Risk Assessment for Coal-Tar-Based Pavement Sealants

ISPAC
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Imagine the result
• Typical Exposures to PAHs
• Human Epidemiological Data of PAH-Exposed Individuals
• Designing Risk Assessment for Coal-Tar-Based Pavement Sealant
Typical Exposures to PAHs

• Food - deposition onto farms, cooking of food, smoking of food
• Air - power plants, vehicle emissions, fireplaces, wood burning stoves, industrial emissions, cigarettes, all combustion sources
• Products - shampoos, ointments, medications, protective paints, protective coatings, fuels, lubricating oils
• Food is the highest exposure to the general population
### Summary of Daily Intakes of Benzo(a)pyrene Toxic Equivalents

<table>
<thead>
<tr>
<th>Source of Exposure</th>
<th>Average Daily B(a)P-TE Intake (ug/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal tar pharmaceuticals</td>
<td>33</td>
</tr>
<tr>
<td>Diet*</td>
<td>0.1 to 1</td>
</tr>
<tr>
<td>Ambient air and indoor air</td>
<td>0.003 to 2</td>
</tr>
<tr>
<td>Smoking</td>
<td>0.2 to 1</td>
</tr>
<tr>
<td>Second hand smoke</td>
<td>0.006 to 0.3</td>
</tr>
<tr>
<td>Coal tar shampoo</td>
<td>0.017</td>
</tr>
</tbody>
</table>

* Up to 6 ug/day in some smoked and open fire cooked foods
Coal Tar Epidemiology

- Long history of use as a medicinal agent
- Coal tar ointments for psoriasis, atopic dermatitis and other skin disorders
- Dandruff shampoos
- Robust epidemiological studies have shown no increase in cancer risk in users of coal tar pharmaceuticals
- Coal tar pharmaceuticals are FDA-approved
Evidence That Coal Tar Does Not Cause Cancer in Humans

• Roelofzen et al. 2010. No Increased Risk of Cancer after Coal Tar Treatment in Patients with Psoriasis or Eczema. *Journal of Investigative Dermatology* 130: 953.
  
• 13,200 patients; Over 8,000 received coal tar treatments

  “This study has sufficient power to show that coal tar treatment is not associated with an increased risk of cancer.”

• Other studies: Maughan et al. (1980); Pittelkow et al. (1981); Jones et al. (1985); Torinuki & Tagami (1988); Jemec & Osterlind (1994); Hannuksela-Svahn et al. (2000)
Why Perform a Human Health Risk Assessment (HHRA) for Coal Tar Sealants?

• No evidence that coal-tar-based sealants affect people’s health
• No evidence of health issues in people who intentionally put pure coal tar on their skin
• Good evidence that it does not
• Nonetheless, there has been concern that coal tar sealants are a source of PAH exposures to the adults and children at their residences
Risk Assessment is a Tiered Process

• Comparison to risk-based Screening Levels
  - Simple
  - General application
  - Can identify NFA

• Screening Level Risk Assessment
  - Slightly more complex
  - Exposure point concentrations and statistical analysis
  - Can support NFA or remedial action on simple sites

• Human Health Risk Assessment
  - Complex
  - Site-specific characterization data
  - Exposure models
  - Deterministic and Probabilistic Approaches
  - Support true risk management decisions
Design Considerations for Any Risk Assessment of Coal-Tar-Based Sealants

• #1 Issue: Sufficient number of samples
• Samples isolated to known and specific coal-tar-based sealant use
• Locations representative of likely exposure
• Appropriate sample collection methods
• Standard risk assessment assumptions
• Consideration of bioavailability
Current State of Available Data Suitable for HHRA

• Inadequate data base of PAHs in soil or settled house dust from coal-tar-based sealants
• HHRA cannot be performed at this time
• However, screening level HHRA recently published
  • USGS & colleagues (Williams et al., 2013)
• ARCADIS performed a critique of this study and re-estimated risks after making assumptions consistent with EPA risk assessment guidance
Soil Data Used in USGS HHRA

- Soil Adjacent to Large Commercial Parking Lots
  - Coal-tar sealed
    - 11 samples available from two locations
    - HHRA used 7
  - Not sealed
    - 7 samples available from two locations
    - HHRA used 3
- Data insufficient for HHRA
- Selective use of data not explained
Isolate Soil Samples To A Specific Coal-Tar-Based Sealant Use

- Soil samples reported in recent studies (USGS 2008, UNHSC 2010) cannot be attributed to coal tar sealed pavement
- Sealed and unsealed lots on UNH campus are next to each other
- Sampling locations overlap with snow plow disposal areas adjacent to abutting parking lots
- Mixing of snow from multiple adjacent lots makes it impossible to link surface soil results to any one parking lot
UNH Soil Samples

Soil Samples

Samples used for HHRA not identified

UNHSC Study
Controlled field experiment

Lot A - Sealed (0.3 acre)

Primary UNHSC Field Site

Lot B - Sealed (0.25 acre)

Lot C - No sealant (9 acres)

Photo: UNHSC, 2010
Where kids play

- Children routinely play in residential yards not at the edge of commercial parking lots
- Such locations not reasonably likely exposure points
- PAH levels much lower adjacent to residential driveways than adjacent to commercial parking lots (USGS, 1997)
- USEPA and state regulators routinely disallow PAH soil sampling anywhere near pavement because of oils, vehicle exhaust, tire wear, etc.
- Samples at the edge of pavement in commercial parking lots not relevant for HHRA
USGS (1997) PAH Study

PAHs are highest from commercial parking lots compared to other sources. Residential driveways are much lower, and residential lawns are lower still.

<table>
<thead>
<tr>
<th>Locations</th>
<th>Total PAH in runoff (µg/L)</th>
<th>BaP in runoff (µg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parking lots</td>
<td>76</td>
<td>4</td>
</tr>
<tr>
<td>Residential Driveways</td>
<td>2</td>
<td>0.3</td>
</tr>
<tr>
<td>Residential Lawns</td>
<td>Not detected (&lt;0.002)</td>
<td>Not detected (&lt;0.002)</td>
</tr>
</tbody>
</table>
Children and adults are not expected to play at the edge of commercial parking lots 365 days per year.

Risk assessments are supposed to evaluate “reasonable” exposures.

USEPA Exposure Factors Handbook child soil ingestion rate for the “Reasonable Maximum Exposure (RME)” case is 200 mg/day, a rate that includes soil and dust exposure combined.

Assume 7-13 year olds ingest soil at 100 mg/day rate to reflect that hand-to-mouth activity drops off after age 6.
Exposure Assumptions Used in HHRA

<table>
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<th>Comparison of Williams et al. (2013) Exposure Assumptions to Standard USEPA HHRA Assumptions</th>
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<tbody>
<tr>
<td>USGS Team HHRA</td>
</tr>
<tr>
<td>Soil ingestion rate for children (0-6 years)</td>
</tr>
<tr>
<td>Soil + Dust ingestion rate for children (0-6 years)</td>
</tr>
<tr>
<td>Soil ingestion rate for children (7-13 years)</td>
</tr>
<tr>
<td>Soil exposure frequency</td>
</tr>
<tr>
<td>Exposure duration for residents</td>
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</tbody>
</table>

Notes:
EFH = Exposure Factors Handbook
*Accounts for ingestion of both outdoor soil and indoor dust and is an upper bound value
Bioavailability

• Risk assessment for PAHs use USEPA toxicity value for BaP & RPFs
• Toxicity value was derived from animals fed pure BaP
• Systemic absorption of pure BaP is ~100%
• PAH are bound to soil and other matrices, such as pieces of asphalt pavement
• PAH from ingested soil are not 100% absorbed if coal tar sealed pavement is the source
Parking lot samples include PAH-containing particles and these particles are postulated to be moved to adjacent surface soil by sheet flow, snow plows, and wind.

Photos: USGS, 2008
Conclusions

• Risk to people living near coal tar sealed pavement has not been established by risk assessments
• Soil exposures to coal tar constituents in areas near sealed pavement where people might actually be exposed have not been characterized
• Recent USGS paper (2013) cannot be used to make any decisions about the risk of coal tar sealants
• Long history of use of coal tar as a therapeutic agent demonstrates that coal tar exposures do not increase people’s risks
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Imagine the result