Pirt Maintenance Coefficient and True Growth Yield

True growth yield and maintenance coefficient of a culture from observed biomass yields at two growth rates (chemostat dilution rates), and the yield at a third.

Input parameters

Unit system: SI

Parameter	Value	Unit
First growth (dilution) rate	0.050000	1/h
Observed yield at the first rate (g biomass/g substrate)	0.40000	
Second growth (dilution) rate	0.30000	1/h
Observed yield at the second rate	0.48000	
Growth rate for the prediction	0.15000	1/h

Calculated results

Parameter	Value	Unit
True growth yield	0.50000	
Maintenance coefficient (g substrate per g biomass per hour)	0.025000	
Observed yield at the growth rate for the prediction	0.46154	
Share of substrate used for maintenance at that rate	7.6923	%

Notes for this case

• Pirt's model splits substrate use into growth and maintenance: 1/Y = 1/Y_G + m_s/μ. Plotting 1/Y against 1/μ (in a chemostat μ equals the dilution rate) gives a straight line with intercept 1/Y_G and slope m_s. At slow growth a large share of the substrate only keeps cells alive, so observed yields fall.

Formula and method

$$\frac{1}{Y} = \frac{1}{Y_G} + \frac{m_s}{\mu}$$

Variables

μ_1	First growth (dilution) rate	1/s
Y_1	Observed yield at the first rate (g biomass/g substrate)	-
μ_2	Second growth (dilution) rate	1/s
Y_2	Observed yield at the second rate	-
μ	Growth rate for the prediction	1/s
Y_G	True growth yield	-
m_s	Maintenance coefficient (g substrate per g biomass per hour)	-
Y	Observed yield at the growth rate for the prediction	-
f_m	Share of substrate used for maintenance at that rate	-

Method and standards

Maintenance model.

Assumptions and limits

- Steady state; maintenance independent of growth rate.

Report details

Report reference	FCC-PTZS-7MQB (the same inputs always give the same reference)
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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/pirt-maintenance-true-yield

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.