Luedeking–Piret Product Formation in Batch Growth

Product concentration in exponential batch growth by the Luedeking–Piret model, splitting growth-associated and non-growth-associated production.

Method: Luedeking–Piret kinetics

Input parameters

Unit system: SI

Parameter	Value	Unit
Growth-associated coefficient (g product per g cells)	2.2000	
Non-growth coefficient	0.050000	1/h
Specific growth rate	0.30000	1/h
Initial biomass	0.50000	g/L
Initial product	0	g/L
Time	8.0000	h

Calculated results

Parameter	Value	Unit
Biomass at time t	5.5116	g/L
Growth-associated product	11.025	g/L
Non-growth-associated product	0.83526	g/L
Product at time t	11.861	g/L
Specific production rate	0.71000	1/h

Notes for this case

• dP/dt = α·dX/dt + βX with X = X₀e^(μt) integrates to P = P₀ + αX₀(e^(μt) − 1) + (β/μ)X₀(e^(μt) − 1). Ethanol and lactic acid are mostly growth-associated (large α); antibiotics are mostly non-growth-associated (large β). Valid only while growth stays exponential.

Formula and method

$$\frac{dP}{dt} = \alpha \frac{dX}{dt} + \beta X, \quad P = P_0 + \left(\alpha + \frac{\beta}{\mu}\right) X_0 \left(e^{\mu t} - 1\right)$$

Variables

α	Growth-associated coefficient (g product per g cells)	-
β	Non-growth coefficient	1/s
μ	Specific growth rate	1/s
X_0	Initial biomass	kg/m³
P_0	Initial product	kg/m³
t	Time	s
X	Biomass at time t	kg/m³
P_g	Growth-associated product	kg/m³
P_n	Non-growth-associated product	kg/m³
P	Product at time t	kg/m³
q_p	Specific production rate	1/s

Method and standards

Product kinetics.

Assumptions and limits

- Exponential growth; constant α and β.

References

Luedeking–Piret kinetics

Report details

Report reference	FCC-R788-7QJ3 (the same inputs always give the same reference)
Generated	23 November 2026, 17:51 UTC
Calculator	Luedeking–Piret Product Formation in Batch Growth
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
Release checks	3 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/chemical/bioprocess/luedeking-piret-product

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.