

Review of the Study “Coal-Tar Based Parking Lot Sealcoat: An Unrecognized Source of PAH to Settled House Dust”-Summary

Study:

Coal-Tar-Based Parking Lot Sealcoat: An Unrecognized Source of PAH to Settled House Dust. Barbara J. Mahler, Peter C. Van Metre, Jennifer T. Wilson, MaryLynn Musgrove, Teresa L. Burbank, Thomas E. Ennis, Thomas J. Bashara. *Environmental Science & Technology* **2010** 44 (3), 894-900

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Study Summary

The study describes an evaluation of PAH in indoor and outdoor dust collected from apartments and their associated parking lots. Of 23 apartments tested, Mahler et al. (2010) determined that 11 had refined tar based pavement sealer (CT) and 12 were unsealed or coated with asphalt based sealer (NCT).

The Study found that median total PAH concentrations of 4,760 ppb and 9.0 ppb in dust collected from refined tar based pavement sealer lots (CT) and lots sealed with asphalt based sealer or no sealer at all (NCT), respectively. The median total PAH concentrations of 129 ppb (CT) and 5.1 ppb (NCT) are reported for indoor dust collected. The presence of refined tar based pavement sealer was reported to explain 48% variance total PAH concentrations in indoor dust. Other factors included land use, frequency of vacuuming, indoor burning, and more were evaluated. The study states that only urban land uses intensity near the sampled apartment has a significant relationship with total PAH concentrations.

Study Review

Introduction:

- Study states that tobacco smoking is a significant source of PAHs in urban homes only. There are scientific studies which state that this is false.

- The study states that heating with coal, vehicle emissions and carpeting have not been demonstrated to be significant factors in PAH concentrations in settled house dust based up a review of scientific literature. There are scientific studies which state that that statement is false.

- USGS incorrectly states that refined tar based pavement sealer is made from crude coal tar. It is made from refined tar.
- USGS incorrectly states that refined tar based sealer is sold in all 50 states. This product is predominantly sold east of the Continental Divide.
- The method utilized by USGS to determine if a coating was refined tar based or asphalt based was a rapid screening test (see Supporting Information from study). This rapid screening test is not recognized by any testing standards organization nor federal/state governments for this application.
- USGS makes the assumption that all PAHs collected are from abraded refined tar based sealer and not from any of the thousands of other sources in the environment. Chemical fingerprinting would have been helpful to determine the source of the PAHs but USGS ran EPA's 16 priority pollutant PAHs, which is insufficient to establish a chemical fingerprint.
- USGS states that median concentration of PAHs in dust swept from parking lots in six cities was 2200 ppb. This is a reference to a previous USGS study (same authors) which implies that refined tar based sealer is a major PAH contributor in the United States. It should be noted that chemical fingerprinting analysis was not performed in this study and all PAHs in the dust gathered was attributed to refined tar based pavement sealer and no other source.

Study Design

- There was a lack of precision in selection of sample locations contributes to variability between the sampled areas and consequently, uncertainty regarding external influences when evaluating the results.
- Small sample size (especially give lack of precision in sample location selection).
- Particle size fraction evaluated not appropriate for dermal and ingestions exposures.
- Dust loading (amount of dust) was not evaluated. Only PAH concentrations in settled house dust were evaluated. Both items need to be examined in order to do a proper evaluation.

- Incomplete evaluation of independent variables.

Analytical Methods

- The raw QA/QC data was not presented in the study. This information would be required for a proper evaluation of data quality. An example of this was why PAHs were detected in 20% of the blank samples.

Sampling Methodology

- Due to a lack of site selection or exclusion criteria other than presence or absence of refined tar sealer parking lots, other potential factors may have been overlooked or unaccounted for. For example, little or no information is presented to support the classification of the refined tar based sealed lot, which can affect the variability of the data.
- Site selection was based solely on the rapid screening test (see introduction).
- No criteria were provided for selection of specific sample locations within each parking lot other than avoidance of painted areas and drip lines.
- Chemical Fingerprinting was not performed on the dust to verify the source of PAHs (combustion sources, crankcase oil, etc.). USGS assumes that all the PAHs in the dust are derived from refined tar based pavement sealer.
- No criteria were provided for selection of apartments other than presence or absence of refined tar based sealed parking lots based on the coffee/tea test. Additional criteria such as apartment age, flooring type and age, and period of time occupied by current owner could have been used to obtain as uniform a sample population as possible and thereby improving comparability between samples.
- It appears that the NCT apartments represent newer housing stock compared to CT apartments. To the extent that older apartments reflect longer-term accumulation of PAHs, for example if the apartment is located nearby a heavily traveled roadway, then apartment age may be a significant variable that has not be evaluated.
- The study appeared that no field rinsate samples were collected as part of QA/QC procedures. Given the elevated levels of PAHs observed, it would have been helpful to evaluate the decontamination

process by collecting rinsate samples to verify the collection equipment was being decontaminated correctly. **Since standard operating procedures were not provided in the Supplementary Information, it is not known what measures (if any) were taken to reduce cross-contamination of samples.**

□The range in the area sampled among apartments (1.6-13 square meters indoor and 2.0-7.5 square meters outdoors). **The rationale for this variability is not provided. This could bias the PAH concentrations high or low, depending upon the sampled location and the loading at that location.**

□USGS failed to utilize EPA and ASTM standards regarding sieved dusts samples that would obtain the size dust that would most likely adhere to skin surface.

Statistical Approach

□USGS only provided the PAH analytical data in the Supplementary Information so the influence of the independent variables could not be verified.

□Other variables that should have been considered but not reported include apartment and flooring age and degree of sealcoat wear.

□If parking lot surface type is believed to be a significant factor in explaining indoor and parking lot dust PAH levels, one might expect that degree of sealcoat wear should also be a factor.

□Other factors such as size of apartment complex or size of associated parking lot might also be expected to be factors in determining PAH levels in indoor dust, but this data was not presented.

□PAH analytical data in the Supplementary Information was evaluated in an attempt to identify patterns in PAHs detected in CT and NCT samples. The information was insufficient to identify unique patterns in the dataset. **Observations appear to most closely resemble what would be considered an "urban background" profile.**

Metrics (measure) for Evaluating Dust Exposure

□Both PAH concentration and dust loading for each living area are needed to assess exposures. While PAH concentrations are useful in providing the amount of PAH in dust, it does not provide information about the amount of dust that is available on an exposure area or surface. **USGS only evaluated PAH concentrations.**

□EPA (2008) and ASTM (2005) and CS3 Inc.(vacuum manufacturer 2004) recommend evaluating both concentrations and loading metrics when evaluating exposures to dust. This was not done in the USGS study.

PAH Toxicity

□Although there are over 100 PAHs, seven of these PAHs have been classified as probable human carcinogens (Group 2B) by EPA (2010). Although studies in humans do not adequately demonstrate that benzo(a)pyrene is responsible for inducing carcinogenicity, there is sufficient animal data demonstrating carcinogenicity of these seven PAHs. To quantify the carcinogenicity of the seven PAHs, a relative potency factor of carcinogenicity was assigned to each of the seven PAHs with benzo(a)pyrene used as the standard compound.

□Table 2 in Mahler et al. (2010) lists analytical results separately as the sum of total PAHs (16 PAHs total) and the sum of the seven carcinogenic PAHs. However, the seven carcinogenic PAHs have not been modified by their relative potencies to benzo(a)pyrene. This would mean that the total of the seven PAHs have been artificially inflated to yield a higher overall PAH concentrations.

Comparison to health-based Standards

□As noted by Mahler et al. (2010), there is no regulatory standard for PAHs in indoor or outdoor dust. Mahler et al. (2010) relied on a German Federal Environmental Agency (FEA) value of 10 ppb for benzo(a)pyrene, established by their Commission for Indoor Air Quality. This FEA value is not health-based criteria. FEA selected this value as the maximum limit of benzo(a)pyrene in house dust in an attempt to minimize exposure to residents. In other words, exceedance of the FEA value does not provide information about residential exposure or risk level.

□One additional item is that USGS stated is that coal tar based flooring adhesives were sold in the United States. Upon speaking with various individuals that have been involved with the carbon products and coatings industries with a combined experience of over 100 years, have never heard of such an adhesive being sold in the United States. This product may have been sold in Germany but in all likelihood not sold into the United States.

World trade Center Criterion

□ Multiple federal, state and local agencies collaborated on development of indoor air and dust screening criteria for chemicals of potential concern (including the seven PAHs) in an attempt to assess environmental health conditions or residences in the vicinity of the collapsed World Trade Center Buildings (WTC 2003). This health-based criterion is based on the toxicity of the seven PAHs relative to Benzo(a)pyrene and assumes exposure via both ingestion and dermal exposure pathways for an individual from age 1 through 31 years. The WTC criterion also takes into account ingestion of dust via hand-to-mouth contact.

□ The WTC health-based criterion of 34 ppb meters squared is considered relevant to residential indoor dust evaluations.

□ Using the Mahler et al. (2010) data and correctly adjusting for the relative potency factor of the seven PAHs, the median seven PAHs indoor dust loading level for an apartment with a refined tar based sealer parking lot is **3.4 ppb meters squared (the standard is 34 ppb meters squared). In other words, these levels are well below health-based standards derived in accordance with WTC methodology.**

□ The exposure model described by Maertens et al. (2008) used in the USGS study, is not as sophisticated as that developed for the WTC criterion.

Dietary PAH Intakes

□ On average the ATSDR (1995) estimates that a total daily intake of PAHs includes 0.16-1.6 ppb from food, 0.207 ppb from air and 0.027 ppb from water. The World Health Organization (WHO 1998) provides a daily intake estimate from food of 0.1-8 ppb. The WHO (1998) notes that while PAHs may be found on fruits and vegetables due to atmospheric deposition and/or due to food processing such as frying and roasting, the highest levels of PAHs have been found in smoked meat (over 100 ppb) and fish (up to 86 ppb).

□ Assuming exposure to the seven PAHs in dust at the highest detected concentrations for a CT location reported by Mahler et al. (2010), the total daily intake of the seven PAHs would be **0.28 ppb. This intake not only is shown to be below an acceptable risk management level through comparison with the WTC criterion, but also consistent with other background exposures via food and air.**

Conclusions

- Short-comings in the study design introduced uncertainty in data quality and in the influence of other variables.
- Both concentrations and dust loading are important factors in evaluating chemicals in dust. The USGS study did not evaluate dust loading.
- Chemical Fingerprinting was not performed on the dust to verify the source of PAHs (combustion sources, crankcase oil, etc.). USGS assumes that all the PAHs in the dust are derived from refined tar based pavement sealer. USGS relied solely on the coffee/tea field screening test to determine if a lot contained refined tar pavement sealer or not. This coffee/tea test is not a standard recognized test so its accuracy in identifying refined tar based pavement sealer is uncertain.
- The USGS did not compare PAH results to a health-based standard to determine the potential risk associated with the levels measured in house dust. Using the WTC criterion indicates that cancer-causing PAHs measured by Mahler et al. (2010) are below levels of concern. In fact, the highest level measured by Mahler et al. (2010) in indoor dust is half of the of the WTC screening level, even though PAH concentrations in dust may be overestimated due to selected sampling method.
- Intake of cancer-causing PAHs in dust occurs every day through the air that we breathe and food we eat. Levels measured by Mahler et al. (2010) that could be taken in via house dust are consistent with background intake levels via food, air and water.
- USGS states that refined tar based pavement sealer might represent the most important, nondietary exposure pathway of the seven PAHs for children living at these residences. Based upon the more advanced WTC criterion, we see that this statement is false.

An interview with USGS scientist Barbara Mahler can be heard in [episode 116](#) of the USGS CoreCast. Link:

<http://www.usgs.gov/corecast/details.asp?ep=116>