

LAMPIRAN

8.1 Tabel Pengamatan

Run	Waktu (menit)	Bukaan Valve	Fluida Panas (°c)		Fluida Dingin (°c)	
			Th In	Th Out	Tc In	Tc Out
1	7	1/4	50	46	29	30
2	7	1/2	50	45	29	31
3	7	3/4	50	44	29	32
4	7	4/4	50	40	29	34

8.2 Hasil Perhitungan

8.2.1 Percobaan pertama

Shell side	Tube side	Temperatur :
IDs = 10 in	IDt = 0,62 in	Th1 = 50 °C = 122 °F
B = 7	ODt = 3/4	Th2 = 46 °C = 114,8 °F
Baffle space = 6 in	BWG = 16	$\Delta Th = 4 \text{ °C} = 7,2 \text{ °F}$
Passes = 1	pitch = triangular	Tc1 = 29 °C = 84,2 °F
Pt = 0,9375	passes= 2	Tc2 = 30 °C = 86 °F
C = 0,99 (fig. 2 Kern)	C = 0,98 (fig2 Kern)	$\Delta Tc = 1 \text{ °C} = 1.8 \text{ °F}$
de = 0,045833333 ft	Nt = 12	

dimana :

$$\begin{aligned} A &= 7080 \text{ cm}^2 \\ &= 0,708 \text{ m}^2 \\ &= 7,618 \text{ ft}^2 \end{aligned}$$

$$\begin{aligned} \Delta T_{LMTD} &= \frac{(Th_1 - T_{c2}) - (Th_2 - T_{c1})}{(\ln(Th_1 - T_{c2}) / (Th_2 - T_{c1}))} \\ &= \frac{(122 - 86) - (113 - 84,2)}{(\ln(122 - 86) / (113 - 84,2))} \\ &= 33,227 \text{ }^\circ\text{F} \end{aligned}$$

1) $\Delta t =$

Hot fluid		cold fluid	Diff
122	Higher Temp	84,2	37,8
114,8	Lower Temp	86	28,8
7,2	Differences	1,8	9

$$\begin{aligned} L &= 1 \text{ m} \\ &= 3,2808399 \text{ ft} \\ &= 39,370079 \text{ in} \end{aligned}$$

$$LMTD = 32,266 \text{ }^\circ\text{F}$$

$$R = \frac{\Delta th}{\Delta tc} = \frac{7,2}{1,8} = 4$$

$$S = \frac{\Delta tc}{th_1 - tc_2} = \frac{1,8}{122 - 114,8} = 0,50$$

$$F_t = 0,98 \text{ (Fig 18 Kern)}$$

$$\begin{aligned}\Delta t &= F_t \times \Delta T_{LMTD} \\ &= 0,98 \times 32,227 \text{ }^\circ\text{F} \\ &= 31,621 \text{ }^\circ\text{F}\end{aligned}$$

Tube

$$\text{Rumus } T_{f_c} = \frac{T_{c \text{ out}} + T_{c \text{ in}}}{2}$$

$$T_{f_c} = \frac{(86+84,2)}{2} = 85,1 \text{ F}$$

Perhitungan C_p aliran dingin (C_{p_c}) dengan menggunakan interpolasi

$$\text{Rumus } C_{p_c} = \frac{T_{\text{diketahui}} - T_{\text{atas}}}{T_{\text{bawah}} - T_{\text{atas}}} ((C_{p_{\text{atas}}} - C_{p_{\text{bawah}}}) + C_{p_{\text{bawah}}})$$

$$\begin{aligned}C_{p_c} &= \frac{(685,1-80)\text{F}}{(90-80)\text{F}} ((4,174-4,179)+4,179) \text{ KJ/kg F} \\ &= 2,04281 \text{ KJ/kg F}\end{aligned}$$

$$m_c = 43 \text{ kg/jam}$$

Perhitungan kapasitas panas aliran dingin (C_c)

$$\text{Rumus } C_c = m_c \times C_{p_c}$$

$$\begin{aligned}C_c &= 43 \text{ kg/jam} \times 2,04281 \text{ Btu/kg F} \\ &= 87 \text{ Btu/jam F}\end{aligned}$$

Perhitungan laju perpindahan panas aliran dingin (Q_c)

$$\text{Rumus } Q_c = m_c \times C_c \times \Delta T_c$$

$$\begin{aligned}Q_c &= 43 \text{ kg/jam} \times 87 \text{ Btu/jam F} \times 32,562 \text{ }^\circ\text{F} \\ &= 119437.1 \text{ btu kg/jam}\end{aligned}$$

Perhitungan untuk mencari koefisien overall (Ud)

$$\text{Rumus} \quad = A \times UD \times \Delta T_{LMTD}$$

$$UD \quad = \frac{Q}{A \times \Delta T_{LMTD}}$$

$$UD \quad = \frac{119437,1}{7,618 \times 33,227}$$

$$UD \quad = 485.8984 \text{ btu kg /jamft}^2 \text{ } ^\circ\text{F}$$

$$UD \text{ Desain} \quad = 500 \text{ btu kg /jamft}^2 \text{ } ^\circ\text{F}$$

Shell

Perhitungan temperature aliran panas rata-rata (T_{fh})

$$\text{Rumus } T_{fh} = \frac{T_{h \text{ in}} + T_{h \text{ out}}}{2}$$

$$T_{fh} = \frac{(114,8 + 122)}{2} = 118,4 \text{ F}$$

Perhitungan Cp aliran panas (C_{ph}) dengan menggunakan interpolasi

$$\text{Rumus } C_{ph} = \frac{T_{diketahui} - T_{atas}}{T_{bawah} - T_{atas}} ((C_{p_{atas}} - C_{p_{bawah}}) + C_{p_{bawah}})$$

$$C_{pc} = \frac{(118,4 - 100)F}{(130 - 100)F} ((4,174 - 4,179) + 4,179) \text{ btu/kg F}$$

$$= 2,560053 \text{ btu/kg F}$$

$$m_h = 38,3 \text{ kg/det}$$

Perhitungan kapasitas panas aliran panas (C_h)

$$\text{Rumus } C_h = m_h \times C_{ph}$$

$$C_h = 38,3 \text{ kg/jam} \times 2,560053 \text{ btu/kg F}$$

$$= 98,05004 \text{ btu/jam F}$$

Perhitungan laju perpindahan panas aliran panas (Q_h)

$$\text{Rumus } Q_h = m_h \times C_h \times \Delta T_h$$

$$\begin{aligned} Q_h &= 38,3 \text{ kg/jam} \times 98,05004 \text{ btu/jam F} \times 32,562 \text{ }^\circ\text{F} \\ &= 122282 \text{ btu/jam} \end{aligned}$$

Perhitungan untuk mencari koefisien overall (U_d)

$$\text{Rumus} \quad = A \times U_D \times \Delta T_{LMTD}$$

$$U_D = \frac{Q}{A \times \Delta T_{LMTD}}$$

$$U_D = \frac{122282}{7,618 \times 33,227}$$

$$U_D = 483.089 \text{ btu kg /jamft}^2 \text{ }^\circ\text{F}$$

$$U_D \text{ Desain} = 500 \text{ btu kg /jamft}^2 \text{ }^\circ\text{F}$$

8.2.2 Percobaan Kedua

Shell side	Tube side	Temperatur :
IDs = 10 in	IDt = 0,62 in	Th1 = 50 °C = 122 °F
B = 7	ODt = ¾	Th2 = 45 °C = 113 °F
Baffle space = 6 in	BWG = 16	ΔTh = 5 °C = 9 °F
Passes = 1	pitch = triangular	Tc1 = 29 °C = 84,2 °F
Pt = 0,9375	passes= 2	Tc2 = 31 °C = 87,8 °F
C = 0, 99 (fig. 2 Kern)	C = 0,98 (fig2 Kern)	ΔTc = 2 °C = 3,6 °F
de = 0,0458 ft	Nt = 12	

$$\begin{aligned}
 A &= 7080 \text{ cm}^2 \\
 &= 0,708 \text{ m}^2 \\
 &= 7,618 \text{ ft}^2
 \end{aligned}$$

$$\begin{aligned}
 \Delta T_{LMTD} &= \frac{(T_{h1}-T_{c2})-(T_{h2}-T_{c1})}{(\ln(T_{h1}-T_{c2})/(T_{h2}-T_{c1}))} \\
 &= \frac{(122-87,8)-(113-84,2)}{(\ln(122-87,8)/(113-84,2))} \\
 &= 31,423 \text{ }^\circ\text{F}
 \end{aligned}$$

2) $\Delta t =$

	Hot fluid		cold fluid	Diff
	122	Higher Temp	84,2	37,8
	113	Lower Temp	87,8	25,2
	9	Differences	3,6	12,6

$$\begin{aligned}
 L &= 1 \text{ m} \\
 &= 3,2808399\text{ft} \\
 &= 39,370079 \text{ in}
 \end{aligned}$$

$$LMTD = 31,423 \text{ }^\circ\text{F}$$

$$R = \frac{\Delta t_h}{\Delta t_c} = \frac{9}{3,6} = 2$$

$$S = \frac{\Delta t_c}{t_{h1}-t_{c2}} = \frac{3,6}{122-87,8} = 0,105$$

$$F_t = 0,98 \text{ (Fig 18 Kern)}$$

$$\Delta t = F_t \times \Delta T_{LMTD}$$

$$= 0,98 \times 31,423 \text{ } ^\circ\text{F}$$

$$= 30,794 \text{ } ^\circ\text{F}$$

1. Perhitungan temperature aliran dingin rata-rata (T_{fc})

$$\text{Rumus } T_{fc} = \frac{T_{c \text{ out}} + T_{c \text{ in}}}{2}$$

Tube

$$T_{fc} = \frac{(87,8 + 84,2)}{2} = 86 \text{ F}$$

Perhitungan C_p aliran dingin (C_{pc}) dengan menggunakan interpolasi

$$\text{Rumus } C_{pc} = \frac{T_{\text{diketahui}} - T_{\text{atas}}}{T_{\text{bawah}} - T_{\text{atas}}} ((C_{p_{\text{atas}}} - C_{p_{\text{bawah}}}) + C_{p_{\text{bawah}}})$$

$$C_{pc} = \frac{(86 - 90)_{\text{F}}}{(80 - 90)_{\text{F}}} ((4,174 - 4,179) + 4,179) \text{ Btu/kg F}$$

$$= 1,6676 \text{ Btu/kg F}$$

$$m_c = 47,2 \text{ kg/jam}$$

Perhitungan kapasitas panas aliran dingin (C_c)

$$\text{Rumus } C_c = m_c \times C_{pc}$$

$$C_c = 47,2 \text{ kg/jam} \times 1,6676 \text{ btu/kg F}$$

$$= 78,71072 \text{ Btu/jam F}$$

Perhitungan laju perpindahan panas aliran dingin (Q_c)

$$\text{Rumus } Q_c = m_c \times C_c \times \Delta T_c$$

$$Q_c = 47,2 \text{ kg/jam} \times 78,71072 \text{ Btu/jam F} \times 30,794 \text{ } ^\circ\text{F}$$

$$= 110893,9 \text{ Btu kg/jam}$$

Perhitungan untuk mencari koefisien overall (Ud)

$$\text{Rumus} = A \times U_D \times \Delta T_{LMTD}$$

$$U_D = \frac{Q}{A \times \Delta T_{LMTD}}$$

$$U_D = \frac{110893,9}{7,618 \times 31,423}$$

$$U_D = 477,9213 \text{ btu/jamft}^2 \text{ } ^\circ\text{F}$$

$$U_D \text{ Desain} = 500 \text{ btu/jamft}^2 \text{ } ^\circ\text{F}$$

Shell

Perhitungan temperature aliran panas rata-rata (T_{fh})

$$\text{Rumus } T_{fh} = \frac{T_{h \text{ in}} + T_{h \text{ out}}}{2}$$

$$T_{fh} = \frac{(113+122)}{2} = 117,5 \text{ F}$$

Perhitungan Cp aliran panas (C_{ph}) dengan menggunakan interpolasi

$$\text{Rumus } C_{ph} = \frac{T_{diketahui} - T_{atas}}{T_{bawah} - T_{atas}} ((C_{p_{atas}} - C_{p_{bawah}}) + C_{p_{bawah}})$$

$$C_{pc} = \frac{(117,5 - 100)F}{(130 - 100)F} ((4,174 - 4,179) + 4,179) \text{ btu/kg F}$$

$$= 2,434833 \text{ btu/kg F}$$

$$m_h = 39 \text{ kg/jam}$$

Perhitungan kapasitas panas aliran panas (C_h)

$$\text{Rumus } C_h = m_h \times C_{ph}$$

$$C_h = 39 \text{ kg/jam} \times 2,434833 \text{ btu/kg F}$$

$$= 94.9585 \text{ btu/jam F}$$

Perhitungan laju perpindahan panas aliran panas (Q_h)

$$\text{Rumus } Q_h = m_h \times C_h \times \Delta T_h$$

$$\begin{aligned}
 Q_h &= 39 \text{ kg/jam} \times 94,9585 \text{ btu/jam F} \times 30,794 \text{ }^\circ\text{F} \\
 &= 114042,9 \text{ btu/jam}
 \end{aligned}$$

Perhitungan untuk mencari koefisien overall (Ud)

$$\begin{aligned}
 \text{Rumus} &= A \times U_D \times \Delta T_{LMTD} \\
 U_D &= \frac{Q}{A \times \Delta T_{LMTD}} \\
 U_D &= \frac{114042,9}{7,618 \times 31,423} \\
 U_D &= 476,4079 \text{ btu kg /jamft}^2 \text{ }^\circ\text{F} \\
 U_D \text{ Desain} &= 500 \text{ btu kg /jamft}^2 \text{ }^\circ\text{F}
 \end{aligned}$$

8.2.2 Percobaan Ketiga

Shell side	Tube side	Temperatur :
IDs = 10 in	IDt = 0,62 in	Th1 = 50 °C = 122 °F
B = 7	ODt = $\frac{3}{4}$	Th2 = 44 °C = 111,2 °F
Baffle space = 6 in	BWG = 16	$\Delta T_h = 6 \text{ }^\circ\text{C} = 10,8 \text{ }^\circ\text{F}$
Passes = 1	pitch = triangular	Tc1 = 29 °C = 84,2 °F
Pt = 0,9375	passes= 2	Tc2 = 32 °C = 89,6 °F
C = 0,99 (fig. 2 Kern)	C = 0,98 (fig2 Kern)	$\Delta T_c = 3 \text{ }^\circ\text{C} = 5,4 \text{ }^\circ\text{F}$
de = 0,045833333 ft	Nt = 12	

$$\begin{aligned}
 A &= 7080 \text{ cm}^2 \\
 &= 0,708 \text{ m}^2
 \end{aligned}$$

$$= 7,618 \text{ ft}^2$$

$$\begin{aligned} \Delta T_{LMTD} &= \frac{(T_{h1}-T_{c2})-(T_{h2}-T_{c1})}{(\ln(T_{h1}-T_{c2})/(T_{h2}-T_{c1}))} \\ &= \frac{(122-89,6)-(111,2-84,2)}{(\ln(122-89,6)/(111,2-84,2))} \\ &= 29,618 \text{ }^\circ\text{F} \end{aligned}$$

3) $\Delta t =$

Hot fluid		cold fluid	Diff
122	Higher Temp	84,2	37,8
111,2	Lower Temp	89,6	19,8
10,8	Differences	5,4	18

$$L = 1 \text{ m}$$

$$= 3,2808399\text{ft}$$

$$= 39,370079 \text{ in}$$

$$LMTD = 29,618 \text{ }^\circ\text{F}$$

$$R = \frac{\Delta t_h}{\Delta t_c} = \frac{12,6}{5,4} = 2$$

$$S = \frac{\Delta t_c}{t_{h1}-t_{c2}} = \frac{5,4}{122-89,6} = 0,167$$

$$F_t = 0,98 \text{ (Fig 18 Kern)}$$

$$\Delta t = F_t \times \Delta T_{LMTD}$$

$$= 0,98 \times 29,618 \text{ }^\circ\text{F}$$

$$= 29,026^\circ\text{F}$$

Tube

Perhitungan temperature aliran dingin rata-rata (T_{fc})

$$\text{Rumus } T_{fc} = \frac{T_{c \text{ out}} + T_{c \text{ in}}}{2}$$

$$T_{fc} = \frac{(89,6 + 84,2)}{2} = 86,9 \text{ F}$$

Perhitungan C_p aliran dingin (C_{pc}) dengan menggunakan interpolasi

$$\text{Rumus } C_{pc} = \frac{T_{\text{diketahui}} - T_{\text{atas}}}{T_{\text{bawah}} - T_{\text{atas}}} ((C_{p_{\text{atas}}} - C_{p_{\text{bawah}}}) + C_{p_{\text{bawah}}})$$

$$C_{pc} = \frac{(86,9 - 90)F}{(80 - 90)F} ((4,174 - 4,179) + 4,179) \text{ Btu/kg F}$$

$$= 1,29239 \text{ btu/kg F}$$

$$m_c = 53,14 \text{ kg/jam}$$

Perhitungan kapasitas panas aliran dingin (C_c)

$$\text{Rumus } C_c = m_c \times C_{pc}$$

$$C_c = 53,14 \text{ kg/jam} \times 1,29239 \text{ btu/kg F}$$

$$= 68,6776 \text{ btu/jam F}$$

Perhitungan laju perpindahan panas aliran dingin (Q_c)

$$\text{Rumus } Q_c = m_c \times C_c \times \Delta T_c$$

$$Q_c = 53,14 \text{ kg/jam} \times 68,6776 \text{ btu/jam F} \times 29,026 \text{ }^\circ\text{F}$$

$$= 102465,5 \text{ btu/jam}$$

Perhitungan untuk mencari koefisien overall (U_d)

$$\text{Rumus } = A \times U_D \times \Delta T_{LMTD}$$

$$\begin{aligned}
 UD &= \frac{Q}{A \times \Delta T_{LMTD}} \\
 UD &= \frac{102456,5}{7,618 \times 29,618} \\
 UD &= 469,4802 \text{ btu kg/jamft}^2 \text{ } ^\circ\text{F} \\
 UD \text{ Desain} &= 500 \text{ btu kg/jamft}^2 \text{ } ^\circ\text{F}
 \end{aligned}$$

Shell

Perhitungan temperature aliran panas rata-rata (T_{fh})

$$\text{Rumus } T_{fh} = \frac{T_{h \text{ in}} + T_{h \text{ out}}}{2}$$

$$T_{fh} = \frac{(111,2 + 122)}{2} = 116,6 \text{ F}$$

Perhitungan C_p aliran panas (C_{p_h}) dengan menggunakan interpolasi

$$\text{Rumus } C_{p_h} = \frac{T_{\text{diketahui}} - T_{\text{atas}}}{T_{\text{bawah}} - T_{\text{atas}}} ((C_{p_{\text{atas}}} - C_{p_{\text{bawah}}}) + C_{p_{\text{bawah}}})$$

$$\begin{aligned}
 C_{p_c} &= \frac{(116,6 - 100)^\circ\text{F}}{(130 - 100)^\circ\text{F}} ((4,174 - 4,179) + 4,179) \text{ btu/kg F} \\
 &= 2,309613 \text{ btu/kg F}
 \end{aligned}$$

$$m_h = 40 \text{ kg/jam}$$

Perhitungan kapasitas panas aliran panas (C_h)

$$\text{Rumus } C_h = m_h \times C_{p_h}$$

$$\begin{aligned}
 C_h &= 45 \text{ kg/jam} \times 2,309613 \text{ btu/kg F} \\
 &= 92,38453 \text{ btu/jam F}
 \end{aligned}$$

Perhitungan laju perpindahan panas aliran panas (Q_h)

$$\text{Rumus } Q_h = m_h \times C_h \times \Delta T_h$$

$$\begin{aligned}
 Q_h &= 45 \text{ kg/jam} \times 92,38453 \text{ btu/jam F} \times 29,026 \text{ F} \\
 &= 107260,8 \text{ btu/jam}
 \end{aligned}$$

Perhitungan untuk mencari koefisien overall (Ud)

$$\text{Rumus} = A \times U_D \times \Delta T_{LMTD}$$

$$U_D = \frac{Q}{A \times \Delta T_{LMTD}}$$

$$U_D = \frac{107260,8}{7,618 \times 29,618}$$

$$U_D = 475,3788 \text{ btu kg /jamft}^2 \text{ } ^\circ\text{F}$$

$$U_D \text{ Desain} = 500 \text{ btu kg /jamft}^2 \text{ } ^\circ\text{F}$$

8.2.4 Percobaan Keempat

Shell side	Tube side	Temperatur :
IDs = 10 in	IDt = 0,62 in	Th1 = 50 °C = 112 °F
B = 7	ODt = ¾	Th2 = 40 °C = 104 °F
Baffle space = 6 in	BWG = 16	ΔTh = 10 °C = 18 °F
Passes = 1	pitch = triangular	Tc1 = 29 °C = 84,2 °F
Pt = 0,9375	passes= 2	Tc2 = 34 °C = 93,2 °F
C = 0, 99 (fig. 2 Kern)	C = 0,98 (fig2 Kern)	ΔTc = 5 °C = 9 °F
de = 0,045833333 ft	Nt = 12	

$$A = 7080 \text{ cm}^2$$

$$= 0,708 \text{ m}^2$$

$$= 7,618 \text{ ft}^2$$

$$\Delta T_{LMTD} = \frac{(Th1 - Tc2) - (Th2 - Tc1)}{\ln(Th1 - Tc2) / (Th2 - Tc1)}$$

$$= \frac{(122 - 93,2) - (104 - 84,2)}{\ln(122 - 93,2) / (104 - 84,2)}$$

$$= 24,020 \text{ } ^\circ\text{F}$$

4) $\Delta t =$

Hot fluid		cold fluid	Diff
122	Higher Temp	84,2	37,8
104	Lower Temp	93,2	10,8
18	Differences	9	27

$$L = 1 \text{ m}$$

$$= 3,2808399\text{ft}$$

$$= 39,370079 \text{ in}$$

$$\text{LMTD} = 24,020 \text{ }^\circ\text{F}$$

$$R = \frac{\Delta th}{\Delta tc} = \frac{18}{198} = 2$$

$$S = \frac{\Delta tc}{th1 - tc2} = \frac{9}{122 - 93,2} = 0,313$$

$$F_t = 0,98 \text{ (Fig 18 Kern)}$$

$$\Delta t = F_t \times \Delta \text{TLMTD}$$

$$= 0,98 \times 24,020 \text{ }^\circ\text{F}$$

$$= 23,539 \text{ }^\circ\text{F}$$

Tube

Perhitungan temperature aliran dingin rata-rata (T_{fc})

$$\text{Rumus } T_{fc} = \frac{T_{c \text{ out}} + T_{c \text{ in}}}{2}$$

$$T_{fc} = \frac{(91,4 + 84,2)}{2} = 87,8 \text{ F}$$

Perhitungan C_p aliran dingin (C_{p_c}) dengan menggunakan interpolasi

$$\text{Rumus } C_{p_c} = \frac{T_{\text{diketahui}} - T_{\text{atas}}}{T_{\text{bawah}} - T_{\text{atas}}} ((C_{p_{\text{atas}}} - C_{p_{\text{bawah}}}) + C_{p_{\text{bawah}}})$$

$$\begin{aligned} C_{p_c} &= \frac{(87,8 - 90)F}{(80 - 90)F} ((4,174 - 4,179) + 4,179) \text{ btu/kg F} \\ &= 0,91718 \text{ btu/kg F} \end{aligned}$$

$$m_c = 60 \text{ kg/jam}$$

Perhitungan kapasitas panas aliran dingin (C_c)

$$\text{Rumus } C_c = m_c \times C_{p_c}$$

$$\begin{aligned} C_c &= 60 \text{ kg/jam} \times 0,91718 \text{ btu/kg F} \\ &= 55,0308 \text{ btu/jam F} \end{aligned}$$

Perhitungan laju perpindahan panas aliran dingin (Q_c)

$$\text{Rumus } Q_c = m_c \times C_c \times \Delta T_c$$

$$\begin{aligned} Q_c &= 60 \text{ kg/jam} \times 55,0308 \text{ btu/jam F} \times 23,539 \text{ }^\circ\text{F} \\ &= 81648,41 \text{ btu kg/jam} \end{aligned}$$

Perhitungan untuk mencari koefisien overall (U_d)

$$\text{Rumus } = A \times U_d \times \Delta T_{LMTD}$$

$$U_d = \frac{Q}{A \times \Delta T_{LMTD}}$$

$$U_d = \frac{86846,69}{7,618 \times 24,020}$$

$$U_d = 446.2064 \text{ btu kg/jamft}^2 \text{ }^\circ\text{F}$$

$$U_d \text{ Desain} = 500 \text{ btu kg/jamft}^2 \text{ }^\circ\text{F}$$

Shell

Perhitungan temperature aliran panas rata-rata (T_{fh})

$$\text{Rumus } T_{fh} = \frac{T_{h \text{ in}} + T_{h \text{ out}}}{2}$$

$$T_{fh} = \frac{(122+104)}{2} = 113 \text{ F}$$

Perhitungan C_p aliran panas (C_{p_h}) dengan menggunakan interpolasi

$$\text{Rumus } C_{p_h} = \frac{T_{\text{diketahui}} - T_{\text{atas}}}{T_{\text{bawah}} - T_{\text{atas}}} ((C_{p_{\text{atas}}} - C_{p_{\text{bawah}}}) + C_{p_{\text{bawah}}})$$

$$\begin{aligned} C_{p_c} &= \frac{(113-100)F}{(130-100)F} ((4,174-4,179)+4,179) \text{ btu/kg F} \\ &= 1,808733 \text{ btu/kg F} \end{aligned}$$

$$m_h = 45 \text{ kg/det}$$

Perhitungan kapasitas panas aliran panas (C_h)

$$\text{Rumus } C_h = m_h \times C_{p_h}$$

$$\begin{aligned} C_h &= 45 \text{ kg/jam} \times 1,808733 \text{ btu/kg F} \\ &= 81,393 \text{ btu/jam F} \end{aligned}$$

Perhitungan laju perpindahan panas aliran panas (Q_h)

$$\text{Rumus } Q_h = m_h \times C_h \times \Delta T_h$$

$$\begin{aligned} Q_h &= 45 \text{ kg/jam} \times 81,393 \text{ btu/jam F} \times 23,539 \text{ }^\circ\text{F} \\ &= 86216,83 \text{ btu/jam} \end{aligned}$$

Perhitungan untuk mencari koefisien overall (U_d)

$$\text{Rumus } = A \times U_D \times \Delta T_{LMTD}$$

$$U_D = \frac{q}{A \times \Delta T_{LMTD}}$$

$$UD = \frac{86216,83}{7,618 \times 24,020}$$

$$UD = 471,1727 \text{ btu kg/jamft}^2 \text{ } ^\circ\text{F}$$

$$UD \text{ Desain} = 500 \text{ btu kg/jamft}^2 \text{ } ^\circ\text{F}$$