Flammability Limits of a Gas Mixture (Le Chatelier)

Lower and upper flammability limits of a mixture of up to four flammable gases from each one's limits and share of the flammable part (Le Chatelier).

Method: Perry's Chemical Engineers' Handbook; 9th ed. (McGraw-Hill, 2019); ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Gas 1 share of the flammable part	80.000	%
Gas 1 LFL	5.0000	%
Gas 1 UFL	15.000	%
Gas 2 share	15.000	%
Gas 2 LFL	3.0000	%
Gas 2 UFL	12.400	%
Gas 3 share	5.0000	%
Gas 3 LFL	2.1000	%
Gas 3 UFL	9.5000	%
Gas 4 share (0 = none)	0	%
Gas 4 LFL	4.0000	%
Gas 4 UFL	75.000	%
Flammable share of the whole gas	100.00	%

Calculated results

Parameter	Value	Unit
Lower flammability limit of the flammable mixture	4.2770	%
Upper flammability limit (approximate)	14.146	%
LFL of the whole gas (inerts included)	4.2770	%

Notes for this case

- Inerts raise the whole-gas LFL as shown, but also narrow the range; no whole-gas UFL is given because inerts change it in a way this rule does not capture. The UFL rule is less reliable than the LFL rule. Use measured limits from the SDS or Perry's sec. 23 tables.

Formula and method

$$LFL_{mix} = \frac{1}{\sum_i y_i / LFL_i}, \quad UFL_{mix} \approx \frac{1}{\sum_i y_i / UFL_i}$$

Variables

y_1	Gas 1 share of the flammable part	-
LFL_1	Gas 1 LFL	-
UFL_1	Gas 1 UFL	-
y_2	Gas 2 share	-
LFL_2	Gas 2 LFL	-
UFL_2	Gas 2 UFL	-
y_3	Gas 3 share	-
LFL_3	Gas 3 LFL	-

UFL_3	Gas 3 UFL	-
y_4	Gas 4 share (0 = none)	-
LFL_4	Gas 4 LFL	-
UFL_4	Gas 4 UFL	-
ϕ_f	Flammable share of the whole gas	-
LFL_{mix}	Lower flammability limit of the flammable mixture	-
UFL_{mix}	Upper flammability limit (approximate)	-
LFL_{gas}	LFL of the whole gas (inerts included)	-

Method and standards

Le Chatelier's rule as in Perry's Eq. (23-1).

Assumptions and limits

- Near-ambient conditions; similar flammable gases.
- Shares adding up to 99–101 % are normalised to 100 %.
- Screening estimate: the whole-gas LFL with inerts is given, but no whole-gas UFL, since inerts narrow the range in a way this rule does not capture.

References

- Perry's Chemical Engineers' Handbook
- 9th ed. (McGraw-Hill, 2019)
- sec. 23 (process safety)
- Eq. (23-1): Le Chatelier's mixing rule

Report details

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

This calculator online

https://calc.firecad.com/chemical/unit-operations/lfl-mixture-le-chatelier

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Reopens the calculator with the inputs of this report.