Fermentation CO_2: Mass, Volume and Recovery

CO_2 released by fermentation from the ethanol produced (Gay-Lussac), its normal volume, the share recoverable and the liquefaction power.

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); Normal volume with the molar volume at 0 °C; …

Input parameters

Unit system: SI

Parameter	Value	Unit
Ethanol produced (absolute)	100.00	kL/d
Share of CO_2 recovered	70.000	%
Recovery and liquefaction energy	150.00	kWh/t
Ethanol density at 20 °C	789.24	kg/m³

Calculated results

Parameter	Value	Unit
CO_2 released	75.395	t/d
CO_2 at normal conditions	1,600.0	Nm³/h
CO_2 recovered	52.776	t/d
Recovery plant power	329.85	kW

Notes for this case

- Fermentation CO_2 is biogenic and food-grade after scrubbing; it is a saleable by-product.

Formula and method

$$\dot{m}_{CO_2} = \dot{V}_e \rho_e \frac{M_{CO_2}}{M_{EtOH}}, \quad \dot{V}_{CO_2} = \frac{\dot{m}_{CO_2}}{M_{CO_2}} V_m, \quad \dot{m}_r = r\,\dot{m}_{CO_2}, \quad P = e\,\dot{m}_r$$

Variables

$\dot{V}_e$	Ethanol produced (absolute)	m³/s
r	Share of CO_2 recovered	-
e	Recovery and liquefaction energy	J/kg
ρ_e	Ethanol density at 20 °C	kg/m³
$\dot{m}_{CO_2}$	CO_2 released	kg/s
$\dot{V}_{CO_2}$	CO_2 at normal conditions	Nm³/s
$\dot{m}_r$	CO_2 recovered	kg/s
P	Recovery plant power	W

Method and standards

Stoichiometry.

Assumptions and limits

- Ideal gas.

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)
- Normal volume with the molar volume at 0 °C
- 1 atm (CODATA)

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/sugar-ethanol/ethanol/fermentation-co2

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.