How is Human Health Risk Determined?

- EPA estimates risk by using a four step risk assessment method

The Four Steps of Risk Assessment

- Hazard Identification
  - Is this chemical harmful to humans?
- Exposure Assessment
  - How much of the chemical are people being exposed to over what time period?
- Dose-Response Assessment
  - What amount of injury is this level of exposure likely to cause?
- Risk Characterization
  - What is the **extra** risk to human health caused by this amount of exposure to this chemical?

Step 1: Hazard Identification

What health problems may be caused by a specific chemical?

- Based on best available information
  - statistical studies of disease in humans
  - laboratory studies with animals
- Already completed for many chemicals
  - EPA Integrated Risk Information System (IRIS) database
  - Health Exposure Affects Summary Tables (HEAST)
  - National Center for Environmental Assessment (NCEA)

CLINTON COAL GAS
CLINTON, IA

MAR. 25, 1999 CAG PRESENTATION BY KSU-TOSC

cyanide – [illegible] a particular compound
ferro ferric cyanide

Site: [illegible]
ID #: IAD984591438
Break: 13.4
Other: [illegible]
3-25-99

#50043

An Overview of Quantitative Risk Assessme

OU#00

a presentation
to the Clinton, Iowa CAG
by
Terrie Boguski

The Great Plains/Rocky Mountain
Hazardous Substance Research Cente

File: Community Relations

Purpose of Presentation

- to assist CAG members in preparing to review and comment on the Clinton Iowa risk assessment report

What is Risk Assessment?

- A method to estimate increased risk of:
  - **human health problems**
  - adverse ecological effects

  as a result of exposure to a toxic pollutant.

How is Human Health Risk Determined?

- EPA estimates risk by using a four step risk assessment method

The Four Steps of Risk Assessment

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  - How much of the chemical are people being exposed to over what time period?
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  - What is the **extra** risk to human health caused by this amount of exposure to this chemical?

Step 1: Hazard Identification

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  - statistical studies of disease in humans
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  - National Center for Environmental Assessment (NCEA)

Some Toxic Pollutants found at our site

- Benzene - a volatile organic compound (VOC)
- Benzo(a)pyrene - a polyaromatic compound (PAH)
- Pentachlorophenol - a phenolic compound
- Arochlor 1016 - a polychlorinated biphenyl (PCB)
- Cyanide - an inorganic compound

Benzene

- Sources
  - cigarette smoke
  - volcanoes and forest fires
  - gasoline
  - petroleum products
  - pesticides
- Effects of long-term exposure
  - bone marrow damage
  - anemia
  - leukemia

Benzo(a)pyrene

- Sources
  - cigarette smoke
  - wood stoves
  - automobile exhaust
  - coal tar
  - wood preservatives
- Effects of long-term exposure
  - likely cancer-causing
  - possible birth defects

Pentachlorophenol

- Sources
  - wood preservatives
  - hazardous waste sites
- Effects of long-term exposure
  - liver, kidney, blood, lung, nervous system, immune system, and digestive system damage
  - possibly cancer-causing

PCBs, such as Arochlor 1016

- Sources
  - coolants and lubricants for electrical equipment
  - old fluorescent lighting fixtures and old appliances
  - hazardous waste sites
- Effects of long-term exposure
  - nose, lungs, and skin irritation
  - possible birth defects
  - possible liver, stomach, and thyroid damage
  - likely cancer-causing

Cyanide

- Sources
  - cigarette smoke
  - industry wastes
  - foods such as lima beans and almonds
- Effects of long-term exposure
  - breathing difficulties
  - heart pains
  - blood changes
  - headaches
  - thyroid enlargement

Hazard Identification for Properties

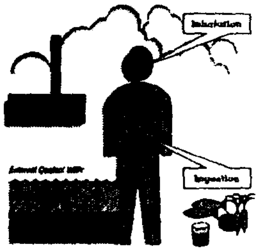
- What toxic pollutants are present at the site?
- Are they in the soil, groundwater, surface water?
- Are toxic vapors being released to the air?
- What is the lateral and vertical extent of contamination?

Step 2: Exposure Assessment

Are people being exposed to toxic pollutants?

- By what exposure pathways?
  - ingestion into the digestive system
  - inhalation into the lungs
  - absorption through the skin

Exposure Pathways



Missouri Risk Assessment

Exposure pathways

Page 1, Paragraph 3

- incidental ingestion of contaminated soil (eating dirt)
- dermal contact with contaminated soil (getting dirt on skin)
- ingestion of contaminated groundwater (drinking the groundwater)
- dermal contact with contaminated groundwater (washing with groundwater)

Missouri Risk Assessment

Page 4, last paragraph and top of page 5

- exposure to contaminated air was not considered a risk
- exposure to surface water was not considered a risk

Step 2: Exposure Assessment

Are people being exposed to toxic pollutants?

- In what amounts?
  What concentrations are present?
  Where?

Missouri Risk Assessment

Concentration values

Page 4, Paragraph 3

- Concentrations of contaminants were assumed to remain constant over time
- For soil contaminants, 95% confidence limits of the mean concentration values were used
- For groundwater contaminants, maximum concentrations were used

Exposure Assessment for Properties

Present and future land use is an issue

- Public or recreational use
  - children may eat surface soil
  - people may swim in surface waters
- Industrial use
  - contaminants may be contained and covered by buildings and parking lots

Missouri Risk Assessment

Page 1, Paragraph 3

- residential exposure
  (someone lives at the site or close by)
- occupational exposure
  (someone works at the site)

Exposure Assessment

- Default exposure factors are often used
- For example:

The EPA Superfund program estimates Reasonable Maximum Exposure (RME) by assuming that an adult:

- drinks 2 liters (about 1/2 gallon) of water per day
- for 350 days per year
- for 30 years
- and weighs 70 kilograms (about 154 pounds)

Missouri Risk Assessment

Pages 12 & 13 Five exposure scenarios

- future resident living on site for 30 years
  - 350 days per year
  - weighs 33 pounds until age 6 and then weighs 154 pounds
  - drinks and bathes in the groundwater
  - eats some dirt
  - wears short pants, short-sleeved shirt, shoes and socks and has direct contact with the soil

Missouri Risk Assessment

Pages 12 & 13 Five exposure scenarios

- a teenage trespasser
  - visits the site twice a week during 3 summer months for 5 years
  - eats some dirt
  - wears short pants, short-sleeved shirt, shoes and socks and has direct contact with the soil

Missouri Risk Assessment

Pages 12 & 13 Five exposure scenarios

- a maintenance worker
  - weighs 154 pounds (70 kilograms)
  - mows grass and performs surface maintenance
  - 78 days per year for 25 years
  - eats some dirt
  - wears short-sleeved shirt, pants, shoes and socks and has direct contact with the soil

Missouri Risk Assessment

Pages 12 & 13 Five exposure scenarios

- a worker exposed to surface soil only
  - weighs 154 pounds (70 kilograms)
  - works on the site 250 days per year for 25 years
  - drinks and washes his/her hands in the groundwater
  - eats some dirt
  - wears short-sleeved shirt, pants, shoes and socks and has direct contact with the soil

Missouri Risk Assessment

Pages 12 & 13 Five exposure scenarios

- a worker doing below ground maintenance
  - weighs 154 pounds (70 kilograms)
  - works on the site 20 days per year for 8 years
  - eats some dirt
  - wears short-sleeved shirt, pants, shoes and socks and has direct contact with the soil

Step 3: Dose-Response Assessment

What is the relationship between the amount of exposure and the health effect?

- Estimates are made based on:
  - health data
  - animal studies
  - assumptions about long term exposure

Dose-Response Assessment

for non-cancer health effects

- dose-response is expressed as an oral reference dose (RfD) or inhalation reference concentration (RfC)
  - this is dose or concentration below which no adverse health effects are expected to occur

Oral Reference Doses (RfD)

Page 21

- Benzene 0.0003 milligrams per kilogram of body weight per day
- Cyanide 0.02 milligrams per kilogram of body weight per day

Dose-Response Assessment

for non-cancer health effects

- risk from exposure to a specific quantity is expressed as a Hazard Index (HI)
  - HI = average daily dose divided by RfD
  - For HI less than 1, no adverse effects are expected
- The total HI for each exposure scenario is the sum of the HI for each contaminant

Dose-Response Assessment

for cancer

- dose-response is expressed as cancer potency slope factor
  - this is the cancer risk per unit of dose
  - multiplying the slope factor times the dose equals the increased risk of cancer
- the total increased cancer risk for each scenario is the sum of the increased risk for each contaminant

Oral Slope Factors

Page 22

- Benzene 0.029 milligrams per kilogram of body weight per day
- Benzo(a)pyrene 7.3 milligrams per kilogram of body weight per day
- Pentachlorophenol 0.12 milligrams per kilogram of body weight per day

Dose-Response Assessment

- Example:
  oral cancer slope factor for benzo(a)pyrene is 7.3 per milligram per kilogram of body weight

  Page 45

  ingesting an average of 0.0000033 milligrams of benzo(a)pyrene per kilogram of body weight per day increases a person's risk of cancer by:
  7.3 X 0.0000033 = 0.000024
  or about 1 in 42,000

Step 4: Risk Characterization

What is the extra risk associated with the chemicals present at a specific site?

- Based on:
  - hazard identification
  - exposure assessment
  - dose-response assessment

Missouri Risk Assessment

Scenario	Total Hazard Index
Residential	10
Trespasser	0.75
Maintenance	0.67
Surface Worker	3
Subsurface Worker	0.09

Page 26 & 27 Clinton, MO report

Missouri Risk Assessment

Scenario	Total Excess Lifetime Cancer Risk
Residential	23 in 10,000
Trespasser	2 in 100,000
Maintenance	2 in 10,000
Surface Worker	6 in 10,000
Subsurface Worker	2 in 100,000

Page 43 & 44 Clinton, MO report

What is Acceptable Risk?

- Not easy to define
- Means different things to different groups of people
  - involuntary risk is less acceptable than voluntary risk
- For EPA, acceptable risk is usually:
  - an excess lifetime cancer risk of 1 in 10,000 to 1 in 1,000,000
  - a hazard index (HI) of less than 1
- Individual states may have different criteria

Possible CAG Input

- Are the land use assumptions appropriate?
- Are the exposure scenarios reasonable?
- Are contaminant concentrations used for the calculations representative of the site conditions?

Additional Resources

- **Baseline Human Health Risk Assessment; Clinton Former Manufactured Gas Plant; Henry County, Missouri**
- ***The IRIS database on the Internet at*** http://www.epa.gov/ngispgm3/iris/
- Proposed Guidelines for Carcinogen Risk Assessment; EPA April 1996 (EPA/600/P-92/003C)

RECEIVED

NOV 4 1997

SUPERFUND DIVISION

Baseline Human Health Risk Assessment
Clinton Former Manufactured Gas Plant
Henry County, Missouri

Prepared By:

Bureau of Environmental Epidemiology
Missouri Department of Health
930 Wildwood Drive
Jefferson City, MO 65102

October, 1997

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Appendices

1.0 INTRODUCTION

1.1 Overview

The Clinton Former Manufactured Gas Plant (FMGP) is located in Clinton, Henry County, MO. The land is currently owned by Missouri Public Service (MPS), a division of Utilicorp United, Incorporated. The Clinton FMGP was a gas manufacturing facility that operated between 1885 and 1930. During operations, gas was manufactured utilizing a coal carbonization process. There is visible solidified tar or asphalt present at two locations on the site as well as stained soil. There is no record of the use of the site between 1930 and 1983, excluding use for storage of utility poles. The Environmental Protection Agency (EPA) requested MPS conduct a Removal Site Evaluation (RSE). A RSE investigation was performed by Burns & McDonnell Waste Consultants, Inc. on May 30 and 31, 1995. A Phase II RSE was performed in November, 1996.

1.2 Site Background

The Clinton FMGP began operations in 1885 using a gas retort, purifier rooms and gas holder. During operations, gas was manufactured in retorts where coal was heated to produce volatile gases and coke. The coke was either sold or used as a heating fuel in the gas production. Gas was cleaned through use of a purification process which consisted of passing the gas through a purifier media (lime or iron oxide) mixed with a fluffing agent, such as wood chips or corn cobs in the purifier rooms. Purifier residuals, clinker and ash, removed from manufactured gas process boilers, had little reuse value. These residuals were typically utilized as fill or disposed of at off-site locations. After production, finished gas was transferred to the gas holder for future use during peak gas usage or plant outages. Gas production ceased in approximately 1930. The site is currently fenced and MPS workers periodically visit the site to load or unload stored materials. The area surrounding the site is a combination of commercial and residential properties.

1.3 Scope of the Risk Assessment

This risk assessment examined risks resulting from exposure to contaminated soil and groundwater at the Clinton FMGP site. Exposure pathways examined include incidental ingestion of contaminated soil, dermal contact with contaminated soil, ingestion of contaminated groundwater, and dermal contact with contaminated groundwater. Because private residences, industrial facilities and commercial properties are currently bordering the site and in close proximity, residential and occupational exposure scenarios were evaluated.

1.4 Organization of the Risk Assessment Report

The risk assessment is divided into seven sections. Site history is given in section 1, Introduction. Data collection and analysis are presented in section 2, Chemicals of Concern. Exposure pathways and quantification of intakes are discussed in section 3, Exposure

Assessment. Toxicity information, including Reference Doses (RfD) and Slope Factors (SF), is provided in section 4, Toxicity Assessment. Section 5, Risk Characterization, integrates exposure and toxicity information to determine if human health hazards are present at the site. Uncertainties are also presented in section 5. Conclusions are presented in section 6, the Summary. References are listed in section 7.

2.0 CHEMICALS OF CONCERN

2.1 Site Setting

The Clinton FMGP is located within the city limits of Clinton, MO in Henry County. The site consists of the southwest portion of the 1.9 acre plot of land and occupies portions of Section 2, Township 41 West, Range 26 North. The approximate geographic coordinates of the site are 38 degrees and 22 minutes (') 31 seconds (' ') north latitude and 93 degrees 46' 0'' west longitude. The site is two miles from the Harry S. Truman Reservoir and approximately four miles northwest of both Swan Lake and Poague State Wildlife Refuge.

The site is located within the Osage Plains physiographic province. Topography is characterized by level to gently rolling plains resulting from erosion and weathering of underlying bedrock. The bedrock belongs to the Cherokee Group of the Pennsylvanian system and is primarily limestone, sandstone, and shale that dips northwest at a very low angle (Burns & McDonnell, 1995). The Cherokee Group in the Clinton, MO area extends to a depth between 50-140 feet below the ground surface. Soil thickness at the site varied between 4.6-12 feet in depth. Surface and shallow soil on the site consist largely of fill, such as gravel or clinker. Deeper soils consist of clay with isolated layers of clay mixed with sand, silt or gravel. There is a drainage ditch crossing the site that flows intermittently. The drainage ditch runs from west of Seventh Street to just east of Sixth Street (Figure 1). The intermittent drainage channel discharges to Coal Creek, a permanent stream located approximately 1/4 mile downgradient of the site. Stratified layers of soil and solidified black tar or asphalt material were identified along the side of that drainage ditch in the approximate location of the former tar well. Thin layers of stained soils characterized by metals, volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs) were encountered in subsurface soils on the site. PAHs are environmental contaminants found in coal tar, and are common products of combustion of organic materials. PAHs assessed in the risk assessment include: acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, naphthalene, and pyrene. Blue stained soil, indicative of ferrocyanide, is present in the area believed to be the location of the gas purifier (Burns and McDonnell, 1995).

2.2 Data Collection

2.2.1 Surface Soil

Surface soil samples were collected 0-0.5 feet below ground surface across the site and on adjacent property owned by MPS. A total of fourteen samples were analyzed for semi-volatile organic compounds (SVOCs), inorganics and cyanide. Sediment sampling was performed at three locations along the drainage ditch that crosses the FMGP site. Six surface samples were obtained from areas in the FMGP process area. One surface soil sample was obtained from an adjacent MPS property located north of the FMGP site.

PAH compounds were detected in the surface soil samples obtained from the vicinity of solidified tar or asphalt material present on the site surface. Unless otherwise indicated, all chemicals that were detected once were retained as chemicals of concern. All volatile organic compounds (VOCs) and SVOCs detected were retained. According to Risk Assessment Guidance for Superfund (EPA 1989), chemicals that are (1) essential human nutrients, (2) present at low concentrations (i.e., only slightly elevated above naturally occurring levels) and (3) toxic only at very high doses (i.e., much higher than those that could be associated with contact at the site) need not be considered further in quantitative risk assessment. Barium, beryllium, chromium, copper, mercury, nickel, selenium and vanadium were present in concentrations near background levels for Henry County, Missouri (Tidball 1984), thus they were removed from consideration in this risk assessment.

For those contaminants which were not detected in all of the soil samples, one-half of the detection limit was used (EPA 1989). Summary statistics for surface soil and sediment taken from the FMGP are presented in Table 1.

Because it is unlikely that a resident, trespasser or worker on the Clinton FMGP site would spend all of their time in the most contaminated areas, 95% Upper Confidence Limits (UCL) of the mean contaminant value of all surface and sediment samples were used to estimate contaminant intake (see Table 1). Contaminant concentrations were assumed to remain constant over time, thus the concentrations presented in Table 1 were used to estimate chemical intake for current and future exposure scenarios.

2.2.2 Subsurface Soil

Subsurface soil samples were obtained from 18 locations in the site area and analyzed for volatile organic compounds (VOCs), PAH compounds, target analyte list (TAL) inorganics, and cyanide. Subsurface soil samples were obtained with geoprobe soil sampling from groundsurface to the top of bedrock or refusal, which ranged from 5 to 12 feet below groundsurface. No analysis of VOCs was performed at levels 11-12 feet below groundsurface level when bedrock or refusal was encountered. Summary statistics for subsurface samples taken from the Site are presented in Table 2. PAH compounds were detected, in stained soils and clinker, in an area where it is suspected to have been the location of the former tar well. Barium, beryllium, chromium, copper, mercury, nickel, selenium and vanadium were present in concentrations near background levels for Henry County, Missouri (Tidball 1984), thus they were removed from consideration in this risk assessment (EPA 1989). 95% UCLs of the mean contaminant value of all subsurface soil samples were used to estimate contaminant intake in Table 2. Contaminant concentrations were assumed to remain constant over time, thus the contaminant concentrations presented in Table 2 were used to estimate chemical intake for future exposure scenarios.

2.2.3 Air

Air monitoring was not conducted during the Removal Site Evaluation. EPA Region VII determined that volatilization of manufactured gas process residual constituents at the surface would not be a significant source of volatile compounds. Therefore, this pathway is not evaluated in the risk assessment.

2.2.4 Surface Water

Two surface water samples were obtained upgradient and downgradient from the site and analyzed for SVOCs. Analysis of surface water samples showed no contaminants were present above detection limits. Therefore, this pathway is not evaluated in the risk assessment.

contamination. Therefore, surface water was not retained as a media of concern. Based upon site conditions, EPA Region VII determined that the potential for contaminant release of potentially significant concentrations into air was minimal. Therefore, no air samples have been collected and analyzed at the site. Consequently, this media was excluded from consideration in the risk assessment.

3.3 Exposure Scenarios (ESs)

Because land use surrounding the Clinton FMGP site is residential, a residential exposure scenario was used to estimate risks from exposure to the site. A residential scenario is generally the most conservative scenario and will result in the highest risk estimates. Nearby residents may inhale fugitive dust from the Clinton FMGP site. This pathway was not evaluated, but risks from this type of exposure are expected to be substantially less than risks for an on-site resident because of particle dispersion and deposition. The Clinton FMGP site is currently used for storage of utility poles and railroad ties. Because workers have access to the site, risks to current and future occupational workers were estimated. A portion of the site is accessible to the public. It is possible that children or adolescents could trespass on the site. Risks posed to an adolescent trespasser were estimated. Five Exposure Scenarios (ES) were evaluated in the risk assessment.

ES1 is a 70 kg is a future residential scenario evaluated for a person living on-site over a 30 year period for a combined receptor age 0-30 years, weighing 15 kg (age 0-6 years) and 70 kg (age 6-30 years). The combined receptor lives on the site for 350 days/year. The receptor ingests groundwater and directly contacts groundwater while living on the site. The receptor exposes 7213 cm^2 and 18150 cm^2 of exposed skin to groundwater as a child and adult, respectively. The receptor incidentally ingests and directly contacts surface soil and sediment. As a child, the resident wears a short-sleeved shirt, short pants, shoes and socks with head, arms, hands and legs exposed (4236 cm^2 of exposed skin). As an adult, the resident wears a short-sleeved shirt, pants, shoes and socks with head, arms and hands exposed (4714 cm^2 of expose skin).

ES2 is an adolescent trespasser scenario evaluated for a 43 kg adolescent (aged 11-16) trespassing on the Clinton FMGP site twice a week during three summer months a year over a 5 year period. The adolescent wears a short-sleeved shirt, short pants, shoes and socks (8322 cm^2 of exposed skin). The adolescent incidentally ingests contaminated soil and sediment and directly contacts contaminated soil and sediment while trespassing on the site.

ES3 is a current maintenance occupational scenario evaluated for a 70 kg adult who mows the grass and performs surface maintenance on the site. The subject is on the site for 78 days a year for a 25 year period. The subject incidentally ingests and directly contacts surface soil and sediment. The worker wears pants, a short-sleeved shirt, shoes and socks while working on the site. The area of exposed skin is 3419 cm^2 .

ES4 is a future occupational scenario evaluated for a 70 kg adult exposed daily to surface soil and sediment (occupational without excavation) while working on the site for a total of 250 days/year over a 25 year period. Exposure results from ingestion of groundwater and dermal contact with groundwater. He has an exposed surface area of 904 cm^2 (hands only) to the groundwater. He is also exposed through incidental ingestion and dermal contact with surface soil and sediment. The future surface occupational worker does not conduct surface or subsurface maintenance on the site. The worker wears a short-sleeved shirt, pants, shoes and socks with exposed skin area to the surface soil of 3419 cm^2 .

ES5 is a future subsurface worker scenario evaluated for a person who is exposed to subsurface soil (i.e., in a trench) while working on the site. The worker is a 70 kg adult who conducts, repairs or performs below ground maintenance work. The subsurface worker averages a 20 days per year on the site for a total of 8 years. The worker incidentally ingests and directly contacts contaminated subsurface soil. The future subsurface worker wears a short-sleeved shirt, pants, shoes and socks with head, arms and hands exposed while working on the site. The area of exposed skin is 3419 cm^2.

3.4 Calculation of Contaminant Intake

Intake rates for all contaminants were quantified using pathway-specific equations given in EPA's (1989) Risk Assessment Guidance for Superfund: Volume I (RAGS). Chemical intakes for all of the occupational exposure scenarios and the adolescent trespasser scenario are as follows:

<u>Ingestion of Contaminated Groundwater:</u>

Intake (mg/kg/day) = CW x IRw x EF x ED / (BW x AT)

<u>Dermal Contact with Contaminated Groundwater:</u>

Absorbed Dose (mg/kg/day) = CW x CF x SA x PC x ET x EF x ED / (BW x AT)

<u>Incidental Ingestion of Contaminated Soil:</u>

Intake (mg/kg/day) = CS x IRs x CF x FI x EF x ED / (BW x AT)

<u>Dermal Contact with Contaminated Soil:</u>

Absorbed Dose (mg/kg/day) = CS x CF x SA x AF x ABS x EF x ED / (BW x AT)

Chemical intakes for the age-adjusted residential scenario were calculated using the equations obtained from Risk Assessment Guidance for Superfund: Part B (EPA 1991) or developed by analogy as follows:

<u>Residential Ingestion of Contaminated Groundwater:</u>

Intake (mg/kg/day) = [(CW x EF)/AT] x [(IRc x EDc)/ BWc + (IRa x EDa)/BWa]

<u>Residential Dermal Contact with Contaminated Groundwater:</u>

Absorbed Dose (mg/kg/day) = [(CW x CF x PC x ET x EF)/AT] x [(SAc x EDc)/BWc +
(SAa x EDa)/BWa]

Table 5.
Summary of Noncarcinogenic Toxicity Information for Chemicals Found at the Clinton Former Manufactured Gas Plant, Clinton, MO

Chemical	Reference	Oral RfD (mg/kg/day)	Effect of Concern
2-Butanone	IRIS	6.0×10^{-1}	Decreased fetal birth weight
Methylene Chloride	IRIS	6.0×10^{-2}	Liver toxicity
Acetone	IRIS	1.0×10^{-1}	Increased liver & kidney weights
Carbon Disulfide	IRIS	1.0×10^{-1}	Fetal toxicity, malformations
Chloroform	IRIS	1.0×10^{-2}	Liver lesions
Benzene	NCEA	3.0×10^{-4}	Hematological effects
Toluene	IRIS	2.0×10^{-1}	Altered kidney and liver weights
Ethylbenzene	IRIS	1.0×10^{-1}	Liver and kidney toxicity
Styrene	IRIS	2.0×10^{-1}	Red blood cell, liver and CNS effects
Xylene (Total)	IRIS	2.0×10^{0}	Hyperactivity, decr. body weight and incr. mortality
Naphthalene	NCEA	4.0×10^{-3}	Hemolytic anemia
Acenaphthene	IRIS	6.0×10^{-2}	Hepatoxicity
Fluorene	IRIS	4.0×10^{-2}	Decreased red blood cell count, packed cell volume hemoglobin level
Fluoranthene	IRIS	4.0×10^{-2}	Nephropathy, incr. liver wt., hematological changes
Anthracene	IRIS	3.0×10^{-1}	NOAEL
Pyrene	IRIS	3.0×10^{-2}	Renal tubular pathology, decreased kidney weights
4-Methylphenol	HEAST	5.0×10^{-2}	Hyperactivity, resp. distress, maternal death
2-Methylphenol	IRIS	5.0×10^{-2}	Decreased body weight, neurotoxicity
2,4-Dimethylphenol	IRIS	2.0×10^{-2}	Nervous system effects, blood alterations
Phenol	IRIS	6.0×10^{-1}	Reduced fetal body weight
Dibenzofuran	NCEA	$4.0\ 10^{-3}$	Kidney abnormalities
Bis(2-Ethylhexyl)phthalate	NCEA	2.0×10^{-2}	Increased relative liver weight
Aluminum	NCEA	1.0×10^{0}	Neurological effects
Antimony	IRIS	4.0×10^{-4}	Decreased longevity, disturbances in blood glucose and cholesterol
Arsenic	IRIS	3.0×10^{-4}	Hyperpigmentation, keratosis, possible vascular complications
Barium	IRIS	7.0×10^{-2}	Incr. blood pressure, fetotoxicity from inhalation
Beryllium	IRIS	5.0×10^{-3}	NOAEL
Cadmium	IRIS	5.0×10^{-4}	Significant protenuria
Chromium III	IRIS	1.0×10^{0}	NOAEL
Chromium VI	IRIS	5.0×10^{-3}	NOAEL
Copper	Provisional*	3.7×10^{-2}	Irritation of gastrointestinal system
Cyanide	IRIS	2.0×10^{-2}	Weight loss, thyroid effects and myelin
Manganese	IRIS	1.4×10^{-1}	Neurologic tremors, weakness, fatigue
Nickel	IRIS	2.0×10^{-2}	Decreased body and organ weights
Selenium	IRIS	5.0×10^{-3}	Clinical selenosis
Silver	IRIS	5.0×10^{-3}	Argyria
Thallium	NCEA	7×10^{-5}	Increased SGOT and serum LDH levels, alopecia
Vanadium	HEAST	7×10^{-3}	None available
Zinc	IRIS	3.0×10^{-1}	Decrease enzyme levels

HEAST-Health Exposure Affects Summary Tables, FFY95 Annual Volume.
IRIS-Integrated Risk Information System.
NCEA-National Center for Environmental Assessment
NOAEL - No Observed Adverse Effects Level
*Provisional RfD derived from Environmental Protection Agency equation: $\text{RfD} = \frac{\text{Drinking Water Criteria* Intake Rate}}{\text{Body Weight}}$

Table 6.

Summary of Carcinogenic Toxicity Information for Chemicals Found at the Clinton Former Manufactured Gas Plant, Clinton, MO

Chemical	Reference	Weight of Evidence	Oral Slope Factor (mg/kg/day)	Site of Tumor
Methylene Chloride	IRIS	B2	7.5×10^{-3}	Liver, lung, leukemia
Chloroform	IRIS	B2	6.1×10^{-3}	Kidney, liver
Benzene	IRIS	A	2.9×10^{-2}	Blood
Bis(2-Ethylhexyl)phthalate	IRIS	B2	1.4×10^{-2}	Liver
Benzo(A)Pyrene*	IRIS	B2	7.3×10^{0}	Lung and digestive system
Benzo(A)Anthracene	Provisional**	B2	7.3×10^{-1}	Lung, Liver
Chrysene	Provisional**	B2	7.3×10^{-2}	Lung, Liver
Benzo(B)Fluoranthene*	Provisional**	B2	7.3×10^{-1}	Lung, Thorax
Benzo(K)Fluoranthene*	Provisional**	B2	7.3×10^{-2}	Lung, Thorax
Dibenz(A,H)Anthracene	Provisional**	B2	7.3×10^{0}	Lung
Indeno(1,2,3-CD)Pyrene	Provisional**	B2	7.3×10^{-1}	Lung, Thorax, Skin
Pentachlorophenol	IRIS	B2	1.2×10^{-1}	Liver
Carbazole	HEAST	B2	2.0×10^{-2}	Liver
Arsenic	IRIS	A	1.5×10^{0}	Lung, Liver, Kidney, Skin & Bladder
Beryllium	IRIS	B2	4.3×10^{0}	Gross tumors, Lung

NA-Not Available

IRIS-Integrated Risk Information System

*Oral to dermal route extrapolation is not appropriate for this chemical

**Calculated SF using the formula $SF_{PAH} = SF_{benzo(a)pyrene}$ x Toxic Equivalency $Factor_{PAH}$ (NCEA 1993)

5.0 RISK CHARACTERIZATION

5.1 Noncarcinogenic Risks

Noncancer hazard quotients were calculated for each contaminant in each pathway by dividing the Chronic Daily Intake (CDI) by the RfD. The noncancer hazard quotients within an exposure pathway were summed to give the pathway hazard indices. The Total Hazard Index was then calculated by summing the pathway hazard indices. According to RAGS, human health risks may exist when the Total Hazard Indices exceeds unity (1.0). Tables 9-13 present the hazard quotients and total hazard indices of each exposure scenario. The hazard quotients and indices are expressed as two significant figures. Calculation worksheets for each scenario are presented in Appendix III.

Five metals (silver, copper, cyanide, nickel and zinc) found in surface soil at the Clinton FMGP site were excluded from the quantitative analysis for dermal exposure because an oral to dermal route extrapolation was not appropriate. Silver, copper and nickel may cause skin discoloration, contact dermatitis, allergic reactions or localized pruritis (itching); consequently oral RfDs may not protective for these effects. Dermal contact with copper, cyanide and zinc may bypass major detoxification mechanisms and possibly causes oral RfDs not to be protective. A qualitative assessment of these effects is presented in Table 8.

5.1.1 ES1 - Residential

The total hazard index for ES1 was 10. Pathway hazard indices for ingestion of contaminated water, dermal contact with contaminated water, and dermal contact with contaminated soil exceeded 1.0. Aluminum, antimony, arsenic, and manganese contributed substantially to the pathway hazard indices for ingestion of contaminated water and dermal contact with contaminated water. Antimony contributed substantially to the pathway hazard index for dermal contact with contaminated soil. Because the total hazard index and pathway hazard indices for chemicals and metals exceeded 1.0, health risks may be present for an adult living on the site directly contacting contaminated soil and drinking and showering in contaminated private well water (Table 9).

5.1.2 ES2 - Adolescent Trespasser

The total hazard index for ES2 was 0.75. None of the pathway hazard indices exceeded 1.0 (Table 10). Therefore, adverse health effects are not expected.

5.1.3 ES3 - Current Maintenance Occupational Worker

The total hazard index for ES3 was 0.67. None of the pathway hazard indices exceeded 1.0 (Table 11). Therefore, adverse health effects are not expected.

5.1.4 ES4 - Future Surface Occupational Worker

The total hazard index for ES4 was 3. Pathway hazard indices for dermal contact with contaminated soil exceeded 1.0. Antimony contributed substantially to the pathway hazard index for dermal contact with contaminated soil. Because the total hazard index and pathway hazard indices for several chemicals and metals exceeded 1.0, health risks may be present for an adult working on the site directly contacting contaminated soil (Table 12).

5.1.5 ES5 - Future Subsurface Occupational Worker

The total hazard index for ES5 was 0.09. None of the pathway hazard indices exceeded 1.0 (Table 13). Therefore, adverse health effects are not expected.

5.2 Carcinogenic Risks

Lifetime excess cancer risks were calculated for each contaminant in each pathway by multiplying the slope factor by the Chronic Daily Intake (CDI). Within a pathway, the chemical specific risks were summed to give the total pathway risk. The Total Excess Lifetime Cancer Risk was then determined by summing the total pathway risks. EPA generally considers a Total Excess Lifetime Cancer Risk for an Exposure Scenario at a Superfund site which exceeds 1 x 10^{-4} (1 in 10,000) to be unacceptable. Calculation worksheets for each scenario are presented in Appendix III.

Some PAHs (benzo(a)pyrene, benzo(b)fluoranthene and benzo(k)fluoranthene) found in surface soil at the Clinton FMGP site were excluded from the quantitative analysis for dermal exposure because an oral to dermal route extrapolation was not appropriate. These PAHs can potentially cause skin cancer at the point of application. Dermal exposure to these PAHs was evaluated qualitatively (see Table 8).

5.2.1 ES1 - Residential

The total excess lifetime cancer risk for ES1 was 2.3 x 10^{-3} (23 in 10,000). The pathway cancer risks for ingestion of contaminated drinking water and ingestion of contaminated soil both exceeded 1 in 10,000. The highest ingestion of contaminated water pathway cancer risk for individual chemicals was from arsenic. The highest ingestion of soil cancer risk for individual chemicals was from benzo(a)pyrene, benzo(a)anthracene, and dibenz(a,h)anthracene. Because the excess lifetime cancer risk for ingestion of contaminated water and soil exceeded 1 x 10^{-4} (1 in 10,000), cancer risks may be present for a combined residential receptor living on the site incidentally ingesting contaminated soil and drinking contaminated private well water (Table 14).

5.2.2 ES2 - Adolescent Trespasser

The total excess lifetime risk for ES2 was 1.7 x 10^{-5} (2 in 100,000). No pathway cancer risks exceeded 1 in 10,000. The total excess lifetime did not exceed 1 x 10^{-4} (1 in 10,000), thus unacceptable cancer risks are not expected for an adolescent trespassing on the site, incidentally ingesting and directly contacting contaminated soil (Table 15).

5.2.3 ES3 - Current Maintenance Occupational Worker

The total excess lifetime cancer risk for ES3 was 1.5 x 10^{-4} (2 in 10,000). Pathway cancer risk for ingestion of contaminated soil exceeded 1 x 10^{-4} (1 in 10,000). The highest ingestion of soil cancer risk for individual chemicals was from benzo(a)pyrene and dibenz(a,h)anthracene. Because the excess lifetime cancer risk for ingestion of contaminated soil exceeded 1 x 10^{-4} (1 in 10,000), cancer risk may be present for a current maintenance occupational worker on the site incidentally ingesting contaminated soil (Table 16).

5.2.4 ES4 - Future Surface Occupational Worker

The total excess lifetime cancer risk for ES4 was 5.5×10^{-4} (6 in 10,000). The pathway cancer risks for ingestion of contaminated soil exceeded 1×10^{-4} (1 in 10,000). The highest ingestion of soil cancer risk for individual chemicals was from benzo(a)pyrene and dibenz(a,h)anthracene. Because the excess lifetime cancer risk for ingestion of contaminated soil exceeded 1×10^{-4} (1 in 10,000), cancer risks may be present for an adult working on the site incidentally ingesting contaminated soil (Table 17).

5.2.5 ES5 - Future Subsurface Occupational Worker

The total excess lifetime cancer risk for ES5 was 1.7×10^{-5} (2 in 100,000). No pathway cancer risks exceeded 1 in 10,000. The total excess lifetime did not exceed 1 in 10,000, thus unacceptable cancer risks are not expected for an adult subsurface worker on the site, incidentally ingesting and directly contacted contaminated soil in the subsurface (Table 18).

Table 14.

Excess Lifetime Cancer Risks for Exposure Scenario 1

Clinton Former Manufactured Gas Plant Site, Clinton, MO

Pathway: Ingestion of contaminated groundwater by a combined receptor, age 0-30, 350 days/year over a 30 year period

Chemical	Concentration (mg/L)	Intake/SF Adjusted for Absorption	Intake (mg/kg/day)	SF $(mg/kg/day)^{-1}$	Cancer Risk	Pathway Cancer Risk
Benzo(A)Anthracene	2.6×10^{-4}	no/no	3.9×10^{-6}	7.3×10^{-1}	2.8×10^{-6}	
Chrysene	2.6×10^{-4}	no/no	3.9×10^{-6}	7.3×10^{-2}	2.8×10^{-7}	
Benzo(B)Fluoranthene	2.0×10^{-4}	no/no	3.0×10^{-6}	7.3×10^{-1}	2.2×10^{-6}	
Benzo(A)Pyrene	2.2×10^{-4}	no/no	3.3×10^{-6}	7.3×10^{0}	2.4×10^{-5}	
Benzo(K)Fluoranthene	9.9×10^{-5}	no/no	1.5×10^{-6}	7.3×10^{-2}	1.1×10^{-7}	
Arsenic	8.5×10^{-3}	no/no	1.3×10^{-4}	1.5×10^{0}	1.9×10^{-4}	
Beryllium	2.7×10^{-4}	no/no	4.0×10^{-6}	4.3×10^{0}	1.7×10^{-5}	2.4×10^{-4}

Pathway: Dermal contact with contaminated groundwater by a combined receptor, age 0-30, 350 days/year over a 30 year period.

Chemical	Concentration (mg/L)	Intake/SF Adjusted for Absorption	Intake (mg/kg/day)	SF $(mg/kg/day)^{-1}$	Cancer Risk	Pathway Cancer Risk
Arsenic	8.5×10^{-3}	yes/yes	8.0×10^{-7}	1.5×10^{0}	1.3×10^{-6}	
Beryllium	2.7×10^{-4}	yes/yes	2.5×10^{-8}	4.3×10^{0}	1.1×10^{-5}	1.2×10^{-5}

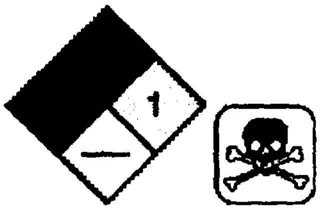
ToxFAQs

Cyanide

CAS# 57-12-5, 74-90-8, 143-33-9, 151-50-8, 592-01-8, 544-92-3, 506-61-6, 460-19-5, 506-77-4

September 1997

Potassium cyanide
KCN
Stereo Image
XYZ File



NFPA Label Key

Material Safety Data Sheet
(University of Utah)

Agency for Toxic Substances and Disease Registry

This fact sheet answers the most frequently asked health questions (FAQs) about cyanide. For more information, call the ATSDR Information Center at 1-800-447-1544. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Cyanide is a very poisonous chemical. Exposure to high levels of cyanide harms the brain and heart, and may cause coma and death. Exposure to lower levels may result in breathing difficulties, heart pains, vomiting, blood changes, headaches, and enlargement of the thyroid gland. Cyanide has been found in at least 415 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is cyanide?

Cyanide is usually found joined with other chemicals to form compounds. Examples of simple cyanide compounds are hydrogen cyanide, sodium cyanide and potassium cyanide. Cyanide can be produced by certain bacteria, fungi, and algae, and it is found in a number of foods and plants. In the body, cyanide combines with a chemical to form Vitamin B_{12}. Cyanide occurs naturally in cassava roots, which are potato-like tubers of cassava plants grown in tropical countries.

Hydrogen cyanide is a colorless gas with a faint, bitter, almond-like odor. Sodium cyanide and potassium cyanide are both white solids with a bitter, almond-like odor in damp air. Cyanide and hydrogen cyanide are used in electroplating, metallurgy, production of chemicals, photographic development, making plastics, fumigating ships, and some mining processes.

What happens to cyanide when it enters the environment?

- Cyanide enters the environment from both natural processes and human industrial activities.
- In air, cyanide is mainly found as gaseous hydrogen cyanide; a small amount is present as fine dust particles.
- It takes about 1–3 years for half of the hydrogen cyanide to disappear from the air.
- Most cyanide in surface water will form hydrogen cyanide and evaporate.
- Cyanide does not build up in the bodies of fish.
- At high concentrations, cyanide becomes toxic to soil microorganisms and can pass through soil into underground water.

How might I be exposed to cyanide?

- Breathing air, drinking water, touching soil, or eating foods containing cyanide
- Smoking cigarettes and breathing smoke-filled air during fires are major sources of cyanide exposure
- Breathing air near a hazardous waste site containing cyanide
- Eating foods containing cyanide compounds, such as cassava roots, lima beans, and almonds
- Working in an industry where cyanide is used or produced, such as electroplating, metallurgy, metal cleaning, and photography

How can cyanide affect my health?

Animal testing is sometimes necessary to find out how toxic substances might harm people or to treat those who have been exposed. Laws today protect the welfare of research animals and scientists must follow strict guidelines.

In large amounts, cyanide is very harmful to people. Exposure to high levels of cyanide in the air for a short time harms the brain and heart, and may cause coma and death.

Exposure to lower levels of cyanide for a long time may result in breathing difficulties, heart pains, vomiting, blood changes, headaches, and enlargement of the thyroid gland. People who eat large amounts of cyanide may have symptoms including deep breathing and shortness of breath, convulsions, and loss of consciousness, and may die. Use of cassava roots as a primary food source in tropical Africa has led to high blood cyanide levels.

People with high blood cyanide levels have also shown harmful effects such as weakness of the fingers and toes, difficulty walking, dimness of vision, deafness, and decreased thyroid gland function, but chemicals other than cyanide may have contributed to these effects. Skin contact with cyanide can produce irritation and sores.

It is not known whether cyanide can directly cause birth defects in people. Birth defects were seen in rats that ate diets of cassava roots. Effects on the reproductive system were seen in rats and mice that drank water containing sodium cyanide.

How likely is cyanide to cause cancer?

The **EPA** has determined that cyanide is not classifiable as to its human carcinogenicity. There are no reports that cyanide can cause cancer in people or animals.

There are medical tests to measure blood and urine levels of cyanide; however, small amounts of cyanide are always detectable in blood and urine. Tissue levels of cyanide can be measured if cyanide poisoning is suspected, but cyanide is rapidly cleared from the body, so the tests must be done soon after the exposure. An almond-like odor in the breath may alert a doctor that a person was exposed to cyanide.

Has the federal government made recommendations to protect human health?

The **EPA** has set a maximum contaminant level of cyanide in drinking water of 0.2 milligrams cyanide per liter of water (0.2 mg/L). The **EPA** requires that spills or accidental releases into the environment of 1 pound or more of hydrogen cyanide, potassium cyanide, sodium cyanide, calcium cyanide or copper cyanide be reported to the **EPA**.

The **Occupational Safety and Health Administration (OSHA)** and the **American Conference of Governmental Industrial Hygienists (ACGIH)** have set a permissible exposure limit of 5 milligrams of cyanide per cubic meter of air (5 mg/m^3) in the workplace during an 8-hour workday, 40-hour workweek.

Glossary

Carcinogenicity:	Ability to cause cancer
CAS:	Chemical Abstracts Service
Milligram (mg):	One thousandth of a gram
PPM:	Parts per million

Reference

Agency for Toxic Substances and Disease Registry. 1995. Toxicological profile for cyanide (update). Atlanta, GA; U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

For more information, contact:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop E-29
Atlanta, GA 30333
Phone: 1-800-447-1544
Fax: 404-639-6359

U.S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry

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ATSDR Information Center / ATSDRIC@cdc.gov / 1-800-447-1544

ToxFAQs

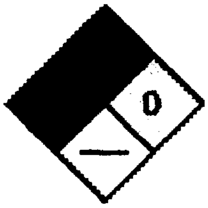
Polychlorinated Biphenyls (PCBs)

CAS# 1336-36-3

September 1997

Octachlorobiphenyl
$C_{12}H_2Cl_8$
Stereo Image
XYZ File

Search ChemFinder



NFPA Label Key

Agency for Toxic Substances and Disease Registry

This fact sheet answers the most frequently asked health questions (FAQs) about polychlorinated biphenyls (PCBs). For more information, call the ATSDR Information Center at 1-800-447-1544. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Polychlorinated biphenyls are a mixture of individual chemicals which are no longer produced in the United States, but are still found in the environment. Polychlorinated biphenyls can cause irritation of the nose and throat, and acne and rashes. They have been shown to cause cancer in animal studies. Polychlorinated biphenyls have been found in at least 383 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are polychlorinated biphenyls?

Polychlorinated biphenyls (PCBs) are a group of manufactured organic chemicals that contain 209 individual chlorinated chemicals (known as congeners). PCBs are either oily liquids or solids and are colorless to light yellow in color. They have no known smell or taste. There are no known natural sources of PCBs. Some commercial PCB mixtures are known in the United States by their industrial trade name, Aroclor.

PCBs don't burn easily and are good insulating material. They have been used widely as coolants and lubricants in transformers, capacitors, and other electrical equipment. The manufacture of PCBs stopped in the United States in 1977 because of evidence that they build up in the environment and cause harmful effects. Products containing PCBs are old fluorescent lighting fixtures, electrical appliances containing PCB capacitors, old microscope oil, and hydraulic fluids.

What happens to PCBs when they enter the environment?

- Before 1977, PCBs entered the air, water, and soil during their manufacture and use.
- Today, PCBs can be released into the environment from hazardous waste sites that contain PCBs, illegal or improper dumping of PCB wastes, and leaks from electrical transformers containing PCBs.
- PCBs may be carried long distances in the air; they remain in the air for approximately 10 days.
- In water, a small amount of the PCBs may remain dissolved, but most sticks to organic particles and sediments.
- PCBs in water build up in fish and marine mammals and can reach levels thousands of times higher than the levels in water.

How might I be exposed to PCBs?

- Using old fluorescent lighting fixtures and old appliances such as television sets and refrigerators; these may leak small amounts of PCBs into the air when they get hot during operation
- Eating food, including fish, meat and dairy products containing PCBs
- Breathing air near hazardous waste sites that contain PCBs
- Drinking PCB-contaminated well water
- Repairing or maintaining PCB transformers

How can PCBs affect my health?

Animal testing is sometimes necessary to find out how toxic substances might harm people or to treat those who have been exposed. Laws today protect the welfare of research animals and scientists must follow strict guidelines.

People exposed to PCBs in the air for a long time have experienced irritation of the nose and lungs, and skin irritations, such as acne and rashes.

It is not known whether PCBs may cause birth defects or reproductive problems in people. Some studies have shown that babies born to women who consumed PCB-contaminated fish had problems with their nervous systems at birth. However, it is not known whether these problems were definitely due to PCBs or other chemicals.

Animals that breathed very high levels of PCBs had liver and kidney damage, while animals that ate food with large amounts of PCBs had mild liver damage. Animals that ate food with smaller amounts of PCBs had liver, stomach, and thyroid gland injuries, and anemia, acne, and problems with their reproductive systems. Skin exposure to PCBs in animals resulted in liver, kidney, and skin damage.

How likely are PCBs to cause cancer?

It is not known whether PCBs causes cancer in people. In a long-term (365 days or longer) study, PCBs caused cancer of the liver in rats that ate certain PCB mixtures.

The **Department of Health and Human Services (DHHS)** has determined that PCBs may reasonably be anticipated to be carcinogens.

Is there a medical test to show whether I've been exposed to PCBs?

There are tests to find out if PCBs are in your blood, body fat, and breast milk. Blood tests are probably the easiest, safest, and best method for detecting recent exposures to large amounts of PCBs.

However, since all people in the industrial countries have some PCBs in their bodies, these tests can only show if you have been exposed to higher-than-normal levels of PCBs. However, these measurements cannot determine the exact amount or type of PCBs you have been exposed to or how long you have been exposed. In addition, they cannot predict whether you will experience any harmful health effects.

Has the federal government made recommendations to protect human health?

The **EPA** has set a maximum contaminant level of 0.0005 milligrams PCBs per liter of drinking water (0.0005 mg/L). The **EPA** requires that spills or accidental releases into the environment of 1 pound or more of PCBs be reported to the **EPA**.

The **Food and Drug Administration (FDA)** requires that milk, eggs, other dairy products, poultry fat, fish, shellfish, and infant foods contain not more that 0.2–3 parts of PCBs per million parts (0.2–3 ppm) of food.

Glossary

Carcinogen:
    A substance with the ability to cause cancer
CAS:
    Chemical Abstracts Service
Milligram (mg):
    One thousandth of a gram
PPM:
    Parts per million

Reference

Agency for Toxic Substances and Disease Registry. 1996. Toxicological profile for polychlorinated biphenyls (update). Atlanta, GA; U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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1600 Clifton Road NE, Mailstop E-29
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Fax: 404-639-6359

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ATSDR ToxFAQs

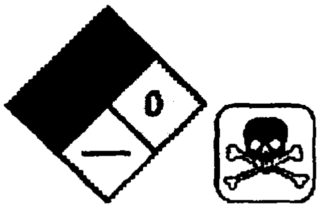
Pentachlorophenol

CAS# 87-86-5

September 1995

Pentachlorophenol
C_6Cl_5OH
Stereo Image
XYZ File

Search ChemFinder



NFPA Label Key

Material Safety Data Sheet
(University of Utah)

Agency for Toxic Substances and Disease Registry

This fact sheet answers the most frequently asked health questions about pentachlorophenol. For more information, you may call the ATSDR Information Center at 1-800-447-1544. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to pentachlorophenol happens mostly to workers at lumber mills and wood-treatment facilities where it is used as a wood preservative. Pentachlorophenol can harm the liver, kidneys, blood, lungs, nervous system, immune system, and gastrointestinal tract. It can also irritate the skin and eyes. This chemical has been found in at least 260 of 1,416 National Priorities List sites identified by the Environmental Protection Agency.

What is pentachlorophenol?
(Pronounced pen'ta-klor'o-fee'nol)

Pentachlorophenol is a manufactured chemical not found naturally in the environment. Pure pentachlorophenol occurs as a colorless crystal. The impure form is dark gray to brown dust, beads, or flakes. It has a sharp chemical odor when hot, but very little smell at room temperature.

Pentachlorophenol was used as a biocide and wood preservative. It was one of the most heavily used pesticides in the United States. Now, only certified applicators can purchase and use pentachlorophenol.

It is still used in industry as a wood preservative for power line poles, railroad ties, cross arms, and fence posts. It is no longer found in wood preserving solutions or insecticides and herbicides that you can buy for home and garden use.

What happens to pentachlorophenol when it enters the environment?

- Pentachlorophenol generally sticks to soil particles, but its movement in soils depends on the soil's acidity.
- Not much pentachlorophenol will evaporate into the air.
- It lasts for hours or days in air, soils, and surface waters.
- It doesn't dissolve easily in water.
- In soils and surface waters, microorganisms break it down into other compounds.
- Sunlight breaks it down in surface waters and air.
- Some of the break-down compounds may harm people.
- It is present in fish, but tissue levels are usually low because pentachlorophenol breaks down in the body.

How might I be exposed to pentachlorophenol?

- Breathing contaminated air while working with treated wood at wood-treatment facilities and lumber mills
- Touching treated lumber, for example, in wood-treatment facilities and lumber mills or in construction or farming
- Breathing contaminated air from log homes made from pentachlorophenol-treated logs
- Breathing contaminated air near waste sites, sites of accidental spills, and work sites
- Touching contaminated soil at waste sites and landfills
- Drinking contaminated water near waste sites, sites of accidental spills, and work sites
- Eating contaminated food, such as fish, or drinking contaminated water, but these exposures are low and are not very common.

How can pentachlorophenol affect my health?

Short-term exposures to large amounts of pentachlorophenol or long-term exposure to low levels can harm the liver, kidneys, blood, lungs, nervous system, immune system, and gastrointestinal tract. Researchers have seen similar effects in animals. Impurities in commercial pentachlorophenol may cause many, but not all, of its harmful effects. Direct contact with pentachlorophenol can irritate the skin, eyes, and mouth, particularly when it is a hot vapor.

We do not know whether pentachlorophenol causes birth defects in people. It caused a decrease in the number of offspring born to animals that were exposed to it while they were pregnant.

How likely is pentachlorophenol to cause cancer?

The International Agency for Research on Cancer has determined that pentachlorophenol is possibly carcinogenic to humans. This conclusion is based on animal studies that showed an increased risk of cancer, specifically in the livers and adrenal glands of mice. There is no good evidence that pentachlorophenol can cause cancer in people.

Is there a medical test to show whether I've been exposed to pentachlorophenol?

Laboratory tests can measure pentachlorophenol in the blood, urine, and body tissues. These tests are only useful shortly after you are exposed because pentachlorophenol leaves the body fairly quickly.

These tests do not tell you how much pentachlorophenol you've been exposed to or if your health will be harmed. The tests are not routinely available at your doctor's office.

Has the federal government made recommendations to protect human health?

The Environmental Protection Agency (EPA) has set a limit for drinking water of 1 part of pentachlorophenol per billion parts of water (1 ppb). EPA recommends that children not drink water containing more than 0.3 parts of pentachlorophenol per million parts of water (0.3 ppm) for longer than one day; adults should not drink water with more than 1 ppm. The EPA requires that spills and accidental releases of pentachlorophenol into the environment of 10 pounds or more must be reported to the EPA.

The Occupational Safety and Health Administration (OSHA), the National Institute for Occupational Safety and Health (NIOSH), and the American Conference of Governmental and Industrial Hygienists (ACGIH) recommend a maximum level of 0.5 milligrams of pentachlorophenol per cubic meter (0.5 mg/m^3) of workplace air for an 8-hour workday over a 40-hour workweek. These agencies advise avoiding eye and skin contact because this may be a route of significant exposure.

Glossary

Biocide:
A substance that can kill living things.
Carcinogenic:
Ability to cause cancer.
Long-term:
Lasting one year or longer.
Milligram (mg):
One thousandth of a gram.
PPB:
Parts per billion.
Short-term:
Lasting 14 days or less.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1994. Toxicological profile for pentachlorophenol (update). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

For more information, contact:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop E-29
Atlanta, GA 30333
Phone: 1-800-447-1544
FAX: 404-639-6315

U.S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry

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ATSDR Information Center / ATSDRIC@cdc.gov / 1-800-447-1544

Agency for Toxic Substances and Disease Registry

Public Health Statement

Benzo[a]pyrene

ATSDR Public Health Statement, May 1990

What is benzo[a]pyrene?

Benzo[a]pyrene (B[a]P) is one of the polycyclic aromatic hydrocarbon (PAH) compounds. Because it is formed when gasoline, garbage, or any animal or plant material burns, it is usually found in smoke and soot. This chemical combines with dust particles in the air and is carried into water and soil and onto crops. Benzo[a]pyrene is found in the coal tar pitch that industry uses to join electrical parts together. It is also found in creosote, a chemical used to preserve wood.

How might I be exposed to benzo[a]pyrene?

People may be exposed to B[a]P from environmental sources such as air, water, and soil and from cigarette smoke and cooked food. Workers who handle or are involved in the manufacture of PAH-containing materials may also be exposed to B[a]P. Typically, exposure for workers and the general population is not to B[a]P alone but to a mixture of similar chemicals.

The general population may be exposed to dust, soil, and other particles that contain B[a]P. The largest sources of B[a]P in the air are open burning and home heating with wood and coal. Factories that produce coal tar also contribute small amounts of B[a]P to the air. People may come in contact with B[a]P from soil on or near hazardous waste sites, such as former gas-manufacturing sites or abandoned wood-treatment plants that used creosote. At this time, B[a]P has been found at 110 out of 1,117 sites on the National Priorities List (NPL) of hazardous waste sites in the United States. As more sites are evaluated by the Environmental Protection Agency (EPA), this number may change. The soil near areas where coal, wood, or other products have been burned is another source of exposure. Exposure to B[a]P and other PAHs may also occur through skin contact with products that contain PAHs such as creosote-treated wood, asphalt roads, or coal tar.

People may be exposed to B[a]P by drinking water from the drinking water supplies in the United States that have been found to contain low levels of the chemical. Foods grown in contaminated soil or air may contain B[a]P. Cooking food at high temperatures, as occurs during charcoal-grilling or charring, can increase the amount of B[a]P in the food. Benzo[a]pyrene has been found in cereals, vegetables, fruits, meats, beverages, chewing tobacco, and in cigarette smoke.

The greatest exposure to B[a]P is likely to take place in the workplace. People who work in coal tar-production plants; coking plants; asphalt-production plants; coal-gasification sites; smoke houses; municipal trash incinerators; and facilities that burn wood, coal, or oil may be exposed to B[a]P in the workplace air. Benzo[a]pyrene may also be found in areas where high-temperature food fryers and broilers are used.

How does benzo[a]pyrene get into my body?

The most common way B[a]P enters the body is through the lungs when a person breathes in air or smoke containing it. It also enters the body through the digestive system when substances containing it are swallowed. Although B[a]P does not normally enter the body through the skin, small amounts could enter if contact occurs with soil that contains high levels of B[a]P (for example, near a hazardous waste site) or if contact is made with heavy oils containing B[a]P.

How can benzo[a]pyrene affect my health?

The U.S. Department of Health and Human Services has determined that B[a]P may reasonably be anticipated to be a carcinogen. Benzo[a]pyrene causes cancer in laboratory animals when applied to their skin. This finding suggests that it is likely that people exposed in the same manner could also develop cancer.

Because studies of B[a]P are not complete, we don't know if B[a]P that is breathed in or swallowed could cause cancer.

Mice fed high levels of B[a]P during pregnancy had trouble reproducing, and so did their offspring. The newborn animals of pregnant mice fed B[a]P also had other harmful effects (for example, birth defects and lower-than-normal body weight). It is possible that similar effects could happen to people exposed to B[a]P.

Is there a medical test to determine if I have been exposed to benzo[a]pyrene?

Very few tests are available that can tell whether exposure to B[a]P has taken place. In the body, B[a]P is changed to related chemical substances called metabolites. The metabolites can bind with DNA, the genetic material of the body, and with hemoglobin, the oxygen-carrying protein in red blood cells. The body's response after exposure can be measured in the blood. However, this test is still being developed. Benzo[a]pyrene can also be found in the urine and blood of individuals exposed to PAHs. It is not possible to know from these tests how much B[a]P a person was exposed to or to predict what health effects may happen at certain levels. Also, none of these tests have been used in exposure situations outside the workplace.

What levels of exposure have resulted in harmful health effects?

No information has been found about specific levels of B[a]P that have caused harmful effects in people after breathing, swallowing, or touching the substance.

Figure 1.1 shows the amount of B[a]P found to cause harmful health effects in laboratory animals after eating B[a]P for short and long periods. Short- and long-term exposures to B[a]P caused death in experimental animals fed the chemical. The offspring of animals that ate 10 milligrams of B[a]P per kilogram of body weight (mg/kg) during pregnancy had trouble reproducing. Some of the offspring weighed less than normal at birth and had birth defects.

A Minimal Risk Level (MRL) is also included in Fig. 1.1. This MRL is based on experiments in animals. The MRL provides a basis for comparison with levels that people might be exposed to in food. If a person is exposed to PAHs at an amount less than the MRL, harmful (noncancer) health effects are not expected to occur.

Because this level is based only on information currently available, some uncertainty is always associated with it. Also, because the method for deriving MRLs does not use any information about cancer, an MRL does not imply anything about the presence, absence, or level of risk for cancer.

What recommendations has the federal government made to protect human health?

Based on information from another PAH chemical, the federal government has developed standards and guidelines to protect individuals from the potential health effects of PAHs, including B[a]P, in drinking water. The U.S. Environmental Protection Agency (EPA) has provided estimates of levels of total cancer-causing PAHs in lakes and streams associated with various risks of developing cancer in people. EPA has also determined that any release of PAHs of more than 1 pound should be reported to the National Response Center.

Pure B[a]P is produced in the United States only as a laboratory chemical. However, B[a]P is a PAH, and PAHs are found in coal tar and in the creosote oils and pitches formed from the production of coal tar. The government's goal has been to protect workers involved with the production of coal tar products. These regulations are for exposure to B[a]P in workplace air. Although government standards are not B[a]P alone, they are useful in controlling exposure to total PAHs.

The National Institute for Occupational Safety and Health (NIOSH) has determined that workplace exposure to coal products can increase the risk of lung and skin cancer in workers and suggests a workplace exposure limit for coal tar products of 0.1 milligram of PAHs per cubic meter of air (0.1 mg/m3) for a 10-hour workday, 40-hour workweek. NIOSH has not suggested a specific workplace limit for B[a]P. The Occupational Safety and Health Administration (OSHA) has set a legal limit of 0.2 milligram of all PAHs per cubic meter of air (0.2 mg/m3).

Where can I get more information?

If you have more questions or concerns, please contact your state health or environmental department or:

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Agency for Toxic Substances and Disease Registry
Division of Toxicology
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1600 Clifton Road, E-29
Atlanta, Georgia 30333

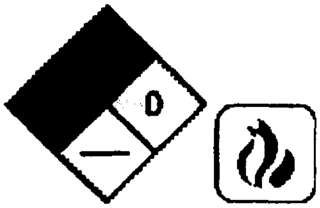
ToxFAQs

Benzene

CAS# 71-43-2

September 1997

Benzene
C_6H_6
Stereo Image
XYZ File



NFPA Label Key

Material Safety Data Sheet
(University of Utah)

Agency for Toxic Substances and Disease Registry

This fact sheet answers the most frequently asked health questions (FAQs) about benzene. For more information, call the ATSDR Information Center at 1-800-447-1544. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Benzene is a widely used chemical formed from both natural processes and human activities. Breathing benzene can cause drowsiness, dizziness, and unconsciousness; long-term benzene exposure causes effects on the bone marrow and can cause anemia and leukemia. Benzene has been found in at least 813 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is benzene?

Benzene is a colorless liquid with a sweet odor. It evaporates into the air very quickly and dissolves slightly in water. It is highly flammable and is formed from both natural processes and human activities.

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

What happens to benzene when it enters the environment?

- Industrial processes are the main source of benzene in the environment.
- Benzene can pass into the air from water and soil.
- It reacts with other chemicals in the air and breaks down within a few days.
- Benzene in the air can attach to rain or snow and be carried back down to the ground.
- It breaks down more slowly in water and soil, and can pass through the soil into underground water.
- Benzene does not build up in plants or animals.

How might I be exposed to benzene?

- Outdoor air contains low levels of benzene from tobacco smoke, automobile service stations, exhaust from motor vehicles, and industrial emissions.
- Indoor air generally contains higher levels of benzene from products that contain it such as glues, paints, furniture wax, and detergents.
- Air around hazardous waste sites or gas stations will contain higher levels of benzene.
- Leakage from underground storage tanks or from hazardous waste sites containing benzene can result in benzene contamination of well water.
- People working in industries that make or use benzene may be exposed to the highest levels of it.

How can benzene affect my health?

Animal testing is sometimes necessary to find out how toxic substances might harm people or to treat those who have been exposed. Laws today protect the welfare of research animals and scientists must follow strict guidelines.

Breathing very high levels of benzene can result in death, while high levels can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. Eating or drinking foods containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, and death.

The major effect of benzene from long-term (365 days or longer) exposure is on the blood. Benzene causes harmful effects on the bone marrow and can cause a decrease in red blood cells leading to anemia. It can also cause excessive bleeding and can affect the immune system, increasing the chance for infection.

Some women who breathed high levels of benzene for many months had irregular menstrual periods and a decrease in the size of their ovaries. It is not known whether benzene exposure affects the developing fetus in pregnant women or fertility in men. Animal studies have shown low birth weights, delayed bone formation, and bone marrow damage when pregnant animals breathed benzene.

How likely is benzene to cause cancer?

The **Department of Health and Human Services (DHHS)** has determined that benzene is a known human carcinogen. Long-term exposure to high levels of benzene in the air can cause leukemia, cancer of the blood-forming organs.

Is there a medical test to show whether I've been exposed to benzene?

Several test can show if you have been exposed to benzene. There is test for measuring benzene in the breath; this test must be done shortly after exposure. Benzene can also be measured in the blood, however, since benzene disappears rapidly from the blood, measurements are accurate only for recent exposures.

In the body, benzene is converted to products called metabolites. Certain metabolites can be measured in the urine. However, this test must be done shortly after exposure and is not a reliable indicator of how much benzene you have been exposed to, since the metabolites may be present in urine from other sources.

Has the federal government made recommendations to protect human health?

The **EPA** has set the maximum permissible level of benzene in drinking water at 0.005 milligrams per liter (0.005 mg/L). The **EPA** requires that spills or accidental releases into the environment of 10 pounds or more of benzene be reported to the **EPA**.

The **Occupational Safety and Health Administration (OSHA)** has set a permissible exposure limit of 1 part of benzene per million parts of air (1 ppm) in the workplace during an 8-hour workday, 40-hour workweek.

Glossary

Anemia:	A decreased ability of the blood to transport oxygen
Carcinogen:	A substance with the ability to cause cancer
CAS:	Chemical Abstracts Service
Chromosomes:	Parts of the cells responsible for the development of hereditary characteristics
Metabolites:	Breakdown products of chemicals
Milligram (mg):	One thousandth of a gram
Pesticide:	A substance that kills pests

Reference

Agency for Toxic Substances and Disease Registry. 1995. Toxicological profile for benzene (update).

Atlanta, GA; U.S. Department of Health and Human Services, Public Health Service.

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HAZARDOUS SUBSTANCE
RESEARCH CENTERS

ENVIRONMENTAL SCIENCE AND TECHNOLOGY BRIEFS FOR CITIZENS

adapted by P. Kulakow

A Guide to Thermal Desorption

Adapted from EPA Technology Fact Sheet: EPA 542-F-96-005

This publication is published by the Hazardous Substance Research Centers as part of their Technical Outreach Services for Communities (TOSC) program series of Environmental Science and Technology Briefs for Citizens. If you would like more information about the TOSC program, contact your regional coordinator:

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Thermal desorption is one of many methods used to clean up soil that has been contaminated with hazardous chemicals. The purpose of this brief is to describe thermal desorption along with some of its advantages and disadvantages. Before any cleanup method is chosen for use at a location, many potential cleanup choices must be carefully studied and compared to determine how well each will work at that site. The information presented in this brief has been adapted from the EPA Technology Fact Sheet: EPA 542-F-96-005.

What is thermal desorption?

Thermal desorption is a way to treat soils contaminated with hazardous wastes. By heating these soils to temperatures of 200-1,000 degrees F, contaminants with low boiling points will vaporize or turn into gas and separate from the soil. These vaporized contaminants are then collected and treated, usually by an air emissions treatment system. (If there are other contaminants present in the soil, they are treated in other ways.)

Thermal desorption is a different process than incineration because it uses heat to physically separate the contaminants from the soil. They will then require further treatment. Incineration uses heat to actually destroy the contaminants.

How does thermal desorption work?

Typical thermal desorption systems are made up of three parts: the pretreatment and material handling system, the desorption unit, and the post-treatment system for both the gas contaminants and the remaining soil (See Figure 1 on page 2).

Pretreatment and Material Handling System

Pretreatment of contaminated material involves sifting it to remove large clods and foreign objects. If the contaminated material is very wet or has a lot of contamination, it may need to be mixed with sand or dried to make it a more workable product for treatment in the desorption unit.

Desorption Unit

The desorption unit is used to heat the contaminated soil to a high enough temperature for a long enough time to dry it and vaporize the contaminants from it. A common design for this unit is a rotary desorber, which has a rotating, cylindrical metal drum. In a direct-fired rotary desorber, the contaminated soil enters the rotating cylinder and is heated by direct contact with a flame or the hot gasses coming off a flame. In an indirect-fired rotary desorber, the soil does not come into contact with a flame or combustion gases. Instead, the outside of the cylinder is heated and the hot metal indirectly heats the soil tumbling inside. As the soil is heated, the contaminants vaporize and become part of the gas stream of air and contaminated vapors flowing through the desorber toward the post-treatment system. Sometimes a non-reactive gas, such as nitrogen, is added to the gas stream to keep the vaporized contaminants from catching fire in the desorption unit and to help in vaporizing and removing the contaminants.

Post-Treatment System

"Offgas" from the desorber is usually processed to take out particulate matter still in the gas stream after the desorption step. The vaporized contaminants in this offgas may be burned in an afterburner, collected on activated carbon, or recovered in condensation equipment. Depending on what the contaminants are and the amount of them present, any or all of these methods can be used. But disposal methods must meet federal, state, and local standards.

Treated soil from the desorber is tested to see how well the process worked in removing the target contaminants. This is usually done by comparing the contaminant levels in treated soils with those of untreated soils. If the treated soil is nonhazardous, it is put back on site or taken somewhere else to be used as backfill. If, however, the soil needs further treatment, it may be treated using another method, or taken off site for disposal.

Why consider thermal desorption?

Thermal desorption works well at separating organics from refining wastes, coal tar wastes, waste from wood treatment, and paint wastes. It can separate solvents, pesticides, PCBs, dioxins, and fuel oils from contaminated soil. The equipment needed to do this can treat up to 10 tons of contaminated soil per hour. Finally, the lower temperatures used in the desorber take less fuel than other treatment methods.

Will it work at every site?

Thermal desorption does not work on most metals, although mercury can be removed by this process. Other metals will tend to stay in the soil and not evaporate enough to be reasonably separated from the soil. Also, capturing evaporated metals might complicate the offgas treatment. A decision about metals needs to be made before the soil is processed.

Thermal desorption does not work well for treating all types of soil. If the soil is wet, water will vaporize along with the contaminants. This means more fuel would be needed to vaporize all of the contaminants in wet soil. Soils high in silt and clay are also harder to treat with thermal desorption. When silt and clay are heated, they give off a dust which can interfere with the air emission equipment used to treat the vaporized contaminants. Also, tightly packed soil often won't permit the heat to make contact with all the contaminants, making it more difficult for them to vaporize. Finally, thermal desorption would not be a very good choice for treating heavy metal contaminants, since they do not separate easily from soil; or strong acids, since they can corrode the treatment equipment.

Where is thermal desorption being used?

Thermal desorption is the treatment method of choice at many Superfund sites. For example, it was used at the TH Agriculture & Nutrition Company site in Albany, Georgia, to treat 4,300 tons of soil contaminated with pesticides. The system ran from July to October 1993 and met the cleanup goals, removing over 98% of the pesticides in the treated soil.

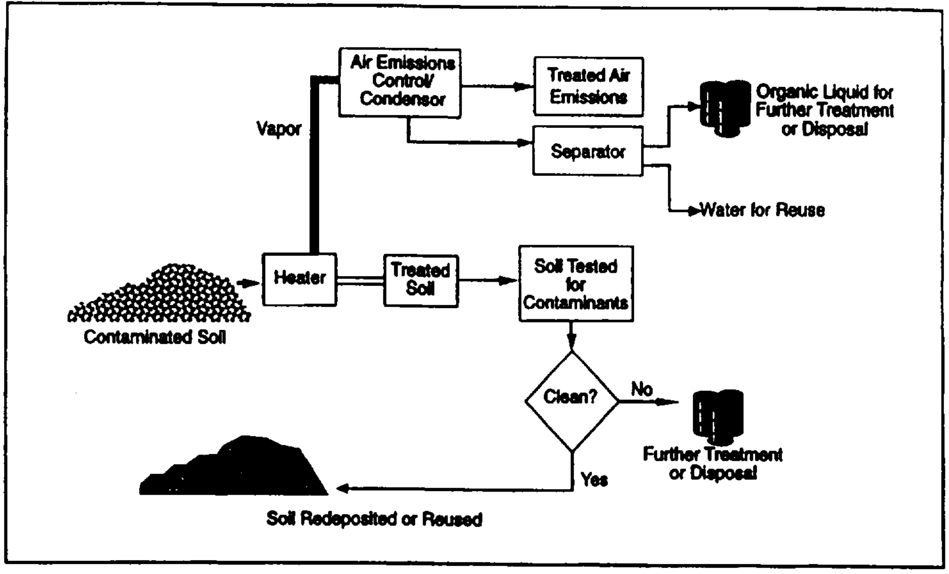
References:

EPA Technology Fact Sheet:EPA 542-F-96-005

■ ■ ■

ABOUT THE AUTHOR: Peter Kulakow has a Ph.D. degree in genetics from the University of California-Davis and is currently doing research on the use of vegetation to clean up hazardous waste sites.

Figure 1. The Thermal Desorption Process. Typical thermal desorption systems are made up of three parts: the pretreatment and material handling system, the desorption unit, and the post-treatment system for both the gas contaminants and the remaining soil.



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Clinton Coal Gas Site

Site location

Former manufactured gas plant (FMGP) in Clinton, Iowa

Site description

Manufactured gas was produced on the FMGP site in Clinton, Iowa, from 1869 until 1952. Later, steel beams for bridges were manufactured on the eastern portion of the site and electric power was generated from coal on the western portion. Currently, the Interstate Power Company (IPW) owns the western part of the site and uses it for a district office, service center, and substation. The former steel manufacturing site is owned by a development company, Riverview Partners. The FMGP location is a Superfund site. IPW and the United States EPA have entered into an Administrative Order of Consent for Engineering Evaluation/Cost Analysis (EE/CA). A citizens advisory group (CAG) has been formed and meets regularly to discuss community concerns surrounding this site.

Organization requesting assistance

Clinton Former Manufactured Gas Plant Community Advisory Group (Click here to go to the Clinton CAG Web Page)

Summary of TOSC assistance

TOSC has proposed helping the Clinton CAG develop background knowledge needed to prepare for interpretation of EPA documents when they are released. This may include several educational presentations over the next few months. Topics of interest to CAG members include the following:

- background discussion of common conditions at former manufactured gas plants
- principles of toxicology and risk assessment
- potential health risks of specific contaminants found at the Clinton site
- principles of hydrogeology and its application at Clinton (movement of contaminants in groundwater)
- how risk assessment is affected by potential land use scenarios
- cleanup strategies used at FMGPs

TOSC may also help the Clinton CAG review and comment on documents released by the EPA. In 1999, two primary documents are expected to be released for comment by the CAG. The EE/CA site assessment and risk characterization is expected to be released in early summer of 1999. The final EE/CA is expected to be released in the fall of 1999.

Clinton Coal Gas Community Advisory Group Web Page

The following links on the Internet provide examples of site assessment, cleanup, and redevelopment activities at several former manufactured gas plants around the country. Although these examples help show the range of activities at former manufactured gas plants, it is important to remember that each site is different and activities at one site may not reflect actions suitable for another site. Activities described at these Web sites may be outdated and may not represent current, ongoing activities.

Documents identified by are in Adobe Acrobat (pdf) format. If you already have Acrobat Reader software on your computer, you can simply click on these links to download the files. If you do not have Acrobat Reader, click here to download and install this software.

Site Updates

1. Clinton Coal Gas Site Community Advisory Group, Clinton, Iowa (2/98)

http://www.epa.gov/rgytgrnj/newsinfo/newsrel/fs_clintcag.pdf

Description of community advisory group for Clinton Coal Gas Site.

Summaries of Clean-up Strategies

1. A Guide to Thermal Desorption

http://www.engg.ksu.edu/HSRC/Tosc/desorp.pdf

Description of thermal desorption, one of many methods used to clean up soil that has been contaminated with hazardous chemicals; includes some of the advantages and disadvantages of this method.
