



BAB III
NERACA MASSA

Kapasitas Produksi = 30.000 ton/tahun
 = 30.000.000 kg/tahun
 Waktu Operasi = 330 hari
 = 24 jam/hari
 Laju Produksi = $\frac{30.000.000 \text{ kg}}{1 \text{ tahun}} \times \frac{1 \text{ tahun}}{330 \text{ hari}} \times \frac{1 \text{ hari}}{24 \text{ jam}}$
 = 90.909,091 kg/hari
 = 3.787,879 kg/jam
 Basis Bahan Baku = 2.377,589 kg/jam

Komposisi Bahan Baku

1. Sikloheksanol (C₆H₁₁OH)

Komponen	%w/w	Fraksi
C ₆ H ₁₁ OH _(l)	99%	0,99
H ₂ O _(l)	1%	0,01

2. Asam Nitrat

Komponen	%	Fraksi
HNO _{3(l)}	58%	0,58
H ₂ O _(l)	42%	0,42

1. REAKTOR (R-210)

Neraca Massa pada Reaktor			
Aliran Masuk (kg/jam)		Aliran Keluar (kg/jam)	
Aliran 1		Aliran 3	
(Tangki C ₆ H ₁₁ OH 99%)		(menuju Evaporator)	
C ₆ H ₁₁ OH _(l)	2.353,813	C ₆ H ₁₁ OH _(l)	94,153
H ₂ O _(l)	23,776	HNO _{3(l)}	473,870
Total	2.377,589	H ₂ O _(l)	7.031,616
Aliran 2		C ₆ H ₁₀ O _{4(l)}	3.297,061
(Tangki HNO ₃ 58%)		Total	10.896,700
HNO _{3(l)}	11.846,760	Aliran 4	
H ₂ O _(l)	4.975,639	(menuju Scrubber)	
Total	16.822,399	NO _{2(g)}	8.303,289
Total	19.199,988	Total	19.199,988

**2. SCRUBBER (D-220)**

Neraca Massa pada Scrubber			
Aliran Masuk (kg/jam)		Aliran Keluar (kg/jam)	
Aliran 4		Aliran 6	
(dari Reaktor)		(menuju ke Lingkungan)	
NO _{2(g)}	8.303,289	NO _{2(g)}	41,309
Total	8.303,289	NO _(g)	1.796,421
Aliran 5		Total	1.837,730
(dari Process Water)		Aliran 7	
H ₂ O _(l)	1.078,3	(menuju Pengolahan Limbah)	
Total	1.078,3	HNO _{3(l)}	7.543,892
		Total	7.543,892
Total	9.381,62	Total	9.381,62

3. EVAPORATOR (V-310)

Neraca Massa pada Evaporator			
Aliran Masuk (kg/jam)		Aliran Keluar (kg/jam)	
Aliran 3		Aliran 8	
(dari Reaktor)		(menuju Kondensor)	
C ₆ H ₁₁ OH _(l)	94,153	H ₂ O _(g)	6.577,728
HNO _{3(l)}	473,870	HNO _{3(g)}	473,870
H ₂ O _(l)	7.031,616		
C ₆ H ₁₀ O _{4(l)}	3.297,061		
Total	10.896,700	Total	7.051,599
Aliran 11		Aliran 9	
(dari Recycle Centrifuge)		(menuju Crystallizer)	
H ₂ O _(l)	66,869	H ₂ O _(l)	520,757
C ₆ H ₁₀ O _{4(l)}	64,699	C ₆ H ₁₀ O _{4(l)}	3.361,760
C ₆ H ₁₁ OH _(l)	92,379	C ₆ H ₁₁ OH _(l)	186,532
Total	223,947	Total	4.069,048
Total	11.120,647	Total	11.120,647



4. CRYSTALLIZER (X-320)

Neraca Massa pada Crystallizer dengan Recycle			
Aliran Masuk (kg/jam)		Aliran Keluar (kg/jam)	
Aliran 9		Aliran 10	
(dari Evaporator)		(menuju Centrifuge)	
$C_6H_{11}OH_{(l)}$	186,532	$C_6H_{11}OH_{(l)}$	186,532
$H_2O_{(l)}$	520,757	$H_2O_{(l)}$	39,228
$C_6H_{10}O_{4(l)}$	3.361,760	$C_6H_{10}O_{4(l)}$	67,235
		$C_6H_{10}O_{4(s)}$	3.776,054
Total	4.069,048	Total	4.069,048

5. CENTRIFUGE

Neraca Massa Centrifuge			
Aliran Masuk (kg/jam)		Aliran Keluar (kg/jam)	
Aliran 10		Aliran 12	
(dari Crystallizer)		(menuju Rotary Dryer)	
$C_6H_{11}OH_{(l)}$	186,532	$C_6H_{11}OH_{(l)}$	3,462
$H_2O_{(l)}$	39,228	$H_2O_{(l)}$	38,500
$C_6H_{10}O_{4(l)}$	67,235	$C_6H_{10}O_{4(l)}$	1,248
$C_6H_{10}O_{4(s)}$	3.776,054	$C_6H_{10}O_{4(s)}$	3.776,054
Total	4.069,048	Total	3.819,263
		Aliran 11	
		(Recycle menuju Evaporator)	
		$H_2O_{(l)}$	0,728
		$C_6H_{10}O_{4(l)}$	65,987
		$C_6H_{11}OH_{(l)}$	183,070
		Total	249,785
Total	4.069,048	Total	4.069,048



6. MOLECULAR SIEVE (D-413)

Neraca Massa Molecular Sieve			
Aliran Masuk (kg/jam)		Aliran Keluar (kg/jam)	
Aliran 13		Aliran 14	
(dari Udara Bebas)		(menuju Heater)	
Udara Bebas	1.175,429	Udara Kering	1.161,458
		Total	1.161,458
		Terserap Molecular Sieve	
		H ₂ O _(l)	13,971
		Total	13,971
Total	1.175,429	Total	1.175,429

7. ROTARY DRYER (B-410)

Neraca Massa Rotary Dryer			
Aliran Masuk (kg/jam)		Aliran Keluar (kg/jam)	
Aliran 12		Aliran 15	
(dari Centrifuge)		(menuju Cooling Conveyor)	
C ₆ H ₁₁ OH _(l)	3,462	C ₆ H ₁₁ OH _(l)	3,427
H ₂ O _(l)	38,500	H ₂ O _(l)	7,494
C ₆ H ₁₀ O _{4(l)}	1,248	C ₆ H ₁₀ O _{4(l)}	1,235
C ₆ H ₁₀ O _{4(s)}	3.776,054	C ₆ H ₁₀ O _{4(s)}	3.738,293
Total	3.819,263	Total	3.750,450
Aliran 14		Aliran 16	
(dari Heater)		(menuju Cyclone)	
Udara panas	12.944,7950	C ₆ H ₁₁ OH _(g)	0,035
		H ₂ O _(g)	31,006
		C ₆ H ₁₀ O _{4(g)}	0,012
		C ₆ H ₁₀ O _{4(s)}	37,761
		Udara panas	12.944,795
		Total	13.013,608
Total	16.764,058	Total	16.764,058



8. CYCLONE (H-415)

Neraca Massa Cyclone			
Aliran Masuk (kg/jam)		Aliran Keluar (kg/jam)	
Aliran 16		Aliran 17	
(dari Rotary Dryer)		(menuju Cooling Conveyor)	
$C_6H_{11}OH_{(g)}$	0,035	$C_6H_{11}OH_{(l)}$	0,034
$H_2O_{(g)}$	31,006	$C_6H_{10}O_{4(l)}$	0,012
$C_6H_{10}O_{4(g)}$	0,012	$C_6H_{10}O_{4(s)}$	37,383
$C_6H_{10}O_{4(s)}$	37,761	Total	37,430
Udara Panas	12.944,795	Aliran 18	
Total	13.013,608	(menuju Lingkungan)	
		$C_6H_{11}OH_{(g)}$	0,000
		$H_2O_{(g)}$	31,006
		$C_6H_{10}O_{4(g)}$	0,000
		$C_6H_{10}O_{4(s)}$	0,378
		Udara panas	12.944,795
		Total	12.976,179
Total	13.013,608	Total	13.013,608

9. COOLING CONVEYOR (J-417)

Neraca Massa Cooling Conveyor			
Aliran Masuk (kg/jam)		Aliran Keluar (kg/jam)	
Aliran 15		Aliran 19	
(Kristal dari Rotary Dryer)		(menuju Ball Mill)	
$C_6H_{11}OH_{(l)}$	3,427	$C_6H_{11}OH_{(l)}$	3,462
$H_2O_{(l)}$	7,494	$H_2O_{(l)}$	7,494
$C_6H_{10}O_{4(l)}$	1,235	$C_6H_{10}O_{4(l)}$	1,248
$C_6H_{10}O_{4(s)}$	3.738,293	$C_6H_{10}O_{4(s)}$	3.775,676
Total	3.750,450	Total	3.787,879
Aliran 17			
(Kristal dari Cyclone)			
$C_6H_{11}OH_{(l)}$	0,034		
$C_6H_{10}O_{4(l)}$	0,012		
$C_6H_{10}O_{4(s)}$	37,383		
Total	37,430		
Total	3.787,879	Total	3.787,879

**10. BALL MILL (C-510)**

Neraca Massa Ball Mill			
Aliran Masuk (kg/jam)		Aliran Keluar (kg/jam)	
Aliran 19		Aliran 20	
(dari Cooling Conveyor)		(menuju Bin Produk)	
$C_6H_{11}OH_{(l)}$	3,462	$C_6H_{11}OH_{(l)}$	3,462
$H_2O_{(l)}$	7,494	$H_2O_{(l)}$	7,494
$C_6H_{10}O_{4(l)}$	1,248	$C_6H_{10}O_{4(l)}$	1,248
$C_6H_{10}O_{4(s)}$	3.775,676	$C_6H_{10}O_{4(s)}$	3.775,676
Total	3.787,879	Total	3.787,879

Spesifikasi Produk:

Komponen	Massa (kg)	Persen Berat (%)
$C_6H_{11}OH_{(l)}$	3,462	0,001
$H_2O_{(l)}$	7,494	0,002
$C_6H_{10}O_{4(l)}$	1,248	0,000
$C_6H_{10}O_{4(s)}$	3.775,676	0,997
Total	3.787,879	1,00

Spesifikasi Produk Komersial:Kadar $C_6H_{10}O_{4(s)}$ = 99,7%Kadar $H_2O_{(l)}$ = 0,20%

Maka, produk $C_6H_{10}O_4$ telah memenuhi syarat komersial, yaitu dengan kadar kemurnian sebesar = 99%