

FEHRL



Risk Assessment – Airborne Emissions

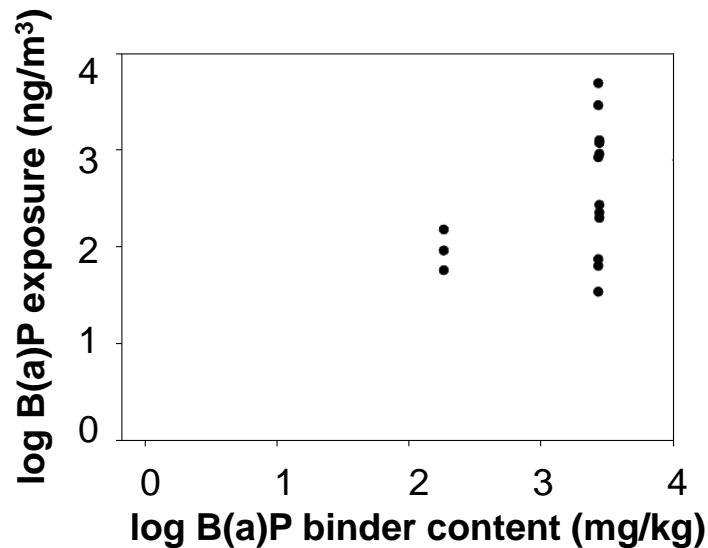


Asphalt fumes



Variable and complex exposure

- Climate, (wind speed and direction, temp etc)
- Work tasks (pavers, screedmen, rakers, rollers etc)
- Ambient environment (tunnel paving, open paving etc)
- Asphalt application (type, temp, protective measures etc)



Modified from Burstyn and Kromhout. *Risk Analysis* 2000

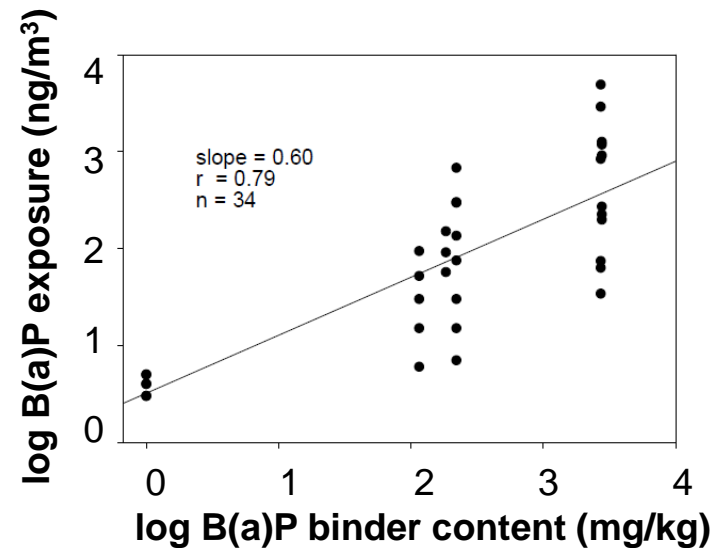
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Large occupational exposure datasets necessary to enable identification of bitumen fume quantity and quality in relation to asphalt constituents



Modified from Burstyn and Kromhout. *Risk Analysis* 2000

Asphalt fumes



Variable and complex exposure

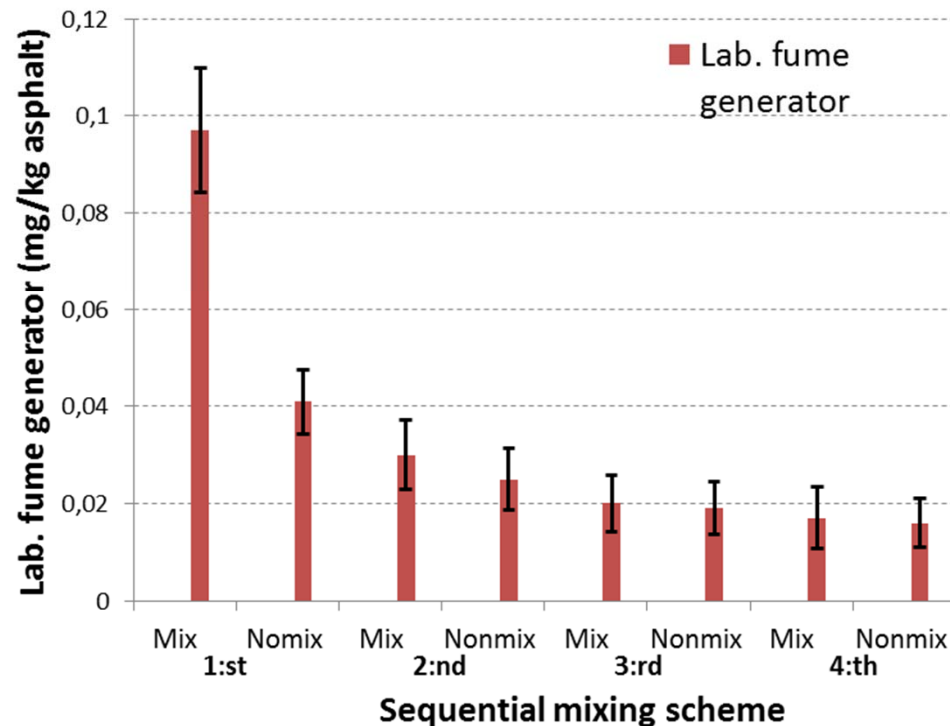
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Variable and complex chemical composition

- Asphalt constituents (type, temp, RA, additives)
- Metric under examination (TPM, BSM, TOC, SVOC, PAH etc)
- Sampling device (type, rate, duration etc),
- Analytical method (extraction, calibration etc)

High variability makes it almost impossible to relate fume emission and exposure to asphalt quality

Asphalt fume generator



Total emissions - TOC

- Quantity of fumes is influenced by depletion

1 mix Plant dryer/mixer

1 nonmix Silo storage

2 mix Transfer to truck

2 nonmix Truck transport

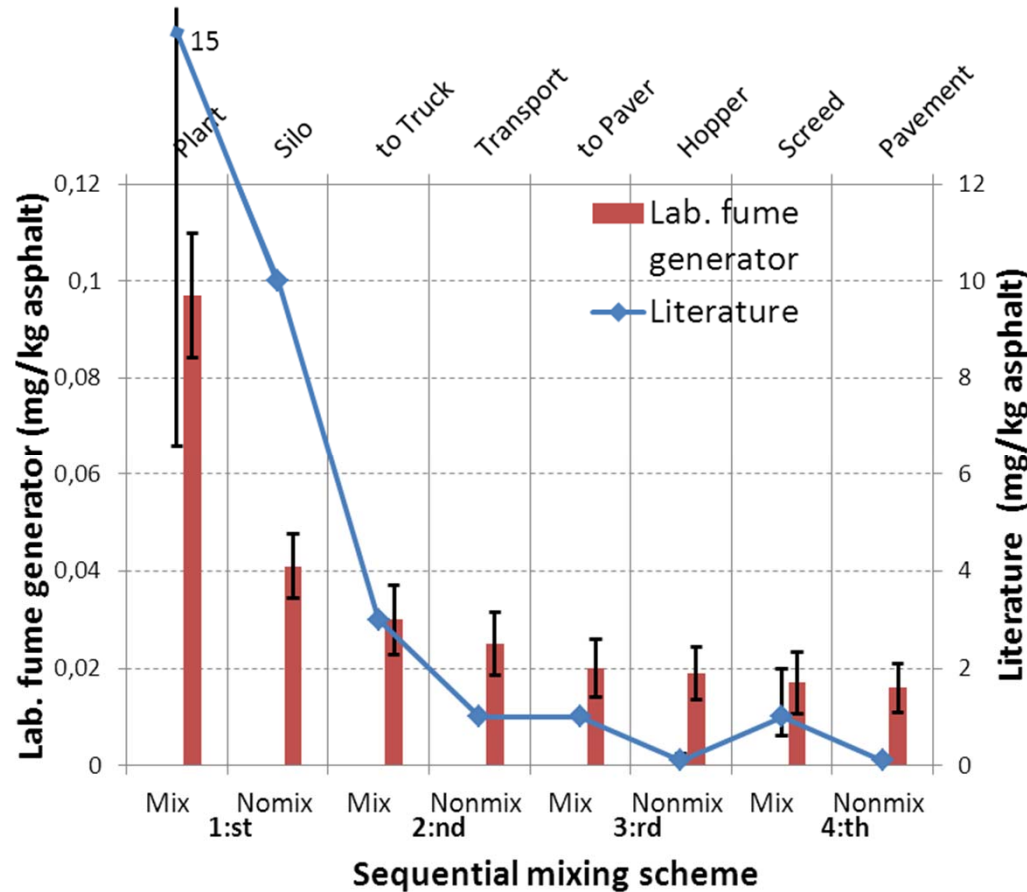
3 mix Transfer to paver

3 nonmix Paver hopper

4 mix Paver screed

4 nonmix Pavement surface

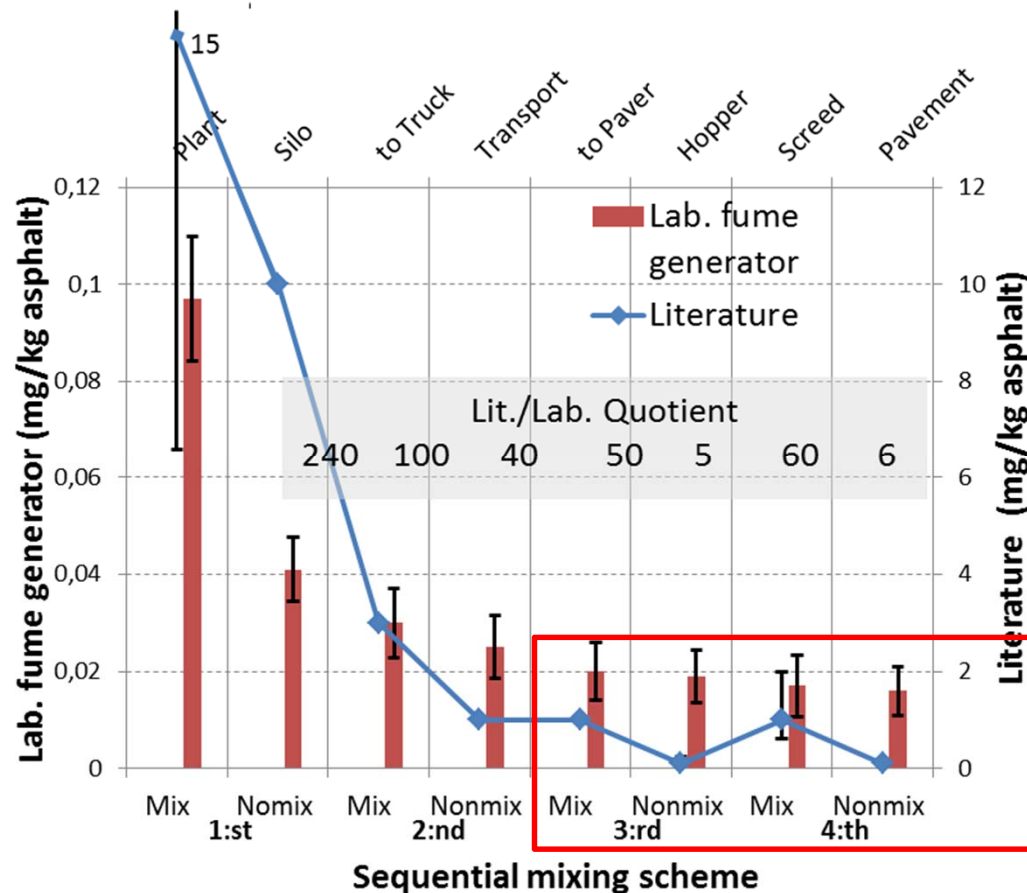
Asphalt fumes - Emissions



Total emissions - TOC

- Quantity of fumes is influenced by depletion
- Emissions after mixing can be substantial
- Lab. fume generator underestimates asphalt fume emission - and depletion

Asphalt fumes - Emissions

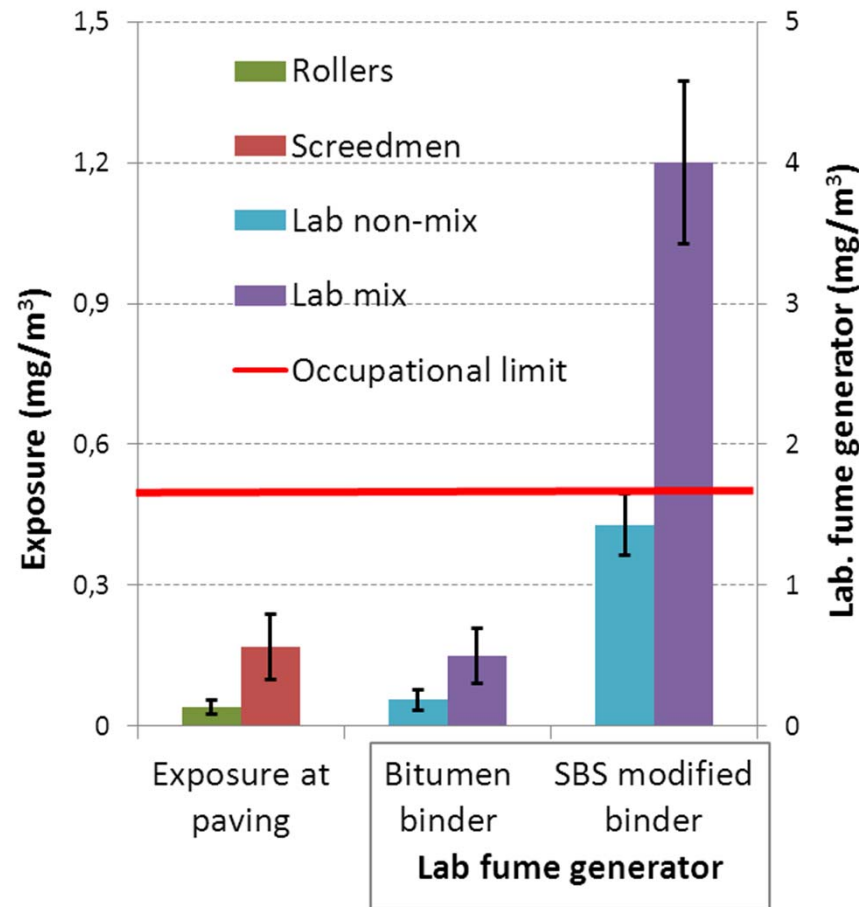


Total emissions - TOC

- Quantity of fumes is influenced by depletion
- Emissions after mixing can be substantial
- Lab. fume generator underestimates asphalt fume emission - and depletion

- Health hazard for paving crews

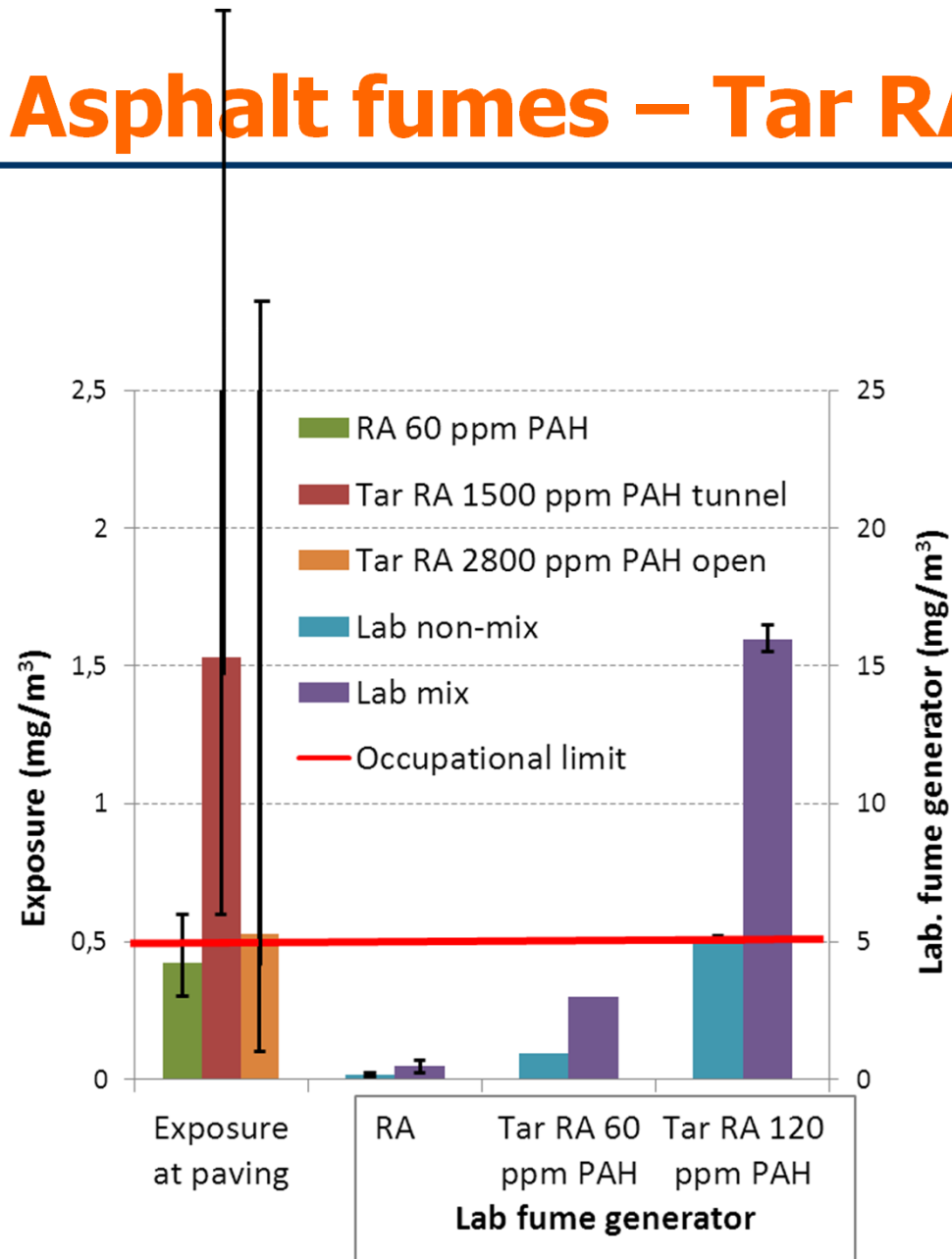
Asphalt fumes – Paving hazards



Benzene-Soluble particulate Matter (BSM)

- Occupational exposure limit (OEL) at $0.5 \text{ mg}/\text{m}^3$ (TWA)
- Lab fume generator BSM (converted) overstates exposure by a factor of 3
- SBS modified binder increases the BSM emission by a factor of 8 - increasing the risk of exceeding BSM OEL

Asphalt fumes – Tar RA



Benzene-Soluble particulate Matter (BSM)

- Tar RA occupational exposure extremely variable
- Lab fume generator BSM (converted) for Tar RA repeatable and dependent on degree of contamination
- Lab fume BSM (converted) overstates exposure (by a factor of ?)
- Tar contaminated RA exceeds BSM OEL at 0.5 mg/m³

Conclusions



- Fume generator enables identification of bitumen fume quantity and quality in relation to asphalt constituents - Input to LCA and Risk assessment.
- RA does not change total emission but quality of fumes
- SBS modified bitumen increases occupational hazard
- Tar contaminated RA exceeds BSM exposure limit

Future work recommendations

- More calibrations of lab fume generator vs. field needed
- Modify lab mixing protocol to improve consistency with field data (higher emission per kg asphalt)
- Introduce lab mixing protocol for hot in place recycling

Hot In Place Recycling



<http://www.youtube.com/watch?v=Dhv9CmfWqUI&feature=g-vrec>