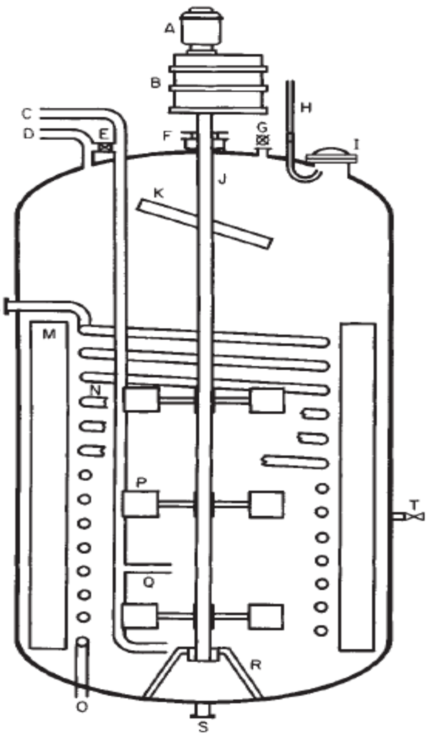
FERMENTOR (R – 02)

Fungsi : Tempat terjadinya fermentasi (Mengubah glukosa menjadi etanol dengan bantuan mikroorganisme Saccharomyces Cerevisiae).

Jenis : Reaktor Batch

Jumlah : 7 buah



Data :

Komponen	**Massa (kg)**	**Fraksi Massa (%)**	**Densitas (kg/m3)**	**Densitas Campuran**
Glukosa	8.653,421	0,146	1.540,000	224,987
Air	49.580,579	0,837	997,000	834,556
Saccharomyces	291,170	0,005	1.670,100	8,210
UREA	232,936	0,004	1.320,000	5,191
H2SO4	240,225	0,004	1.840,000	7,463
NPK	232,936	0,004	1.000,000	3,933
Total	59.231,267	1,000		1.084,340

Tekanan (P) = 1 atm

Temperatur (T) = 30˚C

Densitas campuran (ρ) = 1.084,340 kg/m^3

= 67,714 lb/ft^3

Laju alir massa (W) = 59.231,267 kg/jam

Fermentasi

Konversi (X) = 0,9

Waktu tinggal (τ) = 30 jam

Reaksi

$$C_6H_{12}O_6 \xrightarrow{\text{yeast}} 2C_2H_5OH + 2CO_2$$

Laju alir volumetrik umpan, Q_f

$Q_f = \frac{W}{\rho}$

$= \frac{59.231{,}267\ kg/jam}{1084{,}340\ kg/m^3}$

= 54,624 m^3/jam

Kinetika Reaksi di Fermentor

Fermentasi :

$$\text{Substrat} \xrightarrow{\text{sel}} \text{Produk + Sel Baru}$$

Data untuk fermentasi etanol, sumber : "Modeling Bioreactors", R.Miller & M.Melick, ChemicalEngineering Feb. 16, p.113 (1987)

Product concentration at which all metabolism ceaces, Cp* = 93,000 gr/dm^3

Empirical constant, n = 0,520

A maximum specific growth reaction rate, μ_{max} = 0,330/jam

Parameter analogous to the Michaelis constant, K_S = 1,700 g/dm^3

Cell maintenance, m = 0,030 (gr substrat) / (gr cell.jam)

Yield coefficient pembentukkan sel, $Y'_{c/s}$ = 0,080 gr/gr

Yield coefficient pembentukkan produk, $Y_{p/s}$ = 0,511 g/g

$Y_{p/s} = \frac{Etanol\ terbentuk}{glukosa\ bereaksi}$

$= \frac{3.980{,}574\ kg}{7788{,}079\ kg}$

= 0,511 g/g

$Y_{p/c} = \frac{Y_{p/s}}{Y'_{c/s}}$

$= \frac{0{,}511\ g/g}{0{,}080}$

= 6,389 g/g

Konstanta Deaktivasi

Kd = 0,010 / jam

Glukosa Terbentuk

Glukosa terbentuk = 8.653,421 kg/jam

N_{A0} Glukosa = $\frac{8.653{,}421\ kg/jam}{180\ kg/kmol}$

= 48,075 kmol/jam

C_{A0} Glukosa = $\frac{48{,}075\ kmol/jam}{54{,}624\ m^3/jam}$

= 0,880 kmol/m^3

Konsentrasi Substrat, C_s

$C_S = \frac{8.653{,}421\ kg/jam}{54{,}624\ m^3/jam}$

= 158,417 gr/dm^3

Konsentrasi Sel Mula-Mula

C_{C0} = 18,257 gr/dm^3

Kecepatan Spesifik Pertumbuhan Sel

$\mu = \mu_{max} \frac{C_S}{K_S + C_S}$ (Eq. 12-27 Fogler)

$= 0{,}330/\text{jam} \frac{158{,}417\ \text{gr/dm}^3}{1{,}700\frac{\text{gr}}{\text{dm}^3} + 158{,}417\ \text{gr/dm}^3}$

= 0,326 / jam

Kecepatan Degradasi Sel

$r_d = K_d.C_c$

= 0,010 / jam . 18,257 gr/dm^3

= 0,183 gr/dm^3.jam

Kecepatan Konsumsi Substrat Selama Maintenance

$r_{sm} = m.C_c$

= 0,030 (gr substrat) / (gr cell.jam) . 18,257 gr/dm^3

= 0,548 gr/dm^3.jam

Substrat dikonsumsi / jam = 1,333 gr/dm^3.jam / 30 jam

= 0,018 gr/dm^3

C_C terbentuk = $Y'_{c/s}$. substrat yang dikonsumsi

= 0,080 gr/gr . 1,333 gr/dm^3

= 0,107 gr/dm^3

C_C = 0,001 gr/dm^3 + 18,257 gr/dm^3

= 18,258 gr/dm^3

Kecepatan Pertumbuhan Sel

K_{obs} = faktor inhibisi

$K_{obs} = \left[1 - \frac{C_C - C_{C0}}{C_{p*}}\right]^n$ (Fogler hal.703)

$= \left[1 - \frac{(44{,}536 - 44{,}430) gr/dm^3}{93{,}000\ gr/dm^3}\right]^{0{,}520}$

= 0,999

$r_g = K_{obs} \cdot \mu \cdot C_{C0}$ (Eq.12-30 Fogler)

= 0,999 . 0,326 / jam . 18,257 gr/dm^3

= 5,961 gr/dm^3.jam

Kecepatan Produksi Etanol

$r_p = \frac{dC_p}{dt}$

= $Y_{p/c} \cdot r_g$

= 6,389 g/g . 5,961 gr/dm^3.jam

= 38,083 gr/dm^3.jam

= 38,083 kg/m^3.jam

Menentukan Volume Reaktor, V_R

Arus keluar reaktor = 55.423,762 kg/jam

$V = \frac{55.423,762 \text{ kg/jam}}{38,083 \text{ kg/m}^3\text{jam}}$

$= 1.455,359 \text{ m}^3$

Faktor keamanan = 20 % = 0,2

Maka kapasitas desain reaktor :

V_R = (1 + Faktor keamanan) x V

$= (1 + 0,2) \times 1.455,359 \text{ m}^3$

$= 1.746,431 \text{ m}^3$

Menentukan Konfigurasi Tangki

Diameter Tangki, D_t

V_R = V liquid + V elipsoidal

dimana : $V_L = \frac{\pi \,.\, DT^2}{4} H_L$, dengan H_L = 1,050 Dt

$V_E = \frac{\pi \,.\, DT^2}{6} H_E$, dengan H_E = 0,250 Dt

Maka :

$V_R = \frac{\pi \,.\, DT^2}{4} 1,050 \text{ Dt} + \frac{\pi \,.\, DT^2}{6} 0,250 \text{ Dt}$

$= 0{,}3042\ \pi\ Dt^3$

$D_t = \left[\frac{V_R}{0{,}3042\ \pi}\right]^{1/3}$

$= \left[\frac{1.746{,}431\ m^3}{0{,}3042\ .3{,}14}\right]^{1/3}$

= 12,228 m

Tinggi Tangki, H_R

$V_R = V_S + 2V_E$

V_S = Volume silinder

$= \frac{\pi}{4} . Dt^2 . H_S$ H_S = tinggi silinder

V_E = Volume elipsoidal

$= \frac{\pi}{6} . Dt^2 . H_E$ H_E = tinggi elipsoidal = ¼ Dt

$V_R = V_S + 2V_E$

$1.746{,}431\ m^3 = \left(\frac{\pi}{4}\ Dt^2 H_S\right) + 2\left(\frac{\pi}{6} Dt^2 H_E\right)$

$H_S = \frac{1.746{,}431 - \left(\frac{2.\pi.(12{,}228\ m)^3}{24}\right)}{\frac{(\pi.(12{,}228\ m)^2)}{4}}$

= 10,803 m

H_E = 0,250 Dt

= 0,250 . 12,228 m

= 3,057 m

H_R = H_S + $2H_E$

= 10,803 m + 2. 3,057 m

= 16,917 m

Berdasarkan gambar 1.1 Holland & Chapman, hal 12, dipilih pengaduk “Flat Blade Turbine”. Dari hal 159-161, Holland & Chapman, dipilih konfigurasi tanki Brooks and Shu dengan jaket untuk mempertahankan temperatur. Dengan spesifikasi tangki :

Dt = 12,228 m

Diameter pengaduk, Di

Di = 0,300 Dt

= 0,300 . 12,228 m

= 3,668 m

Tinggi Liquid, H_L

H_L = 1,050 Dt

= 1,050 . 12,228 m

= 12,839 m

Lebar Baffle, W_b

W_b = 0,010 Dt

= 0,010 . 12,228 m

= 0,122 m

Tinggi Pengaduk dari Dasar Tangki, Hi

Hi = 0,300 Dt

= 0,300 . 12,228 m

= 3,668 m

Lebar Blade, q

q = 0,060 Dt

= 0,060 . 12,228 m

= 0,734 m

Panjang Daun Impeller, L

L = 0,250 Di

= 0,250 . 3,668 m

= 0,917 m

Panjang Lilitan Koil, L_C

L_C = 0,650 Dt

$= 0{,}650 \cdot 12{,}228$ m

$= 7{,}948$ m

Diameter Lilitan Koil, D_C

$D_C = 0{,}700$ Dt

$= 0{,}700 \cdot 12{,}228$ m

$= 8{,}560$ m

Tinggi Koil dari Dasar Tangki, H_C

$H_C = 0{,}150$ Dt

$= 0{,}150 \cdot 12{,}228$ m

$= 1{,}834$ m

Posisi Baffle dari Dinding Tangki, r_B

$r_B = \frac{Dt}{48}$

$= \frac{12{,}228\ m}{48}$

$= 0{,}255$ m

Menentukan Tebal Tangki, t

$t = \frac{P \cdot Da}{2 \cdot S \cdot Ej - 0{,}2 \cdot P} + C$

Di mana :

P = Tekanan desain = 1 atm

= 14,696 psi

Da = Diameter tangki = 12,228 m

S = Tekanan kerja yang diinginkan = 13.700 psi (Peter, Table 4, p.570)

= 931,973 atm

E_j = Efisiensi pengelasan = 0,850 (Peter, Table 6, p.571)

C = Tebal korosi yang diizinkan = 0,011 m (Peter, Table 6, p.571)

Maka :

$$t = \frac{1\ atm\ .\ 12{,}228\ m}{(2\ .\ 931{,}973\ atm\ .0{,}850)-(0{,}2\ .\ 1\ atm)} + 0{,}011\ m$$

= 0,019 m

= 18,719 mm

Diameter Luar, OD

OD = ID + 2t (Mc Cabe, hal.275, 1987, terjemahan)

= 12,228 m + 2 . 0,019 m

= 12,265 m

Menentukan Putaran Pengaduk, N

$$\frac{N\ Di}{(\tau\ \ g\ \ gc/\rho)^{0,25}} = 1{,}22 + 1{,}25\,\frac{D_p}{Di}$$

Di mana :

Di = diameter pengaduk = 3,668 m = 366,839 cm = 12,032 ft

S = Konstanta = 7,500

D_p = Diameter partikel = 0,005 cm

V = Viskositas kinematika = 0,009 cm^2/s

g = gravitasi = 980,000 cm/s^2

B = (berat solid/berat liquid) x 100 = 54,310

ρ = Densitas campuran = 1.084,340 kg/m^3

Δρ = Densitas campuran – 1000 = 84,340 kg/m^3

Maka :

$$N = \frac{S\ V^{0,1}\ {D_p}^{0,2}\left(\left(\,g\left(\frac{\Delta\rho}{\rho}\right)\right)\right)^{0,45}\ B^{0,13}}{Di^{0,85}}$$

$$= \frac{7{,}500\left(\frac{0{,}009\ cm^2}{s}\right)^{0,1}(0{,}005\ cm)^{0,2}\left(\left(980{,}000\frac{cm}{s^2}\right)\left(\frac{84{,}340\ kg/m^3}{1.084{,}340\ kg/m^3}\right)\right)^{0,45}(54{,}310)^{0,13}}{(366{,}839\ cm)^{0,85}}$$

= 0,127 rps

Menentukan Power Pengaduk

Nilai reynold number, N_{RE}

$$N_{RE} = \frac{\rho\ N\ Di^2}{\mu}$$

$$= \frac{67{,}714 \frac{lb}{ft^3} .\ 0{,}345\ rps\ .\ (3{,}719\ ft)^2}{0{,}00134}$$

= 931.343,792

Untuk N_{RE} > 10.000 pada tangki yang dilengkapi dengan baffle, maka power pengaduk tidak bergantung pada nilai N_{RE}.

$$P = \frac{K_T . \rho\ .\ N^3 . Di^5}{gc}$$

Di mana :

K_T = Faktor pengaduk = 6,300

$\rho = 67{,}714\ lb/ft^3$

Di = 12,032 ft

gc = 32,172 ft/s^2

Maka :

$$P = \frac{6{,}300\ .\ 67{,}714 \frac{lb}{ft^3} .\ (0{,}345\ rps)^3\ .\ (12{,}032\ \ ft)^5}{32{,}172 \frac{ft}{s^2}\ .\ 550}$$

= 12,544 HP

Efisiensi motor = 87 % = 0,87

P $= \frac{12{,}544\ HP}{0{,}87}$

= 14,419 HP

Dipakai motor = 15 HP

Menentukan Tebal Jaket Pendingin

Dari Tabel 12.1 Typical overall coefficients, Coulson hal 513 diperoleh nilai overall heat transfer coefficient untuk cooling water :

Uc = 250 - 750 W/m2.˚C

Dari Tabel 12.2 fouling factor coefficients, Coulson hal 516 diperoleh nilai fouling factor untuk cooling water :

Rd = 3.000 – 6.000 W/m2.˚C

Jumlah air pendingin = 107.423,869 kg/jam

Densitas air (28˚C) = 996,233 kg/m^3

Residence time = 30 jam

Volumetric flowrate = $\frac{\frac{107.423{,}869 \frac{kg}{jam} \cdot 30\ jam}{996{,}233\ kg/m^3}}{10}$

= 323,490 m^3

Volumetric flow area jacket cooling system, V :

$$\left(\frac{\pi}{4}D^2H_L + \frac{\pi}{3}D^2H_L\right) - \left(\frac{\pi}{4}OD^2H_L + \frac{\pi}{3}OD^2H_L\right)$$

$$\frac{\pi}{4}H_L(D^2 - OD^2) + \frac{\pi}{3}H_L(D^2 - OD^2)$$

Jika $(D^2 - OD^2) = X$, maka :

$$X = \frac{323{,}490\ m^3}{\left(\left(\frac{3{,}14\ .\ 12{,}839\ m}{4}\right)+\left(\frac{3{,}14\ .12{,}839\ m}{3}\right)\right)}\ .\ 0{,}5$$

= 6,878

$D^2 = X + OD^2$

= 6,878 m^2 + (12,265 m)^2

= 157,318 m^2

$D = \sqrt{157{,}318\ m^2}$

= 12,543 m

Lebar Jacket = D – OD

= 12,543 m – 12,265 m

= 0,277 m

Penjadwalan Reaktor

Waktu pengisian (t_f) = 6 jam

Waktu reaksi (t) = 30 jam

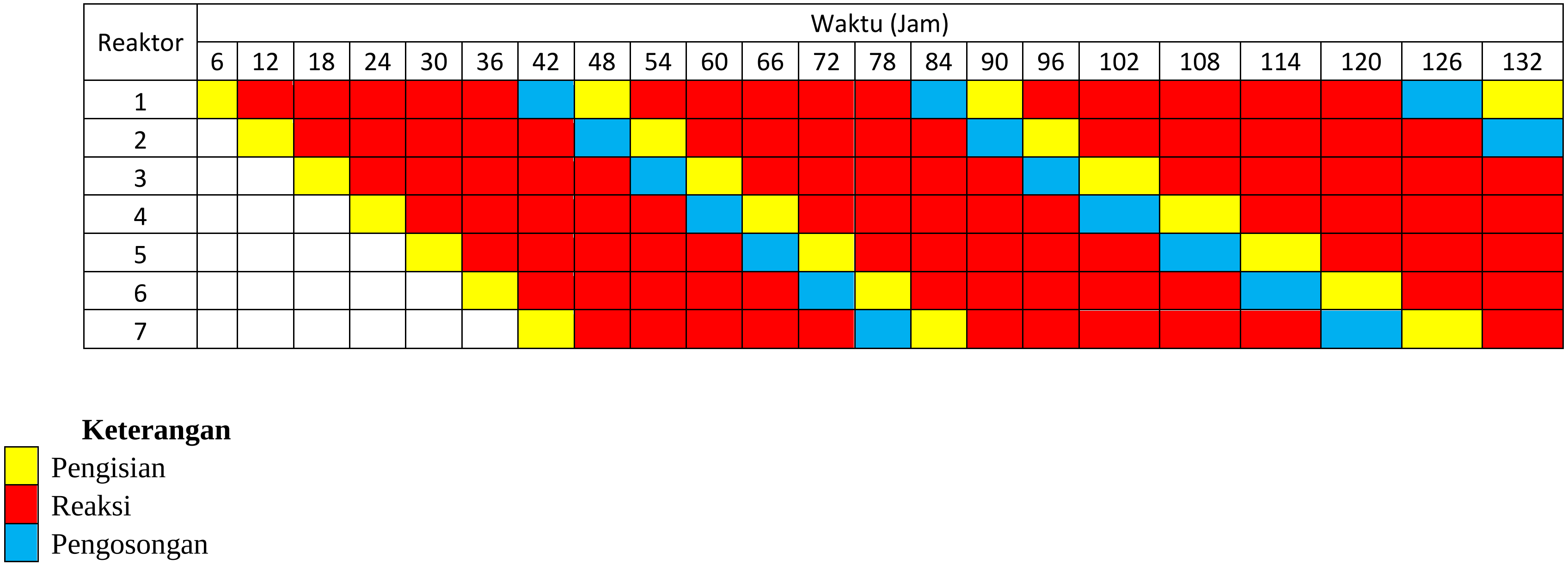
Waktu pengosongan (t_e) = waktu pengisian = 6 jam

Waktu siklus = t_f + t + t_e

= 6 + 30 + 6 + jam

= 42 jam

PENJADWALAN REAKTOR FERMENTOR



` REAKTOR HIDROLISA (R - 01)

Fungsi : Sebagai tempat terjadinya hidrolisa sukrosa menjadi glukosa

Jenis : Batch

Jumlah : 4 unit

Mekanisme reaksi

$C_{12}H_{22}O_{11} + H_2O \xrightarrow{H2SO4} 2C_6H_{12}O_6$

A + B → 2C

NC$_o$ = 29,992 kmol

Xa = $\frac{Massa_{sukrosa\ setelah\ hidrolisa} - Massa_{Air\ hidrolisa}}{Massa_{sukrosa\ setelah\ hidrolisa} - Massa_{Air\ hidrolisa}}$

Xa = $\frac{5128,5 - 269,921}{5398,421 - 269,921}$

= 0,95

NA$_o$ = 14,996 kmol

NB$_o$ = 14,996 kmol

NC$_o$ = 29,992 kmol

Basis = A

X = 0,95

Komponen	Mula - mula	Reaksi	Sisa
A	NA0	NA.X	NA = NA0 - NA0.X
B	NB0	NA0.X	NB = NB0 - NA0.X
C	NC0	2NA0.X	NC = NC0 + 2.NA0.X
Total	NT0		

Komponen	Mula - mula	Reaksi	Sisa
A	14,996	14,2462	0,7498
B	14,996	14,2462	0,7498
C		28,4924	28,4924
Total	NT0		29,992

Mekanisme Reaksi

$C_{12}H_{22}O_{11}$ + H_2O $\rightarrow$ $2C_6H_{12}O_6$

A + B $\rightarrow$ 2C

(-r_A) = k. C_A (orde 1)

Neraca Massa A di dalam reaktor Batch

Rate of mass A input - Rate of mass A output - (r_A)V = $\frac{d_{NA}}{dt}$

N_A = C_A . V

- $(-r_A)$ V = $\frac{d\,(C_A.V)}{dt}$

- $(-r_A)$ V = $C_A \frac{dV}{dt}$ + V $\frac{dC_A}{dt}$

- $(-r_A)$ V = V $\frac{dC_A}{dt}$

- $(-r_A)$ = $\frac{dC_A}{dt}$

Untuk keperluan perancangan, bentuk diferensial tersebut perlu diintegralkan, sehingga parameter perancangan bisa dihitung

t = $\int_{C_{A0}}^{C_A} \frac{d_{CA}}{(-r_A)}$

= $\int_{C_{A0}}^{C_A} \frac{d_{CA}}{k.C_A}$

= - $\frac{1}{k}$ ln C_A $\begin{matrix} C_A \\ C_{A0} \end{matrix}$

= - $\frac{1}{k}$ ln $\frac{C_A}{CA_0}$

= - $\frac{1}{k}$ ln $\frac{C_{A0}\,(1-X)}{C_{A0}}$

$= -\frac{1}{k}\ln(1 - X)$

$= \frac{1}{k}\ln\left(\frac{1}{1-X}\right)$

Mencari nilai k

nilai k dicari dengan persamaan Arrhenius

$k = 9130 \exp\left(-\frac{45.300\ J/mol}{8{,}314\frac{J}{mol}.K\ .\ 303\ K}\right)$

$= 0{,}00014$

Menghitung Waktu Reaksi

$t = \frac{1}{k}\ln\left(\frac{1}{1-X}\right)$

$= \frac{1}{0{,}00014/s}\ln\left(\frac{1}{1-0{,}95}\right)$

= 8 jam

Waktu Siklus = $t_f + t + t_e$

= (4 + 8 + 4) jam

= 16 jam

Menghitung Volume Reaktor

Laju alir bahan = 58474,225 kg/jam

Densitas campuran = 1054,040 kg/m^3

Volume Bahan, V $= \frac{F}{\rho_{campuran}} = \frac{58{,}474{,}225\ kg}{1054{,}04\ kg/m^3}$ = 55,248 m^3

Faktor kelonggaran = 20 %

Volume tangki, V_T = (1 + fk) x V

= (1+0,2) x 55,248 m^3

= 66,298 m^3

Menentukan Konfigurasi Tangki

Diameter Tangki, D_t

V_R = V liquid + V elipsoidal

dimana : $V_L = \frac{\pi \, . \, DT^2}{4} H_L$, dengan H_L = 1,050 Dt

$V_E = \frac{\pi \, . \, DT^2}{6} H_E$, dengan H_E = 0,250 Dt

Maka :

$V_R = \frac{\pi \, . \, DT^2}{4}$ 1,050 Dt + $\frac{\pi \, . \, DT^2}{6}$ 0,250 Dt

= 0,3042 π Dt^3

$D_t = \left[\frac{V_R}{0{,}3042\ \pi}\right]^{1/3}$

$= \left[\frac{51{,}571\ m^3}{0{,}3042\ .3{,}14}\right]^{1/3}$

= 4,110 m

Tinggi Tangki, H_R

$V_R = V_S + 2V_E$

V_S = Volume silinder

$= \frac{\pi}{4} . Dt^2 . H_S$ H_S = tinggi silinder

V_E = Volume elipsoidal

$= \frac{\pi}{6} . Dt^2 . H_E$ $\quad$ H_E = tinggi elipsoidal = ¼ Dt

$V_R = V_S + 2V_E$

$66,298\ m^3 = \left(\frac{\pi}{4}\ Dt^2 H_S\right) + 2\left(\frac{\pi}{6} Dt^2 H_E\right)$

$H_S = \frac{148,232 - \left(\frac{2.\pi.(4,110m)^3}{24}\right)}{\frac{(\pi.(4,110m)^2)}{4}}$

$= 3,631$ m

$H_E = 0,250Dt$

$= 0,250 . 4,110$ m

$= 1,027$ m

maka

$H_R = H_S + 2H_E$

$= 3,631$ m + 2(1,027) m

$= 5,686$ m

Berdasarkan gambar 1.1 Holland & Chapman, hal 12, dipilih pengaduk “Flat Blade Turbin2(e”. Dari hal 159-161, Holland & Chapman, dipilih konfigurasi tanki Brooks and Shu dengan jaket untuk mempertahankan temperatur. Dengan spesifikasi tangki :

Diameter pengaduk, Di

Di = 0,300 Dt

= 0,300 . 4,110 m

= 1,233 m

Tinggi Liquid, H_L

H_L = 1,050 Dt

= 1,050 . 4,110 m

= 4,315 m

Lebar Baffle, W_b

W_b = 0,010 Dt

= 0,010 . 4,110 m

= 0,041 m

Tinggi Dasar Pengaduk dari Dasar Tangki, Hi

Hi = 0,300 Dt

= 0,300 . 4,110 m

= 1,233 m

Lebar Blade, q

q = 0,060 Dt

= 0,060 . 4,110 m

= 0,247 m

Panjang Daun Impeller, L

L = 0,250 Di

= 0,250 . 1,233 m

= 0,308 m

Panjang Lilitan Koil, L_C

L_C = 0,650 Dt

= 0,650 . 1,233 m

= 2,671 m

Diameter Lilitan Koil, D_C

D_C = 0,700 Dt

= 0,700 . 4,110 m

= 2,877 m

Tinggi Koil dari Dasar Tangki, H_C

H_C = 0,150 Dt

= 0,150 . 4,110 m

= 0,616 m

Posisi Baffle dari Dinding Tangki, r_B

$r_B = \frac{Dt}{48}$

$= \frac{4,110\ m}{48}$

= 0,086 m

Menentukan Tebal Tangki, t

$t = \frac{P\ .\ Da}{2\ .\ S\ .\ Ej - 0,2\ .P} + C$

Di mana :

P = Tekanan desain = 1 atm

= 14,696 psi

Da = Diameter tangki = 4,110 m

S = Tekanan kerja yang diinginkan = 13.700 psi (Peter, Table 4, p.570)

= 931,973 atm

E_j = Efisiensi pengelasan = 0,850 (Peter, Table 6, p.571)

C = Tebal korosi yang diizinkan = 0,011 m (Peter, Table 6, p.571)

Maka :

$$t = \frac{1\ atm\ .\ 3{,}780\ m}{(2\ .\ 931{,}973\ atm\ .0{,}850) - (0{,}2\ .\ 1\ atm)} + 0{,}011\ \text{m}$$

= 0,014 m

= 13,394 mm

Diameter Luar, OD

OD = ID + 2t (Mc Cabe, hal.275, 1987, terjemahan)

= 4,110 m + 2 . 0,0014 m

= 4,137 m

Menentukan Putaran Pengaduk, N

$$\frac{N\ Di}{(\tau\ \ g\ \ gc/\rho)^{0{,}25}} = 1{,}22 + 1{,}25\ \frac{D_p}{Di}$$

Di mana :

Di = diameter pengaduk = 1,233 m = 113,386 cm = 4,044 ft

S = Konstanta = 7,500

D_p = Diameter partikel = 0,005 cm

V = Viskositas kinematika = 0,009 cm^2/s

g = gravitasi = 980,000 cm/s^2

B = (berat solid/berat liquid) x 100 = 54,310

ρ = Densitas campuran = 1.084,340 kg/m^3

Δρ = Densitas campuran – 1000 = 84,340 kg/m^3

Maka :

$$N = \frac{S\ V^{0,1}\ Dp^{0,2}\left(\left(g\left(\frac{\Delta\rho}{\rho}\right)\right)\right)^{0,45} B^{0,13}}{Di^{0,85}}$$

$$= \frac{7{,}500\left(\frac{0{,}009\ cm^2}{s}\right)^{0,1}(0{,}005\ cm)^{0,2}\left(\left(980{,}000\frac{cm}{s^2}\right)\left(\frac{84{,}340\ kg/m^3}{1.084{,}340\ kg/m^3}\right)\right)^{0,45}(54{,}310)^{0,13}}{(113{,}386\ cm)^{0,85}}$$

= 0,322 rps

Menentukan Power Pengaduk

Nilai reynold number, N_{RE}

$$N_{RE} = \frac{\rho\ N\ Di^2}{\mu}$$

$$= \frac{67{,}714\frac{lb}{ft^3}\ .\ 0{,}345\ rps\ .\ (3{,}719\ ft)^2}{0{,}00134}$$

= 241.383,836

Untuk N_{RE} > 10.000 pada tangki yang dilengkapi dengan baffle, maka power pengaduk tidak bergantung pada nilai N_{RE}.

$$P = \frac{K_T\ .\rho\ .\ N^3\ .Di^5}{gc}$$

Di mana :

K_T = Faktor pengaduk = 6,300

$\rho = 67{,}714\ lb/ft^3$

Di = 4,044 ft

gc = 32,172 ft/s^2

Maka :

$$P = \frac{6{,}300\ .\ 67{,}714 \frac{lb}{ft^3}.\ (0{,}345\ rps)^3\ .\ (3{,}719\ ft)^5}{32{,}172 \frac{ft}{s^2}\ .\ 550}$$

= 0,867 HP

Efisiensi motor = 87 % = 0,87

$$P = \frac{0{,}707\ HP}{0{,}87}$$

= 0,997 HP

Digunakan power pengaduk 1 HP

PENJADWALAN REAKTOR HIDROLISA

Reaktor	Waktu (Jam)															
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64
1																
2																
3																
4																

Keterangan

Pengisian

Reaksi

Pengosongan