

**BAB IV**  
**NERACA PANAS**

Kapasitas Produksi	=	30.000	ton/tahun
	=	30.000.000	kg/tahun
Waktu Operasi	=	330	hari
	=	24	jam/hari
Laju Produksi	=	$\frac{30.000.000}{1} \frac{\text{kg}}{\text{tahun}} \times \frac{1 \text{ tahun}}{330 \text{ hari}} \times \frac{1 \text{ hari}}{24 \text{ jam}}$	
	=	90.909,091	kg/hari
	=	3.787,879	kg/jam
Satuan Panas	=		Kilokalori/jam

**1. HEATER SIKLOHEKSANOL (E-112)**

Neraca Panas pada Heater Sikloheksanol			
Panas Masuk (kkal/jam)		Panas Keluar (kkal/jam)	
Aliran 1		Aliran 3	
(dari Tangki Sikloheksanol 99%)		(menuju Reaktor)	
C <sub>6</sub> H <sub>11</sub> OH	7.288,896	C <sub>6</sub> H <sub>11</sub> OH	52.662,379
H <sub>2</sub> O	118,991	H <sub>2</sub> O	830,342
<b>Total</b>	<b>7.407,887</b>	<b>Total</b>	<b>53.492,721</b>
(Steam dari Unit Utilitas)		Q <sub>loss</sub>	2.425,518
Q <sub>supply</sub>	48.510,352		
<b>Total</b>	<b>55.918,238</b>	<b>Total</b>	<b>55.918,238</b>

**2. HEATER ASAM NITRAT (E-122)**

Neraca Panas pada Heater Asam Nitrat			
Panas Masuk (kkal/jam)		Panas Keluar (kkal/jam)	
Aliran 2		Aliran 3	
(dari Tangki Asam Nitrat 58%)		(menuju Reaktor)	
HNO <sub>3</sub>	24.877,51	HNO <sub>3</sub>	175.957,42
H <sub>2</sub> O	24.901,60	H <sub>2</sub> O	173.767,73
<b>Total</b>	<b>49.779,11</b>	<b>Total</b>	<b>349.725,15</b>
(Steam dari Unit Utilitas)		Q <sub>loss</sub>	15.786,63
Q <sub>supply</sub>	315.732,68		
<b>Total</b>	<b>365.511,78</b>	<b>Total</b>	<b>365.511,78</b>



### 3. REAKTOR (R-210)

Neraca Panas pada Reaktor			
Panas Masuk (kkal/jam)		Panas Keluar (kkal/jam)	
Aliran 1		Aliran 3	
(dari Heater Sikloheksanol)		(menuju Evaporator)	
C <sub>6</sub> H <sub>11</sub> OH <sub>(l)</sub>	52.662,3788	C <sub>6</sub> H <sub>11</sub> OH <sub>(l)</sub>	2.106,8977
H <sub>2</sub> O <sub>(l)</sub>	830,3421	HNO <sub>3(l)</sub>	57.228,2726
<b>Total</b>	<b>53.492,7209</b>	H <sub>2</sub> O <sub>(l)</sub>	7.039,6418
Aliran 2		C <sub>6</sub> H <sub>10</sub> O <sub>4(l)</sub>	245.616,9859
(dari Heater Asam Nitrat)		<b>Total</b>	<b>311.991,7980</b>
HNO <sub>3(l)</sub>	175.957,4173	Aliran 4	
H <sub>2</sub> O <sub>(l)</sub>	173.767,7327	(menuju Scrubber)	
<b>Total</b>	<b>349.725,150</b>	NO <sub>2(g)</sub>	57.841,888
ΔH <sub>reaksi</sub>	28.758,46	Q <sub>serap</sub>	125.825,447
<b>Total</b>	<b>431.976,33</b>	<b>Total</b>	<b>431.976,33</b>

### 4. SCRUBBER (D-220)

Neraca Panas pada Scrubber			
Panas Masuk (kkal/jam)		Panas Keluar (kkal/jam)	
Aliran 4		Aliran 6	
(dari Reaktor)		(menuju ke Lingkungan)	
NO <sub>2</sub>	57.841,888	NO <sub>2</sub>	287,763
<b>Total</b>	<b>57.841,888</b>	NO	14.996,297
Aliran 5		<b>Total</b>	<b>287,763</b>
(dari Process Water)		Aliran 7	
H <sub>2</sub> O	5.396,740	(menuju ke Pengolahan Limbah)	
<b>Total</b>	<b>5.396,740</b>	HNO <sub>3</sub>	63.645,102
Q <sub>supply</sub>	16.516,353	<b>Total</b>	<b>63.645,102</b>
		Q <sub>loss</sub>	825,818
<b>Total</b>	<b>79.754,980</b>	<b>Total</b>	<b>64.758,683</b>



**5. EVAPORATOR (V-310)**

Neraca Panas pada Evaporator			
Panas Masuk (kkal/jam)		Panas Keluar (kkal/jam)	
Aliran 1		Aliran 3	
(dari Reaktor)		(menuju Crystallizer)	
$C_6H_{11}OH_{(l)}$	2.106,50	$C_6H_{11}OH_{(l)}$	9.321,9115
$HNO_3_{(l)}$	7.038,30	$H_2O_{(l)}$	38.960,5465
$H_2O_{(l)}$	245.570,05	$C_6H_{10}O_{4(aq)}$	129.516,7326
$C_6H_{10}O_{4(l)}$	57.217,34	<b>Total</b>	<b>177.799,191</b>
<b>Total</b>	<b>311.932,18</b>		
Aliran 11		Aliran 4	
(dari Recycle Centrifuge)		(menuju Kondensor)	
$C_6H_{11}OH_{(l)}$	2.066,82	$H_2O_{(g)}$	3.725.118,489
$H_2O_{(l)}$	2.335,32	$HNO_3_{(g)}$	78.674,920
$C_6H_{10}O_{4(l)}$	1.122,79	<b>Total</b>	<b>3.803.793,41</b>
<b>Total</b>	<b>5.524,93</b>		
$Q_{supply}$	3.856.985	$Q_{loss}$	192.849,236
<b>Total</b>	<b>4.174.441,84</b>	<b>Total</b>	<b>4.174.441,84</b>

**6. KONDENSOR EVAPORATOR (E-311)**

Neraca Panas pada Kondensor			
Panas Masuk (kkal/jam)		Panas Keluar (kkal/jam)	
Aliran 1		Steam Condensate	
(dari Evaporator)		(dilakukan Proses Kondensasi)	
$HNO_3_{(l)}$	78.674,92	$HNO_3_{(g)}$	2.481,27
$H_2O_{(l)}$	3.725.118,49	$H_2O_{(g)}$	73.482,25
<b>Total</b>	<b>3.803.793,41</b>	<b>Total</b>	<b>75.963,52</b>
		ke Process Water	
		$HNO_3_{(l)}$	70.569,52
		$H_2O_{(l)}$	3.487.467,22
		<b>Total</b>	<b>3.558.036,74</b>
		$Q_{serap}$	169.793,15
<b>Total</b>	<b>3.803.793,41</b>	<b>Total</b>	<b>3.803.793,41</b>



**7. CRYSTALLIZER (X-320)**

Neraca Panas pada Crystallizer			
Panas Masuk (kkal/jam)		Panas Keluar (kkal/jam)	
Aliran 9		Aliran 10	
(dari Evaporator)		(menuju Centrifuge)	
$C_6H_{11}OH_{(l)}$	9.321,91	$C_6H_{11}OH_{(l)}$	352,4199
$C_6H_{10}O_{4(l)}$	129.516,73	$C_6H_{10}O_{4(l)}$	161,5428
$H_2O_{(l)}$	38.960,55	$H_2O_{(l)}$	196,3241
<b>Total</b>	<b>177.799,19</b>	$C_6H_{10}O_{4(s)}$	6.449,7169
		<b>Total</b>	<b>7.160,0037</b>
$Q_{crystallization}$	235,32	$Q_{serap}$	170.874,50
<b>Total</b>	<b>178.034,51</b>	<b>Total</b>	<b>178.034,51</b>

**8. ROTARY DRYER (B-410)**

Neraca Panas pada Rotary Dryer			
Panas Masuk (kkal/jam)		Panas Keluar (kkal/jam)	
Aliran 12		Aliran 15	
(Kristal Basah dari Crystallizer)		(menuju Cooling Conveyor)	
$C_6H_{11}OH_{(l)}$	10,7206	$C_6H_{11}OH_{(l)}$	201,7765
$H_2O_{(l)}$	192,6803	$H_2O_{(l)}$	652,6873
$C_6H_{10}O_{4(l)}$	2,9982	$C_6H_{10}O_{4(l)}$	55,8925
$C_6H_{10}O_{4(s)}$	6.449,7169	$C_6H_{10}O_{4(s)}$	130.285,6358
<b>Total</b>	<b>6.645,40</b>	<b>Total</b>	<b>130.994,22</b>
Aliran 14		Aliran 16	
(dari Heater)		(menuju Cyclone)	
Udara Panas	575.525,59	$C_6H_{11}OH_{(g)}$	2,0381
		$H_2O_{(g)}$	2.700,4234
		$C_6H_{10}O_{4(g)}$	0,5646
		$C_6H_{10}O_{4(s)}$	1.316,0165
		Udara panas	447.159,7630
		<b>Total</b>	<b>451.176,77</b>
<b>Total</b>	<b>582.170,98</b>	<b>Total</b>	<b>582.170,98</b>



## 9. HEATER UDARA (E-411)

Neraca Panas pada Heater Udara			
Panas Masuk (kkal/jam)		Panas Keluar (kkal/jam)	
Aliran 13		Aliran 14	
(dari Lingkungan)		(menuju Rotary Dryer)	
Udara Bebas	16.828,234	Udara Panas	575.525,588
(Steam dari Unit Utilitas)		$Q_{\text{loss}}$	29.405,124
$Q_{\text{supply}}$	588.102,478		
<b>Total</b>	<b>604.930,712</b>	<b>Total</b>	<b>604.930,712</b>

## 10. COOLING CONVEYOR (J-417)

Neraca Panas pada Cooling Conveyor			
Panas Masuk (kkal/jam)		Panas Keluar (kkal/jam)	
Aliran 15		Aliran 19	
(dari Rotary Dryer)		(menuju Ball Mill)	
$C_6H_{11}OH_{(l)}$	201,7765	$C_6H_{11}OH_{(l)}$	10,7195
$H_2O_{(l)}$	652,6873	$H_2O_{(l)}$	37,5055
$C_6H_{10}O_{4(l)}$	55,8925	$C_6H_{10}O_{4(l)}$	2,9979
$C_6H_{10}O_{4(s)}$	130.285,6358	$C_6H_{10}O_{4(s)}$	6.449,0720
<b>Total</b>	<b>131.195,99</b>	<b>Total</b>	<b>6.500,295</b>
Aliran 16			
(dari Cyclone)			
$C_6H_{11}OH_{(l)}$	2,0178		
$C_6H_{10}O_{4(l)}$	0,5589		
$C_6H_{10}O_{4(s)}$	1.302,8564		
<b>Total</b>	<b>1.305,43</b>	$Q_{\text{serap}}$	126.001,13
<b>Total</b>	<b>132.501,43</b>	<b>Total</b>	<b>132.501,43</b>