



POLYCYCLIC AROMATIC HYDROCARBONS & COAL TAR SEALANTS

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Outline



- Background
- Effects of PAHs
- Sources of PAHs
- Coal Tar
- Current Legislation
- Summary

Background

What are Polycyclic Aromatic Hydrocarbons?

Polycyclic Aromatic Hydrocarbons (PAHs)

- **Hydrocarbons** :

- made up of 2 or more six-carbon ringed compounds called benzene

- **Organic Compound**:

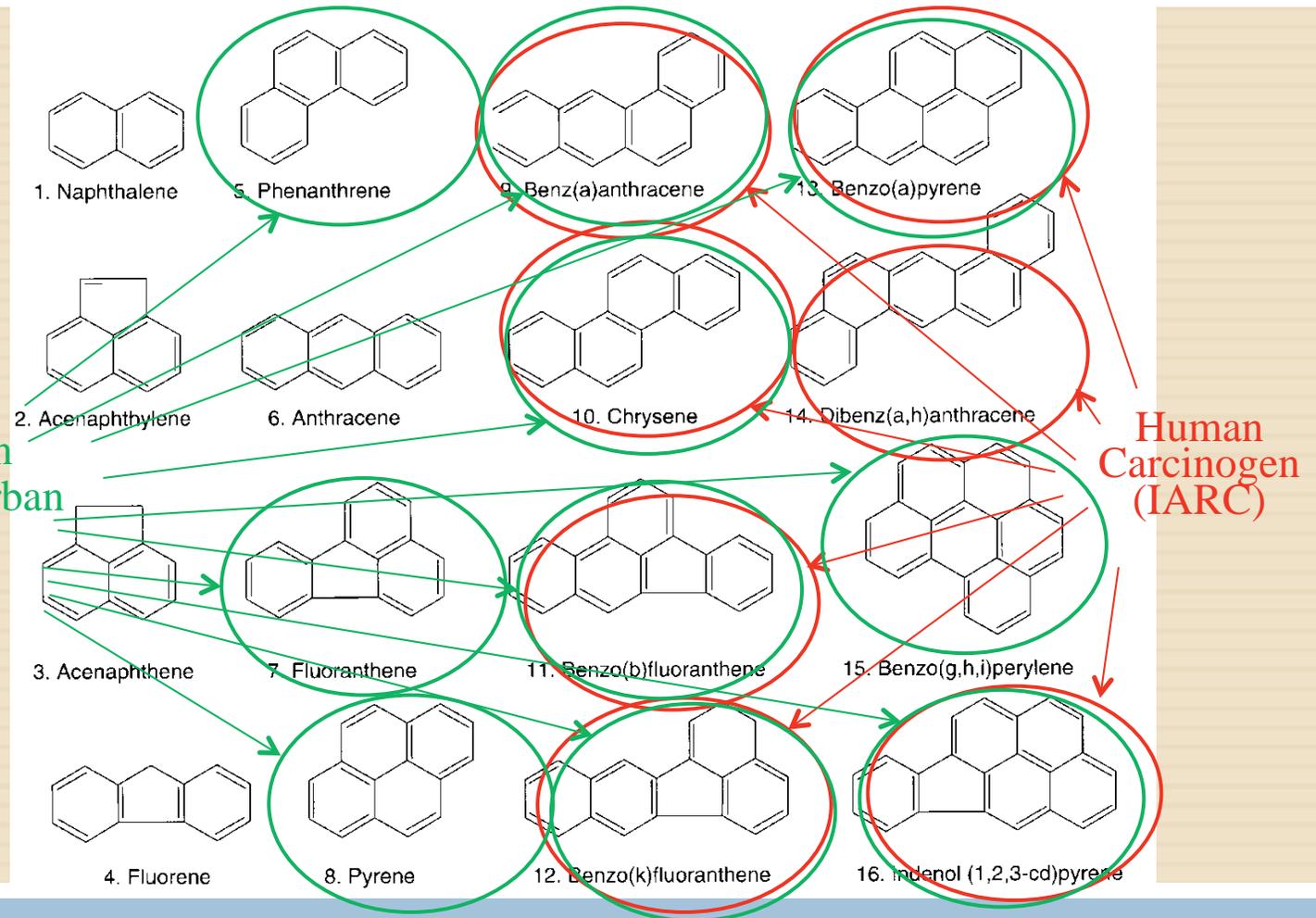
- made up of carbon

- **PAH's**

- Are formed by the incomplete combustion of Organic Materials (e.g. wood or fossil fuels)
 - Tendency to bind to sediment and organic matter
- Thousands of different kinds of PAHs exist, but the EPA lists 16 as Priority Pollutant PAHs.



Common
PAHs in Urban
Runoff



PAH Chemistry – The EPA’s 16 Priority Pollutant PAHs

- High Molecular Weight PAHs have more than two benzene rings
 - Lower water solubility
 - Higher sorption to sediments and organic content in stormwater
 - More persistent in the environment

Effects of PAHs

Effects on Aquatic Environment and Risk to Humans

Effects of PAHs on Environment

- In the lab, frogs take longer to hatch and are smaller developmentally when exposed to coal tar sealant flakes (Bryer, 2006)
 - When exposed to the maximum level of PAHs found in Austin, TX streams all of the frogs died by day six.



Effects of PAHs on Environment

- PAH concentration downstream of coal tar sealed parking lots has toxic effects of benthic, or bottom dwelling, communities (Scoggins, 2007).
 - Leads to impaired aquatic communities since benthic organisms are an important part of the food chain.
- Mouth tumors in fish have been linked to PAH concentration in sediments (Pinkney, 2009).



Photograph by A.E. Pinkney

Risks to Humans

- In humans, PAHs can be absorbed through:
 - Skin,
 - Respiratory tract,
 - Gastrointestinal tract
- Long-term exposure to low levels of PAHs cause an increased risk of:
 - Skin,
 - Lung,
 - Bladder, and
 - Gastrointestinal cancers
- Once absorbed in our body, PAHs enter the lymph system, circulate in the blood and are metabolized primarily in the liver and kidney.



Sources for PAHs

Focus: Coal Tar Sealants



Sources of PAHs

- Natural Sources:
 - Forest and prairie fires, volcanic activity, fossil fuel deposits
- Anthropogenic Sources:



Table 1. Categorization of major sources of PAHs in the Watershed region.

Combustion	Transportation	<u>Materials containing PAHs</u>
Mobile Vehicle exhaust Nonroad engine exhaust	Mobile Vehicle exhaust Nonroad engine exhaust Tire wear Used motor oil (down storm drains, leaking)	Mobile Tire wear Used motor oil (down drain, leaking)
Stationary Wood combustion Other, minor sources	Infrastructure Coal tar parking lot sealants Creosote railroad ties Creosote marine pilings	Infrastructure Coal tar parking lot sealants Creosote railroad ties Creosote utility poles Creosote marine pilings
Other	Other	Other

Sources of PAHs



Median of two lots reportedly sealcoated with coal-tar-based sealcoat Van Metre et al © 2008

Lake in the Hills, Illinois

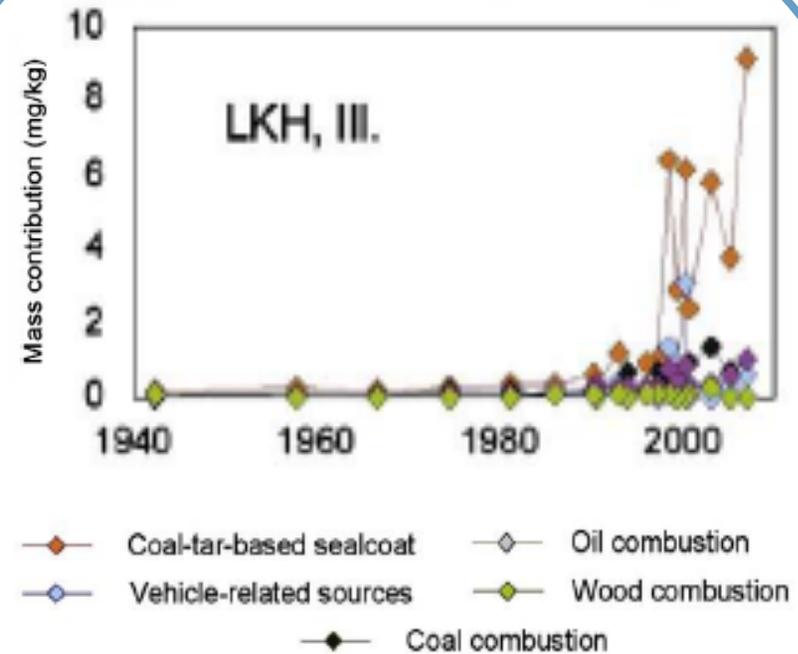


Fig 5. Historical trends in mass contributions of Σ PAH from different sources to eight lakes. P.C. Van Metre, B.J. Mahler © 2010

What is Coal-Tar Based Sealant?



- Coal-tar-based sealant is the black liquid sprayed or painted on many parking lots, driveways, and playgrounds.
- An estimated 85 million gallons are used each year, primarily in the central and eastern U.S.
- Coal tar is known to cause cancer in humans and is made up of more than 50 percent PAHs.

Facts from Recent Studies

- *“Children living near coal-tar-sealed pavement are exposed to twice as many PAHs from ingestion of contaminated house dust than from food”, according to a separate new study by Baylor University and the USGS, published in the journal Environmental Pollution. “Several PAHs are probable human carcinogens and many are toxic to fish and other aquatic life.”*



Source: USGS

Facts from Recent Studies

- Baylor University scientist Spencer Williams used USGS measurements of PAHs in house dust to estimate the potential ingestion of PAHs by young children living near coal-tar-sealed parking lots.
 - Ingestion of PAHs from food has long been thought to be the primary route by which children are exposed to PAHs.
 - Williams' analysis indicated that children living in apartments adjacent to parking lots with coal-tar-based sealcoat likely receive more than twice as much PAHs from incidental ingestion of house dust than from their diet.
 - PAH ingestion by children in those settings was estimated to be 14 times higher than by children in apartments adjacent to unsealed parking lots.

Source: USGS

Facts from Recent Studies

- *“Coal-tar-based sealants are emitting polycyclic aromatic hydrocarbons (PAHs) into the air at rates that may be greater than annual emissions from vehicles in the United States”,* according to new reports by the U.S. Geological Survey, published in the scientific journals [Chemosphere](#) and [Atmospheric Environment](#)

Facts from Recent Studies

- Scientists estimate that the amount of PAHs released to air nationwide each year from new applications of coal-tar-based sealant are similar to or greater than annual PAH emissions from vehicles.
- USGS scientists measured PAHs in air above parking lots, with and without sealcoat, in suburban Austin, Texas.
- In a second study, PAH levels in air and in dried sealant were tracked for one year following sealant application to a parking lot.
 - Two hours after sealcoat application, PAH emissions were 30,000 times higher than those from unsealed pavement.
 - Parking lots with three to eight-year-old sealant released 60 times more PAHs to the air than parking lots without sealant

Source: USGS

Coal Tar

Toxicity and Alternatives



Research

Found high levels of PAHs are primarily from coal tar sealants*

- University of New Hampshire
- United States Geological Survey, Texas and Wisconsin
- Wisconsin Department of Natural Resources
- Minnesota Pollution Control Agency
- City of Austin, TX
- Texas State University
- Baylor University

* Research funded by research institutions and government.

Found PAHs from coal tar sealants are not an issue*

- ENVIRON International
- Exponent Consulting

* Research funded by the Pavement Coatings Technology Council (PCTC)

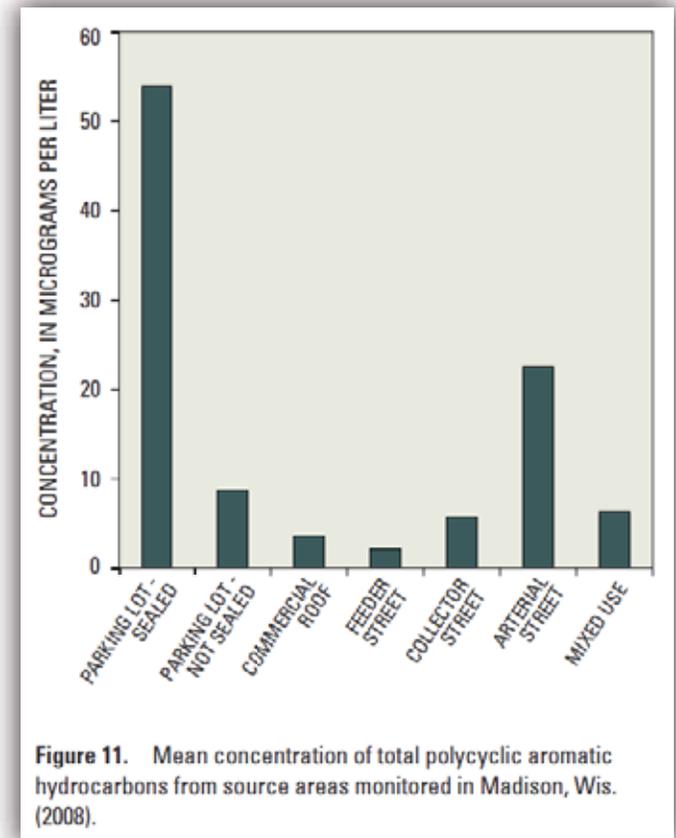
Types of Sealcoat Products



- Two kinds of sealcoat products are widely used: coal-tar-based and asphalt-based.
 - The coal-tar products have PAH levels about 1,000 times higher than the asphalt products.
- Asphalt-based sealcoat is more commonly used on the West Coast and coal-tar-based sealcoat is more commonly used in the Midwest, the South, and the East.

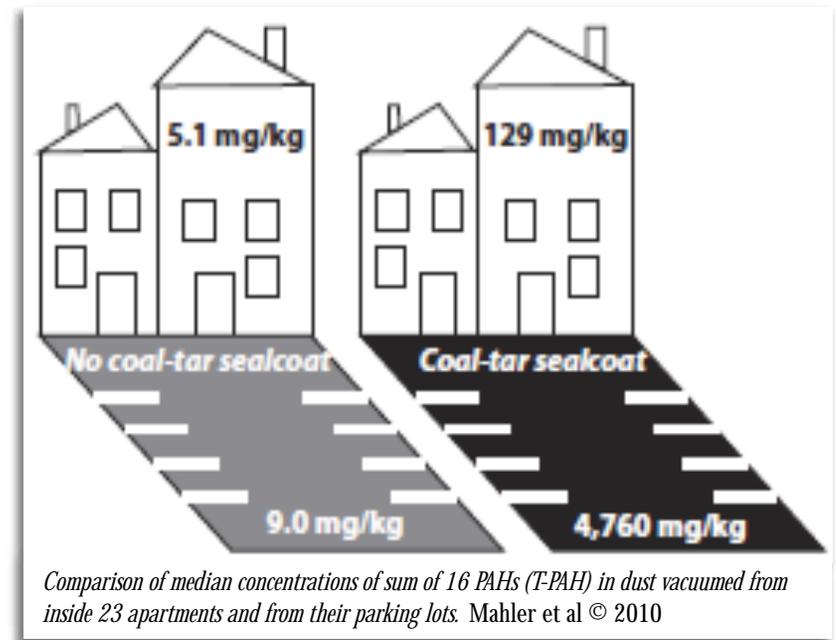
Results

- Particles in runoff from coal tar-sealed parking lots contained PAH concentrations **65 times higher** than unsealed or cement lots (Mahler et al, 2005).
- Levels of PAHs in coal tar sealants have been found to be as high as **50,000 mg/kg** whereas asphalt sealants contain an average of **50 mg/kg** (City of Austin, 2005).
- Concentration of PAHs **were elevated 30 months after sealant was applied** in a downstream wetland (Watts et al, 2010).



Reducing Contamination: Alternatives

- No Sealant
- Asphalt Sealant
- Eco-Friendly Sealcoat
 - STAR GREEN claims to have no PAHs.
- Concrete
- Pervious Pavement
 - Additional benefit: reduces PAH contamination from oil and exhaust (Scholz, 2007).
- Treatment of stormwater runoff



Coal Tar Alternative Products – Commercial/Wholesale

Manufacturer	Product
Neyra www.neyra.com	<ul style="list-style-type: none">• PaveShield (Asphalt-based)• Jennite Asphalt Emulsion (Asphalt-based)
Asphalt System, Inc www.asphaltsystems.biz	<ul style="list-style-type: none">• GSB-88 (Gilsonite)
Seal Master www.sealmaster.net	<ul style="list-style-type: none">• Master Seal Pavement Sealer (Asphalt-based)• Polymer Modified Master Seal (Asphalt-based)
Professional Coating Technology Inc. www.pctworldwide.com	<ul style="list-style-type: none">• COS-50 (Asphalt-based)
Star Seal www.starseal.com	<ul style="list-style-type: none">• STAR GREEN (based on Acrylic polymer, clay, fillers, specialty chemicals)• STAR Micro-Pave (Asphalt-based)

Alternative Sealant Products

- Many products do not contain coal tar and are not included on the above list
- Consumers can determine whether a product contains coal tar by reading the product label or the associated Materials Safety Data Sheet (MSDS) - available from the applicator, retailer, or on the Internet. Watch for the terms: “RT-12,” “refined coal tar,” or “coal tar pitch”

Coal Tar vs. Asphalt-Based Sealant

- Asphalt-based sealants *generally* do not have the same level of resistance to chemicals or weathering as coal tar-based sealants and may need to be re-applied more often.
- There **are** asphalt sealers available that are comparable in performance to coal tar, for example:
 - STAR's Micro-Pave line of performance-driven asphalt-based sealcoats (pavecoat.com).



How do the Costs Compare?

- **Asphalt based:**
 - 19 products with a low of \$12 and **an average of \$20** and maximum of \$32. 11 products less than \$20 per 5 gallon bucket. Product variability: 1 year warranties- 10 years
- **Coal tar based:**
 - 5 products with a low of \$12 and **an average of \$15** but all the available products are less than \$20.
- **Gilsonite based** (a special fossilized asphalt):
 - 2 products with **an average of \$46**
- **Acrylic based:**
 - **1 product for \$42**



Current Regulation

Prohibiting the use of Coal Tar Sealants



Current Policies (In Brief)



- **State**

- Washington State

- **Ordinances**

- Austin, Texas
- Washington D.C.
- Dane County, WI
- Maplewood, White Bear Lake, Centerville, Circle Pines, and Vadnais Heights, MN

- **Government Use Restriction**

- Minnesota State
- Illinois
 - Lake in the Hills
 - McHenry County Government
 - Spring Grove
 - 39 municipalities that participate on the DuPage River Salt Creek Workgroup

Pending Legislation



- Federal Bill
 - to be introduced by Lloyd Doggett (Congressman , TX)
- Illinois
 - SB 3509 - change to the County's code
- New York
 - SB 6535
- California
 - Statewide ban

If Coal Tar Sealants Were Banned...

- Home Depot and Lowe's have discontinued the sale of coal tar sealants throughout the US.
 - They consider it a good business practice to protect the consumer.
- “Because the sealant industry consumes less than 5% of the coal tar pitch produced, it is likely that if coal tar sealants were no longer used the excess coal tar pitch would be absorbed by one of the other industries that use the material.” (Valle, 2007)
 - 75% goes into the production of aluminum where there is the best price return (Heydorn, 2007).
 - The rest is split between railroad, roofing, and finally, seal-coating

If Coal Tar Sealants Were Banned...



- 2006 Coal Tar shortage, the industry simply increased marketing and production of asphalt-based sealants (Heydorn, 2007).

“The industry will find a replacement as long as the value is there, and seal coating will continue to be used...The materials might change but the business will be there.”

Girish Dubey - 2006 president of STAR Inc.

Summary



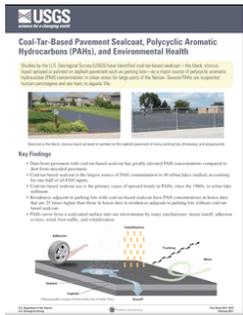
- PAHs are increasing in urban areas around the country
- PAH concentrations above freshly sealed coal tar sealcoat can be 1000's of times higher than other surfaces
- Human health concerns are real
- Even small amounts of sealant can dominate the PAH concentration in a stormwater pond
- Disposal of coal tar sealant contaminated soil can be very expensive
- Coal tar sealants are banned in an increasing number of jurisdictions around the country
 - Bans in the US currently cover about 10.4 million people

Summary



- Coal Tar Sealants have alarmingly high levels of PAH and contribute to PAH contamination in stormwater and nearby surface waters.
- There are alternatives to coal tar sealants that are comparable in quality and cost.
- From the Coal Tar Shortage of 2006, we can see that the reduction of Coal Tar Sealants would have minimal impacts to coal tar producers and contractors.
- Many national retail home improvement chains have stopped selling coal tar sealants

New Publications



- USEPA: Assessment of Water Quality of Runoff from Sealed Asphalt Surfaces
- Mahler, B.J., and Van Metre, P.C., 2011, Coal-tar-based pavement sealcoat, polycyclic aromatic hydrocarbons (PAHs), and environmental health: U.S. Geological Survey Fact Sheet 2011–3010, 6 p.
- Mahler, B.J.; Van Metre, P.C.; Crane, J.L.; Watts, A.W.; Scoggins, M.; Williams, E.S., Coal-tar-based pavement sealcoat and PAHs: Implications for the environment, human health, and stormwater management. [Environ. Sci. Technol., 2012.](#)
- Van Metre, P. C.; Majewski, M. S.; Mahler, B. J.; Foreman, W. T.; Braun, C. L.; Wilson, J. T.; Burbank, T. PAH volatilization following application of coal-tar-based pavement sealant. [Atmos. Environ. 2012.](#)
- Van Metre, P. C.; Majewski, M. S.; Mahler, B. J.; Foreman, W. T.; Braun, C. L.; Wilson, J. T.; Burbank, T. Volatilization of polycyclic aromatic hydrocarbons from coal-tar-sealed pavement. [Chemosphere, 2012.](#)
- Williams, E. S.; Mahler, B. J.; Van Metre, P. C. Coal-tar pavement sealants might substantially increase children's PAH exposures. [Environ. Pollut. 2012.](#)



Questions?

"We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect."

Aldo Leopold, A Sand County Almanac



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Resources

Concentrations of Polycyclic Aromatic Hydrocarbons (PAHs) in Urban Stormwater, Madison, Wisconsin, 2005-08. Selbig, William R. © 2009

Pollution Prevention and Management Strategies for Polycyclic Aromatic Hydrocarbons in the New York/New Jersey Harbor. Valle, Sandra et al © 2007.

Occurrence of polycyclic aromatic hydrocarbons below coal-tar-sealed parking lots and effects on stream benthic macroinvertebrate communities. Scoggins, M et al © 2007

The Effects of Coal Tar Based Pavement Sealer on Amphibian Development and Metamorphosis. Bryer, Pamela et al © 2006

Contribution of PAHs from coal-tar pavement sealcoat and other sources to 40 U.S. lakes. Van Metre, Peter C. and Barbara J. Mahler © 2010

Parking Lot Sealcoat: An Unrecognized Source of Urban Polycyclic Aromatic Hydrocarbons. Mahler, Barbara J. et al © 2005

Polycyclic Aromatic Hydrocarbons in Stormwater Runoff from Sealcoated Pavements. Watts, Allison W. et al © 2010

PAHs in Austin, Texas Sediments and Coal-Tar Based Pavement Sealants Polycyclic Aromatic Hydrocarbons. City of Austin © 2005

“What Happened to Coal Tar in 2006?” Heydorn, Allan; Pavement, January 2007.

Knowing the Facts – Sealcoatings Based on Refined Coal Tar & Asphalt Emulsions; Last accessed Feb. 25, 2011; www.pavecoat.com/know-fact.html

Polycyclic Aromatic Hydrocarbons in Urban Runoff—Sources, Sinks and Treatments: A Review. Prabhukumar, Giridhar et al, Illinois Institute of Technology © 2011

“Coal-Tar-Based Pavement Sealcoat, Polycyclic Aromatic Hydrocarbons (PAHs), and Environmental Health” A USGS publication; Fact Sheet, February 2011