Occupational Health Guideline for Coal Tar Pitch Volatiles

INTRODUCTION
This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

Anthracene
- Formula: C_{14}H_{10}
- Synonyms: None
- Appearance and odor: Pale green solid with a faint aromatic odor.

Phenanthrene
- Formula: C_{14}H_{10}
- Synonyms: None
- Appearance and odor: Colorless solid with a faint aromatic odor.

Pyrene
- Formula: C_{16}H_{10}
- Synonyms: None
- Appearance: Bright yellow solid

Carbazole
- Formula: C_{12}H_{14}N
- Synonyms: None
- Appearance and odor: Colorless solid with a faint aromatic odor.

Benzo(a)pyrene
- Formula: C_{20}H_{12}
- Synonyms: BaP, 3,4-benzopyrene
- Appearance and odor: Colorless solid with a faint aromatic odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)
The current OSHA standard for coal tar pitch volatiles is 0.2 milligram of coal tar pitch volatiles per cubic meter of air (mg/m^3) averaged over an eight-hour work shift. NIOSH has recommended that the permissible exposure limit for coal tar products be reduced to 0.1 mg/m^3 (cyclohexane-extractable fraction) averaged over a work shift of up to 10 hours per day, 40 hours per week, and that coal tar products be regulated as occupational carcinogens. The NIOSH Criteria Document for Coal Tar Products and NIOSH Criteria Document for Coke Oven Emissions should be consulted for more detailed information.

HEALTH HAZARD INFORMATION
- Routes of exposure
Coal tar pitch volatiles can affect the body if they are inhaled or if they come in contact with the eyes or skin.
- Effects of overexposure
Repeated exposure to coal tar pitch volatiles has been associated with an increased risk of developing bronchi-tis and cancer of the lungs, skin, bladder, and kidneys. Pregnant women may be especially susceptible to exposure effects associated with coal tar pitch volatiles. Repeated exposure to these materials may also cause sunlight to have a more severe effect on a person’s skin. In addition, this type of exposure may cause an allergic skin rash.
- Reporting signs and symptoms
A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to coal tar pitch volatiles.
- Recommended medical surveillance
The following medical procedures should be made available to each employee who is exposed to coal tar pitch volatiles at potentially hazardous levels:

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service  Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

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1. Initial Medical Examination:
   - A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the oral cavity, respiratory tract, bladder, and kidneys should be stressed. The skin should be examined for evidence of chronic disorders, for premalignant and malignant lesions, and evidence of hyperpigmentation or photosensitivity.
   - Urinalysis: Coal tar pitch volatiles are associated with an excess of kidney and bladder cancer. A urinalysis should be obtained to include at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment, as well as a test for red blood cells.
   - Urinary cytology: Coal tar pitch volatiles are associated with an excess of kidney and bladder cancer. Employees having 5 or more years of exposure or who are 45 years of age or older should have a urinary cytology examination.
   - Sputum cytology: Coal tar pitch volatiles are associated with an excess of lung cancer. Employees having 10 or more years of exposure or who are 45 years of age or older should have a sputum cytology examination.
   - 14" x 17" chest roentgenogram: Coal tar pitch volatiles are associated with an excess of lung cancer. Surveillance of the lungs is indicated.
   - FVC and FEV (1 sec): Coal tar pitch volatiles are reported to cause an excess of bronchitis. Periodic surveillance is indicated.
   - A complete blood count: Due to the possibility of benzene exposure associated with coal tar pitch volatiles, a complete blood count is considered necessary to search for leukemia and aplastic anemia.
   - Skin disease: Coal tar pitch volatiles are defatting agents and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of these agents.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis, and semi-annually for employees 45 years of age or older or with 10 or more years’ exposure to coal tar pitch volatiles.

   - Summary of toxicology
     Coal tar pitch volatiles (CTPV) are products of the destructive distillation of bituminous coal and contain polynuclear aromatic hydrocarbons (PNA’s). These hydrocarbons sublime readily, thereby increasing the amounts of carcinogenic compounds in working areas. Epidemiologic evidence suggests that workers intimately exposed to the products of combustion or distillation of bituminous coal are at increased risk of cancer at many sites. These include cancer of the respiratory tract, kidney, bladder, and skin. In a study of coke oven workers, the level of exposure to CTPV and the length of time exposed were related to the development of cancer. Coke oven workers with the highest risk of cancer were those employed exclusively at topside jobs for 5 or more years, for whom the increased risk of dying from lung cancer was 10-fold; all coke oven workers had a 7-1/2-fold increase in risk of dying from kidney cancer. Although the causative agent or agents of the cancer in coke oven workers is unidentified, it is suspected that several PNA’s in the CTPV generated during the coking process are involved. Certain industrial populations exposed to coal tar products have a demonstrated risk of skin cancer. Substances containing PNA’s which may produce skin cancer also produce contact dermatitis; examples are coal tar, pitch, and cutting oils. Although allergic dermatitis is readily induced by PNA’s in guinea pigs, it is only rarely reported in humans from occupational contact with PNA’s; these have resulted largely from the therapeutic use of coal tar preparations. Components of pitch and coal tar produce cutaneous photosensitization; skin eruptions are usually limited to areas exposed to the sun or ultraviolet light. Most of the phototoxic agents will induce hypermelanosis of the skin; if chronic photodermatitis is severe and prolonged, leukoderma may occur. Some oils containing PNA’s have been associated with changes of follicular and sebaceous glands which commonly take the form of acne. There is evidence that exposures to emissions at coke ovens and gas retorts may be associated with an increased occurrence of chronic bronchitis. Coal tar pitch volatiles may be associated with benzene, an agent suspected of causing leukemia and known to cause aplastic anemia.

**CHEMICAL AND PHYSICAL PROPERTIES**

- **Physical data—Anthracene**
  1. Molecular weight: 178.2
  2. Boiling point (760 mm Hg): 340 C (644 F)
  4. Vapor density (air = 1 at boiling point of anthracene): 6.15
  5. Melting point: 217 C (423 F)
  6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg
  7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
  8. Evaporation rate (butyl acetate = 1): Not applicable

- **Physical data—Phenanthrene**
  1. Molecular weight: 178.2
  2. Boiling point (760 mm Hg): 340 C (644 F)
  3. Specific gravity (water = 1): 1.18
  4. Vapor density (air = 1 at boiling point of phenanthrene): 6.15
  5. Melting point: 100.5 C (213 F)
  6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg
  7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
  8. Evaporation rate (butyl acetate = 1): Not applicable

- **Physical data—Pyrene**
  1. Molecular weight: 202.3
  2. Boiling point (760 mm Hg): Greater than 360 C (greater than 680 F)
3. Specific gravity (water = 1): 1.28
4. Vapor density (air = 1 at boiling point of pyrene): 6.9
5. Melting point: 150.4 °C (303 °F)
6. Vapor pressure at 20 °C (68 °F): Less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 °C (68 °F):
   Insoluble
8. Evaporation rate (butyl acetate = 1): Not applicable
   • Physical data—Carbazole
     1. Molecular weight: 167.2
     2. Boiling point (760 mm Hg): 355 °C (671 °F)
     3. Specific gravity (water = 1): Greater than 1
     4. Vapor density (air = 1 at boiling point of carba-
        zole): 5.8
     5. Melting point: 246 °C (475 °F)
     6. Vapor pressure at 20 °C (68 °F): Less than 1 mm Hg
     7. Solubility in water, g/100 g water at 20 °C (68 °F):
        Insoluble
     8. Evaporation rate (butyl acetate = 1): Not applicable
        • Physical data—Benzo(a)pyrene
          1. Molecular weight: 252.3
          2. Boiling point (760 mm Hg): Greater than 360 °C
             (greater than 680 °F)
          3. Specific gravity (water = 1): Greater than 1
          4. Vapor density (air = 1 at boiling point of benzo(a)pyrene): 8.7
          5. Melting point: 179 °C (354 °F)
          6. Vapor pressure at 20 °C (68 °F): Less than 1 mm Hg
          7. Solubility in water, g/100 g water at 20 °C (68 °F):
             Insoluble
          8. Evaporation rate (butyl acetate = 1): Not applicable
     • Reactivity
       1. Conditions contributing to instability: None haz-
          ardous
       2. Incompatibilities: Contact with strong oxidizers
          may cause fires and explosions.
       3. Hazardous decomposition products: None
       4. Special precautions: None
     • Flammability
       1. Flash point: Anthracene: 121 °C (250 °F) (closed
          cup); Others: Data not available
       2. Autoignition temperature: Anthracene: 540 °C
          (1004 °F); Others: Data not available
       3. Flammable limits in air, % by volume: Anthra-
          cene: Lower: 0.6; Others: Data not available
       4. Extinguisher: Foam, dry chemical, and carbon
cioxide
     • Warning properties
Grant states that “coal tar and its various crude frac-
tions appear principally to cause reddening and aqua-
omous eczema of the lid margins, with only small ero-
sions of the corneal epithelium and superficial chang-
es in the stroma, which disappear in a month following
exposure. Chronic exposure of workmen to tar fumes
and dust has been reported to cause conjunctivitis and
discoloration of the cornea in the palpebral fissure, either near the limbus or, in extreme cases, across the
whole cornea. Occasionally, epithelioma of the lid
margin has been attributed to contact with coal tar.”

MONITORING AND MEASUREMENT PROCEDURES

• General
Measurements to determine employee exposure are best
taken so that the average eight-hour exposure is based
on a single eight-hour sample or on two four-hour
samples. Several short-time interval samples (up to 30
minutes) may also be used to determine the average
exposure level. Air samples should be taken in the
employee’s breathing zone (air that would most nearly
represent that inhaled by the employee).

• Method
Coal tar products may be sampled by collection on a
glass fiber filter with subsequent ultrasonic extraction
and weighing. An analytical method for coal tar pitch
volatiles is in the NIOSH Manual of Analytical Methods,
017-033-00267-3).

RESPIRATORS

• Good industrial hygiene practices recommend that
engineering controls be used to reduce environmental
concentrations to the permissible exposure level. How-
ever, there are some exceptions where respirators may
be used to control exposure. Respirators may be used
when engineering and work practice controls are not
technically feasible, when such controls are in the
process of being installed, or when they fail and need to
be supplemented. Respirators may also be used for
operations which require entry into tanks or closed
vessels, and in emergency situations. If the use of
respirators is necessary, the only respirators permitted
are those that have been approved by the Mine Safety
and Health Administration (formerly Mining Enforce-
ment and Safety Administration) or by the National
Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respira-
tory protection program should be instituted which
includes regular training, maintenance, inspection,
cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to
use impervious clothing, gloves, face shields (eight-inch
minimum), and other appropriate protective clothing
necessary to prevent skin contact with condensed coal
tar pitch volatiles, where skin contact may occur.

• If employees’ clothing may have become contaminat-
ed with coal tar pitch volatiles, employees should
change into uncontaminated clothing before leaving the
work premises.

• Clothing contaminated with coal tar pitch volatiles
should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of coal tar pitch volatiles from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the coal tar pitch volatiles, the person performing the operation should be informed of coal tar pitch volatiles’s hazardous properties.

* Employees should be provided with and required to use splash-proof safety goggles where condensed coal tar pitch volatiles may contact the eyes.

SANITATION

* Workers subject to skin contact with coal tar pitch volatiles should wash with soap or mild detergent and water any areas of the body which may have contacted coal tar pitch volatiles at the end of each work day.
* Employees who handle coal tar pitch volatiles should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.
* Areas in which exposure to coal tar pitch volatiles may occur should be identified by signs or other appropriate means, and access to these areas should be limited to authorized persons.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to coal tar pitch volatiles may occur and control methods which may be effective in each case:

<table>
<thead>
<tr>
<th>Operation</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liberation from extraction and packaging from coal tar fraction of coking</td>
<td>Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment</td>
</tr>
<tr>
<td>Use as a binding agent in manufacture of coal briquettes used for fuel; use as a dielectric in the manufacture of battery electrodes, electric-arc furnace electrodes, and electrodes for alumina reduction</td>
<td>Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment</td>
</tr>
<tr>
<td>Use in manufacture of roofing felts and papers and roofing</td>
<td>Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment</td>
</tr>
</tbody>
</table>

Operation

Use for protective coatings for pipes for underground conduits and drainage; use as a coating on concrete as waterproofing and corrosion-resistant material; use in road paving and sealing

Controls

Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

* Eye Exposure
If condensed coal tar pitch volatiles get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with these chemicals.

* Skin Exposure
If condensed coal tar pitch volatiles get on the skin, wash the contaminated skin using soap or mild detergent and water. Be sure to wash the hands before eating or smoking and to wash thoroughly at the close of work.

* Breathing
If a person breathes in large amounts of coal tar pitch volatiles, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

* Rescue
Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility’s emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

* Persons not wearing protective equipment and clothing should be restricted from areas of releases until cleanup has been completed.
* If coal tar pitch volatiles are released in hazardous concentrations, the following steps should be taken:
  1. Ventilate area of spill.
2. Collect released material in the most convenient and safe manner for reclamation or for disposal in sealed containers in a secured sanitary landfill.

- Waste disposal method:
  Coal tar pitch volatiles may be disposed of in sealed containers in a secured sanitary landfill.

REFERENCES


<table>
<thead>
<tr>
<th>Condition</th>
<th>Minimum Respiratory Protection* Required Above 0.2 mg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particulate and Vapor Concentration</td>
<td></td>
</tr>
<tr>
<td>2 mg/m³ or less</td>
<td>A chemical cartridge respirator with an organic vapor cartridge(s) and with a fume or high-efficiency filter.</td>
</tr>
<tr>
<td></td>
<td>Any supplied-air respirator.</td>
</tr>
<tr>
<td></td>
<td>Any self-contained breathing apparatus.</td>
</tr>
<tr>
<td>10 mg/m³ or less</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s) and with a fume or high-efficiency filter.</td>
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<tr>
<td></td>
<td>A gas mask with a chin-style or a front- or back-mounted organic vapor canister and with a full facepiece and a fume or high-efficiency filter.</td>
</tr>
<tr>
<td></td>
<td>Any supplied-air respirator with a full facepiece, helmet, or hood.</td>
</tr>
<tr>
<td></td>
<td>Any self-contained breathing apparatus with a full facepiece.</td>
</tr>
<tr>
<td>200 mg/m³ or less</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.</td>
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<tr>
<td></td>
<td>A powered air-purifying respirator with an organic vapor cartridge and a high-efficiency particulate filter.</td>
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<tr>
<td>400 mg/m³ or less</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.</td>
</tr>
<tr>
<td>Greater than 400 mg/m³ or entry and escape from unknown concentrations</td>
<td>Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.</td>
</tr>
<tr>
<td></td>
<td>A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.</td>
</tr>
<tr>
<td>Fire Fighting</td>
<td>Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.</td>
</tr>
<tr>
<td>Escape</td>
<td>Any gas mask providing protection against organic vapors and particulates, including pesticide respirators which meet the requirements of this class.</td>
</tr>
<tr>
<td></td>
<td>Any escape self-contained breathing apparatus.</td>
</tr>
</tbody>
</table>

*Only NIOSH-approved or MSHA-approved equipment should be used.