Science Policy Outreach Task Force at Northwestern University

HEALTH IMPACTS OF COAL-TAR BASED SEALANTS

SPOTlight: Coal-tar based sealants contain high levels of PAHs—a class of chemicals that is known to cause cancer and birth defects—in much higher concentrations that its alternatives.



What are coal-tar based sealants?

- Pavement sealants extend the life of pavement by protecting it from water, chemicals, and solar radiation. Most sealants use either coal-tarpitch or asphalt as the main component. Coal-tar based sealants are primarily used on driveways and parking lots east of the Continental Divide at ~85 million gallons per year in the US. [1]
- Coal-tar-pitch is a byproduct of coal processing and is the binder used in coal-tar sealants. Coal-tar-pitch contains hundreds of types of polycyclic aromatic hydrocarbons (PAHs), a class of substances known for causing harmful health effects. [2]
- As sealants wear down over the course of a few years, these harmful chemicals end up in the air, dust, and water systems. A 2010 study found that apartments next to coal-tar sealed parking lots have 25 times higher PAH levels in their household dust than apartments next to parking lots with other types of surfaces. [3, 4]

What are the human health effects?

- Coal-tarpitch and several PAHs are listed by the International Agency for Cancer Research as Group 1 carcinogens, or chemicals known to cause cancer in humans. A study on women found that exposure to multiple sources of PAHs was linked to a 30-50% increase in cases of breast cancer. [5, 6]
- Studies conducted on people with high occupational exposure to PAHs have revealed short-term symptoms that include eye irritation, nausea, vomiting, diarrhea, and skin inflammation. [7]
- Long-term exposure is linked to DNA mutation and loss of function in the heart and lungs.[8, 9]

What are health effects to pregnant women and small children?

- Exposure to high levels of PAHs during pregnancy is linked to low birth weight, premature delivery, delayed child development, and childhood asthma. [10, 11]
- Occupational exposure to PAHs has been associated with gastroschisis, a condition in which a baby's bowels develop *outside* of its body, for mothers over the age of 20. [12]
- One study found that risk of neural tube defects (the precursor to the brain and spinal cord) increased 4.5 times in cases where placental PAH levels were above average. [13]

What are the effects on the environment?

- Exposure to PAHs leads to stunted growth, slow development, and death in African clawed frogs, as well as stunted growth and diminished ability to swim in salamanders. [14, 15]
- Fish, including bullhead catfish commonly found in Illinois, are known to experience tumors, reproduction problems, immunotoxicity, and harmful effects to embryo growth as a result of exposure to PAHs. [16]

What are the acceptable limits of exposure?

- Due to the complex nature of mixtures that contain hundreds of PAHs, the dose-response relationships and long-term health effects, with the exception of cancer, for many isolated PAHs are not well understood. [17]
- The National Institute for Occupational Safety and Health recommends an exposure limit for coal-tar-pitch volatile agents of 0.1 mg/m³, which is far exceeded in air near recently applied coal-tar based sealant. [18, 19]
- Minnesota, Washington, and several local municipalities have banned the use of coal-tar based sealants. [20]

What are the alternatives?

- Asphalt sealants contain PAHs in 1000x *lower* concentrations than coal-tar sealants. [3]
- Some sealants contain little to no PAHs, such as acrylic and agricultural oil based sealants, but must be reapplied more often than coal-tar and asphalt based sealants [21]

References and additional resources

- Scoggins, M., et al. (2009), A Photographic Method for Estimating Wear of Coal Tar Sealcoat from Parking Lots. Environmental Science & Technology. 43(13): p. 4909-4914. DOI: 10.1021/es9003119
- [2] Guillén, M.D., et al. (1992), Polynuclear aromatic hydrocarbon retention indices on SE-54 stationary phase of the volatile components of a coal tar pitch: Relationships between chromatographic retention and thermal reactivity. J. Chromatogr. A. 591(1): p. 287-295. DOI: 10.1016/0021-9673(92)80246-Q
- [3] Mahler, B.J., et al. (2012), Coal-Tar-Based Pavement Sealcoat and PAHs: Implications for the Environment, Human Health, and Stormwater Management. *Environ Sci Technol.* **46**(6): p. 3039-3045. DOI: 10.1021/es203699x
- [4] Mahler, B.J., et al. (2010), Coal-tar-based parking lot sealcoat: an unrecognized source of PAH to settled house dust. Environ Sci Technol. 44(3): p. 894-900. DOI: 10.1021/es902533r
- [5] White, A.J., et al. (2016), Exposure to multiple sources of polycyclic aromatic hydrocarbons and breast cancer incidence. *Environ Int.* 89-90: p. 185-92. DOI: 10.1016/j.envint.2016.02.009
- [6] International Agency for Research on Cancer. (2020), IARC Monographs on the Identification of Carcinogenic Hazards to Humans. <u>https://monographs.iarc.fr/list-of-classifications</u>
- [7] Unwin, J., et al. (2006), An Assessment of Occupational Exposure to Polycyclic Aromatic Hydrocarbons in the UK. *The Annals of Occupational Hygiene*. **50**(4): p. 395-403. DOI: 10.1093/annhyg/mel010
- [8] García-Suástegui, W.A., et al. (2010), Seasonal variations in the levels of PAH–DNA adducts in young adults living in Mexico City. *Mutagenesis*. 26(3): p. 385-391. DOI: 10.1093/mutage/geq104
- [9] Kuo, C.Y., Y.W. Hsu, and H.S. Lee. (2003), Study of Human Exposure to Particulate PAHs Using Personal Air Samplers. Archives of Environmental Contamination and Toxicology. 44(4): p. 0454-0459. DOI: 10.1007/s00244-002-1177-4
- [10] Perera, F., et al. (2005), DNA Damage from Polycyclic Aromatic Hydrocarbons Measured by Benzo[a]pyrene-DNA Adducts in Mothers and Newborns from Northern Manhattan, The World Trade Center Area, Poland, and China. *Cancer Epidemiol. Biomark. Prev.* 14(3): p. 709-714. DOI: 10.1158/1055-9965.EPI-04-0457
- [11] Perera, F. and J. Herbstman. (2011), Prenatal environmental exposures, epigenetics, and disease. *Reproductive Toxicology*. 31(3): p. 363-373. DOI: 10.1016/j.reprotox.2010.12.055
- [12] Lupo, P.J., et al. (2012), Maternal Occupational Exposure to Polycyclic Aromatic Hydrocarbons: Effects on Gastroschisis among Offspring in the National Birth Defects Prevention Study. *Environmental Health Perspectives*. **120**(6): p. 910-915. DOI: doi:10.1289/ehp.1104305
- [13] Ren, A., et al. (2011), Association of selected persistent organic pollutants in the placenta with the risk of neural tube defects. PNAS. 108(31): p. 12770-12775. DOI: 10.1073/pnas.1105209108
- [14] Bryer, P.J., J.N. Elliott, and E.J. Willingham. (2006), The Effects of Coal Tar Based Pavement Sealer on Amphibian Development and Metamorphosis. *Ecotoxicology*. 15(3): p. 241-247. DOI: 10.1007/s10646-005-0055-z
- [15] Bommarito, T., D.W. Sparling, and R.S. Halbrook. (2010), Toxicity of coal-tar pavement sealants and ultraviolet radiation to Ambystoma Maculatum. *Ecotoxicology*. 19(6): p. 1147-1156. DOI: 10.1007/s10646-010-0498-8
- [16] Collier, T.K., et al., 4 Effects on Fish of Polycyclic Aromatic HydrocarbonS (PAHS) and Naphthenic Acid Exposures, in Fish Physiology, K.B. Tierney, A.P. Farrell, and C.J. Brauner, Editors. 2013, Academic Press. p. 195-255.
- [17] Kim, K.-H., et al. (2013), A review of airborne polycyclic aromatic hydrocarbons (PAHs) and their human health effects. *Environment International.* 60: p. 71-80. DOI: <u>https://doi.org/10.1016/j.envint.2013.07.019</u>
- [18] The National Institute for Occupational Safety and Health. (2019), Coal Tar Pitch Volatiles. https://www.cdc.gov/niosh/npg/npgd0145.html
- [19] Van Metre, P.C., et al. (2012), PAH volatilization following application of coal-tar-based pavement sealant. Atmospheric Environment. 51: p. 108-115. DOI: <u>https://doi.org/10.1016/j.atmosenv.2012.01.036</u>
- [20] U.S. Environmental Protection Agency. (2018), Stormwater Best Management Practice: Polycyclic Aromatic Hydrocarbons, Coal-Tar Sealcoat, and Stormwater Pollution. <u>https://www.epa.gov/sites/production/files/2018-02/documents/pah-coal-tar_sealcoat-swpoll.pdf</u>
- [21] Minnesota Pollution Control Agency. (2013), Choosing alternatives to coal tar-based pavement sealcoats: Guidance for property owners, associations and managers. <u>http://bapac.pvpc.org/docs/owners/3</u>. Alternatives Minnesota Pollution Control Agency 5-24-13.pdf

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