BITUMEN FUMES

CAS number: 8052-42-4

Synonyms: Asphaltic bitumen, asphaltum, bitumen, hot mix asphalt, judean pitch, mineral pitch, petroleum asphalt, road asphalt, road tar

Workplace exposure standard (amended)

TWA: **0.5 mg/m^3**

STEL: —

Peak limitation: —

Notations: —

IDLH: —

Sampling and analysis: The recommended value is readily quantifiable through currently available sampling and analysis techniques.

Recommendation and basis for workplace exposure standard

A TWA of 0.5 mg/m^3 is recommended to protect for irritant effects of the respiratory tract and eyes in exposed workers. The TWA is also recommended to minimise potential carcinogenic risks.

Discussion and conclusions

Bitumen is a black or brown solid or viscous liquid that is taken from distillation of crude petroleum oil. It is a complex mixture of chemicals, determined by the crude source, the refining process and application. Heated asphalts release vapours that condense upon cooling, termed asphalt or bitumen fumes. Bitumen fumes comprise of a complex mixture of constituents and thus evaluating toxicity is problematic (ACGIH, 2018; HCOTN, 2007, NICNAS, 2018).

Bitumen fumes are reported to be associated with carcinogenicity and mutagenicity in humans and animals. However, evidence is limited and inconclusive (ACGIH, 2018; HCOTN, 2007; NICNAS, 2018). A study in roofers reported conjunctivitis at concentrations greater than 0.2 mg/m^3. However, this study noted that these effects might be associated with coal tar pitch. Another worker study reported mucous membrane irritation at greater than 0.4 mg/m^3 but the symptoms did not correlate with the amount of volatile compounds. These results are considered as non-specific irritant effects and associated with coal tar pitch or other substances present in the fumes. Animal studies also showed consistent results indicating non-specific irritation. The key study for the recommended TWA is a study of 170 asphalt workers evaluating personal exposures over two days, reported no change in pulmonary function and minimal symptoms at exposures below 0.5 mg/m^3 (ACGIH, 2018).

The recommended TWA of 0.5 mg/m^3 is considered to protect for the irritation and carcinogenic effects in exposed workers.

Recommendation for notations

Not classified as a carcinogen according to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

Not classified as a skin sensitiser or respiratory sensitiser according to the GHS.

There are insufficient data to recommend a skin notation.

APPENDIX

Primary sources with reports

Source	Year set	Standard
SWA	***1991***	***TWA: 5 mg/m³***
ACGIH	***2001***	***TLV-TWA: 0.5 mg/m³ (as benzene-soluble inhalable aerosol)***

TLV-TWA recommended to protect for mucous membrane and ocular irritation.

Summary of data:

The terms asphalt, bitumen, pitch and tar are used interchangeably which add to misunderstandings in the literature and the complexity of evaluation.

The major chemical groups of bitumen are asphaltenes, saturates (straight and branch-chained hydrocarbons), cyclics (naphthene and aromatics), resins and oils comprising saturated and unsaturated hydrocarbons.

Human data:

- Irritation of conjunctiva and mucous membranes following exposure
- Increase in mucous membrane irritation associated with increase in asphalt temperature
- Burns, epitheliomas, headaches, rhinitis, bronchitis, laryngitis, laryngeal cancers and other adverse health effects reported in workers exposed to coal-oil, tar, asphalt and soot
- Conjunctivitis in roofers reported at >0.2 mg/m^3
  - effects may be associated with coal tar pitch
- Mucous membrane irritation in workers reported at ≥0.4 mg/m^3
  - symptoms did not correlate with the amount of volatile compounds (no further information)
- No change in pulmonary function and minimal symptoms ≤0.5 mg/m^3 (measured by respirable particulate or benzene-soluble fraction of total particulate) in asphalt workers (n=170, 2 d)
- Epidemiological studies of roofers and highway paving workers identified increased rates of leukaemia and lung, urinary and digestive tract cancers
- Increase in asphalt temperature is associated with an increase in symptoms.

Animal data:

- Frequent exposures to dense oil vapour from heated asphalt resulted in minor transient conjunctivitis and slight corneal infiltration (rabbits; no further information)
- Studies on chronic and carcinogenic effects related to solutions, emulsions or fractions of whole asphalt (not fumes) with varying outcomes:
  - pneumonitis, patchy emphysema, localised bronchitis and papillary adenoma at autopsy reported in mice following exposure to an aerosol of asphalt (n=20, 30 min/d, 5 d/wk, up to 82 wk; no concentration provided)
  - emphysema, focal lung collapse, epithelial hyperplasia and large areas of peribronchial round cell infiltration observed in mice exposed to asphalt smoke (n=30, 6–7.5 h/d, 5 d/wk, up to 21 mo); no concentration provided; effects reported are consistent with exposure to any nonspecific respiratory irritant.

Source	Year set	Standard

Carcinogenicity:
• Asphalt fumes reported as carcinogenic in animals:
  ○ carcinogenicity likely related to PAH and other substances present in fumes
• Asphalt fumes appear mutagenic, although substantially less so than coal tar pitch fumes:
  ○ low potency carcinogenicity in rats if exposure materials do not involve coal tar
• Epidemiological evidence of increased rates of leukaemia and lung, urinary and digestive tract cancers:
  ○ information on confounders such as smoking and coal tar exposure not available; introducing questions on validity.
 	
Skin and sensitiser notations are not warranted based on the current information.		

DFG	***2002***	***NA***
A MAK is not recommended. Summary of additional data: • Evidence derived from ACGIH and NIOSH reviews • No evidence for a tumorigenic effect of inhaled bitumen fumes in animals: ○ evidence for carcinogenicity when applied to skin • Unclear whether carcinogenic in humans.		
SCOEL	***NA***	***NA***
No report.		
OARS/AIHA	***NA***	***NA***
No report.		
HCOTN	***2007***	***NA***
Available data is too limited to provide a health-based OEL. Summary of additional data: • Non-carcinogenic acute and repeated bitumen fume exposure reported as nose and throat irritation • NOAEL 20 mg/m^3 in rats (bitumen fumes, 6 h/d, 5 d/wk for 14 wk).		

Secondary source reports relied upon

Source		Year	Additional information
NICNAS	✓	2018	• Hazardous properties depend on the form, ambient temperature and fumes produced from heating

Source	Year	Additional information
		• Temperature of fume generation affects the chemical composition in the fume • NOAEC 28 mg/m^3 in rats (90 d) • Asphalt fume condensates are mutagenic (related to the temperature at which they are generated and levels of polycyclic aromatic compounds) • As fumes from asphalts have been associated with carcinogenicity and mutagenicity in humans and animals, consideration must be made for whether current exposure standard is adequate to minimise the risk to exposed workers.

Carcinogenicity — non-threshold based genotoxic carcinogens

Is the chemical mutagenic?	Insufficient data
Is the chemical carcinogenic with a mutagenic mechanism of action?	Insufficient data

Insufficient data are available to determine if the chemical is a non-threshold based genotoxic carcinogen.

Notations

Source	Notations
SWA	—
HCIS	NA
NICNAS	NA
EU Annex	NA
ECHA	NA
ACGIH	Carcinogenicity – A4
DFG	Carcinogenicity – 2; H (skin)
SCOEL	NA
HCOTN	NA
IARC	NA
US NIOSH	NA

NA = not applicable (a recommendation has not been made by this Agency); — = the Agency has assessed available data for this chemical but has not recommended any notations

Skin notation assessment

Calculation
Insufficient data to assign a skin notation

IDLH

Is there a suitable IDLH value available?	No

Additional information

Molecular weight:	NA
Conversion factors at 25°C and 101.3 kPa:	1 ppm = Number mg/m^3; 1 mg/m^3 = Number ppm
This chemical is used as a pesticide:	☐
This chemical is a biological product:	☐
This chemical is a by-product of a process:	✓
A biological exposure index has been recommended by these agencies:	✓ ACGIH ☐ DFG ☐ SCOEL

Workplace exposure standard history

Year	Standard
Click here to enter year	

References

American Conference of Industrial Hygienists (ACGIH®) (2018) TLVs® and BEIs® with 7th Edition Documentation, CD-ROM, Single User Version. Copyright 2018. Reprinted with permission. See the *TLVs® and BEIs® Guidelines section* on the ACGIH website.

Deutsche Forschungsgemeinschaft (DFG) (2000) Bitumen (vapour and aerosol) – MAK value documentation.

Health Council of the Netherlands (HCOTN) (2008) Bitumen (vapour and aerosol). Health-based recommended occupational exposure limit. The Hague: Health Council of the Netherlands; publication no. 2007/01OSH.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2018) Asphalt: Human health tier II assessment – IMAP report.