Gasketed Plate Heat Exchanger: Coefficients, U and Pressure Drop

Channel velocity, film coefficients, overall coefficient against the duty's requirement, and channel and port pressure drops of a gasketed plate heat exchanger.

Input parameters

Unit system: SI

Parameter	Value	Unit
Duty	1,000.0	kW
Log mean temperature difference	8.0000	K
Correction factor for the pass arrangement	95.000	%
Effective area of one plate	0.50000	m^2
Effective plate length	1.2000	m
Effective plate width	0.42000	m
Plate spacing (channel gap)	3.5000	mm
Channels per pass	25.000	
Passes	2.0000	
Plate thickness	0.60000	mm
Plate conductivity (titanium 21, stainless 16)	16.000	W/(m·K)
Port diameter	150.00	mm
Stream 1 flow	86,400	kg/h
Stream 1 density	990.00	kg/m^3
Stream 1 viscosity	0.60000	mPa·s
Stream 1 conductivity	0.63000	W/(m·K)
Stream 1 Prandtl number	3.9000	
Stream 1 fouling coefficient	20,000	$W/(m^2·K)$
Stream 2 flow	86,400	kg/h
Stream 2 density	998.00	kg/m^3
Stream 2 viscosity	1.0000	mPa·s
Stream 2 conductivity	0.60000	W/(m·K)
Stream 2 Prandtl number	7.0000	
Stream 2 fouling coefficient	10,000	$W/(m^2·K)$

Calculated results

Parameter	Value	Unit
Number of plates	101.00	
Heat transfer area	50.500	m^2
Overall coefficient required	2,605.5	$W/(m^2·K)$
Stream 1 channel velocity	0.65966	m/s
Stream 1 Reynolds number	7,619.0	
Stream 1 film coefficient	13,455	$W/(m^2·K)$

Parameter	Value	Unit
Stream 2 channel velocity	0.65437	m/s
Stream 2 Reynolds number	4,571.4	
Stream 2 film coefficient	11,617	W/(m²·K)
Overall coefficient (with fouling)	2,874.4	W/(m²·K)
Margin over the requirement	10.318	%
Stream 1 pressure drop (channels + ports)	0.26690	bar
Stream 2 pressure drop (channels + ports)	0.30463	bar

Notes for this case

• The general correlations Nu = 0.26 Re^0.65 Pr^0.4 and j_f = 0.60 Re^-0.3 with d_e = 2b; port losses 1.3 velocity heads per pass. Manufacturers' plate-specific correlations should be used for final design.

Formula and method

$$\frac{h_p d_e}{k_f} = 0.26\,Re^{0.65}\,Pr^{0.4}, \quad d_e = 2b, \quad j_f = 0.60\,Re^{-0.3}$$

$$\Delta P_p = 8 j_f \frac{L_p N_p}{d_e}\frac{\rho u_p^2}{2} + 1.3 N_p \frac{\rho u_{pt}^2}{2}, \quad \frac{1}{U} = \frac{1}{h_1} + \frac{1}{h_{f1}} + \frac{t_p}{k_p} + \frac{1}{h_2} + \frac{1}{h_{f2}}$$

Variables

Q	Duty	W
ΔT_{lm}	Log mean temperature difference	K
F_t	Correction factor for the pass arrangement	-
A_p	Effective area of one plate	m²
L_p	Effective plate length	m
w	Effective plate width	m
b	Plate spacing (channel gap)	m
N_c	Channels per pass	-
N_p	Passes	-
t_p	Plate thickness	m
k_p	Plate conductivity (titanium 21, stainless 16)	W/(m·K)
d_{port}	Port diameter	m
$\dot{m}_1$	Stream 1 flow	kg/s
ρ_1	Stream 1 density	kg/m³
μ_1	Stream 1 viscosity	Pa·s
k_1	Stream 1 conductivity	W/(m·K)
Pr_1	Stream 1 Prandtl number	-
$h_{f,1}$	Stream 1 fouling coefficient	W/(m²·K)
$\dot{m}_2$	Stream 2 flow	kg/s
ρ_2	Stream 2 density	kg/m³
μ_2	Stream 2 viscosity	Pa·s
k_2	Stream 2 conductivity	W/(m·K)
Pr_2	Stream 2 Prandtl number	-

$h_{f,2}$	Stream 2 fouling coefficient	W/(m²·K)
N	Number of plates	-
A	Heat transfer area	m²
U_{req}	Overall coefficient required	W/(m²·K)
u_1	Stream 1 channel velocity	m/s
Re_1	Stream 1 Reynolds number	-
h_1	Stream 1 film coefficient	W/(m²·K)
u_2	Stream 2 channel velocity	m/s
Re_2	Stream 2 Reynolds number	-
h_2	Stream 2 film coefficient	W/(m²·K)
U	Overall coefficient (with fouling)	W/(m²·K)
$U/U_{req} - 1$	Margin over the requirement	-
ΔP_1	Stream 1 pressure drop (channels + ports)	Pa
ΔP_2	Stream 2 pressure drop (channels + ports)	Pa

Method and standards

Generalised plate heat exchanger correlations for preliminary design.

Assumptions and limits

- Chevron plates with typical geometry; single-phase duties.

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

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