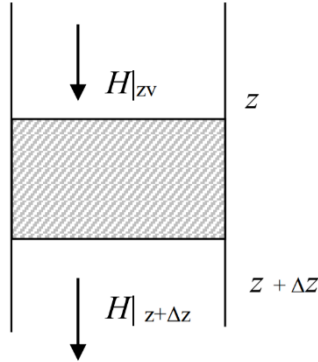


BAB VI

NERACA PANAS

Persamaan neraca panas pada elemen volume



Heat of input – heat of output – heat of generation – heat transfer = Acc

$$H_{A|z} - H_{A|z + \Delta z} + (-r_A) \cdot \Delta H_R \cdot V - U d \cdot N t \cdot \Delta z \cdot \pi \cdot O D \cdot (T - T_p) = 0$$

$$H_{A|z} - H_{A|z + \Delta z} + (-r_A) \cdot \Delta H_R \cdot \frac{\pi}{4} \cdot I D^2 \cdot \Delta z \cdot N t - U d \cdot N t \cdot \Delta z \cdot \pi \cdot O D \cdot (T - T_p) = 0$$

$$H_{A|z} - H_{A|z + \Delta z} = -(-r_A) \cdot \Delta H_R \cdot \frac{\pi}{4} \cdot I D^2 \cdot \Delta z \cdot N t - U d \cdot N t \cdot \Delta z \cdot \pi \cdot O D \cdot (T - T_p)$$

$$\frac{H_{A|z} - H_{A|z + \Delta z}}{\Delta z} = -(-r_A) \cdot \Delta H_R \cdot \frac{\pi}{4} \cdot I D^2 \cdot N t - U d \cdot N t \cdot \pi \cdot O D \cdot (T - T_p)$$

$$\lim_{\Delta z \rightarrow 0} \frac{H_{A|z} - H_{A|z + \Delta z}}{\Delta z} = -(-r_A) \cdot \Delta H_R \cdot \frac{\pi}{4} \cdot I D^2 \cdot N t - U d \cdot N t \cdot \pi \cdot O D \cdot (T - T_p)$$

$$-\frac{dH}{dz} = -(-r_A) \cdot \Delta H_R \cdot \frac{\pi}{4} \cdot I D^2 \cdot N t - U d \cdot N t \cdot \pi \cdot O D \cdot (T - T_p)$$

$$\frac{dH}{dz} = -(-r_A) \cdot \Delta H_R \cdot \frac{\pi}{4} \cdot I D^2 \cdot N t - U d \cdot N t \cdot \pi \cdot O D \cdot (T - T_p)$$

Dimana :

$$H = Q = \sum F_i \cdot C_{pi} \cdot (T - T_{ref})$$

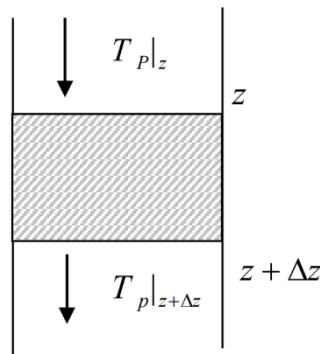
$$dH = \sum F_i \cdot C_{pi} \cdot dT$$

Sehingga :

$$\sum F_i \cdot C_{pi} \cdot \frac{dT}{dz} = (-r_A) \cdot \Delta H_R \cdot \frac{\pi}{4} \cdot I D^2 \cdot N t - U d \cdot N t \cdot \pi \cdot O D \cdot (T - T_p)$$

$$\frac{dT}{dz} = \frac{F_{A0} \cdot (\Delta H_R) \cdot \frac{dx}{dz} - U d \cdot N t \cdot \pi \cdot O D \cdot (T - T_p)}{\sum F_i \cdot C_{pi}} \dots \dots \dots (2)$$

Persamaan neraca panas pendingin



Heat of input – heat of output + heat transfer = Acc

$$Wp.Cp_p.Tp|_z - Wp.Cp_p.Tp|_{z+\Delta z} + Ud.Nt.\Delta z.\pi.OD.(T - T_p) = 0$$

$$Wp.Cp_p.Tp|_z - Wp.Cp_p.Tp|_{z+\Delta z} = -Ud.Nt.\Delta z.\pi.OD.(T - T_p)$$

$$\frac{Wp.Cp_p.Tp|_z - Wp.Cp_p.Tp|_{z+\Delta z}}{\Delta z} = -Ud.Nt.\Delta z.\pi.OD.(T - T_p)$$

$$\lim_{\Delta z \rightarrow 0} \frac{Wp.Cp_p.Tp|_z - Wp.Cp_p.Tp|_{z+\Delta z}}{\Delta z} = -Ud.Nt.\Delta z.\pi.OD.(T - T_p)$$

$$-\frac{dT_p}{dz} = -\frac{Ud.Nt.\Delta z.\pi.OD.(T - T_p)}{Wp.Cp_p}$$

$$\frac{dT_p}{dz} = \frac{Ud.Nt.\Delta z.\pi.OD.(T - T_p)}{Wp.Cp_p} \dots\dots\dots(3)$$

Pressure drop

Pada reaktor, pressure drop dicari menggunakan persamaan Ergun (Fogler, p.159)

$$\frac{dP}{dz} = -\frac{Gt}{\rho_g.g.D_p} \cdot \frac{1-\epsilon}{\epsilon^3} \cdot \left[\frac{150.(1-\epsilon).\mu}{D_p} + 1.75.Gt \right] \dots\dots\dots(4)$$

Persamaan 1,2,3, dan 4 adalah persamaan diferensial simultan sehingga untuk menyelesaikannya membutuhkan metode Euler, maka diperoleh konversi reaksi, panjang reaktor, suhu reaksi keluar, dan suhu pendingin keluar.

1. Reaktor *Fixed Bed Multitube*

Tabel 6.1. Neraca Panas pada Reaktor *Fixed Bed Multitube*

Panas Masuk (kJ/jam)		Panas Keluar (kJ/jam)	
Arus 6b	11.919.328,728	Arus 7	10.077.566,768
Panas yang ditambahkan	-2.117.255,899	Panas reaksi	-275.493,939
Total	9.802.072,829	Total	9.802.072,829

2. Separator-01

Tabel 6.2. Neraca Panas pada Separator-01

Panas Masuk (kJ/jam)		Panas Keluar (kJ/jam)	
Arus 7c	-1.236.769,832	Arus 8	752.608,336
		Arus 10	1.022.983,332
		Panas yang diambil	-3.012.361,500
Total	-1.236.769,832	Total	-1.236.769,832

3. Separator-02

Tabel 6.3. Neraca Panas pada Separator-02

Panas Masuk (kJ/jam)		Panas Keluar (kJ/jam)	
Arus 10c	-484.664,807	Arus 11	45.662,053
		Arus 12	875.770,202
		Panas yang diambil	-1.406.097,061
Total	-484.664,807	Total	-484.664,807

4. Adsorber-01

Tabel 6.4. Neraca Panas pada Adsorber-01

Panas Masuk (kJ/jam)		Panas Keluar (kJ/jam)	
	803.081,262	Arus 9	780.838,133

Arus 8 & Arus 11c		Panas yang hilang	22.243,129
Total	803.081,262	Total	803.081,262

5. Adsorber-02

Tabel 6.5. Neraca Panas pada Adsorber-02

Panas Masuk (kJ/jam)		Panas Keluar (kJ/jam)	
Arus 8 & Arus 11c	803.081,262	Arus 9	780.838,133
		Panas yang hilang	22.243,129
Total	803.081,262	Total	803.081,262

6. Menara Distilasi

Tabel 6.6. Neraca Panas pada Menara Distilasi

Panas Masuk (kJ/jam)		Panas Keluar (kJ/jam)	
Arus 12c	1.764.244,368	Arus 13	237.335,893
Panas Reboiler	17.373.083,168	Arus 14	1.972.828,829
		Panas Kondensor	16.927.162,813
Total	19.137.327,536	Total	19.137.327,536