Fermentation, Distillation and Overall Efficiency

Fermentation efficiency from alcohol in the wash against theory, distillation efficiency from alcohol recovered, and overall efficiency, from plant figures.

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
Fermentable sugar fed (as invert)	192.00	t
Alcohol in wash (absolute)	112,000	L
Alcohol recovered (absolute)	110,400	L
Ethanol density at 20 °C	789.24	kg/m³

Calculated results

Parameter	Value	Unit
Theoretical alcohol	124,418	L
Fermentation efficiency	90.019	%
Distillation efficiency	98.571	%
Overall efficiency	88.733	%

Formula and method

$$\eta_f = \frac{V_w}{V_{th}}, \quad \eta_d = \frac{V_r}{V_w}, \quad \eta_o = \eta_f \eta_d$$

Variables

m_{TRS}	Fermentable sugar fed (as invert)	kg
V_w	Alcohol in wash (absolute)	m³
V_r	Alcohol recovered (absolute)	m³
ρ_e	Ethanol density at 20 °C	kg/m³
V_{th}	Theoretical alcohol	m³
η_f	Fermentation efficiency	-
η_d	Distillation efficiency	-
η_o	Overall efficiency	-

Method and standards

Definitions.

Assumptions and limits

- Same period for all figures. Notes flag efficiencies above 100 %, which point to measurement errors.

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

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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-distillation-efficiency

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.