

BAB IV

NERACA MASSA DAN NERACA PANAS

a. Neraca Massa

Kapasitas produk per tahun	=	10000 ton / tahun												
Waktu operasi satu tahun	=	330 hari												
Kapasitas pabrik per jam	=	$10000 \frac{\text{ton}}{\text{tahun}} \times \frac{1000 \text{ kg}}{1 \text{ ton}} \times \frac{1 \text{ tahun}}{330 \text{ hari}} \times \frac{1 \text{ hari}}{24 \text{ jam}}$												
	=	1262,6263 kg/jam												
Kemurnian	=	98,78%												
Komposisi produk	=	<table> <tr> <td>$\text{C}_5\text{H}_{12}\text{O}_4$</td> <td>=</td> <td>1247,2125 kg/jam</td> </tr> <tr> <td>HCOONa</td> <td>=</td> <td>0,7527 kg/jam</td> </tr> <tr> <td>H_2O</td> <td>=</td> <td>14,6610 kg/jam</td> </tr> <tr> <td>Total</td> <td>=</td> <td>1262,6263 kg/jam</td> </tr> </table>	$\text{C}_5\text{H}_{12}\text{O}_4$	=	1247,2125 kg/jam	HCOONa	=	0,7527 kg/jam	H_2O	=	14,6610 kg/jam	Total	=	1262,6263 kg/jam
$\text{C}_5\text{H}_{12}\text{O}_4$	=	1247,2125 kg/jam												
HCOONa	=	0,7527 kg/jam												
H_2O	=	14,6610 kg/jam												
Total	=	1262,6263 kg/jam												
Komposisi umpan	=	1. $\text{CH}_2\text{O}_{(l)}$ <table> <tr> <td>CH_2O 30%</td> <td>=</td> <td>1396,8075 kg/jam</td> </tr> <tr> <td>CH_3OH 0,5%</td> <td>=</td> <td>15,87kg/jam</td> </tr> <tr> <td>H_2O 69,5%</td> <td>=</td> <td>1955,1616 kg/jam</td> </tr> </table>	CH_2O 30%	=	1396,8075 kg/jam	CH_3OH 0,5%	=	15,87kg/jam	H_2O 69,5%	=	1955,1616 kg/jam			
CH_2O 30%	=	1396,8075 kg/jam												
CH_3OH 0,5%	=	15,87kg/jam												
H_2O 69,5%	=	1955,1616 kg/jam												
		2. $\text{CH}_3\text{CHO}_{(l)}$ <table> <tr> <td>CH_3CHO 98%</td> <td>=</td> <td>12,2434 kg/jam</td> </tr> <tr> <td>H_2O 2%</td> <td>=</td> <td>4,2751 kg/jam</td> </tr> </table>	CH_3CHO 98%	=	12,2434 kg/jam	H_2O 2%	=	4,2751 kg/jam						
CH_3CHO 98%	=	12,2434 kg/jam												
H_2O 2%	=	4,2751 kg/jam												
		3. $\text{NaOH}_{(l)}$ <table> <tr> <td>NaOH 48%</td> <td>=</td> <td>465,087 kg/jam</td> </tr> <tr> <td>H_2O 52%</td> <td>=</td> <td>226,9384 kg/jam</td> </tr> </table>	NaOH 48%	=	465,087 kg/jam	H_2O 52%	=	226,9384 kg/jam						
NaOH 48%	=	465,087 kg/jam												
H_2O 52%	=	226,9384 kg/jam												
Umpan basis	=	100 kgmol/jam												
Produk Basis	=	992,1456 kg/jam												
Produk Sebenarnya	=	1004,4071 kg/jam												
Faktor koreksi	=	$\frac{\text{produk sebenarnya}}{\text{produk basis}}$												
	=	$\frac{1004,4071}{992,1456} = 1,2571$												

MIXER - 110

Fungsi = Mengencerkan formaldehid dengan larutan *recycle* dan *make up water*

Tabel 4.1.1 Neraca Massa disekitar Mixer-110 adalah :

NM MIXER				
KOMPONEN	INPUT			OUTPUT
	ARUS 1	ARUS 2	ARUS 21	ARUS 3
	kg/jam	kg/jam	kg/jam	kg/jam
CH ₂ O	1100,6843	0,0000	296,1232	1396,8075
H ₂ O	1115,3479	416,1013	423,7123	1955,1615
CH ₃ OH	15,8700	0,0000	0,0000	15,8700
SUB TOTAL	2231,9023	416,1013	719,8355	3367,8390
TOTAL		3367,8390		3367,8390

REAKTOR - 210

Fungsi = Mereaksikan CH₂O dan CH₃CHO dengan NaOH menjadi C₅H₁₂O₄

Tabel 4.1.2 Neraca Massa disekitar Reaktor-210 adalah :

NM REAKTOR				
KOMPONEN	INPUT			OUTPUT
	Arus 3	Arus 4	Arus 5	Arus 6
	kg/jam	kg/jam	kg/jam	kg/jam
CH ₃ CHO	0,0000	512,2434	0	108,5956
CH ₂ O	1396,8075	0	0	296,1232
CH ₃ OH	15,8700	0	0	15,8700
C ₅ H ₁₂ O ₄	0	0	0	1247,4914
HCOONa	0	0	0	623,1423
NaOH	0	0	465,0870	98,5984
H ₂ O	1955,1615	4,2751	226,9384	2186,3751
SUB TOTAL	3367,8390	516,5185	692,0254	4576,2
TOTAL		4576,3829		4576,1960

NEUTRALLIZER - 310

Fungsi = Menetralkan NaOH dengan menggunakan CH_2O_2

Tabel 4.1.3 Neraca Massa disekitar Neutralizer-310 adalah :

NM NEUTRALLIZER			
KOMPONEN	INPUT		OUTPUT
	ARUS 6	ARUS 7	ARUS 8
	kg/jam	kg/jam	kg/jam
CH ₃ CHO	108,5956	0	108,5956
CH ₂ O	296,1232	0	296,1232
CH ₃ OH	15,8700	0	15,8700
C ₅ H ₁₂ O ₄	1247,4914	0	1247,4914
HCOONa	623,1423	0	790,7898
NaOH	98,5984	0	0
CH ₂ O ₂	0,0000	113,4591	0
H ₂ O	2186,3751	7,8371	2238,6222
SUBTOTAL	4576,1960	121,2962	4697,4922
TOTAL	4697,4922		4697,4922

CENTRIFUGE-410

Fungsi = Memisahkan kristal NaCOOH dengan *mother liquor*

Tabel 4.1.4 Neraca massa sekitar Centrifuge-410 adalah :

NM CENTRIFUGE-01			
KOMPONEN	INPUT		OUTPUT
	ARUS 8	ARUS 9	ARUS 16
	kg/jam	kg/jam	kg/jam
CH ₃ CHO	108,5956	0	108,5956
CH ₂ O	296,1232	0	296,1232
CH ₃ OH	15,8700	0	15,8700
C ₅ H ₁₂ O ₄	1247,4914	0	1247,4914
HCOONa	790,7898	715,5123	75,2775
H ₂ O	2238,6222	223,8622	2014,7600
SUBTOTAL	4697,4922	939,3745	3758,1177
TOTAL	4697,4922		4697,4922

ROTARY DRYER-420

Fungsi = Mengeringkan kristal NaCOOH dengan udara panas.

Tabel 4.1.5 Neraca Massa sekitar Rotary Dryer-420 :

NM ROTARY DRYER-01			
KOMPONEN	INPUT		OUTPUT
	Arus 9	Arus 10	Arus 11
	kg/jam	kg/jam	kg/jam
HCOONa	715,5123	708,3572	7,1551
H ₂ O	223,8622	22,3862	201,4760
SUBTOTAL	939,3745	730,7434	208,6311
TOTAL	939,3745	939,3745	

CYCLONE - 422

Fungsi : Menangkap padatan NaCOOH yang terikut oleh udara panas.

Tabel 4.1.6. Neraca Massa Cyclone – 01

CYCLONE-01			
KOMPONEN	INPUT		OUTPUT
	Arus 11	Arus 13	Arus 12
	kg/jam	kg/jam	kg/jam
HCOONa	7,1551	7,0836	0,0716
H ₂ O	201,4760	0,0000	201,4760
SUBTOTAL	208,6311	7,0836	201,5476
TOTAL	208,6311	208,6311	

BELT CONVEYOR - 431

Fungsi : Mendinginkan kristal NaCOOH sampai suhu kamar.

Tabel 4.1.7 Neraca Massa Belt Conveyor - 01

BELT CONVEYOR-01			
KOMPONEN	INPUT		OUTPUT
	Arus 10	Arus 13	Arus 14
	kg/jam	kg/jam	kg/jam
HCOONa	708,3572	7,0836	715,4407
H ₂ O	22,3862	0,0000	22,3862
SUBTOTAL	730,7434	7,0836	737,8270
TOTAL	737,8270	737,8270	

EVAPORATOR-510

Fungsi = Menguapkan CH_3CHO dan CH_3OH

Tabel 4.1.8 Neraca Massa sekitar Evaporator-510 :

NM EVAPORATOR-01			
KOMPONEN	INPUT		OUTPUT
	Arus 16	Arus 17	Arus 19
	kg/jam	kg/jam	kg/jam
CH_3CHO	108,5956	108,5956	0
CH_2O	296,1232	0,0000	296,1232
CH_3OH	15,8700	15,8700	0
$\text{C}_5\text{H}_{12}\text{O}_4$	1247,4914	0,0000	1247,491
HCOONa	75,2775	0,0000	75,277
H_2O	2014,7600	124,9448	1889,815
SUBTOTAL	3758,1177	249,410	3508,71
TOTAL	3758,1177	3758,1177	

KONDESOR-512

Fungsi : mengembunkan CH_3CHO , CH_3OH dan H_2O

Tabel 4.1.9 Neraca Massa sekitar kondesor-512

NM KONDENSOR-01			
KOMPONEN	INPUT		OUTPUT
	Arus 17	Arus 18	
	kg/jam	kg/jam	
CH_3CHO (g)	108,5956	0,0000	
CH_3CHO (l)	0,0000	108,5956	
CH_3OH (g)	15,8700	0,0000	
CH_3OH (l)	0,0000	15,8700	
H_2O (g)	124,9448	0	
H_2O (l)	0	124,9448	
TOTAL	249,4104	249,4104	

EVAPORATOR-520

Fungsi = Menguapkan CH_2O dan H_2O

Tabel 4.1.10 Neraca Massa sekitar Evaporator-520

NM EVAPORATOR-02			
KOMPONEN	INPUT		OUTPUT
	ARUS 19	ARUS 20	ARUS 22
	kg/jam	kg/jam	kg/jam
CH ₂ O	296,1232	296,1232	0
C ₅ H ₁₂ O ₄	1247,4914	0,0000	1247,491
HCOONa	75,2775	0,0000	75,277
H ₂ O	1889,8152	423,7123	1466,103
SUBTOTAL	3508,7072	719,836	2788,87
TOTAL	3508,7072	3508,7072	

KONDESOR-522

Fungsi : Mengkondensatkan CH_2O dan H_2O

Tabel 4.1.11 Neraca Massa sekitar kondesor-522

NM KONDENSOR		
KOMPONEN	INPUT	OUTPUT
	Arus 20	Arus 21
	kg/jam	kg/jam
CH ₂ O (g)	296,1232	0,0000
CH ₂ O (l)	0,0000	296,1232
H ₂ O (g)	423,7123	0
H ₂ O (l)	0	423,7123
TOTAL	719,8355	719,8355

KRISTALIZER-610

Tugas = Mengkristalkan larutan $C_5H_{12}O_4$

Tabel 4.1.12 Neraca Massa sekitar Kristalizer-610

KOMPONEN	NM CRISTALIZER		
	INPUT		OUTPUT
	Arus 22	Arus 23	Arus 24
	kg/jam		kg/jam
$C_5H_{12}O_4$ (s)	0	0,0000	1247,3373
$C_5H_{12}O_4$ (aq)	1247,4914	0,1541	0,0000
HCOONa	75,2775	74,5247	0,7528
H ₂ O	1466,1029	1319,4926	146,6103
subtotal	2788,8717	1394,1714	1394,7003
TOTAL	2788,8717	2788,8717	

ROTARY DRYER-620

Fungsi = Mengeringkan kristal $C_5H_{12}O_4$ dengan udara panas

Tabel 4.1.13 Neraca massa sekitar Centrifuge-620

KOMPONEN	NM ROTARY DRYER-02		
	INPUT		OUTPUT
	Arus 24	Arus 25	Arus 26
	kg/jam		kg/jam
$C_5H_{12}O_4$ (s)	1247,3373	1234,8639	12,4734
HCOONa	0,7528	0,7452	0,0075
H ₂ O	146,6103	14,6610	131,9493
SUBTOTAL	1394,7003	1250,2702	144,4302
TOTAL	1394,7003	1394,7003	

CYCLONE-622

Fungsi : Menangkap padatan $C_5H_{12}O_4$ yang terikut oleh udara panas.

Tabel 4.1.14 Neraca Massa Cyclone – 02

CYCLONE-02			
KOMPONEN	INPUT		OUTPUT
	Arus 26	Arus 27	Arus 28
	kg/jam	kg/jam	kg/jam
C ₅ H ₁₂ O ₄ (s)	12,4734	0,1247	12,3486
HCOONa	0,0075	0,0001	0,0075
H ₂ O	131,9493	131,9493	0,0000
SUBTOTAL	144,4302	132,0741	12,3561
TOTAL	144,4302	144,4302	

BELT CONVEYOR - 631

Fungsi : Mendinginkan kristal $C_5H_{12}O_4$ sampai suhu kamar.

Tabel 4.1.15 Neraca Massa Belt Conveyor – 02

BELT CONVEYOR-02			
KOMPONEN	INPUT		OUTPUT
	Arus 25	Arus 28	Arus 29
	kg/jam	kg/jam	kg/jam
C ₅ H ₁₂ O ₄ (s)	1234,8639	12,3486	1247,2125
HCOONa	0,7452	0,0075	0,7527
H ₂ O	14,6610	0,0000	14,6610
SUBTOTAL	1250,2702	12,3561	1262,6263
TOTAL	1262,6263		1262,6263

4.2 Neraca Panas

Basis perhitungan : 1 jam operasi

Suhu referensi : 298,15 K

Satuan Panas (energi) : KJ

Satuan Cp : J/mol K

Tekanan : atm

Kapasitas panas bahan dipengaruhi suhu, Cp = f(T) mengikuti persamaan :

$$C_p = A + BT + CT^2 + DT^3 + ET^4$$

Dalam bentuk integral:

$$\int C_p dT = A(T - 298) + \frac{B}{2}(T^2 - 298^2) + \frac{C}{3}(T^3 - 298^3) + \frac{D}{4}(T^4 - 298^4) + \frac{E}{5}(T^5 - 298^5)$$

Keterangan:

Cp = Kapasitas panas (J/kmol K)

A,B,C,D,E = Koefisien regresi komponen

Data konstanta kapasitas panas masing-masing komponen dalam berbagai wujud:

Tabel 4.2.1 Konstanta Kapasitas Panas

Komponen	CP=A+BT+CT ² +DT ³ +E ⁴					BM kg/kmol
	A	B	C	D	E	
CH ₂ O(g)	34,428	-0,0298	0,000151	-0,000000127	3,39E-11	30,031
CH ₃ OH(g)	40,046	-0,038287	0,0002453	-2,1679E-07	5,990E-11	32,0417
CH ₃ CHO(g)	30,827	-0,007604	0,0003235	-3,2747E-07	9,727E-11	44,0524
H ₂ O(g)	33,933	-0,008481	-2,99E-05	-0,00017825	3,693E-12	18,0152
CH ₂ O(l)	17,4	0	0	0	0	30,031
CH ₃ OH(l)	40,152	0,31046	-0,001029	1,4598E-06	0	32,0417
CH ₃ CHO(l)	45,056	0,44853	-0,001661	0,0000027	0	44,0524
H ₂ O(l)	92,053	-0,039953	-0,000211	5,3469E-07	0	18,0152
NaOH(l)	87,639	-1,925564	-4,54E-06	1,1863E-09	0	39,997
CH ₂ O ₂ (l)	-16,11	0,87229	-0,002367	2,4454E-06	0	46,0253
C ₅ H ₁₂ O ₄ (aq)	-1429,74	9,5192	-0,01668	0,000010341	0	136,1459
NaCOOH(aq)	27,1	0	0	0	0	68,0071
C ₅ H ₁₂ O ₄ (s)	694,78	-3,7257	6822,1	0	0	136,1459
NaCOOH(s)	18,3	0	0	0	0	68,0071

MIXER - 110

Fungsi = Mengencerkan senyawa formaldehid dari *recycle* dan *make up water*

Tabel 4.2.2 Neraca Panas sekitar Mixer 120

KOMPONEN	Q masuk,kj/jam			Q
	ARUS 1	ARUS 2	ARUS 14	keluar,kj/jam
CH ₂ O	3188,6896	0,0000	857,8708	744,4818
H ₂ O	332,5363	8718,8907	8878,37	7541,7585
CH ₃ OH	13948,5873	0,0000	0,00	36,4334
SUB TOTAL	17469,8132	8718,8907	9736,24	8322,6737
	panas yang dikeluarkan			27602,2722
TOTAL	35924,9459			45213,0387

HEATER-216

Fungsi = Menaikkan suhu CH₂O dari 30°C sampai 35°C

Tabel 4.2.3 Neraca Panas sekitar heater-216

KOMPONEN	Q masuk	Q keluar
CH ₂ O	832,0814	8191,308
H ₂ O	8429,0385	82873,84
CH ₃ OH	40,7224	519,5324
Subtotal	9301,8424	91584,68
Q loss		4330,67578
Beban pemanas	86613,5157	
Total	95915,36	95915,36

HEATER-217

Fungsi = Menaikkan suhu CH_3CHO dari tangki dari 30°C sampai 35°C

Tabel 4.2.4 Neraca Panas sekitar heater-217

Komponen	Qmasuk	Q keluar
CH_3CHO	1070,4491	210476,8131
H_2O	3048,5233	600554,1993
Sub Total	4896,1094	874694,0983
Q loss		45802,8037
Beban Pemanas	916056,0740	
Total	920496,9020	927607,7951

REAKTOR-210

Fungsi = Mereaksikan CH_2O dan CH_3CHO dengan NaOH agar menjadi $\text{C}_5\text{H}_{12}\text{O}_4$

Tabel 4.2.5 Neraca Panas sekitar Reaktor 210

Neraca panas				
Komponen	Q masuk			Q keluar
	arus 3	arus 4	arus 5	arus 6
CH_3CHO	0	12197,145	0	2585,7947
CH_2O	8191,3083	0	0	1736,5574
CH_3OH	519,5324	0	0	402,8729
$\text{C}_5\text{H}_{12}\text{O}_4$	0	0	0	19581,4363
HCOONa	0	0	0	2513,2723
NaOH	0	0	-58431,38	-12387,4519
H_2O	82873,8415	89,6903	9619,29	92582,8170
Panas Reaksi				122,0759
Beban pendingin		52077,9486		
Sub Total	91584,6823	12286,835	-48812,09	107015,2987
Total		107137,3746		107137,3746

NEUTRALIZER-310

Fungsi = Menetralkan NaOH dengan menggunakan CH_2O_2

Tabel 4.2.6 Neraca Panas sekitar Reaktor-310

Komponen	Q masuk		Q keluar
	arus 6	arus 7	arus 8
CH ₃ CHO	1287,0942	0,0000	1287,094
CH ₂ O	868,2787	0,0000	868,279
CH ₃ OH	200,8787	0,0000	200,879
C ₅ H ₁₂ O ₄	-1245260,3	0,0000	9529
HCOONa	1256,6361	0,0000	1594,716
NaOH	-6133,5954	0,0000	0,000
CH ₂ O ₂	0,0000	1231,1919	0,000
H ₂ O	46322,8231	166,2086	47430,88
Panas Reaksi			46,1215
Beban pendingin	1261017,8040		
Sub Total	-1201458,2	1397,4005	60910,89
Total	60957,0133		60957,01

CENTRIFUGE-410

Fungsi = Memisahkan padatan HCOONa dengan *mother liquor*

Tabel 4.2.7 Neraca Panas sekitar CF- 330

Komponen	Q masuk	Q keluar	
	Arus 8	Arus 9	Arus 10
CH ₃ CHO	1287,0942	0,0000	1287,094
CH ₂ O	868,2787	0,0000	868,2787
CH ₃ OH	200,8787	0,0000	200,8787
C ₅ H ₁₂ O ₄	9529,0438	0,0000	9529,044
HCOONa	1594,7159	1442,9105	151,8054
H ₂ O	47430,8805	474,3088	46956,57
Sub Total		1917,2193	58993,67
Total	60910,8918	60910,8918	

ROTARY DRYER - 01

Fungsi : Meringankan kristal NaCOOH dengan udara panas.

Tabel 4.2.8 Neraca Panas Rotary Dryer - 01

KOMPONEN	Q MASUK (kJ/jam)	Q KELUAR (kJ/jam)	
	ARUS 7	ARUS 8	ARUS 9
NaCOOH	85905,1604	1099,9753	108897,5551
H ₂ O	4752,4933	9735,3529	603,0152
Beban Pemanas	29678,2448		
Subtotal	90657,6538	10835,3282	109500,5703
Total	120335,8985	120335,8985	

BELT CONVEYOR - 01

Fungsi : Mendinginkan kristal NaCOOH sampai suhu kamar.

Tabel 4.2.9 Neraca Panas Belt Conveyor - 01

Komponen	Input (kJ/jam)		Output (kJ/jam)	
	Arus 9	Arus 17	Arus 20	Q Lepas
NaCOOH	108897,5551	1088,9756	5455,7220	-
H ₂ O	603,0152	-	31,7914	-
Sub Total	109517,6118	1088,9756	5488,3947	105118,1926
Total	110606,5873	110606,5873		

HEATER-514

Fungsi = Menaikkan suhu bahan dari 30°C sampai 70°C

Tabel 4.2.10 Neraca Panas sekitar heater-514

KOMPONEN	Q masuk	Q keluar
CH ₃ CHO	1287,0942	12047,568
CH ₂ O	868,2787	7814,508
CH ₃ OH	200,8787	1851,667
C ₅ H ₁₂ O ₄	9529,0438	103245,45
HCOONa	151,8054	1366,249
H ₂ O	46956,5717	421077,26
SUB TOTAL	58993,6725	547402,70
Q loss		25705,7381
Beban pemanas	514114,7624	
TOTAL	573108,43	573108,43

EVAPORATOR-510

Tugas = Menguapkan CH₃CHO, CH₃OH dan H₂O

Tabel 4.2.11 Neraca Panas sekitar Evaporator-510

Komponen	Panas Masuk		Panas Keluar	
	Arus 10	Arus 11	Arus 13	
CH ₃ CHO	12047,5676	5826,136	0,000	
CH ₂ O	7814,5081	0,000	7814,508	
CH ₃ OH	1851,6669	1048,695	0,000	
C ₅ H ₁₂ O ₄	103245,449	0,000	103245,4	
HCOONa	1366,2488	0,000	1366,249	
H ₂ O	421077,257	10987,15	410090,1	
Sub total	547402,697	17861,98	522516,3	
beban pemanas	-7.394,11			
Q loss			-369,71	
Total	540.008,59		540.008,59	

KONDESOR-522

Tugas = Mengkondensasikan CH_3CHO , CH_3OH dan H_2O untuk di distilasi

Tabel 4.2.12 Neraca Panas sekitar Kondesor-522

Komponen	Panas Masuk	Panas Keluar
	Arus 13	Arus 14
CH_3CHO	5826,1364	1287,094
CH_3OH	1048,6951	200,879
H_2O	10987,1516	1225,236
Sub total	17861,983	2713,21
beban pendingin		15148,77
Total	17.861,98	17.861,98

HEATER-523

Fungsi = Menaikkan suhu bahan dari 70°C sampai 100°C

Tabel 4.2.13 Neraca Panas sekitar heater-523

KOMPONEN	Q masuk	Q keluar
CH_2O	7814,5081	13024,180
$\text{C}_5\text{H}_{12}\text{O}_4$	103245,449	190785,02
HCOONa	1366,2488	2277,081
H_2O	410090,105	683637,03
SUB TOTAL	522516,311	889723,31
Q loss		19326,6842
Beban pemanas	386533,6838	
TOTAL	909049,99	909049,99

EVAPORATOR-520

Tugas = Menguapkan CH_2O dan H_2O

Tabel 4.2.14 Neraca Panas sekitar Evaporator-520

Komponen	Panas Masuk		Panas Keluar	
	Arus 13	Arus 14	Arus 16	
CH_2O	13024,1802	27760,094	0,000	
$\text{C}_5\text{H}_{12}\text{O}_4$	190785,017	0,000	190785,0	
HCOONa	2277,0813	0,000	2277,1	
H_2O	683637,032	218826,90	464810,1	
Sub total	889723,310	246586,99	657872,2	
beban pemanas	15.511,49			
Q loss			775,57	
Total	905.234,80	905.234,80		

KONDESOR-522

Tugas = Mengkondensasikan CH_2O dan H_2O untuk di distilasi

Tabel 4.2.15 Neraca Panas sekitar Kondesor-522

Komponen	Panas Masuk		Panas Keluar	
	Arus 14	Arus 15		
CH_2O	27760,0945	868,279		
H_2O	218826,898	14638,245		
Sub total	246586,992	15506,52		
beban pendingin			231080,47	
Total	246.586,99	246.586,99		

COOLER-612

Fungsi = Menurunkan suhu larutan dari evaporator 100°C menjadi 30°C

Tabel 4.2.16 Neraca Panas sekitar cooler-612

Komponen	Panas Masuk	Panas Keluar
$\text{C}_5\text{H}_{12}\text{O}_4$	190785,0173	-1,1106228
HCOONa	2277,081271	-151,80542
H_2O	464810,134	-31140,849
Sub total	657872,233	-31293,76
beban pendingin		689166,00
Total	657.872,23	657.872,23

KRISTALIZER-612

Fungsi = Mengkristalkan larutan $C_5H_{12}O_4$

Tabel 4.2.17 Neraca Panas sekitar kristalizer-612

Komponen	Q masuk	Q keluar
$C_5H_{12}O_4$ (s)	1511,0234	-1513,5767
$C_5H_{12}O_4$ (aq)	50466,0679	-9093,6905
HCOONa	0,1031	-0,0508
H ₂ O	0,0782	-0,0357
panas kristalisasi	-1413158,6124	
Sub Total	-1284247,6050	-107725,5855
Beban pendingin		-1176522,02
Total	-1284247,6050	-1284247,6050

ROTARY DRYER - 02

Fungsi : Mengeringkan kristal $C_5H_{12}O_4$ dengan udara panas.

Tabel 4.2.18 Neraca Panas Rotary Dryer - 02

Komponen	Input (kJ/jam)		Output (kJ/jam)	
	Arus 11	Arus 13	Arus 14	
$C_5H_{12}O_4$ (s)	10692,9699	534,6485	52930,2012	
HCOONa	942,9825	1905,3949	470,4968	
H ₂ O	8,0979	0,4049	40,0848	
Beban pemanas	44237,1808	-	-	
Sub Total	11644,0504	2440,4483	53440,7829	
Total	55881,2312		55881,2312	

BELT CONVEYOR - 02

Fungsi : Mendinginkan kristal $C_5H_{12}O_4$ sampai suhu kamar.

Tabel 4.2.19 Neraca Panas Belt Conveyor - 02

Komponen	Input (kJ/jam)		Output (kJ/jam)	
	Arus 15	Arus 19	Arus 21	Q Lepas
$C_5H_{12}O_4$ (s)	52930,2012	529,3020	15003,0554	-
HCOONa	470,4968	-	31,4735	-
H ₂ O	40,0848	0,4008	2,6990	-
Sub Total	53440,7829	529,7029	15037,2280	38933,2578
Total	53970,4858		53970,4858	