PI Tuning for Integrating (Level-Type) Processes (SIMC)

PI settings for an integrating process such as level or drum pressure by Skogestad's SIMC rule from the integrating rate and dead time, with arrest time.

Method: Skogestad (2003); J. Process Control 13: 291 (SIMC rules, integrating processes: K_c = 1/(k'(τ_c + θ)), T_i = 4(τ_c + θ))

Input parameters

Unit system: SI

Parameter	Value	Unit
Integrating rate (% PV per % output, per unit time) Slope of the PV trend after a step in output, divided by the step; choose 1/min for a rate read per minute.	0.010000	1/s
Dead time	5.0000	s
Closed-loop time constant (default = dead time)	5.0000	s

Calculated results

Parameter	Value	Unit
Controller gain	10.000	
Integral time	40.000	s
Approximate arrest time 2(τ_c + θ) (rule of thumb)	20.000	s

Notes for this case

- Skogestad (2003) SIMC rule for integrating processes. For surge-tank averaging level control use a larger τ_c to let the level swing and smooth the outlet flow.

Formula and method

$$K_c = \frac{1}{k'(\tau_c + \theta)}, \quad T_i = 4(\tau_c + \theta), \quad t_{arrest} \approx 2(\tau_c + \theta)$$

Variables

k'	Integrating rate (% PV per % output, per unit time)	1/s
θ	Dead time	s
τ_c	Closed-loop time constant (default = dead time)	s
K_c	Controller gain	-
T_i	Integral time	s
t_{arrest}	Approximate arrest time 2(τ_c + θ) (rule of thumb)	s

Method and standards

SIMC rule.

Assumptions and limits

- Pure integrator with dead time.
- k' is a rate (per second, or per minute with the unit chosen); a rate read per minute and entered as per second would make K_c 60 times too small.
- The arrest time 2(τ_c + θ) is a rule-of-thumb estimate, not part of the SIMC rules.

References

- Skogestad (2003)
- J. Process Control 13: 291 (SIMC rules, integrating processes: K_c = 1/(k'(τ_c + θ)), T_i = 4(τ_c + θ))

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/instrumentation/control-loops/integrating-process-tuning

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Reopens the calculator with the inputs of this report.