

RUBBERIZED ASPHALT

Findngs from Sampling during Paving Operations

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THE
COHEN
GROUP



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SCOPE

- Evaluate airborne exposure to asphalt fumes during asphalt paving
- Total particulates
- Benzene soluble fraction

- Worker complaints of eye irritation and upper respiratory irritation during previous paving operations





ASPHALT RUBBER

- Asphalt rubber is a blend of asphalt cement, reclaimed tire rubber, and certain additives in which the rubber component is at least 15 percent by weight of the total blend and has reacted in the hot asphalt cement sufficiently to cause swelling of the rubber particles.
- **Terminal blend** – a form of the wet process where crumb rubber is blended with hot asphalt binder at the refinery or at an asphalt binder storage and distribution terminal and transported to the asphalt concrete mixing plant or job site for use.

RUBBERIZED ASPHALT MIXTURE

HOT-MIX ASPHALT

- ~6.5% petroleum asphalt base oil
- ~ 19% Crumb rubber w/extender oil (rubber modified binder)
- Extender oil is a heavy naphthenic distillate solvent extract
 - California (Caltrans) specification
- Asphalt odor reduction – “cherry scented” additive; 2 gallons/10,000 of based oil
- Base oil and extender oil is premixed.
- Mixed with aggregated and heated to rubberized asphalt cement

CALTRANS

- By the mid-1990s, over 100 field projects, both rehabilitation and maintenance jobs, were constructed throughout the state.

Two types of asphalt rubber binders (Type I and Type II) were used. Type II asphalt rubber binder requires asphalt modifier (extender oil) and high natural rubber while Type I does not. Type II binders performed better than Type I binders



CALTRANS

- By 2010, approximately 31% of all HMA placed by Caltrans was RHMA, equal to roughly 1.2 million tons. It was projected that about 2.2 million tons of RHMA would be used by the end of 2011.

OPERATIONS

- Hot rubberized asphalt delivered to work site by bottom dumping trucks
- Typically asphalt delivered on roadbed along a line (windrow) in front of the paver.
- In front of the paver is a pick up machine attached to the paver
 - Asphalt is picked up from road surface and transferred by conveyor to the hopper of the paver





EQUIPMENT

- Asphalt paving machine with a “pick-up” machine
 - From windrow
 - Auger delivery system
 - Screed has a asphalt heater
- Shuttle Buggy – HMA from truck to a paver











EQUIPMENT

- Dump trucks
- Rollers – breakdown and finishing rollers









PAVER OPERATOR

- Paver Operator – operates the paver; Approximately 10 feet above paving surface. Positioned behind asphalt hopper






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SCREED OPERATOR

- Lower platform at back of the paver (switching to either side as necessary, responsible for controlling asphalt application temperature, width, depth of the asphalt extruded from the bottom of the paver









LABORER

- Laborer – typically raking and shoveling (declumping) – positioned behind the paver, either side of the screed
 - Evening out spots on the asphalt mat
 - Prior to compacting



DUMP

Responsible for directing the dump trucks into their locations ahead of the paver and releasing the loads of hot asphalt onto the roadbed

- Dump trucks
- Bottom-dumping trucks









Buggy Operator



Roller



ASPHALT FUMES

- Asphalt has been confused in the literature with coal tar and pitch
- Coal tar produced by destructive distillation of coal and other organic materials
- Pitch – residue from fractional distillation of coal tar
- Coal tar pitch processes typically exceed 1000°C
- Asphalt road paving typically less than 160°C
- Per Documentation of TLVs – Concentrations of PAHs in coal tar pitch volatiles are 2-3 orders of magnitude higher

HEALTH HAZARDS

- Current scientific literature – noxious, commonly causing eye and upper respiratory tract (nose, mouth, throat) irritation
- Chronic health effects including carcinogenicity has not been found
- The carcinogenicity potential is considered low, provided the substances are not contaminated with coal tar
- Coal tar is not a constituent of paving asphalt

SAMPLING

- Tared 37-mm diameter 2 micron Teflon filters
- Flow rate – 1 lpm
- Total Particulates (total mass)
- Benzene soluble fraction
 - NIOSH method 5042
 - Portion of the sample that is comprised of non-specific hydrocarbons extracted by benzene during analysis



REGULATORY STANDARDS

- Cal/OSHA PEL
 - Asphalt petroleum fumes (as a total aerosol)
 - 5 mg/m³
 - Does not specifically address the acute exposure concerns regarding eye and upper respiratory
- ACGIH TLV
 - Benzene-soluble fraction (asphalt fumes as benzene-soluble aerosol)
 - 0.5 mg/m³
 - Minimize potential for mucous membrane and ocular irritation

EXPOSURE LEVELS

- Varied significantly from job to job
 - Screed – peak level - 3.96 mg/m³
 - Mean concentration – 0.47 mg/m
 - Paver Operator – peak level - 2.42 mg/m³
 - Mean concentration – 0.44 mg/m³
 - Dump Man – peak level - 0.68 mg/m³
 - Mean concentration – 0.35 mg/m³
 - Laborer – peak level was 0.83 mg/m³
 - Mean concentration was 0.22
 - Roller Operator – 0.2 mg/m³

Except when wind conditions were moderate and parallel to the paver operator and perpendicular to the dump man, exposure levels for BSF were often below the TLV

OTHER EXPOSURES

- PAH sampling – levels very low – typically none detect
- Volatile Organic Compounds – typically none detect or well below respective OELs

ENVIRONMENTAL FACTORS

- Wind direction/wind speed
- Topographical conditions – enclosed areas
 - Hills
 - Trees
- Temperature of asphalt laid

OTHER FACTORS

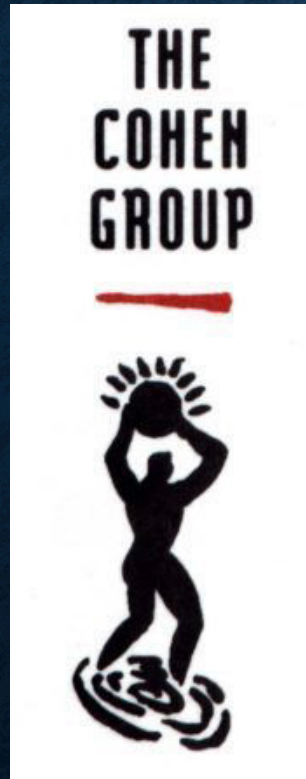
- Temperature of the mix
 - High temperatures while “cooking” asphalt at plant due to long distances appeared to be a factor
- Proximity to asphalt plant
- Duration of paving
- Delays with trucks

OTHER HAZARDS

- Noise
- Fatigue
- Long hours
- Late night/early morning hours
- Vehicle traffic!!

ADDITIONAL TESTING/ FOLLOW-UP

- GC/MS asphalt fume
- Without extension oil
- Warm Mix
- Increase ventilation at screed
- Provide ventilation at hopper of paver



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