You're standing on it!

Coal-Tar-Based Pavement Sealcoat, PAHs, and the Environment: An Introduction

Barbara Mahler  U.S. Geological Survey
What Are PAHs?
(polycyclic aromatic hydrocarbons)

- Large group of organic compounds
- Many are carcinogenic, mutagenic, teratogenic, or toxic
- Produced by combustion of organic matter

Urban sources:
- Used motor oil
- Exhaust
- Industrial emissions
- Asphalt
- Tires
- Coal-tar-based pavement sealant

What is the relative importance of these sources?
Chemistry of PAHs

- Phenanthrene
- Coronene
- Pyrene
- Benzo[a]pyrene

\( \text{phenanthrene} + \text{pyrene} = \text{coronene} \)
Why be concerned about PAHs?

- PAHs have adverse health effects for biota and humans

Photo courtesy of Jim Negus

Healthy bullhead, Tennessee

Photo courtesy of Fred Pinckney

A brown bullhead, Anacostia River, Maryland
Why be concerned about PAHs?

- PAHs are increasing in U.S. lakes

City of Austin provides the first clues

- Extremely high (~1,500 mg/kg) PAHs in some small drainages

- Compare to Probable Effect Concentration (PEC) of 23 mg/kg
What could be the source?

1,500 mg/kg in creek sediment

- Tire wear particles  
  - 175 (mean of 3 studies)
- Road dust  
  - 59
- Brake lining particles  
  - 9
- Air particles, major roadway  
  - 104
- Fresh asphalt  
  - 2
- Weathered asphalt  
  - 9
- Fresh motor oil  
  - 7
- Used motor oil  
  - 726
- Diesel engine  
  - 304 (mean of 2 studies)
- Gasoline engine  
  - 35
- Coal-tar-based pavement sealcoat  
  - 92,000 (mean of 6 products)

All concentrations in mg/kg
Pavement sealcoat
Two kinds of sealcoat

- Asphalt-based product
  - PAH content ~ 50 mg/kg
  - West of the Continental Divide

- Coal-tar based product
  - PAH content ~92,000
  - East of the Continental Divide
Some information about coal tar pitch

• Coal tar pitch is the residue remaining after the distillation of crude coal tar.
• The pitch is refined into different grades of viscosity, of which RT-12 (used for pavement sealer) is the most viscous.
• Variously referred to as refined coal tar, coal tar emulsion, RT-12, refined coal tar pitch emulsion, etc.
• CAS # 65996-93-2 → “coal tar pitch”
MATERIAL SAFETY DATA SHEET

I. General Information

Chemical Name & Synonyms
Dispersion of refined coal tar and mineral fillers in water.

Trade Name & Synonyms

Hazardous Materials Identification System (HMIS)
HEALTH  FLAMMABILITY  REACTIVITY  PERSONAL PROTECTION
2       0          0  C

Proper DOT Shipping Name
None

DOT Hazard Classification
None

Manufacturer

Manufacturer's Phone #

Manufacturer's Address

Chemtrec Phone #

II. Hazardous Ingredients

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>CAS NO.</th>
<th>Percent</th>
<th>Exposure Limit</th>
</tr>
</thead>
</table>
| Refined Coal Tar    | 65996-93-2| 31 - 34 | 0.2 mg/m³ OSHA PEL Coal tar volatiles benzene soluble fraction 8 hr work shift avg.

III. Physical Data

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiling Point (°F)</td>
<td>IBP 212°F</td>
</tr>
<tr>
<td>Specific Gravity (H₂O=1)</td>
<td>1.2</td>
</tr>
<tr>
<td>Vapor Pressure (mm Hg.)</td>
<td>Not Determined</td>
</tr>
<tr>
<td>Percent Volatile by Volume</td>
<td>Not Determined</td>
</tr>
<tr>
<td>Vapor Density (Air =1)</td>
<td>&gt;1</td>
</tr>
<tr>
<td>Evaporation Rate (butyl acetate=1)</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Solubility in Water</td>
<td>Dispersible, not soluble.</td>
</tr>
<tr>
<td>pH</td>
<td>7.4</td>
</tr>
</tbody>
</table>

Appearance & Odor
Viscous brown black liquid with musky coal tar smell.

IV. Fire & Explosion Hazard Data

Flash Point (Test Method)  
Auto Ignition Temperature
Substance Profiles

Coal Tars and Coal Tar Pitches*
Known to be human carcinogens

Carcinogenicity

Coal tars and coal tar pitches are known to be human carcinogens based on sufficient evidence of carcinogenicity in humans. Numerous studies, mostly case reports, have found that occupational exposure to coal tars or coal-tar pitches (coal-tar distillates) is associated with skin cancer, including scrotal cancer; workers in these studies have included patent-fuel (coal-briquette) workers, pitch loaders, workers in electrical trades, and optical-lens polishers. A 1946 study in the United Kingdom found that patent-fuel workers were 500 times as likely as other workers to die of scrotal cancer. In addition, there have been many case reports of skin cancer among patients using therapeutic coal-tar preparations. Occupational exposure to coal tar or coal-tar pitches also has been associated with cancer at other tissue sites, including the lung, bladder, kidney, and digestive tract. Excesses of lung cancer were found in several epidemiological studies of workers exposed to coal-tar fumes in coal ether, ethanol, methanol, and formaldehyde. Low-temperature coal tar pitches are black, viscous liquids that may be released from high-temperature coal tars (HSDB 2003). Coal-tar pitches are a product formed during the distillation of synthetic methy1 and polymethyl methacrylate (IARC 1985).

Use

Coal tars and coal-tar pitches are widely used in industrial, consumer products. They are used in the production of refined chemicals, coal-tar pitch, and crude distillation of crude coal. Coals and hearth furnace and blast furnace dusts.
Coal-tar sealcoat

Used motor oil
Environmental relevance

• Are concentrations elevated?
• Does it stay on site or is it mobile?
• How extensive is use?
USGS - City of Austin Joint Study

- Sampled runoff from 13 parking lots
- Analyzed particles and water for PAHs
PAHs in Parking Lot Runoff Particles

Reilly Site, MN
3,000 max
Black River, OH
1,100

Superfund Sites

Applied over coal-tar-sealcoated pavement
PAHs in Parking Lot Runoff Particles

- Used Oil: 730 mg/kg
- Tires: 80-200 mg/kg
- Asphalt: 2-10 mg/kg

**PEC = 23**
9 U.S. Cities: Pavement Dust PAH (mg/kg)

Sealed:
- Asphalt: 5.2
- Coal tar: 2.1
- <1

Unsealed:
- Asphalt: 8.5
- Coal tar: 0.8
- <8.5

Other values:
- 570
- 3,400
- 1,300
- 3,200
- 3,800
- 1,200
- 24
- 54
- 47
- 21
- 30
Sealcoat use is extensive
Some examples ...

- Sealcoat industry estimates 20,000 tons (~4,800,000 gallons) of CT-based sealcoat applied in Texas annually
- Principal applicator in Springfield, MO, estimates 200,000 gallons applied annually in Springfield area.
- 1,400,000 gallons applied annually to New York Harbor watershed

- Area covered:
  - 4 watersheds in Texas: 1-2% total area
  - 1 watershed in Illinois: 4% of area
    - 42% of parking lot area
    - 89% of driveway area
Sealcoat: Presentations and posters at the NWQMC

- Stormwater treatment and management
- Source apportionment to U.S. lakes
- Public policy and decision making

Poster Session
- Volatility from the pavement surface
- Contribution to PAHs in house dust