Haldane (Andrews) Growth Rate with Substrate Inhibition

Specific growth rate under substrate inhibition by the Haldane–Andrews model, the substrate concentration of fastest growth and the peak growth rate.

Method: Haldane–Andrews kinetics

Input parameters

Unit system: SI

Parameter	Value	Unit
Maximum specific growth rate (Monod)	0.50000	1/h
Saturation constant	0.20000	g/L
Inhibition constant	20.000	g/L
Substrate concentration	5.0000	g/L

Calculated results

Parameter	Value	Unit
Specific growth rate	0.38760	1/h
Substrate for fastest growth	2.0000	g/L
Peak growth rate	0.41667	1/h
Rate relative to peak	93.023	%

Notes for this case

• μ = μ_max·S/(K_s + S + S²/K_i). Growth peaks at S = √(K_sK_i) and falls at higher substrate: phenol-degrading cultures and high-sugar fermentations behave so. A chemostat then has two steady states for one dilution rate; only the low-substrate one is stable. Fed-batch keeps S near S_opt.

Formula and method

$$\mu = \frac{\mu_{max} S}{K_s + S + S^2/K_i}, \quad S_{opt} = \sqrt{K_s K_i}$$

Variables

μ_{max}	Maximum specific growth rate (Monod)	1/s
K_s	Saturation constant	kg/m³
K_i	Inhibition constant	kg/m³
S	Substrate concentration	kg/m³
μ	Specific growth rate	1/s
S_{opt}	Substrate for fastest growth	kg/m³
μ_{peak}	Peak growth rate	1/s
μ/μ_{peak}	Rate relative to peak	-

Method and standards

Inhibition kinetics.

Assumptions and limits

- Single limiting, inhibiting substrate.

References

Haldane–Andrews kinetics

Report details

Report reference	FCC-ZCSW-44NP (the same inputs always give the same reference)
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Calculator	Haldane (Andrews) Growth Rate with Substrate Inhibition
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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/haldane-substrate-inhibition

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.