LLC

I.E.1b.

IMP DOC No. 91 BOPEC 195

C1	✓	C4		C7	
C2	✓	C5		C8	
C3		C6	✓	C9	

DATE 5-6-91

May 6, 1991

Annette M. Stanley
Manager, Environmental Programs
Chemical Manufacturers Association
2501 M. Street, NW
Washington, DC 20037

Dear Ms. Stanley:

RE: NESHAP Subpart FF on Waste Benzene Operations

Find attached a copy of the workbook distributed at the EPA Workshop on "Organic Air Emissions from Waste Management Facilities." Also included are other handouts and information obtained at the Workshop that was held in Dallas, Texas, on December 11-12, 1990.

I attended the April 25, 1991, meeting of the CMA workgroup on implementing NESHAP subpart FF and agreed to supply this copy to you for possible distribution to other CMA members that did not attend the EPA workshop. I ask that you please return the material to me when you are finished.

Sincerely,

Stephen J. Zuiss

Stephen J. Zuiss
Chemical Engineer
Environmental Affairs

ZL151/sdm

Attachments

United States
Environmental Protection
Agency

Office of Air Quality
Planning and Standards

Center for Environmental
Research Information

Technology Transfer

EPA

Workshop— Air Emissions from Waste Management Facilities

August 28-29, 1990
Boston, Massachusetts

September 11-12, 1990
Elizabeth, New Jersey

October 23-24, 1990
Chicago, Illinois

November 13-14, 1990
Atlanta, Georgia

December 11-12, 1990
Dallas, Texas

January 15-16, 1991
Sacramento, California

January 22-23, 1991
Seattle, Washington

February 12-13, 1991
Kansas City, Missouri

February 26-27, 1991
Philadelphia, Pennsylvania

March 26-27, 1991
Denver, Colorado

United States
Environmental Protection
Agency

Center for Environmental Research
Information
Cincinnati, OH 45268

BULK RATE
POSTAGE & FEES PAID
EPA
PERMIT NO. G-35

Official Business
Penalty for Private Use $300

000098098 CRRI
C. A. CHAFFIN ENGR
TEXAS EASTMAN CO
PO BOX 7444
LONGVIEW TX 75602

CERI-90-51a

These two-day workshops are sponsored jointly by the Office of Air Quality Planning and Standards and the Center for Environmental Research Information, with support from the Office of Solid Waste and Emergency Response.

Purpose

Air emissions from waste management pose a threat to human health and the environment. The chemicals processed during waste management operations can volatilize into the atmosphere and cause toxic or carcinogenic effects, or contribute to ozone formation. Regulations have been developed to control air emissions from these operations. In June of 1990, the Environmental Protection Agency (EPA) promulgated standards under the authority of Section 3004 of the Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act (RCRA). The standards limit organic air emissions as a class from process vents and equipment leaks at hazardous waste treatment, storage, and disposal facilities requiring a permit under Subtitle C of the RCRA. Additional RCRA standards are under development. In March of 1990, the EPA promulgated standards under the authority of Section 112 of the Clean Air Act (CAA) that limit emissions of benzene from benzene waste operations.

Presentations and case studies will be used at this workshop to focus on waste management sources of air emissions, control technologies, and the RCRA and CAA regulations. Speakers will include the developers of the regulations. The sessions are open to interested individuals and should be of interest to regulatory agency personnel, waste management facility owners/operators, consulting engineers, and others concerned with air emissions from waste management activities.

Registration

No fee is charged to attend this workshop. However, registration is limited and is filled on a first-come, first-served basis. The attached registration form should be completed and mailed as soon as possible. You will then receive confirmation information, including a final agenda and meeting site. To register by telephone, please call PEER Consultants, P.C., at (513) 252-1222.

Hotel Information

Room reservations are to be made by you directly with the hotel and should be made early. The reserved block of rooms will be assured only up to the cutoff date, which is 3 weeks prior to each workshop. Be sure to mention that you are attending this EPA workshop so that you will qualify for the special room rates.

For additional information call:

PEER Consultants, P.C.
Dayton, Ohio
(513) 252-1222.

Workshop Dates and Locations

August 28-29,1990
The 57 Park Plaza Hotel
200 Stuart Street.
Boston, MA 02116
(617) 482-1800

September 11-12, 1990
Holiday Inn Jetport
1000 Spring Street
Elizabeth, NJ 07201
(201) 355-1700

October 23-24, 1990
Holiday Inn Mart Plaza
350 North Orleans Street
Chicago, IL 60654
(312) 836-5000

November 13-14, 1990
Holiday Inn - Downtown
175 Piedmont Ave., NE
Atlanta, GA 30303
(404) 659-2727

December 11-12, 1990 TUES/WEDS
Dallas Park Plaza
1914 Commerce Street
Dallas, TX 75201
(214) 747-7000

January 15-16, 1991
Hyatt Regency - Sacramento
1209 "L" Street
Sacramento, CA 95814
(916) 443-1234

January 22-23, 1991
Radisson Hotel
17001 Pacific Highway South
Seattle, WA 98188
(206) 244-6000

February 12-13, 1991
Hilton Plaza Inn
45th & Main
Kansas City, MO 64111
(816) 753-7400

February 26-27, 1991
Holiday Inn - Independence Mall
4th & Arch Streets
Philadelphia, PA 19106
(215) 923-8660

March 26-27, 1991
Marriott Southeast
I-25 at Hampden Ave.
Denver, CO 80222
(303) 758-7000

Program

Day One

8:30 a.m.	Registration
9:00 a.m.	**Introduction and Welcome**
9:15 a.m.	**Air Pollution Overview**
9:35 a.m.	**RCRA Background—General**
10:00 a.m.	Break
10:15 a.m.	**RCRA Air Rules**
10:55 a.m.	**CAA Background**
11:30 a.m.	**Questions and Discussion**
11:45 a.m.	Lunch
1:00 p.m.	**Sources of Air Emissions**
2:30 p.m.	Break
2:45 p.m.	**Control Technologies**
4:00 p.m.	**Estimating Organic Emissions**
4:45 p.m.	**Questions and Discussion**
5:00 p.m.	Adjourn

Day Two

8:30 a.m.	**Process Vent Standards (Subpart AA)**
9:45 a.m.	**Questions and Discussion**
10:00 a.m.	Break
10:15 a.m.	**Equipment Leak Standards (Subpart BB)**
11:30 a.m.	**Questions and Discussion**
11:45 a.m.	Lunch
1:00 p.m.	**Benzene Wastes NESHAP**
2:15 p.m.	**Questions and Discussion**
2:30 p.m.	Break
2:45 p.m.	**Case Studies**
4:30 p.m.	**Course Evaluation/Adjourn**

NOTE: Session order and times are subject to change.

12-11-90
DALLAS

United States
Environmental Protection
Agency

Office of Air Quality
Planning and Standards
RTP, NC 27711

Office of Research
and Development
Cincinnati OH 45268

Technology Transfer

October 1990

(STEVE ZUISS)
TEXAS EASTMAN
PO BOX 7444
LONGVIEW, TEXAS
75607

EPA

Workshop — Organic Air Emissions from Waste Management Facilities

Speaker Slide Copies and Supporting Information

ORGANIC AIR EMISSIONS FROM WASTE MANAGEMENT FACILITIES

Speaker Slide Copies and Supporting Information

December 1990

Document Prepared by

PEER Consultants, P.C.
Dayton, OH 45432

and

Slides and Presentations Prepared by

Research Triangle Institute
RTP, NC 27709

for

Office of Research and Development
Cincinnati, OH 45268

and

Office of Air Quality
Planning and Standards
RTP, NC 27711

NOTICE

This document is a preliminary draft. It has not been formally released by the U.S. Environmental Protection Agency and should not at this stage be construed to represent Agency policy. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

TABLE OF CONTENTS

Notice ii
Abbreviation Index iv

Section 1
Air Pollution Overview 1-1
Abstract 1-2
Slides 1-3

Section 2
Sources and Controls 2-1
Abstract 2-2
Bibliography 2-3
Slides 2-4

Section 3
RCRA Organic Air Rules - Process Vents 3-1
Abstract 3-2
Bibliography 3-3
Slides 3-4
Attachments 3-18

Section 4
Equipment Leak Standards 4-1
Abstract 4-2
Bibliography 4-3
Slides 4-4

Section 5
Phase II Air Rules 5-1
Abstract 5-2
Slides 5-3

Appendix A
RCRA Overview A-1
Slides A-2

Appendix B
Case Study: Measuring and Estimating Emissions B-1
Slides B-2

Appendix C
Case Study: Equipment Leaks Testing—U.S. EPA Method 21 . . . . . C-1
Slides C-2

Appendix D
Case Study: Computerized Emissions Models D-1
Slides D-2

Appendix E
Case Study: Process Vent Rule Applicability and Compliance E-1
Slides E-2

Appendix F
Case Study: Application of Benzene Waste Operations NESHAP to Wastewater Treatment Systems F-1
Slides F-2

Appendix G
Benzene Waste Operations NESHAP G-1
Slides G-2

ABBREVIATION INDEX

ACT	Alternative Control Techniques Document
API	American Petroleum Institute
ARAR	Applicable, Relevant, and Appropriate Requirements
ASTM	American Society for Testing and Materials
ASTSWMO	Association of State and Territorial Solid Waste Management Officials
Atm	Atmosphere
BDAT	Best Demonstrated Available Technology
Btu	British Thermal Units
BZ	Benzene
^{o}C	Celsius
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
CERI	Center for Environmental Research Information
CFC	Chlorofluorocarbons
cfm	Cubic Feet per Minute
CFR	Code of Federal Regulations
CPI	Corrugated Plate Interceptor
CTG	Control Techniques Guideline Document
CWA	Clean Water Act
DOT	Department of Transportation
DRE	Destruction and Removal Efficiency
dscm	Dry Standard Cubic Meter
EDC	Ethylene Dichloride

EP	Extraction Procedure
EPA	United States Environmental Protection Agency
ESD	Emission Standards Division
ER	Emission Rate
FID	Flame Ionization Detector
FR	Federal Register
ft	Feet
gal	Gallon
GC	Gas Chromatography
h	Hours
HAP	Hazardous Air Pollutant
HLC	Henry's Law Constant
HON	Hazardous Organic NESHAP
HSWA	Hazardous and Solid Waste Amendments
HWMU	Hazardous Waste Management Unit
IR	Infrared
kg	Kilograms
kPa	Kilopascal
L	Liters
lb	Pounds
LDAR	Leak Detection and Repair
LDR	Land Disposal Restrictions
m^3	Cubic Meters
Mg	Megagrams

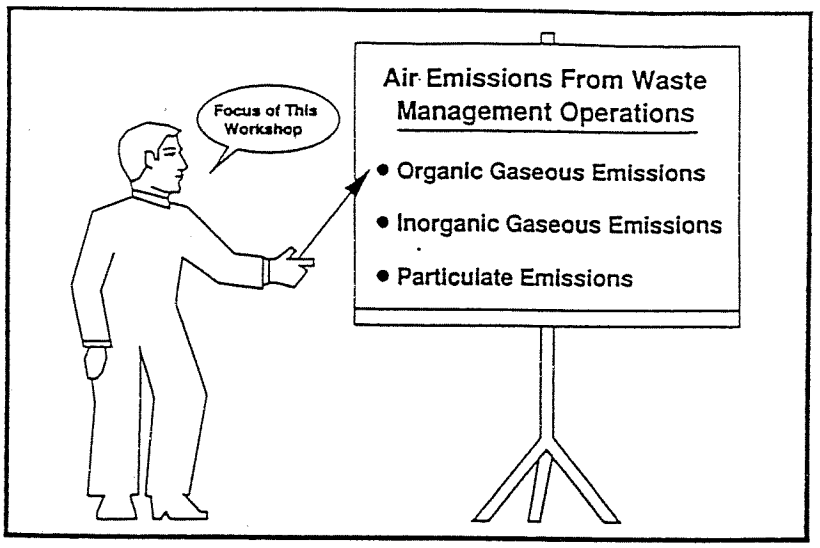
MS	Mass Spectrometry
MW	Megawatts
NAAQS	National Ambient Air Quality Standards (CAA)
NAPCTAC	National Air Pollution Control Techniques Advisory Committee
NCP	National Contingency Plan (CERCLA)
NESHAP	National Emission Standard for Hazardous Air Pollutants (CAA)
NPDES	National Pollution Discharge Elimination System (CWA)
NSPS	New Source Performance Standards (CAA)
OAQPS	Office of Air Quality Planning and Standards
OAR	Office of Air and Radiation
ORD	Office of Research and Development
o/o	Owner/Operator
OSW	Office of Solid Waste
OSWER	Office of Solid Waste and Emergency Response
PCB	Polychlorinated Biphenyls
PM	Particulate Matter
POTW	Publicly Owned Treatment Works
ppm	Parts per Million
ppmv	Parts per Million by Volume
ppmw	Parts per Million by Weight
psia	Pounds per Square Inch Absolute
psig	Pounds per Square Inch Gauge
RAC	Reference Air Concentration
RACT	Reasonably Available Control Technology
RCRA	Resource Conservation and Recovery Act

s	Seconds
SARA	Superfund Amendments and Reauthorization Act
scf	Standard Cubic Feet
scfm	Standard Cubic Feet per Minute
SIC	Standard Industrial Classification
SIP	State Implementation Plan
SOCMI	Synthetic Organic Chemical Manufacturing Industry
SW	Solid Waste
SWMU	Solid Waste Management Unit
TAB	Total Annual Benzene-in-Waste
TCLP	Toxicity Characteristic Leachate Procedure
TFE	Thin-Film Evaporation
TOC	Total Organic Carbon
TRS	Total Reduced Sulfur
TSDF	Treatment, Storage, and Disposal Facilities (RCRA)
UV	Ultraviolet
VO	Volatile Organic
VOC	Volatile Organic Compounds
VOL	Volatile Organic Liquid
WWT	Wastewater Treatment
WWTS	Wastewater Treatment System
yr	Year

AIR POLLUTION OVERVIEW

ABSTRACT: AIR POLLUTION OVERVIEW

The introductory session provides a broad overview of the need to control organic air emissions. Human health and environmental problems caused by organic air emissions or to which organic air emissions contribute are discussed. Major problems discussed are those resulting from troposheric ozone formation and exposure to air toxics. Other problems discussed include stratospheric ozone depletion, global climate change, and acid rain. The statutory mechanisms under which organic air emissions are regulated are discussed with emphasis on the Clean Air Act and the Resource Conservation and Recovery Act (RCRA). The specific rules that apply to waste management operations and that are the focus of the workshop are introduced. These are the rules developed by EPA under RCRA Section 3004(n) that apply to RCRA-permitted hazardous waste treatment, storage, disposal facilities (TSDF), and the rule promulgated under Section 112 of the Clean Air Act that limits emissions from benzene waste operations.



AIR POLLUTION OVERVIEW

OUTLINE OF THIS PRESENTATION

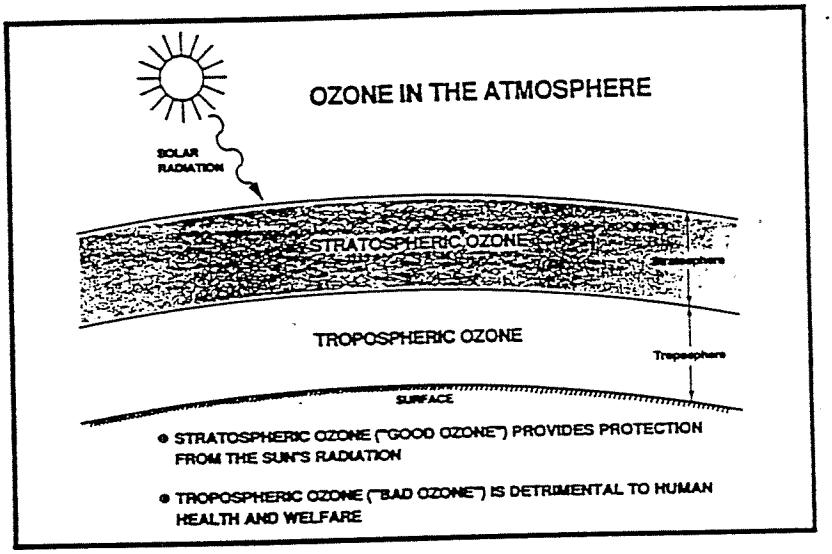
- Problems caused by organic air emissions
- Magnitude of the problems and contribution of waste management operations
- Federal laws that address organic emissions

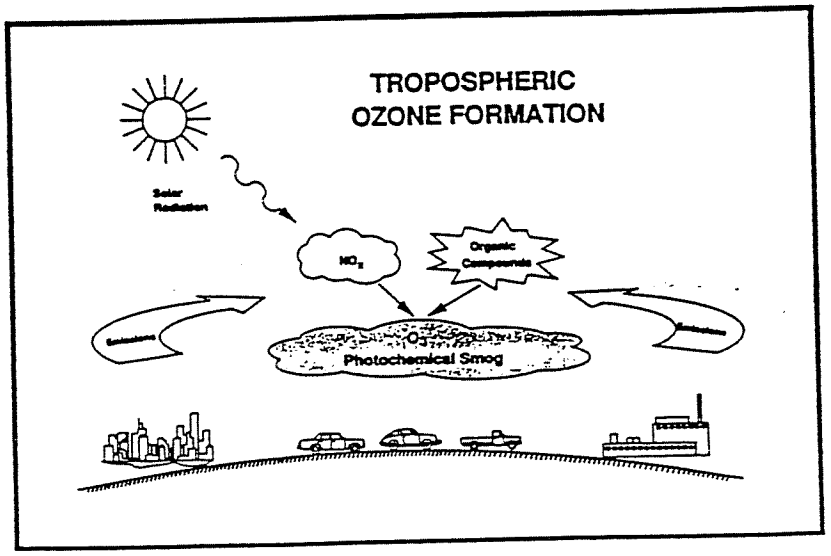
WHY BE CONCERNED ABOUT ORGANIC AIR EMISSIONS?

ORGANIC AIR EMISSIONS

MAJOR CONCERNS

- OZONE
- AIR TOXICS





HEALTH EFFECTS OF OZONE

Acute Effects

- Inflammation of the lung
- Impaired breathing
- Coughing
- Chest pain
- Nausea
- Throat irritation

Chronic Effects

- Increased susceptibility to respiratory infection
- Permanent damage to lung tissues and breathing capacity

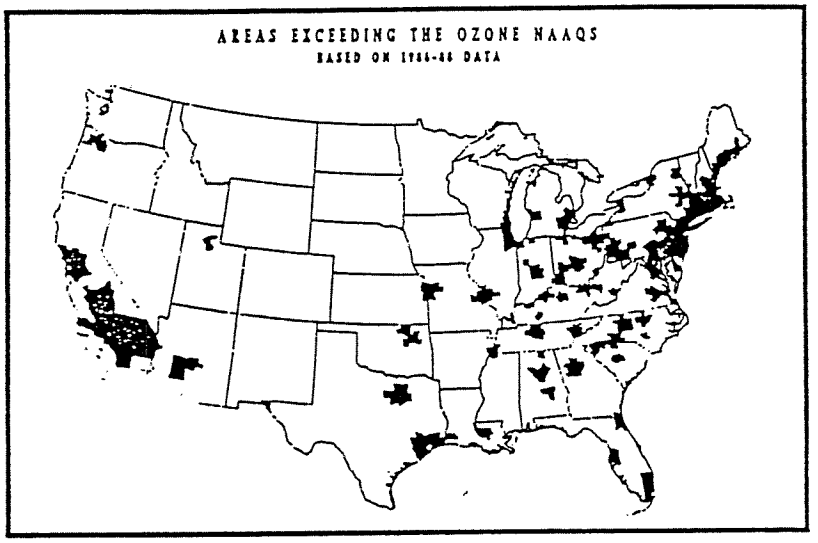
(PHOTOGRAPH OF LUNG FROM 19 YEAR OLD ACCIDENT VICTIM IN LOS ANGELES SHOWING LUNG DAMAGE POSSIBLY DUE TO OZONE EXPOSURE)

WELFARE EFFECTS OF OZONE

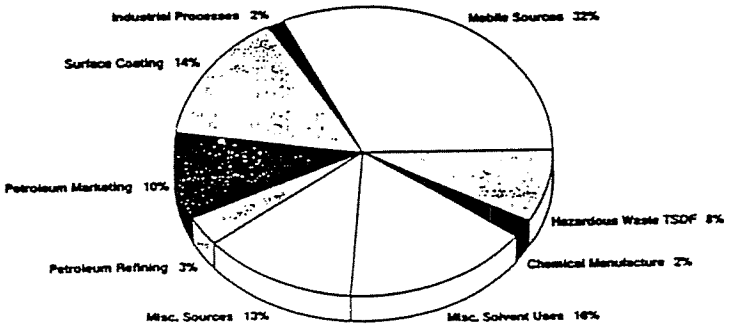
- Materials damage due to oxidation
- Reduction in crop yields
- Lower forest growth rate and premature leaf-drop
- $2 - 3 billion annual damage to commercial crops and forests

TROPOSPHERIC OZONE - MAGNITUDE OF THE PROBLEM

- NAAQS for ozone is 0.12 ppm
- NAAQS routinely exceeded in more than 60 areas nationwide
- Over 100 million people live in areas exceeding NAAQS
- Some areas may not attain standard for next 30 years
- Some scientists are calling for a more stringent standard



SOURCES OF NATIONWIDE VOC EMISSIONS



AIR TOXICS - WHAT ARE THEY?

- Air pollutants that cause cancer or other human health effects
- Clean Air Act amendments identify 189 compounds
- Thousands of point and area sources

AIR TOXICS - HEALTH EFFECTS

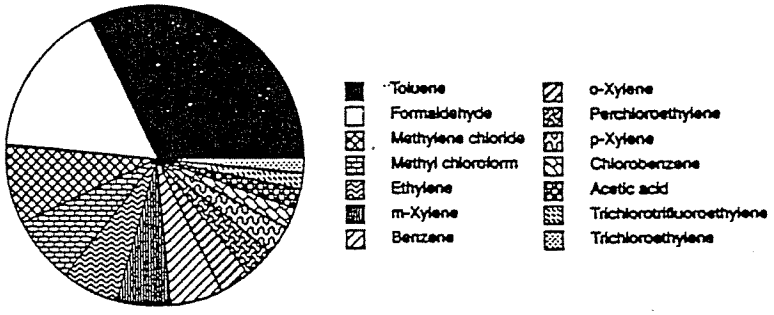
- Occur due to acute or chronic exposure
- Effects:
  - Neurological
  - Behavioral
  - Reproductive
  - Cancer

AIR TOXICS - MAGNITUDE OF THE PROBLEM

- During 1987, major U.S. industries estimated releases of 2.4 billion pounds of toxic pollutants to the air (SARA 313)
- Air toxics are estimated to account for 1,600 to 3,000 cancer deaths per year
- Estimates of the average urban individual lifetime cancer risk from toxic air pollution are as high as 1 in 1000

Top Fourteen VOC/HAP Chemicals

Mass Emissions Basis



ESTIMATED CANCER IMPACTS OF TSDF AIR EMISSIONS

- 140 cancer incidences per year nationwide
- Maximum individual risk of cancer = 2×10^{-2}

ORGANIC AIR EMISSIONS

OTHER CONCERNS

- GLOBAL CLIMATE CHANGE
- ACID RAIN

FEDERAL LAWS THAT ADDRESS THE PROBLEM

- RCRA/HSWA
- CLEAN AIR ACT
- CERCLA/SARA

FEDERAL LAWS

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

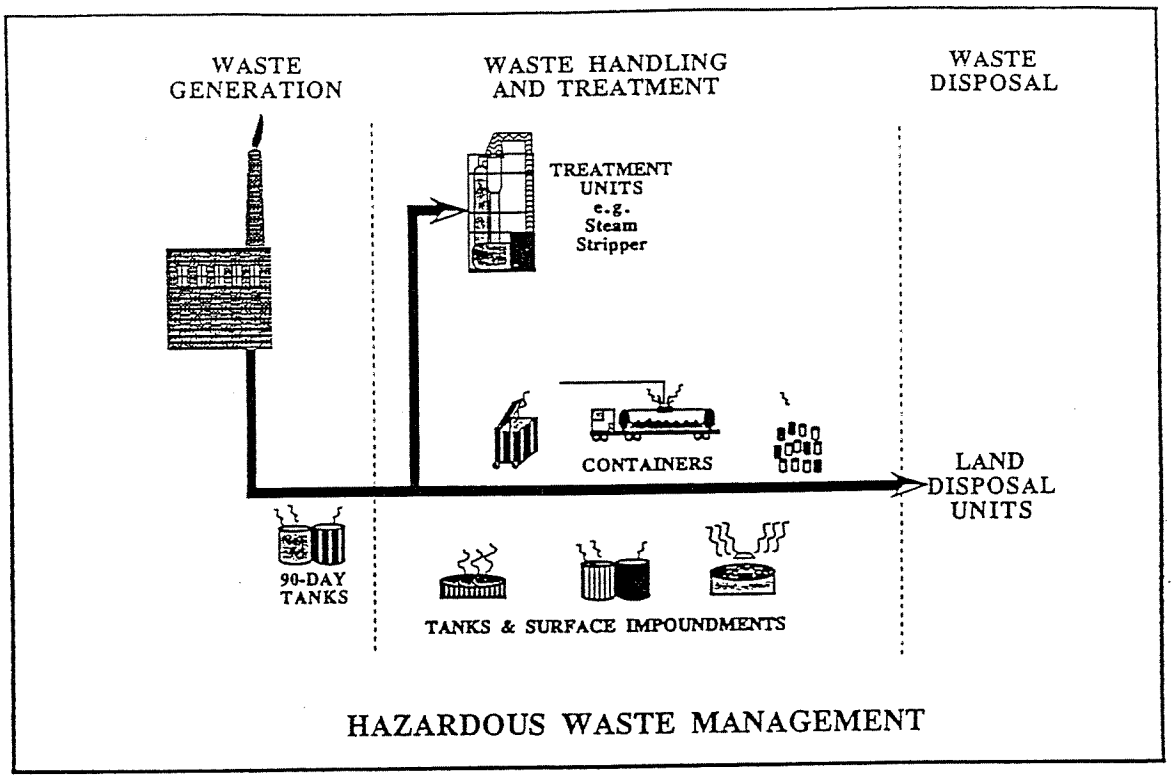
- Section 3004(n)
- Corrective Action
- Land Disposal Restrictions
- Other Programs

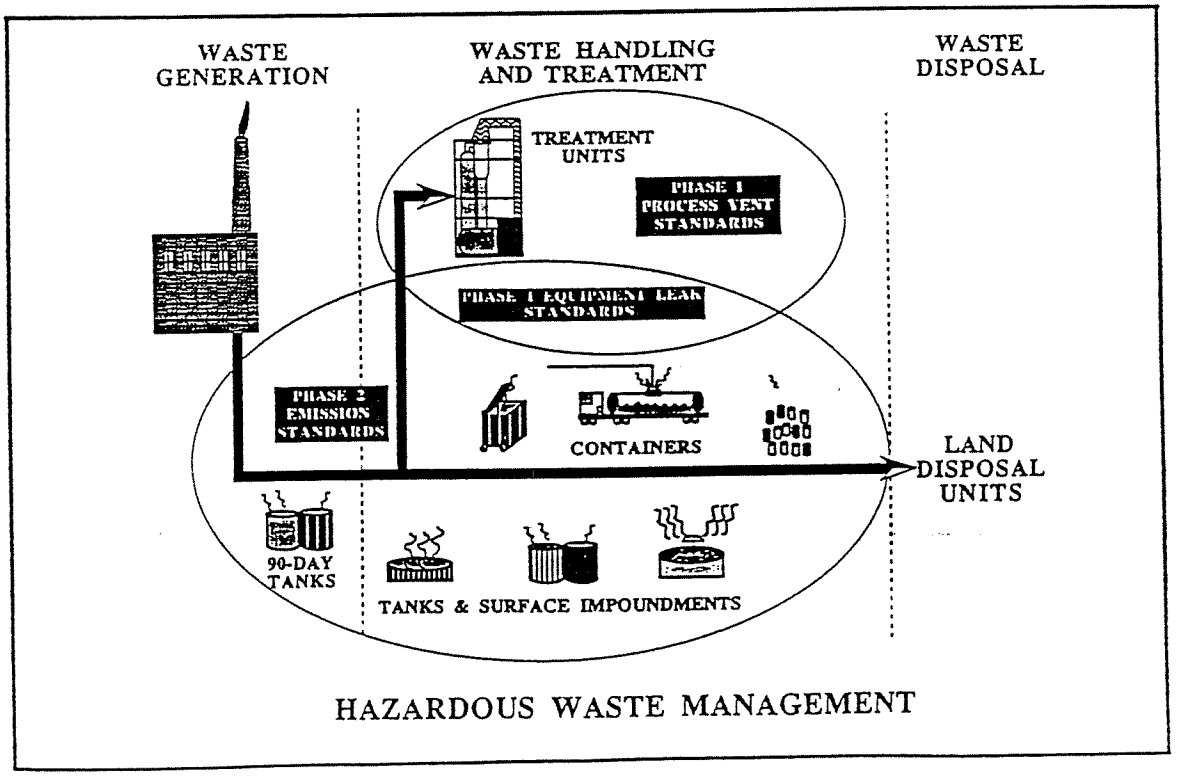
STANDARDS DEVELOPMENT UNDER SECTION 3004(n)

→ PHASE I
- Total organics
- Process vents and equipment leaks
- Promulgated 6/21/90 (55 FR 25454)

PHASE II
- Total organics
- Tanks, surface impoundments, containers and miscellaneous units
- Proposal package in OMB

PHASE III
- Individual constituent standards, as needed, to supplement Phase I and Phase II standards
- Early Work Group stage


WASTE GENERATION
WASTE HANDLING AND TREATMENT
WASTE DISPOSAL
TREATMENT UNITS e.g. Steam Stripper
CONTAINERS
LAND DISPOSAL UNITS
90-DAY TANKS
TANKS & SURFACE IMPOUNDMENTS
HAZARDOUS WASTE MANAGEMENT


WASTE GENERATION
WASTE HANDLING AND TREATMENT
WASTE DISPOSAL
TREATMENT UNITS
PHASE 1 PROCESS VENT STANDARDS
PHASE 1 EQUIPMENT LEAK STANDARDS
PHASE 2 EMISSION STANDARDS
CONTAINERS
LAND DISPOSAL UNITS
90-DAY TANKS
TANKS & SURFACE IMPOUNDMENTS
HAZARDOUS WASTE MANAGEMENT

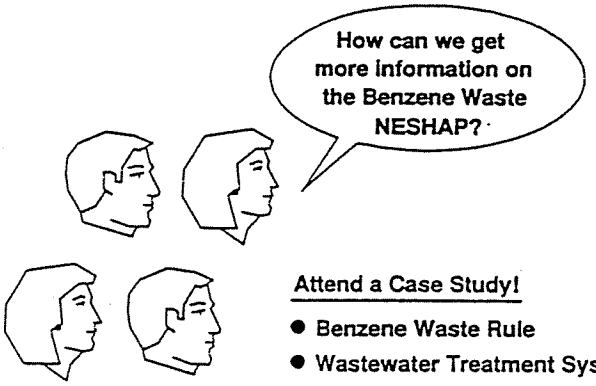
FEDERAL LAWS

CLEAN AIR ACT

- National Ambient Air Quality Standards (NAAQS)
  - Criteria pollutants
  - PM, SO_2, CO, NO_X, O_3, Pb
- New Source Performance Standards (NSPS)
  - Criteria pollutants
  - Designated pollutants (e.g. TRS)
- National Emission Standards for Hazardous Air Pollutants (NESHAP)

National Emission Standards for Hazardous Air Pollutants; Benzene Waste Operations

- Promulgated March 7, 1990 (55 FR 8292)
- 40 CFR Part 61 Subpart FF
- Applies to chemical plants, petroleum refineries, coke by-product recovery plants, and certain TSDF
- Compliance deadline for existing facilities: March 7, 1992



Attend a Case Study!

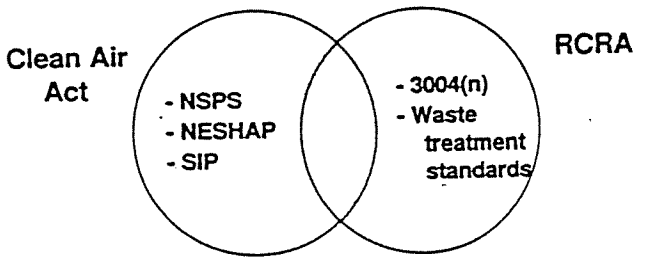
- Benzene Waste Rule
- Wastewater Treatment Systems
- Implementation Discussion (regulators only, please)

FEDERAL LAWS

CERCLA/SARA
(Superfund)

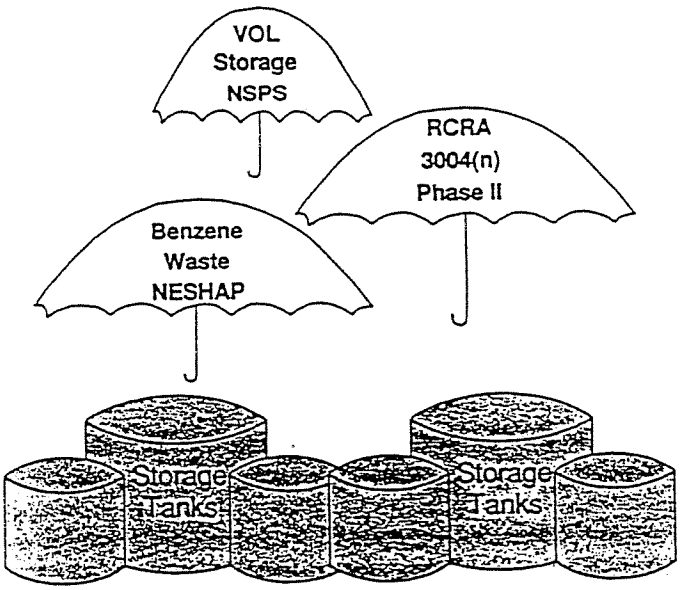
- Site-specific risk analysis required for removal and remediation actions
- Removal and remediation actions must comply with Federal and State laws that are applicable or relevant and appropriate (ARARS)
- Toxic Release Inventory Required by SARA Title 313

OVERLAP OF STATUTORY COVERAGE FOR AIR EMISSION SOURCES



- Control requirements consistent and complimentary to the extent possible
- Compliance must be demonstrated with all applicable rules

STORAGE TANKS ARE UNDER SEVERAL "REGULATORY UMBRELLAS"



CONCLUSIONS

- Organic air emissions contribute to major air pollution problems
- Waste management operations are a significant source of organic air emissions
- Organic air emissions are being controlled under several federal laws

EPA

SOURCES AND CONTROLS

ABSTRACT: SOURCES AND CONTROLS

The session on sources and controls focuses on the major sources of air emissions at waste management facilities, how these emissions occur, and how they can be controlled. The major sources that are discussed in detail include surface impoundments, the very broad and diverse category of tanks and ancillary equipment, containers, and other major land disposal sources. As each source is described, controls that are inherent to that source or commonly found on that particular source are presented. In addition, details are provided on the basic mechanisms by which emissions occur and the major factors that affect the emissions.

After the discussion of sources and their inherent controls, air pollution control devices that may be generally applicable to any enclosed or vented source (i.e., add–on controls) are described. The discussion of control devices focuses on their applicability, control performance, and the major factors affecting performance. Organic removal (i.e., pretreatment) and destruction processes are also discussed as a means for controlling air emissions and reducing or eliminating the emission potential. This discussion describes processes that remove or destroy the organics in the waste, which may eliminate the need to control subsequent waste processing steps.

BIBLIOGRAPHY:
SOURCES AND CONTROLS

1. U.S. EPA, OAQPS. "Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF) -- Background Information for Promulgated Organic Emission Standards for Process Vents and Equipment Leaks." EPA-450/3-89-009. July 1990.

2. U.S. EPA, OAQPS. "Hazardous Waste TSDF - Technical Guidance Document for RCRA Air Emission Standards for Process Vents and Equipment Leaks." EPA-450/3-89-21. July 1990.

3. U.S. EPA, OAQPS. "Alternative Control Technology Document - Organic Waste Process Vents" to be published in December 1990.

4. U.S. EPA, AEERL. "Handbook: Control Technologies for Hazardous Air Pollutants". EPA/625/6-86/014. September 1986.

5. U.S. EPA, OAQPS. "VOC Emissions from Petroleum Refinery Wastewater Systems -- Background Information for Proposed Standards." EPA-450/3-85-001a. February 1985.

6. U.S. EPA, OAQPS. "Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF) -- Air Emission Models." EPA-450/3-87-026. November 1989.

7. U.S. EPA, ORD/HWERL. "Preliminary Assessment of Hazardous Waste Pretreatment as an Air Pollution Control Technique." EPA-600/2-86-028. NTIS PB46-17209/A6. March 1986.

8. U.S. EPA, Control Technology Center. "Industrial Wastewater Volatile Organic Compound Emissions -- Background Information for BACT/LAER Determinations." EPA-450/3-90-004. January 1990.

9. U.S. EPA, OAQPS. "Hazardous Waste TSDF -- Background Information Document for Proposed RCRA Air Emission Standards." EPA-450/3-89-23. (Will be available to the public upon proposal of the standard.)

Highlights

- Open sources with large surface areas have high emission potential
- Aeration, agitation, heating increase emissions
- Tanks are a diverse group of sources
- Sources can be covered and enclosed, vented to a control device
- Organic removal or waste destruction is the best control option

Outline

- **Introduction**
- Sources and inherent controls
- Air pollution control devices
- Organic removal or destruction
- Summary

Introduction

- Sources
  - — Impoundments
  - — Containers
  - — Tanks
  - — Land disposal sources
- Emission mechanisms
- Emission controls

Outline

- Introduction
- **Sources and inherent controls**
- Air pollution control devices
- Organic removal or destruction
- Summary

Sources and Inherent Controls

- **Surface impoundments**
- Tanks and ancillary equipment
- Containers
- Land disposal sources

SURFACE IMPOUNDMENTS

Definition

". . . depression, manmade excavation, or diked area formed primarily of earthen materials . . . designed to hold liquid wastes or wastes containing free liquids . . . "

SURFACE IMPOUNDMENTS

Uses

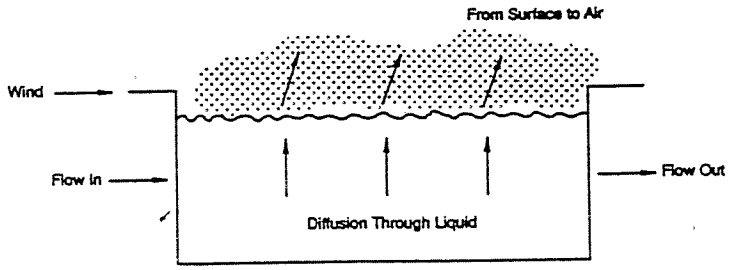
- Storage
- Equalization
- Neutralization
- Evaporation
- Solids settling
- Biodegradation

SURFACE IMPOUNDMENTS

A High Percentage of Organics Is Emitted because of . . .

- Surface areas up to many acres
- Residence times of days, weeks, or months
- Aeration or agitation

Emissions from Impoundments and Other Open Liquid Surfaces

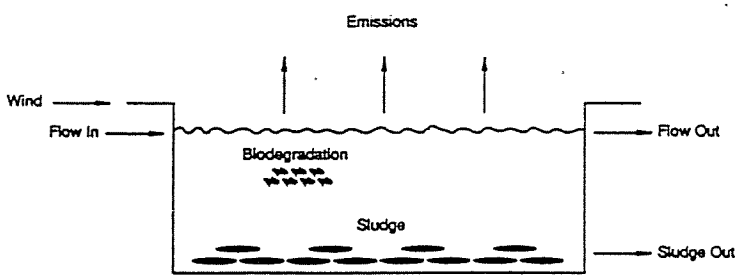


SURFACE IMPOUNDMENTS

Major Factors Affecting Emissions

- Constituent volatility
- Residence time
- Surface area
- Turbulence (aeration, agitation)
- Windspeed and temperature
- Extent of competing mechanisms (such as biodegradation)

Fate of Organics: Emissions, Effluent, Biodegradation, Sludge



SURFACE IMPOUNDMENTS

Models for Open Liquid Surfaces

- Applicable to impoundments and open tanks
- Models for calm surfaces and turbulent surfaces
- Emissions modeled as two steps
- Models for flowthrough systems and evaporation ponds
- Rate of biodegradation (if any) included

SURFACE IMPOUNDMENTS

Controls: Air-supported Structures

- Fans maintain pressure to inflate structure
- Air vented to a control device
- Demonstrated on 1-acre aerated lagoon
- Subject to condensation, high temperatures, accelerated corrosion, special worker safety procedures
- Control efficiency determined by vent's control device (over 95%)

SURFACE IMPOUNDMENTS

Controls: Floating Membrane Covers

- Demonstrated on water reservoirs, anaerobic digester
- Design considerations: seal at edges, removal of rainwater, gas vents, sludge removal
- Emissions from organic permeation of membrane
- Control efficiency (theoretical) of 50% to 95+%

Sources and Inherent Controls

- Surface impoundments
- **Tanks and ancillary equipment**
- Containers
- Land disposal sources

TANKS

Highlights

- Diverse group of sources
- Open tanks have high emission potential
- Heating, agitation, aeration increase emissions
- Biodegradation decreases emissions
- Some have inherent controls
- Control by covering, enclosing, venting to control device

TANKS

Definition

". . . stationary device designed to contain an accumulation of hazardous waste which is constructed primarily of nonearthen materials which provide structural support."

TANKS

Definitions

Tank system:
". . . a tank and its associated ancillary equipment . . . . "

Ancillary equipment:
". . . such devices as piping, fittings, flanges, valves, and pumps . . . ."

TANKS

Categories

I. Organic liquids

II. Aqueous wastes (wastewater)

III. Sludges

IV. Ancillary equipment

TANKS

I. Organic Liquids

- Covered storage tanks
- Distillation (solvent recovery)
- Solvent extraction

TANKS

Organic Liquids: Covered Tanks

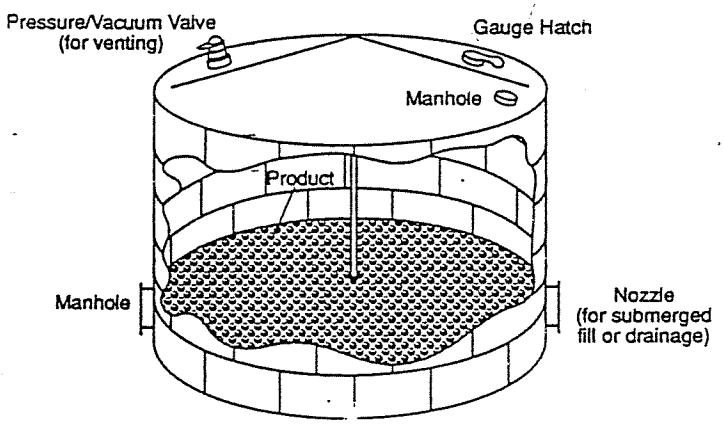
- Fixed-roof
- Floating roof
- Pressure tanks

TANKS

Fixed-Roof

- Common for hazardous waste storage, especially organic liquids
- Emissions through roof's vent equipped with:
  - — Vent pipe open to atmosphere
  - — Pressure/vacuum relief valve
  - — Air pollution control device

Typical Fixed-Roof Tank

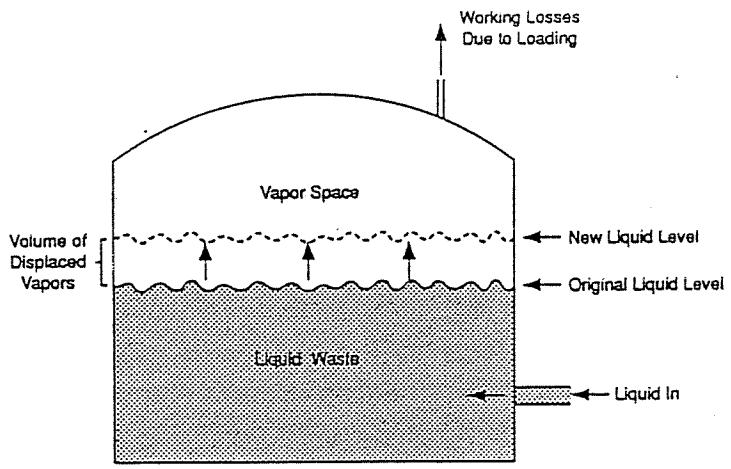


TANKS

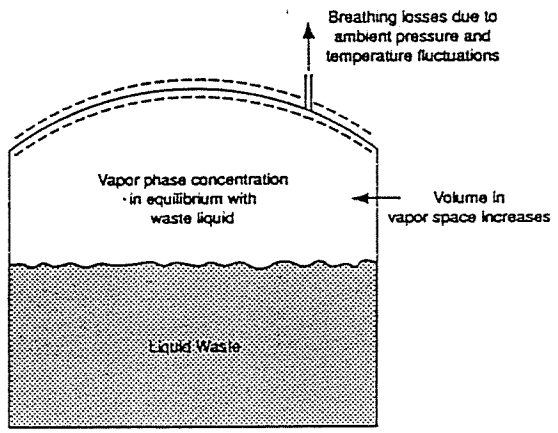
Emissions from Fixed-Roof Tanks

- Working (loading) losses and breathing losses
- Affected by net vapor displacement rate, vapor phase concentration
- Aeration and heating significantly increase emissions (some treatment tanks)

Covered Tanks (Working Losses)



Covered Tanks (Breathing Losses)



TANKS

Emission Models for Fixed-Roof Tanks

- Working loss = waste volume x vapor concentration
- Concentration in vapor
  - — Measure, or
  - — Estimate from volatility
- Breathing losses: low compared to working losses
- Constant level: low working losses

Henry

TANKS

Fixed-Roof Tanks as a Control

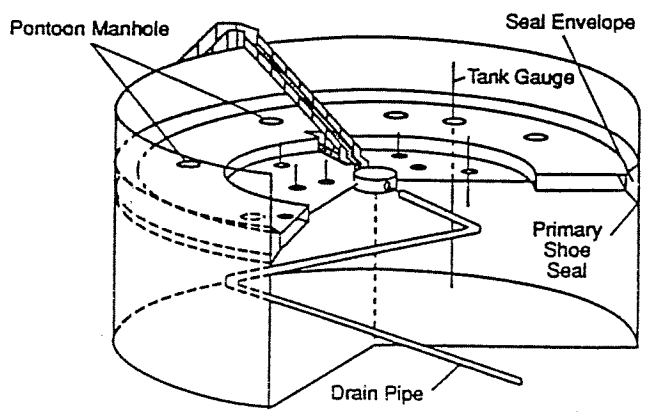
- Retrofit open tank, replace impoundment
- 86% to 99% control for open tank
- 20% to 45% more control with pressure-relief device at 2.5 psig (uncommon)

TANKS

Floating Roof

- Common at petroleum refineries, gasoline marketing
- Can be internal or external
- Reduces vapor displacement
- Emissions from "standing losses" and "withdrawal losses"

External Floating Roof Tank



TANKS

Floating Roof as an Emission Control

- Retrofit open tank, fixed-roof tank
- Must be compatible with waste, process, tank
- 93% to 97% retrofitting fixed-roof (large tanks, organic liquids)
- 74% to 82% reduction for fixed-roof (various types of wastes)
- 96% to 99% reduction for open tank

TANKS

Pressure Tanks

- Most fixed roofs at atmospheric pressure; some up to 2.5 psig, which provides 20% to 45% control of emissions
- Low-pressure tanks up to 2 atm, high-pressure greater than 2 atm
- Vapors generally contained, except when pressure-vacuum relief valve opens

TANKS

Organic Liquids: Distillation

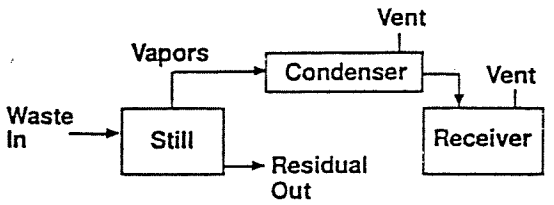
- Separation based on differences in volatility of components
- Continuous or batch (most common at TSDF)
- At atmospheric pressure, vacuum, or greater than atmospheric pressure

TANKS

Emissions from Distillation

- Emissions through overhead system vent, collection tank vents, vacuum system
- Primary condenser is an inherent control
- Pollution control devices can be added to vents

Emission Sources for Distillation

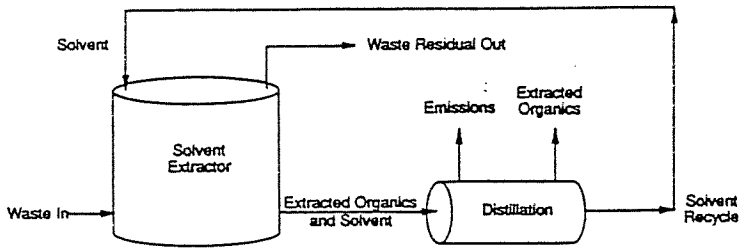


TANKS

Organic Liquids: Solvent Extraction

- Constituent preferentially dissolves in solvent
- Extract separated from treated waste
- Solvent in extract recovered by distillation
- Emissions from distillation vents

Emissions from Solvent Extraction



TANKS

Solvent Extraction: Uses

- Used for phenol, acetic acid, hydroxy aromatic acids, petroleum oils
- Also applicable for organic sludges
- Removals of 80% to 100%
- Waste residual usually requires more treatment

TANKS

II. Aqueous Wastes (Wastewater)

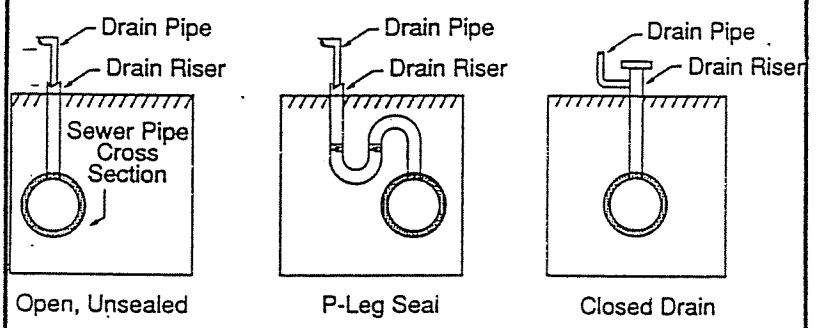
- Wastewater collection
- Oil-water separators
- Open wastewater treatment tanks
- Air and steam strippers

TANKS

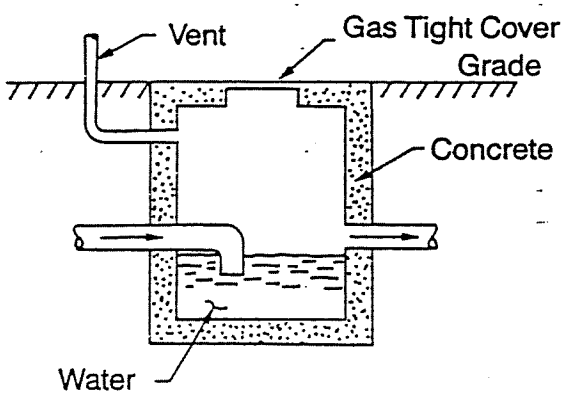
Wastewater Collection Systems

- Individual drains, sewers, junction boxes, sumps
- Emissions from direct contact with air, induced draft
- Roughly 20% to 40% of benzene can be emitted in collection systems
- Control by covering, vent to control device

Individual Drains



Typical Junction Box

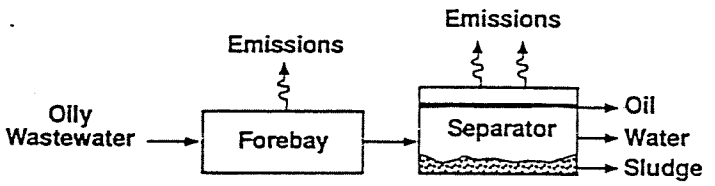


TANKS

Oil-Water Separators

- May be open, covered, or controlled by covering and venting to control device
- API and PPI separators common at refineries
- Separates oil, water, and sludge

Oil-Water Separator



TANKS

Wastewater Treatment

- Generally open
- Emission mechanisms similar to impoundments
- Smaller surface areas than impoundments
- Residence time of hours
- Control by covering, vent to a control device

TANKS

Typical Open Tank Processes

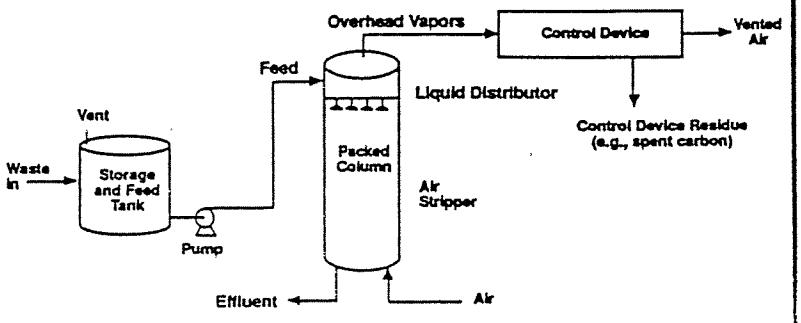
- Equalization
- Neutralization
- Solids settling, separation
- Biodegradation
- Oxidation reactions
- Precipitation
- Adsorption
- Air flotation

TANKS

Air Stripping

- Volatiles stripped from waste by contact with air
- Contact in spray towers, packed towers, mechanical and diffused-air aeration
- Most common for dilute aqueous wastes; used for groundwater
- Vented air controlled by carbon adsorption, catalytic incineration (condensers are uncommon)

Schematic Diagram of an Air Stripping System

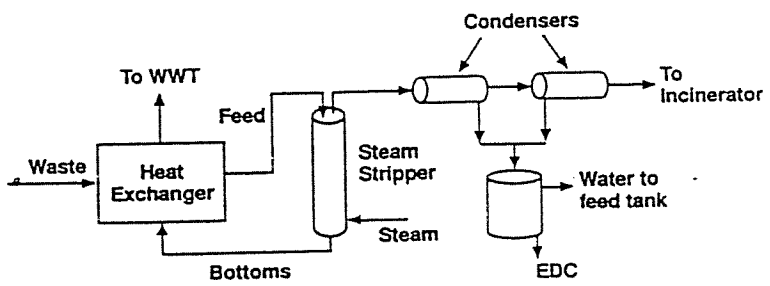


TANKS

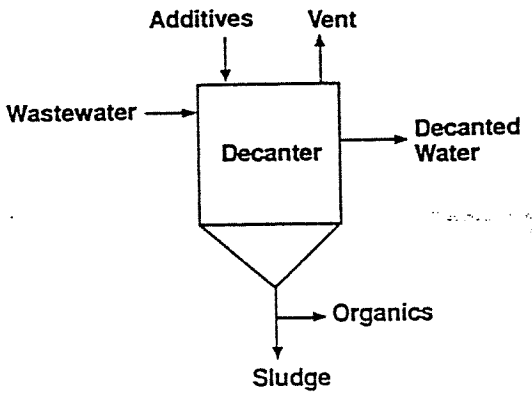
Steam Stripping

- Batch or continuous (most common for large wastewater streams)
- Direct contact between steam and waste
- Vapors condensed and organic layer decanted; aqueous layer recycled to feed
- Continuous devices with trays or packing require low solids content

Steam Stripper for Ethylene Dichloride/Vinyl Chloride



Preliminary Treatment Prior to Stripping



TANKS

Emissions from Steam Stripping

- Emissions from condenser/decanter vent, collection tanks
- Primary condenser provides an inherent control
- Additional control from control devices on vents

TANKS

III. Sludges

- Fixation
- Dewatering
- Thin-film evaporators

TANKS

Sludges: Fixation

- Also called stabilization, solidification
- Cement-like substances (lime, flyash, kiln dust) most common fixative
- Steps are (1) mixing, (2) curing, and (3) disposal
- Not only in tanks, but also containers (next source type)

TANKS

Emissions from Fixation

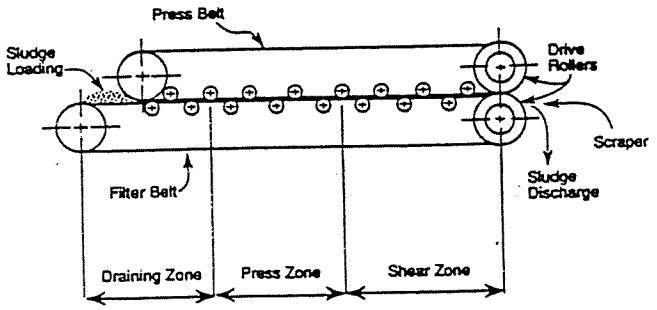
- Most volatiles emitted during mixing (60% to 90%)
- Organics also emitted during curing
- Exothermic reactions increase emissions
- Control by covers or enclosures vented to control device

TANKS

Sludges: Dewatering

- Used to reduce water content of sludges
- Filter press
  - Plate and frame
  - Recessed plate
  - Belt filter
- Rotary vacuum filter
- Centrifugal filter

Belt Filter Press



TANKS

Emissions from Dewatering

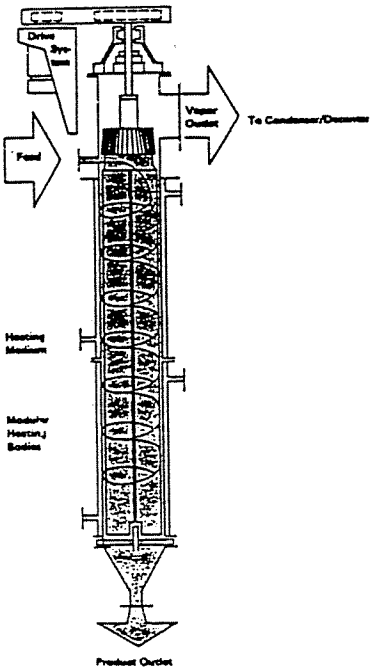
- Discharge of solids and filtrate
- Exposed area of waste on moving belts
- Leaks
- Vacuum pumps (if used)
- Control by enclosure vented to control device

TANKS

Sludges: Thin-Film Evaporation

- For viscous liquids, sludges, slurries
- Thin layer of waste spread on heated surface
- Adaptable to many physical forms and waste compositions

Flow Path of Thin-Film Evaporator



TANKS

Emissions from Thin-Film Evaporation

- Emissions through overhead system vents, collection tanks, vacuum system if used
- Primary condenser is an inherent control
- Additional control from control devices on vents

TANKS

IV. Ancillary Equipment

- Pumps
- Valves
- Pressure-relief devices
- Compressors
- Sampling connections
- Open-ended lines

ANCILLARY EQUIPMENT

Leak Detection and Repair (LDAR)

- Procedure to reduce emissions
- Survey components for leaks using portable organic vapor detector (Method 21)
- Adjust, repair, replace as necessary

Sources and Inherent Controls

- Surface impoundments
- Tanks and ancillary equipment
- **Containers**
- Land disposal sources

CONTAINERS

Definition

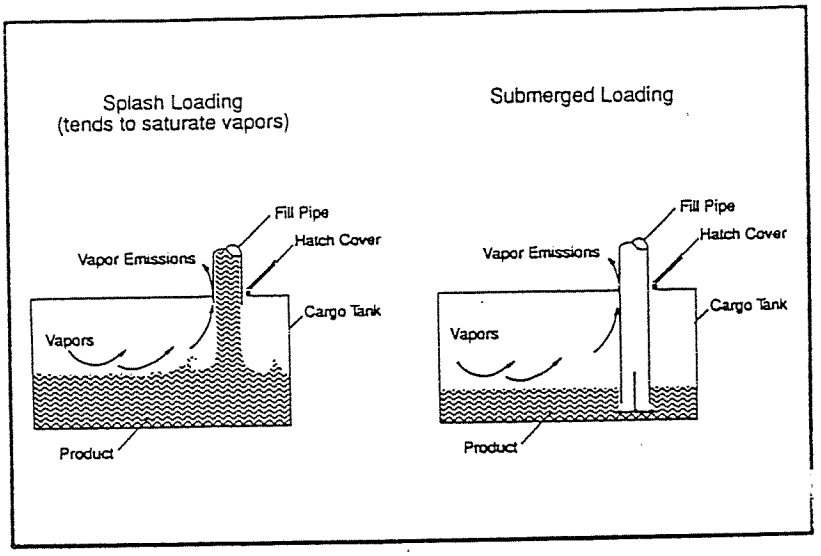
"Any **portable** device in which a material is stored, transported, treated, disposed of, or otherwise handled."

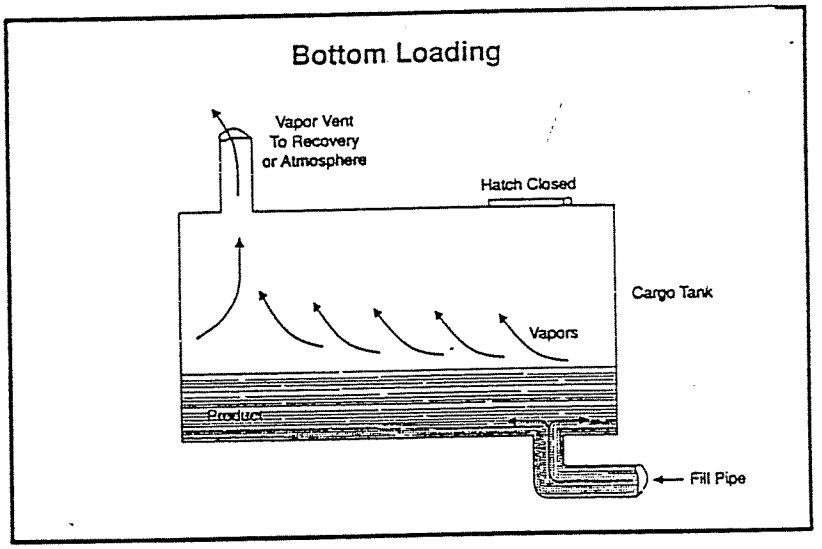
– includes tank trucks

CONTAINERS

Controls

- Submerged loading
  - — Influent pipe below surface
  - — Prevents splashing, saturation of vapors
  - — Control efficiency of 65%
- Cover or enclose and vent to a control device
- Housekeeping in drum storage area





AM

PM

Sources and Inherent Controls

- Surface impoundments
- Tanks and ancillary equipment
- Containers
- **Land disposal sources**

LAND DISPOSAL

Major Land Disposal Sources

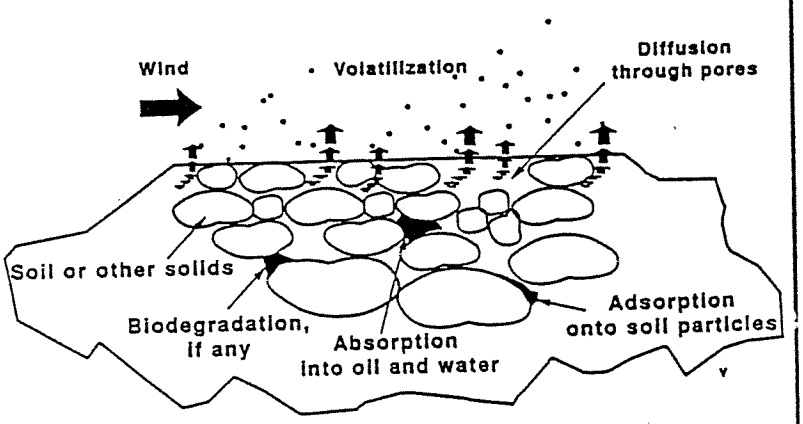
- Land treatment
- Landfills
- Waste piles

LAND DISPOSAL

Land Treatment

" . . . hazardous waste is applied onto or incorporated into the soil surface."

Land Treatment Emission Mechanisms

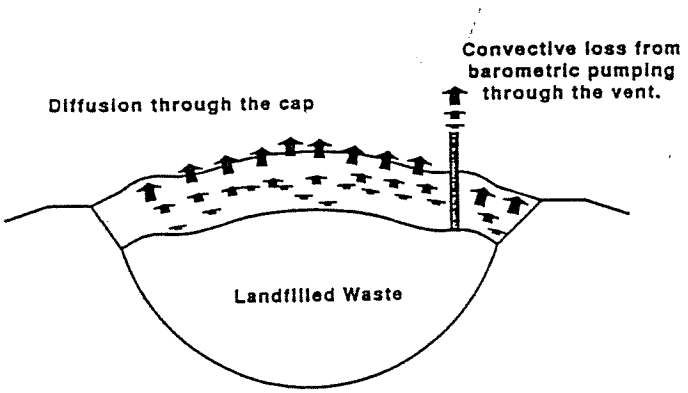


LAND DISPOSAL

Landfills

- Composed of active and covered cells
- Volatiles rapidly emitted from surface of active cells
- After covering and compacting with soil, emissions occur by diffusion, barometric pumping, gas venting

Emissions From A Closed Landfill



LAND DISPOSAL

Wastepile

"Noncontainerized accumulation of solid, nonflowing hazardous waste used for treatment or storage."

LAND DISPOSAL

Controls

- Flexible membrane covers
- Covers supported by rigid structure, vent to control device
- Air-supported structures, vent to control device
- Remove or destroy organics before disposal

Outline

- Introduction
- Sources and inherent controls
- **Air pollution control devices**
- Organic removal or destruction
- Summary

Air Pollution Control Devices

- Carbon adsorption
- Condensation
- Absorption
- Combustion
  - — Flares
  - — Thermal incineration
  - — Catalytic incineration
  - — Boilers or process heaters

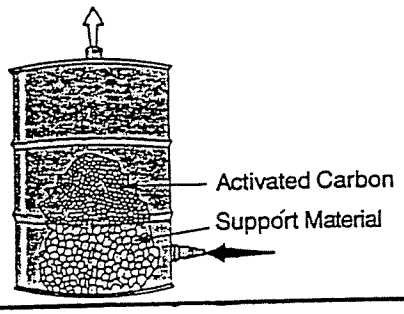
CONTROL DEVICES

Carbon Adsorbers

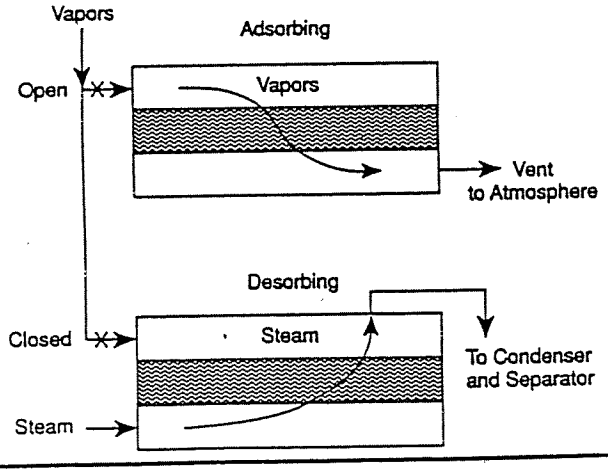
- Organics selectively collected on surface of activated carbon
- Breakthrough: organics detected exiting the bed
- Essentially complete removal until breakthrough
- Efficiency at least 95%
- Carbon canisters and fixed bed (regenerable)

Carbon Canisters

- For vent flows less than 100 CFM
- Cannot be regenerated in canister



Two-stage Adsorption System



CONTROL DEVICES

Carbon Adsorbers: Design Considerations

- Capacity vs. vapor concentration
- Bed design (depth, pressure drop)
- Flow rate
- Humidity
- Temperature

CONTROL DEVICES

For Effective Control by Adsorbers . . .

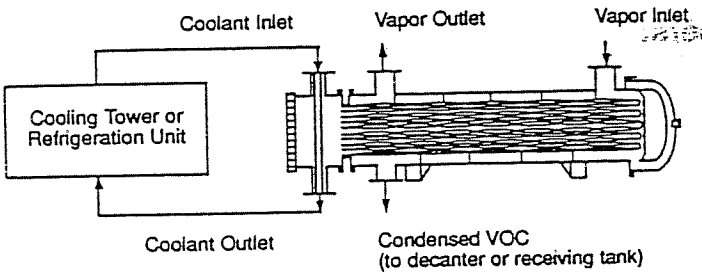
- Monitor for breakthrough, or
- Replace carbon before breakthrough (based on operating experience)
- Control emissions from regeneration or disposal

CONTROL DEVICES

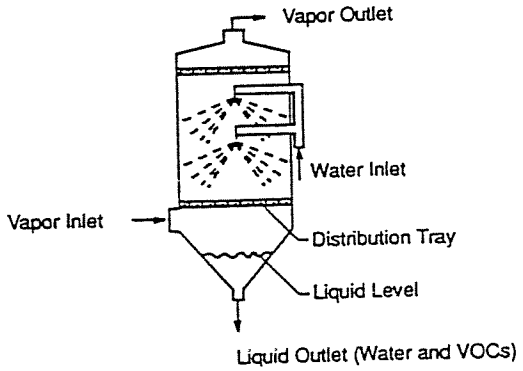
Condensation

- Cool vapor phase to dewpoint
- Surface condenser - most common, noncontact (usually shell and tube)
- Contact condensers: cheap and efficient, but could have a treatment and disposal problem
- Coolants: cooling tower water, refrigerated water, brines, glycols
- Efficiency determined by vapor phase concentration and condenser temperature

Schematic Diagram of a Shell-and-Tube Surface Condenser



Schematic Diagram of a Contact Condenser

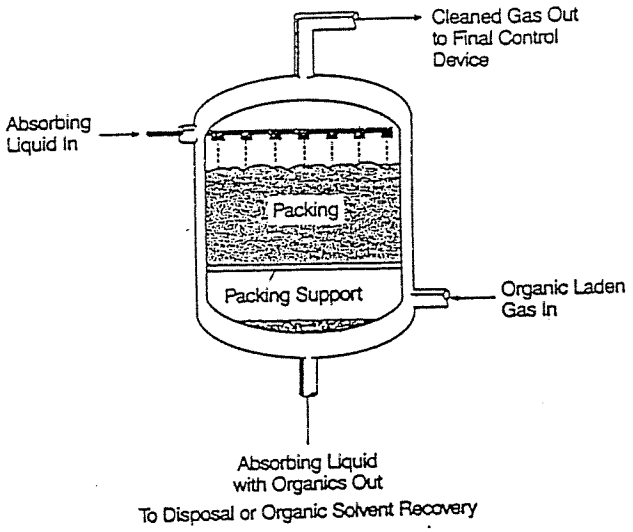


CONTROL DEVICES

Absorption

- Vent gas component dissolves in liquid
- Contact in spray towers, scrubbers, packed or plate columns
- Common use is to remove SO_2, H_2S, HCl, NH_3 from air with water
- Solvents: water, mineral oils, nonvolatile oils, aqueous solutions of oxidizing agents
- Efficiencies 60% - 96%; 87% for methylene chloride by water

Packed Tower for Gas Absorption



CONTROL DEVICES

Combustion Equipment

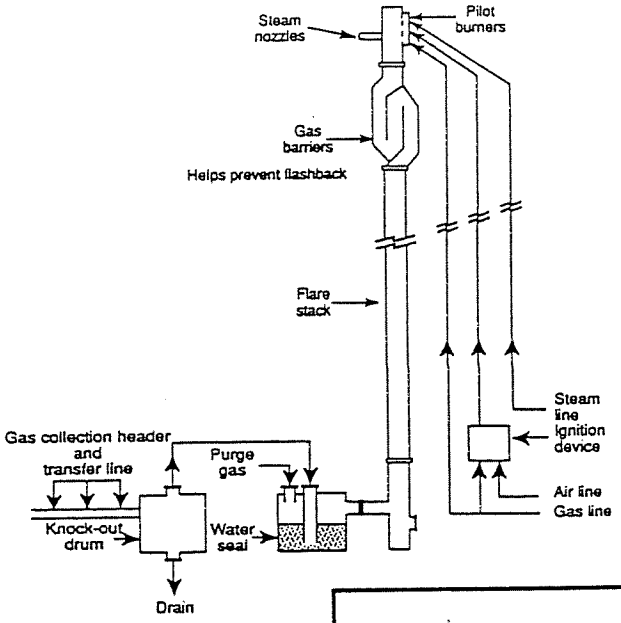
- Flares
- Thermal oxidizers (incinerators, boilers, process heaters)
- Catalytic incinerators

CONTROL DEVICES

Flares

- Open combustion process
- Steam injection improves combustion
- Destruction efficiency at least 98%

Steam-assisted Elevated Flare System

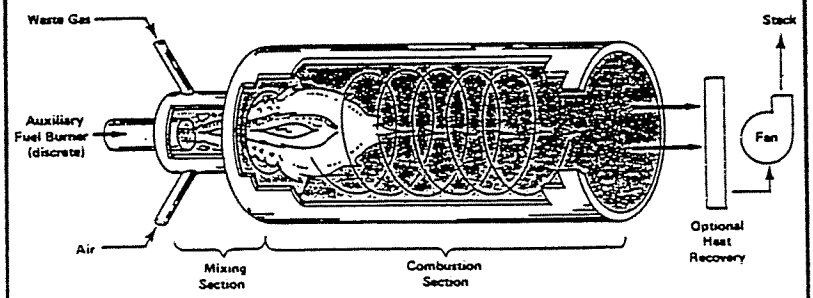


CONTROL DEVICES

Thermal Incineration

- Requires high temperatures, good mixing, sufficient oxygen, adequate residence time
- Auxiliary fuel if vent gas less than 50 Btu/scf
- Capacity of 200 to 500,000 scfm
- Destruction efficiency at least 98%

Thermal Incinerator

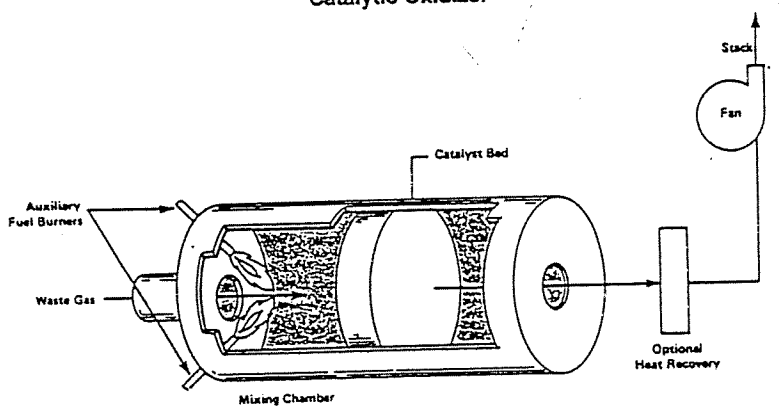


CONTROL DEVICES

Catalytic Incinerators

- Oxidation at lower temperatures with catalyst (320 - 650 °C)
- Catalyst adversely affected by high temperatures, high concentrations, fouling (particulate matter, polymers),deactivation (halogens or some metals)
- Can achieve 98% or higher destruction

Catalytic Oxidizer



CONTROL DEVICES

Existing Boilers or Process Heaters

- Control provided by existing equipment
- Vent stream added as fuel, secondary combustion air, or as diluent
- Vapors with halogens or sulfur usually avoided
- Recovers heating value of vent stream
- Can achieve 98% or higher destruction

Outline

- Introduction
- Sources and inherent controls
- Air pollution control devices
- **Organic removal or destruction**
- Summary

Organic Removal or Destruction

- Steam stripping
- Air stripping
- Thin-film evaporation
- Solvent extraction
- Distillation
- Waste incineration

ORGANIC REMOVAL

Features

- Avoids need for controls on subsequent processes (hence pretreatment)
- Removal efficiency depends on waste constituents and process design
- Can remove essentially all of highly volatile compounds
- Applicable to many wastes and compounds

ORGANIC REMOVAL

Control Efficiency

- Percent removed from waste
- Emissions from removal process
- Emissions before removal process installed
- Percent control of 98 to 99+ is possible

ORGANIC REMOVAL

Example: Steam Stripping Benzene from Water

- 99.5% to 99.9% removed from water
- 0.7% to 1.4% emitted from stripping system
- Control efficiency of 98% to 99% (if 70% emitted in WWT)

ORGANIC DESTRUCTION

Waste Incineration

- Used for wastes that were previously land-disposed
- Destruction of 99.99% or higher demonstrated in many units
- Applicable to organic wastes and sludges

Outline

- Introduction
- Sources and inherent controls
- Air pollution control devices
- Organic removal or destruction
- Summary

SUMMARY

Sources

- Impoundments
- Tanks
- Containers
- Land disposal sources
- Miscellaneous

SUMMARY

Characteristics Affecting Emissions

- Exposed surface areas
- Residence time
- Constituent volatility
- Turbulence

SUMMARY

Emission Mechanisms

- Area sources
  - Diffusion through waste to surface
  - Transfer from surface to air

SUMMARY

Emission Mechanisms (con.)

- Enclosed sources
  - Vapor space contains organics
  - Displacement of vapor
    - Working losses
    - Breathing losses
- Evaporation of leaks and spills

SUMMARY

Competing Mechanisms

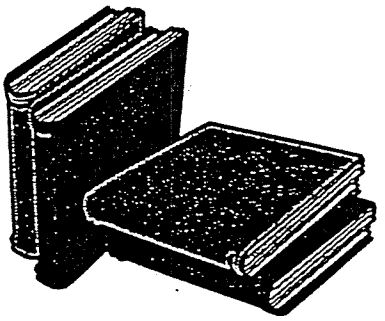
- Biodegradation
- Adsorption
- Absorption
- Removal with effluent

SUMMARY

Controls

- Cover or enclose open area sources
- Control devices for vapors captured by enclosure
- Organic removal or waste incineration (instead of covers/control devices)
- Work practices for leaks (LDAR) and spills

RCRA Organic Air Rules - Process Vents



40 CFR Parts 264 and 265
Subpart AA
(55 FR 25454, June 21, 1990)

ABSTRACT: PROCESS VENT STANDARDS (SUBPART AA)

The objective of the presentation on the RCRA process vent rules is to provide a basic understanding of the new RCRA air emission standards for process vents in order that those persons required to comply, implement, or enforce the rules can do so effectively and timely. The presentation clearly explains the process vent rule applicability criteria which include facility authorization under RCRA, hazardous waste management unit type, and waste organic concentration. Technical requirements for emission controls and the facility "bubble" concept for emission rate limits are explained. Recordkeeping and reporting requirements are also discussed.

The process vent standards in 40 CFR Parts 264 and 265, Subpart AA, limit organic air emissions at hazardous waste treatment, storage, and disposal facilities (TSDF) requiring a permit under Subtitle C of the Resource Conservation and Recovery Act (RCRA). The standards were promulgated on June 21, 1990 (55 FR 25454) under the authority of Section 3004(n) of the Hazardous and Solid Waste Amendments (HSWA) to the RCRA. The Subpart AA standards are applicable to process vents associated with distillation, fractionation, thin-film evaporation, solvent extraction, and air and steam stripping operations that manage hazardous wastes with 10 parts per million by weight (ppmw) or greater total organic concentration. The RCRA air rules for process vents require that owners/operators of TSDFs subject to the provisions of Subpart AA: (1) reduce total organic emissions from all affected process vents at the facility to below 1.4 kg/h (3 lb/h) and 2.8 Mg/yr (3.1 ton/yr), or (2) install and operate a control device(s) that reduces total organic emissions from all affected process vents at the facility by 95 weight percent. The process vent rules do not require use of any specific types of equipment or add-on control devices. Condensers, carbon adsorbers, incinerators, and flares are demonstrated emission control technologies for the regulated processes, although the choice of control is not limited to these. To ensure that control devices perform according to their design, the rules for process vents require that specific control device operating parameters be monitored continuously and the monitoring information be recorded in the facility operating record.

BIBLIOGRAPHY

1. "Hazardous Waste Treatment, Storage, and Disposal Facilities -- Organic Air Emission Standards for Process Vents and Equipment Leaks." Federal Register, Vol. 55 pages 25454-25519. June 21, 1990.

2. U.S. EPA, OAQPS, "Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF) -- Background Information for Promulgated Organic Emission Standards for Process Vents and Equipment Leaks," EPA-450/3-89-009, July 1990.

3. U.S. EPA, OAQPS. "Hazardous Waste TSDF - Technical Guidance Document for RCRA Air Emission Standards for Process Vents and Equipment Leaks." EPA-450/3-89-21. July 1990.

4. U.S. EPA, OAQPS. "Alternative Control Technology Document - Organic Waste Process Vents" to be published in December 1990.

5. U.S. EPA, OAQPS. "RCRA TSDF Air Emissions - Background Technical Memoranda for Proposed Standards." EPA-450/3-86-009. October 1990.

6. "Hazardous Waste Treatment, Storage, and Disposal Facilities; Air Emission Standards for Volatile Organics Control." Federal Register, Vol. 52, pages 3748-3770. February 5, 1987.

7. U.S. EPA/ORD/IERL. "Process Design Manual for Stripping of Organics." Cincinnati, OH. Publication No. EPA-600/2-84-139. August 1984.

8. U.S. EPA. Cincinnati, OH. Hazardous Waste Engineering Research Laboratory, Office of Research and Development. "Air Strippers and Their Emissions Control at Superfund Sites." Publication No. EPA-600/D-88-153. August 1988.

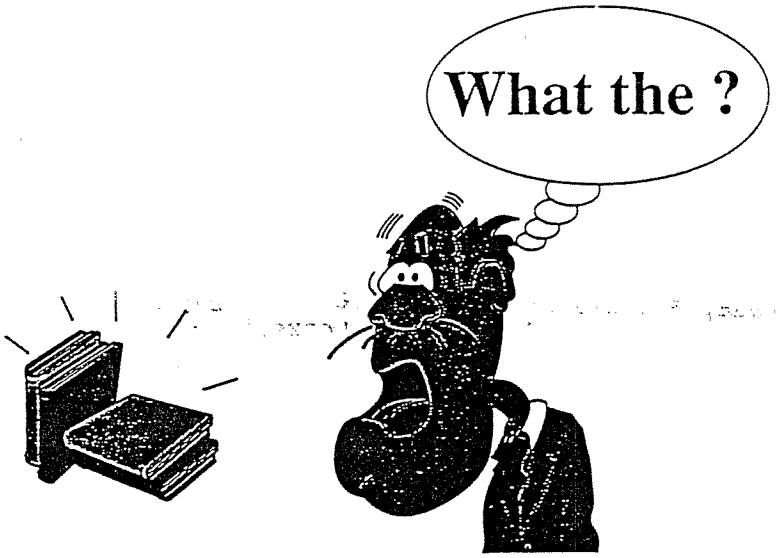
9. U.S. EPA. "Air Stripping of Contaminated Water Sources - Air Emissions and Controls." Control Technology Center. Research Triangle Park, NC. Publication No. EPA-450/3-87-017. August 1987.

10. U.S. EPA/ORD/HWERL. "Preliminary Assessment of Hazardous Waste Pretreatment as an Air Pollution Control Technique." Publication No. EPA-600/2-86-028, NTIS PB46-17209/A6. March 1986.

11. U.S. EPA. "Distillation Operations in Synthetic Organic Chemical Manufacturing-Background Information for Proposed Standards." EPA Publication No. EPA-450/3-83-005a. December 1983.

12. U.S. EPA. Air Pollution Training Institute, RTP, NC 27711. "APTI Course 415 Control of Gaseous Emissions." EPA-450/2-81-005. December 1981.

13. U.S. EPA. "OAQPS Control Cost Manual, 4th Edition." EPA 450/3-90-006. OAQPS, RTP, NC 27711. January, 1990.



Purpose of presentation

Process Vents

- Answer common questions on the RCRA air rules for organic emissions from process vents

Basic questions

Process Vents

Who is affected ?

Why was Subpart AA developed ?

How many facilities are out there ?

Questions on details

Process Vents

What units are regulated ?
How does the regulation work?
When do the regulations become effective ?
What are the requirements for control devices ?
What records have to be maintained ?
What reports have to be filed ?

Who is affected ?

Process Vents

- Facilities subject to Part 270
  - Permitted
  - Interim status
- Previously exempt hazardous waste recycling units at these facilities

What units are affected?

Process Vents

- Steam strippers
- Distillation
- Fractionation
- Thin-film evaporation
- Solvent extraction
- Air strippers

What units are exempted ?

Process Vents

- Production
- Wastewater treatment tanks
- Subtitle D
- Domestic Sewage
- Closed-loop reclamation
- Additional detail provided in your workshop manual on page 3-18 as Attachment A of this session

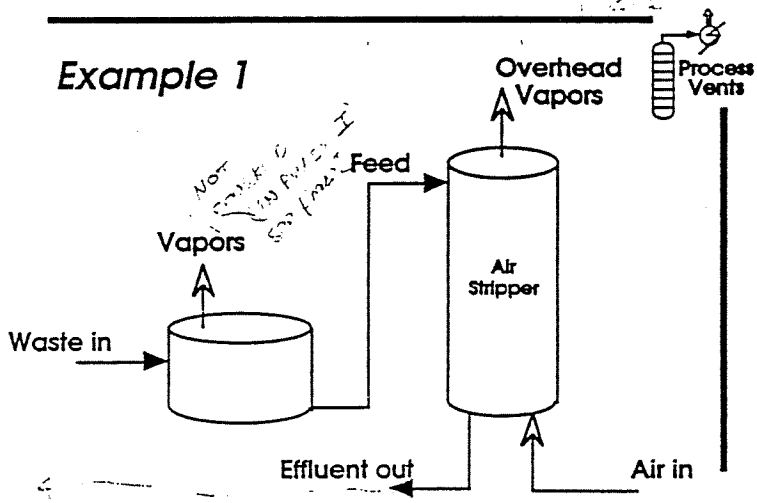
What vents are covered ?

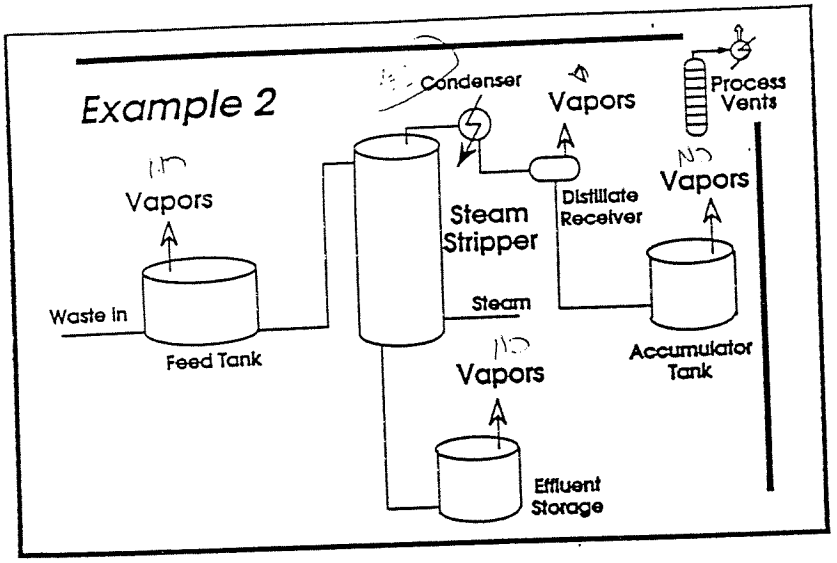
Process Vents

- On affected units that manage hazardous waste with 10 ppmw or greater total organics on a time-weighted, annual average basis
- On tanks associated with an affected unit if emissions from these process units are vented through the tank

Example 1

Process Vents





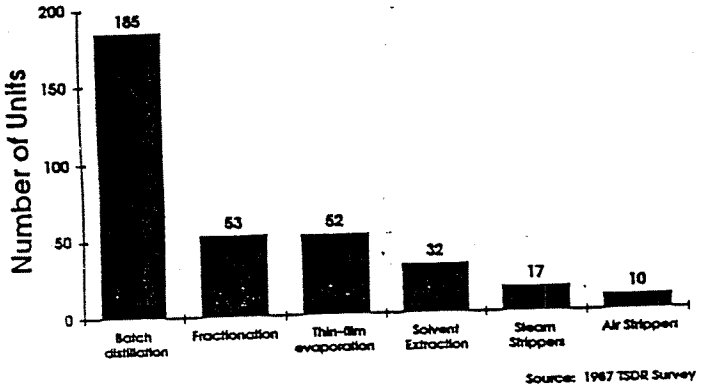
Why was Subpart AA developed?

Process Vents

- To protect human health and the environment
- To control emissions from land-disposal restriction treatment technologies

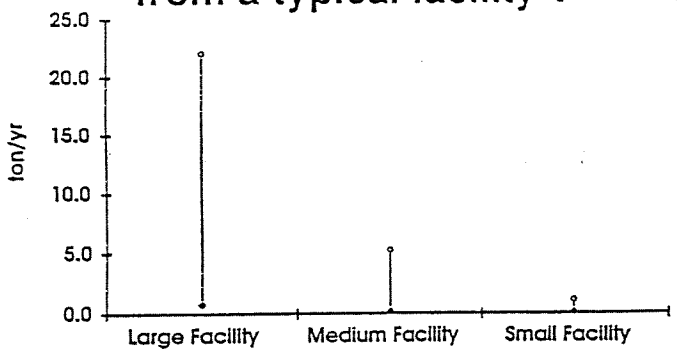
How many units are out there?

Process Vents



What are the annual emissions from a typical facility ?

Process Vents



Model Plants - Annual Emissions Estimates

Process Vents

How do the regulations work?

1. IDENTIFY affected process vents
2. DETERMINE emission rates
3. SUM individual rates
4. COMPARE to emission rate limits
5. REDUCE emissions below limits or 95%

Process Vents

1 IDENTIFY

- Units covered by the standards
  - Distillation
  - Air stripping
  - Solvent extraction
  - Fractionation
  - Steam stripping
  - Thin-film evaporation

<u>which</u>

- Average <u>10 ppmw</u> or greater organics in waste

❷ DETERMINE

Process Vents

- Hourly and annual emission rates with either
  - Direct measurement
  - Use of knowledge

❸ SUM

Process Vents

- The individual emission rates to get a facility process rate

❹ COMPARE

Process Vents

- The total facility process vent emissions to the hourly and annual emission rate limits

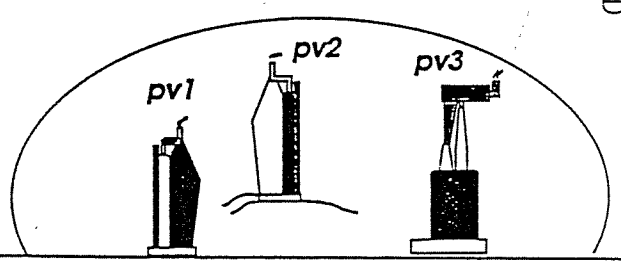
⑤ REDUCE

Process Vents

- Facilities exceeding the emission rate limits must install controls which
  - Reduce facility emissions below 3 lb/hr and 3.1 ton/yr, or
  - Reduce facility emissions by 95 percent

Facility Bubble for Emission Rate (ER)

Process Vents

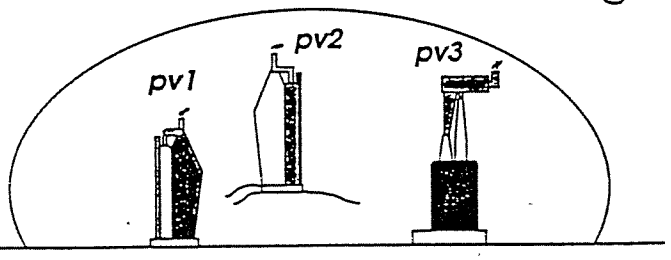


$$ER_{Facility} = \sum_{i=1}^{n} ER_{pvi}$$

$$ER_{Facility} = ER_{pv1} + ER_{pv2} + ER_{pv3}$$

Example 3 - Control Options for a Facility

Process Vents

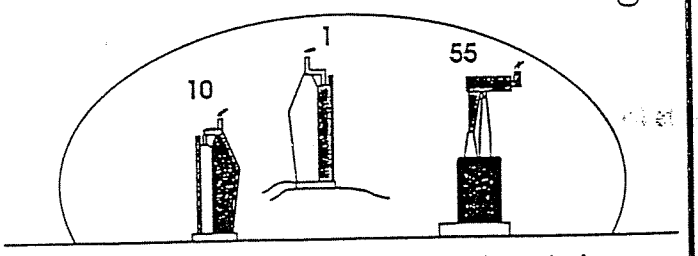


$$ER_{Facility} = ER_{pv1} + ER_{pv2} + ER_{pv3}$$

$$ER_{Facility} = 10 + 1 + 55 = 66 \text{ ton/yr}$$

Example 3 (cont.) - Control Options for a Facility

Process Vents



ER $_{Facility}$ = 66 ton/yr

66 (1-.95) = 3.3
3.3 ton/yr vs. 3.1 ton/yr

Option 1 - 95% control on all three vents

Option 2 - 88% control on *pv1* and 98% control on *pv3*

When do the regulations become effective?

Process Vents

- Regulations become effective on 12/21/90
- Compliance date depends on classification of facility

When do the regulations become effective? (cont.)

Process Vents

- Interim status facilities have until 6/21/92 to install control equipment
- Permitted facilities are shielded from Phase I air standards

Region VI are about pending (in public [illegible])

What are the requirements for control devices ?

Process Vents

- No specific device required
- Individual performance requirements for
  - Vapor recovery systems
  - Enclosed combustion devices
  - Flares
- Equipment must be properly operated, maintained, and continuously monitored

What are the requirements for vapor recovery systems (e.g. condensers or adsorbers) ?

Process Vents

- Recovery efficiency of 95 weight percent or better
- Primary recovery devices do not count toward the 95 weight percent

What are the requirements for enclosed combustion devices (e.g., vapor incinerators, boilers, or process heaters) ?

Process Vents

- Designed and operated with a destruction efficiency of 95 weight percent or greater or
- Minimum residence time of 0.5 second at a minimum temperature of 760 °C

What are the alternative requirements for incinerators ?

Process Vents

- Reduce incinerator exhaust to a concentration of 20 ppmv total organics or less

What are the requirements for flares ?

Process Vents

- No visible emissions
- Flame present at all times
- Net heating value requirements
- Exit velocity requirements

Note

Process Vents

- Design requirements for demonstrated control technologies are presented on page 3-20 in Attachment B of this session in your workshop manual

Process Vents

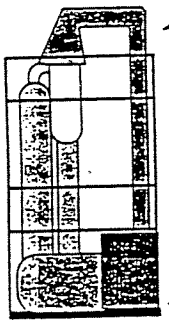
What are the owner/operator responsibilities for control devices ?

- Inspect readings from each monitoring device daily
- Immediately implement corrective measures, if necessary

Process Vents

What is a closed-vent system ?

Process Vents



- Ducts, pipes, connectors, and blowers which transport vapors or gases from equipment to a control device

What records have to be maintained ?

Process Vents

- Facility compliance documents
- Control device records

Facility compliance documents

Process Vents

- Waste stream determinations
- Emission rate determinations

Control device records

Process Vents

- Control device implementation schedule
- Design and operating information
- Control device exceedance records
- Information on alternative controls

Note

Process Vents

- Details on recordkeeping requirements provided on page 3-23 in Attachment C of this session in your workbook

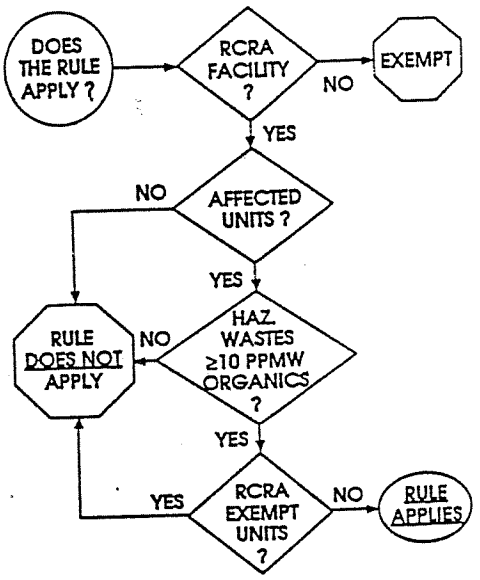
What reports have to be filed ?

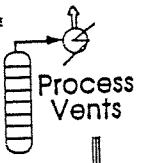
Process Vents

- Facilities with RCRA permits must report semiannually all exceedances > 24 hours
- Interim-status facilities are not required to report control device exceedances

Summary

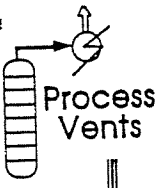
Applicability Decision Tree





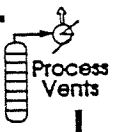
Summary

What are the emission rate limits ?



- Reduce total organic emissions from <u>all</u> affected process vents
  - Below 3 lb/hr <u>and</u> 3.1 ton/yr, or
  - By 95% after primary recovery

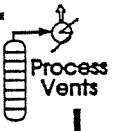
Attachment A - RCRA Exempt Units



Production Units

- Applies to hazardous wastes generated in production or process-related equipment
- Exemption applies until waste is removed from the unit, unless the waste remains in unit for > 90 days after operation ceases
- 40 CFR 261.4(c)

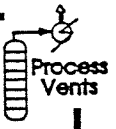
Attachment A - RCRA Exempt Units



Generator Accumulation Tanks

- Generators who accumulate waste in tanks or containers for < 90 days are excluded from permitting requirements
- 40 CFR 270 and 40 CFR 262.34

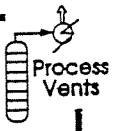
Attachment A - RCRA Exempt Units



Totally Enclosed Treatment Units

- Exempt from RCRA Subtitle C under
  - 40CFR 264.1(g)(5)
  - 40CFR 265.1(c)(9)
  - 40CFR 270.1(c)(2)

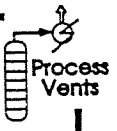
Attachment A - RCRA Exempt Units



Closed-Loop Reclamation Units

- 40 CFR261.4 amended to allow control of reclamation of hazardous wastes
- Amendments did not change closed-loop reclamation exemption in 40 CFR 261.4(a)(8)

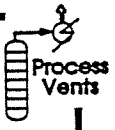
Attachment A - RCRA Exempt Units



Wastewater Treatment Units

- Units regulated under Section 402 or 307(b) of the Clean Water Act are not subject to RCRA Subtitle C standards
- 40 CFR 270.1(c)

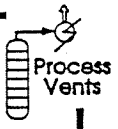
Attachment A - RCRA Exempt Units



Domestic Sewage Units

- Domestic sewage excluded from definition of solid waste
- Domestic sewage units are not subject to hazardous waste regulations
- 40 CFR 261.4(a)(1)

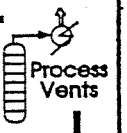
Attachment A - RCRA Exempt Units



Subtitle D Units

- Subtitle D wastes not subject to hazardous waste regulations
- Subtitle D wastes include hazardous wastes generated by conditionally exempt small-quantity generators

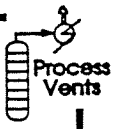
Attachment B - Control Device Design



Thermal Incinerators

- Minimum and average combustion zone temperature
- Combustion zone residence time
- 40 CFR 264.1035(b)(4)(iii)(A)

Attachment B - Control Device Design



Catalytic Incinerators

- Minimum and average temperature across the catalyst bed inlet and outlet
- 40 CFR 264.1035(b)(4)(iii)(B)

Attachment B - Control Device Design

Process Vents

Boilers and Process Heaters

- Minimum and average combustion zone temperature
- Combustion zone residence time
- Location of vent introduction into combustion zone
- 40 CFR 264.1035(b)(4)(iii)(C)

Attachment B - Control Device Design

Process Vents

Flares

- No site-specific design analysis required
- Flares must meet specified design and operation requirements (40 CFR 264.1033(d))
- 40 CFR 264.1035(b)(4)(iii)(D)

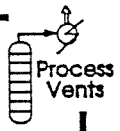
Attachment B - Control Device Design

Process Vents

Condensers

- Outlet gas organic concentration level
- Outlet gas temperature
- Coolant fluid inlet and outlet temperature
- 40 CFR 264.1035(b)(4)(iii)(E)

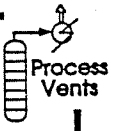
Attachment B - Control Device Design



Regenerable Carbon Adsorption Systems

- Outlet organic concentration level
- Number, type, and capacity of carbon beds
- Type and working capacity of activated carbon
- Total steam flow over regeneration cycle

Attachment B - Control Device Design



Regenerable Carbon Adsorption Systems (continued)

- Duration of the steaming and cooling/drying cycles
- Carbon bed temperature after regeneration
- Carbon bed regeneration time
- Design service life of activated carbon
- 40 CFR 264.1035(b)(4)(iii)(F)

Attachment B - Control Device Design

Nonregenerable Carbon Adsorption - Carbon Cannisters

- Outlet organic concentration level
- Carbon bed capacity
- Type and working capacity of activated carbon
- Carbon replacement interval
- 40 CFR 264.1035(b)(4)(iii)(G)

Attachment C - Recordkeeping

Process Vents

Compliance Documentation

Information and data to support:

- Waste determinations
- Identification of affected process vents
- Unit throughputs and operating hours
- Emission rate for each affected vent
- Emission rate for total facility
- Basis for determining emission rates

Attachment C - Recordkeeping

Process Vents

Control Device Implementation Schedule

- Dates for design, construction, and operation of control devices
- Schedule may allow 18 months for installation of control devices
- Must be in operating record on effective date
- 40 CFR 264.1035(b)(1)

Attachment C - Recordkeeping

Process Vents

Control Device Design Documentation

- Design analysis
- References and sources used
- Statement by owner/operator certifying device is designed for maximum emissions
- Statement by owner/operator certifying device is designed for 95% efficiency
- Performance test results
- 40 CFR 264.1033

Attachment C - Recordkeeping

Process Vents

Control Device Operating Records

- Description and date of each modification to closed-vent system or control device
- Identification of operating parameter to be monitored, description of monitoring device, and diagram of monitoring sensor locations
- 40 CFR 264.1035(c)

Attachment C - Recordkeeping

Process Vents

Control Device Exceedance Reports

- Must report periods when control device operates outside design tolerances
- Records include date, duration, cause, and corrective measures taken
- 40 CFR 264.1035(c)(5)

Attachment C - Recordkeeping

Process Vents

Control Device Exceedance Reports Thermal Incinerators

(Operating at 0.5 s and 760 °C)

- Periods when the combustion temperature is below 760 °C
- 40 CFR 264.1035(c)(4)(i)

Attachment C - Recordkeeping

Process Vents

Control Device Exceedance Reports Thermal Incinerators

(Operating at 95% or 20 ppmw)

- Periods when the combustion temperature is more than 28 °C below the design average temperature
- 40 CFR 264.1035(c)(4)(ii)

Attachment C - Recordkeeping

Process Vents

Control Device Exceedance Reports Catalytic Incinerators

- Periods when the vent stream temperature at the catalyst bed inlet is more than 28 °C below the design average temperature, or
- Periods when the temperature difference across the catalyst bed is less than 80% of the design average temperature difference
- 40 CFR 264.1035(c)(4)(iii)

Attachment C - Recordkeeping

Process Vents

Control Device Exceedance Reports Boilers and Process Heaters

- Periods when the combustion temperature is more than 28 °C below the design average temperature
- A change in the location where the vent stream is introduced to the combustion zone
- 40 CFR 264.1035(c)(4)(iv)

Attachment C - Recordkeeping

Process Vents

Control Device Exceedance Reports Flares

- Periods when the flame is not ignited
- 40 CFR 264.1035(c)(4)(v)

Attachment C - Recordkeeping

Process Vents

Control Device Exceedance Reports Condensers

with Temperature Monitors

- Periods when the temperature of the condenser exhaust is more than 6 °C above the design average temperature, or
- Periods when the temperature of the coolant fluid exiting the condenser is more than 6 °C above the design average temperature
- 40 CFR 264.1035(c)(4)(vii)

Attachment C - Recordkeeping

Process Vents

Control Device Exceedance Reports Carbon Adsorbers

Regenerated On-site with Concentration Monitors

- Periods when the organic concentration in the carbon bed exhaust is more than 20% greater than the design concentration
- 40 CFR 264.1035(c)(4)(viii

Attachment C - Recordkeeping

Process Vents

Control Device Exceedance Reports Carbon Adsorbers

Regenerated On-site with Fixed Regeneration Schedule

- Periods when the process vent stream continues to flow to the device beyond the predetermined bed regeneration time
- 40 CFR 264.1035(c)(4)(ix)

Attachment C - Recordkeeping

Process Vents

Information on Alternative Control Devices

- Owner/operator must record information indicating proper operation
- Regional administrator will specify appropriate recordkeeping requirements in permit negotiation process
- 40 CFR 264.1035(e)

EPA

EQUIPMENT LEAK STANDARDS

ABSTRACT: EQUIPMENT LEAK STANDARDS (SUBPART BB)

This session covers the organic air emission standards for equipment leaks at hazardous waste TSDFs codified in Subpart BB of 40 CFR Parts 264 and 265. The lesson is designed to provide a basic understanding of the equipment leak rules to aid RCRA permit writers and enforcement personnel in determining compliance and to aid facility owners and operators in achieving compliance.

The session begins with a review of the background of the equipment leak rules followed by a detailed presentation of the applicability of the rules. The control requirements are briefly summarized with references to the standards for details. Waste stream determinations for the purposes of applicability are covered in detail and the recordkeeping and reporting requirements are summarized. As is the case with the control requirements, references to the standard are provided for details of the recordkeeping requirements.

BIBLIOGRAPHY

1. "Hazardous Waste Treatment, Storage, and Disposal Facilities -- Organic Air Emission Standards for Process Vents and Equipment Leaks." Federal Register, Vol. 55 pages 25454-25519. June 21, 1990.

2. U.S. EPA, OAQPS, "Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF) -- Background Information for Promulgated Organic Emission Standards for Process Vents and Equipment Leaks," EPA-450/3-89-009, July 1990.

3. U.S. EPA, OAQPS. "Hazardous Waste TSDF - Technical Guidance Document for RCRA Air Emission Standards for Process Vents and Equipment Leaks." EPA-450/3-89-21. July 1990.

4. U.S. EPA, OAQPS. "RCRA TSDF Air Emissions - Background Technical Memoranda for Proposed Standards." EPA-450/3-86-009. October 1986.

5. "Hazardous Waste Treatment, Storage, and Disposal Facilities; Air Emission Standards for Volatile Organics Control." Federal Register, Vol. 52, pages 3748-3770. February 5, 1987.

6. U.S. Environmental Protection Agency. Fugitive Emission Sources of Organic Compounds--Additional Information on Emissions, Emission Reductions, and Cost. Research Triangle Park, NC. Publication No. EPA-450/3-82-010. April 1982.

7. U.S. Environmental Protection Agency, Air Pollution Training Institute, Research Triangle Park, NC 27711. "APTI Course SI:417 Controlling VOC Emissions from Leaking Process Equipment." EPA 450/2-82-015. August 1982.

Organic Air Emission Standards
for Equipment Leaks
at Hazardous Waste Treatment,
Storage, and Disposal Facilities

40 CFR Parts 264 and
265 Subpart BB

Purpose

- Provide basic understanding of Subpart BB equipment leak rules promulgated under Section 3004(n) of RCRA

Highlights

- Standards generally affect equipment contacting organic wastes
- Facilities may have hundreds of these potential sources
- Standards include leak detection and repair (LDAR) and specified equipment
- Compliance is demonstrated through the maintenance of records

Topics

- Background
- Applicability
- Waste stream determination
- Control requirements
- Recordkeeping requirements
- Reporting requirements
- Summary

Topics

- **Background**
- Applicability
- Waste stream determination
- Control requirements
- Recordkeeping requirements
- Reporting requirements
- Summary

Background

Subpart BB Equipment Leak Standards

- Promulgated June 21, 1990 (55 FR 25454)
- Effective date December 21, 1990

Background

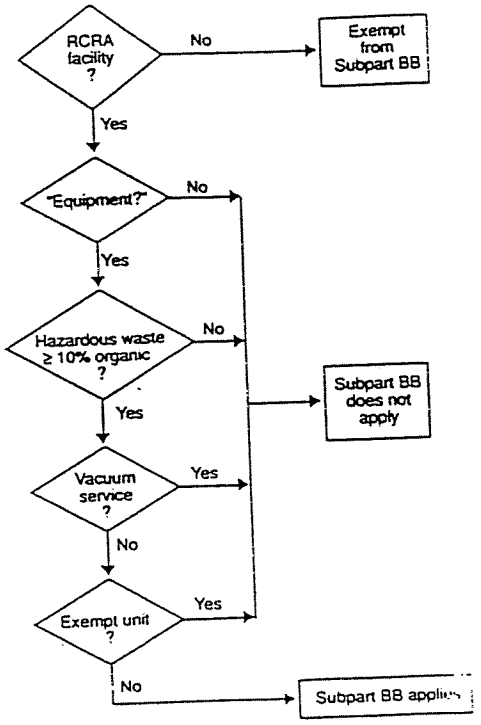
Standards

- Adopted from CAA standards for:
  - Benzene equipment leaks
  - SOCMI
  - Petroleum refineries
  - Coke oven by-product plants
- Revised to RCRA format
- Parts 264 and 265 rules identical except reporting is not required by Part 265

Topics

- Background
- **Applicability**
- Waste stream determination
- Control requirements
- Recordkeeping requirements
- Reporting requirements
- Summary

Applicability

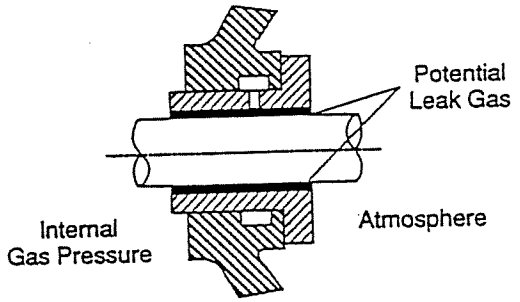


Applicability

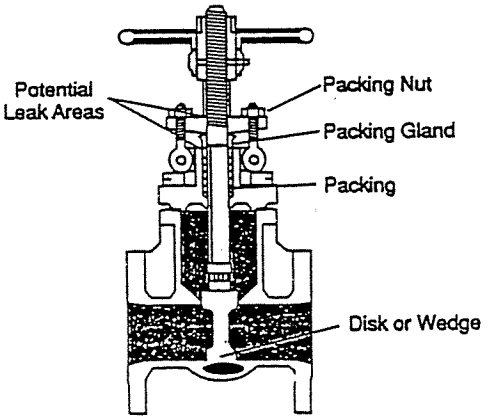
Equipment Covered by Subpart BB

- Pumps
- Valves
- Compressors
- Sampling connections systems
- Open-ended valves or lines
- Pressure-relief devices
- Flanges and other connectors

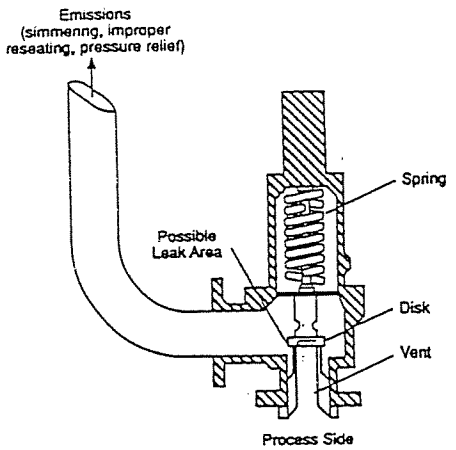
Labyrinth Shaft Seal for Compressors



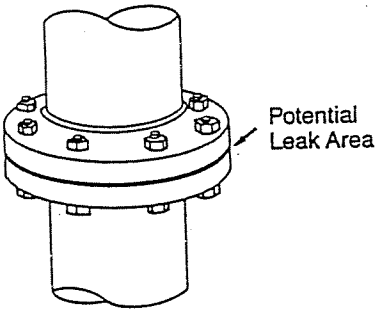
Rising Stem Gate Valve



Spring-Loaded Relief Valve



Flanged Joint



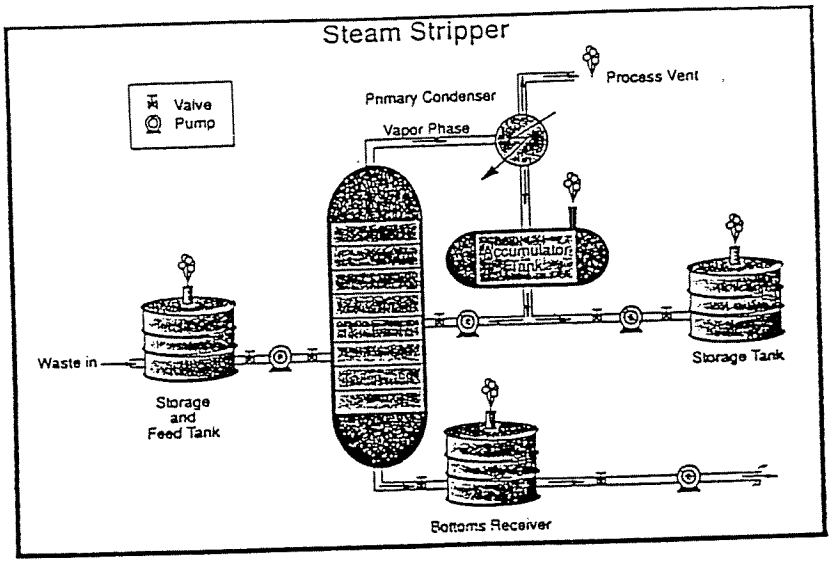
Leaks caused by

- Improperly chosen gaskets
- Damaged gaskets
- Poor assembly
- Vibrations

Applicability

Equipment

- Affected equipment is found in destruction or recycling/recovery processes; for example:
  - Incineration
  - Distillation
  - Solvent extraction
  - Steam stripper
  - Storage tanks for reclaimed organics



Topics

- Background
- Applicability
- **Waste stream determination**
- Control requirements
- Recordkeeping requirements
- Reporting requirements
- Summary

Waste Stream Determination

- Waste organic content at least 10% by weight
- Gas or liquid at operating conditions
- Liquid stream light or heavy liquid

Waste Stream Determination

Basis of Determinations

- Knowledge
- Analysis by direct measurement

Waste Stream Determination

Examples of Knowledge

- No organics used
- Identical to other process
- Prior speciation analysis with no process changes

Waste Stream Determination

Applicability of Organic Content Analytical Methods

Method	Compounds most applicable
ASTM E 260-85 (General GC analysis)	Multiple compounds
ASTM D 2267-88 (Aromatics by GC)	Benzene, toluene, C8, and heavier aromatics
Method 9060 (SW-846) (Total organic carbon [TOC])	Organic carbon greater than 1 mg/L
Method 8240 (SW-846) (Volatiles by gas chromatograph/mass spectrometer [GC/MS])	Generally used to measure Appendix VIII compounds in wastewaters, sludges, and soils
ASTM E 168-88 (Infrared [IR] analysis)	Single- or double-component systems
ASTM E 169-87 (Ultraviolet [UV] analysis)	Single- or double-component systems

Waste Stream Determination

Applicability of Organic Analytical Detectors

Method	Compounds most applicable
Flame ionization	All
Photoionization	Aromatics
Hall electrolytic conductivity device	Halogenated
Nondispersive infrared	Any compound with C-H bond
Mass spectrometer	All

Waste Stream Determination

Gaseous Waste Determination

- Gas at operating conditions

Example: Overhead stream from distillation prior to the condenser

Waste Stream Determination

Light/Heavy Liquid Determination

- A light liquid:
  - Is a liquid at operating temperatures
  - Contains compound(s) with vapor pressure >0.3 kPa (0.04 psia) at 20 °C (68 °F)
  - Total concentration of pure components with vapor pressure >0.3 kPa at 20 °C is greater than 20%
- All liquids not light liquids are heavy liquids.

Topics

- Background
- Applicability
- Waste stream determination
- **Control requirements**
- Recordkeeping requirements
- Reporting requirements
- Summary

Control Requirements

Work Practice

- Work practices are based on a leak detection and repair program (LDAR)
- LDAR varies by source type, but includes:
  - Leak detection monitoring
  - Inspections - visual and olfactory
  - Repair within a given time frame

Control Requirements

Leak Detection Monitoring with Method 21

- Portable total organic analyzer is used to locate leaks from valves, flanges, and pumps
- A leak is defined as 10,000 ppm, based on a reference compound
- The Subpart BB reference compound is methane or n-hexane
- A response factor must be determined for each compound to be measured

Control Requirements

Repairs

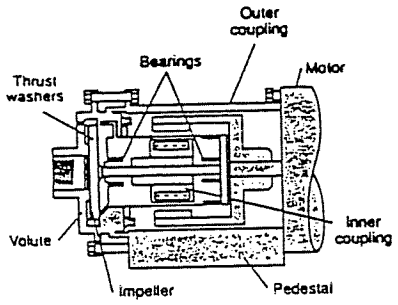
- The first repair attempt must be made within 5 calendar days of detecting leak
- Repair must be completed within 15 calendar days of detecting leak

Control Requirements

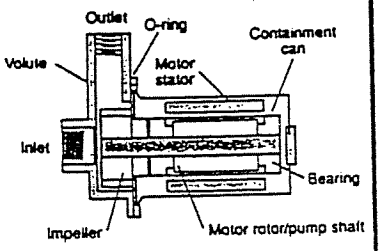
Emission Limits

- For equipment designed not to leak (e.g., no waste contact with external activating mechanisms)
- No detectable emissions (Method 21)
- Compliance test initially and at least annually

Sealless Pumps Can Be Designated for No Detectable Emissions

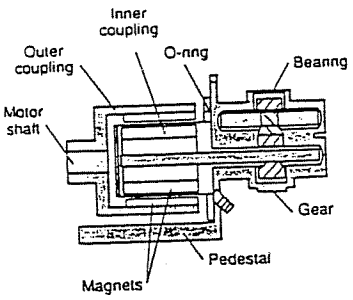


a. Magnetically coupled centrifugal pump

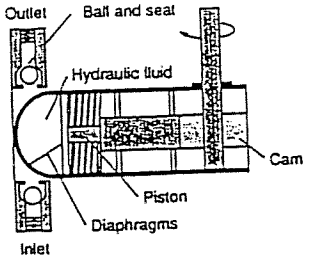


b. Canned motor centrifugal pump

Sealless Pumps Can Be Designated for No Detectable Emissions



c. Magnetically coupled gear pump



d. Hydraulically backed diaphragm metering pump

Control Requirements

Equipment Standards

- Specified equipment (dual seals, closed vents, caps, closed loop sampling)
- Checked by visual inspection and for detectable emissions (Method 21)
- Leaks must be repaired within 15 days

Control Requirements

Summary

Source	Service	Emission Limit		Equipment Specification		Work Practice
Pump	Light liquid	No detectable emissions	(or)	Dual seals, closed vent	(or)	Monthly monitoring (and) weekly inspection
	Heavy liquid	———		———		*
Valve	Gas & light liquid	No detectable emissions	(or)	———		Monthly monitoring
	Heavy liquid	———		———		*

*Monitoring is required if evidence of a leak is found.
☐ Indicates the primary control method.

Control Requirements

Summary (continued)

Source	Service	Emission Limit	Equipment Specification	Work Practice
Pressure-relief device	Gas	No detectable emissions	Closed vent	—
	Light & heavy liquids	—	—	*
Flange/ connector	Gas & light & heavy liquids	—	—	*

*Monitoring is required if evidence of a leak is found.
☐ Indicates the primary control method.

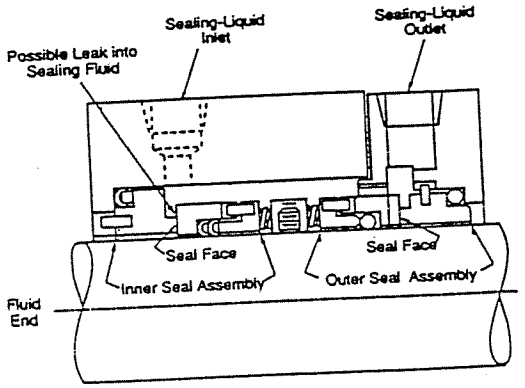
Control Requirements

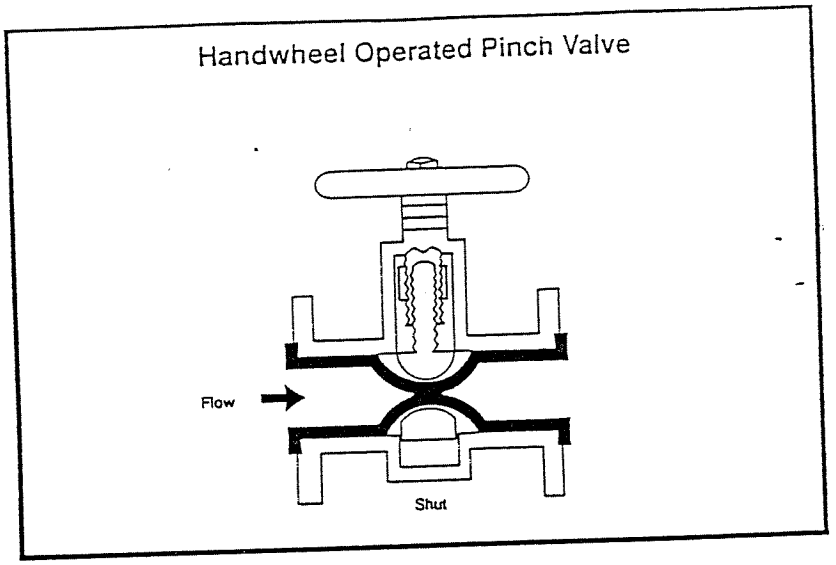
Summary (concluded)

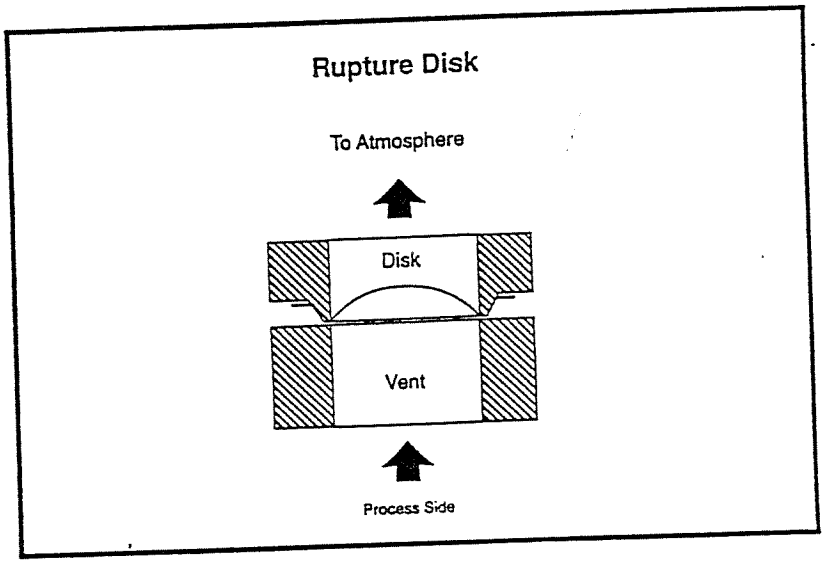
Source	Service	Emission Limit		Equipment Specification	Work Practice
Compressor	Gas	No detectable emissions	(or)	Seal system with barrier fluid, or closed vent	—
Sampling connection	Gas & light & heavy liquids	—		Closed-purge system or closed vent	—
Open-ended line	Gas & light & heavy liquids			Cap, plug, flange, or second valve	

☐ Indicates the primary control method.

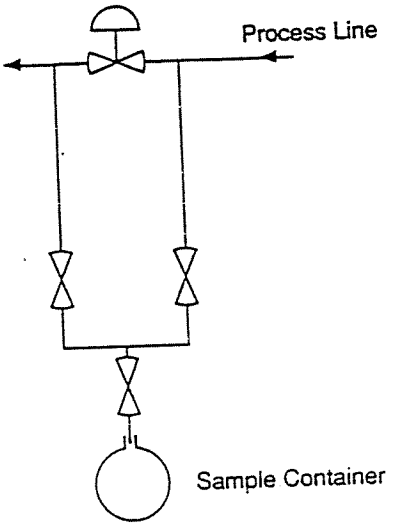
Double Mechanical Seal with Barrier Fluid Controls Emissions

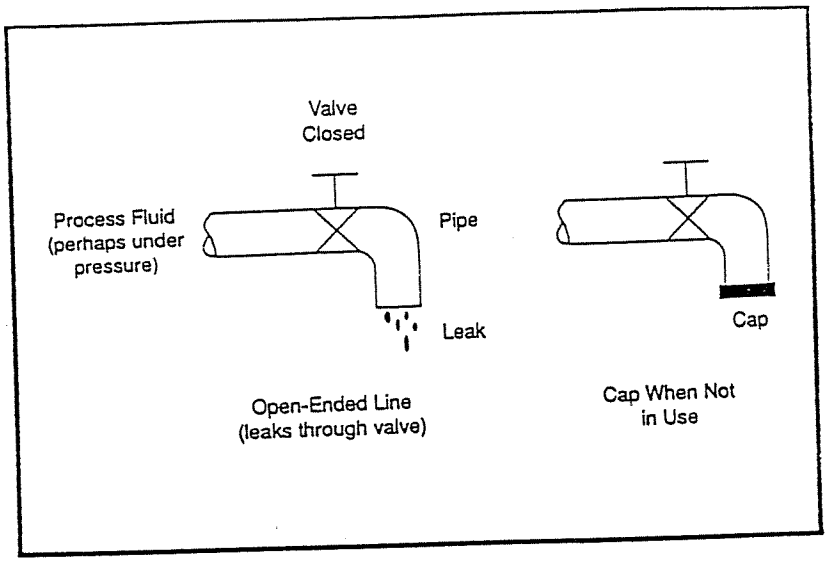






Closed-Loop Sampling System
(To Avoid Losses from Sampling)





Control Requirements

Equipment Leak Model Units

Model Unit	Pumps	Valves	Sampling Connections	Open-ended Lines	Pressure-relief Devices
A	15	364	26	105	9
B	5	121	9	35	3
C	3	72	5	21	2

Control Requirements

Equipment Leak Impacts

Model Unit	Emissions (Mg/yr)	Emission Reductions (Mg/yr)	Emission Reductions (%)	Capital Costs* ($)	Annual Costs* ($)
A	41.1	30.4	74	68,300	31,000
B	13.7	10.2	74	27,000	11,900
C	8.3	6.2	74	18,700	8,100
Nationwide	26,200	19,000	72.5	127 million	32.9 million

*Costs are in 1986 dollars.

Topics

- Background
- Applicability
- Waste stream determination
- Control requirements
- **Recordkeeping requirements**
- Reporting requirements
- Summary

Recordkeeping

Compliance with the control requirements of Subpart BB is demonstrated through the maintenance of records

Recordkeeping Requirements

General Records Required

- Equipment-specific identification information (Section 264.1064[b])
- Closed-vent system and control device information (Section 264.1064[e])
- Information on equipment not subject to monthly LDAR (Section 264.1064[g])

Recordkeeping Requirements

General Records Required
(continued)

- Marking of leaking equipment (Section 264.1064[c]).
- Information on leaking equipment (Section 264.1064[d])
- Barrier fluid system sensor information (Section 264.1064[j])
- Information for determining exemptions (Section 264.1064[k])

Recordkeeping Requirements

Records Retention

- Three years for records of:
  - Monthly leak monitoring and repair
  - Detectable emission monitoring
  - Closed-vent and control device operations
- Other records in the facility operating record must be kept for the life of the facility.

Topics

- Background
- Applicability
- Waste stream determination
- Control requirements
- Recordkeeping requirements
- Reporting requirements
- Summary

Reporting Requirements

Information Required in Semiannual Reports (264.1065)

- Control device exceedances uncorrected for >24 hours - dates, duration, cause, corrective measures
- Pumps in LL service, valves in G/LL service, compressors not repaired in 15 days
- No report required if no exceedances
- Facilities subject to interim status provisions, Part 265, are not required to report.

Topics

- Background
- Applicability
- Waste stream determination
- Control requirements
- Recordkeeping requirements
- Reporting requirements
- Summary

Summary

Equipment Leak Rules

- Equipment at new or existing TSDF requiring RCRA Subtitle C permit
- Equipment containing or contacting wastes with at least 10% organic
- Control requirements vary by type of service—gas, light liquid, heavy liquid
- Recordkeeping requirements to demonstrate compliance
- Semiannual reporting of exceedances

Summary

Types of Equipment Leak Standards

Sources	Equipment		Work Practice		Emission Limit
Pumps	●	(or)	●	(or)	●
Valves			●	(or)	●
Compressors	●	(or)			●
Sampling connection systems	●				
Open-ended valves or lines	●				
Pressure-relief devices			●		●
Flanges and other connectors			●		

EPA

PHASE II
AIR RULES

ABSTRACT: RCRA PHASE II RULEMAKING

Under the RCRA Phase II rulemaking, the U.S. EPA is developing new standards and amendments that would control more TSDF waste management units and add new requirements and implementation changes to the existing RCRA air emission standards under Subpart AA (TSDF treatment unit process vents) and Subpart BB (TSDF equipment leaks). A new Subpart CC would be added to 40 CFR Parts 264 and 265 requiring organic emission controls be applied to TSDF tanks, surface impoundments, containers, and certain miscellaneous units based on the volatile organic concentration of the waste managed in the unit. In addition, compliance with the air emission control requirements relevant to tanks and containers under Subparts AA, BB, and CC would be included as a condition to maintain a permit exemption for 90–day accumulation tanks and containers. Also, the U.S. EPA would amend 40 CFR 270.4 to require the owner or operator of an existing permitted TSDF to comply with the RCRA air emission standards for interim status facilities (40 CFR 265 Subparts AA, BB, and CC) until the facility's permit is modified or renewed. Finally, to be consistent with Subpart CC, the U.S. EPA would add to Subparts AA and BB requirements for managing spent carbon removed from carbon adsorbers.

Purpose

- Summarize the proposed Subpart CC control requirements
- Present other requirements proposed in the Phase II rulemaking

Highlights of Phase II Rulemaking

- Control more TSDF waste management units
- Based on volatile organic concentration of waste
- New requirements added and implementation changes for Subparts AA and BB

Outline

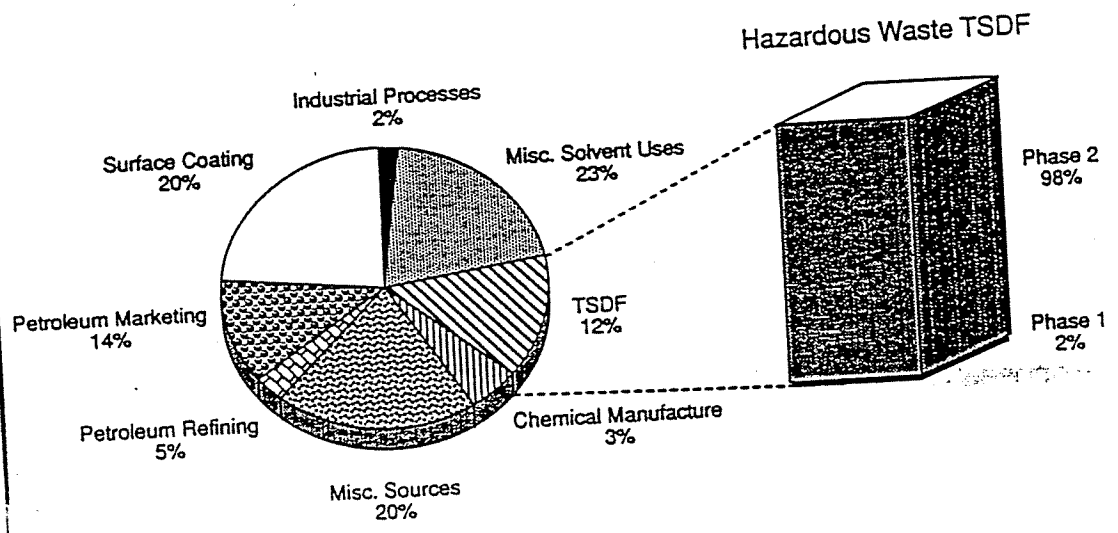
- Background
- Proposed Subpart CC Standards
- Proposed Test Methods
- Other Proposed Amendments
- Summary

Background

TSDF Organic Emissions

- Contribute to ambient ozone formation
  - 1.8 million megagrams per year of organics
- Impact public health
  - 140 cancer incidences per year nationwide
  - Maximum individual risk of cancer $= 2 \times 10^{-2}$
- Contribute to stratospheric ozone depletion

National VOC Emissions - Stationary Sources



Rulemaking Status

- Proposal
- Public hearing
- Public comment period ends
- EPA reviews and considers public comments
- Final rules promulgated

Outline

- Background
- **Proposed Subpart CC standards**
- Proposed test methods
- Other proposed amendments
- Summary

Proposed Subpart CC Standards

- Add air emission control requirements for more TSDF waste management units
- Same implementation as Subparts AA and BB
  - Subpart CC in Part 264 for permitted TSDF
  - Subpart CC in Part 265 for interim status TSDF
- Requirements identical except for reporting in Part 264

Subpart CC Standards

Applicability

- RCRA Subtitle C facilities
- Waste management units
  - Tanks
  - Surface impoundments
  - Containers
  - Miscellaneous units

Subpart CC Standards

Control Strategy

- Identify waste streams with significant emission potential
- Control waste from point where it is generated through treatment to remove or destroy organics
- Other rules establish treatment standards

Subpart CC Standards

Demonstration of Compliance

Either:

1. Install and operate organic emission controls

   or

2. Determine that waste managed in unit at all times has a volatile organic concentration <500 ppmw

   or

3. Certify that waste managed in the unit complies with Part 268 land disposal restrictions treatment standards for organics

Subpart CC Standards

Tanks

- Cover and vent to a control device
- Alternative controls:
  - External floating roof
  - Fixed roof with internal floating roof
- Control device not required for certain tanks:
  - Organic vapor pressure below certain limits, and
  - Waste managed in a "quiescent" manner

Subpart CC Standards

Surface Impoundments

- Cover and vent to a control device
- Control device not required when waste is managed in a "quiescent" manner

Subpart CC Standards

Containers – includes drums

- Cover
- Submerge fill pumpable waste
- Enclose and vent to a control device during certain waste treatment processes (e.g., waste fixation)

Subpart CC Standards

Miscellaneous Units

- Case-by-case determination based on similarity
- Comply with requirements in 40 CFR Subparts AA, BB, or CC
- Example:

  If → miscellaneous unit resembles a surface impoundment

  Then → comply with surface impoundment standards

Outline

- Background
- Proposed Subpart CC standards
- **Proposed test methods**
- Other proposed amendments
- Summary

Test Methods

Background

- Used to determine which waste streams require controls
- Focus on organics potentially emitted rather than total organics
- Does not measure specific organic compounds
- Methods would be added to both:
  - 40 CFR 60 Appendix A
  - "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (SW-846)

Test Methods

Volatile Organic Concentration

- Reference Method 25D/Test Method 5100
- Procedure:
  1. Collect representative samples; minimizing loss of volatiles
  2. Heat sample and purge with nitrogen
  3. Analyze purged stream for carbon, as methane, and halogens, as chloride
  4. Sum methane mass and chloride mass

Test Methods

Organic Vapor Pressure

- Reference Method 25E/Test Method 5110
- Procedure:
  1. Collect representative samples
  2. Analyze head space vapor for carbon as propane
  3. Calculate vapor organic pressure from measured propane concentration

Outline

- Background
- Proposed Subpart CC standards
- Proposed test methods
- **Other proposed amendments**
- Summary

Proposed Amendments

- Add new requirements and implementation changes to Subparts AA and BB
- Affect:
  - 90-day accumulation of hazardous waste
  - Implementation of RCRA air rules
  - Management of spent carbon from carbon adsorbers

90-Day Accumulation

Current Requirements

- Generator tanks and containers accumulating waste for 90 days or less
- Exempt from the permitting requirements if comply with certain conditions in 40 CFR 262.34(a)
- Conditions include compliance with:
  - 40 CFR 265 Subpart I for containers
  - 40 CFR 265 Subpart J for tanks

90-Day Accumulation

Proposed Requirements

- Add air emission control requirements to maintain permit exemption
- Amend 40 CFR 265 Subparts I and J
- Conditions for exemption for a tank or container would include compliance with relevant requirements in Subparts AA, BB, and CC

RCRA Rule Implementation

Current Practice for New RCRA Rules

- Interim status TSDF comply by rule's effective date
- Permitted TSDF comply when the facility's permit is modified or renewed

RCRA Rule Implementation

Proposed Implementation of RCRA Air Rules

- Change implementation practice for Subparts AA, BB, and CC by amending 40 CFR 270.4
- Would require compliance by rule's effective date regardless of permit status

"Permit to k Shield"

RCRA Rule Implementation

Proposed Implementation of RCRA Air Rules (continued)

- TSDF with a permit issued **before** effective date would comply with the Part 265 standards until the facility's permit is modified or renewed
- TSDF with a permit issued or renewed **after** effective date would comply with the Part 264 standards

Spent Carbon

Current Management

- Activated carbon periodically replaced
- Spent carbon saturated with organics
- No environmental benefit if the organics adsorbed on spent carbon are released to the atmosphere

Spent Carbon

Proposed Management Requirements

- Add requirements requiring offsite regeneration, reactivation, or disposal be controlled
- Amend Subparts AA and BB to be consistent with Subpart CC

Spent Carbon

Proposed Management Requirements (continued)

- Would require certification that spent carbon is managed in either:
  1. Regeneration/reactivation process that minimizes air emissions

     or

  2. Incinerator complying with 40 CFR 264 Subpart O

266
waste fuel

Outline

- Background
- Proposed Subpart CC standards
- Proposed test methods
- Other proposed amendments
- Summary

Summary

- Establish air emission standards for TSDF tanks, surface impoundments, containers, and miscellaneous units
- Require organic emission controls be applied to waste streams with volatile organic concentration ≥500 ppmw
- Add new waste test methods to determine volatile organic concentration and organic vapor pressure

Summary
(continued)

- Add compliance with relevant air emission control requirements under Subparts AA, BB, and CC to maintain permit exemption for 90-day tanks and containers
- Require permitted TSDF comply with Subparts AA, BB, and CC under Part 265 until the facility's permit is modified or renewed
- Add spent carbon management requirements to Subparts AA and BB consistent with Subpart CC

EPA

RCRA OVERVIEW

RCRA Overview–Purpose

- Summarize RCRA
- Discuss structure of Subtitle C program
- Review goals of Subtitle D program
- Provide context for TSDF air emission rules

RCRA Overview – Highlights

- RCRA – The Act
- Subtitle C – Hazardous Waste

40 CFR Parts addressing TSDF air emissions:	
264	Permitted TSDF standards
265	Interim status TSDF standards
270	Permit program

- Subtitle D – Solid Waste (nonhazardous)

RCRA Overview–Outline

1. RCRA Overview
   - RCRA Orientation Video Segment 1 "Introduction to RCRA" (12 minutes)
2. Subtitle C - Structure and Operation
3. Relationship of 3004(n) Standards to Other RCRA Rules
4. Additional RCRA Air Standards

Resource Conservation and Recovery Act (RCRA)

Title II – Solid Waste Disposal

Subtitle C – Hazardous Waste Management

RCRA Subtitle C – Hazardous Waste Management

A Federal "cradle-to-grave" system to manage hazardous waste
Statutes and regulations for hazardous waste:

- Identification and listing of hazardous waste
- Generators
- Transporters
- Treatment, storage, and disposal facilities
- Permitting
- Enforcement
- State authorization

RCRA Hazardous Waste Program – Title 40, Code of Federal Regulations

40 CFR Part	Title
260	Hazardous waste management system: general
261	Identification and listing of hazardous waste
262	Standards applicable to generation of hazardous waste
263	Standards applicable to transporters of hazardous waste
264	Standards for owners and operators of hazardous waste treatment, storage, and disposal facilities
265	Interim status standards for owners and operators of hazardous waste treatment, storage, and disposal facilities

RCRA Hazardous Waste Program – Title 40, Code of Federal Regulations (continued)

40 CFR Part	Title
266	Standards for the management of specific hazardous wastes and specific types of hazardous waste management facilities
267	Interim status standards for owners and operators of new hazardous waste land disposal facilities
268	Land disposal restrictions
270	EPA-administered permit programs: the hazardous waste permit program
271	Requirements for authorization of State hazardous waste programs
124	Procedures for decisionmaking

Waste Classifications

- Definition of solid waste
- Definition of hazardous waste
- Exclusions to definitions

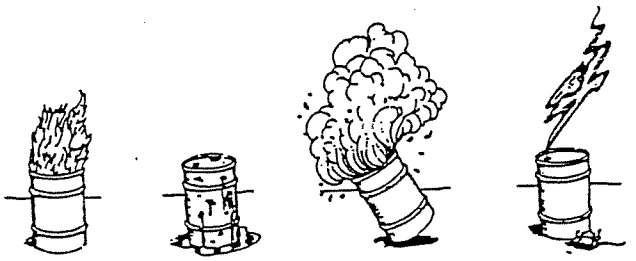
Hazardous Waste Definition

- Characteristic wastes
- Listed wastes
- Mixture rule wastes
- Derived from rule wastes

Hazardous Waste Characteristics

- Define characteristics in terms of
  - Physical,
  - Chemical, or
  - Other hazardous waste properties
- Measure properties by standardized and available testing protocols

Hazardous Waste Characteristics (con.)



Characteristic	Ignitable	Corrosive	Reactive	Toxic*
RCRA Code	D001	D002	D003	D004 - D043

*Toxicity characteristic leaching procedure (effective 9/29/90).

Hazardous Waste Listings

Category	RCRA Codes
Nonspecific industry sources	F__
Specific industry sources	K__
Commercial chemical products, manufacturing chemical intermediates, and contaminated soils and cleanup materials	P__ and U__

RCRA Waste Codes

F001 - F028 Wastes from Non-Specific Sources

Examples:

- Spent halogenated degreasing solvents (F001)
- Sludges from electroplating (F006)

RCRA Waste Codes

K001 - K136 Wastes from Specific Sources

Examples:

- Oil emulsion solids from petroleum refining (K049)
- Wastewater sludge from toxaphene production (K041)

RCRA Waste Codes

P001 - 122 and U001 - 359 Discarded/Offspec Chemical Products/Species

Examples:

- Container residue - dieldrin (P037)
- Spill residue - pyridine (U196)

Generators

- Facility owner or operator or person who first creates a hazardous waste

  or

- Person who first makes the waste subject to Subtitle C regulations:
  - Combines hazardous wastes
  - Imports hazardous waste

Generators (con.)

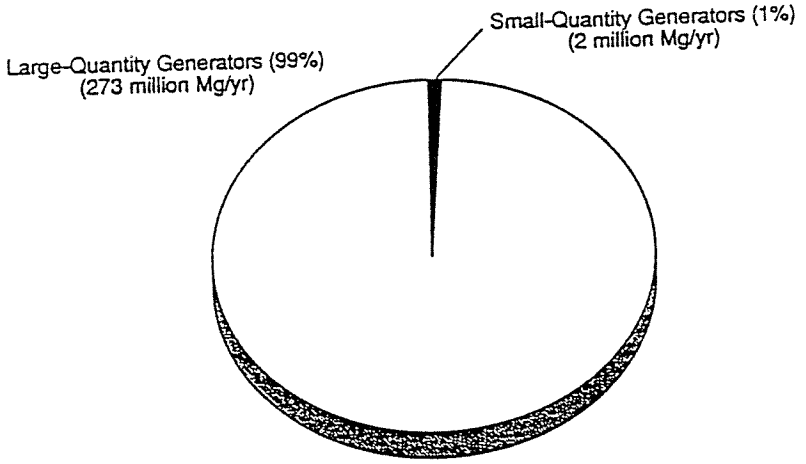
- Three categories:
  - Large-quantity generators → greater than 1,000 kg/mo
  - Small-quantity generators → 100 to 1,000 kg/mo
  - Conditionally exempt small-quantity generators → less than 100 kg/mo, or less than 1 kg/mo if acutely hazardous

Generators (con.)

- EPA identification numbers
- Pretransport requirements
- Manifests for shipments
- Recordkeeping and reporting
- Hazardous waste accumulation time
  - No permit required if accumulated less than
    - 90 days – large-quantity generators
    - 180 or 270 days – small-quantity generators
    - No time limit – conditionally exempt small-quantity generators

Hazardous Waste Generator Statistics

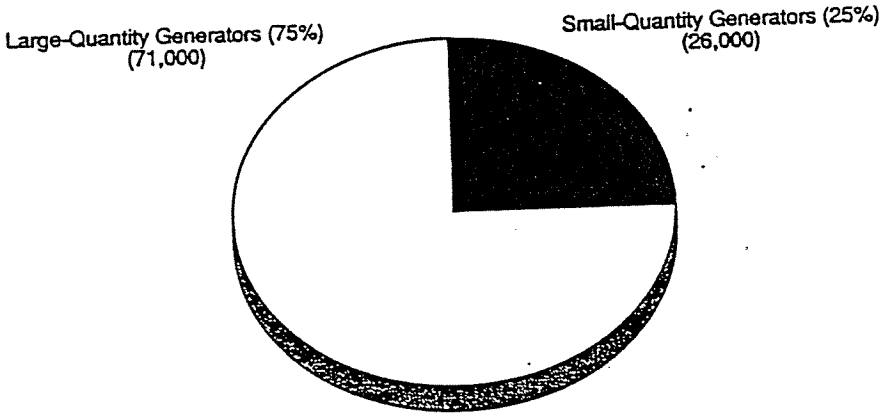
Waste Quantity by Generator Size



Source: EPA OSWER, The Hazardous Waste System, June 1987.

Hazardous Waste Generator Statistics

Number of Generators by Generator Size



Source: EPA Office of Solid Waste, April 1984 and June 1986.

Transporters

- EPA identification number
- Marking, labeling, packaging, placarding, and spill reports
- Manifest system
- Handling hazardous waste discharges
- Storage more than 10 days – RCRA storage permit

Basic Permitting Requirements

- Any facility that treats, stores, or disposes of hazardous waste must have a permit
- Permit exemptions limited to:
  - Generator accumulation time
  - Emergency situations
  - Imminent and substantial endangerment situations

Interim Status Standards

- Applies to facilities not yet permitted
- To qualify for interim status, a facility must:
  - Exist when it becomes subject to permit requirements
  - Notify EPA under RCRA Section 3010
  - Submit Part A permit application which
    - Describes waste types and quantities
    - Identifies waste management processes

Interim Status is Temporary!

- Available only until the final permit decision

Interim Status Standards (con.)

- Self-implementing
- Administrative standards (apply to all facilities):
  - Waste analysis plan
  - Personnel training program
  - Contingency plan
  - Manifest system
  - Closure and post-closure plans
  - Financial responsibility

Interim Status Standards (con.)

- Technical standards address specific types of units:
  - Containers
  - Tanks
  - Surface impoundments
  - Wastepiles
  - Landfills
  - Land treatment units
  - Incinerators
  - Thermal treatment units
  - Chemical, physical, and biological treatment

Components of a Permit

- General facility standards
  - Security
  - Inspection
  - Personnel training
  - Location standards
  - Preparedness and prevention
  - Manifest system
  - Recordkeeping and reporting

Components of a Permit (con.)

- Waste analysis plan
- Contingency plan
- Training plan
- Closure plan
- Post-closure plan
- Corrective action schedule of compliance
- Air emissions

Components of a Permit (con.)

- Unit-specific standards
  - Containers
  - Tanks
  - Surface impoundments
  - Wastepiles
  - Landfills
  - Land treatment units
  - Incinerators
  - Miscellaneous units (Subpart X)

RCRA Permit Process – Key Steps

- Applicant submits Part B permit application
- EPA reviews application
- EPA prepares draft permit
- EPA issues public notice to local newspapers and radio stations
  - Notice of draft permit, or
  - Notice of intent to deny permit

RCRA Permit Process – Key Steps (con.)

- EPA allows 45-day comment period
- EPA holds public hearing, if requested
- EPA issues final decision and responds to comments
- Public appeals decision (if desired)

Statutory Deadlines for Permitting

Waste Management Process	Application Due	Agency Decision
Land disposal facilities	11/85	11/88
Incinerators	11/86	11/89
Storage/treatment and miscellaneous units (Subpart X)	11/88	11/92

Land Disposal Restrictions

- Requires treatment prior to land disposal
- Exception
  - Case-by-case petition demonstrating no migration from disposal unit
  - Treatability
  - National treatment capacity
  - Surface impoundment exemption
- 2-Year variance where no treatment capacity exists

Relationship of 3004(n) Standards to Other Rules

- Hazardous waste toxicity characteristic
- Land disposal restrictions (LDR) under Section 3004(m)
- Corrective action under Section 3004(u)
- CERCLA/SARA

Toxicity Characteristic

Background

- RCRA interprets "hazardous" characteristic as:
  - Ignitable
  - Reactive
  - Corrosive
  - Toxic
- 40 Toxic organic and inorganic compounds and elements
- Concentration-based limits for toxicity characteristic leaching procedure
- Effective date = September 25, 1990

Toxicity Characteristic

Relation to Section 3004(n) Standards

- Increases the volume of waste managed as hazardous

Land Disposal Restrictions

- Implementation of restrictions

Solvents and dioxins	November 8, 1986
California list	July 8, 1987
First third scheduled wastes	August 8, 1988
Second third scheduled wastes	June 8, 1989
Third third scheduled wastes	May 8, 1990
Newly listed wastes (post-1984)	LDR determination 6 months after listing

40 CFR 271 – Requirements for Authorization of State Hazardous Waste Programs

Procedures to grant States authority to administer RCRA in lieu of Federal authority.

Standards Development under Section 3004(n)

Phase I
- Total organics
- Process vents and equipment leaks
- Promulgated 6/21/90 (55 FR 25454)

Phase II
- Total organics
- Tanks, surface impoundments, containers and miscellaneous units

Phase III
- Individual constituent standards, as needed, to supplement Phase I and Phase II standards

Land Disposal Restrictions

Background

- Treatment required before land disposal
- Land disposal units include:
  - — Landfills
  - — Surface impoundments
  - — Wastepiles
  - — Land treatment units
  - — Underground injection wells
- Final effective date = May 8, 1990
- Surface impoundments (treatment) exempt if dredged annually

Land Disposal Restrictions

Air Emissions Reduced by Land Ban

Organic Emission Sources	Yes	No
Tanks		√
Containers		√
Process vents		√
Equipment leaks		√
Miscellaneous units		√
Surface impoundments		√
Landfills	√	
Land treatment units	√	
Wastepiles	√	
Underground injection wells	√	

Land Disposal Restrictions

Impact on TSDF Air Emissions

- Treatment can cause cross-media air emissions
- Treatment reduces air emissions from land disposal units

Land Disposal Restrictions

Relation to TSDF Air Standards

- Phase I addresses LDR treatment process emissions
- Phase II suppresses emissions to LDR treatment unit for removal or destruction

Corrective Action

Background

- Addresses constituent releases to air, water, and soil
- Applies to hazardous and solid waste management units at TSDF
- Establishes site-specific compliance standards for releases to each media

Corrective Action

Relation to Section 3004(n) Air Standards

- Corrective action units must comply with air rules
- Corrective action relies on Section 3004(n) for control of organic emissions

CERCLA/SARA

Background

- Authorizes EPA to "remove" and "remediate" hazardous substance releases
- "Removal"—short-term action to minimize exposure
  Example: cleanup of a transportation spill
- "Remediation"—long-term action to provide permanent remedy

CERCLA/SARA

Criteria

- Site-specific
- 10^{-6} target risk
- Meet ARARs

CERCLA/SARA

ARARs – "Applicable or Relevant and Appropriate Requirements"

- "Applicable" requirements - rules applicable to CERCLA actions
- "Relevant and appropriate" requirements - rules not applicable but similar

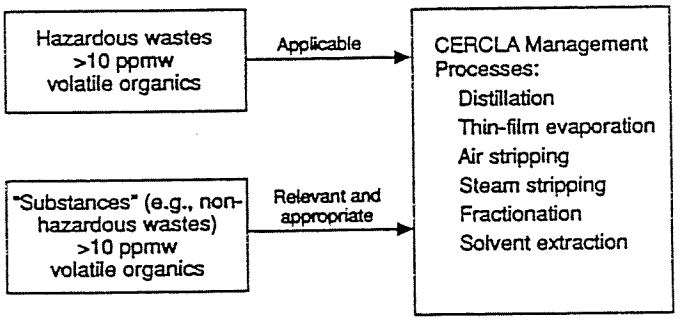
CERCLA/SARA

ARARs – Relation to TSDF Air Standards

- Phase I may be ARARs for certain processes
- Phase II when promulgated may be ARARs for certain processes
- Hazardous waste generated at CERCLA sites would be managed at TSDF (under air standards)

CERCLA/SARA

ARARS — Potential Relation to TSDF Air Standards



CERCLA/SARA

ARARs – Relation to TSDF Air Standards

- Phase I process vent standards are neither "applicable" nor "relevant and appropriate" to:
  - — Soil excavation
  - — In situ steam stripping of soil
  - — In situ stabilization
  - — In situ soil vapor extraction
  - — Soil washing
  - — Bioremediation
  - — Low-temperature thermal desorption

Additional RCRA Air Standards

Currently Regulated

Land disposal units (particulates)

Incinerators

Miscellaneous units (general)

Thermal treatment units
(interim status TSDF only)

Boilers and industrial furnaces

Land Disposal Units

40 CFR 264/265, Subparts L, M, & N

- General design and operating practices to limit particulates
- Applicable to:
  - Wastepiles
  - Land treatment units
  - Landfills
- Guidance document:
  Hazardous Waste TSDF—Fugitive Particulate Matter Air Emissions Guidance Document, May 1989
  (EPA 450/3-089-019, NTIS No. PB 90103250)

Incinerators

40 CFR 264/265, Subpart O

- Performance standard:
  99.99% Destruction and removal efficiency for principal organic hazardous constituents
- Air emission limits on:
  - Hydrochloric acid
  - Particulates
  - Carbon monoxide
- Revised risk-based regulations proposed in April 1990

Miscellaneous Units
40 CFR 264, Subpart X

- Must prevent air releases that adversely affect human health and the environment

Thermal Treatment Units
40 CFR 265, Subpart P

- Interim status facilities only
- Requires monitoring for:
  - Visible emissions
  - Operating conditions
- Prohibits open burning (except for explosives)

Boilers and Industrial Furnaces
40 CFR, Part 266

- Proposed — 52 FR 16987 (May 6, 1987)
- Performance standard:
  99.99% Destruction and removal efficiency for principal organic hazardous constituents
- Air emission limits on:
  - Carbon monoxide
  - Metals
  - Hydrochloric acid

Case Study: Measuring and Estimating Emissions

Measure or Estimate?

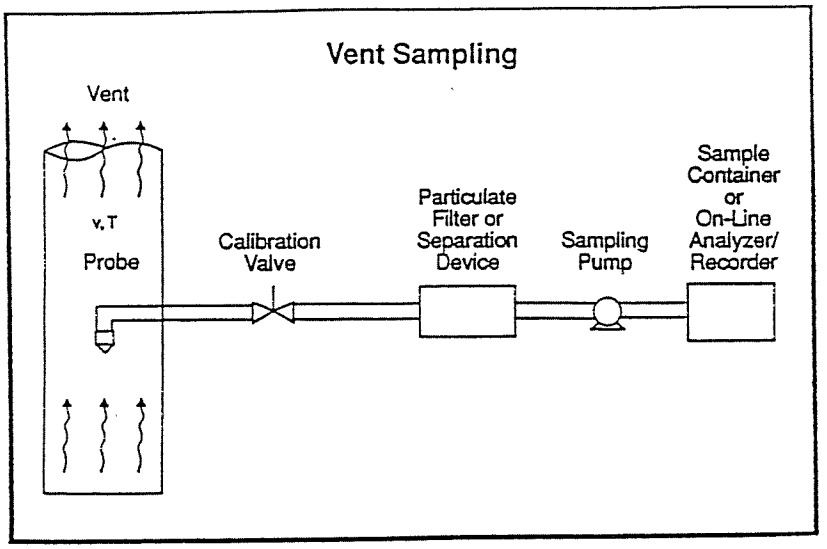
- Sources to be constructed
- Enclosed vented sources
- Accuracy that can be obtained
- Is upper bound sufficient?
- Variability (waste, operation, weather)
- Cost and timing

Emission Measurements

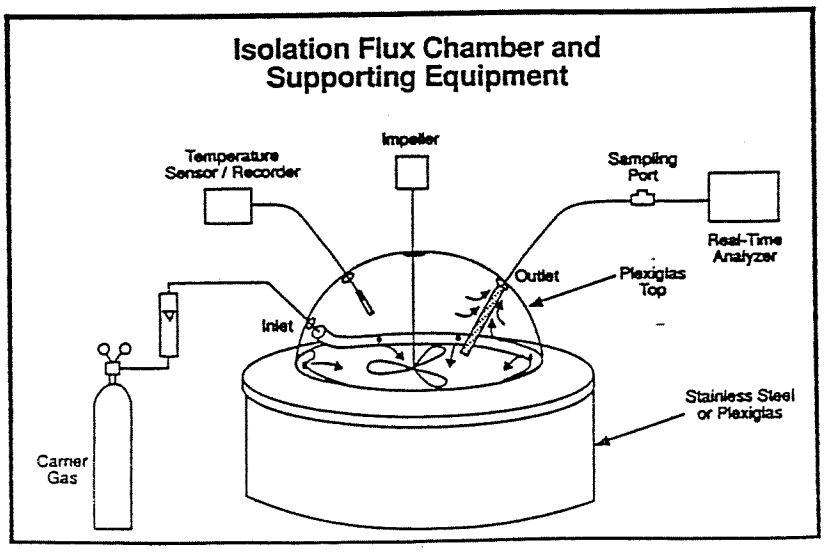
- Direct measurement
- Indirect measurement
- Engineering calculation

Direct Measurement

- Vent sampling
- Isolation flux chamber



Sampling Approach	Applicable to TSDF Emission Sources
Vent sampling	Vented treatment systems Vented landfills Vented storage buildings Storage tanks Solvent recovery



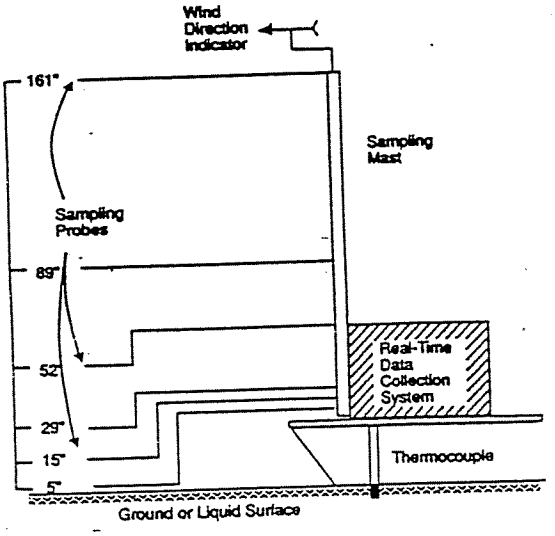
Sampling Approach	Applicable to TSDF Emission Sources
Isolation flux chamber	Active landfills Inactive landfills Surface impoundments Land treatment Cracks on landfill cap Vents

Indirect Measurement

- Concentration—profile technology
- Transect technology

Concentration-Profile Technology

log spacing



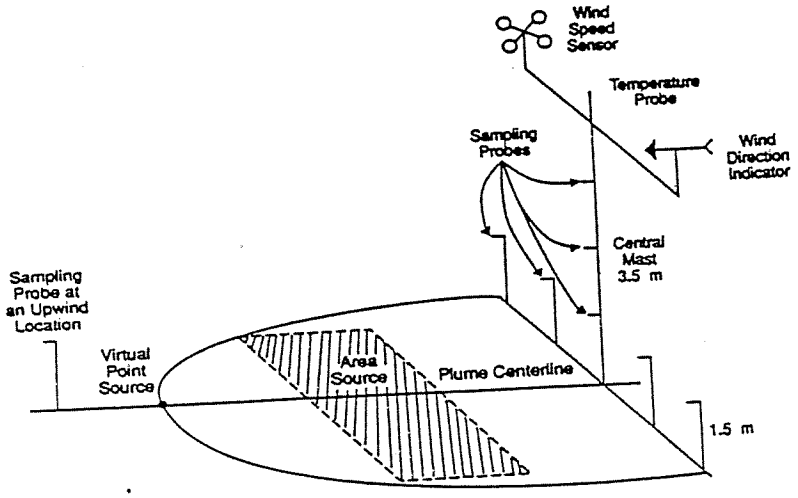
Sampling Approach	Applicable to TSDF Emission Sources
Concentration — profile technology	Surface impoundments Land treatment

Concentration Profile Technology

- Not suitable for quiescent or unstable wind conditions
- Not applicable to heterogeneous site with many different emission sources

Transect Technology

Plume Mapping

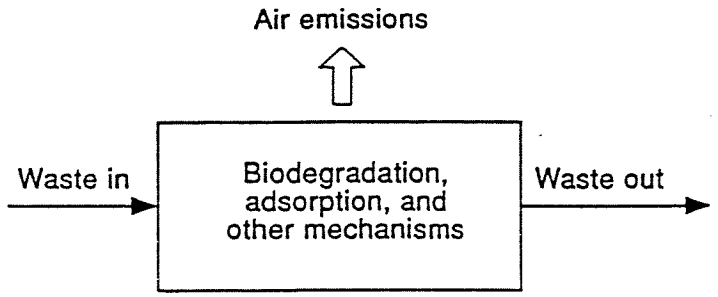


Sampling Approach	Applicable to TSDF Emission Sources
Transect technology	Active landfills Surface impoundments Land treatment Drum storage area

Transect Technology

- Not suitable for quiescent or unstable wind conditions
- Applicable to disturbed and undisturbed area sources
- Applicable to heterogeneous site

Mass Balance Approach



Sampling Approach	Applicable to TSDF Emission Sources
Mass balance	Solvent recovery process Surface impoundments Land treatment Wastewater treatment

Mass Balance Approach

- Accuracy limited by precision of measurements
- Difficult for non-steady-state and heterogeneous waste streams
- Other competing mechanisms should be quantified

Emission Measurements

PROS	CONS
• Site-specific results	• Affected by site and ambient conditions
• Standardized methods	• Cost
• Reasonable precision	• Time requirements
	• Sensitivity varies

Tracer Gas to [illegible]

[illegible]

Estimating Emissions

- Overview
- Models for open liquid surfaces
  - Wastewater treatment tanks
  - Surface impoundments
- Models for porous solids
  - Land treatment
  - Landfills
  - Waste piles

Overview

Why Use Models?

- Evaluate estimates or measurements
- Sources to be constructed
- Measurements impractical or inaccurate
- Understand factors affecting emissions
- Sensitivity analysis: bounds on estimates
- Environmental and health impact analyses

Overview

Modeling Limitations

- Real system always more complex
- Uncertainties and effect on accuracy
- Availability of inputs
  - Parameters describing system
  - Variables (e.g., waste, process)

Overview

Volatility

- Concentration in vapor/concentration in waste
- Henry's law constant for aqueous wastes
- Measured data available for some compounds
- Approximated by vapor pressure/solubility
- For organic liquids, estimate volatility from vapor pressure and mol fraction in liquid

Overview

Examples of Volatility with Equal Volume of Vapor and Waste

- Benzene dissolved in water
  - 20% in vapor
  - 80% in water
- Benzene dissolved in oil
  - 0.2% in vapor
  - 99.8% in oil
- Phenol dissolved in water
  - <0.002% in vapor
  - 99.998+% in water

Overview

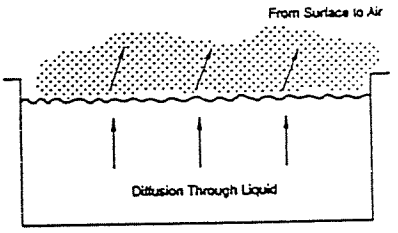
Emission Potential

- Quantity of waste, Q
- Concentration of organics **entering** source, C
- Potential emissions = Q x C
- Models estimate fraction emitted, f
- Emissions = Q x C x f

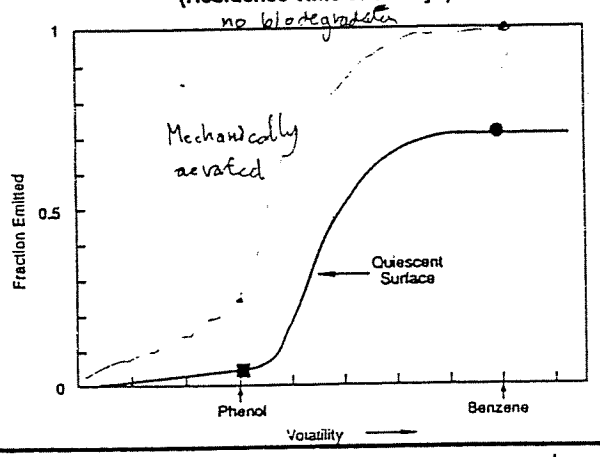
Open liquid surfaces

Modeling Approach

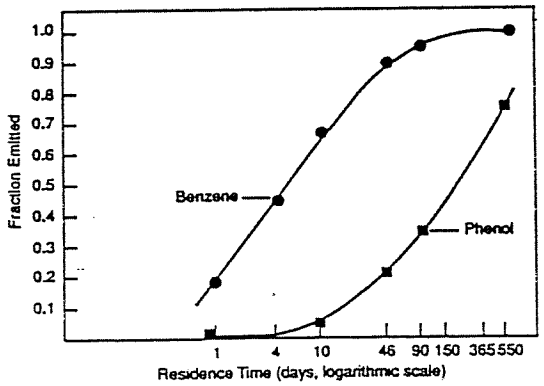
- Two mechanisms in series
  - Through liquid to surface
  - From surface to air
- Rate-controlling step
  - Liquid phase
  - Gas phase
- Other removal mechanisms
  - With effluent
  - Biodegradation
  - Sludge



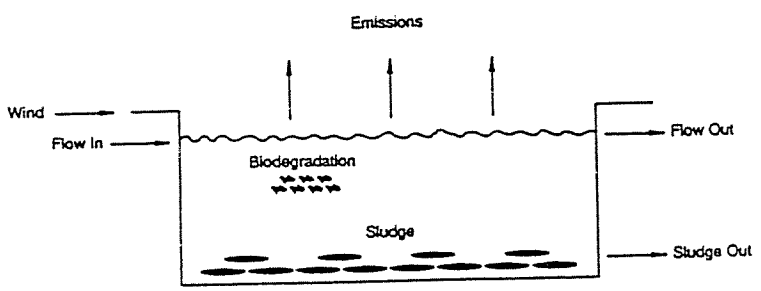
Effect of Volatility on Emissions from a Surface Impoundment
(Residence Time of 10 days)



Effect of Residence Time on Emissions from an Impoundment



Fate of Organics: Emissions, Effluent, Biodegradation, Sludge



Open liquid surfaces

Mass Transfer Correlations (Calm Surfaces)

- Liquid-phase mass transfer
  - Diffusivity in liquid
  - Wind speed
  - Fetch/depth
- Gas-phase mass transfer
  - Volatility
  - Diffusivity in air
  - Wind speed
  - Diameter

Open liquid surfaces

Mass Transfer Correlations (Turbulent Surfaces)

- Developed for mechanical aeration
- Major parameters
  - Power (hp) to aerators
  - Diffusivities
  - Impeller diameter and speed.
- Combine for calm and turbulent
  - Fraction of area that is calm
  - Fraction that is turbulent
  - Weight coefficient based on fractions

Open liquid surfaces

Biodegradation Model

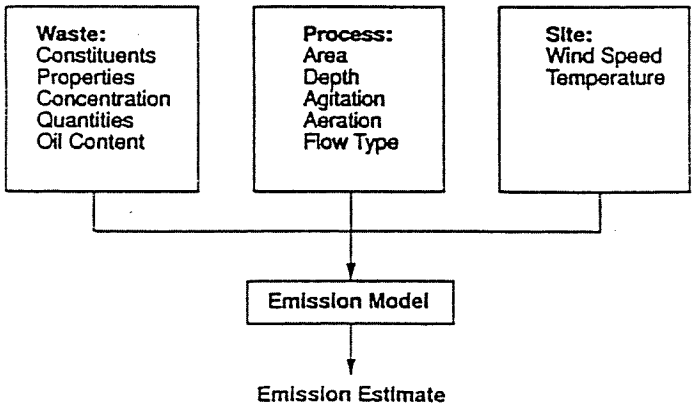
- Monod kinetics
- Effect of concentration
- Biomass concentration
- Data available for many compounds

Open liquid surfaces

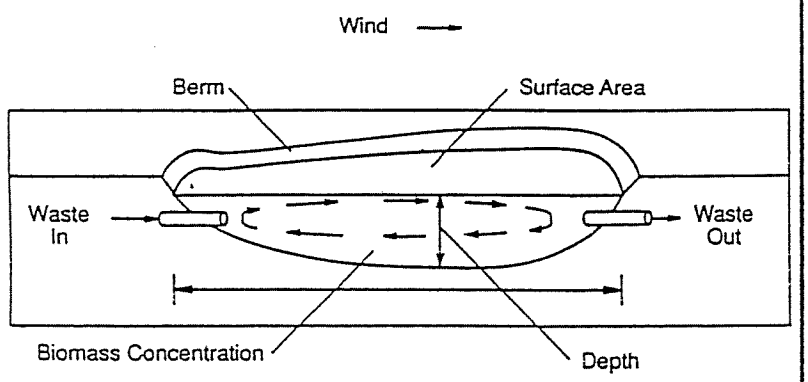
Special Cases

- Plug flow vs. well mixed
- Oil-film surface
- Diffused-air aeration
- Disposal impoundment

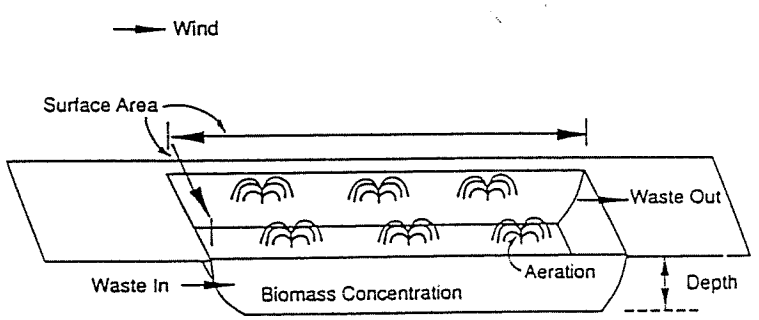
Typical Model Inputs (Liquid Surfaces)



Model Inputs for a Surface Impoundment



Model Inputs for an Aerated Lagoon

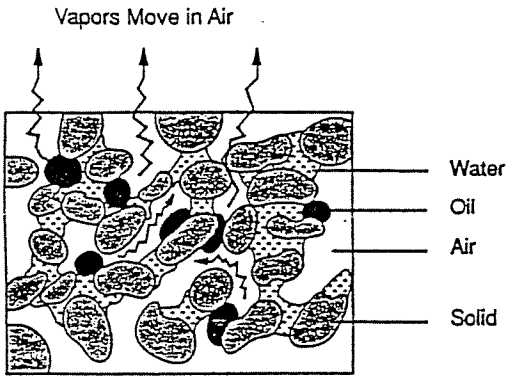


Porous solids

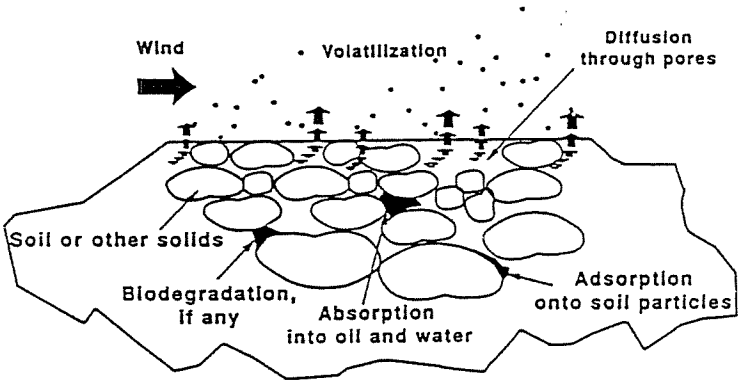
Modeling Approach

- Before mixing:
  - Thin layer of waste on surface
  - Use gas-phase mass transfer coefficient
- After mixing:
  - Air (in soil) and waste at equilibrium
  - Diffusion through air voids to surface

Air Porosity vs. Total Porosity



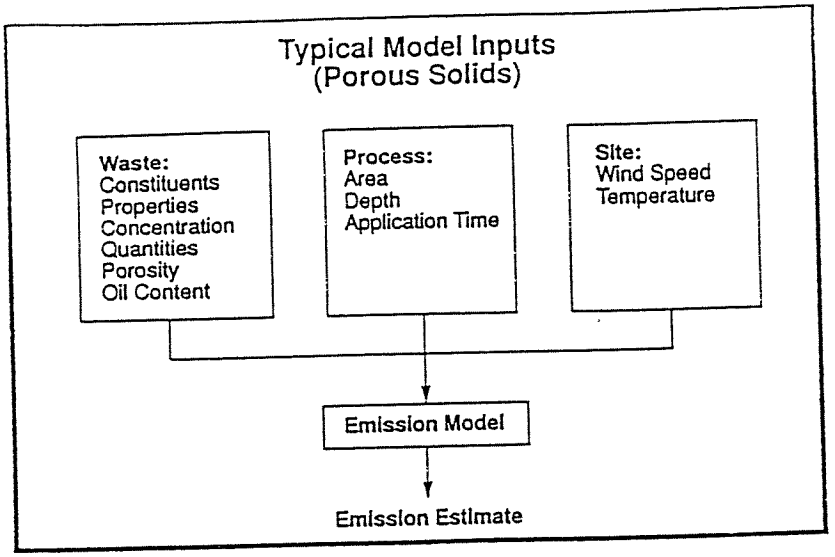
Land Treatment Emission Mechanisms

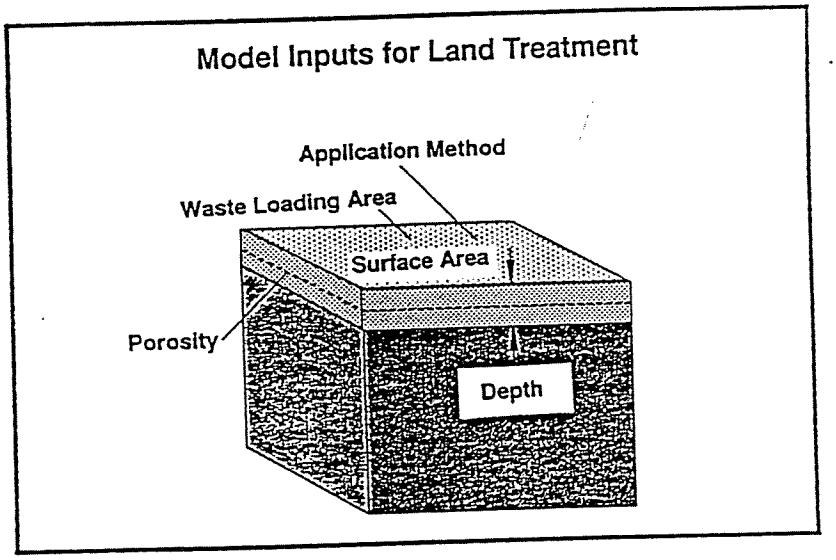


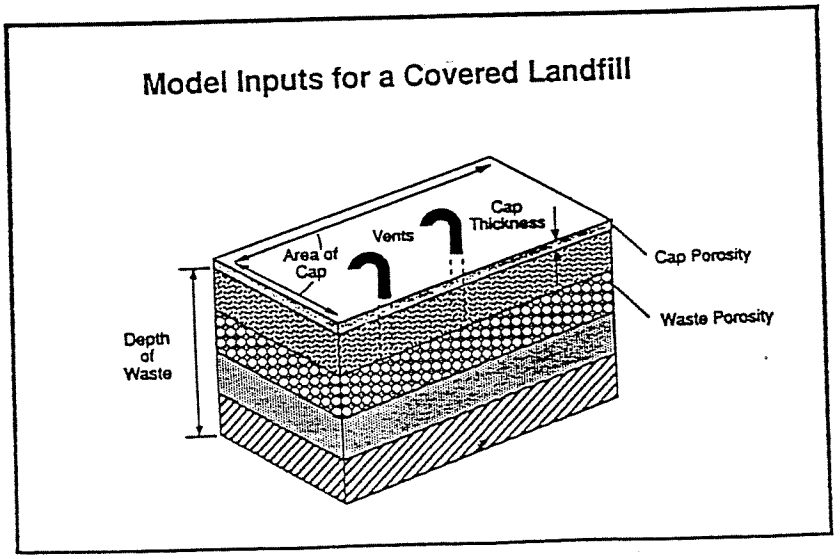
Porous solids

Biodegradation

- Land treatment data available for benzene and toluene
- Aqueous data available for many compounds
- Land treatment biorate extrapolated from aqueous data
- Rate is first-order for concentration


Typical Model Inputs
(Porous Solids)
Waste:
Constituents
Properties
Concentration
Quantities
Porosity
Oil Content
Process:
Area
Depth
Application Time
Site:
Wind Speed
Temperature
Emission Model
Emission Estimate


Model Inputs for Land Treatment
Application Method
Waste Loading Area
Surface Area
Porosity
Depth


Model Inputs for a Covered Landfill
Cap Thickness
Vents
Area of Cap
Cap Porosity
Waste Porosity
Depth of Waste

Case Study:
Equipment Leaks Testing
EPA Method 21

OVERVIEW

- Method 21
- Instruments and their operation
- Field monitoring concerns
- Comparison of available instruments

METHOD 21

- For Subpart BB - identifies leaks, does not quantify emissions
- Promulgated in 40 CFR Part 60, Appendix A
- Revised June 22, 1990 (55 FR 25602)

METHOD 21 SPECIFICATIONS:

- Instrument must respond to specific compounds
- Scale readable to 2.5% of leak concentration
- Sample gas flow rate between 0.1 and 3.0 liters per minute
- Instrument must be rated intrinsically safe

METHOD 21
PERFORMANCE CRITERIA:

- Response factors less than 10
- Response time less than 30 seconds
- Calibration precision equal to or less than 10% of the calibration gas concentration

PERFORMANCE EVALUATION REQUIREMENTS:

- Response factors needed for each compound
- Response time checked initially and after modifications affecting sample flow
- Calibration precision checked quarterly

INSTRUMENTS AND THEIR OPERATION

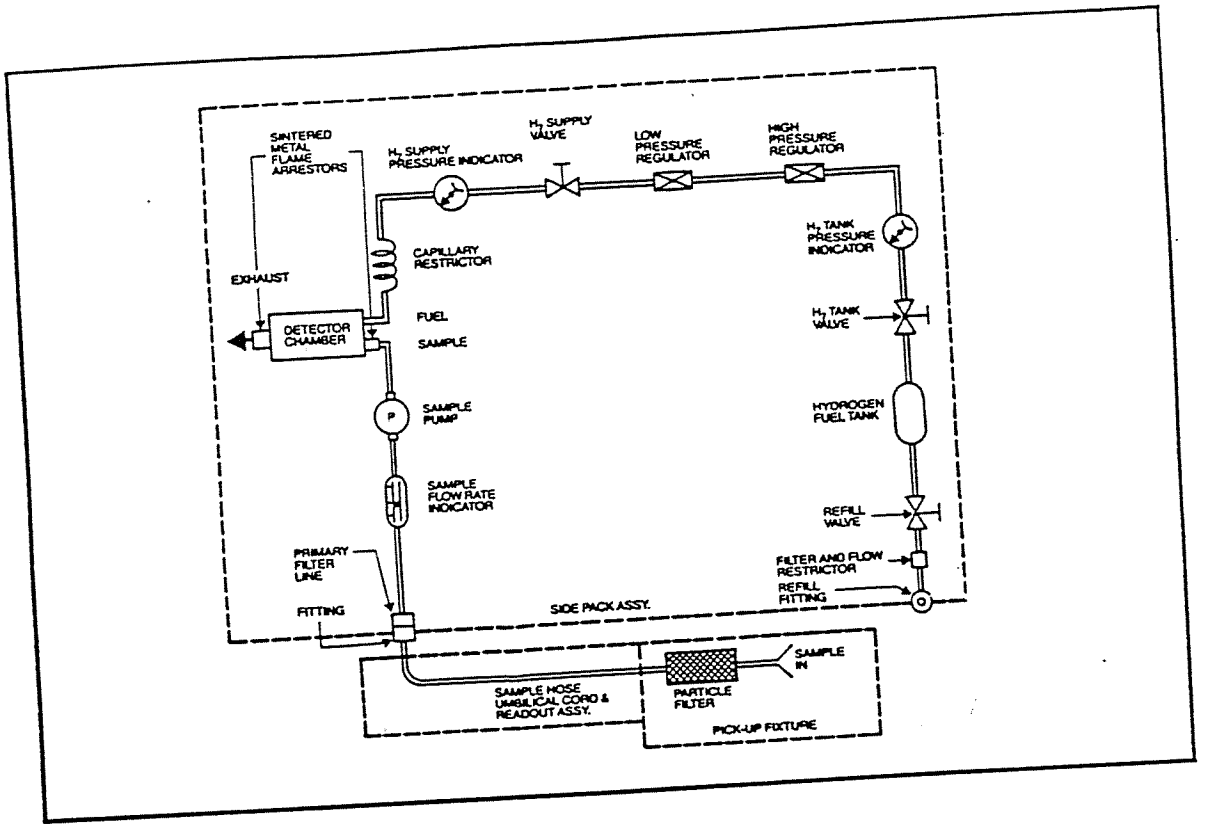
- Types of Instruments
- Daily pre-use checks (video)
- Calibration gases
- Response factors

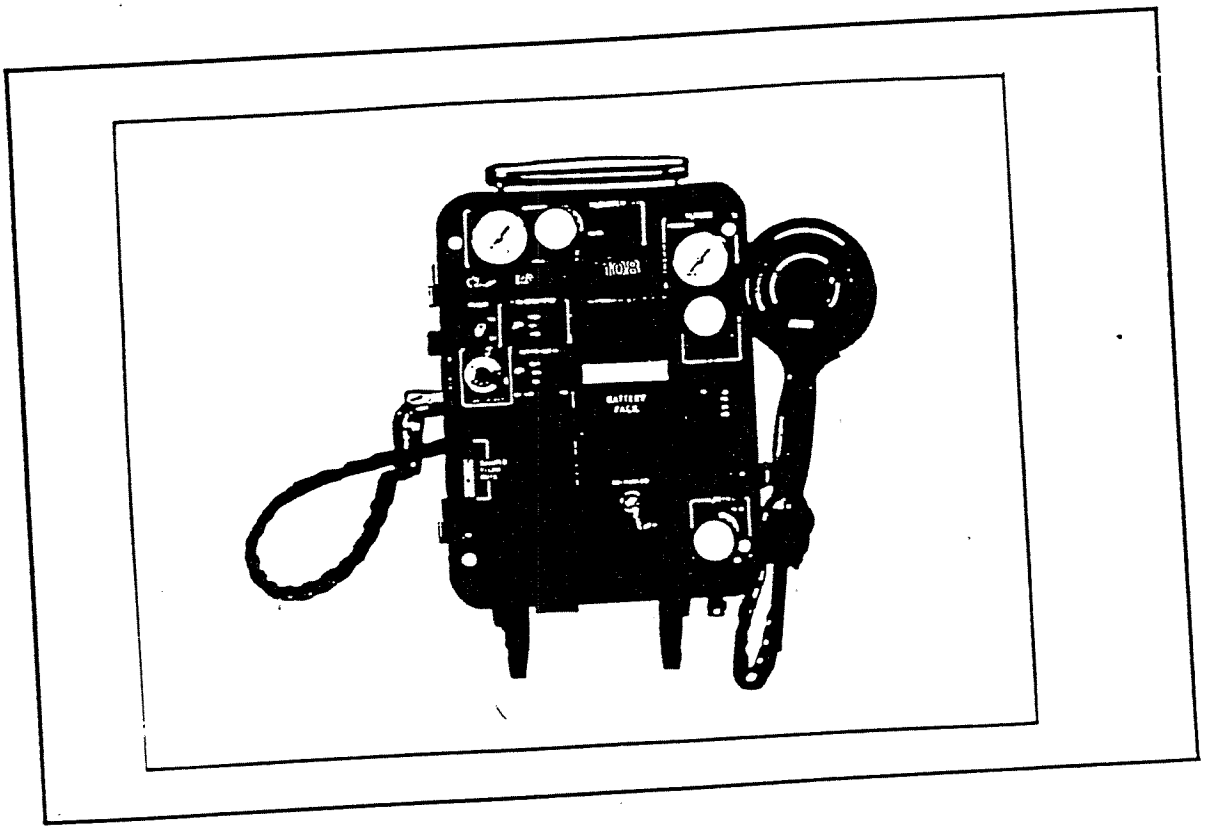
TYPES OF PORTABLE ORGANIC ANALYZERS:

- Flame ionization
- Catalytic combustion
- Photoionization
- Infrared

FLAME IONIZATION DETECTOR OPERATING PRINCIPLES:

- Sample gas is mixed with pure hydrogen
- Organic vapors form positive ions during combustion
- Ions are collected and current flow is amplified


SINTERED METAL FLAME ARRESTORS
H_2 SUPPLY PRESSURE INDICATOR
H_2 SUPPLY VALVE
LOW PRESSURE REGULATOR
HIGH PRESSURE REGULATOR
H_2 TANK PRESSURE INDICATOR
CAPILLARY RESTRICTOR
EXHAUST
DETECTOR CHAMBER
FUEL
SAMPLE
H_2 TANK VALVE
SAMPLE PUMP
HYDROGEN FUEL TANK
SAMPLE FLOW RATE INDICATOR
REFILL VALVE
PRIMARY FILTER LINE
FILTER AND FLOW RESTRICTOR
REFILL FITTING
FITTING
SIDE PACK ASSY.
SAMPLE IN
SAMPLE HOSE UMBILICAL CORD & READOUT ASSY.
PARTICLE FILTER
PICK-UP FIXTURE

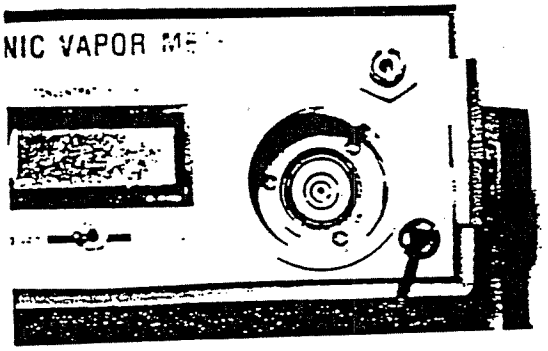


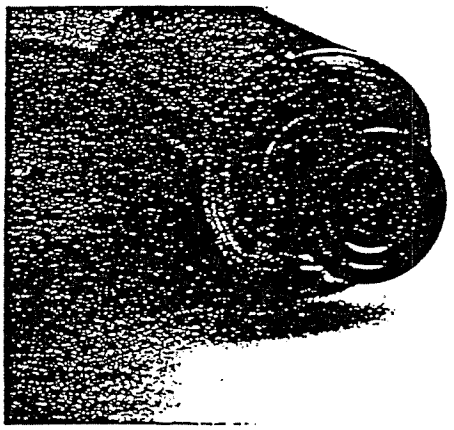
PHOTOIONIZATION ANALYZER OPERATING PRINCIPLES:

- Organic vapor is exposed to high energy UV light
- Ions are formed, collected, and amplified

PHOTOIONIZATION LAMP CLEANING:

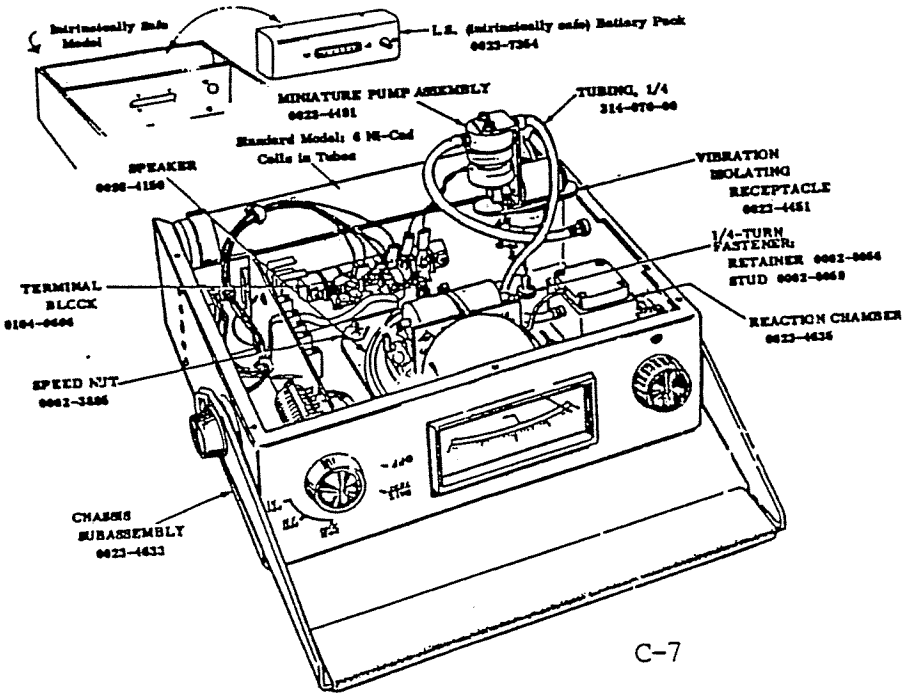
- Frequency - when routine response checks indicate a loss in sensitivity
- Procedure - cleaning compounds or solvents (check with the instrument supplier)





CATALYTIC COMBUSTION ANALYZER OPERATING PRINCIPLES:

- Sample gas exposed to catalyst coated wire
- Heat of combustion of organic vapor changes electrical resistance of wire
- Change in resistance is detected by Wheatstone bridge circuit



DAILY PRE-USE CHECKS:

(Video - 11 minutes)

- Battery status
- Amplifier linearity
- Probe leak checks
- Probe/filter deposits
- Sample gas flow rate
- Hydrogen pressure

CALIBRATION GASES:

- Flame ionization detectors and catalytic combustion analyzers
  - 10,000 ppm methane (n-hexane) in air
  - Also suggest 500 ppm in air

CALIBRATION GASES:

- Photoionization analyzers
  - Poor response to methane and n-hexane
  - Other compounds may be used (e.g., benzene)
  - Conversion factors are needed when other compounds used

RESPONSE FACTOR DEFINITION:

$$\text{Response factor} = \frac{\text{actual conc.}}{\text{meter reading}}$$

EXAMPLE 1

Instrument	⇨	Catalytic combustion
Organic vapor	⇨	Methanol
Actual conc.	⇨	10,000 ppm
Meter reading	⇨	5,000 ppm
Response factor	⇨	2

EXAMPLE 2

Instrument	⇨	Flame ionization
Organic vapor	⇨	o-Chlorotoluene
Actual conc.	⇨	3,028 ppm
Meter reading	⇨	6,056 ppm
Response factor	⇨	0.5

EXAMPLE 3

Instrument	⇨	Catalytic combustion
Organic vapor	⇨	1,1,2,2-Tetra Chloroethane
Actual conc.	⇨	5,980 ppm
Meter reading	⇨	427 ppm
Response factor	⇨	14

RESPONSE FACTORS VARY WITH ORGANIC VAPOR CONCENTRATION

EXAMPLE 1: RESPONSE FACTORS AT VARIOUS CONCENTRATIONS

Instrument	⇨	Catalytic combustion
Organic vapor	⇨	Methanol
Actual conc. (ppm)	⇨	Response factors

Actual conc. (ppm)	Response factors
50	17
500	14
2000	13
5000	18
10000	21
20000	25

EXAMPLE 2: RESPONSE FACTORS AT VARIOUS CONCENTRATIONS

Instrument ⇨ Flame ionization

Organic vapor ⇨ O-Chlorotoluene

Actual conc. (ppm) ⇨ Response factors

Actual conc. (ppm)	Response factors
200	0.6
1500	0.5
3100	0.5

EXAMPLE 3: RESPONSE FACTORS AT VARIOUS CONCENTRATIONS

Instrument ⇨ Catalytic combustion

Organic vapor ⇨ 1,1,2,2-Tetrachloroethane

Actual conc. (ppm) ⇨ Response factors

Actual conc. (ppm)	Response factors
210	8.3
572	8.3
1453	11.0
1453	11.0

PUBLISHED RESPONSE FACTOR TABLES PRESENT ESTIMATED VALUES AT A CONCENTRATION OF 10,000 ppm

RESPONSE FACTOR USE:

- Response factors used only for selecting instruments
- Not used for adjusting meter readings during leak tests

LIMITATIONS OF PUBLISHED RESPONSE FACTORS:

- Less than 300 organic compounds have been tested
- There are instrument-to-instrument variations in response

EXAMPLE 4: INSTRUMENT VARIATIONS

Instrument → Flame ionization

Organic vapor → Cyclohexanol

Actual conc. → Response factors

(ppm)	Unit #1	Unit #2
200	20	22
700	17	17
1200	12	14

EXAMPLE 5: INSTRUMENT VARIATIONS

Instrument ⟹ Catalytic combustion

Organic vapor ⟹ Meta-xylene

Actual conc. ⟹ Response factors

(ppm)	Unit #1	Unit #2
200	3.5	1.7
1500	9.4	2.0
3000	12.8	1.6
4500	15.0	1.5
7000	37.9	1.7

FIELD MONITORING CONCERNS:

(Video - 17 minutes)

- Poor capture
- Gross contamination
- Adverse weather
- Potential health and safety hazards

CONTAMINATION RELATED INSTRUMENT PROBLEMS:

- Flame ionization detectors
  - flame-out
  - condensation in flame arrestors/sample lines
- Catalytic combustion analyzers
  - volatilization of catalyst of detector wires
  - condensation in sample lines
- Photoionization analyzers
  - condensation on lamp window

HEALTH AND SAFETY CONSIDERATIONS:

- Inhalation hazards
  - Keep portable organic analyzer on at all times to indicate localized areas where pollutants have accumulated
  - Use relatively long probe so user does not have to be exposed to leak plume
- Electrical and explosion hazards
  - Use only instruments rated intrinsically safe for class 1, division 1 and class 2, division 1 conditions
  - Use only instrument recorders which satisfy the above requirements
  - Do not touch rotating shafts with metallic probes or other parts
  - Do not use cigarette lighters to check instrument response
- Burn hazards
  - Avoid hot surfaces adjacent to equipment being screened
- Walking and climbing hazards
  - Avoid exposed rotating equipment
  - Avoid equipment more than 2 meters above secure platforms or surfaces
  - Climb ladders properly

COMPARISON OF AVAILABLE INSTRUMENTS: CRITERIA

- Method 21 requirements
- Ease of use
- Instrument Costs
- Other concerns

CRITERIA

MEET METHOD 21 REQUIREMENTS

- Response factors

CRITERIA

EASE OF USE

- Response time
- Configuration
- Calibration
- Reliability

CRITERIA

INSTRUMENT COSTS

- Capital
- Operating

COMPARISON OF AVAILABLE INSTRUMENTS*

Criteria	*Analyzer type*			
	Flame ionization	Photo-ionization	Catalytic combustion	Infra-red
Ease of use				
Response time	Fast	Fast	Medium	Slow
Weight (portability)	Heavy	Light	Light	Heavy
Contamination susceptability	Low	Moderate	Low	Moderate
Configuration	Excellent	Adequate	Adequate	Adequate
Maximum concentration capability	Excellent	Adequate	Excellent	Excellent

*A variety of models are available; the comparisons are subjective and based on experience with a limited number of models.

COMPARISON OF AVAILABLE INSTRUMENTS (cont)*

Criteria	*Analyzer type*			
	Flame ionization	Photo-ionization	Catalytic combustion	Infra-red
Costs				
Capital	Moderate	Moderate	Low	Moderate
Operating	Moderate	Moderate	Moderate	Moderate
Other Concerns				
Ruggedness	Good	Good	Good	Good
Maximum hold feature	No	Yes	No	No
Calibration	Good	Good	Good	Good
Capture Capability	Excellent	Adequate	Moderate	Moderate

*A variety of models are available; the comparisons are subjective and based on experience with a limited number of models.

Case Study: Computerized Emissions Models

COMPUTER MODELS

- CHEMDAT7 (available)
- CHEM7 (available)
- LAND7 (available)
- Combined model (soon)
  - —Compiled program
  - —Automatic assistance

CHEMDAT7
(Lotus 123 Spreadsheet)

- Surface impoundments
  - aerated
  - nonaerated
  - disposal
  - oil film
- Open top tanks
  - aerated
  - nonaerated
- Land treatment
- Active landfills
- Capped landfills
- Waste piles

CHEM7

- Compiled program
- Automatic assistance
- Provides compound properties for CHEMDAT7

LAND7

- Compiled program
- Automatic assistance
- Land treatment
- Waste piles

COMBINED MODELS

- Available soon
- One compiled program
- Include all major sources
- Automatic assistance features
- Structure like LAND7

REFERENCE MATERIALS

- Emission Model Report
  - Documentation
  - Sample Calculations
  - Background Information
- User's Guide
  - CHEMDAT7
  - LAND7

Write: USEPA - OAQPS
Petroleum Section - MD-13
Attn: Emission Model Report
RTP, NC 27711

CASE STUDY: LAND7

- LAND7 menu
- Important inputs
- Example calculations (land treatment)

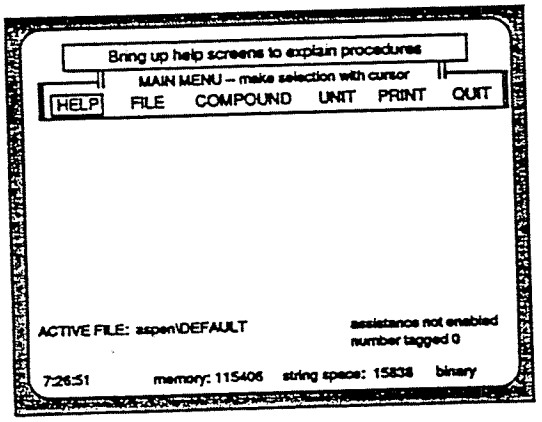


Figure 1. MAIN menu.

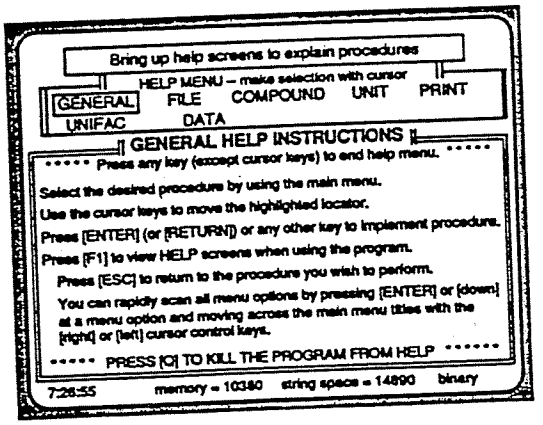


Figure 2. HELP menu.

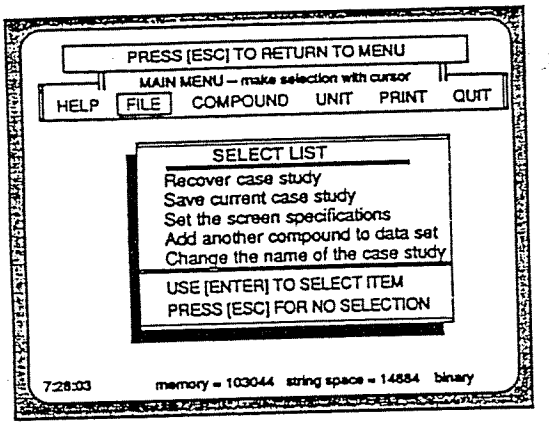


Figure 3. FILE menu.

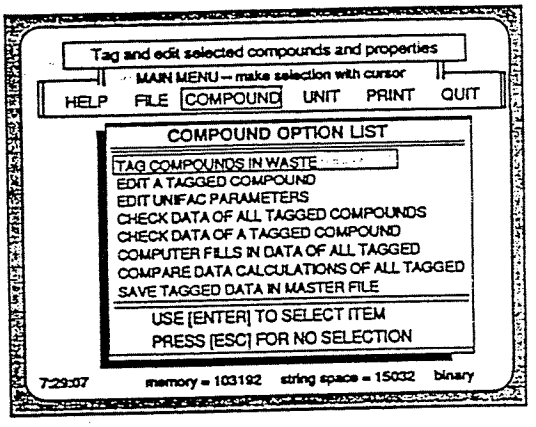


Figure 4. COMPOUND menu.

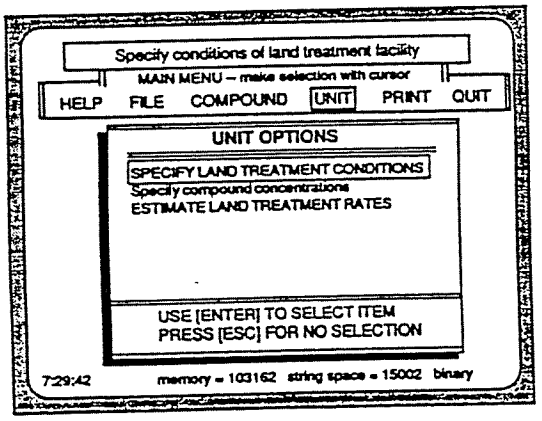


Figure 5. UNIT menu.

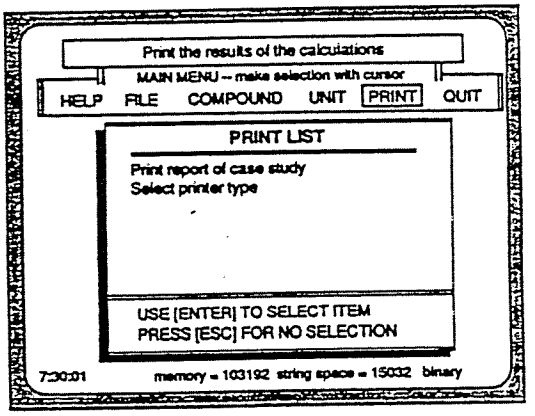


Figure 6. PRINT menu.

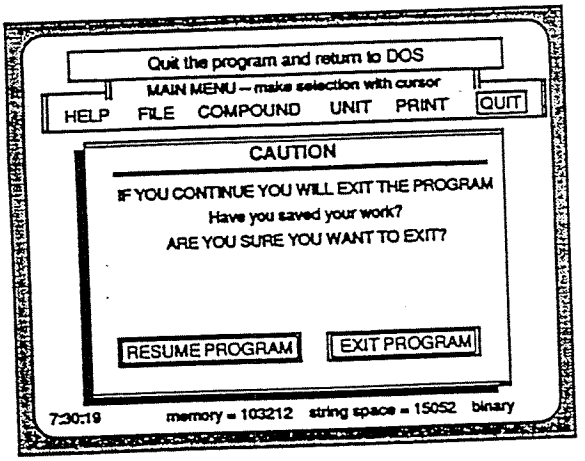


Figure 7. QUIT menu.

INPUTS: POROUS MODEL

- Time surface is exposed
- Concentrations
- Area and depth
- Oil content
- Temperature
- Air and total porosity

EXAMPLE OF LAND7 INPUTS

SPECIFIED PARAMETERS FOR LAND TREATMENT

wind (cm/s)	447
Temp (C)	25
Oil content of waste (fraction)	.1
concentration of compound (ppm)	0
Time between applications (days)	30
Waste loading (g oil/cc soil)	.034
Thickness of contaminated soil (cm)	20
Area of land treatment (m2)	24964
Aqueous waste, =1	0
Biomass density	.00179
Total porosity	.61
Air porosity	.5
width of land treatment area (meters)	158
length of land treatment area (meters)	158
amount of waste applied (gallons)	450000
fraction liquid in waste	.1
BENZENE	5 ppmw

STATUS CHECK

Area of land treatment (m2) is relatively large.

EXAMPLE OF LAND7 RESULTS

SOURCE: land treatment
COMPOUND: BENZENE

Equilibrium Keq	2.123418E-02
biological time const days-1	29.42251
maximum fraction biodegraded	.0930385
fraction biodegraded during time period	9.282061E-02
fraction emitted during time period	.9064917
residual comcentration in oil (ppmw)	3.43848E-03
diffusion coef cm2/s	2.351761E-02
emission rate during time period (g/s)	2.968397E-04
(Mg/year)	9.361136E-03
emission factor (g/cm2-s)	1.189071E-12
Short term emissions, first day (g/s)	3.599377E-03
Peak emissions, fifteen minutes (g/s)	1.766045E-02

The reference emission factor is 1.252787E-12 g/cm2-sec.

COMPOUND PROPERTIES OF BENZENE

Type of compound A aromatic	.87
density (g/cc)	78.1
molecular weight	.088
diffusion coef. air (cm2/s)	95.2
vapor pressure (mm Hg)	.0055
Henry's law constant (atm m3/mol)	6.905
vapor pressure temp. coefficients	1211.033
	220.79
biorate constant Kmax (mg/g-l-hr)	19
UNIFAC code	16:00000000000

STATUS CHECK

The estimated vapor diffusion coefficient is .1173281 cm2/s
The estimated vapor pressure is 95.02693 mm Hg.

CASE STUDY: CHEMDAT7

- CHEMDAT7 menu
- Important inputs
- Example calculations
  - Activated sludge
  - Impoundment (as time permits)
  - Landfill (as time permits)

CHEMDAT7 MAIN MENU

DATA-FORMS VIEW SORT PRINT SELECT HELP QUIT
Go to data entry forms.

DATA-FORMS VIEW SORT PRINT SELECT HELP QUIT
Go to a portion of worksheet (Results).

DATA-FORMS VIEW SORT PRINT SELECT HELP QUIT
Select compounds or rearrange order.

DATA-FORMS VIEW SORT PRINT SELECT HELP QUIT
Print a portion of worksheet.

DATA-FORMS VIEW SORT PRINT SELECT HELP QUIT
Select which models to use.

DATA-FORMS VIEW SORT PRINT SELECT HELP QUIT
Look at instructional screen.

CHEMDAT7 HELP MENU

GENERAL MODEL DATA LANDTREAT LANDFILL BIO-RATE IMPOUND QUIT
View general help screen information.

GENERAL MODEL DATA LANDTREAT LANDFILL BIO-RATE IMPOUND QUIT
Help in selecting the data for your unit.

GENERAL MODEL DATA LANDTREAT LANDFILL BIO-RATE IMPOUND QUIT
Discussion of data entry for new compounds or properties.

GENERAL MODEL DATA LANDTREAT LANDFILL BIO-RATE IMPOUND QUIT
Information for the use of the land treatment model.

GENERAL MODEL DATA LANDTREAT LANDFILL BIO-RATE IMPOUND QUIT
Information for the use of the landfill model.

GENERAL MODEL DATA LANDTREAT LANDFILL BIO-RATE IMPOUND QUIT
Information for the use of biological reaction rates.

GENERAL MODEL DATA LANDTREAT LANDFILL BIO-RATE IMPOUND QUIT
Information for the use of the impoundment model.

DATA FORMS

IMPOUND AERATED CLOSED-LF OPEN-LF/WP LAND-TREAT
CONC IMPORT DEFAULT

IMPOUND: Use for impoundments and open tanks that are not mechanically agitated or aerated.

AERATED: Use for agitated tanks and impoundments.

CLOSED-LF: Closed or capped landfills.

OPEN-LF/WP: Open, active landfills and waste piles.

LAND-TREAT: Land treatment.

CONC: Use differing concentrations for compounds.

IMPORT: Import compound data.

DEFAULT: Put in default parameters.

INPUTS: OPEN LIQUID SURFACES

- Quantity or flow rate
- Concentrations
- Area and depth
- Aeration rate
- Agitation parameters
- Windspeed

CHEMDAT7 RESULTS FOR QUIESCENT IMPOUNDMENT
(all concentrations at 10 ppm)

NON-AERATED WASTEWATER TREATMENT

WINDSPEED	4.47 m/s
depth	1.8 m
AREA	1500 m2
FLOW	0.00156 m3/s
VO inlet conc.	10 mg/l
TOTAL ORGANICS IN	250 mg/l
ACTIVE BIOMASS	0 g/l
BIOMASS SOLIDS IN	0 g/l
TEMPERATURE	25 deg. C
AL AIR EMISSIONS	2.61 Mg/yr

COMPOUND NAME	EFFLUENT	EMISS.	BIOL.	PHOTOL. & HYDRO.	ADSORB.	air emiss. (Mg/yr)
BENZENE	0.199	0.801	0.000	0.000	0.000	0.3943
CARBON TETRACHLORIDE	0.210	0.790	0.000	0.000	0.000	0.3887
METHANOL	0.523	0.477	0.000	0.000	0.000	0.2345
METHYL ETHYL KETONE	0.251	0.749	0.000	0.000	0.000	0.3688
METHYLENE CHLORIDE	0.181	0.819	0.000	0.000	0.000	0.4031
PHENOL	0.895	0.105	0.000	0.000	0.000	0.0518
TETRACHLOROETHLYENE	0.218	0.782	0.000	0.000	0.000	0.3847
TOLUENE	0.213	0.787	0.000	0.000	0.000	0.3873

CHEMDAT7 RESULTS FOR AERATED IMPOUNDMENT
(all concentrations at 10 ppm)

AERATED WASTEWATER TREATMENT

WINDSPEED	4.47 m/s
DEPTH	1.8 m
AREA	1500 m2
FLOW	0.031 m3/s
ACTIVE BIOMASS	0.3 g/l
BIOMASS SOLIDS IN	0 g/l
VO INLET CONC.	10 mg/l
TOTAL ORGANICS IN	250 mg/l
TOTAL BIORATE	19 mg/g bio-hr
FRACT. AGITATED	0.247
SUBMERGED AIR FLOW	0 m3/s
Number impellers	1
Oxygen trans. rat.	3 lbO2/h-hp
POWR (total)	75 HP
Power efficiency	0.85
Temperature	25 deg C
impeller dia	61 cm
impeller speed	126 rad/s

COMPOUND NAME	RELATIVE AERATED WASTEWATER VOC PAT EFFLUENT	EMISS.	BIOL.	PHOTOL. & HYDRO.	ADSORB.	air emiss. (Mg/yr)
BENZENE	0.016	0.821	0.163	0.000	0.0002	8.0283
CARBON TETRACHLORIDE	0.015	0.842	0.143	0.000	0.0003	8.2340
METHANOL	0.381	0.085	0.531	0.000	0.0026	0.8299
METHYL ETHYL KETONE	0.224	0.508	0.266	0.000	0.0016	4.9678
METHYLENE CHLORIDE	0.019	0.926	0.055	0.000	0.0002	9.0565
PHENOL	0.011	0.000	0.989	0.000	0.0001	0.0028
TETRACHLOROETHLYENE	0.017	0.902	0.081	0.000	0.0003	8.8196
TOLUENE	0.015	0.729	0.256	0.000	0.0003	7.1275

CASE STUDY

PROCESS VENT RULE APPLICABILITY and COMPLIANCE

Presented at

U.S. Environmental Protection Agency
Workshop on
Air Emissions from Waste Management Facilities

PROCESS VENT CASE STUDY

Review of RCRA Air Emission Standard for Process Vents Hazardous Waste TSDF Operations

Situation

The XYZ Manufacturing Company operates various manufacturing processes that generate approximately 1,000 tons of hazardous waste per year. This qualifies the XYZ Manufacturing Company as a large quantity generator under RCRA . The facility is a RCRA TSDF operating under interim status. As the owner/operator of the facility, you are required to:

1) determine the applicability of the RCRA air rules for process vents (i.e., 40 CFR 265, Subpart AA) to the hazardous waste management unit emission sources at the facility,

2) determine compliance status of current process vent emissions and emission controls in relation to the control requirements in 40 CFR 265, Subpart AA,

3) determine what action can be taken to comply with the regulation, if the emission reductions are required under the process vents standards.

Determinations

1. Determine which process vents are subject to the requirements of Subpart AA and why. For each process vent identified in Figure 1 and 2, circle all of the following statements that are correct (note: some vents will have more than one applicable statement; all relevant and appropriate choices should be circled)

   a. Vent is a process vent associated with one of the unit operations specified in the rule that manages a hazardous waste with organic concentration of greater than 10 ppmw and therefore is subject to the requirements of Subpart AA.

   b. Vent is not a process vent as defined in the rule and therefore is not subject to the requirements of Subpart AA.

   - The operation/process associated with the vent is not one of the unit operations specified in Subpart AA applicability (Section 265.1030(b)), or

   - The passage of gases (i.e., vent emissions) into the atmosphere is not process related. For example, emissions are caused by tank loading and unloading (working losses) rather than the process or unit operation.

   c. Vent is not subject to the requirements of Subpart AA because the waste managed in the unit has an organic concentration concentration of less than 10 ppmw.

   d. Vent is not subject to the requirements of Subpart AA because the operation/process associated with the vent is not subject to RCRA Subtitle C or is a RCRA exempt unit.

Vent No.	Answers	Vent No.	Answers
1	a,b,c,d	10	a,b,c,d
2	a,b,c,d	11	a,b,c,d
3	a,b,c,d	12	a,b,c,d
4	a,b,c,d	13	a,b,c,d
5	a,b,c,d	14	a,b,c,d
6	a,b,c,d	15	a,b,c,d
7	a,b,c,d	16	a,b,c,d
8	a,b,c,d	17	a,b,c,d
9	a,b,c,d		

Comments

a. The process vent rules apply only to those waste management units or unit operations that are specified in the rules. Affected unit operations include: distillation, fractionation, thin-film evaporation, solvent extraction, steam stripping and air stripping.

Vents on control devices (e.g., condensers and carbon adsorbers) and on tanks serving the affected unit operations (e.g., distillate receivers, bottoms receivers, surge control tanks, decant separator tanks, or hot wells) are also subject to the standards if emission from the process are vented through them (e.g., uncondensed overhead vapors from a distillation operation).

b. A process vent means any open-ended pipe or stack that is vented to the atmosphere either directly, through a vacuum-producing system, or through a tank or air pollution control device. Emissions (i.e., gases or fumes) must be process-related such as evaporation produced by heating or caused by mechanical means such as a vacuum-producing system.

c. The process vent rules apply to affected units managing hazardous waste with a total organic concentration of 10ppmw or greater on an annual average basis. Units managing wastes with an annual average of less than 10ppmw are not subject to the rules.

d. If the unit is exempt from RCRA Subtitle C, it is not subject to the requirements of Subpart AA. Examples of types of RCRA exempt units are listed below:

- Units such as product (not hazardous waste) distillation columns generating organic hazardous waste still bottoms are not subject to the standards while the wastes are in the product distillation column unit.

- Elementary neutralization and wastewater treatment tanks as defined by 40 CFR 260.10.

- Units managing Subtitle D wastes or nonhazardous wastes.

- Generators that accumulate hazardous waste in tanks and containers for 90 days or less.

2. Calculate the total facility process vent emission rate (ER).

Case 1:

$ER_{(Hourly)}$ =

$ER_{(Annual)}$ =

Case 2:

$ER_{(Hourly)}$ =

$ER_{(Annual)}$ =

Total Facility ER is equal to the sum emission rates for all individual process vents located at the facility that are subject to the requirements of Subpart AA.

$$ER_{facility} = \sum_{i=1}^{n} ER_{pvi}$$

Process Vent Emission Rate (ER) and Operating Hour(OH) Data:

Case 1:

Vent Id.#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
ER(lb/hr)	9.3	6.1	0.07	0.49	0.16	1.0	0.20	0.12	1.2	0.13	0.06	6.1	8.9	1.2	0.13	0.84	1.5
OH(hr/yr)	4160	4160	8760	2000	8760	2000	8760	2000	2000	8760	2000	4160	2000	2000	2000	4160	2000
ER(ton/yr)	19.3	12.7	0.31	0.49	0.7	1.0	0.88	0.12	1.2	0.57	0.06	12.7	8.9	1.2	0.13	1.7	1.5

Case 2:

Vent Id.#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
ER(lb/hr)	8.1	5.2	0.11	1.0	0.18	0.8	0.08	0.11	1.0	0.15	0.05	4.5	9.0	1.1	0.15	1.7	2.2
OH(hr/yr)	4160	4160	8760	4000	8760	4000	8760	2000	2000	8760	2000	4160	2000	2000	2000	4160	2000
ER(ton/yr)	16.8	10.8	0.48	2.0	0.79	1.5	0.35	0.11	1.0	0.66	0.05	9.3	9.0	1.1	0.15	3.5	2.2

3. Based on the total facility process vent emission rate (ER) calculated above, identify which course of action from among those listed below, is required:

   a. ER below emission rate limits; therefore, no emission reduction required.

   b. ER above emission rate limits; must reduce emissions from each individual process vent by 95%.

   c. ER above emission rate limits; must reduce total facility process vent emissions by 95%.

   d. ER above emission rate limits; but can control one or more vents to get below limits.

   e. ER above emission rate limits; but can reduce operating hours in order to get below the limits.

After identifying all affected process vents, you must determine whether the total facility affected process vent emission rate is below the emission rate limits (see operating data under #2 and compliance criteria given below.)

If the total facility process vent emission rate for hourly or yearly emissions exceeds the limits in the regulation, then some type action must be taken to reduce emissions below the limits. If the emission rate limits cannot be attained, total facility process vent emissions must be reduced, by 95% or more, through use of a control device.

Compliance Criteria

Total facility process vent emission rate must be below the following emission rate limits:

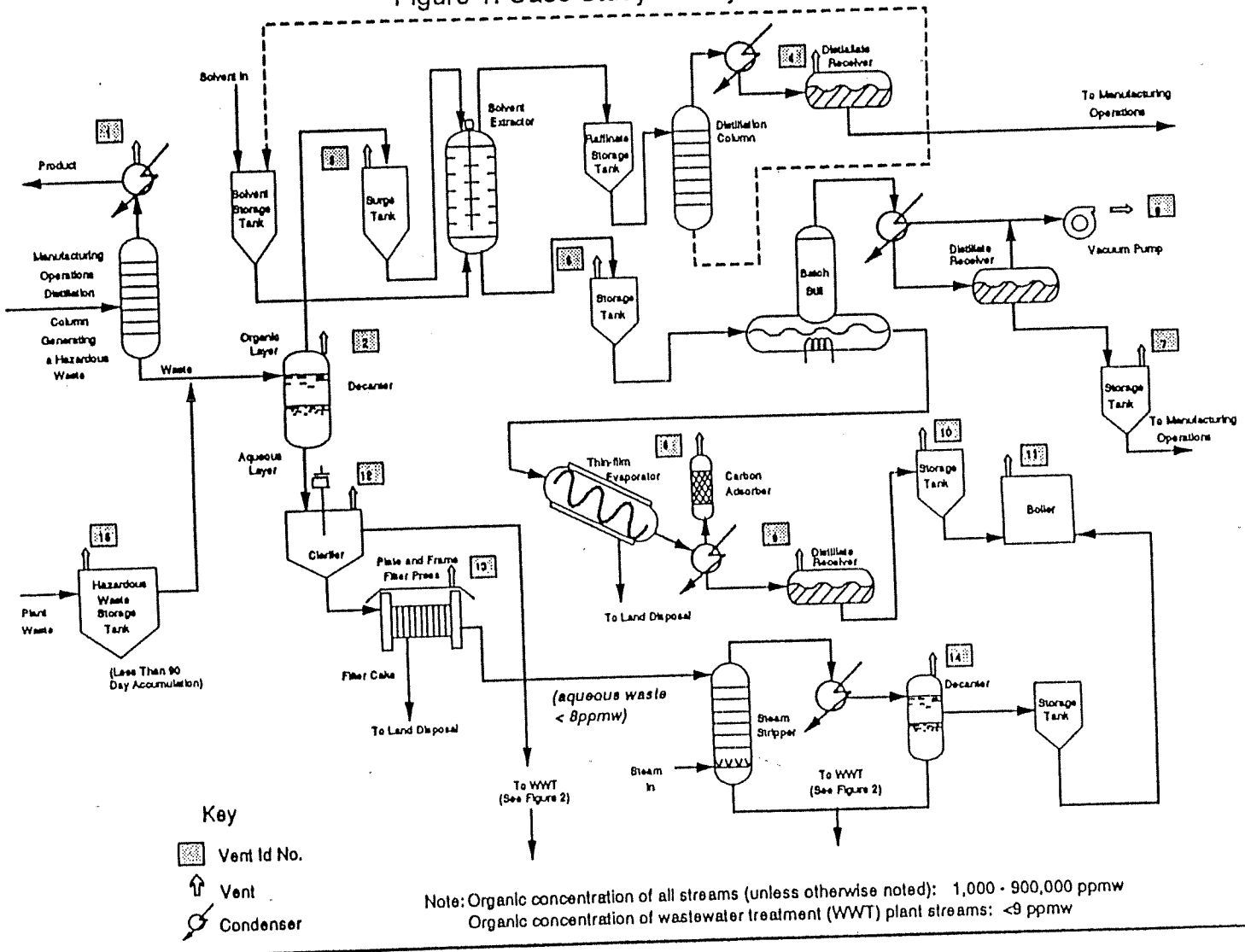
Short Term - < 1.4 kg/h (3 lb/h) AND Long Term - < 2.8 Mg/yr (3.1 short tons/yr)

Recommended Control Action

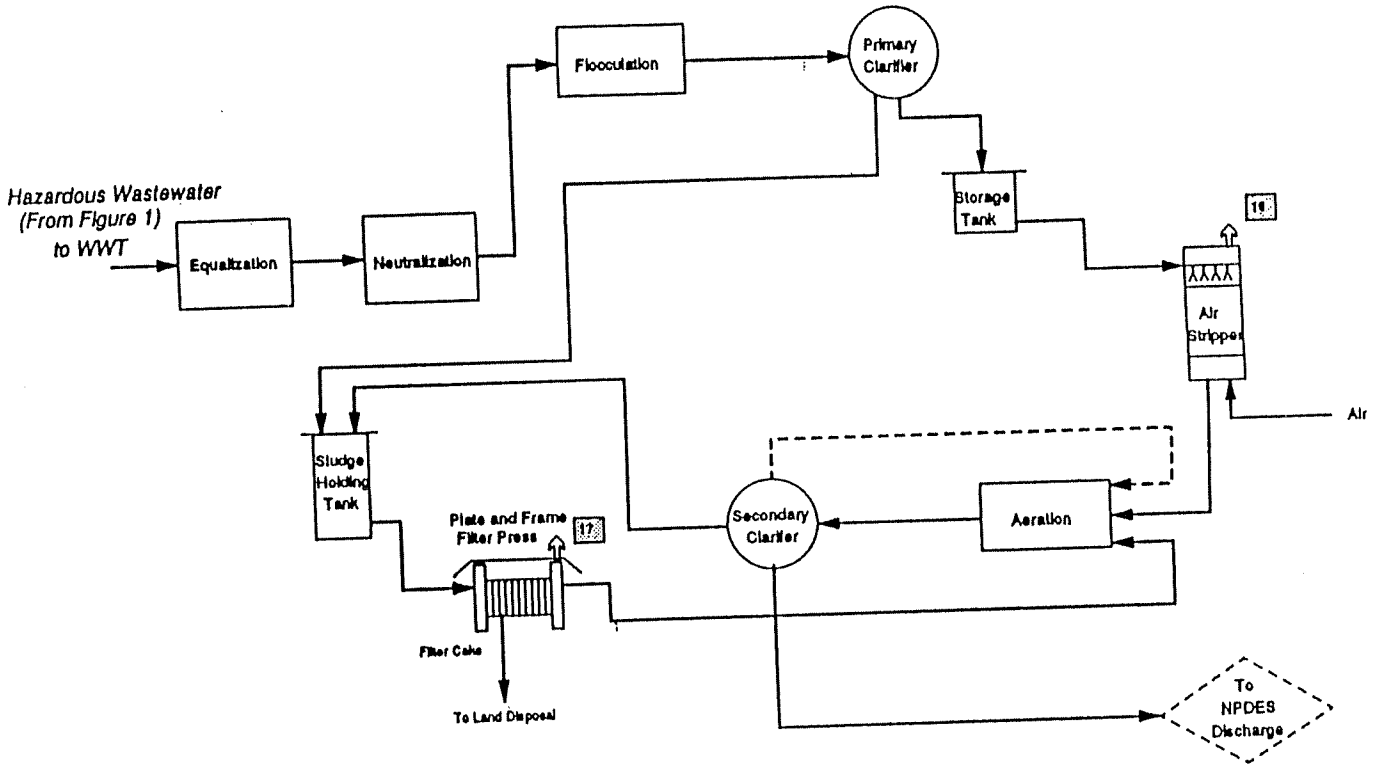
Case 1: _____

Case 2: _____

Figure 1. Case Study Facility XYZ



Note: Organic concentration of all streams (unless otherwise noted): 1,000 - 900,000 ppmw
Organic concentration of wastewater treatment (WWT) plant streams: <9 ppmw



Key

Vent Id No.

Vent

Note: Organic concentration of wastewater treatment (WWT) plant streams: < 9 ppmw

Figure 2. Case Study Facility XYZ Wastewater Treatment Plant (WWT) with NPDES Permit

CASE STUDY

APPLICATION
of
BENZENE WASTE OPERATIONS NESHAP
to
WASTEWATER TREATMENT SYSTEMS

Presentation Slides

GENERAL STANDARDS

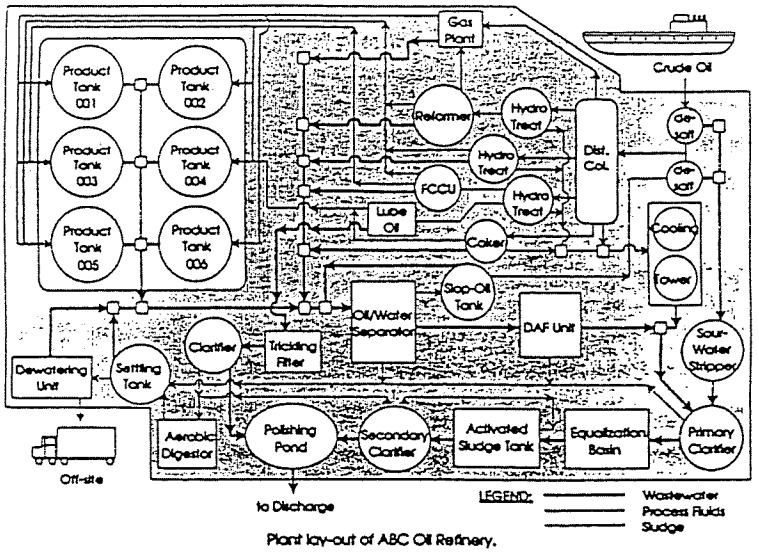
- Facilities with 10 Mg/yr or more total annual benzene in waste treat and control certain waste streams
- Treat identified waste streams to remove or destroy benzene
- Apply organic emission controls prior to and during treatment to achieve treatment requirements

WHAT ARE THE TREATMENT REQUIREMENTS?

- Reduce benzene concentration to less than 10 ppmw
- Remove or destroy benzene by 99% or more
- Dilution of wastes to meet requirements is prohibited
- Mixing of wastes is allowed to facilitate treatment in *"wastewater treatment system"* with special requirements

WHAT IS A *"WASTEWATER TREATMENT SYSTEM"*?

- . . . a unit that ultimately discharges under NPDES permit
- Manages certain wastes:.
  - → Process wastewater
  - → Product tank drawdown
  - → Landfill leachate or
  - → Wastes mixed with any of these
- Typically includes:
  - → Individual drain systems
  - → Oil-water separators
  - → Dissolved air floatation (DAF) units
  - → Equalization tanks
  - → Biological treatment units



Plant lay-out of ABC Oil Refinery.

WHAT ARE THE SPECIAL REQUIREMENTS?

- All units comprising the wastewater treatment system must use organic emission controls except for those units where both the:

  (1) Benzene concentration of wastewater entering unit is less than 10 ppmw benzene

  and

  (2) Total annual benzene quantity in wastewaters first entering all uncontrolled wastewater treatment system units facility-wide is less than 1 Mg/yr

- Benzene in wastewaters entering an *"enhanced biodegration unit"* is excluded from the calculation of total annual benzene quantity

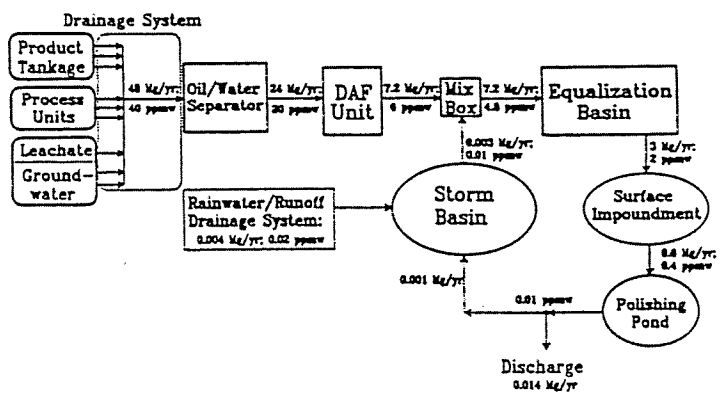


Figure 1. Wastewater treatment system showing benzene concentrations and flow rates: Example 1.

WHAT IS AN *"ENHANCED BIODEGRADATION UNIT"*?

- Wastewater treatment system unit that: includes activated sludge
  - → Uses a suspended growth process
  - → Generates biomass
  - → Uses recycled biomass
  - → Periodically removes biomass
- Examples of processes not considered enhanced
  - → Large, shallow biological impoundments
  - → Attached growth processes such as trickling filters or rotating biological contactors

70-90% removed bio[illegible]

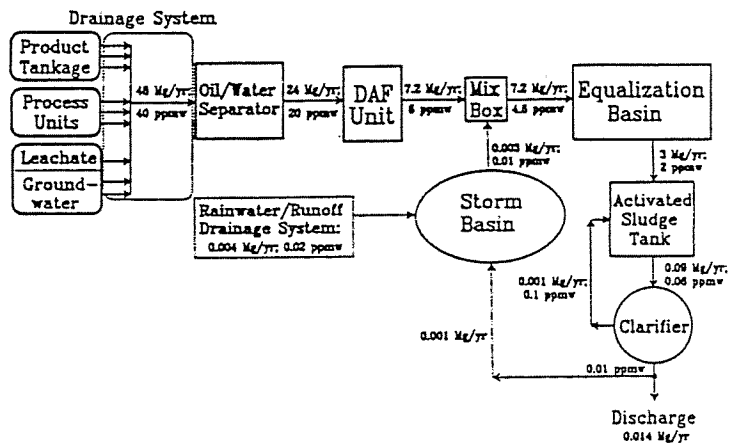
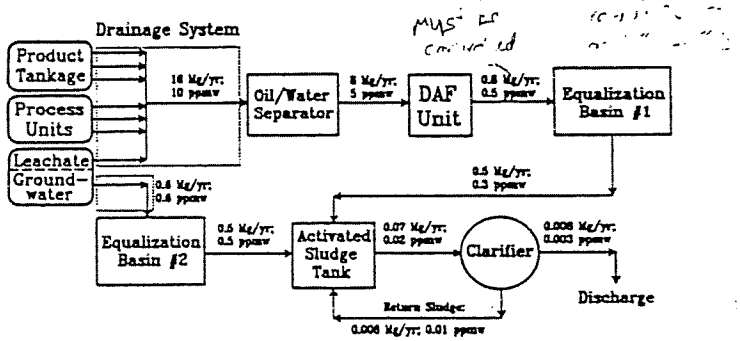


Figure 2. Wastewater treatment system showing benzene concentrations and flow rates: Example 2.



Wastewater treatment system showing benzene concentrations and mass flow rates. Example 3.

CASE STUDY

APPLICATION
of
BENZENE WASTE OPERATIONS NESHAP
to
WASTEWATER TREATMENT SYSTEMS

Presented at

U.S. Environmental Protection Agency
Workshop on
Air Emissions from Waste Management Facilities

CASE STUDY:
APPLICATION OF NATIONAL EMISSION STANDARD FOR BENZENE WASTE OPERATIONS TO WASTEWATER TREATMENT SYSTEMS

OVERVIEW

This case study provides examples of the application of the National Emission Standard for Benzene Waste Operations (40 CFR 61 Subpart FF) to wastewater treatment systems. The standards for wastewater treatment systems that manage and treat aggregated or mixed waste streams are reviewed using some simple examples. Then, a case study problem is presented to illustrate the application of the standard to a "real world" wastewater treatment system at a petroleum refinery.

STANDARDS FOR WASTEWATER TREATMENT SYSTEMS

The Benzene Waste Operations NESHAP requires owners and operators of affected facilities at which the total annual benzene quantity from the facility waste is equal to or greater than 10 Mg/yr to remove or destroy benzene contained in certain waste streams using a treatment process or wastewater treatment system. Section 61.348 of the rule establishes the treatment standards for treatment processes or wastewater treatment systems. These standards require that if an owner or operator chooses to aggregate or mix waste streams to facilitate treatment in a wastewater treatment system, then the waste streams must be treated in a wastewater treatment system that meets special requirements. Each waste management unit that comprises the wastewater treatment systems at the facility must use the appropriate emission controls as specified under Sections 61.343 through 61.347 until both of the following conditions are met:

1. The waste entering an uncontrolled unit is less 10 ppmw benzene;

   and

2. The total facility-wide wastewater treatment system annual benzene quantity first entering any uncontrolled unit is less than 1 Mg/yr.

Application of Basic Standards

Figure 1 illustrates the application of the basic standards. The drainage system, the oil/water separator and the dissolved air flotation (DAF) unit shown in Figure 1 require controls because they receive waste with benzene concentrations of 10 ppmw or higher. The next three units require controls because, even though the benzene concentration is below 10 ppmw, the mass flow rate of benzene (i.e., the annual benzene quantity) entering the units is greater than 1 Mg/yr.

Enhanced Biodegradation Units

There is one major exclusion to the 1 Mg/yr benzene quantity limit. The rule excludes the benzene quantity entering an "enhanced biodegradation" unit from the total annual benzene quantity inventory for the wastewater treatment system if the enhanced biodegradation unit is the first exempt unit. Section 61.348(b)(2)(ii)(B) provides guidelines regarding operating conditions for what is defined as "enhanced biodegradation" unit. These guidelines basically describe the operation of a conventional activated sludge wastewater treatment process. Activated sludge systems with benzene concentrations of 10 ppmw or higher in any influent stream will still require controls, but, if the benzene concentration is less than 10 ppmw, the annual benzene quantity entering an activated sludge system does not count towards the 1 Mg/yr control limit. Therefore, if we replace the surface impoundment in Figure 1 with an activated sludge system (refer to Figure 2), no controls are then required after the equalization basin.

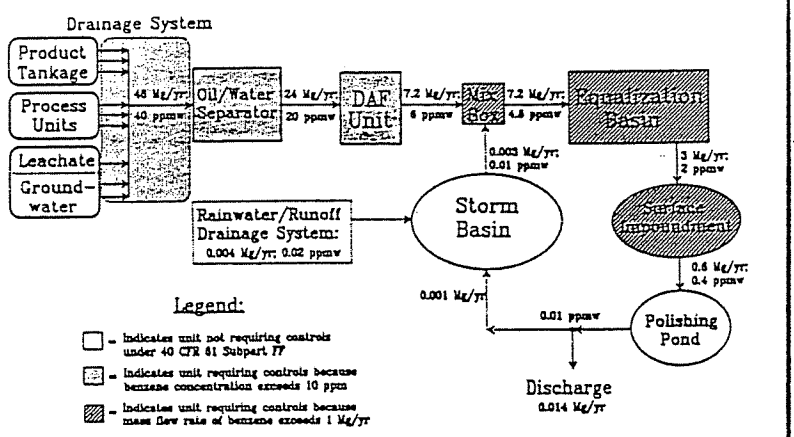


Figure 1. Wastewater treatment system showing benzene concentrations and flow rates: Example 1.

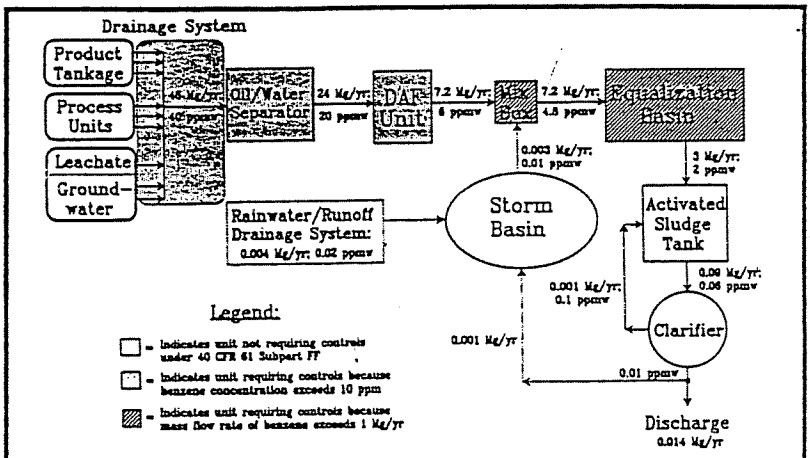


Figure 2. Wastewater treatment system showing benzene concentrations and flow rates: Example 2.

Multiple Wastewater Treatment Systems

It is important to point out that the 1 Mg/yr of benzene control limit pertains to the total annual benzene quantity of the facility's wastewater treatment system and not to the annual benzene quantity of a single waste stream. For example, referring to Figure 3, Equalization Basin #1 has an annual benzene quantity of 0.8 Mg/yr while the groundwater waste stream entering Equalization Basin #2 has an annual benzene quantity of 0.6 Mg/yr. In a single train system, these equalization basins would not require controls. However, the cumulative or total annual benzene quantities for the uncontrolled units in this dual train facility is 1.4 Mg/yr, which exceeds the 1.0 Mg/yr control limit. Therefore, one of the equalization basins in Figure 3 must be controlled. There is no requirement provided in the rule that determines which basin is controlled since controlling either basin reduces the total annual benzene quantity in the uncontrolled units to less than 1 Mg/yr. Therefore, in order to comply with the rule, the facility owner or operator can choose which of the equalization basins is controlled as is shown in Figures 3a and 3b. Note that, if Equalization Basin #2 is selected to be controlled, then the groundwater drainage system must also be controlled.

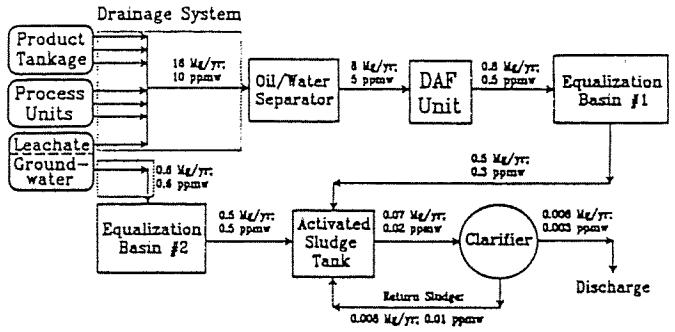


Figure 3. Wastewater treatment system showing benzene concentrations and mass flow rates. Example 3.

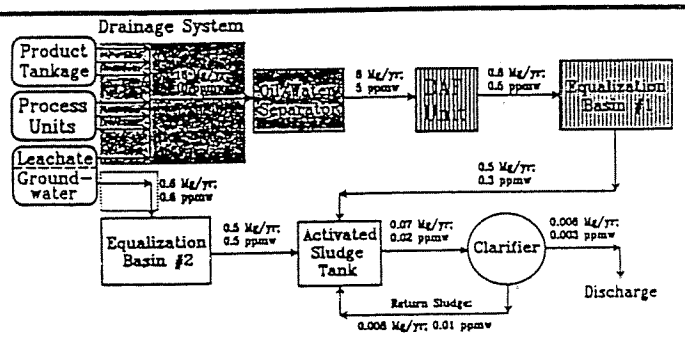


Figure 3a. Wastewater treatment system showing benzene concentrations and mass flow rates. Example 3; Solution A.

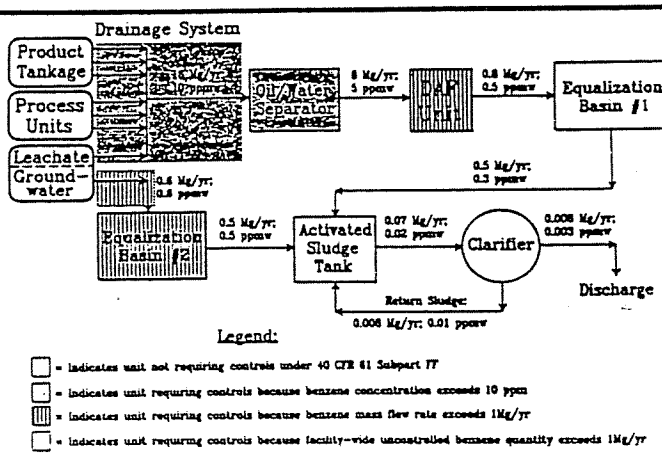


Figure 3b. Wastewater treatment system showing benzene concentrations and mass flow rates. Example 3; Solution B.

CASE STUDY

SITUATION

The ABC Oil Company operates a refinery that is determined to have a total annual benzene (TAB) quantity greater than 10 Mg/yr and, therefore, the refinery owner/operator is required to manage the benzene-containing waste streams in controlled units and treat the waste to comply with the National Emission Standard for Benzene Waste Operations (40 CFR 61 Subpart FF). As shown Figure 4, the refinery already operates an advanced wastewater treatment system capable of treating the refinery wastewater streams to meet the Section 61.348 treatment standards. As owner/operator of the ABC Oil Company you must now decide which of the units comprising your wastewater treatment system must use controls to comply with the standards.

PROBLEM

Identify which waste management units comprising the refinery wastewater treatment system require controls. Possible answers for each waste management unit are:

a. No controls required

b. Controls required: Benzene concentration entering the unit is 10 ppmw or more

c. Controls required: TAB quantity entering the unit is 1 Mg/yr or more

d. Controls required: Total TAB quantity managed in exempt wastewater treatment units at refinery is 1 Mg/yr or more NOT

For each waste management unit shown in Figure 5, circle all correct answers (more than one answer may be correct for a particular unit).

		NO
1.	Individual Drain Systems Assume mixing of >10 & <10	a b c d
2.	Sour Water Stripper	a b c d
3.	Oil/Water Separator	a b c d
4.	DAF Unit	a b c d
5.	Primary Clarifier	a b c d
6.	Equalization Basin	a b c d
7.	Activated Sludge Tank	a b c d
8.	Secondary Clarifier	a b c d
9.	Trickling Filter	a b c d
10.	Clarifier	a b c d
11.	Polishing Pond	a b c d

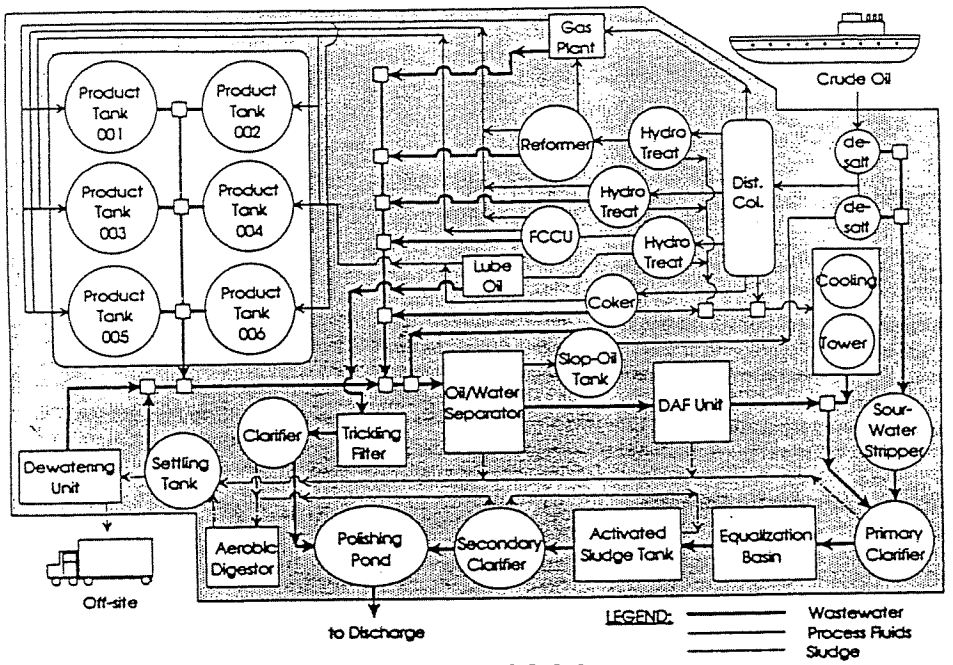


Figure 4. Plant lay-out of ABC Oil Refinery.

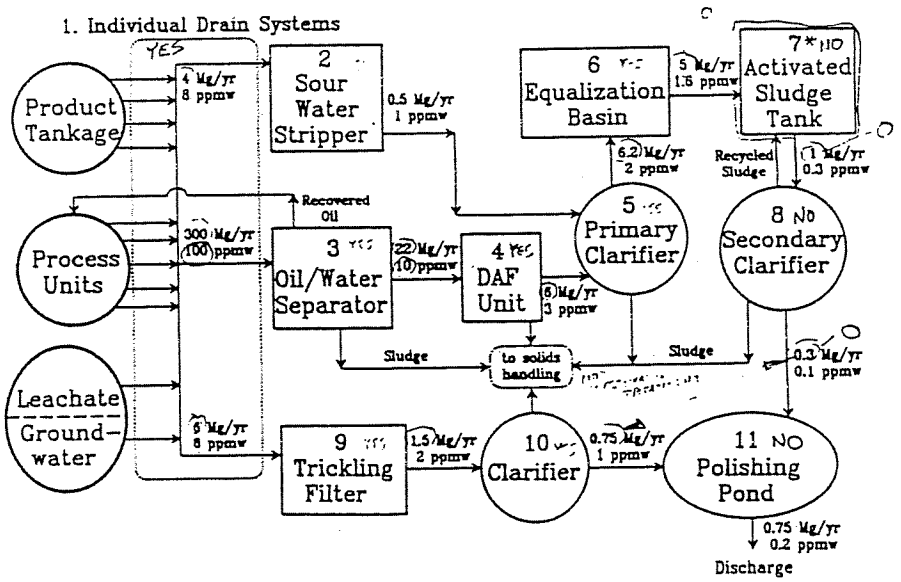


Figure 5. Wastewater treatment system showing benzene concentrations and mass flow rates: Case Study.

EPA

BENZENE WASTE OPERATIONS NESHAP

Purpose

To summarize the major requirements of the NESHAP for benzene waste operations

Outline

- Overview
- Applicability
- Control requirements
- Compliance
- Summary

Outline

- **Overview**
- Applicability
- Control requirements
- Compliance
- Summary

Overview

Background

- Benzene waste rule one of last under "old Section 112"
- Rules promulgated March 7, 1990 (45 FR 8292)
- Impacts of standards
  - Reduce benzene emissions from 6,000 to 450 Mg/yr
  - Reduce maximum risk from 2×10^{-3} to 5×10^{-5}
  - Reduce annual cancer incidence from 0.6 to 0.05

Overview

Regulatory Approach

- Identify facilities whose benzene emissions pose public health problem
- Identify waste streams that create benzene emission problem
- Treat identified waste streams to remove or destroy benzene
- Apply organic emission controls prior to and during treatment

Applicability

How Is TAB Determined?

- Determine waste flow and benzene concentration at "point of generation"
  - Knowledge of waste or process
  - Direct measurement
- Based on the following for each waste ≥10% water:
  - Total annual quantity of waste
  - Annual average benzene concentration

Applicability

Total Annual Benzene in Waste (TAB)

$$TAB = \sum_{i=1}^{n} (Q_i C_i)$$

Q = annual waste quantity

C = annual average benzene concentration

n = number of affected waste streams with >10% water content

Applicability

What Is Point of Generation?

- Where substance first becomes a waste
  - Prior to losses due to emissions
  - Prior to mixing
  - Prior to any waste treatment
- Can occur after a process unit or waste management unit
- Definition does not allow wastes to be excluded from rule
- Pollution prevention that eliminates waste or reduces benzene allowed

Applicability

Which Waste Streams Require Control?

- Generally, streams with ≥10 ppmw benzene at point of generation
  - Exclusions for certain process wastewater streams

Applicability

What Is Process Wastewater?

- Water that contacts benzene within manufacturing process unit
- Certain waste streams are not process wastewater
  - Organic wastes
  - Process fluids
  - Product tank drawdown
  - Cooling tower blowdown
  - Steam trap condensate
  - Landfill leachate

Applicability

What are the Process Wastewater Exclusions?

- Waste streams less than 0.02 L/min or 10 Mg/yr
- Waste streams >10 ppmw benzene if process wastewater TAB less than 1 Mg/yr for combination of:
  - TAB in untreated streams at point of generation
  - TAB in treated streams at exit to treatment unit

Outline

- Overview
- Applicability
- **Control requirements**
- Compliance
- Summary

Control Requirements

Overview

- Affected wastes treated to remove or destroy benzene
- Control air emissions from management units prior to and during treatment
- Mixing of wastes to facilitate treatment allowed
- Dilution of waste to comply with treatment standards prohibited
- Treatment can occur onsite or offsite

Control Requirements

What Are the Treatment Requirements?

- Reduce benzene concentration to <10 ppmw
- Remove or destroy benzene by 99% or more
- Special requirements for certain wastewater treatment systems (WWTS)

Control Requirements

What Are the Treatment Requirements?
(continued)

- Compliance with treatment requirements of other statutes:
  - RCRA waste combustion rules
  - RCRA land disposal restrictions
  - Benzene-specific effluent guidelines

Control Requirements

What Are the Treatment Processes?

- Steam stripper
- Thin-film evaporator
- Waste incinerator
- Other processes that meet performance standards
- Wastewater treatment systems (WWTS)

Control Requirements

What Is a Wastewater Treatment System?

- . . . a unit that ultimately discharges under NPDES permit
- Manages certain wastes:
  - Process wastewater
  - Product tank drawdown
  - Landfill leachate
  - Wastes mixed with any of these
- Typically includes:
  - Individual drain systems
  - Oil-water separators
  - Air flotation units
  - Equalization tanks
  - Biological treatment units

Control Requirements

What are the Alternative Standards for WWTS?

- If wastes with ≥10 ppmw benzene mixed with wastes <10 ppmw benzene in WWTS, special provisions apply
- All units in WWTS must be controlled until both:
  - The wastes entering an uncontrolled unit are <10 ppmw
  - The WWTS TAB first entering an uncontrolled unit is <1 Mg/yr
- TAB entering enhanced biodegradation is excluded from the 1-Mg/yr determination

Treatment

How Is an Enhanced Biodegradation Unit Defined?

- A WWTS process unit that:
  - Uses a suspended growth process
  - Generates biomass
  - Uses recycled biomass
  - Periodically removes biomass
- Examples of processes not considered enhanced
  - Large, shallow biological impoundments
  - Attached growth processes such as trickling filters or rotating biological contactors

Control Requirements

What Are the General Control Requirements?

- Apply controls prior to and during treatment
- Cover or enclose waste management unit
- Generally, convey emissions through closed-vent system to control device
- Control devices remove or destroy ≥95% of organics

Control Requirements

What Are the Affected Waste Management Units?

- Tanks
- Surface impoundments
- Oil-water separators
- Containers
- Individual drain systems

Control Requirements

Tanks

- Requirements would apply to most noncombustion treatment processes
- Cover and vent to control device
- Alternative controls: meeting requirements of VOL storage NSPS (40 CFR 60 Subpart Kb)
  - Fixed-roof and internal floating
  - External floating roof

Control Requirements

Surface Impoundments

- Cover
- Vent to control device

Control Requirements

Containers

- Cover
- Submerge fill for pumpable waste
- Enclose and vent to control device during waste treatment

Control Requirements

Oil-Water Separators

- Cover and vent to control device
- Alternative controls
  - Floating roof
  - Meeting the requirements of petroleum refinery wastewater systems NSPS (40 CFR 60, Subpart QQQ)

Control Requirements

Individual Drain Systems

- Cover each opening and vent to control device
- Alternative controls
  - Comply with NSPS control requirements (40 CFR 60, Subpart QQQ) and
  - Control junction box emissions
    - Install water seals on junction box
    - Vent junction box to closed-vent system and control device

Outline

- Overview
- Applicability
- Control requirements
- **Compliance**
- Summary

Compliance

How Is Compliance Insured?

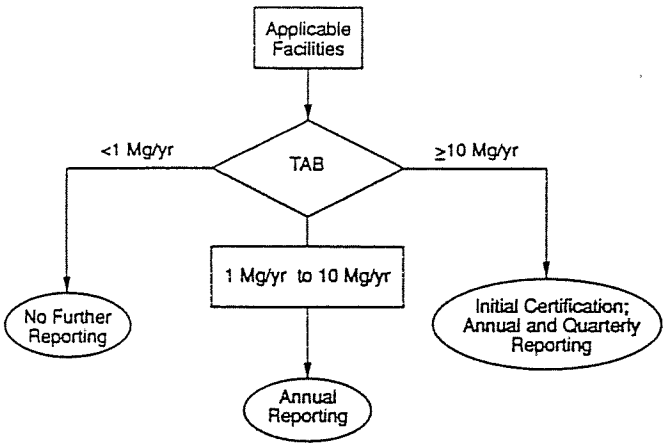
- Initial determination of TAB
- Certification of compliance
- Monitoring and inspections
- Records
- Reports

Compliance

Initial Determination of TAB

- Existing facilities report June 7, 1990
- Updates allowed as new information obtained
- New sources report at startup
- Report to include:
  - TAB for wastes with ≥10% water
  - Identification of streams to be controlled
  - Details on basis for benzene waste streams not controlled

Compliance



Compliance

Certification of Compliance

- Submitted by March 7, 1992, or by date of new source startup
- Certifies installation of required equipment
- Certifies completion of initial testing and inspections

Compliance

Monitoring and Inspections

- For both treatment and control processes:
  - Install continuous monitoring equipment
  - Record all important process parameters
  - Inspect monitoring data daily
- Monthly effluent sampling for treatment processes
- Quarterly visual inspections of covers
- Annual detectable emission surveys for closed-vent systems

Compliance

Recordkeeping Requirements

- Record information documenting compliance
  - Waste determination results
  - Treatment and control equipment design
  - Inspection and monitoring results
- Maintain records onsite for 2 years

Compliance

Reporting Requirements

- Quarterly reports documenting inspections
- Quarterly reports documenting incidences of upsets
- Annual reports summarizing:
  - Incidences of detectable emissions
  - Visual inspections of tears, gaps, etc.
  - Repairs and corrective action

Outline

- Overview
- Applicability
- Control requirements
- Compliance
- Summary

Summary

- The rule applies to owners and operators of:
  - Chemical manufacturing plants
  - Petroleum refineries
  - Coke by-product recovery plants
  - Offsite TSDF receiving waste from above
- Treatment and control required for:
  - Facilities with ≥10 Mg/yr TAB
  - Waste streams within those facilities with ≥10 ppmw benzene

Summary
(continued)

- Treatment requirements
  - <10 ppmw or
  - ≥99 wt % benzene removal
- Control prior to treatment and noncombustion treatment units
  - No detectable emissions
  - ≥ 95% total organic removal

Applicability

What Is a Waste?

- Waste defined very broadly (CAA 40 CFR Part 60, Subpart Kb)
- Excluded Wastes
  - Wastes in the form of gases and vapors
  - Segregated stormwater streams
  - Certain in-process recycle streams

Applicability

Definition of Waste

"Any material resulting from industrial, commercial, mining, or agricultural operations, or from community activities that is discarded or is being accumulated, stored, or physically, chemically, thermally, or biologically treated prior to being discarded, recycled, or discharged."

CASE STUDY

PROCESS VENT RULE
APPLICABILITY
and
COMPLIANCE

Presented at

U.S. Environmental Protection Agency
Workshop on
Air Emissions from Waste Management Facilities

PROCESS VENT CASE STUDY

Review of RCRA Air Emission Standard for Process Vents Hazardous Waste TSDF Operations

Situation

The XYZ Manufacturing Company operates various manufacturing processes that generate approximately 1,000 tons of hazardous waste per year. This qualifies the XYZ Manufacturing Company as a large quantity generator under RCRA . The facility is a RCRA TSDF operating under interim status. As the owner/operator of the facility, you are required to:

1) determine the applicability of the RCRA air rules for process vents (i.e., 40 CFR 265, Subpart AA) to the hazardous waste management unit emission sources at the facility,

2) determine compliance status of current process vent emissions and emission controls in relation to the control requirements in 40 CFR 265, Subpart AA,

3) determine what action can be taken to comply with the regulation, if the emission reductions are required under the process vents standards.

Determinations

1. Determine which process vents are subject to the requirements of Subpart AA and why. For each process vent identified in Figure 1 and 2, circle all of the following statements that are correct (note: some vents will have more than one applicable statement; all relevant and appropriate choices should be circled)

   a. Vent is a process vent associated with one of the unit operations specified in the rule that manages a hazardous waste with organic concentration of greater than 10 ppmw and therefore is subject to the requirements of Subpart AA.

   b. Vent is not a process vent as defined in the rule and therefore is not subject to the requirements of Subpart AA.

   - The operation/process associated with the vent is not one of the unit operations specified in Subpart AA applicability (Section 265.1030(b)), or

   - The passage of gases (i.e., vent emissions) into the atmosphere is not process related. For example, emissions are caused by tank loading and unloading (working losses) rather than the process or unit operation.

   c. Vent is not subject to the requirements of Subpart AA because the waste managed in the unit has an organic concentration concentration of less than 10 ppmw.

   d. Vent is not subject to the requirements of Subpart AA because the operation/process unit associated with the vent is not subject to RCRA Subtitle C or is exempt from RCRA permitting.

Vent No.	Answers	Vent No.	Answers
1	a,b,c,d	10	a,b,c,d
2	a,b,c,d	11	a,b,c,d
3	a,b,c,d	12	a,b,c,d
4	a,b,c,d	13	a,b,c,d
5	a,b,c,d	14	a,b,c,d
6	a,b,c,d	15	a,b,c,d
7	a,b,c,d	16	a,b,c,d
8	a,b,c,d	17	a,b,c,d
9	a,b,c,d		

Comments

a. The process vent rules apply only to those waste management units or unit operations that are specified in the rules. Affected unit operations include: distillation, fractionation, thin-film evaporation, solvent extraction, steam stripping and air stripping.

   Vents on control devices (e.g., condensers and carbon adsorbers) and on tanks serving the affected unit operations (e.g., distillate receivers, bottoms receivers, surge control tanks, decant separator tanks, or hot wells) are also subject to the standards if emission from the process are vented through them (e.g., uncondensed overhead vapors from a distillation operation).

b. A process vent means any open-ended pipe or stack that is vented to the atmosphere either directly, through a vacuum-producing system, or through a tank or air pollution control device. Emissions (i.e., gases or fumes) must be process-related such as evaporation produced by heating or caused by mechanical means such as a vacuum-producing system.

c. The process vent rules apply to affected units managing hazardous waste with a total organic concentration of 10ppmw or greater on an annual average basis. Units managing wastes with an annual average of less than 10ppmw are not subject to the rules.

d. If the unit is exempt from RCRA Subtitle C, it is not subject to the requirements of Subpart AA. Examples of types of RCRA exempt units are listed below:

- Units such as product (not hazardous waste) distillation columns generating organic hazardous waste still bottoms are not subject to the standards while the wastes are in the product distillation column unit.

- Elementary neutralization and wastewater treatment tanks as defined by 40 CFR 260.10.

- Units managing Subtitle D wastes or nonhazardous wastes.

- Generators that accumulate hazardous waste in tanks and containers for 90 days or less.

2. Calculate the total facility process vent emission rate (ER).

Case 1:

$ER_{(Hourly)}=$

$ER_{(Annual)}=$

Case 2:

$ER_{(Hourly)}=$

$ER_{(Annual)}=$

Total Facility ER is equal to the sum emission rates for all individual process vents located at the facility that are subject to the requirements of Subpart AA.

$$ER_{facility} = \sum_{i=1}^{n} ER_{pvi}$$

Process Vent Emission Rate (ER) and Operating Hour(OH) Data:

Case 1:

Vent Id.#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
ER(lb/hr)	9.3	6.1	0.07	0.49	0.16	1.0	0.20	0.12	1.2	0.13	0.06	6.1	8.9	1.2	0.13	0.84	1.5	2.81 ok
OH(hr/yr)	4160	4160	8760	2000	8760	2000	8760	2000	2000	8760	2000	4160	2000	2000	2000	4160	2000	
ER(ton/yr)	19.3	12.7	0.31	0.49	0.7	1.0	0.88	0.12	1.2	0.57	0.06	12.7	8.9	1.2	0.13	1.7	1.5	2.81 ok

Case 2:

Vent Id.#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
ER(lb/hr)	8.1	5.2	0.11	1.0	0.18	0.8	0.08	0.11	1.0	0.15	0.05	4.5	9.0	1.1	0.15	1.7	2.2	2.91 ok
OH(hr/yr)	4160	4160	8760	4000	8760	4000	8760	2000	2000	8760	2000	4160	2000	2000	2000	4160	2000	
ER(ton/yr)	16.8	10.8	0.48	2.0	0.79	1.5	0.35	0.11	1.0	0.66	0.05	9.3	9.0	1.1	0.15	3.5	2.2	4.61

3. Based on the total facility process vent emission rate (ER) calculated above, identify which course of action from among those listed below, is required:

lb/hr & tpy

CASE 1 a. ER below emission rate limits; therefore, no emission reduction required.

b. ER above emission rate limits; must reduce emissions from each individual process vent by 95%.

CASE 2 c. ER above emission rate limits; must reduce total facility process vent emissions by 95%.

or d. ER above emission rate limits; but can control one or more vents to get below limits.

e. ER above emission rate limits; but can reduce operating hours in order to get below the limits.

After identifying all affected process vents, you must determine whether the total facility affected process vent emission rate is below the emission rate limits (see operating data under #2 and compliance criteria given below.)

If the total facility process vent emission rate for hourly or yearly emissions exceeds the limits in the regulation, then some type action must be taken to reduce emissions below the limits. If the emission rate limits cannot be attained, total facility process vent emissions must be reduced, by 95% or more. through use of a control device.

Compliance Criteria

Total facility process vent emission rate must be below the following emission rate limits:

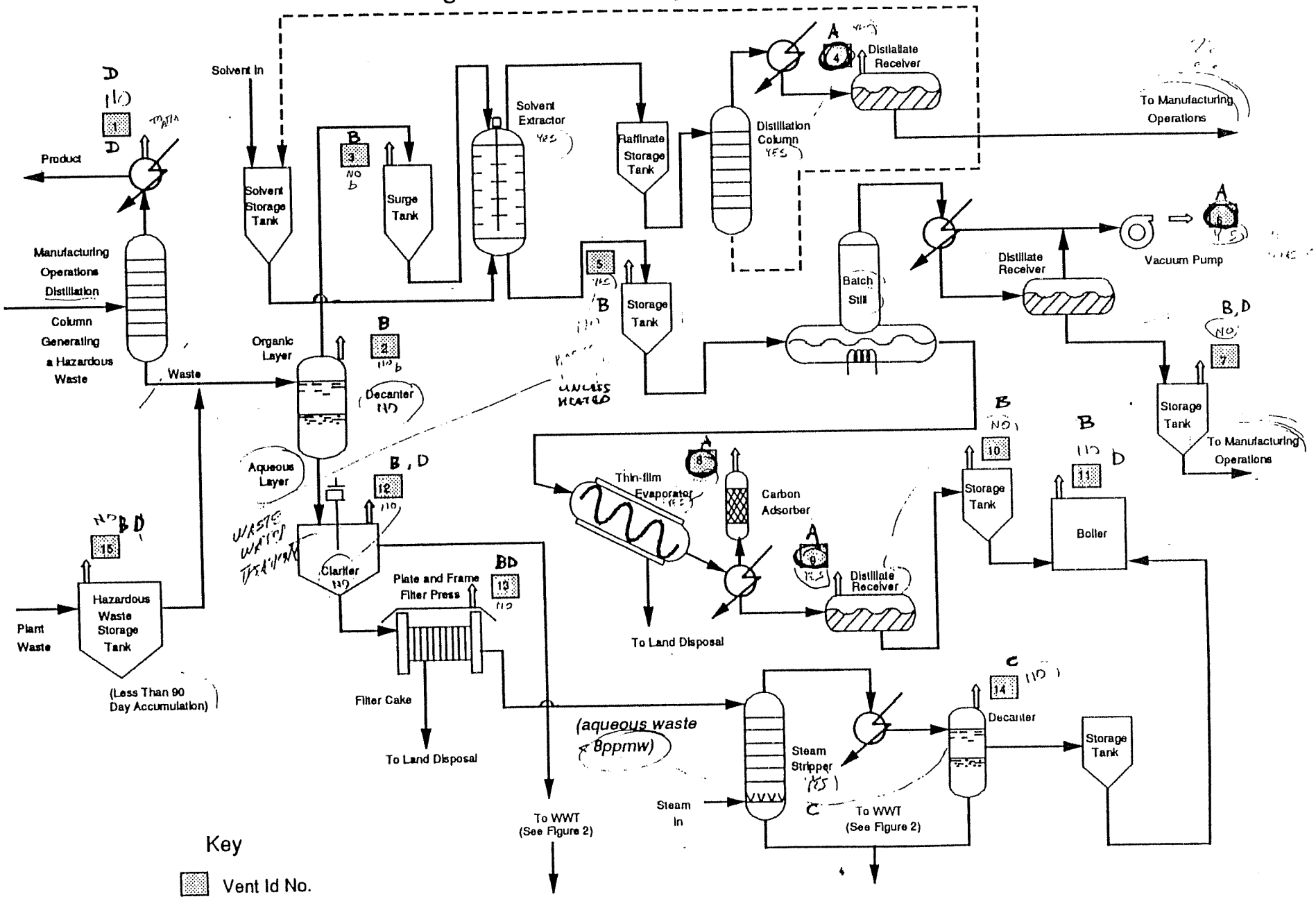
Short Term - < 1.4 kg/h (3 lb/h) **AND** Long Term - < 2.8 Mg/yr (3.1 short tons/yr)

Recommended Control Action

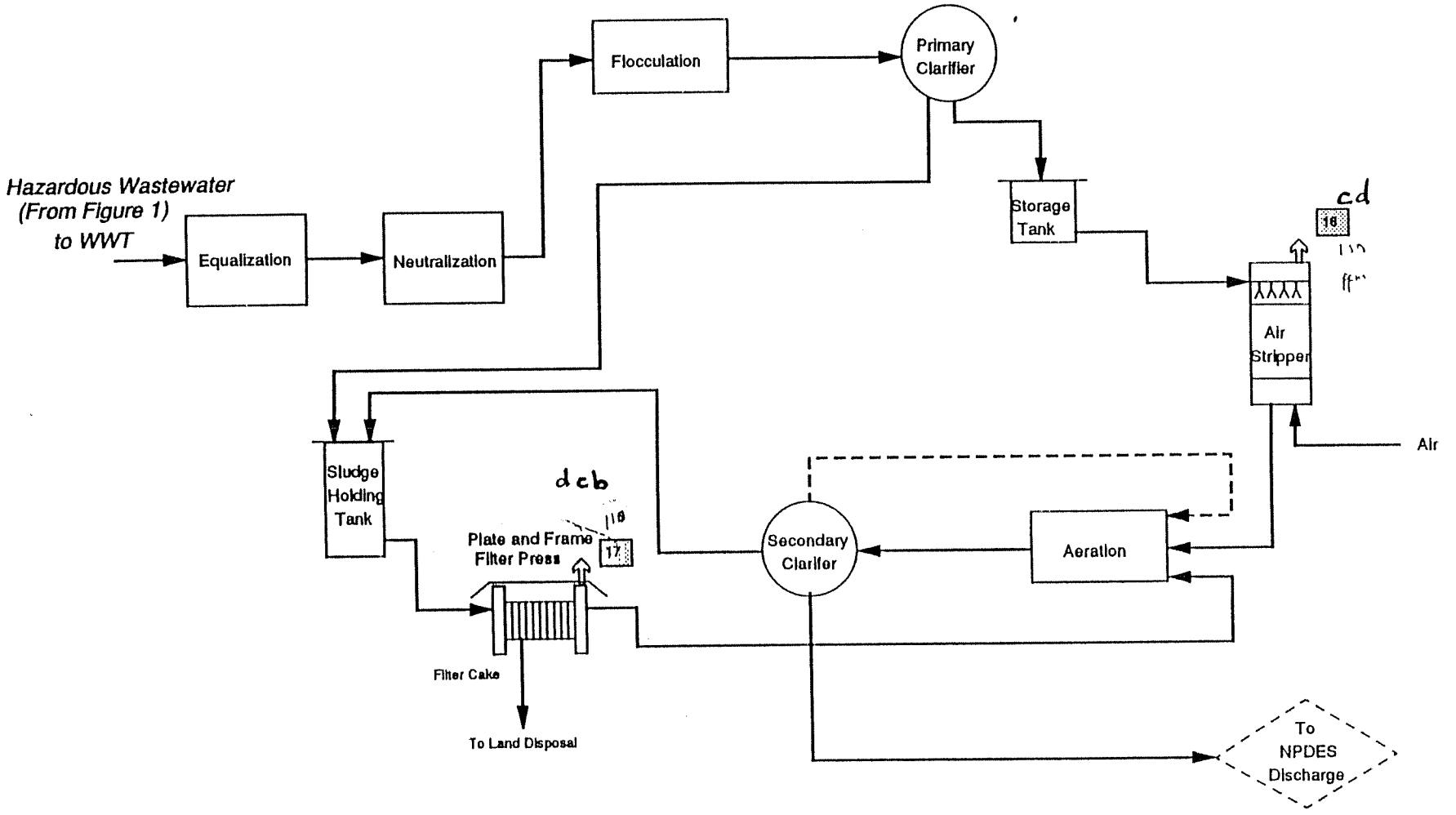
Case 1: _____

Case 2: _____

Figure 1. Case Study Facility XYZ



Note: Organic concentration of all streams (unless otherwise noted): 1,000 - 900,000 ppmw
Organic concentration of wastewater treatment (WWT) plant streams: <9 ppmw



Key

Vent Id No.

Vent

Note: Organic concentration of wastewater treatment (WWT) plant streams: < 9 ppmw

Figure 2. Case Study Facility XYZ Wastewater Treatment Plant (WWT) with NPDES Permit

APPLICATION of BENZENE WASTE OPERATIONS NESHAP to WASTEWATER TREATMENT SYSTEMS CASE STUDY

PROBLEM SOLUTION

1.	Individual Drain Systems	a	**b**	**c**	**d**
2.	Sour Water Stripper	a	b	**c**	**d**
3.	Oil/Water Separator	a	**b**	**c**	**d**
4.	DAF Unit	a	**b**	**c**	**d**
5.	Primary Clarifier	a	b	**c**	**d**
6.	Equalization Basin	a	b	**c**	**d**
7.	Activated Sludge Tank	**a**	b	c	d
8.	Secondary Clarifier	**a**	b	c	d
9.	Trickling Filter	a	b	**c**	**d**
10.	Clarifier	a	b	**c**	**d**
11.	Polishing Pond	**a**	b	c	d

The attached figure highlights the waste management units that require controls. A discussion of the answer for each waste management unit is presented beginning on the following page.

1. **Individual Drain Systems.** Individual process wastewater streams, product tank drawdown streams, and landfill leachate streams containing benzene concentrations above and below 10 ppmw are mixed together in the drain systems for purpose of managing these wastewater streams in the refinery's wastewater treatment system. Therefore, the wastewater treatment system must comply with the requirements specified in Section 61.348(b). The combined wastewater streams contain benzene concentrations greater than 10 ppmw and/or total annual benzene (TAB) quantities greater than 1 Mg/yr. Assuming at this point in the determination that Unit 1 and all remaining units (i.e., Units 2 through 11) are uncontrolled, the total TAB quantity that would be managed in exempt wastewater treatment units is calculated by summing the individual TAB quantities at each location where a waste stream first enters an uncontrolled waste management unit. In this case, the total TAB quantity is calculated to be 310 Mg/yr (the sum of the individual drain system quantities). Thus, the individual drain systems are required to use controls because the conditions specified in answers "b", "c", and "d" are not met.

2. **Sour Water Stripper.** The sour water stripper treats wastewater containing benzene and, therefore, is considered to be part of the refinery wastewater treatment system. The benzene concentration of the wastewater stream entering the unit is less than 10 ppmw (8 ppmw). However, the TAB quantity of the wastewater stream entering the unit is greater than 1 Mg/yr (4 Mg/yr). Assuming at this point in the determination that Unit 2 and the remaining units (i.e., Units 3 through 11) are uncontrolled, the total TAB quantity that would be managed in exempt wastewater treatment units is calculated to be 310 Mg/yr (the sum of the individual TAB quantities entering the sour water stripper, oil/water separator, and trickling filter). Thus, the sour water stripper is required to use controls because the conditions specified in answers "c" and "d" are not met.

3. **Oil/Water Separator.** The benzene concentration of the wastewater stream entering the unit is greater than 10 ppmw (100 ppmw), and the TAB quantity of the wastewater stream entering the unit is greater than 1 Mg/yr (300 Mg/yr). Assuming at this point in the determination that Unit 3 and the remaining units (i.e., Units 4 through 11) are uncontrolled, the total TAB quantity that would be managed in exempt wastewater treatment units is calculated to be 306.5 Mg/yr. Thus, the oil/water separator is required to use controls because the conditions specified in answers "b", "c", and "d" are not met.

4. **DAF Unit.** The effluent from the oil/water separator is discharged directly to the DAF unit. The benzene concentration of the wastewater stream entering the DAF unit is equal to 10 ppmw and the TAB quantity of the wastewater stream entering the DAF unit is greater than 1 Mg/yr (22 Mg/yr). Assuming at this point in the determination that Unit 4 and the remaining units (i.e., Units 5 through 11) are uncontrolled, the total TAB quantity that would be managed in exempt wastewater treatment units is calculated to be 28.5 Mg/yr. Thus, the DAF unit is required to use controls because the conditions specified in answers "b", "c", and "d" are not met. Remember that the standards require the benzene concentration of the wastewater stream entering

the unit to be less than 10 ppmw as one of the conditions to be exempt from having to use controls. Therefore, answer "b" applies to this unit.

5. **Primary Clarifier.** There are two wastewater streams entering the primary clarifier; one stream from the DAF unit and one stream from the sour water stripper. Therefore, the first step is to add the benzene concentrations and TAB quantities from the two streams. The total benzene concentration of the wastewater streams entering the unit is less than 10 ppmw (4 ppmw). However, the total TAB quantity of the wastewater streams entering the unit is greater than 1 Mg/yr (6.5 Mg/yr). Assuming at this point in the determination that Unit 5 and the remaining units (i.e., Units 6 through 11) are uncontrolled, the total TAB quantity that would be managed in exempt wastewater treatment units is calculated to be 12.5 Mg/yr. Thus, the primary clarifier is required to use controls because the conditions specified in answers "c" and "d" are not met.

6. **Equalization Basin.** The equalization basin only receives wastewater from the primary clarifier. Consequently, the benzene concentration of the wastewater stream entering the unit remains less than 10 ppmw (2 ppmw). However, the total TAB quantity of the wastewater stream entering the unit still is greater than 1 Mg/yr (6.2 Mg/yr). Thus, the unit is required to use controls. Assuming at this point in the determination that Unit 6 and the remaining units (i.e., Units 7 through 11) are uncontrolled, the total TAB quantity that would be managed in exempt wastewater treatment units is calculated to be 12.2 Mg/yr. Thus, the equalization basin is required to use controls because the conditions specified in answers "c" and "d" are not met.

7. **Activated Sludge Tank.** The activated sludge tank is considered an "enhanced biodegradation unit" in accordance with the requirements specified in Section 61.348(b)(2)(ii)(B) of the rule. This section of the rule specifies that the TAB quantity managed or treated in an enhanced biodegradation unit is not included in the calculation of the TAB quantity, if the enhanced biodegradation unit is the first exempt unit (i.e., uncontrolled unit) in which the waste is managed or treated. Therefore, the only requirement the activated sludge tank must meet to be exempt from having to use controls is for the benzene concentration of the wastewater stream entering the unit to be less than 10 ppmw. The benzene concentration of the wastewater stream entering the activated sludge tank is 1.6 ppmw. Thus, the activated sludge unit is not required to use controls (answer "a").

8. **Secondary Clarifier.** The secondary clarifier only receives wastewater from the activated sludge tank. As discussed above, the activated sludge unit is an enhanced biodegradation unit which is exempt from having to use controls. Thus, the secondary clarifier is not required to use controls (answer "a") because all of the waste managed in the secondary clarifier is received from an uncontrolled unit.

9. Trickling Filter. The tricking filter is not considered an "enhanced biodegradation unit" because it is a supported growth process rather than a suspended growth process, and it does not recycle biomass. Therefore, the tricking filter must meet both the benzene concentration and TAB quantity conditions in order to be exempt from having to use controls. The benzene concentration of the wastewater stream entering the unit is less than 10 ppmw (8 ppmw). However, the TAB quantity of the wastewater stream entering the unit is greater than 1 Mg/yr (6 Mg/yr). Knowing at this point in the determination that Unit 7 does not require controls and assuming that Unit 9 and the remaining units (i.e., Units 10 and 11) are uncontrolled, the total TAB quantity that would be managed in exempt wastewater treatment units is calculated to be 6 Mg/yr (the sum of the individual TAB quantities entering the activated sludge tank, which is set to 0 Mg/yr because it is an exempt enhanced biodegradation unit, plus the trickling filter). Thus, the trickling filter is required to use controls because the conditions specified in answers "c" and "d" are not met.

10. Clarifier. The clarifier only receives wastewater from the trickling filter. Consequently, the benzene concentration of the wastewater stream entering the unit remains less than 10 ppmw (2 ppmw). However, the total TAB quantity of the wastewater stream entering the unit still is greater than 1 Mg/yr (1.5 Mg/yr). Knowing at this point in the determination that Unit 7 is uncontrolled and assuming that Units 10 and 11 are uncontrolled, the total TAB quantity that would be managed in exempt wastewater treatment units is calculated to be 1.5 Mg/yr (the sum of the individual TAB quantities entering the activated sludge tank, which is set to 0 Mg/yr, plus the clarifier). Thus, the clarifier is required to use controls because the conditions specified in answers "c" and "d" are not met.

11. Polishing Pond. There are two wastewater streams entering the polishing pond; one stream from the secondary clarifier and one stream from the clarifier. Therefore, the first step is to add the benzene concentrations and TAB quantities from the two streams. The total benzene concentration of the wastewater streams entering the unit is less than 10 ppmw (1.1 ppmw). The TAB quantity in the wastewater stream from the clarifier is 0.75 Mg/yr, The TAB quantity in the wastewater stream from the secondary clarifier is 0.3 Mg/yr. However, for the purpose of determining compliance with the standards, the wastewater stream entering the secondary clarifier is set to 0 Mg/yr (refer to the discussion for the secondary clarifier). Consequently, it must follow that the waste stream exiting the secondary clarifier is also set to 0 Mg/yr. Even though the total TAB quantity of the wastewater streams entering the polishing pond is actually 1.05 Mg/yr, the total TAB quantity of the wastewater streams entering the unit is calculated to be 0.75 Mg/yr to determine compliance with the standards. Thus, total TAB quantity of the wastewater stream entering the polishing pond is less than 1 Mg/yr, and the unit is <u>not</u> required to use controls (answer "a").

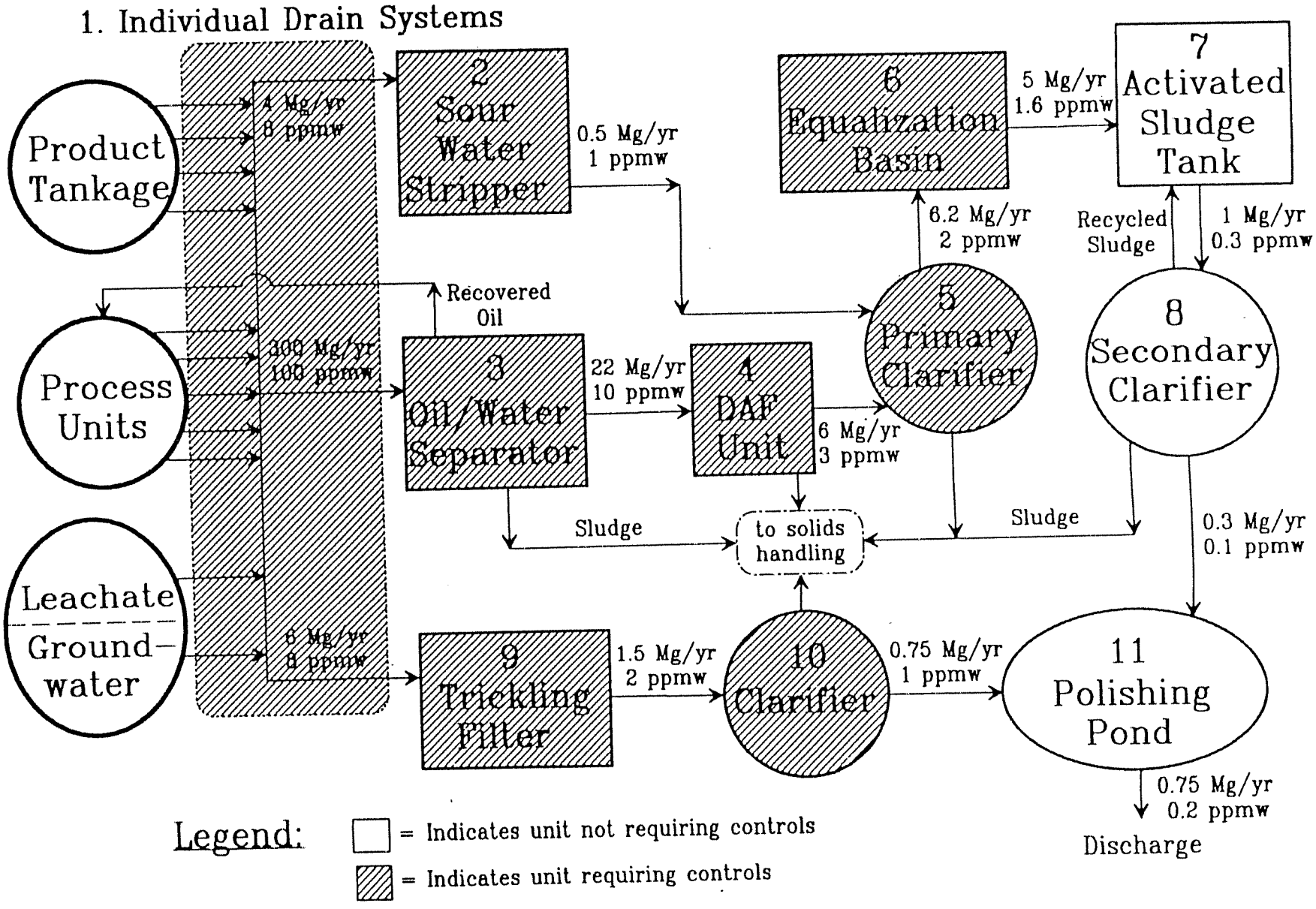


Figure Wastewater treatment system showing benzene concentrations and mass flow rates: Case Study Solution.

Review of RCRA Air Emission Standard for Process Vents
Hazardous Waste TSDF Operations -- Case Study

Solution

1. Vent Ans.

1--------d	5--------b	9--------a	13--------b,d	17--------b,c,d
2--------b	6--------a	10--------b	14--------c,d	
3--------b	7--------b,d	11--------b	15--------b,d	
4--------a	8--------a	12--------b,d	16--------c,d	

2. Case 1: ER Hourly = $\sum_{i=1}^{n} ER_{pvi} = 0.49 + 1.0 + 0.12 + 1.2 =$ **2.81 lb/hr**

ER Annual = $\sum_{i=1}^{n} ER_{pvi} = 0.49 + 1.0 + 0.12 + 1.2 =$ **2.81 tons/yr**

Case 2: ER Hourly = $\sum_{i=1}^{n} ER_{pvi} = 1.0 + 0.8 + 0.11 + 1.0 =$ **2.91 lb/hr**

ER Annual = $\sum_{i=1}^{n} ER_{pvi} = 2.0 + 1.5 + 0.11 + 1.0 =$ **4.61 tons/yr**

3. Case 1: Total Hourly Facility Emission = 2.81 lbs/hr
Total Hourly Facility Emission Cutoff = 3 lbs/hr
2.81 < 3 ; Total Hourly Facility Emission below cutoff

Total Annual Facility Emission = 2.81 ton/yr
Total Annual Facility Emission Cutoff = 3.1 short ton/yr
2.81 < 3.1 ; Total Annual Facility Emission below cutoff

(a) Total facility emissions are below emission rate limits, therefore no further emission reduction required.

Case 2: Total Hourly Facility Emissions = 2.91 lbs/hr
Total Hourly Facility Emission Cutoff = 3 lbs/hr
2.91 < 3 ; Total Hourly Facility Emissions below cutoff

Total Annual Facility Emissions = 4.61 ton/yr
Total Annual Facility Emission Cutoff = 3.1 short ton/yr
4.61 > 3.1 ; Total Annual Facility Emissions above cutoff

(c),(d),(e) Total facility annual emissions above cutoff, must reduce facility process vent emissions by 95%, or control one or more vents to get the total facility process vent emissions below the emission rate limits, or reduce operating hours on vent 4 and 6 (e.g., by at least 50%) to get below the emission rate limits.

EMISSION EQUATIONS: OPEN LIQUID SURFACES

Fick's 2nd law of diffusion

- Basic Equation

$$E = K\,A\,C$$

E = emissions, g/s

K = mass transfer coefficient, m/s

A = area, m^2

C = concentration, g/m^3

- Mass transfer coefficient, m/s

$$1/K = 1/k_L + 1/(k_G \bullet K_{eq})$$

k_L = liquid-phase coefficient, m/s

k_G = gas-phase coefficient, m/s

K_{eq} = equilibrium constant, dimensionless

- Liquid-phase coefficient, m/s (calm surfaces)

$$k_L = [2.605 \times 10^{-9}\,(F/D) + 1.3 \times 10^{-7}]\,U^2\,[D_w/D_{ether}]^{2/3}$$

(For $U > 3.25$ and $14 < F/D < 51$)

F/D = fetch-to-depth ratio

U = windspeed, m/s

D_w = diffusivity in water, cm^2/s

D_{ether} = diffusivity of ether in water, cm^2/s

- Gas-phase coefficient, m/s (calm surfaces)

$$k_G = 4.8 \times 10^{-3}\ U^{0.78}\ Sc^{-0.67}\ d_e^{-0.11}$$

Sc = air viscosity/(air density • D_a)

D_a = diffusivity in air, cm^2/s

d_e = effective diameter of source, m

- Equilibrium constant (aqueous wastes)

$$K_{eq} = H / (R\ T)$$

H = Henry's law constant, atm•m^3/mol

R = gas constant, 8.2×10^{-5} atm•m^3/mol•K

T = temperature, K

- Biodegradation: Monod kinetics

$$r = V\ K_{max}\ b_i\ C / (K_s + C)$$

r = biodegradation rate, g/s

V = volume, m^3

K_{max} = maximum rate constant, g/s•g biomass

b_i = biomass concentration, g/m^3

C = concentration, g/m^3

K_s = half saturation constant, g/m^3

For high concentrations:

$$r = V\ K_{max}\ b_i$$

For low concentrations:

$$r = V\ K_{max}\ b_i\ C / K_s$$

- **Liquid-phase coefficient, m/s (turbulent surface)**

$k_L = [8.2 \times 10^{-9}\ J\ POWR\ (1.02)^{t-20}\ O_t\ 10^6\ MW/(V\ a_v\ \rho)]\ (D_w/D_{O2})^{.5}$

J = oxygen transfer rating, lb/h•hp

$POWR$ = power to aerators, hp

T = temperature, °C

O_t = oxygen transfer correction factor

MW = molecular weight of liquid

V = aerated volume, ft^3

a_v = surface to volume ratio, ft^{-1}

ρ = density of liquid, g/cm^3

D_w = diffusivity in water, cm^2/s

D_{O2} = diffusivity of O_2 in water, cm^2/s

- **Gas-phase coefficient, m/s (turbulent surface)**

$k_G = 1.35 \times 10^{-7}\ R_e^{1.42}\ p^{.4}\ Sc^{.5}\ F_r^{-.2}\ D_a\ MW_a\ /\ d$

$R_e = d^2\ w$ (air density)/(air viscosity)

d = impeller diameter, cm

w = speed of impeller, rad/s

$p = P_I\ g_c\ /\ (\rho\ d^{*5}\ w^3)$

P_I = power to impeller, ft•lb/s

g_c = constant, 32 lb_m•$ft/s^2/lb_f$

d^* = impeller diameter, ft

S_c = air viscosity/(air density•D_a)

$F_r = d^*\ w^2\ /\ g_c$

MW_a = molecular weight of air

Other symbols as previously defined

- Land treatment model (porous solids)

short term:

$(K_{eq}\ D_e\ t / l^2 < 0.213)$

$$E = M_o/l\ [1/(\varepsilon_a/K_{eq}\ k_G + (\pi t/D_e\ K_{eq})^{.5})]\ e^{-t/tb}$$

long term:

$(K_{eq}\ D_e\ t / l^2 >/ 0.213)$

$$E = M_o\ (2\ K_{eq}\ D_e/l^2)\ \exp(-a - t/tb)$$

E = emissions, $g/cm^2/s$

$a = K_{eq}\ D_e\ \pi^2\ t / 4\ l^2$

M_o = initial loading, g/cm^2

l = mixing depth, cm

ε_a = air porosity

t = time after application, s

tb = biological decay time constant

D_e = diffusion coefficient, cm^2/s

- **Diffusion coefficient**

$$D_e = D_a\ \varepsilon_a^{10/3} / \varepsilon_T^2$$

D_a = diffusivity in air, cm^2/s

ε_a = soil air-filled porosity

ε_T = total porosity