Gas Composition: Volume % to Mass %

Converts a gas analysis by volume (mole) to mass fractions and gives the mixture molar mass.

Method: IUPAC 2013 standard atomic weights

Input parameters

Unit system: SI

Parameter	Value	Unit
Oxygen (O2) by volume	20.950	%
Nitrogen (N2) by volume	78.080	%
Carbon dioxide (CO2) by volume	0.040000	%
Water vapour (H2O) by volume	0	%
Sulphur dioxide (SO2) by volume	0	%
Carbon monoxide (CO) by volume	0	%
Hydrogen (H2) by volume	0	%
Argon (Ar) by volume	0.93000	%

Calculated results

Parameter	Value	Unit
Oxygen by mass	23.143	%
Nitrogen by mass	75.514	%
Carbon dioxide by mass	0.060773	%
Water vapour by mass	0	%
Sulphur dioxide by mass	0	%
Carbon monoxide by mass	0	%
Hydrogen by mass	0	%
Argon by mass	1.2826	%
Mixture molar mass	28.966	kg/kmol

Formula and method

$$M = \sum_i y_i M_i \qquad w_i = \frac{y_i\, M_i}{M}$$

Variables

y_i	mole (volume) fraction of species *i*: $y_{O_2}, y_{N_2}, y_{CO_2}, y_{H_2O}, y_{SO_2}, y_{CO}, y_{H_2}, y_{Ar}$	–
M_i	molar mass of species *i*	kg/kmol
M	molar mass of the mixture	kg/kmol
w_i	mass fraction of species *i*: $w_{O_2}, w_{N_2}, w_{CO_2}, w_{H_2O}, w_{SO_2}, w_{CO}, w_{H_2}, w_{Ar}$	–

Method and standards

Molar masses are computed from the IUPAC 2013 conventional atomic weights (C 12.011, H 1.008, O 15.999, N 14.007, S 32.06, Ar 39.948 kg/kmol). The conversion is exact for ideal-gas mixtures.

Assumptions and limits

- Ideal gas: volume fraction equals mole fraction.
- Only O_2, N_2, CO_2, H_2O, SO_2, CO, H_2 and Ar can be entered; hydrocarbons and H_2S of a fuel gas are not covered.
- Fractions that do not sum to 1 are normalised; the page reports the original sum.

References

- IUPAC 2013 standard atomic weights

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/boilers-power-plant/combustion/volume-to-weight

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.