Rotary Kiln Shell Heat Loss by Radiation and Convection

Heat lost from a rotary kiln shell from its mean surface temperature, emissivity and convective coefficient, the loss per kg of clinker and the loss per metre.

Method: Radiation and convection from a surface

Input parameters

Unit system: SI

Parameter	Value	Unit
Shell outside diameter	4.8000	m
Kiln length	74.000	m
Mean shell temperature	300.00	°C
Ambient temperature	30.000	°C
Shell emissivity	80.000	%
Convective coefficient	12.000	W/(m²·K)
Clinker production	3,000.0	t/d

Calculated results

Parameter	Value	Unit
Radiation coefficient	16.712	W/(m²·K)
Shell area	1,115.9	m²
Shell heat loss	8.6506	MW
Loss per metre	116.90	kW/m
Loss per kg clinker	249.14	kJ/kg

Notes for this case

• Q = (h_r + h_c)A(T_s − T₀), h_r = εσ(T_s² + T₀²)(T_s + T₀). Use a shell scanner's profile in segments for accuracy, since the burning zone runs much hotter than the inlet. Shell losses are typically 100–200 kJ/kg clinker; wind and shell fans raise h_c. Coating loss shows as hot spots.

Formula and method

$$\dot{Q} = (h_r + h_c)\pi D L (T_s - T_0), \quad h_r = \varepsilon\sigma(T_s^2 + T_0^2)(T_s + T_0)$$

Variables

D	Shell outside diameter	m
L	Kiln length	m
T_s	Mean shell temperature	K
T_0	Ambient temperature	K
ε	Shell emissivity	-
h_c	Convective coefficient	W/(m²·K)
$\dot{m}_{cl}$	Clinker production	kg/s
h_r	Radiation coefficient	W/(m²·K)
A	Shell area	m²
$\dot{Q}$	Shell heat loss	W
$\dot{Q}/L$	Loss per metre	W/m
q_{sp}	Loss per kg clinker	J/kg

Method and standards

Shell loss.

Assumptions and limits

- Uniform mean shell temperature; grey surface; no shading by tyres.

References

Radiation and convection from a surface

Report details

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Release checks	3 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/cement/kiln-shell-heat-loss

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.