Inerting by Pressure or Sweep Purging: Cycles and Nitrogen

Oxygen left after nitrogen pressure-purge cycles, cycles needed for a target, nitrogen used, and the sweep-through purge volume for the same target.

Method: Purging by ideal mixing (definitions; see Perry's sec. 23 on inerting)

Input parameters

Unit system: SI

Parameter	Value	Unit
Vessel volume	10.000	m³
Initial oxygen	21.000	%
Target oxygen	6.0000	%
Low pressure of the cycle (absolute)	1.0132	bar
High pressure of the cycle (absolute)	5.0000	bar
Temperature	25.000	°C

Calculated results

Parameter	Value	Unit
Pressure cycles needed	1.0000	
Oxygen after those cycles	4.2556	%
Nitrogen for the pressure purge	45.053	kg
Nitrogen volume for a sweep purge (at vessel conditions)	12.528	m³

Notes for this case

• Ideal mixing assumed; dead legs and poor mixing need more nitrogen. Verify with an oxygen analyser. Pure nitrogen assumed: impure or PSA nitrogen leaves an oxygen floor at its own O_2 content. Screening estimate only, not a safety study or a basis for protective design.

Formula and method

$$y_j = y_0 \left(\frac{p_L}{p_H}\right)^j, \quad m_{N_2} = j\frac{(p_H - p_L)V}{RT}M_{N_2}, \quad Qt = V\ln\frac{y_0}{y_t}$$

Variables

V	Vessel volume	m³
y_0	Initial oxygen	-
y_t	Target oxygen	-
p_L	Low pressure of the cycle (absolute)	Pa
p_H	High pressure of the cycle (absolute)	Pa
T	Temperature	K
j	Pressure cycles needed	-
y_j	Oxygen after those cycles	-
m_{N_2}	Nitrogen for the pressure purge	kg
Qt	Nitrogen volume for a sweep purge (at vessel conditions)	m³

Method and standards

Ideal-mixing purge relations.

Assumptions and limits

- Ideal gas; perfect mixing; pure nitrogen. Impure nitrogen (99 % or PSA 97 %) carries its own oxygen, which sets a floor on the

oxygen reached; more cycles are then needed, or the target cannot be met.

References

• Purging by ideal mixing (definitions; see Perry's sec. 23 on inerting)

Report details

Report reference	FCC-D8R3-STCR (the same inputs always give the same reference)
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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/chemical/process-safety/nitrogen-purge-cycles

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.