Exposure to Mixed Vapours: TWA, Mixture TLV and Exposure Index

Eight-hour time-weighted average from up to three exposure periods, and the exposure index ΣC/TLV of a mixture of up to three substances with additive effects.

Method: Crowl and Louvar; Chemical Process Safety: Fundamentals with Applications; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Concentration in period 1	100.00	
Duration of period 1	4.0000	h
Concentration in period 2	50.000	
Duration of period 2	2.0000	h
Concentration in period 3	0	
Duration of period 3	2.0000	h
Mixture: concentration of substance A	100.00	
TLV of substance A	200.00	
Mixture: concentration of substance B	50.000	
TLV of substance B	100.00	
Mixture: concentration of substance C (0 = none)	0	
TLV of substance C	100.00	

Calculated results

Parameter	Value	Unit
Eight-hour time-weighted average (same unit as C)	62.500	
Exposure index of the mixture	1.0000	
TLV of the mixture as sampled (same unit)	150.00	

Notes for this case

- The TWA divides by 8 hours whatever the total time entered (time not entered counts as zero exposure). The mixture rule assumes the substances act on the same organ (additive effects).
- A screening estimate for training and early design, not a hazard or risk study.

Formula and method

$$TWA = \frac{C_1 t_1 + C_2 t_2 + \dots}{8\ \mathrm{h}}, \quad EI = \sum \frac{C_i}{TLV_i}, \quad TLV_{mix} = \frac{\sum C_i}{EI}$$

Variables

C_1	Concentration in period 1	-
t_1	Duration of period 1	s
C_2	Concentration in period 2	-
t_2	Duration of period 2	s
C_3	Concentration in period 3	-
t_3	Duration of period 3	s
C_A	Mixture: concentration of substance A	-

TLV_A	TLV of substance A	-
C_B	Mixture: concentration of substance B	-
TLV_B	TLV of substance B	-
C_C	Mixture: concentration of substance C (0 = none)	-
TLV_C	TLV of substance C	-
TWA	Eight-hour time-weighted average (same unit as C)	-
$\sum C_i/TLV_i$	Exposure index of the mixture	-
TLV_{mix}	TLV of the mixture as sampled (same unit)	-

Method and standards

Time weighting and the additive mixture rule.

Assumptions and limits

- Additive effects; 8-hour shift.

References

• Crowl and Louvar
• Chemical Process Safety: Fundamentals with Applications
• 2nd ed. (Prentice Hall, 2002)
• ch. 3
• eqs. 3-1 to 3-3 (TLV-TWA and mixtures)

Report details

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Release checks	2 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/chemical/process-safety/tlv-mixture-twa

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.