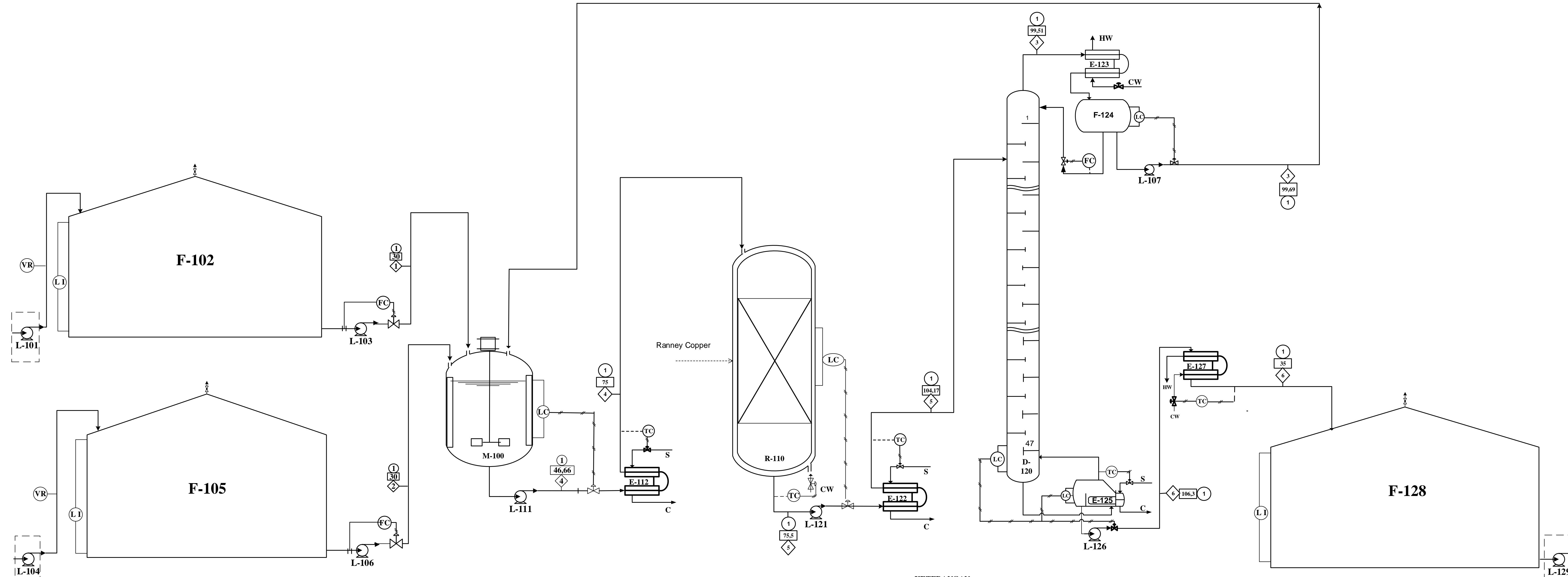



**DIAGRAM ALIR PROSES
PERANCANGAN PABRIK AKRILAMIDA DARI AKRILONITRIL MELALUI PROSES
HIDROLISIS
KAPASITAS 15.000 TON PER TAHUN**



KETERANGAN:
M-100 : Mixer
R-110 : Reaktor
D-120 : Menara Distilasi
E-111 : Heater 1
E-121 : Heater 2
E-126 : Cooler
E-122 : Condensor 1
E-124 : Reboiler
F : Tanki
L : Pompa
CW : Cooling Water
HW : Hot Water
LI : Level Indikator
LC : Level Controller
TC : Temperature Controller
PC : Pressure Controller
VR : Volume Recorder
S : Steam
C : Condensate
----- : Elektrik
[] : Mekanik
[] : Pneumatik
◇ : Nomor Arus
□ : Suhu, °C
○ : Tekanan, Atm

NO	KOMPONEN	ARUS MASSA, Kg/Jam					
		Arus 1	Arus 2	Arus 3	Arus 4	Arus 5	Arus 6
1	C ₃ H ₃ N	707,2050	-	21,6469	728,8519	81,8656	0,2187
2	H ₂ O	-	1186,7272	469,2479	1665,9520	1415,9562	946,7083
3	C ₃ H ₅ ON	-	-	-	-	947,0051	946,0051
4	C ₇ H ₉ O ₂	0,0073	-	-	0,0073	0,0073	0,0073
JUMLAH		707,2122	1186,7272	490,8948	2384,8342	2384,8342	1893,9394



**JURUSAN TEKNIK KIMIA
FAKULTAS TEKNIK
UNIVERSITAS MUHAMMADIYAH SURAKARTA**

**DIAGRAM ALIR PROSES
PRARANCANGAN PABRIK AKRILAMIDA DARI
AKRILONITRIL MELALUI PROSES HIDROLISIS
KAPASITAS 15.000 TON PER TAHUN**

Digambar Oleh:
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Dosen Pembimbing:
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2. M. Mujiburrahman, ST., MT., PhD

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function dYdZ=Hidrolisa_ACN(Z,Y)
global FA0 FB0 T0 RHOBULK EP DP Tr DHro ALT

% Sub Rutin Untuk Perhitungan Reaktor Single Bed Katalitik

% Keterangan Y
% Y(1) = X
% Y(2) = T
% Y(3) = P

% Neraca mol (Kmol/jam)
FA=FA0*(1-Y(1)); % mol c3h3n
FB=FB0-(FA0*Y(1)); % mol h2o
FC=FA0*Y(1); % mol c3h5on
FT=FA+FB+FC; % jumlah mol keluar reaktor

% Fraksi mol komponen
xmola=FA/FT; % fraksi mol c3h3n
xmolb=FB/FT; % fraksi mol h2o
xmolc=FC/FT; % fraksi mol c2h5on

% massa komponen (kg/jam)
massaA=FA*53; % berat c3h3n
massaB=FB*18; % berat air
massaC=FC*71; % berat c3h5on
sigmamassa=massaA+massaB+massaC; % berat total (kg/jam)

% fraksi massa komponen
xmassaA=massaA/sigmamassa; % fraksi berat c3h3n
xmassaB=massaB/sigmamassa; % fraksi berat h2o
xmassaC=massaC/sigmamassa; % fraksi berat c3h5on

% berat molekul rata-rata (kg/kmol)
BMRATA=xmola*53+xmolb*18+xmolc*71;

% data Cp (kJ/(kmol.K))
CPA=((33.362)*(Y(2))+((0.58644)/2)*(Y(2)^2)+((-0.0018625)/3)*(Y(2)^3)+(((2.4956E-6)/4)*(Y(2)^4)));
CPB=((92.053)*(Y(2))+((-3.9953E-2)/2)*(Y(2)^2)+((-2.1103E-4)/3)*(Y(2)^3)+(((5.3469E-7)/4)*(Y(2)^4)));
CPC=(-48.597)*(Y(2))+((1.0637)/2)*(Y(2)^2)+((-2.3221E-3)/3)*(Y(2)^3)+(((1.9286E-6)/4)*(Y(2)^4)));

ICPA0=((33.362)*(T0-Tr)+((0.58644)/2)*(T0^2-Tr^2)+((-0.0018625)/3)*(T0^3-Tr^3)+(((2.4956E-6)/4)*(T0^4-Tr^4)));
ICPB0=((92.053)*(T0-Tr)+((-3.9953E-2)/2)*(T0^2-Tr^2)+((-2.1103E-4)/3)*(T0^3-Tr^3)+(((5.3469E-7)/4)*(T0^4-Tr^4)));
ICPC0=(-48.597)*(T0-Tr)+((1.0637)/2)*(T0^2-Tr^2)+((-2.3221E-3)/3)*(T0^3-Tr^3)+(((1.9286E-6)/4)*(T0^4-Tr^4)));

ICPAA=((33.362)*(Y(2)-Tr)+((0.58644)/2)*(Y(2)^2-Tr^2)+((-0.0018625)/3)*(Y(2)^3-Tr^3)+(((2.4956E-6)/4)*(Y(2)^4-Tr^4)));

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ICPBA= ((92.053)) * (Y(2)-Tr) + ((-3.9953E-2)/2) * (Y(2)^2-Tr^2) + ((-2.1103E-4)/3) * (Y(2)^3-Tr^3) + (((5.34695E-7)/4) * (Y(2)^4-Tr^4));
ICPCA= ((-48.597)) * (Y(2)-Tr) + ((1.0637)/2) * (Y(2)^2-Tr^2) + ((-2.3221E-3)/3) * (Y(2)^3-Tr^3) + (((1.9286E-6)/4) * (Y(2)^4-Tr^4));

DHr=DHro+ICPAA+ICPBA+ICPCA; % entalpi reaksi kj/jam pada suhu reaksi

FCp=(FA*CPA)+(FB*CPB)+(FC*CPC); % jumlah total Fi*CPi

% Data viskositas (micropoise)
% Konversi ke kg/m.j, dikalikan 3.6
% Log10Vis=A+B/T+CT+DT2
VAI=10^((-6.3470)+(8.1502E-2/Y(2))+(1.5664E-2*Y(2))+(-1.7275E-5*(Y(2)^2)));
VA=VAI*3.6E-4;
VBI=10^((-10.2158)+(1.7925E3/Y(2))+(1.7730E-2*Y(2))+(-1.2631E-5*(Y(2)^2)));
VB=VBI*3.6E-4;
VCI=10^((2.7157)+(2.5375E-2/Y(2))+(-1.1286E-2*Y(2))+(7.4172E-6*(Y(2)^2)));
VC=VCI*3.6E-4;
Vrat=1/((xmassaA/VA)+(xmassaB/VB)+(xmassaC/VC));

% massa jenis umpan untuk fungsi suhu
% RO = A.B^(-(1-((T/TC)^n)))
% satuan gr/ml = kg/L dikonversi mjd kg/m3
ROA=(0.2503*(0.2293^(-(1-(Y(2)/535))^0.28939))) *1000;
RcA=xmassaA*ROA;
ROB=(0.3471*(0.274^(-(1-(Y(2)/647.13))^0.28571))) *1000;
RcB=xmassaB*ROB;
ROC=(0.2738*(0.252^(-(1-(Y(2)/710))^0.2857))) *1000;
RcC=xmassaC*ROC;
RHOCamp=1/(RcA+RcB+RcC);

% menghitung kecepatan reaksi
k=(1.0654)*exp(-45.8E3/(8.314*Y(2)));
RX=k*3.39*(FA^0.66)*(FB^1.27)*(FC^-0.46);

G=(sigmamassa/ALT)/3600; % superficial mass velocity (kg/s.m^2)

dXdZ=(ALT*(RX)*RHOBULK)/FA0;
dTdZ=(FA0*dXdZ*(-DHr))/FCp;
dPdZ=-(((G^2)/DP/RHOCamp)*((1-EP)/(EP^3))*((150*(1-EP)/(DP*G/Vrat))+1.75))*(0.986923/10^5);
dAdZ=-(ALT*(RX)*RHOBULK);
dBdZ=-(ALT*(RX)*RHOBULK);
dCdZ=(ALT*(RX)*RHOBULK);
dYdZ=[dXdZ dTdZ dPdZ dAdZ dBdZ dCdZ];
dYdZ=dYdZ';

```

```

% PROGRAM UTAMA REAKTOR SINGLE BED KATALITIK
% REAKSI PEMBENTUKAN ACRYLAMIDE DARI ACRYLONITRILE
% DENGAN PROSES HIDROLISA

clear all
clc
global FA0 FB0 T0 RHOBULK EP DP Tr DHro ALT

% Keterangan Y
% Y(1) = X
% Y(2) = T
% Y(3) = P

% komponen
% A = c3h3n (acrylonitrile)
% B = H2O (Air)
% C = c3h5on (Acrylamide)

% reaksi
% c3h3n + h2o -> c3h5on
% A + B -> C

% data umpan reaktor
X0=0+eps; % konversi mula-mula
T0=75+273.15; % suhu mula-mula (K)
P0=1; % Tekanan mula-mula (1atm)
FA0=13.7354; % kmol/jam
FB0=91.922; % kmol/jam

% data operasional
Tr=298.15; % suhu ref (K)
DHro=-113.13E3; % entalpi panas reaksi pada 298K (j/kmol)
ID=3; % diameter dalam reaktor (m)
ALT=(pi*(ID^2))/4; % Luas penampang reaktor (m^2)

% data katalis
% katalis yg digunakan adalah raney copper
RHOBULK=1.200*1000; % densitas katalis (kg/m^3)
DP=0.032; % diameter partikel (m) -> 0,02 - 0,5
EP=0.95; % porositas tumpukan

% menghitung laju alir masing" komponen
% menyusun DP simulan
Z0=0:0.01:15;
Y0=[X0 T0 P0 FA0 FB0 0];
[Z, Y]=ode45('Hidrolisa_ACN', Z0, Y0);
X=Y(:, 1);
T=Y(:, 2);
P=Y(:, 3);
FA=Y(:, 4);
FB=Y(:, 5);
FC=Y(:, 6);
FAi=FA.*53;

```

```

FBi=FB.*18;
FCi=FC.*71;
disp(' ')
disp('Hasil Perhitungan Bed')
disp('-----')
disp(' ')
disp(' Tinggi      Konversi   Suhu      Pressure
Komposisi(kgmol)      komposisi (kg) ')
disp(' (m)              (K)          (atm)      C3H3N      H2O
C3H5ON      C3H3N      H2O          C3H5ON')
disp('=====')
disp('=====')

for i=1:1368
    fprintf(1,'%8.4f %10.4f %10.4f %10.4f %10.4f %10.4f %10.4f
%10.4f %10.4f %10.4f \n',[ Z(i) X(i) T(i) P(i) FA(i) FB(i) FC(i)
FAi(i) FBi(i) FCi(i)])
end
disp('-----')
disp(' ')
Xout=Y(1161,1);
disp(['Konversi=' num2str(Xout)])
disp(' ')
Tout=Y(1161,2);
Suhu=Tout-273.15;
disp(['Suhu Keluar Reaktor=' num2str(Suhu) 'oC'])
disp(' ')
Pout=Y(1161,3);
pressure_drop=(P0-Pout)*14.7;
disp(['Pressure drop=' num2str(pressure_drop) 'psi'])

figure (1)
plot (Z,X,'black-')
title ('Distribusi Konversi')
xlabel ('panjang (m)')
ylabel ('konversi')
figure (2)
plot (Z,T,'black-')
title ('Distribusi Temperatur')
xlabel ('panjang (m)')
ylabel ('Temperatur (K)')
figure (3)
plot (Z,P,'black-')
title ('Distribusi Tekanan')
xlabel ('Panjang (m)')
ylabel ('Tekanan (atm)')
figure (4)
plot (Z,FAi,'r-.',Z,FBi,'k-',Z,FCi,'blue-', 'linewidth',2)
title ('Distribusi Komposisi')
xlabel ('Panjang (m)')
ylabel ('Komposisi (kg)')
legend (' komposisi Acrylonitrile','Komposisi Air','Komposisi
Acrylamide')

```

COMMAND WINDOW

Hasil Perhitungan Bed

Tinggi (m)	Konversi (K)	Suhu (atm)	Pressure C3H3N	Komposisi(kgmol) H2O C3H5ON			komposisi (kg) C3H3N H2O C3H5ON		
0.0000	0.0000	348.1500	1.0000	13.7354	91.9220	0.0000	727.9762	1654.5960	0.0000
0.0100	0.0155	348.1569	1.0000	13.5222	91.7088	0.2132	716.6786	1650.7591	15.1345
0.0200	0.0249	348.1610	1.0000	13.3938	91.5804	0.3416	709.8725	1648.4476	24.2522
0.0300	0.0327	348.1645	1.0000	13.2856	91.4722	0.4498	704.1390	1646.5004	31.9328
0.0400	0.0398	348.1676	1.0000	13.1891	91.3757	0.5463	699.0214	1644.7623	38.7885
0.4200	0.1885	348.2345	0.9999	11.1458	89.3324	2.5896	590.7296	1607.9839	183.8587
0.4300	0.1914	348.2358	0.9999	11.1067	89.2933	2.6287	588.6566	1607.2799	186.6357
0.4400	0.1942	348.2371	0.9999	11.0680	89.2546	2.6674	586.6036	1606.5827	189.3859
0.4500	0.1970	348.2384	0.9999	11.0296	89.2162	2.7058	584.5701	1605.8920	192.1101
0.5300	0.2185	348.2482	0.9999	10.7346	88.9212	3.0008	568.9325	1600.5812	213.0586
0.5400	0.2211	348.2494	0.9999	10.6991	88.8857	3.0363	567.0497	1599.9417	215.5808
0.5500	0.2236	348.2506	0.9999	10.6638	88.8504	3.0716	565.1815	1599.3072	218.0834
0.5600	0.2262	348.2517	0.9999	10.6288	88.8154	3.1066	563.3278	1598.6777	220.5667
0.5700	0.2287	348.2529	0.9999	10.5941	88.7807	3.1413	561.4882	1598.0529	223.0311
0.5800	0.2312	348.2540	0.9999	10.5597	88.7463	3.1757	559.6625	1597.4328	225.4769
0.5900	0.2337	348.2552	0.9999	10.5255	88.7121	3.2099	557.8504	1596.8174	227.9044
0.6000	0.2362	348.2563	0.9998	10.4915	88.6781	3.2439	556.0519	1596.2066	230.3137
1.4100	0.3954	348.3304	0.9996	8.3044	86.4910	5.4310	440.1354	1556.8387	385.5981
1.4200	0.3970	348.3312	0.9996	8.2823	86.4689	5.4531	438.9603	1556.4396	387.1723

1.4300	0.3986	348.3320	0.9996	8.2602	86.4468	5.4752	437.7897	1556.0421	388.7405
1.4400	0.4002	348.3327	0.9996	8.2382	86.4248	5.4972	436.6236	1555.6461	390.3026
1.4500	0.4018	348.3335	0.9996	8.2163	86.4029	5.5191	435.4620	1555.2515	391.8587
1.4600	0.4034	348.3342	0.9996	8.1944	86.3810	5.5410	434.3048	1554.8586	393.4088
2.1300	0.4980	348.3793	0.9995	6.8947	85.0813	6.8407	365.4177	1531.4629	485.6916
2.1400	0.4993	348.3799	0.9995	6.8774	85.0640	6.8580	364.5004	1531.1514	486.9204
2.1500	0.5006	348.3805	0.9995	6.8601	85.0467	6.8753	363.5860	1530.8408	488.1454
2.1600	0.5018	348.3811	0.9995	6.8429	85.0295	6.8925	362.6743	1530.5312	489.3667
2.1700	0.5031	348.3817	0.9995	6.8258	85.0124	6.9096	361.7654	1530.2225	490.5842
2.1800	0.5043	348.3823	0.9994	6.8087	84.9953	6.9267	360.8593	1529.9148	491.7981
4.1900	0.6976	348.4769	0.9989	4.1542	82.3408	9.5812	220.1728	1482.1345	680.2649
4.2000	0.6983	348.4773	0.9989	4.1440	82.3306	9.5914	219.6306	1481.9503	680.9913
4.2100	0.6990	348.4777	0.9989	4.1338	82.3204	9.6016	219.0896	1481.7666	681.7160
4.2200	0.6998	348.4780	0.9989	4.1236	82.3102	9.6118	218.5498	1481.5833	682.4391
4.2300	0.7005	348.4784	0.9989	4.1134	82.3000	9.6220	218.0113	1481.4004	683.1606
4.2400	0.7013	348.4788	0.9989	4.1033	82.2899	9.6321	217.4739	1481.2179	683.8804
4.2500	0.7020	348.4791	0.9989	4.0932	82.2798	9.6422	216.9377	1481.0358	684.5987
4.2600	0.7027	348.4795	0.9989	4.0831	82.2697	9.6523	216.4028	1480.8541	685.3153
8.2600	0.8992	348.5793	0.9979	1.3845	79.5711	12.3509	73.3807	1432.2805	876.9110
8.2700	0.8995	348.5795	0.9979	1.3803	79.5669	12.3551	73.1560	1432.2042	877.2120
8.2800	0.8998	348.5796	0.9979	1.3761	79.5627	12.3593	72.9317	1432.1281	877.5124
8.2900	0.9001	348.5798	0.9979	1.3718	79.5584	12.3636	72.7080	1432.0521	877.8121
8.3000	0.9004	348.5799	0.9979	1.3676	79.5542	12.3678	72.4848	1431.9763	878.1112
8.3100	0.9007	348.5801	0.9979	1.3634	79.5500	12.3720	72.2620	1431.9006	878.4095
9.3400	0.9695	355.1950	0.9976	0.4189	78.6055	13.3165	22.2034	1414.8996	945.4692
9.3500	0.9697	355.1964	0.9976	0.4165	78.6031	13.3189	22.0732	1414.8554	945.6437

9.3600	0.9699	355.1978	0.9976	0.4140	78.6006	13.3214	21.9435	1414.8113	945.8174
9.3700	0.9700	355.1992	0.9976	0.4116	78.5982	13.3238	21.8143	1414.7674	945.9905
9.3800	0.9702	355.2006	0.9976	0.4092	78.5958	13.3262	21.6856	1414.7237	946.1629

Konversi=0.97021

Suhu Keluar Reaktor=82.0506oC

Pressure drop=0.035348psi

