CARBOFURAN

CAS number: 1563-66-2

Synonyms: 7-benzofuranol, 2,3-dihydro-2,2-dimethylmthylcarbamate, carbamic acid, furadan

Chemical formula: $C_{12}H_{15}NO_3$

Structural formula: —

Workplace exposure standard (retained)

TWA: **0.1 mg/m^3**

STEL: **—**

Peak limitation: **—**

Notations: **—**

IDLH: **—**

Sampling and analysis:

Recommendation and basis for workplace exposure standard

A TWA of 0.1 mg/m^3 is recommended to protect for cholinesterase inhibition in exposed workers.

Discussion and conclusions

Carbofuran is used primarily as an insecticide, acaricide and nematicide.

It acts as a cholinesterase inhibitor producing effects in workers including blurred vision, nausea, excessive perspiration and a general sense of weakness.

Data in humans are inconsistent. A controlled oral dose study in humans reported a NOAEL of 0.05 mg/kg for cholinesterase inhibition. This equates to an inhalational concentration of 0.35 mg/m^3 over an eight hour work day. An observational study in pesticide formulation plant workers associated significant cholinesterase inhibition with exposure to mean airborne concentrations of 0.025 to 1.1 mg/m^3. Comparatively, no adverse effects in workers exposed to mean concentrations ranging between 0.018 to 0.067 mg/m^3 were reported in the same study (ACGIH, 2018).

In animals, a NOAEL of 0.22 mg/kg/day is reported in a four-week feeding study of dogs (ACGIH, 2018). This corresponds to an eight hour inhalational exposure in workers of 1.5 mg/m^3. An inhalation study in monkeys reports a NOAEL of 0.56 mg/m^3 (0.42 mg/m^3 as carbofuran) following a six hour exposure to 75% wettable powder.

The recommended TWA is derived from the inhalational study in monkeys, with the application of generic conversion factor of four to account for interspecies differences. The recommended TWA of 0.1 mg/m^3 is considered sufficient to protect for cholinesterase inhibition 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.

A skin notation is not recommended based on evidence in animals and humans.

APPENDIX

Primary sources with reports

Source	Year set	Standard
SWA	***1991***	***TWA: 0.1 mg/m^3***
ACGIH	***2004***	***TLV-TWA: 0.1 mg/m^3***

TLV-TWA recommended to minimise the risk of cholinesterase inhibition and other biological effects in exposed workers.
Summary of data:
Used primarily as an insecticide, acaricide and nematicide.
TLV derived from animal-based NOAEL, corresponding to human dose that does not impact on worker's red blood cell cholinesterase activity.
Human data:
• No adequate human dose-response data
• Controlled oral dose study in healthy males identified a NOAEL of 0.05 mg/kg
  ○ equates to inhalation concentration of 0.35 mg/m^3 based on 70 kg worker inhaling 10 m^3 per 8 h shift
• No adverse effects (cholinesterase inhibition) in workers exposed to 0.018–0.067 mg/m^3
  ○ significant cholinesterase inhibition associated with exposed to 0.025–1.1 mg/m^3.
 	
Animal Data:
• NOAEL: 0.22 mg/kg/d (dogs, oral, 4 wk); determined ≡1.5 mg/m^3 8 h worker exposure
• No increase in tumours or other carcinogenic effects reported in 2 yr carcinogenicity studies on rats and mice, oral dose up to 500 ppm
• Exposure to 50% wettable powder:
  ○ LC_{50}: 108 mg/m^3 (male rats, no duration noted)
  ○ LC_{50}: 133 mg/m^3 (rats, no duration noted)
• Exposure to 75% wettable powder:
  ○ NOAEL: 0.56 mg/m^3; LOAEL 0.86 mg/m^3 for cholinesterase depression (monkeys, 6 h)
  ○ LC_{50}: 45 mg/m^3 (female guinea pigs, 4 h)
  ○ LC_{50}: 53 mg/m3 (male guinea pigs, 4 h)
  ○ LD_{50}: 3,400 mg/kg (rabbits, dermal).
Most genotoxicity assays returned negative results. Positive results were at near lethal doses and considered to have weak genotoxic potential at best.
Assigned an A4, not classified as human carcinogen.
Insufficient data available to assign a sensitiser or skin notation.		

DFG	***NA***	***NA***
No report.		
SCOEL	***NA***	***NA***
No report.		

Source	Year set	Standard
OARS/AIHA	***NA***	***NA***
No report.		
HCOTN	***NA***	***NA***
No report.		

Secondary source reports relied upon

Source		Year	Additional information
US EPA	✓	1987	• NOAEL of 0.5 mg/kg/d (dogs, oral); RBC and plasma cholinesterase inhibition and testicular and uterine effects.

Carcinogenicity — non-threshold based genotoxic carcinogens

Is the chemical mutagenic? No

The chemical is not a non-threshold based genotoxic carcinogen.

Notations

Source	Notations
SWA	NA
HCIS	NA
NICNAS	NA
EU Annex	NA
ECHA	NA
ACGIH	Carcinogenicity – A4
DFG	NA
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	
Adverse effects in human case study:	no
Dermal LD_{50} ≤1000 mg/kg:	no
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 not warranted

IDLH

Is there a suitable IDLH value available?	No

Additional information

Molecular weight:	221.26
Conversion factors at 25°C and 101.3 kPa:	1 ppm = Number mg/m^3; 1 mg/m^3 = 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.

US Environmental Protection Authority (US EPA) (1984) Integrated Risk Information System (IRIS) Chemical Assessment Summary – Carbofuran.