Steam-Heated Drum Dryer Evaporation Capacity

Evaporation and product output of a steam-heated drum dryer from the drum size, wrap angle, overall coefficient, steam and product temperatures and moistures.

Method: Conduction drum dryer heat balance

Input parameters

Unit system: SI

Parameter	Value	Unit
Drum diameter	1.2000	m
Drum length	3.0000	m
Share of the drum surface covered by product	75.000	%
Overall heat transfer coefficient	1,000.0	W/(m²·K)
Steam temperature inside the drum	165.00	°C
Mean product temperature on the drum	100.00	°C
Latent heat at the product temperature	2,257.0	kJ/kg
Feed solids (wet basis)	30.000	%
Product solids (wet basis)	96.000	%

Calculated results

Parameter	Value	Unit
Effective heated area	8.4823	m²
Heat transferred	551.35	kW
Evaporation	879.42	kg/h
Product output	383.75	kg/h
Feed rate	1,228.0	kg/h
Steam condensed (latent heat at the steam temperature)	960.98	kg/h

Notes for this case

• Steam condensing inside the drum heats the thin film of product on the outside; the heat flow is U A (T_s − T_p) over the covered part of the drum. Almost all of it evaporates water, so evaporation ≈ Q/λ. A water balance on the solids gives the product rate: each kg of product removes (1/x_f − 1/x_p) kg of water per kg of solids. Feed preheating, sensible heat and heat losses are neglected here, so the true output is somewhat lower. Typical U values are 1000–2000 W/(m²·K) for thin films.

Formula and method

$$\dot{Q} = U\pi DLf(T_s - T_p), \quad \dot{m}_w = \frac{\dot{Q}}{\lambda}, \quad \dot{m}_p = \frac{\dot{m}_w}{1/x_f - 1/x_p}$$

Variables

D	Drum diameter	m
L	Drum length	m
f	Share of the drum surface covered by product	-
U	Overall heat transfer coefficient	W/(m²·K)
T_s	Steam temperature inside the drum	K
T_p	Mean product temperature on the drum	K
λ	Latent heat at the product temperature	J/kg

x_f	Feed solids (wet basis)	-
x_p	Product solids (wet basis)	-
A	Effective heated area	m²
$\dot{Q}$	Heat transferred	W
$\dot{m}_w$	Evaporation	kg/s
$\dot{m}_p$	Product output	kg/s
$\dot{m}_f$	Feed rate	kg/s
$\dot{m}_{st}$	Steam condensed (latent heat at the steam temperature)	kg/s

Method and standards

Drum dryer.

Assumptions and limits

- Steady state; sensible heat and losses neglected.

References

Conduction drum dryer heat balance

Report details

Report reference	FCC-BZ7P-S68C (the same inputs always give the same reference)
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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/chemical/drying/drum-dryer-capacity

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Reopens the calculator with the inputs of this report.