LAMPIRAN

Perhitungan Perancangan Heat Exchanger

Shell side		Tube side		Temperatur :	
IDs	= 10 in	IDt	= 0,62 in	Th1 = 60^{O}C	140^{O}F
B	= 7	ODt	= ¾	Th2 = 36^{O}C	96,8^{O}F
Baffle space	= 6 in	BWG	= 16	Th1 = 24^{O}C	43,2 ^{O}F
Passes	= 1	pitch	= triangular	Tc1 = 28^{O}C	82,4^{O}F
Pt	= 0,9375	passes	= 2	Tc2 = 36^{O}C	96,8^{O}F
C	=0,99(fig.2 Kern)	C	=0,98(fig2 Kern)	ΔTc = 8 ^{O}C	14,4 ^{O}
de	=0,045833333 ft	Nt	= 12		

Shell

1. Heat Balance :

$$\Delta T_{LMTD} = \frac{\Delta T1 - \Delta T2}{ln\,\Delta t1/\Delta t2}$$

$$= \frac{43,2 - 14,4}{\ln\left(\frac{43,2}{14,4}\right)}$$

= 26,215 ^{o} F

Q = 67900,423 Btu/jam

Q shell = W x C(Th1-Th2)

W shell = Q/C(Th1-Th2)

= 67900,423 / (0,99 x 43,2 ^{o}F)

= 1587,646lb/jam

Q tube = W x C(Th1-Th2)

W tube = Q/C(Th1-Th2)

= 67900,423 / (0,98 x 14,4 ^{o}F)

= 4811,538lb/jam

2. Δt =

Hot Fluid		Cold Fluid	Differential
140	Higher Temp	82,4	57,6
96,8	Lower Temp	96,8	0
43,2	Diffrential	14,4	57,6

L = 1 m

= 3,2808399 ft

= 39,370079 in

LMTD = 26,215^{o}F

R = $\frac{43,2}{14,4}$

= 3

S = $\frac{14,4}{140 - 96,8}$

= 0,333

Ft = 0,98 (Fig 18 Kern)

Δt = Ft x ΔTLMTD

= 0,98 x 26,215^{o}F

= 25,691^{o}F

Shell

3. Hot Fluid; shell side, water
4. As = ID x C'B / 144Pt

dengan C' = Pt – OD

= 0,9375 – ¾

= 0,188 in

B = L/b

$= \frac{39{,}370079 \text{ in}}{6\ in}$

= 7

As = ID x C'B / 144Pt

= 10 in x 0,188 x (7 / 144) x 0,9375

= 0,091 ft^2

5. Gs = W/as

= 1587,646lb/jam / 0,091 ft^2

= 17.446,66 lb/jam ft^2

6. At Ta = (Th1 +Th2) /2

= (140^oF + $96{,}8^oF$) / 2

= $118{,}4^oF$

7. Ds = IDs/12

= 10 in / 12

= 0,833 ft

8. Res = (Ds x Gs) / µ

= (0,833 ft x 17.446,66 lb/jam ft^2) / 0,8712 lb/jam ft

= 16.681,667 (Turbulen)

9. jH = 380 (fig 28 Kern)

10. At Ta = 118,4^{o}F

c = 1 Btu/lb °F

k = 0.898 Btu/(jam)(ft2)(°F/ft) (Tabel 4 Kern)

$(c\mu/k)^{(1/3)}$ = $(0,99 \times 0,8712/0,898)^{(1/3)}$

= 0,98664

11. ho = jH x k/de x $(c\mu/k)^{(1/3)}$

=380x0,898 Btu/(jam)(ft^2)(°F) / (0,045833333 ft) x 0,98664)

= 90552,580 Btu/jam ft^{2o}F

Tube

3. Cold Fluid; tube side, water
4. a't = 0,302 in^2 (table 10 Kern)

   at = Ntxa't / 144xn

$= 12 \times (0{,}302\ in^2 /144) \times 2$

$= 0{,}0503\ ft^2$

5. Gt = w/at

$= 4811{,}538 lb/jam / 0{,}0503\ ft^2$

$= 95.656{,}82\ lb/jamft^2$

vel, v = $Gt/3600_{\varrho}$

= 95.656,82 lb/jam /

(3600 X62,5)

= 0,425 ft/sec

6. At ta = (Tc1+Tc2) / 2

= (82,4°F + 96,8 °F) / 2

= 89,6 °F

µ = ((0,95.2,42)+(0,8.2,42))/2

= 0,8712lb/jamft

= 2,118 lb/jamft(fig. 14)

µ = ((0,35.2,42)+(0,37.2,42))/2

= 0,8712lb/jamft

7. D = IDt/12

= 0,62/12

= 0,052 ft

8. Ret = D x Gt/µ

= 0,052 ft x 95.656,82 lb/jamft^2/ 2,118 lb/jamft

= 2.348,5150 (laminar)

9. hi = 415 Btu/jam (ft2) (°F) (fig 25 kern)

10. hio = hi x ID/OD

= 415 Btu/jam (ft2) (°F) x (0,62 in / ¾)

= 343,067

12) Clean overall (Uc) = hio x ho/hio + ho

= (343,067 x 90552,580) / (343,067 + 90552,580)

= 341,772 Btu/(jam)(ft^2)(°F)

13) Design overall coefficient U_D :

U_D = 340 btu/jam ft^2 °F didapat dari tabel.8 Kern

$U_D = \frac{Q}{A \, \Delta T}$

340 btu/jam ft^2 °F $= \frac{67900{,}423 \frac{\text{Btu}}{\text{jam}}}{A \; 26{,}215\,°\text{F}}$

A $= \frac{67900{,}423 \text{ Btu /jam}}{340 \text{ btu /jam ft2 oF.26,215 o F}}$

A = 7,618 ft^2

14) Rd = Uc-UD / UcxUD

= (341,772– 340) / (341,772x 340)

= 0,00002 (hr))(ft^2)(°F) / Btu

Summary

90552,580	h outside	343,067
Uc	341,772	
U_D	340	
Rd Calculated	0.00002	
Rd Required	0.001	

Pressure Drop

Shell

1) Res = 16.681,667

f = 0.001 ft/in^2

2) No. of crosses, N + 1 = 12L/B

= 12 x 6,56167979

= 78,74

Ds = 10/12

= 0,833 ft

3) ΔPs = (f x Gs^2 x Ds x (N+1)) / (5,22 x 10^{10} x Ds x Ǿs)

$= ((0,001 \times (17.446,66 \text{ lb/jam ft}^2)^2 \times 0,833 \times 78,74)) / (5,22 \times 10^{10} \times 0,833 \times 1)$

$= 0,000$ psi

Tube

1) Ret $= 2.348,5150$

$= 0,00015 \text{ ft}^2 / \text{in}^2$

2) ΔPt $= (f \times Gt^2 \times L \times n) / (5,22 \times 10^{10} \times Ds \times Ǿt)$

$= ((0,00015 \times (95.656,82)^2 \times 1 \times 2) / (5,22 \times 10^{10} \times 0,052 \times 1)$

$= 0,001$ psi

3) Gt $= 95.656,82 \text{ lb/jamft}^2$

$V^2/2G' = 0,03$

4) ΔPr $= 4\ n/s\ (v^2/2G')$

$= 4 \times (2/1) \times 0,03$

$= 0,24$ psi

ΔPT $= \Delta Pt + \Delta Pr$

$= 0,001 + 0,24$

$= 0,241$ psi