Heatless Desiccant Dryer Purge Air Loss and Cost

Purge air fraction of a heatless (pressure-swing) desiccant dryer from Skarstrom's volume ratio and pressures, the purge flow, compressor power lost and annual cost.

Method: Skarstrom purge criterion for pressure-swing adsorption

Input parameters

Unit system: SI

Parameter	Value	Unit
Dried air flow	600.00	Nm³/h
Dryer operating pressure (absolute)	8.0000	bar
Purge (regeneration) pressure (absolute)	1.0300	bar
Purge-to-feed actual volume ratio (Skarstrom ≥ 1)	1.1500	
Compressor specific energy	0.11000	kWh/m³
Running hours per year	8,000.0	h
Electricity price per kWh	8.0000	

Calculated results

Parameter	Value	Unit
Purge as share of dried air	14.806	%
Purge flow	88.837	Nm³/h
Compressor power for purge	9.7721	kW
Annual energy	78.177	MWh
Annual cost	625,416	

Notes for this case

• Skarstrom's criterion: the purge must sweep at least the same actual volume at low pressure as the feed at high pressure, so the purge mass share is r·p_purge/p_line. Heatless dryers at 7 barg therefore lose about 13–15 % of the dried air; heated-purge and blower-purge dryers use much less. Dew-point-dependent switching cuts purge at part load. Power = purge flow × compressor specific energy (normal m³ basis).

Formula and method

$$\phi = r_S \frac{p_{purge}}{p_{line}}, \quad Q_p = \phi Q, \quad P_p = Q_p e$$

Variables

Q	Dried air flow	Nm³/s
p_{line}	Dryer operating pressure (absolute)	Pa
p_{purge}	Purge (regeneration) pressure (absolute)	Pa
r_S	Purge-to-feed actual volume ratio (Skarstrom ≥ 1)	-
e	Compressor specific energy	J/m³
t	Running hours per year	s
c_e	Electricity price per kWh	-
ϕ	Purge as share of dried air	-
Q_p	Purge flow	Nm³/s
P_p	Compressor power for purge	W
E	Annual energy	J

C	Annual cost	-

Method and standards

Purge loss.

Assumptions and limits

- Fixed-cycle heatless dryer; purge at the stated pressure.

References

Skarstrom purge criterion for pressure-swing adsorption

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/mechanical/compressors/desiccant-dryer-purge-loss

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.