



Environmental Health Technical Brief

Coal Tar Driveway Sealant

Environmental & Occupational Health Assessment Program

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Resealing driveways is a common maintenance activity by homeowners. However, this can involve the handling of a product which contains toxic and carcinogenic ingredients. The product, coal tar sealant, may also be used by commercial contractors who seal driveways, access roads and parking lots. When the sealant is applied it releases vapors which can be a transient odor and exposure issue. However, recent data show that the greater concern is from the degradation of the sealed pavement surface over time; this can release toxic ingredients in coal tar, thus creating risks to human health and the environment. An alternative product is an asphalt-based sealant. It does not contaminate the environment and is an effective sealant. However, homeowners and particularly contractors may still use the coal tar-based sealant. This technical brief describes research by the United States Geological Survey (USGS) on this topic and its implications for protecting public health in Connecticut.

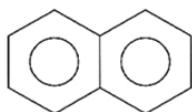
What is Coal Tar Sealant?

The main ingredient of coal tar sealant is coal tar pitch, a heavy viscous black oil that is a byproduct of coking operations and other processes involving coal (e.g., coal gasification). The sealant is painted or sprayed onto the pavement surface and allowed to cure before being driven or walked upon. The sealant protects the underlying road surface so that much more costly repaving can be avoided.

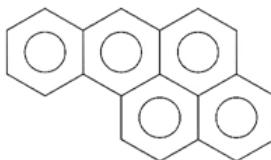
Coal tar pitch is a complex mixture of over 10,000 chemicals, a sizeable percentage of which is from the class called polycyclic aromatic hydrocarbons (PAHs). The PAH content of coal tar has been estimated at 5% (50,000 ppm) (USGS: <http://tx.usgs.gov/sealcoat.html>), a high concentration compared to background soil concentrations of PAHs which are typically less than 10 ppm.

What are the Potential Health Risks?

PAHs are a wide variety of multi-ringed compounds that include numerous carcinogens and chemicals capable of other kinds of toxicity. Highlighted in the figure below are naphthalene, a PAH of moderate volatility, which can damage the liver, respiratory tract, eyes and nose (if inhaled). Also shown in the figure is benzo(a)pyrene (BaP), a potent human carcinogen. These chemicals are relatively stable in nature but when taken up by humans and wildlife are converted to more toxic and reactive metabolites.



Naphthalene
 $C_{10}H_8$



Benzopyrene
 $C_{20}H_{12}$

BaP is the most heavily studied PAH as it is one of the most toxic and carcinogenic members of this class. The BaP content of coal tar is approximately 2%. While BaP is also present in air pollution, cigarette smoke and char-broiled meats, its high content in coal tar makes this a potentially important source of exposure. The only other significant source of coal tar exposure are coal tar based ointments and shampoos for the treatment of psoriasis and dandruff. While coal tar is a potent skin carcinogen in animal studies (e.g., Siddens et al. 2012), the cancer risk from the dermatological use of coal tar has not been clearly established. As described below, USGS has measured PAH levels in house dust adjacent to coal tar sealed parking lots and converted these measurements to estimates of human cancer risk.

The USGS Studies

Through a series of detailed studies, USGS researchers identified coal tar sealant as an important source of PAHs, initially finding this to be true for streams and lakes, and then to street and house dust. These studies have been reported in peer reviewed publications and USGS reports that are available on their website (<http://tx.usgs.gov/sealcoat.html>).

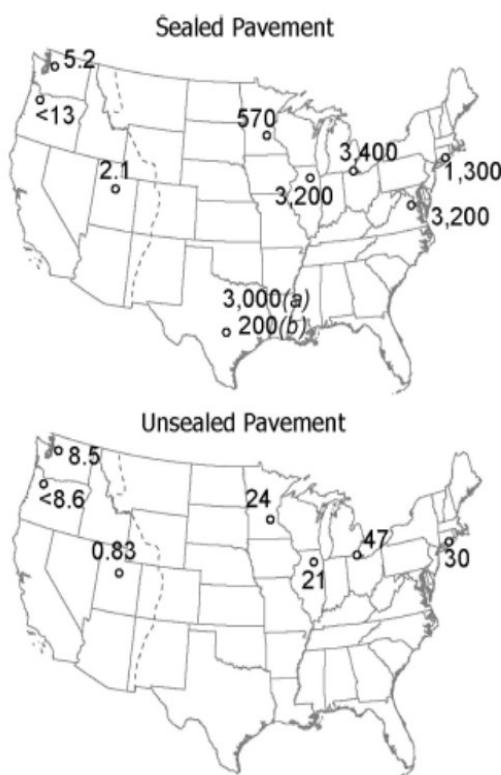


Figure 1. USGS PAH Data for Sealed and Unsealed Parking Lots Across the U.S.

Discovery of PAH Release from Applied Coal Tar Sealant

The USGS has a mandate to monitor water and sediment quality across the country. Their evaluation of lake sediment has typically shown decreasing trends of legacy contaminants such as banned pesticides and PCBs. However, in 2005 USGS reported an increasing trend of PAHs in lake sediment from suburban and urban areas. This trend led to a search for the source of the increasing PAH in the environment. PAHs are well known as combustion byproducts and so are common air pollutants, a factor which can contribute to the levels in water bodies. However, air pollutant levels of PAHs have not been rising dramatically in recent years so this was unlikely to be the explanation. Other potential sources of PAHs such as used motor oil, do not have high enough PAH concentrations to explain the sediment data. The first clue was a study in Austin TX which identified high concentrations of PAHs in the sediments of a small stream in a residential area; when the concentrations were followed upstream they pointed to a drainage outfall from a parking lot that had been coated with coal tar sealant. Follow-up investigations demonstrated that the dust swept up from parking lots treated with coal tar sealant had very high PAH content (in the thousands of ppm) while lots not sealed with coal tar were on average, 80 fold lower (Van Metre et al. 2009).

Figure 1 summarizes these results, first by comparing sealed lots in the eastern and western US. Coal tar sealant is sold in the eastern and central US but is not available for purchase in the far west; this differential is clearly shown in the top map in Figure 1. The **unsealed** lots from midwestern and eastern locations had very low PAH content in dust (bottom of Figure 1). This indicates that lots in the same geographic zone and thus exposed to similar ambient conditions had vastly different PAH content depending upon whether they were sealed (top vs bottom map). The PAH content of soil and street dust near the sampled lots reflected the differences seen on the lots suggesting that the sealcoated lots represent a source of PAH contamination not only to local streams but also to the neighboring community (Van Metre et al. 2009).

Evaluation of PAH Contamination of Homes

USGS also sampled the floor dust in 23 ground floor apartments either adjacent to coal tar sealed parking lots or adjacent to unsealed lots (Mahler et al. 2010). They measured the levels of 16 priority pollutant PAHs, 7 of which are considered by USEPA to be carcinogenic. The results are summarized in Figure 2. Coal tar lots had 530 times higher PAH level in pavement dust than did the non-sealed lots. Indoor house dust showed on average 25 fold high PAH content for the apartments adjacent to coal tar lots as compared to non-coal tar. A variety of factors that could contribute to indoor levels of PAHs (e.g., smoking, surrounding urban land use) were taken into account and did not offer an explanation for the high PAH levels in some apartments and not others. Rather, the strongest correlate of apartment PAH levels was the nearby presence of a coal tar sealed parking lot.

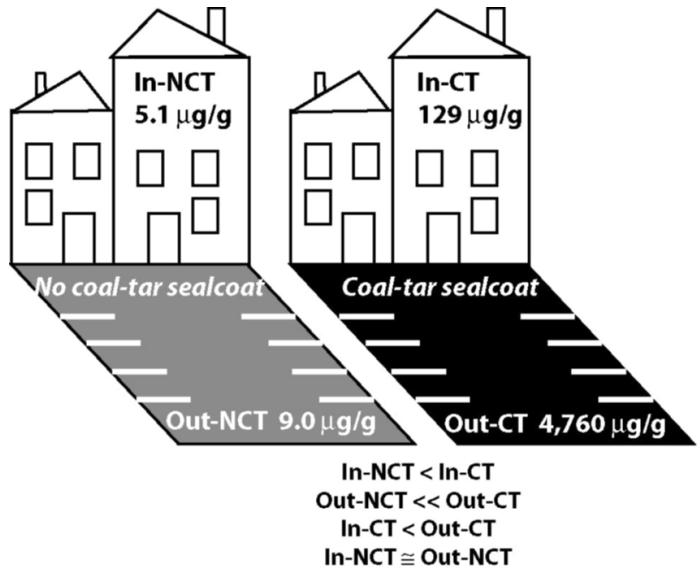
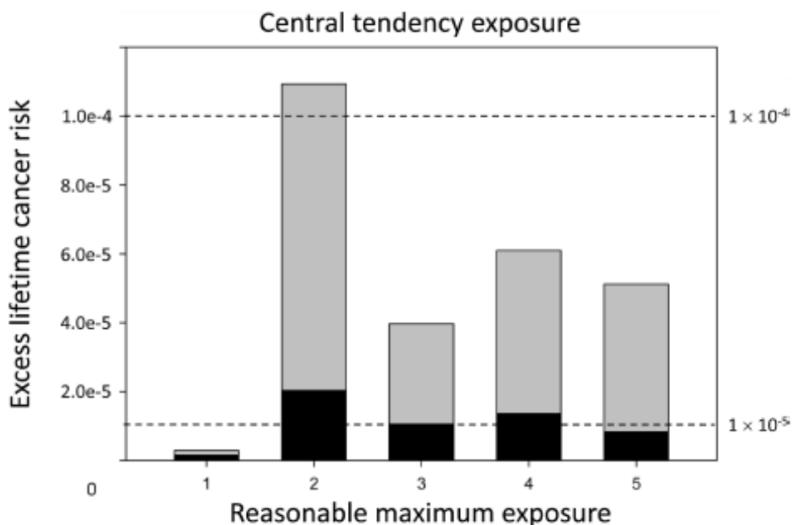


Figure 2. USGS Results at 23 Ground Level Apartments Next to Paved Parking Lots. In-CT means indoor dust next to coal tar lot; In-NCT means indoor dust next to non-coal tar lot; Out-CT means outdoor dust on a coal tar sealed lot; Out-NCT means outdoor dust on a non-coal tar lot.

Evaluation of Cancer Risk from House Dust Contaminated with Coal Tar PAHs

USGS combined with Baylor University to calculate the cancer risk associated with the data from the 23 homes sampled for soil and house dust (Williams et al. 2013). Five different exposure scenarios were constructed representing ingestion of soil/house dust adjacent to coal tar sealed lots for the entire lifespan vs from only certain periods during childhood and compared to background conditions (no coal tar sealant in the immediate environment). Elevated cancer risk above de minimis (1 in a million) was found for all coal-tar related scenarios but not for the background scenario (Figure 3). House dust ingestion on a daily basis was estimated to contribute roughly 1 in 100,000 cancer risk (10x de minimis) while ingestion of house dust plus soil adjacent to the apartment was estimated to create risks over 1 in 10,000 (100x de minimis). The reasonable maximum risks in Figure 3b represent high end but still realistic rates of soil and dust ingestion (95th %). The PAH driving the risk was BaP (75% of the cancer risk); this PAH is well characterized for its cancer potential and risk to human health. Overall, risks from ingestion of house dust and soil adjacent to coal tar sealed lots was 40 fold greater than the background risk, and these estimates do not take into account children's play on the parking lots themselves. Parking lot dust was shown to have the highest PAH content. Further, the USGS sampling was conducted 2.5 years after coal tar sealcoat had been banned in the city where the samples were taken (Austin TX). After this period of weathering, PAH levels in dust may have declined. For perspective on this exposure relative to typical background exposures, food is an important source of PAHs, especially char-broiled meats. The level of PAH exposure from house dust ingestion was 2 to 3 times higher than dietary ingestion of PAHs for young children (Williams et al. 2013).

3a.



3b.

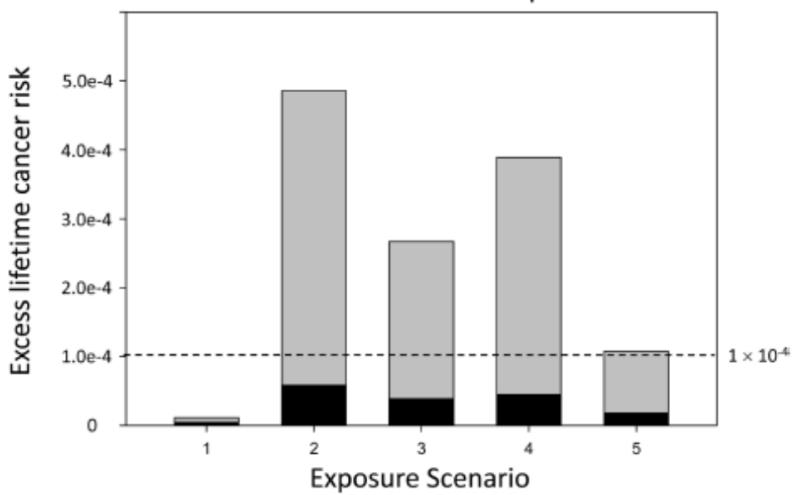


Figure 3. Central and Upper Bound (reasonable maximum) Estimates of Cancer Risk Associated with 5 Coal Tar Scenarios: 1) Background - no coal tar sealant; 2) Lifetime exposure – 70 years of living adjacent to coal tar lot; 3) Early childhood – first 6 years adjacent to coal tar lot; 4) Full childhood – first 18 years adjacent to coal tar lot; 5) Adult only – childhood free of coal tar contamination. Each bar composed of dark shading (house dust risk) and light shading (soil risk).

The significance of these findings is that coal tar sealant has clearly been shown to release PAHs into the human environment to contaminate parking lot surfaces and adjacent soil and indoor house dust. This contamination will also occur with coal tar treated driveways. These are all areas where children play which will naturally lead to exposure via the inadvertent ingestion of soil and dust. Some of the PAHs present in coal tar are potent carcinogens (e.g., BaP). This leads to an elevated cancer risk, estimated by USGS and Baylor Univ to be 40 fold greater than the background from soil and house dust not affected by the breakdown of coal tar sealant. This PAH source of exposure is substantial relative to dietary exposure and thus represents a controllable source of cancer risk.

Is there an alternative sealant?

Yes, driveways, access roads and parking lots can be sealed with an asphalt sealant that has an oil rather than coal-tar basis. This alternative is low in PAHs and is widely used in locales where coal tar sealant is not available for sale. Asphalt seal coat is comparable in cost and is sufficiently protective of pavement in low wear areas (e.g. driveways, parking lots) to hold up over time. A number of large retailers have stopped carrying coal tar sealants even in the Midwest and Eastern parts of the US. Thus, coal tar sealant is less available to homeowners than in the past but contractors and some homeowners may still get this product.

What is the regulatory status of coal tar sealant?

Coal tar sealant has been banned in two states, Washington and Minnesota, and in a number of cities and towns (e.g., Washington DC, Austin TX). We are not aware of any efforts at the federal (USEPA) or local (cities and towns in Connecticut) level to further regulate this product.

Options for managing this issue in Connecticut

Local health departments can educate the public regarding this consumer product on their webpage with link to fact sheets available on the internet (see below). Further, outreach to developers, pavers, property management companies and building owners can inform them of the risks associated with coal tar sealant while pointing out the alternative. Town Public Works departments should be aware of this information so that resealing at parks, schools and other town projects does not involve coal tar-based sealant. The local health department can also recommend to the town council to institute a local ordinance limiting the use of coal tar sealants (see model ordinance below).

Resources and References

Resources

- [USA Today, 2013: Toxic Driveways? Cities Ban Coal Tar Sealants](#)
- [USGS Research](#)
- [Model Ordinance](#)
- [USEPA Fact Sheet](#)
- [University of Wisconsin Fact Sheet](#)
- [Great Lakes Fact Sheet](#)

References

- Mahler BJ, Metre PC, Wilson JT, Musgrove M, Burbank TL, Ennis TE, Bashara TJ. (2010) Coal-tar-based parking lot sealcoat: an unrecognized source of PAH to settled house dust. *Environ Sci Technol.* 44: 894-900.
- Siddens LK, Larkin A, Krueger SK, Bradfield CA, Waters KM, Tilton SC, Pereira CB, Löhr CV, Arlt VM, Phillips DH, Williams DE, Baird WM. (2012) Polycyclic aromatic hydrocarbons as skin carcinogens: comparison of benzo[a]pyrene, dibenzo[def,p] chrysene and three environmental mixtures in the FVB/N mouse. *Toxicol Appl Pharmacol.* 264: 377-86.
- Van Metre PC, Mahler BJ, Wilson JT. (2009) PAHs underfoot: contaminated dust from coal-tar sealcoated pavement is widespread in the United States. *Environ Sci Technol.* 43: 20-5.
- Williams ES, Mahler BJ, Van Metre PC. (2013) Cancer risk from incidental ingestion exposures to PAHs associated with coal-tar-sealed pavement. *Environ Sci Technol.* 47: 1101-9.

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