Rotary Dryer Volume from Volumetric Heat Transfer

Rotary dryer volume, diameter and length from the heat duty, a volumetric heat transfer coefficient and the log-mean temperature difference between gas and solids.

Input parameters

Unit system: SI

Parameter	Value	Unit
Heat to the solids and water	1,500.0	kW
Volumetric heat transfer coefficient, W/(m³·K) Per kelvin: W/(m³·K), entered in W/m³ per K in every unit system. Convert Btu/(h·ft³·°F) by × 18.63.	150.00	W/m³
Gas in	400.00	°C
Gas out	110.00	°C
Solids in	25.000	°C
Solids out	90.000	°C
Flow arrangement	Co-current	
Length to diameter ratio	6.0000	

Calculated results

Parameter	Value	Unit
Log-mean temperature difference	121.11	K
Dryer volume	82.569	m³
Diameter	2.5973	m
Length	15.584	m

Formula and method

$$\Delta T_{lm} = \frac{\Delta T_1 - \Delta T_2}{\ln(\Delta T_1/\Delta T_2)},\quad \mathrm{co-current}:\ \Delta T_1 = T_{g1} - T_{s1},\ \Delta T_2 = T_{g2} - T_{s2};\quad \mathrm{counter-current}:\ \Delta T_1 = T_{g1} - T_{s2},\ \Delta T_2 = T_{g2} - T_{s1}$$

$$V = \frac{Q}{U_a\,\Delta T_{lm}},\quad D = \sqrt[3]{\frac{4V}{\pi(L/D)}}$$

Variables

Q	Heat to the solids and water	W
U_a	Volumetric heat transfer coefficient, W/(m³·K)	W/(m³·K)
T_{g1}	Gas in	K
T_{g2}	Gas out	K
T_{s1}	Solids in	K
T_{s2}	Solids out	K
flow	Flow arrangement	-
L/D	Length to diameter ratio	-
ΔT_{lm}	Log-mean temperature difference	K
V	Dryer volume	m³
D	Diameter	m
L	Length	m

Method and standards

Volumetric heat transfer design.

Assumptions and limits

- Uniform U_a; ΔT_lm between gas and solids.
- U_a is entered in W/(m³·K) in every unit system (no per-degree volumetric quantity exists for automatic conversion); 1 Btu/(h·ft³·°F) = 18.63 W/(m³·K).

Report details

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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/drying/rotary-dryer-volume

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.