WOOD DUSTS

CAS number: —

Synonyms: —

Chemical formula: —

Workplace exposure standard (amended)

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

STEL: **—**

Peak limitation: **—**

Notations: **Sk., RSEN, DSEN**

IDLH: **—**

Sampling and analysis: The recommended value is quantifiable through 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 asthma, lung function impairment and respiratory tract irritation in exposed workers.

There are insufficient health-based data to recommend a STEL. The previous STEL of 5 mg/m^3 for softwood dusts is recommended to be withdrawn.

Discussion and conclusions

The characteristics of different woods, e.g. hard- or softwood types, depend on the species of tree from which they are produced. Different types of wood are commonly encountered together during processing (ACGIH, 2018). Wood dust exposure occurs primarily in processing industries including logging operations, sawmills, pulp mills, and furniture, cabinet, and other wood product manufactories.

Critical effects of exposure are lung function impairment, chronic respiratory symptoms, respiratory irritation and, for wood dusts from some tree species, asthma and dermal and respiratory sensitisation.

Epidemiological data regarding occupational exposure are extensive. However, air concentrations associated with the onset of decreased pulmonary function and the development of occupational asthma are inconsistent, ranging approximately between 1.4 and 5.7 mg/m^3 inhalable dust (ACGIH, 2018). This discrepancy is possibly due to differences in the age, chemical composition (e.g. oils/extracts), species of wood, particle size of the measured dusts and sampling methodology (ACGIH, 2018). Data about the effects of occupational exposure to western red cedar specifically, are less conflicting and indicate a threshold for decreased pulmonary function and occupational asthma between 0.5 and 1 mg/m^3 (ACGIH, 2018). Decreased pulmonary function, chronic respiratory symptoms and eye and throat irritation are associated with inhalable dust concentrations of 3.2 and 4.8 mg/m^3 in Australian sawmill workers and joiners exposed to a variety of wood types in one study (ACGIH, 2018). Cases of occupationally induced contact dermatitis are reported in several studies in

workers exposed to woods of different tree species (ACGIH, 2018; DFG, 2018). Sensitisation potential depends largely on the chemical composition of individual wood species (DFG, 2002).

Occupational exposure is causally associated with cancer of the nasal cavity and paranasal sinuses in the available epidemiological data (ACGIH, 2018; DFG, 2002; IARC, 2012). These data indicate a threshold for carcinogenicity exists based on qualitative dose-response information, but are insufficient to quantify a NOAEC for this endpoint. Case studies in furniture manufacturers strongly associate incidence of nasal cavity cancers with exposure to beech and oak wood dust specifically (ACGIH, 2018; IARC, 1995). Association between exposure to other wood dusts and cancer is suggested, but less conclusive (ACGIH, 2018).

Based on the available epidemiological data, ACGIH (2018) recommends a TLV-TWA of 0.5 mg/m^3 for western red cedar to protect for asthma and a TLV-TWA of 1 mg/m^3 for wood dust from all other tree species to protect for lung function impairment and respiratory irritation. DFG (2002) does not recommend a MAK due to a lack of a threshold for carcinogenic activity. Cases of occupational asthma are reported for exposure to wood dust from tree species other than western red cedar and ACGIH (2018) advises consideration of the TLV-TWA of 0.5 mg/m^3 in cases where the potential for development of asthma is not excluded.

In view of the qualitative evidence for asthma from other wood types, likely co-exposure to dusts from different tree species in occupational settings, and uncertainty in the database regarding a threshold for carcinogenicity, a TWA of 0.5 mg/m^3 is recommended for exposure to all wood dusts. The recommended TWA is expected to be protective of asthma, lung function impairment and respiratory irritation and minimise potential for cancer. Due to the chronic nature of the observed critical effects and lack of information on responses to acute exposures, there are insufficient health-based data to recommend a STEL. The previous STEL of 5 mg/m^3 for softwood dusts is recommended to be withdrawn and is consistent with the ACGIH (2018) evaluation.

Regarding evidence of dermal and respiratory sensitisation for various woods, RSEN and DSEN notations are recommended for all wood types, which is consistent with the previous sensitiser notation for hard- and softwoods. Further assessment of additional sources regarding the effects of exposure to wood dust from different tree species is recommended during subsequent reviews of the WES.

Recommendation for notations

Not classified as a carcinogen according to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS). However, an entry for wood dusts or similar materials was not available in the HCIS database during this evaluation. Both the ACGIH (2018) and DFG (2002) recommend the equivalent of a category 1A notation for beech and oak wood dusts, whereas IARC (2012) recommends this notation for dust from all tree species. Recommendations regarding other tree species by these agencies are inconsistent. A review of the carcinogenicity notation is recommended during subsequent reviews and should consider the notations recommended by ACGIH (2018), DFG (2002), and IARC (2012).

Not classified as a skin sensitiser or respiratory sensitiser according to the GHS. However, an entry for wood dusts or similar materials was not available in the HCIS database during this evaluation. A sensitiser notation was previously assigned to both hard- and softwood dusts, which is consistent with the individual recommendations of DFG (2018). However, it is inconsistent with the ACGIH (2018) evaluation, which recommends RSEN and DSEN notations for western red cedar only.

A skin notation is recommended based on evidence for contact dermatitis in workers.

APPENDIX

Primary sources with reports

Source	Year set	Standard
SWA	***1991***	***TWA: 1 mg/m³ (certain hardwoods such as beech and oak)*** ***TWA: 5 mg/m³; STEL 10 mg/m³ (softwood)***
ACGIH	***2015***	***TLV-TWA (Western red cedar): 0.5 mg/m³*** ***TLV-TWA (All other species): 1 mg/m³***

Grouped assessment of hard- and softwoods based on impaired pulmonary function and respiratory irritation; western red cedar is evaluated separately within the same assessment due to specific evidence for a different endpoint (asthma). Separate assessments of hardwoods and softwoods withdrawn in 2005 (previous TLV-TWA for certain hardwoods: 1 mg/m³; TLV-TWA and TLV-STEL for softwoods 5 and 10 mg/m³, respectively, as adopted by SWA).

Based on the available epidemiological data, beech and oak are confirmed human carcinogens (A1); birch, mahogany, teak, and walnut are suspected carcinogens (A2) based on epidemiological data; all other species are not classifiable as human carcinogens (A4).

RSEN and DSEN notations are recommended only for western red cedar based on specific workplace exposure data.

Summary of information:

Concentrations of inhalable particulate matter (IPM) typically overestimated and total dust underestimated due to differences in respective sampling methods. ACGIH considers a conversion factor of 2.5 for IPM to total dust concentrations appropriate based on dust ratios between IPM and total of 1.2–4.2 reported in parallel measurements.

Western red cedar

TLV-TWA for western red cedar based on a NOAEC reported in several workplace studies in which total dust concentrations <1 mg/m³ were associated with a 5% increase in incidence of occupational asthma, not at concentrations of 0.5 mg/m³.

All other species

TLV-TWA for all other tree species based on weight of evidence of available epidemiological data, which overall indicate onset of lung function impairment or respiratory irritation/disease at concentrations ≈1.4 mg/m³. ACGIH, however, notes the results of these studies are inconsistent and absence of adverse effects are frequently reported near 3 mg/m³ inhalable dust.

Human data:

Western red cedar

- No decrease in FEV_1 in mill workers (n=74) exposed at 0.5 mg/m³ total dust in workplace study (average 4.7 mg/m³):
  - 5% decrease in FEV_1 in groups exposed at 3.6 mg/m³, 11% at 4.8 mg/m³, and 24% at 6.8 mg/m³
- 6% incidence of occupational asthma at <1 mg/m³ (n=301), 5% incidence at 1–2 mg/m³ (n=20), and 15% at 2–6 mg/m³ (n=13) reported in workplace study of sawmill workers:

All other wood species

- Available epidemiological studies rarely distinguish between exposure to hard- and softwoods:
  - workers investigated in these studies are typically exposed to both types

Source	Year set	Standard

- Cases of allergic contact dermatitis reported in workers often with additional respiratory/mucosal symptoms, e.g. conjunctivitis, rhinitis, and asthma (no further details provided)
- Significantly reduced mucociliary clearance in 11% of workers exposed at 2.2 mg/m^3 and >10 mg/m^3 in 63% of workers (n=68):
  - no difference in lung function
  - reports of prolonged colds, asthma, sneezing, and nasal obstruction at >5 mg/m^3 (no further details provided)
- Lower pulmonary function at 2–9.9 mg/m^3 x yr than lowest 5% of normal population in 10 woodworking companies (n=1,157):
  - cited authors recommend personal exposures should not exceed 2 mg/m^3
- Decreases in FEV_1 and FVC in workers across shifts at 5.7 mg/m^3 in a furniture factory:
  - not reported at 3.3 mg/m^3 in another factory case control study (n=113)
- Sawmill workers (n=94) exposed at 1.4 mg/m^3 PM_{10} dusts reported to be 2.5 times more likely than oil field worker controls (n=165) for asthma, shortness of breath, chest tightness and wheezing and associated with lower FEV_1 and FVC values
- Positive association to lower pulmonary function in Australian sawmill workers (n=105) and joiners (n=63) respectively exposed at 4.8 and 3.2 mg/m^3 inhalable dust, 0.3 and 0.7 mg/m^3 respirable dust, and 3.5 and 0.6 ng/m^3 endotoxin compared with maintenance worker controls (n=30):
  - increased prevalence of cough, headaches, chronic bronchitis, and eye and throat irritation in all wood-exposed workers
- Agency recommends TLV-TWA of 0.5 mg/m^3 for western red cedar:
  - protective of asthma
  - should be considered in workplace assessments for other tree species due to qualitative evidence for asthma in other wood species
- Pooled data from 12 carcinogenicity case-control studies indicate increased risk of sino-nasal adenocarcinoma associated with wood dust exposure (n=680 males, 2,349 male controls, n=250 females, 787 female controls):
  - no quantitative exposure data available
  - exposure groups assigned based on job title
  - no excess in lowest exposure category, slight, but significant excess in moderate exposure category (OR=3.1), and large excess in highest exposure group (OR=46)
- Carcinogenicity notations based on results of several case studies of furniture manufacturers exposed primarily to oak and beech wood dust with strong association between incidence of adenocarcinoma and exposure
  - suggestive relationship in other cases between carcinogenicity and exposure to birch, mahogany, teak, and walnut
  - current mechanistic data inconclusive
  - dust from other tree species may also be carcinogenic
- Increased incidence of chromatid breaks (OR=2.8) in exposed workers with lung cancer (n=165, 239 controls)
- Increased incidence of micronuclei *in vivo* in peripheral lymphocytes in workers exposed to linden and poplar dust (n=298) compared to controls (n=45):
  - effects not dose-dependent
- Significant increase in micronucleus formation *in vivo* in peripheral lymphocytes in workers exposed to birch dust at 1.26±0.46 mg/m^3 (n=83).

Animal data:

Source	Year set	Standard
• Dose-dependent micronucleus formation *in vivo* in nasal epithelium from hardwood dust exposure (rats, no further details provided). Insufficient data to recommend a TLV-STEL and skin notation.		
DFG	***1983***	***Not assigned***
Summary of additional information Separate evaluations for beech and oak dust, and all other species undertaken. MAK not established for either group due to carcinogenicity in humans; beech and oak are confirmed human carcinogens (category 1), evidence for all other species is inconclusive, but suggestive of human carcinogenicity (category 3). Dermal and respiratory sensitisation potential depends primarily on the chemical composition of the wood species. Forty three tree species are reported individually in separate assessments, 18 recommend a dermal sensitiser notation (Sh); western red cedar classified as a dermal and respiratory sensitiser (Sah) based on case reports of respiratory sensitisation and contact dermatitis in exposed workers (also reported in ACGIH, 2018). Human data: • Inhibition of mucociliary clearance and resultant chronic inflammation may contribute to tumorigenicity, but carcinogenic mechanism of action not established in available studies • No additional carcinogenicity information reported, human carcinogenicity studies used to support classifications are the same as ACGIH (2018) and consistent with the IARC (1995) evaluation • Positive airway and dermal sensitisation reported in several clinical studies of western red cedar dust exposure. Animal data: • Dermal sensitisation following dermal induction with ethyl acetate extract of western red cedar wood (guinea pigs, induction: 3 times/wk, 2 wk, no further details provided).		
SCOEL	***NA***	***NA***
No report.		
OARS/AIHA	***NA***	***NA***
No report.		
HCOTN	***NA***	***NA***
No report.		

Secondary source reports relied upon

Source		Year	Additional information
IARC	✓	1995, 2012	• Increased risk of cancer of nasal cavities and paranasal sinuses associated with wood dust exposure in available cohort and case-control studies • Insufficient data to evaluate cancer risk attributable to softwood dusts exposure alone due to frequent co-exposure to hardwood dusts: ○ risk of nasal cavity and paranasal sinus cancer elevated in available studies of softwood dust exposure, but not as

Source	Year	Additional information
		high in those with mixed exposures or hardwood dust alone ○ difficult to attribute excess risk to specific tree species • No causal association between wood dust exposure and cancer of oropharynx, hypopharynx, lung, lymphatic and haematopoietic systems, stomach, colon or rectum in available epidemiological data • Polar extracts of beech wood (hardwood) are mutagenic in *in vitro* in bacteria and mammalian cells and *in vivo* in rodents: ○ similar results obtained with oak wood (hardwood) extracts ○ extracts of spruce (softwood) are non-mutagenic • Mechanism of carcinogenicity is unknown based on inconclusive mechanistic studies • Sufficient evidence for carcinogenicity of wood dust in humans; inadequate evidence for carcinogenicity in animals • Overall: carcinogenic to humans (Group 1).
Nordic Council	✘	2020 No English report available; ongoing document.

Carcinogenicity — non-threshold based genotoxic carcinogens

Is the chemical mutagenic?	Yes
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	Sen
HCIS	NA
NICNAS	NA
EU Annex	NA
ECHA	NA
ACGIH	*Oak, beech*: Carcinogenicity – A1 *Birch, mahogany, teak, walnut*: Carcinogenicity – A2 *Western red cedar*: Carcinogenicity – A4, RSEN, DSEN *All other species*: Carcinogenicity – A4

Source	Notations
DFG	*Oak, beech*: Carcinogenicity – 1 *Western red cedar*: Carcinogenicity – 3, Sa (respiratory sensitiser), Sh (dermal sensitiser) *All other species*: Carcinogenicity – 3, species classified individually with respect to sensitisation potential
SCOEL	NA
HCOTN	NA
IARC	Carcinogenicity – Group 1
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	
Adverse effects in human case study:	yes
Dermal LD_{50} ≤1000 mg/kg:	
Dermal repeat-dose NOAEL ≤200 mg/kg:	
Dermal LD_{50}/Inhalation LD_{50} <10:	
In vivo dermal absorption rate >10%:	
Estimated dermal exposure at WES >10%:	
	a skin notation is warranted

IDLH

Is there a suitable IDLH value available?	No

Additional information

Molecular weight:	N/A
Conversion factors at 25°C and 101.3 kPa:	1 ppm = N/A; 1 mg/m^3 = N/A
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) (2002) Wood dust – MAK value documentation.

Deutsche Forschungsgemeinschaft (DFG) (2002) Thuja species – MAK value documentation.

Deutsche Forschungsgemeinschaft (DFG) (2018) List of MAK and BAT Values 2018.

International Agency for Research on Cancer (IARC) (1995). Wood dust and formaldehyde. IARC Monographs – 62.

International Agency for Research on Cancer (IARC) (2012) Arsenic, metals, fibres, and dusts. IARC Monographs – 100C.