Asymptotic Fouling Resistance with Time (Kern–Seaton Model)

Fouling resistance growth toward its asymptotic value, the time to reach a chosen fraction, and the fouled overall coefficient after a running time.

Input parameters

Unit system: SI

Parameter	Value	Unit
Asymptotic fouling resistance	3.0000e-04	m²·K/W
Time constant (time to 63 % of the asymptote)	2,000.0	h
Running time	4,380.0	h
Clean overall coefficient	1,500.0	W/(m²·K)
Fraction of the asymptote for the time question	95.000	%

Calculated results

Parameter	Value	Unit
Fouling resistance after the running time	2.6642e-04	m²·K/W
Share of the asymptote reached	88.808	%
Fouled overall coefficient	1,071.7	W/(m²·K)
Loss of overall coefficient	28.553	%
Time to reach the chosen fraction	5,991.5	h
Fully fouled overall coefficient	1,034.5	W/(m²·K)

Notes for this case

• Deposition at a constant rate with removal proportional to the deposit (Kern and Seaton; Taborek et al.) gives R_f = R_f,∞(1 − e^(−t/τ_c)). Fit R_f,∞ and τ_c from plant U-versus-time data; there is often an induction period before fouling starts.

Formula and method

$$R_f(t) = R_{f,\infty}\left(1 - e^{-t/\tau_c}\right), \quad t_f = -\tau_c \ln(1-f), \quad \frac{1}{U_f} = \frac{1}{U_c} + R_f$$

Variables

$R_{f,\infty}$	Asymptotic fouling resistance	m²·K/W
τ_c	Time constant (time to 63 % of the asymptote)	s
t	Running time	s
U_c	Clean overall coefficient	W/(m²·K)
f	Fraction of the asymptote for the time question	-
$R_f(t)$	Fouling resistance after the running time	m²·K/W
$R_f/R_{f,\infty}$	Share of the asymptote reached	-
$U_f(t)$	Fouled overall coefficient	W/(m²·K)
$1 - U_f/U_c$	Loss of overall coefficient	-
t_f	Time to reach the chosen fraction	s
$U_{f,\infty}$	Fully fouled overall coefficient	W/(m²·K)

Method and standards

Asymptotic deposition–removal fouling model.

Assumptions and limits

- Constant operating conditions; no induction period.

Report details

Report reference	FCC-SMPC-B8FW (the same inputs always give the same reference)
Generated	23 November 2026, 18:09 UTC
Calculator	Asymptotic Fouling Resistance with Time (Kern–Seaton Model)
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
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/mechanical/heat-transfer/asymptotic-fouling-resistance

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Reopens the calculator with the inputs of this report.