation vehicles.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Hydrolysis data indicate that methyl bromide breaks down at a rate of 1.4 mg/liter water/day at 25° C. Methyl bromide is not expected to run off fields to surface water because of application methods.

Chemical Class: Halogenated Hydrocarbons.

Physical State or Appearance: Odorless and colorless compressed liquified gas.

Physical Dangers: The gas is heavier than air. Combustible under specific conditions.

Chemical Dangers: The substance decomposes on heating and on burning producing toxic and corrosive fumes including hydrogen bromide, bromine and carbon oxybromide. Reacts with strong oxidants. Attacks many metals in presence of water. Attacks aluminum, zinc and magnesium with formation of pyrophoric compounds causing fire and explosion hazard.

Physical Characteristics:

Boiling point: 4° C

Melting point: -94° C

Relative density (water = 1): 1.7

Solubility in water, ml/100 ml at 20° C: 1.5

Relative vapor density (air = 1): 3.3

Auto-ignition temperature: 537° C

Explosive limits, vol% in air: 10-16

Octanol/water partition coefficient as log Pow: 1.19

Methyl Parathion

Commonly Used Names: Parathion-methyl and metafos. Trade names include Bladan M, Cekumethion, Dalf, Dimethyl Parathion, Devithion, E 601, Folidol-M, Fosferno M50, Gearphos, Kilex Parathion, Metacide, Metaphos, Metron, Nitrox 80, Partron M, Penncap-M, Tekwaisa.

Molecular Formula: C₈H₁₀NO₅PS

Molecular Weight: 263.20

Common Uses: Methyl parathion is used to kill insects on farm crops, especially cotton. The EPA now restricts how methyl parathion can be used and applied; only trained people are allowed to spray it. Methyl parathion can no longer be used on food crops commonly consumed by children.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Methyl parathion enters the environment primarily through spraying on farm crops. Methyl parathion breaks down quickly to other chemical compounds by interacting with water, bacteria in the water, and sunlight. Methyl parathion sticks to soil and generally does not move from the soil to groundwater. Methyl parathion does not appear to accumulate in fish or plants.

Chemical Class: Organophosphate Insecticide.

Physical State or Appearance: Methyl parathion is an insecticide that does not occur naturally in the environment. Pure methyl parathion exists as white crystals. Impure methyl parathion is a brownish liquid that smells like rotten eggs.

Physical Dangers: N/A

Chemical Dangers: N/A

Physical Characteristics:

Melting Point: 36° C

Boiling Point: 143° at 1.0mm Hg

Density: 1.36

Soluble at .005g/100 mL

Flash Point: 46.1°

Mirex

Commonly Used Names: 1,1a,2,2,3,4,5,5,5a,5b,6 - dodecachlorooctahydro-1,3,4-methano-1H-cyclobuta(cd)pentalene. Trade Names: CG-1283, Dechlorane., Chlordecone, Kepone & ENT-025719

Molecular Formula: C₁₀Cl₁₂

Molecular Weight: 545.54

Common Uses: Mirex has not been manufactured or used in the United States since 1978. Mirex was used to control fire ants, and as a flame retardant in plastics, rubber, paint, paper, and electrical goods from 1959 to 1972. Mirex was sold as a flame retardant.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Mirex and chlordecone break down slowly in the environment, and they may stay for years in soil and water. They do not evaporate to any great extent from surface water or surface soil. Mirex and chlordecone do not dissolve easily in water, but they easily stick to soil and sediment particles. They are not likely to travel far through the soil and into underground water. They can build up in fish or other organisms that live in contaminated water or that eat other contaminated animals.

Chemical Class: Organochlorine Pesticide.

Physical State or Appearance: Mirex is a manufactured insecticides that do not occur naturally in the environment. Mirex is a white crystalline solid and is odorless.

Physical Dangers: N/A

Chemical Dangers: N/A

Physical Characteristics:

Boiling Point: 210° F

pH: 6.5

Specific Gravity: 1.01

Completely Soluble

Volatile: 100

Molinate

Commonly Used Names: Trade Names: Hydram, Ordram and Yalan.

Molecular Formula: C₉H₁₇NOS

Molecular Mass: 187.2994

Common Uses: Molinate is a selective herbicide, it is used to control weeds in rice paddies.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Molinate is highly soluble in water and because it has a soil half-life of moderate duration (12 days), it is expected to have a large potential to contaminate groundwater. Molinate binds strongly to soil particles. Soil microorganisms are responsible for most of the breakdown of molinate. It is relatively stable to breakdown by hydrolysis. When applied at recommended rates, it does not persist in soil. Molinate has a soil half-life of 3 weeks. Molinate rapidly volatilizes if the soil is wet. Molinate is rapidly taken up by plant roots and transported to the leaves. In the leaves, molinate inhibits leaf growth and development. It is rapidly metabolized in non-susceptible plants. Resistant plants produce carbon dioxide and other

naturally occurring plant products such as amino acids and organic acids.

Chemical Class: Thiocarbamate

Physical State or Appearance: Molinate is a non-corrosive, clear liquid with an aromatic or spicy odor.

Physical Dangers: N/A

Chemical Dangers: The explosion hazard will depend on the solvent used in the formulation, or on the characteristics of the dust. Liquid products containing organic solvents may be flammable. Extinguish fires with alcohol-resistant foam, carbon dioxide, or powder. With sufficient burning or external heat, mirex will decompose, emitting toxic fumes. Fire-fighters should wear a self-contained breathing apparatus, eye protection, and full protective clothing. Confine the use of water spray to the cooling of unaffected stock, thus avoiding the accumulation of polluted run-off from the site.

Physical Characteristics:

Boiling Point: 202° at 10mm Hg

Density: 1.06

Water Solubility: .08g/100 mL solubility in Water

Flash point: 139°C

Specific gravity: 1.0626-1.0669 at 20°

Vapor pressure: 0.0056 mm Hg at 25°C

Koc:50 g/ml(7).

1,5-Naphthalene Diisocyanate

Commonly Used Names: *Naphthalene*, 1,5-Diisocyanatonaphthalene

Molecular Formula: C₁₂H₆O₂N₂/C₁₀H₆(NCO)₂

Molecular Mass: 210.19

Common Uses: Burning tobacco or wood produces naphthalene. The major products made from naphthalene are moth repellents. It is also used for making dyes, resins, leather, tanning agents, and the insecticide, carbaryl.

Areas with Highest Concentrations: Alabama, Florida, Illinois, Indiana, Louisiana, Michigan, Ohio, Oklahoma, .Pennsylvania and Texas.

Reactions in the Environment: Naphthalene evaporates easily. In air, moisture and sunlight break it down, often within 1 day. Naphthalene in water is destroyed by bacteria or evaporates into air. Naphthalene binds weakly to soils and sediments. It does not accumulate in animals or fish. If dairy cows are exposed to naphthalene, some of it will be in their milk. If laying hens are exposed, some of it will be in their eggs.

Chemical Class: Polycyclic Aromatic Hydrocarbon.

Physical State or Appearance: Naphthalene is a white solid or light yellow crystals that is found naturally in fossil fuels.. It has a strong, but not unpleasant smell.

Physical Dangers: Combustible.

Chemical Dangers: The substance decomposes on heating producing toxic fumes (nitrogen oxides).

Physical Characteristics:

Melting point: 130° C

Boiling Point: 217.9° C

Flash point: 174° F (79° C)
Density: 1.58

Nickel
(powder)

Commonly Used Names: N/A

Molecular Formula: Ni

Molecular Mass: 58.7

Common Uses: Nickel is a very abundant element. In the environment, it is found primarily combined with oxygen (oxides) or sulfur (sulfides). It is found in all soils and is emitted from volcanos. . Some of the metals that nickel can be alloyed with are iron, copper, chromium, and zinc. These alloys are used in the making of metal coins and jewelry and in industry for making metal items. Nickel compounds are also used for nickel plating, to color ceramics, to make some batteries, and as substances known as catalysts that increase the rate of chemical reactions.

Areas with Highest Concentrations: Alabama, Arizona, California, Coastal Massachusetts to Washington DC, Idaho, Indiana, Montana, Nevada, Ohio, South Carolina and Texas.

Reactions in the Environment: Small nickel particles in the air settle to the ground or are taken out of the air in rain. Much of the nickel in the environment is found with soil and sediments because nickel attaches to particles that contain iron or manganese, which are often present in soil and sediments. Nickel does not appear to collect in fish, plants, or animals used for food.

Chemical Class: Inorganic.

Physical State or Appearance: Pure nickel is a hard, silvery-white metal that is combined with other metals to form mixtures called alloys.

Physical Dangers: Dust explosion possible if in powder or granular form, mixed with air.

Chemical Dangers: Reacts violently, in powder form, with titanium powder and potassium perchlorate, and oxidants such as ammonium nitrate, causing fire and explosion hazard. Reacts slowly with non-oxidizing acids and more rapidly with oxidizing acids. Toxic gases and vapors (such as nickel carbonyl) may be released in a fire involving nickel.

Physical Characteristics:

Boiling point: 2730° C

Melting point: 1455° C

Relative density (water = 1): 8.9

Solubility in water: None

Nitrobenzene

Commonly Used Names: Nitrobenzol.

Molecular Formula: C₆H₅NO₂

Molecular Mass: 123.11

Common Uses: It is produced in large quantities for use in industry. Most of the nitrobenzene produced in the United States is used to manufacture a chemical called aniline. Nitrobenzene is also used to produce lubricating oils such as those used in motors and machinery. A small amount of nitrobenzene is used in the manufacture of dyes, drugs, pesticides, and synthetic rubber.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Very low levels of nitrobenzene may be found in air. It may be present in water from industrial releases. In water, nitrobenzene will be broken down by sunlight. Nitrobenzene in soil can move into the groundwater, be taken up by plants, evaporate to the air, and be broken down by bacteria. It does not appear to concentrate in fish or other aquatic animals.

Chemical Class: Nitro Compound.

Physical State or Appearance: Nitrobenzene is an industrial chemical. It is an oily yellow liquid with an almond-like odor.

Physical Dangers: N/A

Chemical Dangers: On combustion, forms corrosive fumes including nitrogen oxides. Reacts violently with strong oxidants and reducing agents, causing fire and explosion hazard. Attacks many plastics. Forms explosive (thermally unstable) substances or mixtures with many organic and inorganic compounds like oxidants, aluminium chloride with phenol, potassium hydroxide anhydrous or with small amounts of methanol, aniline with glycerol, phosphorus pentachloride, nitric acid, sulphuric acid, potassium.

Physical Properties:

Boiling point: 211° C

Melting point: 6° C

Relative density (water = 1): 1.2

Solubility in water: 0.2

Vapor pressure, Pa at 20° C: 20

Relative vapor density (air = 1): 4.2

Relative density of the vapor/air-mixture at 20° C (air = 1): 1.00

Flash point: 88° C c c

Auto-ignition temperature: 480° C

Explosive limits, vol% in air: 1.8-40

Octanol/water partition coefficient as log Pow: 1.86

Organotins

Commonly Used Names: N/A

Molecular Formula: R_4Sn , R_3SnX , R_2SnX_2 , or R_4SnX_3 .

Molecular Mass: Varies

Common Uses: Used as heat stabilizers in the manufacture of PVC and CPVC plastics, including water pipes and in some food packaging materials. Also used in the preservation of materials such as wood and textiles, as fungicides, miticides and disinfectants.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Unknown quantity in air and low concentrations in water.

Chemical Class: Organotins.

Physical State or Appearance: Varies.

Physical Dangers: Varies.

Chemical Dangers: Varies.

Physical Characteristics: Varies.

Parathion

Commonly Used Names: O,O-Diethyl-O-(4-nitrophenyl)phosphorothioate, Phosphorothioic acid O,O-diethyl O-(4-nitrophenyl)ester, Ethyl parathion, thiophos.

Molecular Formula: $(C_2H_5O)_2PSOC_6H_4NO_2$

Molecular Mass: 291.27

Common Uses: Insecticide for wheat and nuts. Parathion controls a variety of insects such as aphids, mites, beetles, Lepidoptera, leaf hoppers, leafminers, and other pests found on fruits, cotton, vegetables, and forage crops. It also controls several soil insects such as wireworms, rootworms, and symphilids. Used for control of nematodes in beet & ornamentals.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Parathion is released to the environment primarily in its use as a broad- spectrum insecticide in agricultural applications although more localized releases may occur in wastewater spills, and fugative emissions during its production, transport, storage, and formulation. When sprayed on a field or orchard it will exist primarily as an aerosol in the source area and as a combination of vapor and aerosol downwind. The vapor will be rapidly photolyzed (half-life 5 min in summer sunlight) to paraoxon. It will bind tightly to soil and decay by biological and chemical hydrolysis in several weeks forming p-nitrophenol, diethylthiophosphoric acid, and paraoxon. . Photolysis may occur on the soil surface.

Degradation in flooded soil is much faster and is probably due to surface catalyzed hydrolysis; aminoparathion is formed under these low oxygen conditions. Residues will generally remain in the upper 6 inches of soil so leaching into groundwater is unlikely. Parathion released into surface waters will be removed in approximately a week. The primary removal mechanism is adsorption to sediment and particulate matter where biodegradation or chemical hydrolysis will occur. Bioconcentration will be low to moderate.

Chemical Class: N/A

Physical State or Appearance: Pale yellow to brown (technical product) liquid, with characteristic odor.

Physical Dangers: The vapor is heavier than air and may travel along the ground; distant ignition possible.

Chemical Dangers: The substance decomposes on heating producing toxic gases including carbon monoxide, sulfur oxides, phosphorous oxides, nitrogen oxides. Reacts with strong oxidants. Attacks some forms of plastics, rubber and coatings. Rapidly hydrolysed by alkalis.

Physical Characteristics:

Boiling point: 375° C

Melting point: 6° C

Relative density (water = 1): 1.26

Solubility in water, ml/100 ml at 25° C: 0.0024

Vapor pressure, Pa at 20° C: 0.005

Relative vapor density (air = 1): 10

Flash point: 120-160° C

Pentachlorophenol

Commonly Used Names: Technical grade pentachlorophenol, PCP.

Molecular Formula: C₆Cl₅OH

Molecular Mass: 266.4

Common Uses: Pentachlorophenol is a manufactured chemical that does not occur. Humans are usually exposed to impure pentachlorophenol. Pentachlorophenol was widely used as a pesticide and wood preservative. Since 1984, the purchase and use of pentachlorophenol has been restricted to certified applicators. It is no longer available to the general public. It is still used industrially as a wood preservative for utility poles, railroad ties, and wharf pilings.

Areas with Highest Concentrations: Arkansas, Alabama, Idaho, Louisiana, Mississippi, Oregon, South Carolina, Texas, and Washington.

Reactions in the Environment: Pentachlorophenol can be found in the air, water, and soil. It enters the environment through evaporation from treated wood surfaces, industrial spills, and disposal at uncontrolled hazardous waste sites. Pentachlorophenol is broken down by sunlight, other chemicals, and microorganisms to other chemicals within a couple of days to months. Pentachlorophenol is found in fish and other foods, but tissue level are usually low.

Chemical Class: Halogenated Semi-Volatile Organics; Chlorinated Phenol.

Physical State or Appearance : Pure pentachlorophenol exists as colorless crystals. Impure pentachlorophenol (the form usually found at hazardous waste sites) is dark gray to brown and exists as dust, beads, or flakes.

Physical Dangers: N/A

Chemical Dangers: The substance decomposes on heating above 200° C, producing toxic fumes and toxic gases including hydrogen chloride, dioxines, chlorinated phenols. Reacts violently with strong oxidants and water, causing fire and explosion hazard.

Physical Properties:

Boiling point (decomposes): 309° C

Melting point: 191° C

Relative density (water = 1): 1.98

Solubility in water, g/100 ml at 20° C: 0.001

Vapor pressure, Pa at 20° C: 0.02

Relative vapor density (air = 1): 9.2

Relative density of the vapor/air-mixture at 20° C (air = 1): 1.00

Octanol/water partition coefficient as log Pow: 5.01

Phenol

Commonly Used Names: Carboic acid, Phenic acid , Hydroxybenzene

Molecular Formula: C₆H₆O/C₆H₅OH

Molecular Mass: 94.1

Common Uses: Phenol is used primarily in the formation of phenolic resins. It is also used in the manufacture of nylon and other synthetic fibers. It is also used in slimicides (chemicals that kill bacteria and fungi in slimes), as a disinfectant, as an antiseptic, and in medicinal preparations, such as mouthwash and sore throat lozenges.

Areas with Highest Concentrations: Alabama, Florida, Illinois, Indiana, Louisiana, North Carolina, Ohio, South Carolina, Texas and Virginia.

Reactions in the Environment: Following small, single releases, phenol does not remain in the air long (generally, half is removed from the air in less than a day). It generally remains in the soil only about 2 to 5 days. It can remain in water for longer than 9 days. Larger or repeated releases can remain in the air, water and soil for much longer periods of time. Small amounts of phenol may be found in organisms that live in contaminated water.

Chemical Class: Aromatic Hydroxyl Compound.

Physical State or Appearance: Phenol is a manufactured substance. It is a colorless-to-white solid when pure but it is ordinarily yellow to pink crystals. The commercial product is a liquid. It has sickeningly sweet odor.

Physical Dangers: The vapor is heavier than air.

Chemical Dangers: Upon heating, toxic fumes are formed. The solution in water is a weak acid. Reacts with oxidants causing fire and explosion hazard.

Physical Characteristics

Boiling point: 182° C

Melting point: 43° C

Relative density (water = 1): 1.06

Solubility in water, g/100 ml: 7

Solubility in water: moderate

Vapor pressure, Pa at 20° C: 47

Relative vapor density (air = 1): 3.2

Relative density of the vapor/air-mixture at 20° C (air = 1): 1.001

Flash point: 79° C c.c.

Auto-ignition temperature: 715° C

Explosive limits, vol% in air: 1.36-10

Octanol/water partition coefficient as log Pow: 1.46

Polychlorinated Biphenyls

Commonly Used Names: PCBs

Molecular Formula: C₁₂Cl₂H₁₀

Molecular Mass: N/A

Common Uses: PCBs are created at municipal and industrial incinerators from the burning of organic wastes. PCBs have been used widely as coolants and lubricants. Manufacturing stopped in 1977.

Areas with Highest Concentrations: Alabama, Arizona, California, Kansas, Michigan, New York, Nevada, Oregon, Texas, and Utah.

Reactions in the Environment: PCBs do not break down in our environment and can have severe health effects on humans. PCBs in the air eventually return to our land and water by settling or from runoff in snow and rain. In our water, PCBs build up in fish and can reach levels hundreds of thousand of times higher than the levels in water. Fish consumption advisories are in effect for PCBs in all five of the Great Lakes. PCBs are the leading chemical risk from fish consumption.

Chemical Class: Benzenes.

Physical State or Appearance: PCBs are either oily liquids or solids, are colorless to light yellow, and have no smell or taste.

Physical Dangers: N/A

Chemical Dangers: N/A

Physical Characteristics:

Fire Resistant

Low Volatility

Stable

Polychlorinated Dibenzo-p-dioxins

Commonly Used Names: Dioxins

Molecular Formula: $C_{12}H_4Cl_4O_2$

Molecular Mass: 322

Common Uses: CDDs are not intentionally manufactured by industry except for research purposes. They (mainly 2,3,7,8-TCDD) may be formed during the chlorine bleaching process at pulp and paper mills. CDDs are also formed during chlorination by waste and drinking water treatment plants. They can occur as contaminants in the manufacture of certain organic chemicals. CDDs are released into the air in emissions from municipal solid waste and industrial incinerators. Uses include incineration of municipal solid waste and medical waste, secondary copper smelting, forest fires, land application of sewage sludge, cement kilns, coal fired power plants, residential wood burning, and chlorine bleaching of wood pulp.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Dioxins are widely distributed throughout the environment in low concentrations, are persistent and bioaccumulated, most people have detectable levels of dioxins in their tissues. These levels, in the low parts per trillion, have accumulated over a lifetime and will persist for years, even if no additional exposure were to occur. This background exposure is likely to result in an increased risk of cancer and is uncomfortably close to levels that can cause subtle adverse non-cancer effects in animals and humans. When released into the air, some CDDs may be transported long distances, even around the globe. When released in waste waters, some CDDs are broken down by sunlight, some evaporate to air, but most attach to soil and settle to the bottom sediment in water. CDD concentrations may build up in the food chain, resulting in measurable levels in animals.

Chemical Class: Benzenes with Oxygens.

Physical State or Appearance: This family includes seven of the polychlorinated dibenzo dioxins (PCDDs), ten of the polychlorinated dibenzo furans (PCDFs) and twelve of the polychlorinated biphenyls (PCBs). In the pure form, CDDs are crystals or colorless solids.

Physical Dangers: N/A

Chemical Dangers: N/A

Physical Characteristics:

Melting Point: 305° C

Polychlorinated Dibenzofurans

Commonly Used Names: Furans.

Molecular Formula: N/A

Molecular Mass: N/A

Common Uses: Dioxins and furans are created and released into the environment as the by-products of specific activities. For example, we create dioxins and furans when we burn garbage and fuel. They are also by-products from the production of iron and steel; backyard burning of household waste, especially plastics; wood burning, especially if the wood has been chemically treated; fuel burning, including diesel fuel and fuel for agricultural purposes and home-heating; and electrical power generation.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Dioxins and furans can travel long distances in the atmosphere, so we may be exposed to dioxins and furans that are created in other parts of the world. These substances work their way up the food chain by dissolving and remaining stored in the body fat of animals. Because of this, we actually take more dioxins and furans into our bodies through food than through air, water or soil. Meat, dairy products, and fish have higher levels of dioxins and furans than fruits, vegetables and grains.

Chemical Class: Benzenes with Oxygen.

Physical State or Appearance: Similar to dioxins.

Physical Dangers: Similar to dioxins.

Chemical Dangers: Similar to dioxins.

Physical Characteristics: Similar to dioxins.

1,2 - Dichloropropane

Commonly Used Names: *Propylene Dichloride*

Molecular Mass: $C_3H_6Cl_2$

Molecular Mass: 112.9864

Common Uses: 1,2 Dichloropropane production in the United States has declined over the past 20 years. It was used in the past as a soil fumigant, chemical intermediate, and industrial solvent and was found in paint strippers, varnishes, and furniture finish removers. Most of these uses were discontinued. Today, almost all of it is used as a chemical intermediate to make perchloroethylene and several other related chlorinated chemicals.

Areas with Highest Concentrations: California, Colorado, Massachusetts, Michigan, New York and Pennsylvania.

Reactions in the Environment: 1,2 Dichloropropane released to air can spread to areas far from where it was released because it is not rapidly broken down by reactions with other chemicals and sunlight. Most of 1,2 dichloropropane in water will evaporate to the air. When released to the soil, it is not easily broken down by bacteria, but will easily evaporate to the air and filter into the groundwater. It does not build up in the food chain.

Chemical Class: N/A

Physical Appearance: Colorless liquid with odor like chloroform.

Physical Dangers: N/A

Chemical Dangers: N/A

Physical Characteristics:

Melting Point: -100.4° C

Boiling Point: 96.8° C

Density: 1.1558

Vapor Density: 3.9

Flash Point: 15° C

Slightly Soluble 27g/100 mL

Toxaphene

Commonly Used Names: Chlorinated camphene, polychlorocamphene, Camphechlor chlorocamphene,

Molecular Formula: C₁₀H₁₀Cl₈ (approx.)

Molecular Mass: 413.8 (average)

Common Uses: Toxaphene is an insecticide containing over 670 chemicals.. Toxaphene was one of the most heavily used insecticides in the United States until 1982, when it was canceled for most uses; all uses were banned in 1990. It was used primarily in the southern United States to control insect pests on cotton and other crops. It was also used to control insect pests on livestock and to kill unwanted fish in lakes.

Areas with Highest Concentrations: N/A

Reactions in the Environment: Toxaphene may enter the environment from hazardous waste sites. It may enter the air by evaporation. It does not dissolve well in water, so it is more likely to be found in air, soil, or sediment at the bottom of lakes or streams, than in surface water. Toxaphene breaks down very slowly in the environment. Toxaphene accumulates in fish and mammals.

Chemical Class: N/A

Physical State or Appearance: It is usually found as a solid or gas, and in its original form it is a yellow to amber waxy solid that smells like turpentine.

Physical Dangers: Combustible under specific conditions. Liquid formulations containing organic solvents may be flammable.

Chemical Dangers: The substance decomposes on heating above 155° C, on burning and/or under influence of alkali, strong sunlight, and catalysts like iron producing toxic fumes including hydrogen chloride. Attacks many metals in presence of water.

Physical Characteristics:

Melting point: 65-90° C

Relative density (water = 1): 1.6

Solubility in water: None

Vapor pressure, Pa at 20° C: negligible

Octanol/water partition coefficient as log Pow: 2.47 - 5

Trichloroethylene

Commonly Used Names: 1,1,2-Trichloroethylene, Trichloroethene, Ethylene trichloride, TCE.

Molecular Formula: C₂HCl₃/ClCH=CCl₂

Molecular Mass: 131.4

Common Uses: It is used mainly as a solvent to remove grease from metal parts, but it is also an ingredient in adhesives, paint removers, typewriter correction fluids, and spot removers.

Trichloroethylene is not thought to occur naturally in the environment. However, it has been found in underground water sources and many surface waters as a result of the manufacture, use, and disposal of the chemical.

Areas with Highest Concentrations: Coastal East from Massachusetts to Virginia, Illinois, Michigan, Minnesota, Ohio, Southern California, and Wisconsin.

Reactions in the Environment: Trichloroethylene dissolves a little in water, but it can remain in groundwater for a long time. Trichloroethylene quickly evaporates from surface water, so it is commonly found as a vapor in the air. Trichloroethylene evaporates less easily from the soil than from surface water. It may stick to particles and remain for a long time. Trichloroethylene may stick to particles in water, which will cause it to eventually settle to the bottom sediment.

Trichloroethylene does not build up significantly in plants and animals.

Chemical Class: Aliphatic Volatile Organic - Liquid Solvent.

Physical State or Appearance: Trichloroethylene (TCE) is a nonflammable, colorless liquid with a somewhat sweet odor and a sweet, burning taste.

Physical Dangers: The vapor is heavier than air. As a result of flow, agitation, etc., electrostatic charges can be generated.

Chemical Dangers: On contact with hot surfaces or flames this substance decomposes forming toxic and corrosive fumes (phosgene, hydrogen chloride, chlorine). The substance decomposes on contact with strong alkali producing dichloroacetylene, which increases fire hazard. Reacts violently with metals such as lithium, magnesium aluminum, titanium, barium and sodium. Slowly decomposed by light in presence of moisture, with formulation of corrosive hydrochloric acid.

Physical Characteristics:

Boiling point: 87° C

Melting point: -73° C

Relative density (water = 1): 1.5

Solubility in water, g/100 ml at 20° C: 0.1

Vapor pressure, kPa at 20° C: 7.8

Relative vapor density (air = 1): 4.5

Relative density of the vapor/air-mixture at 20° C (air = 1): 1.3

Auto-ignition temperature: 410° C

Explosive limits, vol% in air: 8-10.5

Octanol/water partition coefficient as log Pow: 2.42

Trifluralin

Commonly Used Names: a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p- toluidine

Molecular Formula: C₆H₁₄N₂O

Molecular Mass: 335.32

Common Uses: Herbicide on grass to control broadleaf weeds, and some crops, flowers and shrubs.

Areas with Highest Concentrations: N/A

Reactions in the Environment: If released to the surface of soils, trifluralin will rapidly volatilize. In soil, trifluralin is not expected to sorb strongly to organic matter and thus may leach into groundwater. In general, trifluralin is not expected to be persistent in soils because of removal by volatilization and biodegradation. If released to water, trifluralin will have a slight tendency to sorb to suspended organic matter, biota, and sediments. Bioconcentration will not be significant. Volatilization of trifluralin from water will probably not be significant except possibly from shallow rivers. Photolysis may be the most important degradative process for trifluralin in water. In the atmosphere, trifluralin probably will rapidly photolyze. Trifluralin has been found in wastewater, secondary effluent from textile plants, in soils treated with the herbicide trifluralin, in the breathing zone of workers mixing and applying trifluralin, and in cooked fish.

Chemical Class: N/A

Physical State or Appearance: Clear orange liquid with aromatic odor.

Physical Dangers: Combustible.

Chemical Dangers: Combustion with nitrous oxides, carbon monoxide, carbon dioxide, and fluorinated hydrocarbons. Avoid contact with strong oxidizers.

Physical Characteristics:

Flash Point: 210° F

Boiling Point: 450 to 520° F

Vapor Pressure: 68° F to 1mm Hg

Vapor Density: 4.7

pH: 5.0 to 8.0

Vinyl Chloride

Commonly Used Names: Chloroethene, Chloroethylene, VCM (cylinder), ethylene monochloride

Molecular Formula: C₂H₃Cl/H₂C=CHCl

Molecular Mass: 62.5

Common Uses: It is a manufactured substance that is used to make polyvinyl chloride (PVC). PVC is used to make a variety of plastic products, including pipes, wire and cable coatings, and the furniture and automobile upholstery. Vinyl chloride also results from the breakdown of other substances, such as trichloroethane, trichloroethylene, and tetrachloroethylene.

Areas with Highest Concentrations: Maryland, Massachusetts, New York, New Jersey, Southern California and Virginia.

Reactions in the Environment: Liquid vinyl chloride evaporates easily into the air. Vinyl chloride, if it is near the surface of soil or water, can also evaporate. Vinyl chloride in the air can break down within a few days to other substances, some of which can be harmful. Small amounts of vinyl chloride can dissolve in water. Vinyl chloride formed from the breakdown of other chemicals can enter groundwater. Vinyl chloride is unlikely to build up in plants or animals.

Chemical Class: Vinylic Halogenated Volatile Organic Gas.

Physical State or Appearance: Vinyl chloride is a colorless, flammable gas at normal temperatures with a mild, sweet odor.

Physical Dangers: The gas is heavier than air, and may travel along the ground; distant ignition possible.

Chemical Dangers: The substance can under specific circumstances form peroxides, initiating explosive polymerization. The substance will polymerize readily due to heating and under the influence of air, light, and on contact with a catalyst, strong oxidizing agents and metals such as copper and aluminum, with fire or explosion hazard. The substance decomposes on burning producing toxic and corrosive fumes (hydrogen chloride and phosgene).

Physical Characteristics:

Boiling point: -13°C

Melting point: -154°C

Relative density (water = 1): 0.9

Solubility in water: None

Relative vapor density (air = 1): 2.2

Flash point: -78°C c.c

Auto-ignition temperature: 472°C

Explosive limits, vol% in air: 3.6-33

Octanol/water partition coefficient as log Pow: 0.6

Extremely flammable

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