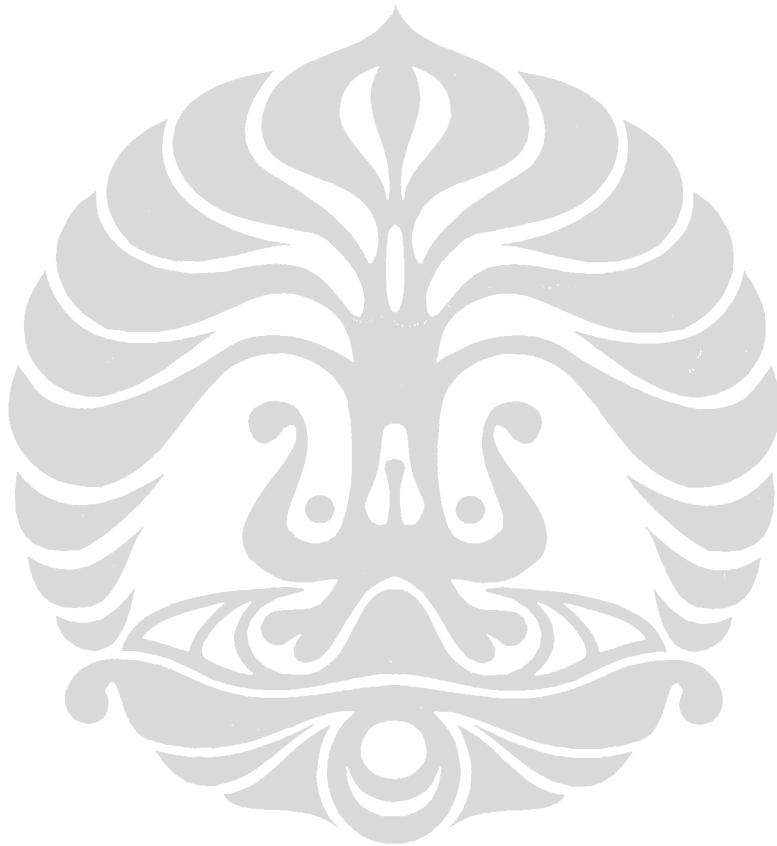


LAMPIRAN



Lampiran 1 Data Hasil Optimasi pada Microsoft Excel

	Fungsi Tujuan (USD)	3,198,961	Harga Minyak	77	USD/Bbls
	batasan cairan (BLS)	50,000	Harga gas pipa	3000	USD/BBTU
	batasan gas (MMSCF)	300	Harga Propana	747	USD/MT
	cairan yang diproses (BLS)	36,386	Harga Butana	727	USD/MT
	gas yang diproses (MMSCF)	300	Harga Kondensat	77	USD/Bbls
No Sumur	laju alir gas (MMSCFD)	Xgasmx	bukaan katup (%)	laju alir minyak(bbls/d)	laju alir air(bbls/d)
X1	22.000	22	100	924.0	0.9
X2	11.535	40	29	306.0	230.7
X3	0.040	0.04	100	4.0	10.3
X4	2.540	2.54	100	254.0	0.3
X5	39.000	39	100	2147.0	3988.0
X6	1.000	1	100	28.0	0.2
X7	4.500	4.5	100	353.0	30.0
X8	40.000	40	100	1472.0	1204.0
X9	2.000	2	100	261.0	214.0
X10	1.000	1	100	111.0	261.0
X11	38.000	38	100	2184.0	5617.0
X12	3.000	3	100	378.0	66.0
X13	10.000	10	100	1341.0	42.0
X14	3.000	3	100	208.0	11.0
X15	0.000	35	0	0.0	0.0
X16	0.000	12	0	0.0	0.0
X17	40.000	40	100	1512.0	1512.0
X18	0.230	0.23	100	23.0	0.0
X19	22.000	22	100	2332.0	1387.0
X20	1.000	1	100	106.4	959.3
X21	0.045	0.045	100	2.3	0.0
X22	2.950	2.95	100	295.0	0.0
X23	0.030	0.03	100	3.0	10.4
X24	0.000	0.5	0	0.0	0.0
X25	16.000	16	100	1269.0	355.0
X26	19.000	19	100	1723.0	114.0
X27	0.000	0.8	0	0.0	0.0
X28	0.000	0.5	0	0.0	0.0
X29	11.000	11	100	1824.0	135.0
X30	0.000	3	0	0.0	0.0
X31	0.130	0.13	100	13.0	0.0
X32	10.000	10	100	602.0	563.0

Lampiran 2 Solver yang digunakan pada Microsoft Excel

The screenshot displays the Microsoft Excel Solver interface. The Solver Parameters dialog box is open, showing the following configuration:

- Set Target Cell:** \$H\$3
- Equal To:** Max
- By Changing Variable Cells:** \$J\$11:\$J\$12
- Subject to the Constraints:**
 - \$J\$4 <= \$J\$4
 - \$J\$5 <= \$J\$5
 - \$J\$11 <= \$J\$11
 - \$J\$11 >= 0
 - \$J\$12 <= \$J\$12
 - \$J\$12 >= 0

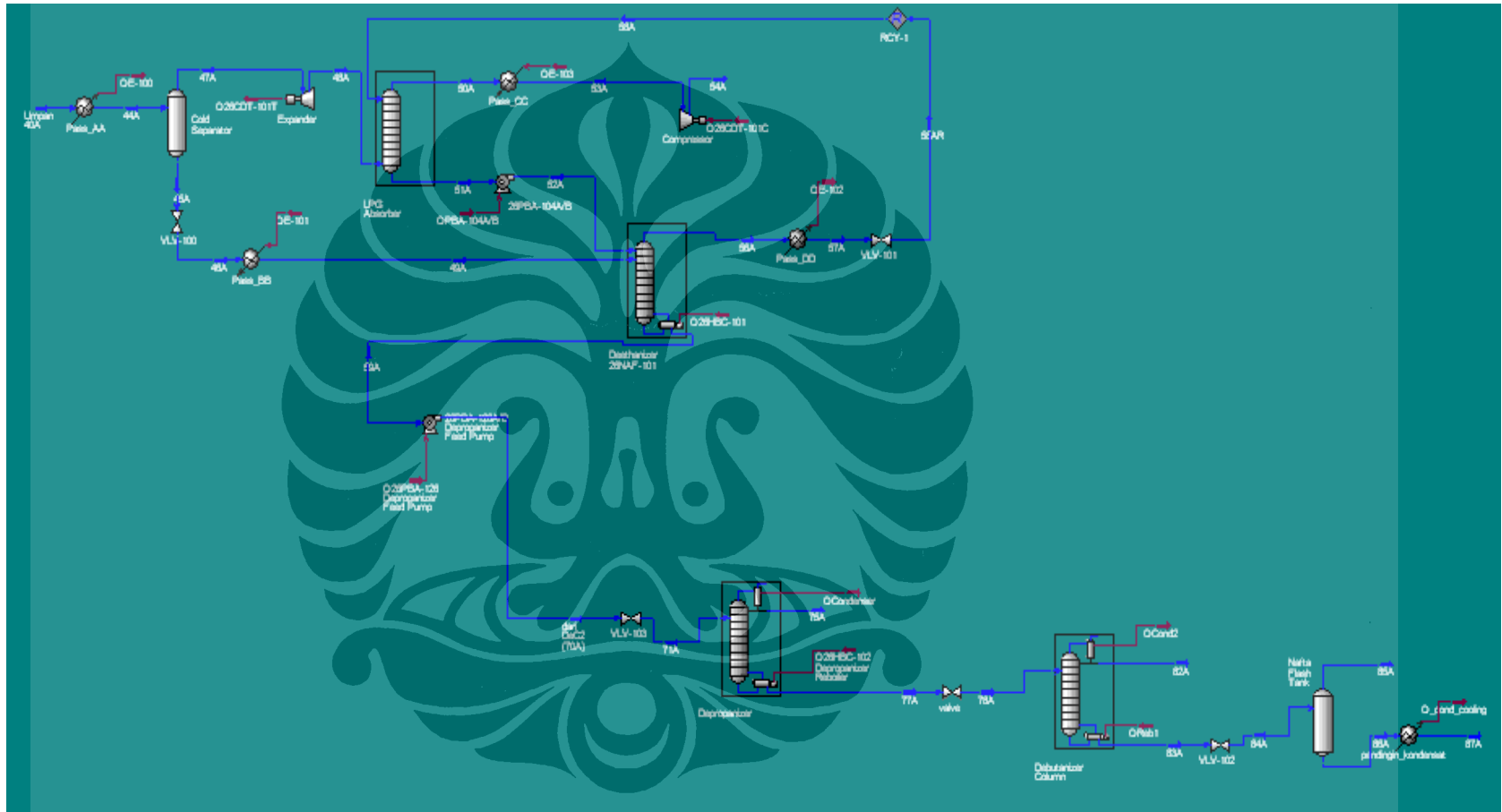
The background spreadsheet contains the following data:

No	Sumur	Konstanta Minyak	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19
11	A01	X1	3,23																		
12	A02	X2	2,04																		
13	A04	X3	7,70																		
14	A05	X4	7,70																		
15	A06	X5	4,23																		
16	A07	X6	2,19																		
17	A08	X7	6,04																		
18	A09	X8	2,83																		
19	A10	X9	10,04																		
20	A11	X10	8,54																		
21	A12	X11	4,42																		
22	A13	X12	9,702	2,769	1,298	835	351	499	15,103	3,000	3	45,308	148								
23	A15	X13	10,326	2,951	550	351	439	14,617	10,000	10	146,170	138,3									
24	A16	X14	5,339	2,796	1,215	677	384	10,411	3,000	3	31,232	73									
25	A17	X15	385	2,935	115	129	147	3,710	0,000	35	129,863	5,005005									
26	A18	X16	385	2,817	813	526	254	4,796	0,000	12	57,548	5,005005									
27	A20	X17	2,911	2,799	1,583	758	260	8,311	40,000	40	332,438	75,6									
28	A21	X18	7,700	2,940	671	364	242	11,918	0,230	0,23	2,741	100,1001									
29	A01	X19	8,163	2,872	1,224	964	664	13,778	??	??	??	169,0461									

The Solver Options dialog box is also visible, showing the following settings:

- Max Time:** 100 seconds
- Iterations:** 1000
- Precision:** 0.00001
- Tolerance:** 5%
- Convergence:** 0.0001
- Assume Linear Model:**
- Use Automatic Scaling:**
- Assume Non-Negative:**
- Show Iteration Results:**
- Estimates:** Tangent
- Derivatives:** Forward
- Search:** Newton
- Quadratic
- Central
- Conjugate

Lampiran 3 Diagram laju alir pada Simulasi Hysys



Lampiran 4 Konfigurasi Kolom Deethanizer pada Simulasi Hysys

Column: Deethanizer 26NAF-101 / COL2 Fluid Pkg: Basis-1 / Peng-Robinson

Design

Column Name: Deethanizer 26NAF-1 Sub-Flowsheet Tag: COL2

Top Stage Inlet: 52A

Optional Inlet Streams:

Stream	Inlet Stage
49A	10_Ma
<< Stream >>	

Stage Numbering: Top Down Bottom Up

Optional Side Draws:

Stream	Type	Draw Stage
<< Stream >>		

Reboiler Energy Stream: Q26HBC-101

Bottoms Liquid Outlet: 59A

Num of Stages: n = 25

P1: 244.7 psia

P reb: 248.7 psia

Delta P: 0.1450 psi

Dyhd Vapour Outlet: 56A

Buttons: Design, Parameters, Side Ops, Rating, Worksheet, Performance, Flowsheet, Reactions, Dynamics

Buttons: Delete, Column Environment..., Run, Reset, Converged, Update Outlets, Ignored

Column: Deethanizer 26NAF-101 / COL2 Fluid Pkg: Basis-1 / Peng-Robinson

Design

Optional Checks: Input Summary View Initial Estimates...

Profile: Temp Press Flows

Temperature vs. Tray Position from Top:

Specifications:

	Specified Value	Current Value	Wt. Error	Active	Estimate	Current
Reboiler Temperature	162.0 F	162	-0.0000	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
C2 recovery	0.9910	0.991	-0.0000	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C2 in Dyhd	0.5000	0.434	-0.3716	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C1 in Dyhd	0.5000	0.485	-0.0880	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
C3+ in Btm	0.9000	0.995	3.6481	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Buttons: Design, Parameters, Side Ops, Rating, Worksheet, Performance, Flowsheet, Reactions, Dynamics

Buttons: Delete, Column Environment..., Run, Reset, Converged, Update Outlets, Ignored

Lampiran 5 Konfigurasi Kolom Depropanizer pada Simulasi Hysys

Column: Depropanizer / COL3 Fluid Pkg: Basis-2 / Peng-Robinson

Design

Column Name: Depropanizer Sub-Flowsheet Tag: COL3

Condenser: Total Partial Full Reflux

Condenser Energy Stream: QCondenser

Delta P: 0.1450 psi

Dyhd Liquid Outlet: 75A

Inlet Streams:

Stream	Inlet Stage
71A	10_Ma
<< Stream >>	

Optional Side Draws:

Stream	Type	Draw Stage
<< Stream >>		

Reboiler Energy Stream: Q26HBC-102 Deprope

Bottoms Liquid Outlet: 77A

Stage Numbering: Top Down Bottom Up

Num of Stages: n = 24

P cond: 224.7 psia

P reb: 226.7 psia

Delta P: 0.0000 psi

Buttons: Design Parameters Side Ops Rating Worksheet Performance Flowsheet Reactions Dynamics

Buttons: Delete Column Environment... Run Reset Converged Update Outlets Ignored

Column: Depropanizer / COL3 Fluid Pkg: Basis-2 / Peng-Robinson

Design

Optional Checks: Input Summary View Initial Estimates...

Profile: Temp Press Flows

Temperature vs. Tray Position from Top

Tray	Temperature (F)
0	100.0
5	110.0
10	120.0
15	130.0
20	140.0
25	150.0

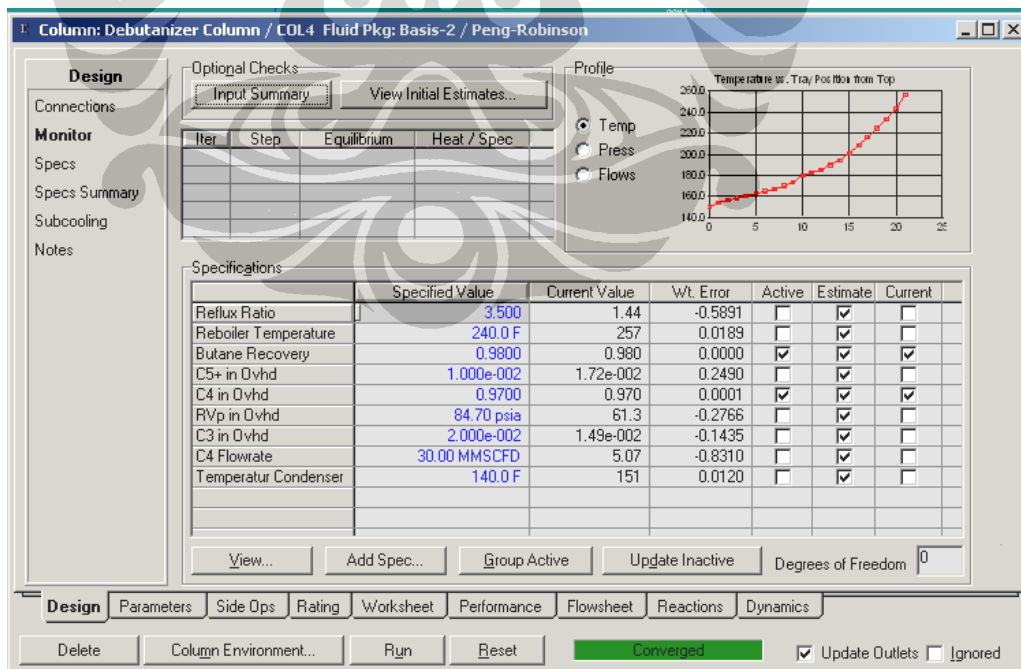
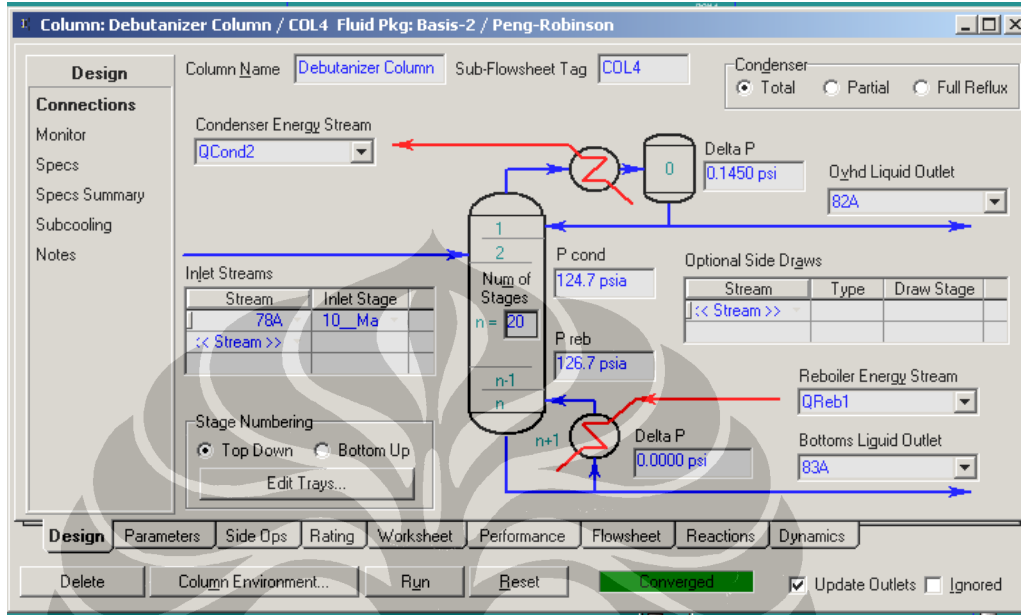
Specifications:

	Specified Value	Current Value	Wt. Error	Active	Estimate	Current
C4 + in Dvhd	4.000e-002	3.69e-002	-0.0494	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
reboiler temp	230.0 F	231	0.0012	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Reflux Ratio	1.250	1.80	0.4428	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
C3 in Dvhd	0.9600	0.960	0.0000	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C2 in Dvhd	2.000e-002	8.60e-003	-0.3894	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RVP Dvhd	214.7 psia	187	-0.1286	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
C3 recovery	0.9920	0.992	-0.0000	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C3 flowrate	30.00 MMSCFD	9.61	-0.6796	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
C3 in Btm	1.000e-002	1.00e-002	0.0000	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Temperature Condenser	100.0 F	114	0.0154	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Buttons: Design Parameters Side Ops Rating Worksheet Performance Flowsheet Reactions Dynamics

Buttons: Delete Column Environment... Run Reset Converged Update Outlets Ignored

Lampiran 6 Konfigurasi Kolom Debutanizer pada Simulasi Hysys



Lampiran 7 Spesifikasi LPG Propana Saudi Aramco

SAUDI ARAMCO PRODUCT SPECIFICATION

NUMBER: A-140
 ISSUE DATE: 10/14/98
 REPLACES: 03/10/98
 PAGE NO.: 1 OF 1

REFRIGERATED PROPANE LPG (a)

TEST	GUARANTEE	METHOD
Composition, liquid volume % Ethane Propane Butanes Pentanes and heavier Total Olefins	Max 2.0 Min 95.0 Max 4.0 Nil Max 0.1	ASTM D-2163
Corrosive Compounds, Copper strip	Max No 1b	ASTM D-1838
Hydrogen Sulfide, ppm (wt) (Note b)	Max 5	Lead acetate paper per Exxon Lab. Inspection Circular 200.14 UOP-212
Specific Gravity 60°F/60°F	To be reported	ASTM D-2598
Sulfur (Total), ppm (wt) (µg/g)	Max 30	ASTM D-2784 or ASTM D-4045 modified (Note d)
Vapor Pressure @ 100°F, psig (kPa(g))	Max 200 (1380)	ASTM D-2598 or ASTM D-1267
Water Content , ppm (wt)	Max 10 (Note c)	ASTM E-700

- Notes:
- a. Odorant not required in refrigerated propane LPG.
 - b. Hydrogen sulfide test required only when volatile sulfur test exceeds 5 ppm. Passing test of hydrogen sulfide shall be reported as "Not more than 5 ppm".
 - c. Product shall contain no free water.
 - d. ASTM D-4045 as modified by Saudi Aramco can also be used as an alternative method of testing.

Lampiran 8 Spesifikasi LPG Butana Saudi Aramco

SAUDI ARAMCO PRODUCT SPECIFICATION

NUMBER: A-160
 ISSUE DATE: 10/14/98
 REPLACES: 03/10/98
 PAGE NO.: 1 OF 1

REFRIGERATED BUTANE LPG (a)

TEST	GUARANTEE	METHOD
Composition, liquid volume % Propane Iso-butane N-butane Isopentane and heavier Olefins	Max 2.0 Max 29.0 Min 68.0 Max 1.0 Max 0.1	ASTM D-2163
Corrosive Compounds, Copper strip	Max No. 1b	ASTM D-1838
Hydrogen Sulfide, ppm (wt) (Note b)	Max 5	Exxon Laboratory Inspection Circular 200.14 or UOP-212
Specific Gravity, 60 °F/60 °F	To be reported	ASTM D-2598
Total Sulfur, ppm (wt) (µg/g)	Max 30	ASTM-D-2784 or ASTM D-4045 modified (Note d)
Vapor Pressure @ 100°F, psig (kPa(g))	Max 70 (483)	ASTM D-2598 or ASTM D-1267
Water Content, ppm (wt)	Max 10 (Note c)	ASTM E-700

- Notes:
- a) Odorant not required in refrigerated butane LPG.
 - b) Hydrogen sulfide test required only when volatile sulfur test exceeds 5 ppm. Passing test of hydrogen sulfide shall be reported as "Not more than 5 ppm".
 - c) Product shall contain no free water.
 - d) ASTM D-4045 as modified by Saudi Aramco can also be used as an alternative method of testing.

Lampiran 9 Hasil Simulasi Unit Deethanizer

Unit Deethanizer	Kondisi proses	keterangan
T_masuk Heat Exchanger Pass_AA (F)	88.5	ditentukan
T_keluar Heat Exchanger Pass_AA (F)	0.0	ditentukan
T_masuk Heat Exchanger Pass_BB (F)	-29.1	dihitung
T_keluar Heat Exchanger Pass_BB (F)	82.5	ditentukan
T_masuk Heat Exchanger Pass_CC (F)	-97.5	dihitung
T_keluar Heat Exchanger Pass_CC (F)	83.5	ditentukan
T_masuk Heat Exchanger Pass_DD (F)	-0.7	dihitung
T_keluar Heat Exchanger Pass_DD (F)	-91.3	ditentukan
Tekanan_masuk Expander (psia)	718	ditentukan
Tekanan_keluar Expander (psi)	215	ditentukan
Recovery C3+	0.9	dihitung
Recovery C2	0.99	ditentukan
Tekanan Umpan kolom /Reboiler (psia)	248.7	ditentukan
Tekanan LPG Absorber (psia)	244.7	ditentukan
Jumlah tahap	21	ditentukan
Lokasi umpan	10	ditentukan
Temperatur reboiler kolom deethanizer (F)	162	dihitung
Fraksi C3+ di bawah kolom	0.995	dihitung
Laju alir C3 + di bagian bawah kolom DeC2 (MMSCFD)	17.7	dihitung
Dewpoint gas menuju pipa pada 700 psia	-64 F	dihitung (spesifikasi maksimum 55 F)
Fraksi Methana pada gas menuju pipa	0.89	dihitung (spesifikasi maksimum 0.8)

Lampiran 10 Hasil Simulasi Unit Depropanizer

Kolom Depropanizer	Kondisi Proses	Spesifikasi Penjualan	Keterangan
Recovery C3	0.99		ditentukan
Fraksi C3 di atas	0.96	Min 0.95	ditentukan
Tekanan umpan /reboiler (psia)	227		ditentukan
Hilang tekan antara kolom bagian bawah dan atas (psia)	2		ditentukan
Jumlah tahap	25		ditentukan
Lokasi umpan	10		ditentukan
Temperatur Reboiler (F)	231		dihitung
Rasio Refluks	1.8		dihitung
Temperatur Kondenser (F)	114		dihitung
Fraksi C4+ di atas kolom	0.037	Maks 0.04	dihitung
Fraksi C2 di atas kolom	0.009	Maks 0.02	dihitung
RVP di atas kolom (psia)	187	Maks 200	dihitung

Lampiran 11 Hasil Simulasi Kolom Debutanizer

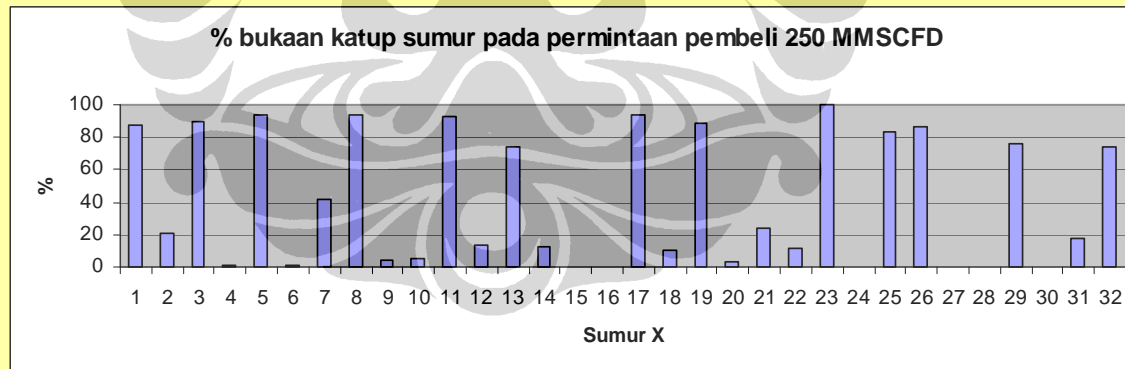
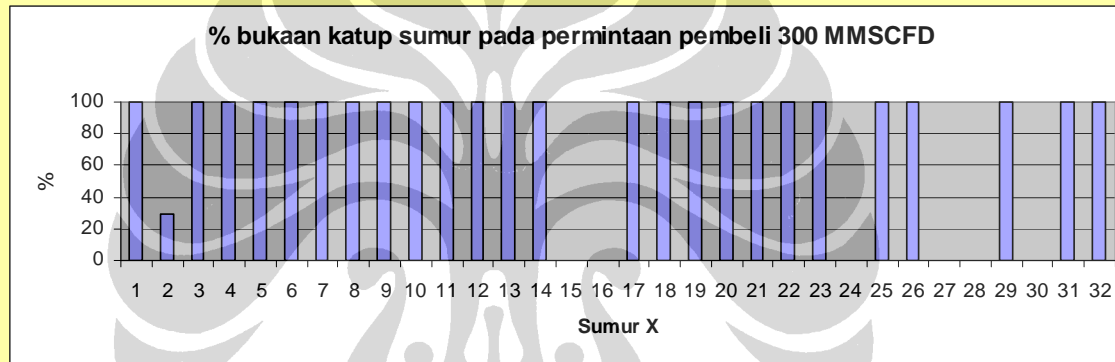
Kolom Debutanizer	Kondisi Proses	Spesifikasi Penjualan	Keterangan
C4 Recovery	0.98		ditentukan
Fraksi C4 di atas	0.97	Min 0.97	ditentukan
Jumlah tahap	21		ditentukan
Lokasi umpan	10		ditentukan
Tekanan umpan/reboiler (psi)	127		ditentukan
Hilang tekan antara kolom bagian bawah dan atas (psia)	2		ditentukan
Temperatur Reboiler (F)	257		dihitung
Rasio Refluks	1.4		dihitung
Temperatur Kondenser	151		dihitung
Fraksi C5+ di atas kolom	0.017	Maks 0.02	dihitung
Fraksi C3 di atas kolom	0.015	Maks 0.02	dihitung
RVP di atas kolom	61.3	Maks 70	dihitung

Lampiran 12 Hasil Simulasi Tangki Stabilisasi Kondensat

Tangki Stabilisasi Kondensat	Kondisi Proses	Spesifikasi Penjualan	Keterangan
Tekanan_umpan (psi)	26.7		ditentukan
T_keluar pendingin (F)	80		ditentukan
Laju Alir Produk (MMSCFD)	1.278		dihitung
RVP Kondensat (Psia)	11.5	< 13 psia	dihitung
SG	0.6405	0.64-0.74	dihitung
Fraksi Uap Kondensat	0		dihitung

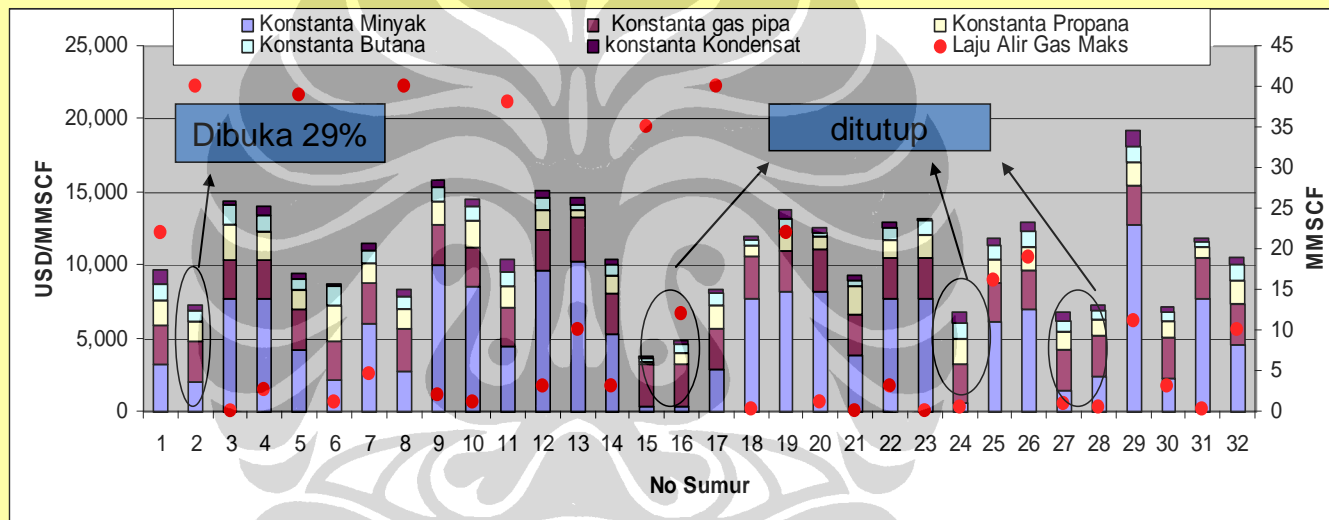
Lampiran 13 Hasil Optimasi Sumur

Hasil Optimasi Sumur



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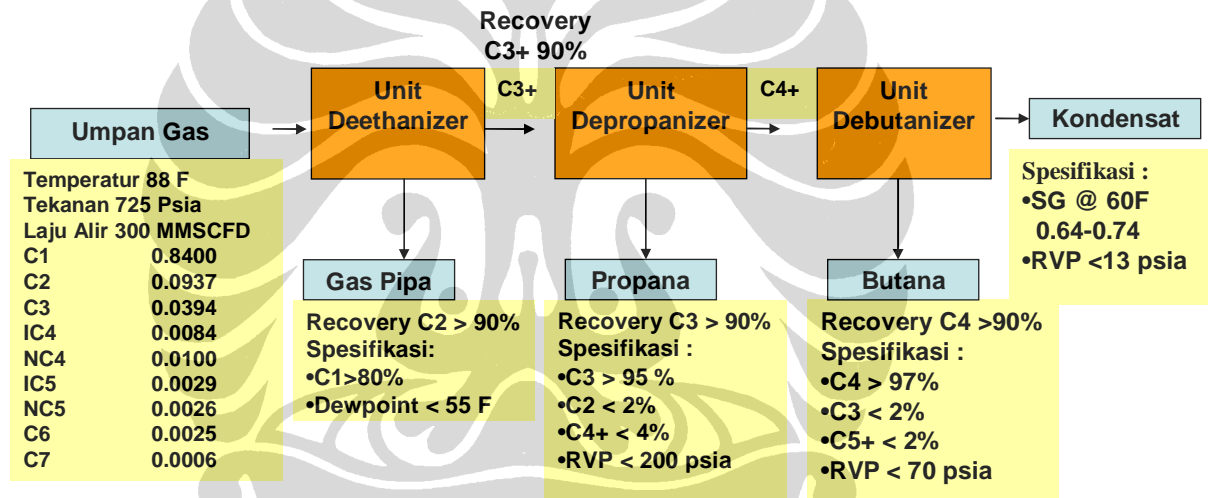
Kontribusi Konstanta Masing-Masing Produk dari Setiap Sumur pada persamaan tujuan

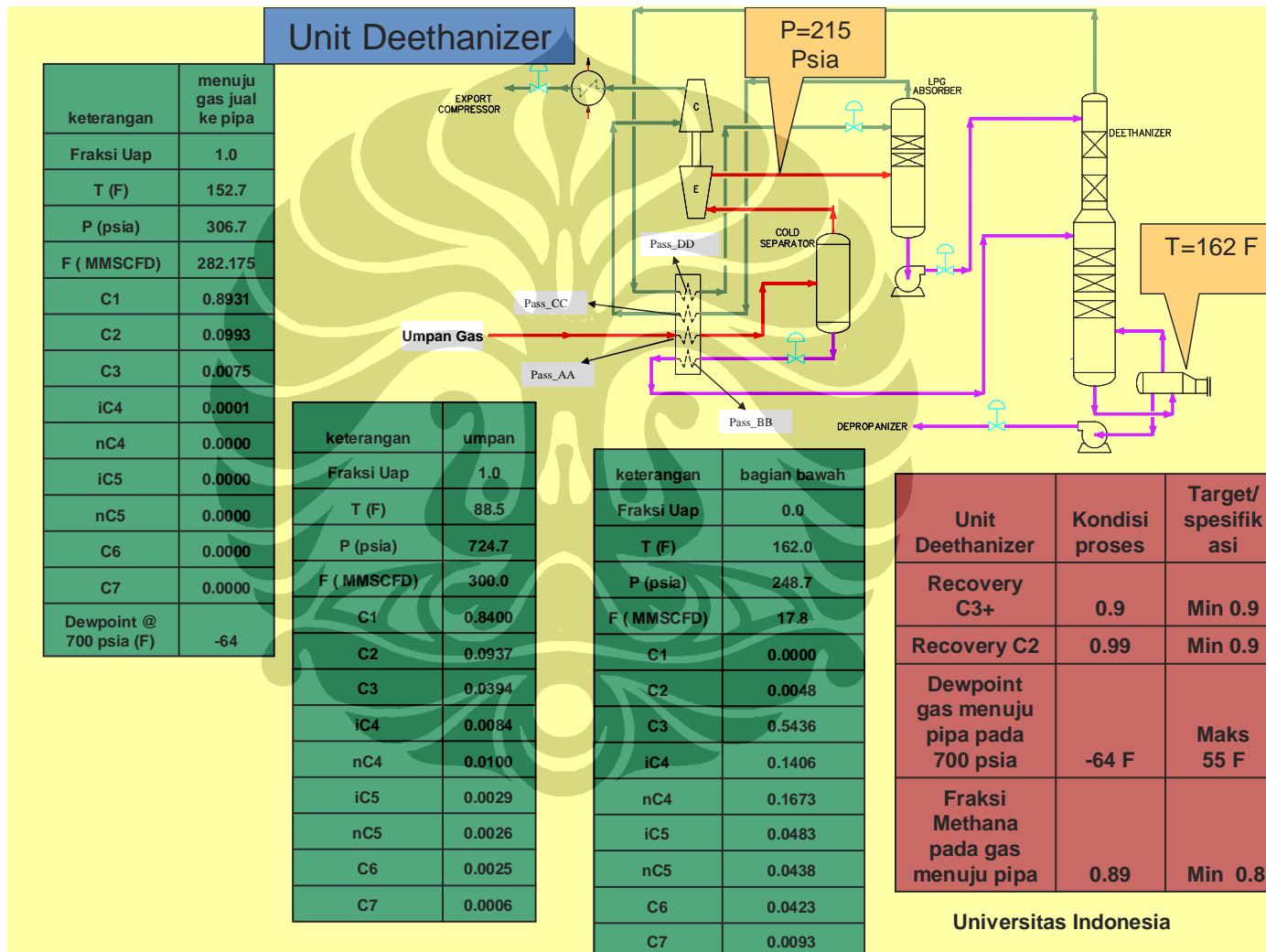


- Konstanta minyak = $\frac{\text{harga minyak}}{\text{GOR}}$
- Konstanta gas pipa = $(1,01x\% C_1 + 1,769x\% C_2) \times \text{harga gas pipa}$
- Konstanta propana = $(52,7x\% C_3) \times \text{harga propana}$
- Konstanta butana = $(69,5x\% NC_4 + 74,2x\% IC_4) \times \text{harga butana}$
- Konstanta kondensat = $(869x\% IC_5 + 860x\% NC_5 + 977x\% C_6 + 1096x\% C_7) \times \text{harga kondensat}$

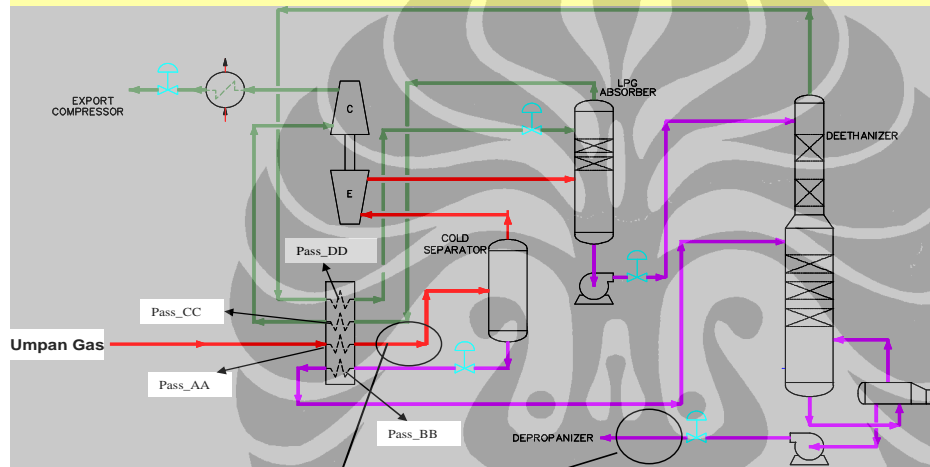
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Simulasi Hysys pada Unit Fraksinasi Gas



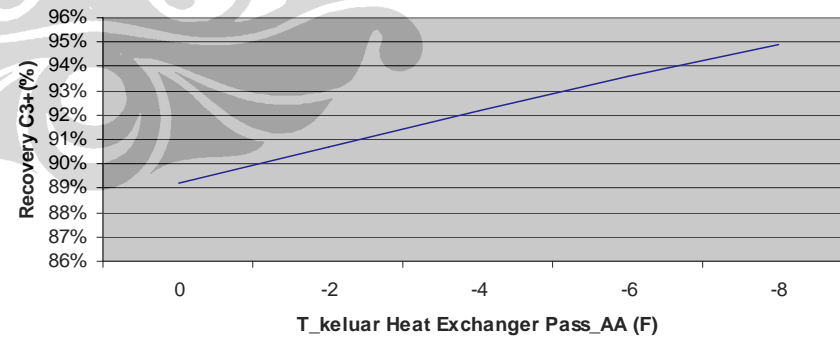


Pengaruh Perubahan Temperatur Umpan terhadap Recovery C3+ pada Unit Deethanizer

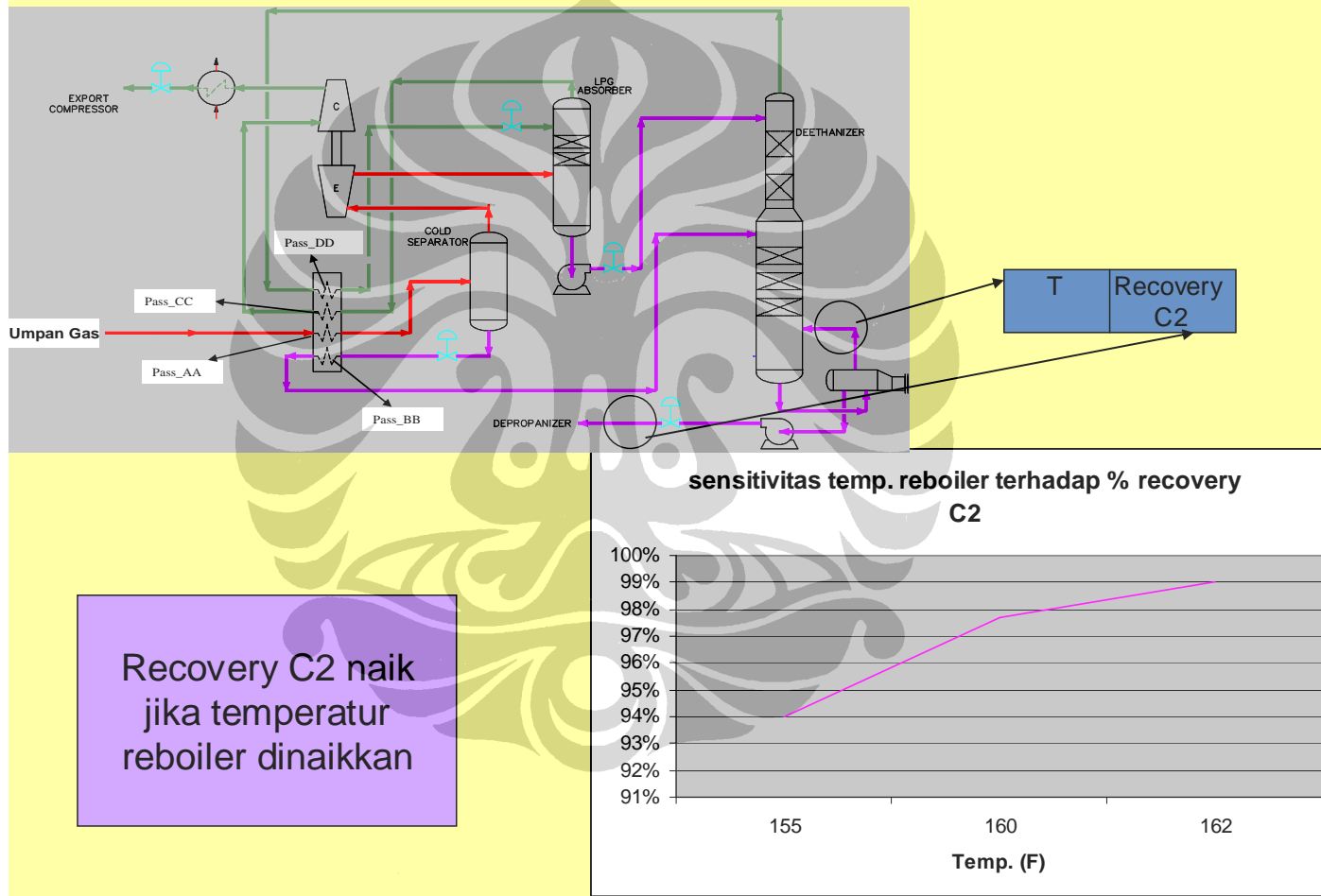


Recovery C3+ naik jika temperatur umpan lebih didinginkan

Sensitivitas recovery C3+ terhadap perubahan temperatur



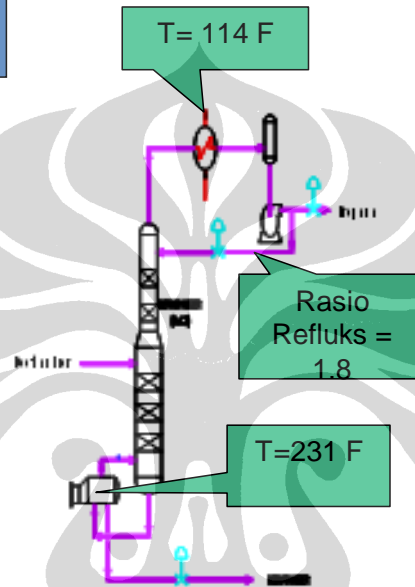
Pengaruh Perubahan Temperatur Reboiler pada Kolom Deethanizer terhadap Recovery C2



Recovery C2 naik jika temperatur reboiler dinaikkan

Unit Depropanizer

keterangan	umpan
Fraksi Uap	0.1
T (F)	154.7
P (psia)	226.7
F (MMSCFD)	17.8
C1	0.0000
C2	0.0048
C3	0.5436
iC4	0.1406
nC4	0.1673
iC5	0.0483
nC5	0.0438
C6	0.0423
C7	0.0093



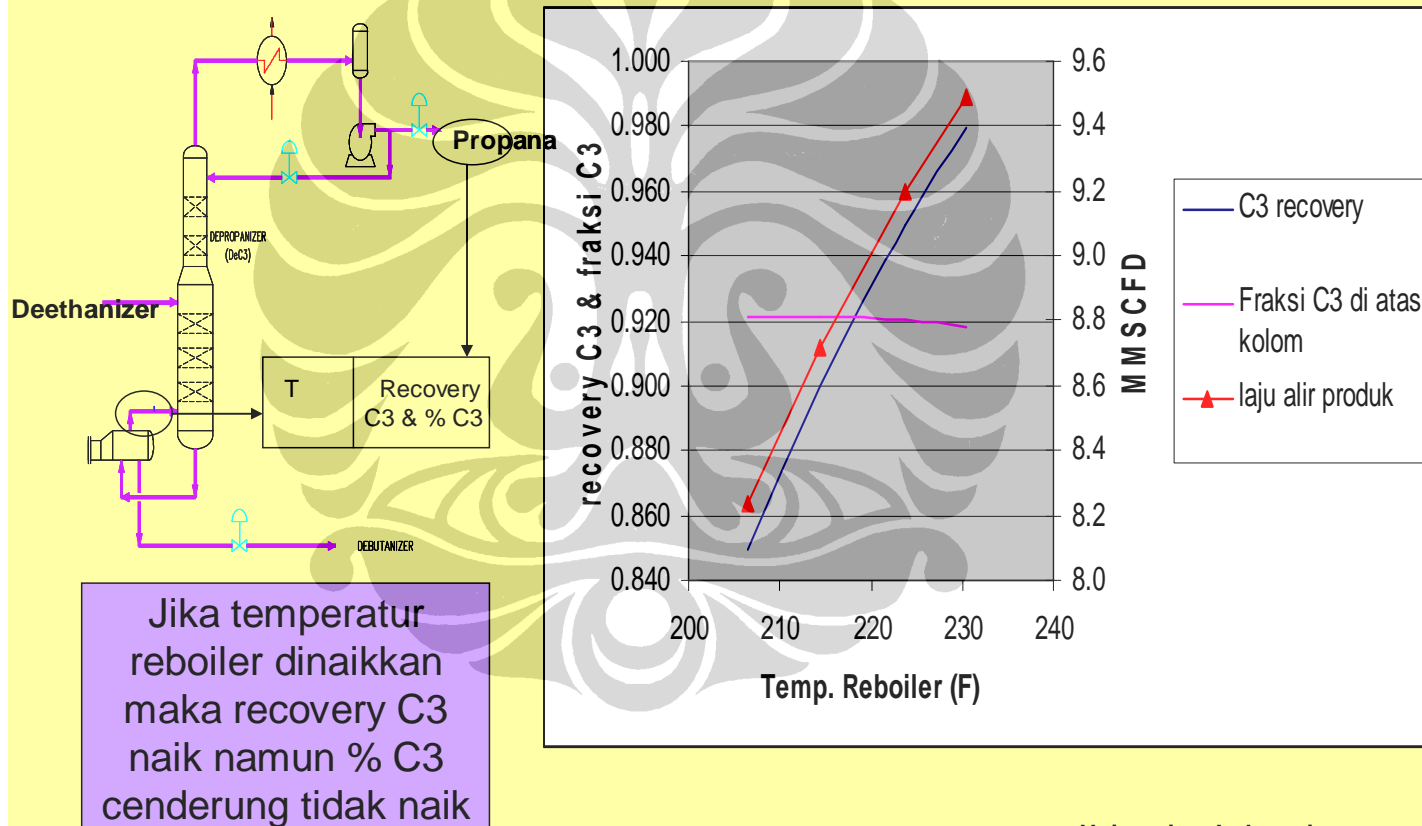
keterangan	bagian atas
Fraksi Uap	0.0
T (F)	113.8
P (psia)	224.7
F (MMSCFD)	10.0
C1	0.0000
C2	0.0086
C3	0.9600
iC4	0.0287
nC4	0.0047
iC5	0.0000
nC5	0.0000
C6	0.0000
C7	0.0000

keterangan	bagian bawah
Fraksi Uap	0.0
T (F)	231.0
P (psia)	226.7
F (MMSCFD)	7.8
C1	0.0000
C2	0.0000
C3	0.0100
iC4	0.2865
nC4	0.3757
iC5	0.1101
nC5	0.1000
C6	0.0965
C7	0.0212

Kolom Depropanizer	Kondisi Proses	Target/Spesifikasi
Recovery C3	0.99	Min 90%
Fraksi C3 di atas	0.96	Min 0.95
Fraksi C4+ di atas kolom	0.037	Maks 0.04
Fraksi C2 di atas kolom	0.009	Maks 0.02
RVP di atas kolom (psia)	187	Maks 200

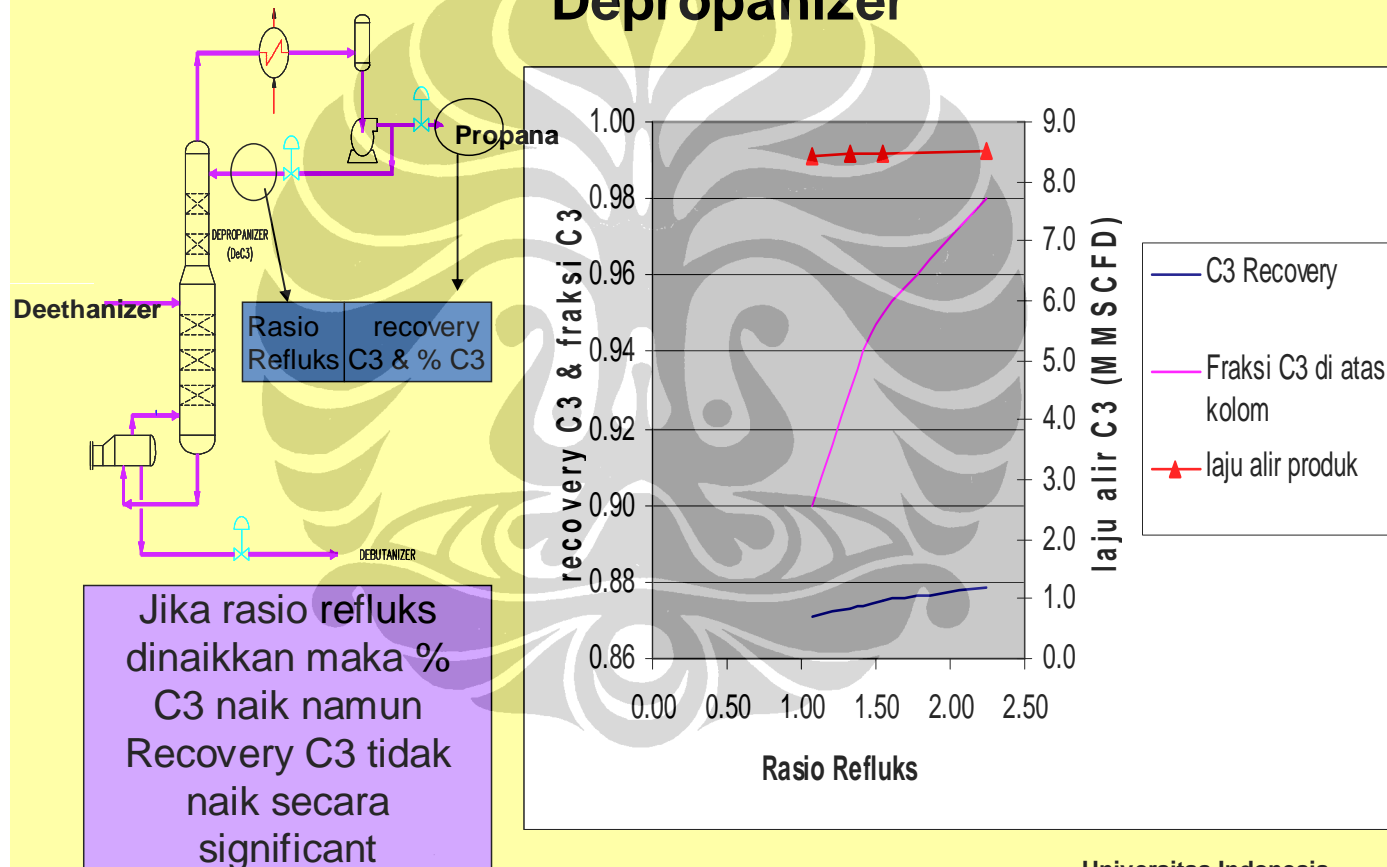
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Pengaruh Perubahan Temperatur Reboiler pada Unit Depropanizer



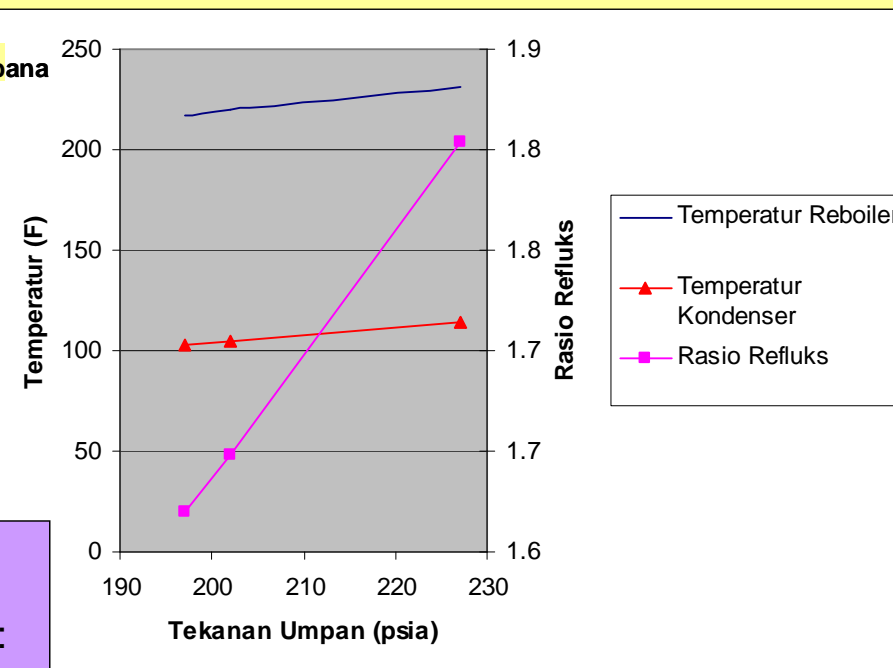
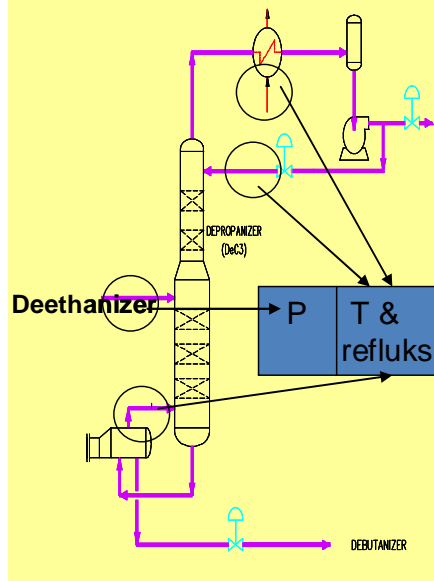
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Pengaruh Perubahan Rasio Refluks pada Unit Depropanizer



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Pengaruh Perubahan Tekanan Umpan pada Unit Depropanizer

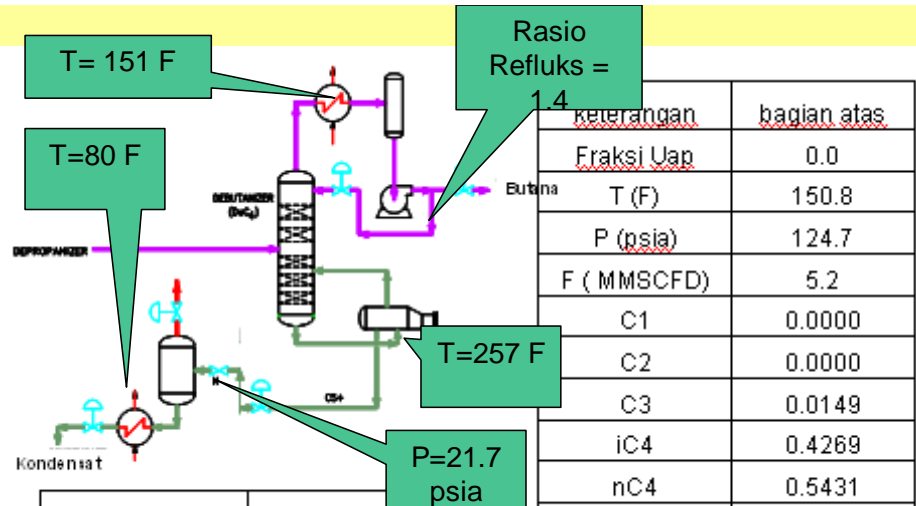


Semakin besar tekanan umpan, variabel proses : temperatur reboiler, rasio refluks dan temperatur kondenser semakin besar

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Unit Debutanizer

keterangan	umpan
Fraksi Uap	0.3
T (F)	183.8
P (psia)	126.7
F (MMSCFD)	7.8
C1	0.0000
C2	0.0000
C3	0.0100
iC4	0.2865
nC4	0.3757
iC5	0.1101
nC5	0.1000
C6	0.0965
C7	0.0212



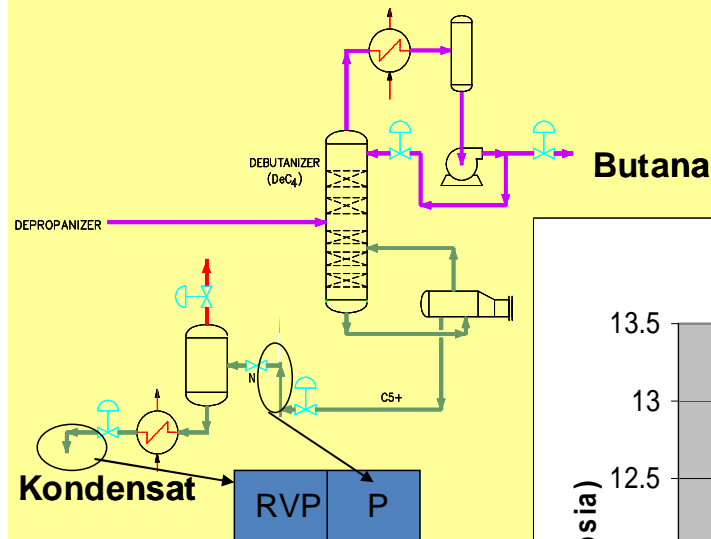
keterangan	Kondensat
Fraksi Uap	0.0
T (F)	80.0
P (psia)	21.7
F (MMSCFD)	1.3
C1	0.0000
C2	0.0000
C3	0.0000
iC4	0.0009
nC4	0.0165
iC5	0.2326
nC5	0.2558
C6	0.3875
C7	0.1068

keterangan	bagian atas
Fraksi Uap	0.0
T (F)	150.8
P (psia)	124.7
F (MMSCFD)	5.2
C1	0.0000
C2	0.0000
C3	0.0149
iC4	0.4269
nC4	0.5431
iC5	0.0125
nC5	0.0025
C6	0.0000
C7	0.0000

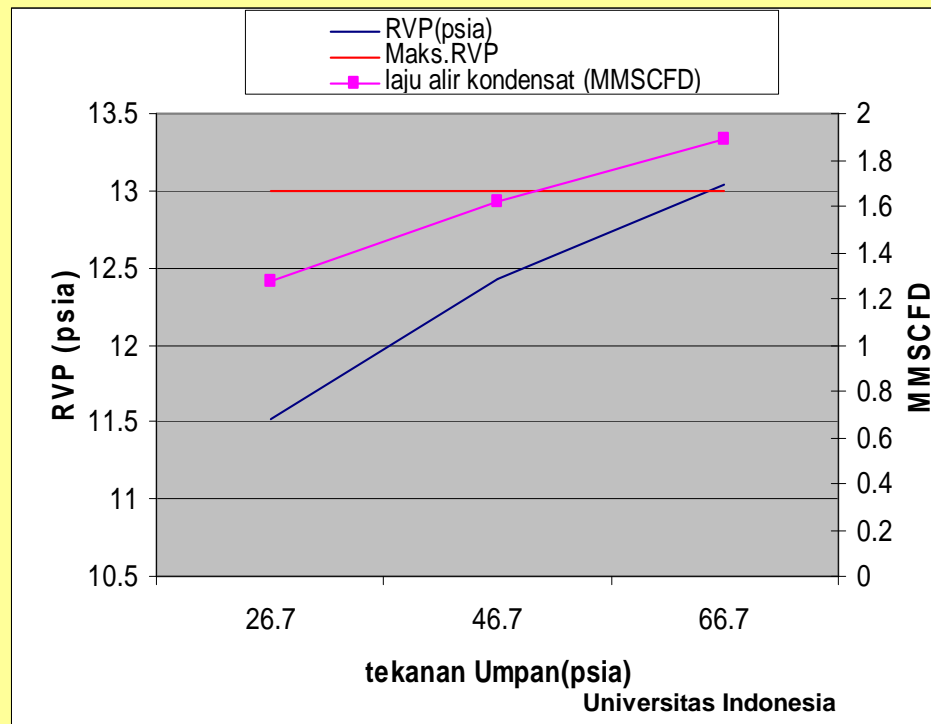
Unit Debutanizer	Kondisi Proses	Target/ Spesifikasi
Recovery C4	0.98	Min 90%
Fraksi C4 di atas kolom	0.97	Min 0.97
Fraksi C5+ di atas kolom	0.017	Maks 0.02
Fraksi C3 di atas kolom	0.015	Maks 0.02
RVP di atas kolom	61.3	Maks 70
RVP Kondensat (Psia)	11.5	Maks 13 psia
SG	0.6405	0.64-0.74

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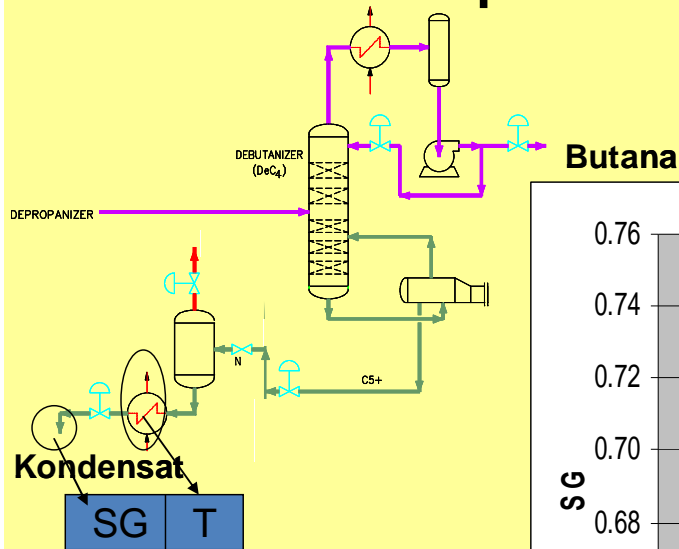
Pengaruh Perubahan Tekanan terhadap RVP Kondensat



Semakin rendah tekanan maka nilai RVP semakin rendah namun laju alir produk semakin rendah



Pengaruh Perubahan Temperatur terhadap Specific Gravity (SG)



Semakin dingin temperatur, nilai SG semakin tinggi

