# Ethanol from Whey (Lactose)

Ethanol from whey or permeate from lactose and fermentation efficiency (lactose → 4 ethanol + 4 $CO_2$) and whey per litre of ethanol (Alcohol Textbook ch. 7).

**Method:** Jacques; Lyons and Kelsall (eds.); ...

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Whey or permeate | 10.000 | $m^3/h$ |
| Whey density | 1,025.0 | $kg/m^3$ |
| Lactose<br>Alcohol Textbook: lactose 4.4 % in whey, 4.8 % in permeate. | 4.4000 | % |
| Fermentation efficiency | 80.000 | % |
| Ethanol density at 20 °C | 789.24 | $kg/m^3$ |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Lactose | 451.00 | kg/h |
| Theoretical ethanol per kg lactose | 0.53835 | |
| Ethanol | 194.24 | kg/h |
| Ethanol | 246.11 | L/h |
| Whey per litre of ethanol | 40.633 | |

**Notes for this case**

- The Alcohol Textbook: at 80 % yield from 4.4 % lactose, a litre of ethanol needs about 42 L of whey. Kluyveromyces yeasts ferment lactose directly.

## Formula and method

$$Y = \frac{4M_E}{M_{lactose}}, \quad \dot{m}_E = Q\rho_w x_L Y \eta, \quad \dot{V}_E = \frac{\dot{m}_E}{\rho_e}$$

### Variables

| | | |
|---|---|---|
| $Q$ | Whey or permeate | $m^3/s$ |
| $\rho_w$ | Whey density | $kg/m^3$ |
| $x_L$ | Lactose | - |
| $\eta$ | Fermentation efficiency | - |
| $\rho_e$ | Ethanol density at 20 °C | $kg/m^3$ |
| $\dot{m}_L$ | Lactose | kg/s |
| $Y$ | Theoretical ethanol per kg lactose | - |
| $\dot{m}_E$ | Ethanol | kg/s |
| $\dot{V}_E$ | Ethanol | $m^3/s$ |
| $Q/\dot{V}_E$ | Whey per litre of ethanol | - |

### Method and standards

Stoichiometry with efficiency.

### Assumptions and limits

- Lactose is the only fermentable sugar.

### References


- Jacques
- Lyons and Kelsall (eds.)
- The Alcohol Textbook
- 4th ed. (Nottingham University Press, 2003)
- ch. 7 (O'Shea)
- whey composition and alcohol production
- Stoichiometry $C_{12}H_{22}O_{11} + H_2O \rightarrow 4\ C_2H_5OH + 4\ CO_2$ with IUPAC atomic masses


## Report details

| | |
|---|---|
| Report reference | FCC-G6JA-7RPN (the same inputs always give the same reference) |
| Generated | 17 November 2026, 19:48 UTC |
| Calculator | Ethanol from Whey (Lactose) |
| Method last reviewed | 13 November 2026 |
| Software release | FireCAD Calc, release of 17 November 2026 |
| 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/whey-ethanol-yield

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.