Theoretical Ethanol and CO_2 from Sugar (Gay-Lussac)

Theoretical ethanol by mass and volume and CO_2 from a mass of glucose (hexose) or sucrose by the Gay-Lussac equation, with a fermentation efficiency.

Method: Gay-Lussac stoichiometry $C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2$ with IUPAC atomic masses; ethanol density 789.24 kg/m³ at 20 °C (OIML R 22)

Input parameters

Unit system: SI

Parameter	Value	Unit
Sugar fermented	1.0000	t
Sugar	Glucose / invert (hexose)	
Fermentation efficiency	100.00	%
Ethanol density at 20 °C	789.24	kg/m³

Calculated results

Parameter	Value	Unit
Ethanol	0.51143	t
Ethanol at 20 °C (absolute)	648.01	L
Ethanol per tonne of sugar	648.01	L/t
CO_2 released	0.48857	t

Notes for this case

- Theoretical yield: yeast growth and by-products keep real fermentation efficiency near 88–92 %.

Formula and method

$$C_6H_{12}O_6 \rightarrow 2\,C_2H_5OH + 2\,CO_2, \quad m_e = 2 n_{hex} M_{EtOH} \eta_f$$

Variables

m	Sugar fermented	kg
sugar	Sugar	-
η_f	Fermentation efficiency	-
ρ_e	Ethanol density at 20 °C	kg/m³
m_e	Ethanol	kg
V_e	Ethanol at 20 °C (absolute)	m³
y	Ethanol per tonne of sugar	m³/kg
m_{CO_2}	CO_2 released	kg

Method and standards

Stoichiometry.

Assumptions and limits

- Complete conversion to ethanol at η_f = 1. Below that, ethanol and CO_2 are both scaled by η_f; sugar diverted to yeast growth and by-products also releases some CO_2, so the CO_2 figure is then a lower estimate.

References

• Gay-Lussac stoichiometry $C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2$ with IUPAC atomic masses; ethanol density 789.24 kg/m³ at 20 °C (OIML R 22)

Report details

Report reference	FCC-ABTX-DVTY (the same inputs always give the same reference)
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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/sugar-ethanol/ethanol/ethanol-from-sugar-theoretical

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.