Effect of Fouling on a Heat Exchanger (Clean vs Dirty U)

Dirty overall coefficient from the clean coefficient and the fouling resistances, the extra area needed, and the duty lost by an existing exchanger at the same LMTD.

Method: 1/U_d = 1/U_c + R_f; i + R_f; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Clean overall coefficient	850.00	W/(m²·K)
Fouling resistance, inside, referred to the outside area (R_fi d_o/d_i)	1.8000e-04	m²·K/W
Fouling resistance, outside (referred to the same area)	3.5000e-04	m²·K/W

Calculated results

Parameter	Value	Unit
Dirty (service) coefficient	586.00	W/(m²·K)
Extra area needed for the same duty	45.050	%
Duty lost at the same LMTD	31.058	%
Cleanliness factor	68.942	%

Notes for this case

- Fouling resistances from your experience or a published table (TEMA). Lower LMTD after fouling also lowers duty further in practice.

Formula and method

$$\frac{1}{U_d} = \frac{1}{U_c} + R_{f,i} + R_{f,o}$$

Variables

U_c	Clean overall coefficient	W/(m²·K)
$R_{f,i}$	Fouling resistance, inside, referred to the outside area (R_fi d_o/d_i)	m²·K/W
$R_{f,o}$	Fouling resistance, outside (referred to the same area)	m²·K/W
U_d	Dirty (service) coefficient	W/(m²·K)
$A_d/A_c - 1$	Extra area needed for the same duty	-
$1 - U_d/U_c$	Duty lost at the same LMTD	-
U_d/U_c	Cleanliness factor	-

Method and standards

Resistances in series.

Assumptions and limits

- Uniform fouling.
- Both resistances on the area basis of U_c (usually the outside area): multiply an inside resistance by d_o/d_i before entering it.

References

- 1/U_d = 1/U_c + R_f
- i + R_f
- o (Kern, Process Heat Transfer)

Report details

Report reference	FCC-6RTV-RGTJ (the same inputs always give the same reference)
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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/mechanical/heat-transfer/heat-exchanger-fouling

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.