

## DAFTAR PUSTAKA

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## LAMPIRAN

### 1. Contoh Perhitungan ( Temperatur 50°C )

N = 1401 rpm	T = 21,63 Nm
t = 24 detik	ho = 44,87 mmWC
Kd = 0,6	Do = 20 mm
LHV <sub>bb</sub> = 37323,78318 kJ/kg	Beban = 12 kg
PV plot area = 5280,18 cm	ρf = 0,832

#### 1. Daya indikasi (IP)

$$IP = \frac{\frac{PV \text{ plot area} \cdot N}{n \cdot 60}}{1000000} = \frac{\left(\frac{5280,18 \cdot 1401}{2,60}\right) \cdot 100}{1000000} = 6,16 \text{ kWatt}$$

#### 2. Daya efektif (BP)

$$BP = \frac{T \cdot N}{9549,3} = \frac{(21,63 \text{ Nm})(1401 \text{ rpm})}{9549,3} = 3,17 \text{ kWatt}$$

#### 3. Konsumsi Bahan Bakar (FC)

$$FC = \frac{VGU \cdot 10^{-3} \cdot \rho f \cdot 3600}{t} = \frac{(10 \text{ cc})(10^{-3})(0,8389)(3600)}{24 \text{ detik}} = 1,2 \text{ kg/h}$$

#### 4. Konsumsi Bahan Bakar Spesifik (SFC)

$$SFC = \frac{FC}{BP} = \frac{1,2}{3,17} = 0,38 \frac{\text{kg}}{\text{kWh}}$$

#### 5. Laju Aliran Massa Aktual (M<sub>a</sub>)

$$\begin{aligned} M_a &= Kd \cdot \frac{\pi}{4} \cdot Do^2 \cdot 10^{-6} \cdot 3600 \cdot 4,4295 \cdot \sqrt{ho \cdot \rho a} \\ &= (0,6) \cdot \left(\frac{3,14}{4}\right) (20)^2 (10^{-6})(3600)(4,4295) \sqrt{(44,87) \left(1,2 \frac{\text{kg}}{\text{m}^3}\right)} \\ &= (22,01) \frac{\text{kg}}{\text{h}} \end{aligned}$$

#### 6. Volume silinder

$$\begin{aligned} V_s &= \frac{\pi \cdot d^2 \cdot s \cdot z}{4 \cdot 10^6} \\ &= \frac{3,14 \cdot (87,5)^2 \cdot 110 \cdot 1}{4 \cdot 10^6} \\ &= 0,661 \text{ m}^3/\text{s} \end{aligned}$$

7. Laju Aliran Massa Theoritis (Mth)

$$\begin{aligned} M_{th} &= \frac{Vs \cdot 10^{-3} \cdot N \cdot 60 \cdot \rho_{ud}}{Ka} \\ &= \frac{(0,661 \text{ m}^3/\text{s})(10^{-3})(1401 \text{ rpm})(60)(1,2 \text{ kg}/\text{m}^3)}{2} \\ &= 33,34 \frac{\text{kg}}{\text{h}} \end{aligned}$$

8. Perbandingan Udara Bahan Bakar (AFR)

$$AFR_{act} = \frac{ma}{FC} = \frac{22,01 \text{ kg}/\text{h}}{1,2 \text{ kg}/\text{h}} = 18,22$$

9. Efisiensi Volumetrik ( $\eta_{vol}$ )

$$\eta_{vol} = \frac{M_{act}}{M_{th}} \cdot 100 \% = \frac{22,01 \text{ kg}/\text{h}}{33,34 \text{ kg}/\text{h}} \cdot 100 \% = 66,01 \%$$

10. Kalor Masuk ( $Q_{in}$ )

$$\begin{aligned} Q_{in} &= \frac{FC \cdot LHV_{bb}}{3600} = \frac{(1,2 \text{ kg}/\text{h})(37323,78318 \text{ kJ}/\text{kg})}{3600} \\ &= 12,52 \text{ kWatt} \end{aligned}$$

11. Efisiensi Thermis ( $\eta_{th}$ )

$$\eta_{th} = \frac{BP}{Q_{in}} \cdot 100 \% = \frac{(3,17) \text{ kWatt}}{(12,52) \text{ kWatt}} \cdot 100 \% = 25,32 \%$$

## 2. Tabel Perhitungan

TEMPERATUR 30°C													
No	Beban (kg)	Putaran (rpm)	Torsi (Nm)	BP (kW)	IP (kW)	FC (kg/h)	SFC(kg/kW.h)	Ma (kg/h)	Mth (kg/h)	AFR	Qtot (kW)	$\eta_{vo}$ (%)	$\eta_{th}$ (%)
1	3	1494	5,60	0,87	5,25	0,50	0,574	24,15	35,55	47,99	5,21	67,93	16,78
2	6	1495	11,16	1,74	5,89	0,60	0,345	23,76	35,58	39,34	6,26	66,78	27,88
3	9	1461	16,24	2,48	6,14	0,85	0,344	23,27	35,58	27,19	8,87	66,93	27,99
4	12	1415	21,79	3,22	6,44	1,10	0,343	22,45	35,58	20,27	11,48	66,67	28,1
No	BHP (%)	Qpm (%)	Qgb (%)	Qoth (%)									
1	16,77	30,97	39,35	12,89									
2	27,89	31,09	40,53	0,47									
3	28,01	25,73	34,63	11,61									
4	28,12	22,87	31,44	17,56									

TEMPERATUR 50°C													
No	Beban (kg)	Putaran (rpm)	Torsi (Nm)	BP (kW)	IP (kW)	FC (kg/h)	SFC(kg/kW.h)	Ma (kg/h)	Mth (kg/h)	AFR	Qtot (kW)	$\eta_{vo}$ (%)	$\eta_{th}$ (%)
1	3	1474	5,60	0,86	4,95	0,553	0,64	23,72	35,08	42,84	5,74	67,62	15,05
2	6	1458	10,93	1,66	5,35	0,654	0,39	23,23	34,70	35,51	6,78	66,96	24,58
3	9	1457	15,67	2,38	5,84	0,805	0,33	23,16	34,67	28,75	8,34	66,79	28,62
4	12	1401	21,63	3,17	6,16	1,208	0,38	22,01	33,34	18,22	12,52	66,01	25,32

No	BHP (%)	Qpm (%)	Qgb (%)	Qoth (%)
1	15,06	27,70	35,47	21,75
2	24,60	27,25	36,02	12,11
3	28,63	26,45	36,29	8,61
4	25,34	20,37	29,02	25,25

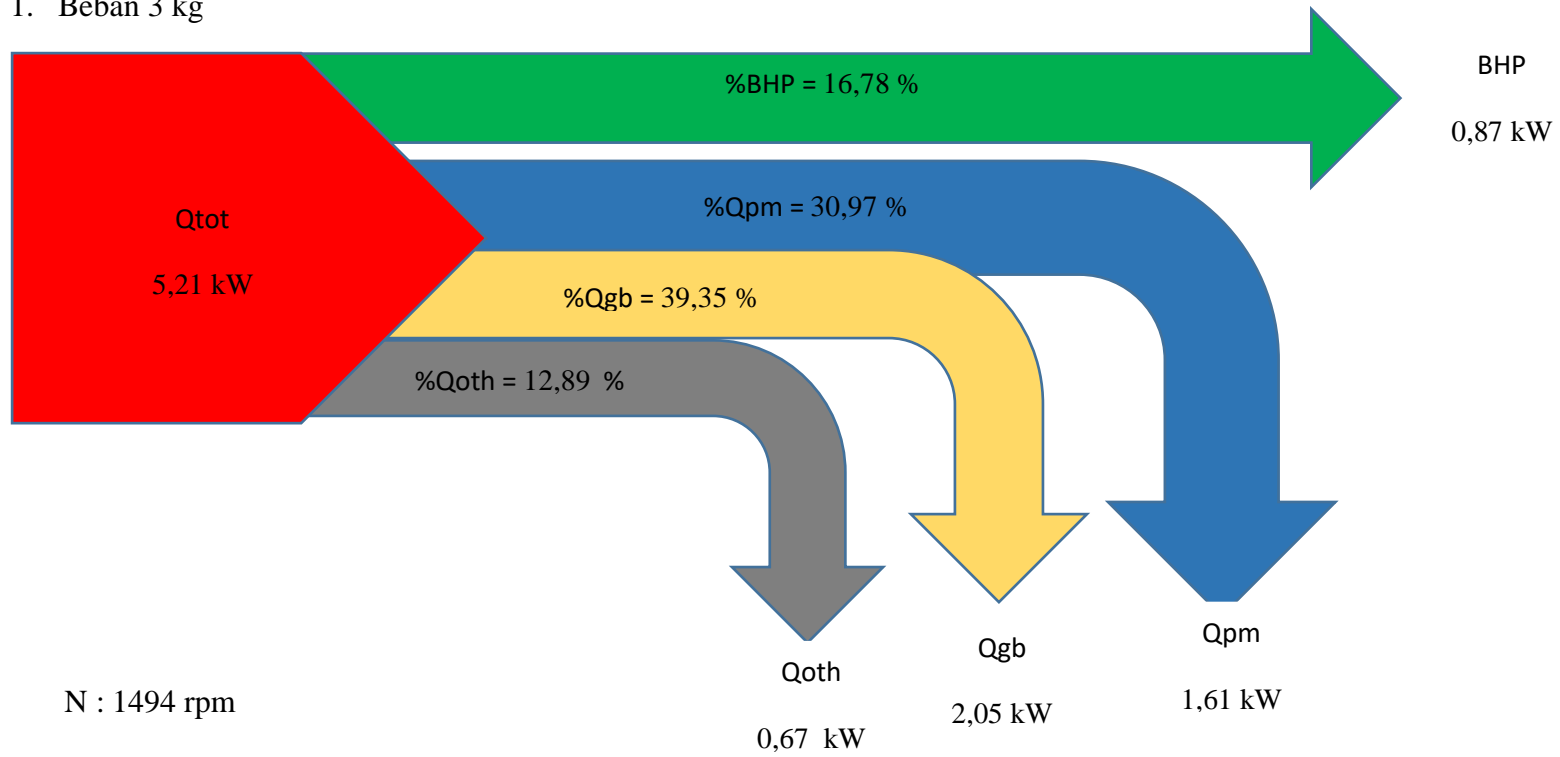
TEMPERATUR 60°C													
No	Beban (kg)	Putaran (rpm)	Torsi (Nm)	BP (kW)	IP (kW)	FC (kg/h)	SFC(kg/kW.h)	Ma (kg/h)	Mth (kg/h)	AFR	Qtot (kW)	$\eta_{vo}$ (%)	$\eta_{th}$ (%)
1	3	1481	5,79	0,89	4,74	0,60	0,67	23,73	35,24	39,29	6,26	67,34	14,33
2	6	1471	10,94	1,68	5,33	0,70	0,41	23,41	35,01	33,22	7,30	66,87	23,05
3	9	1480	16,25	2,51	5,8	0,85	0,33	23,35	35,22	27,29	8,87	66,29	28,37
4	12	1391	21,78	3,17	6,13	1,20	0,38	22,12	33,1	18,31	12,52	66,84	25,31
No	BHP (%)	Qpm (%)	Qgb (%)	Qoth (%)									
1	13,83	28,12	35,00	23,03									
2	23,09	27,42	35,82	13,65									
3	28,08	26,07	35,71	10,12									
4	27,49	22,95	32,42	17,12									

TEMPERATUR 70°C													
No	Beban (kg)	Putaran (rpm)	Torsi (Nm)	BP (Kw)	IP (kW)	FC (kg/h)	SFC(kg/kW.h)	Ma (kg/h)	Mth (kg/h)	AFR	Qtot (kW)	$\eta_{vo}$ (%)	$\eta_{th}$ (%)
1	3	1479	5,47	0,84	5,07	0,553	0,653	23,76	35,2	42,91	5,74	67,5	14,75
2	6	1468	10,96	1,68	5,57	0,654	0,388	23,43	34,93	35,81	6,78	67,07	24,82
3	9	1449	16,24	2,46	5,96	0,805	0,326	23,21	34,48	28,82	8,34	67,3	29,49
4	12	1408	21,47	3,16	6,26	1,258	0,397	22,46	33,51	17,85	13,04	67,04	24,25
No	BHP (%)	Qpm (%)	Qgb (%)	Qoth (%)									
1	14,76037	31,6785843	40,33038	13,2307									
2	24,84652	28,7123302	38,58764	7,85351									
3	29,52582	26,78429	37,65514	6,03475									
4	24,27185	19,7890406	28,68794	27,2512									

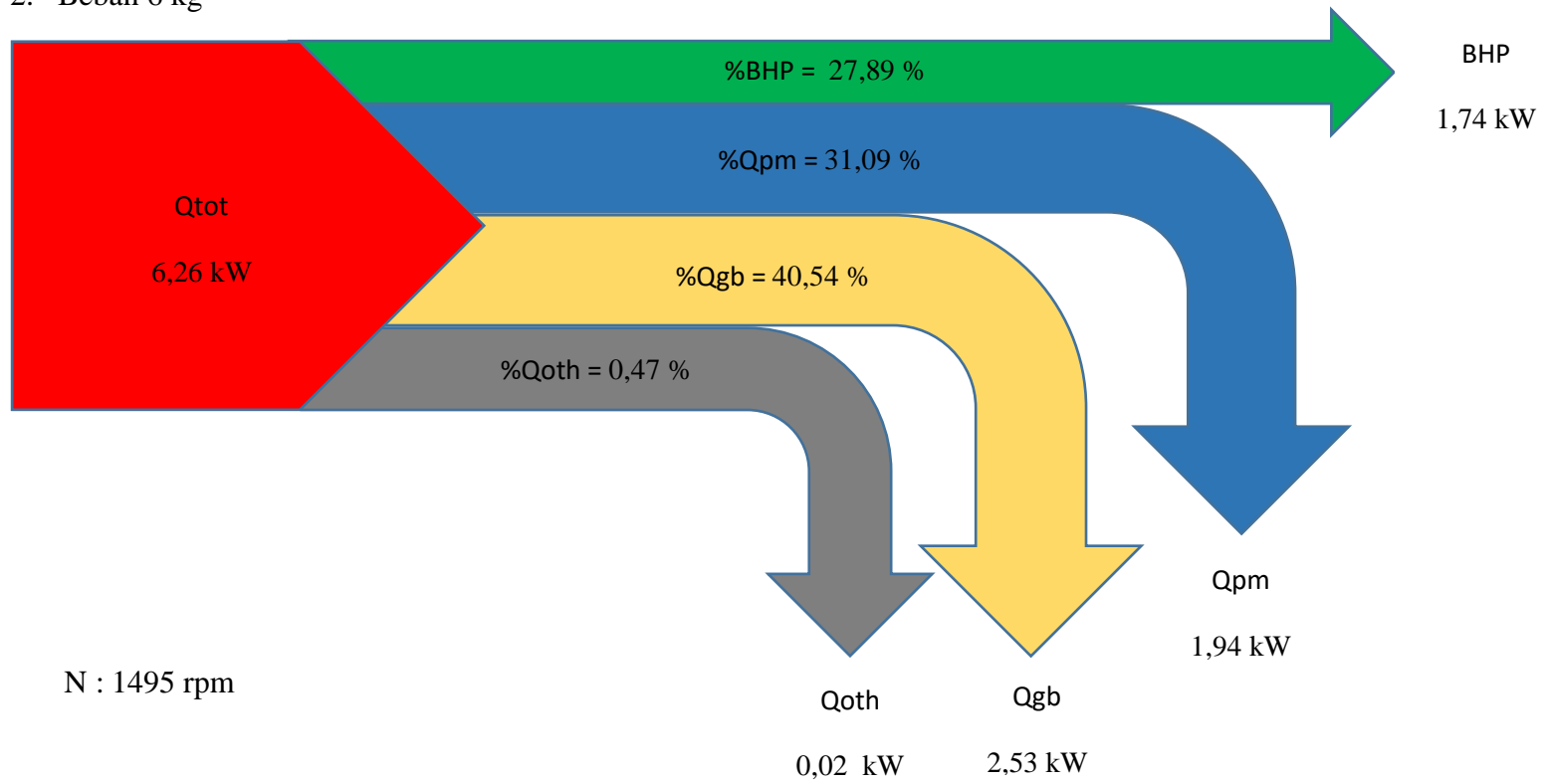


### 3. Diagram Sankay Temperatur 30°C

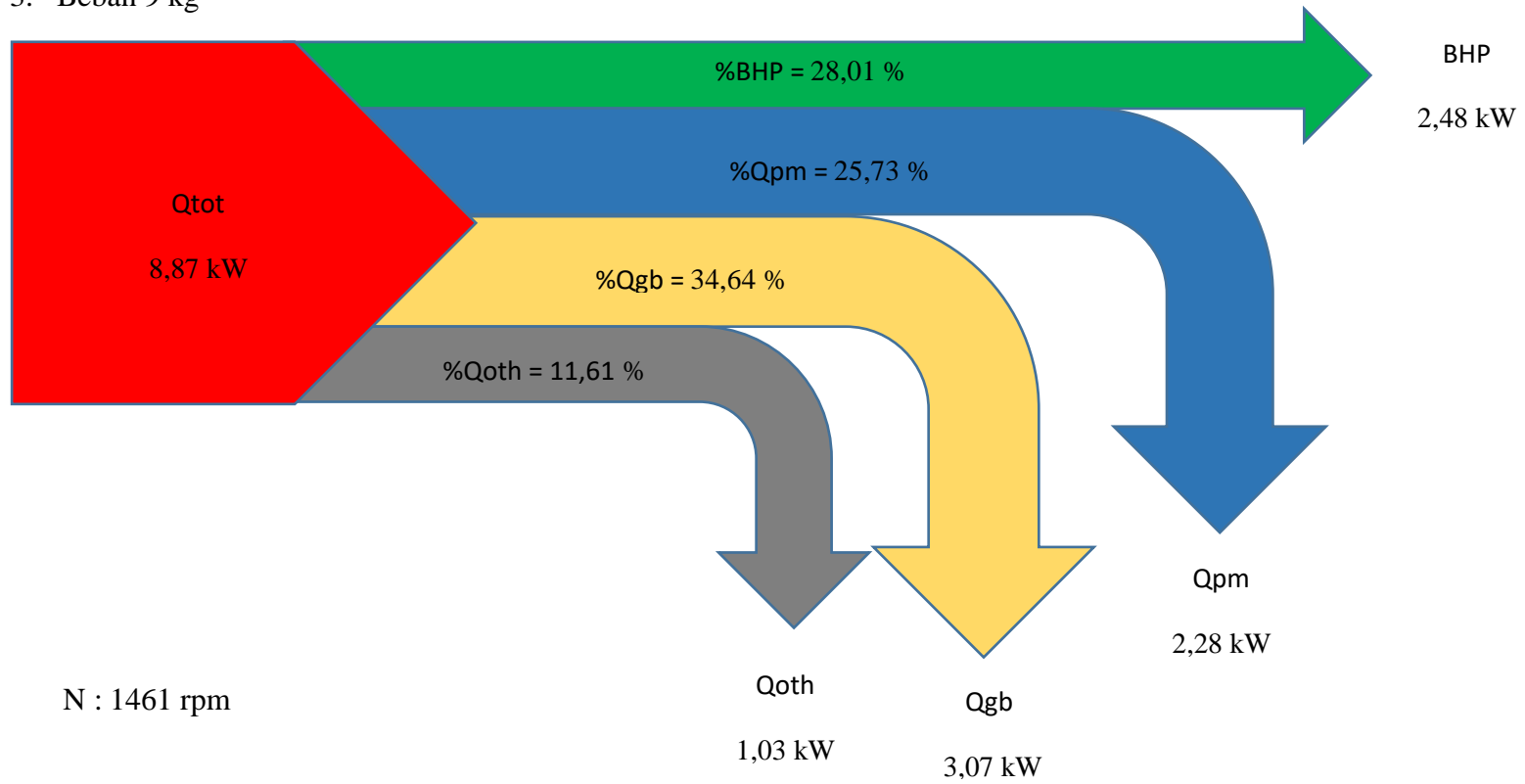
1. Beban 3 kg



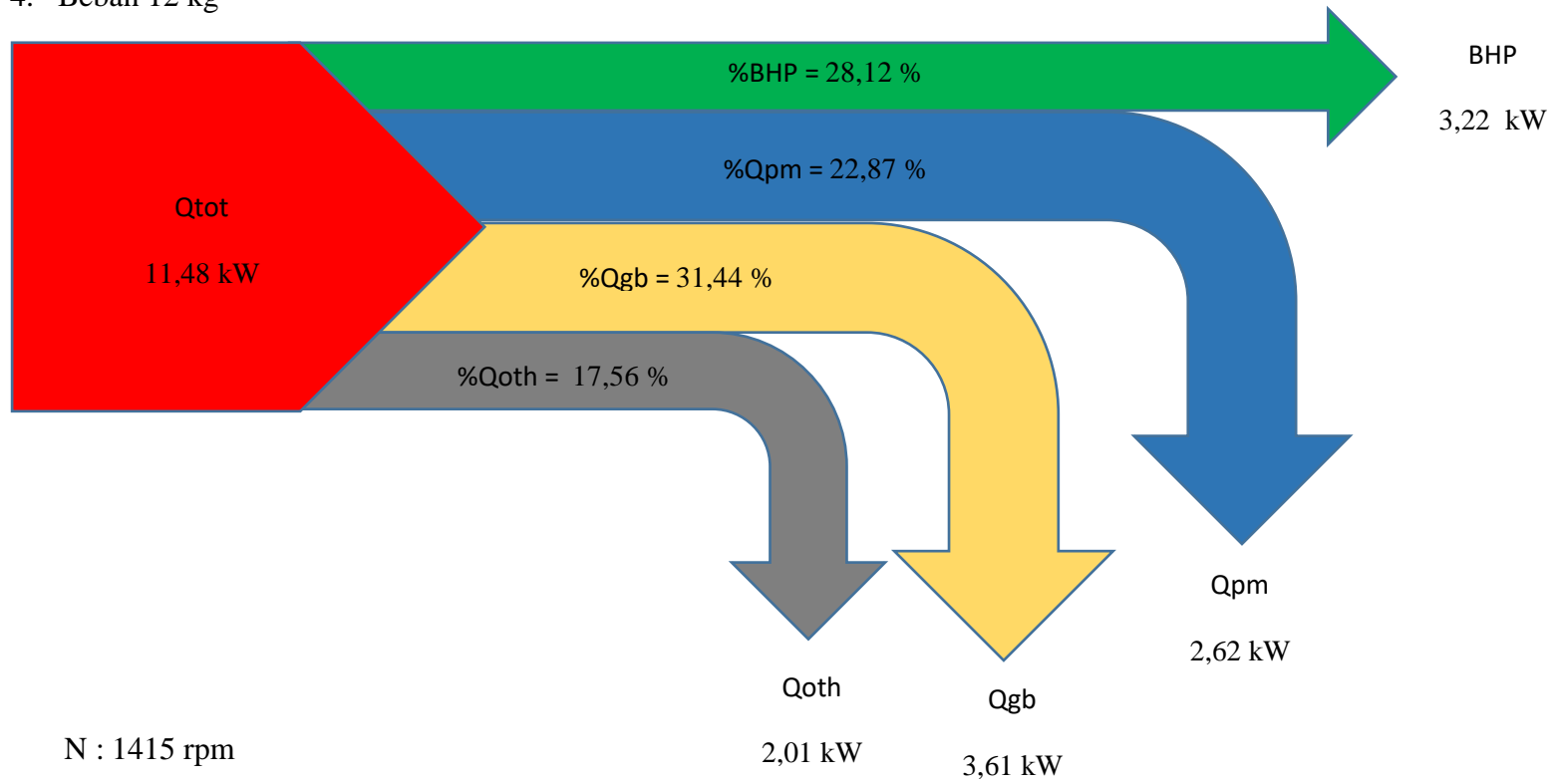
2. Beban 6 kg



3. Beban 9 kg

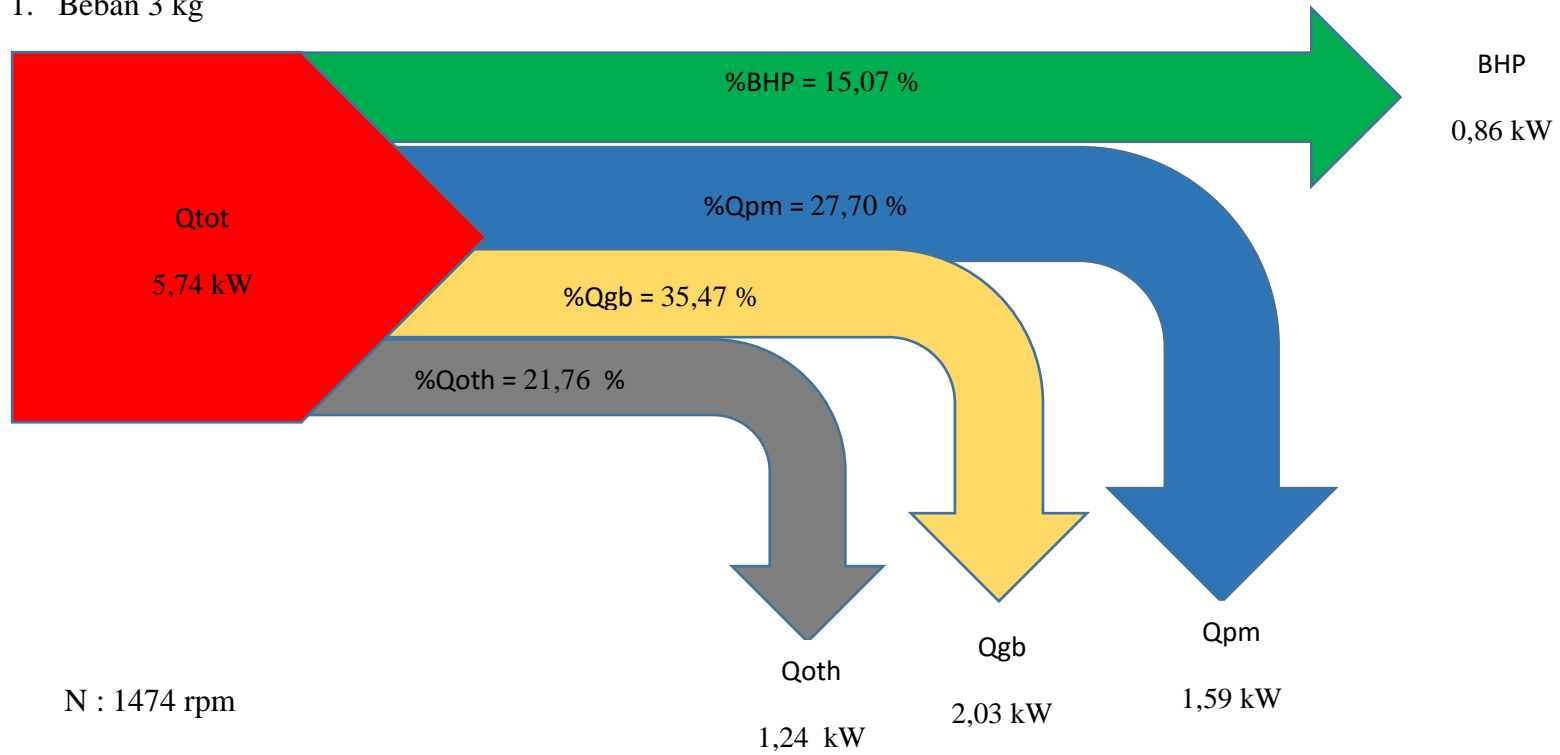


4. Beban 12 kg

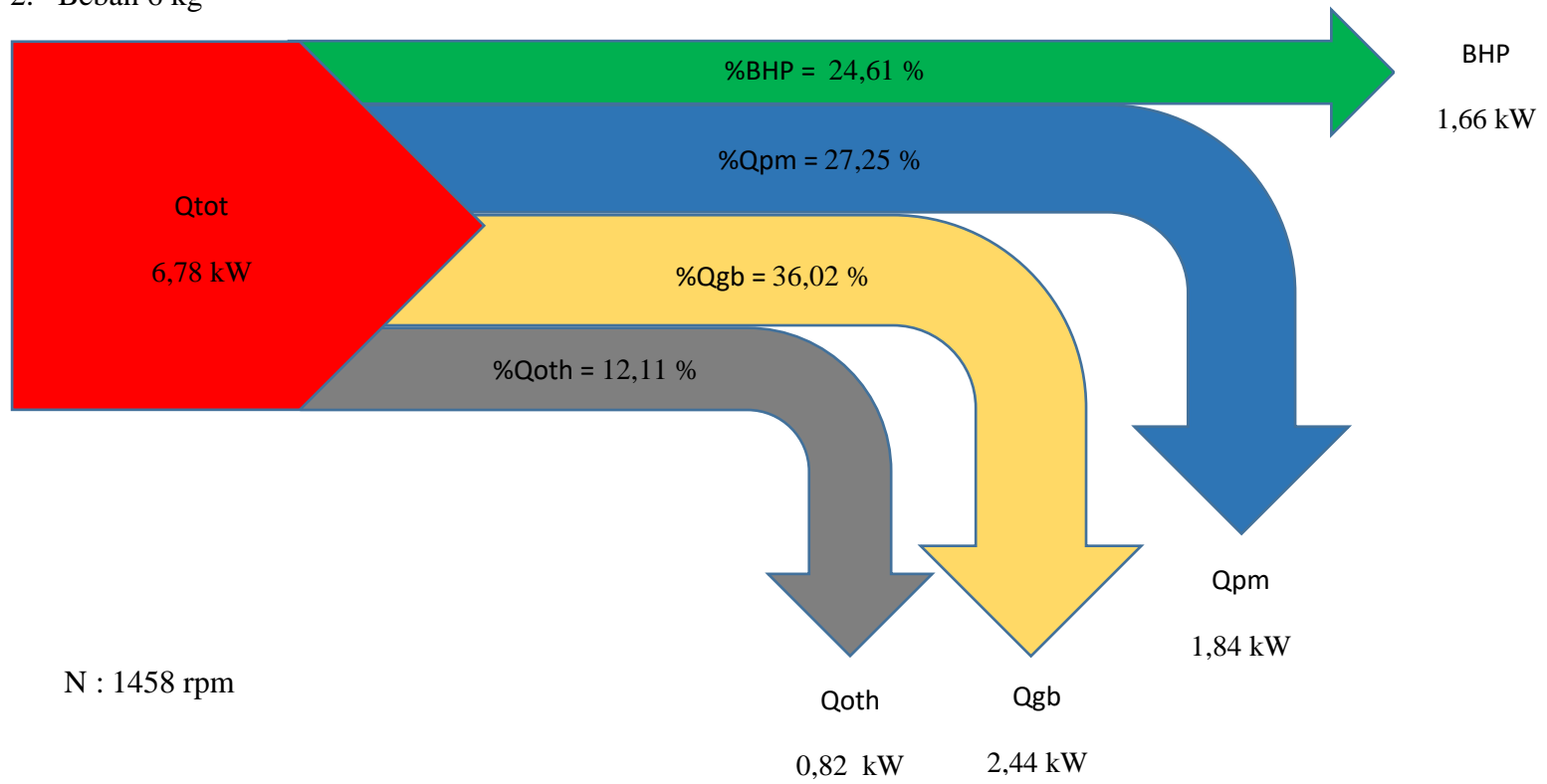


#### 4. Diagram Sankay Temperatur 50°C

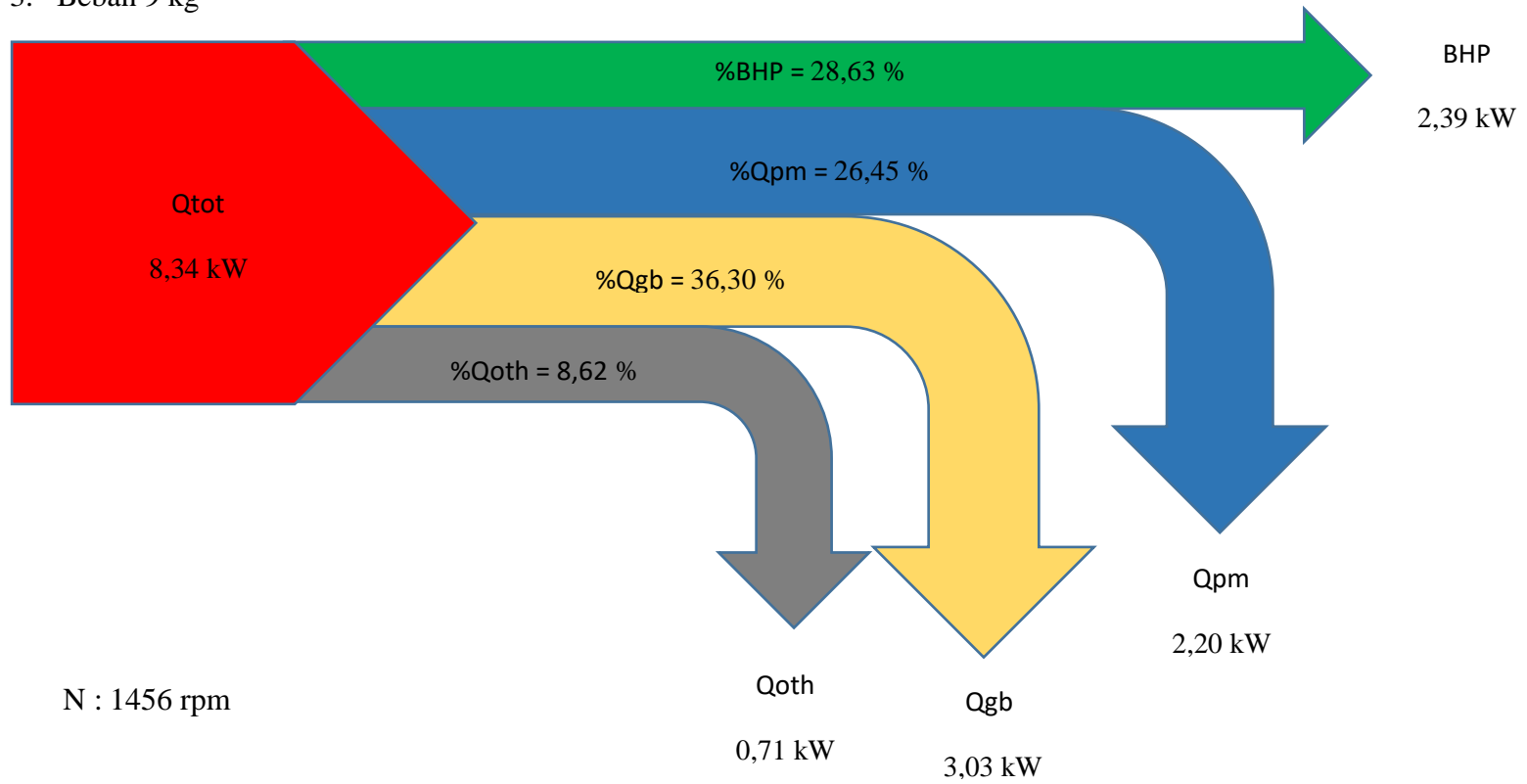
1. Beban 3 kg



2. Beban 6 kg

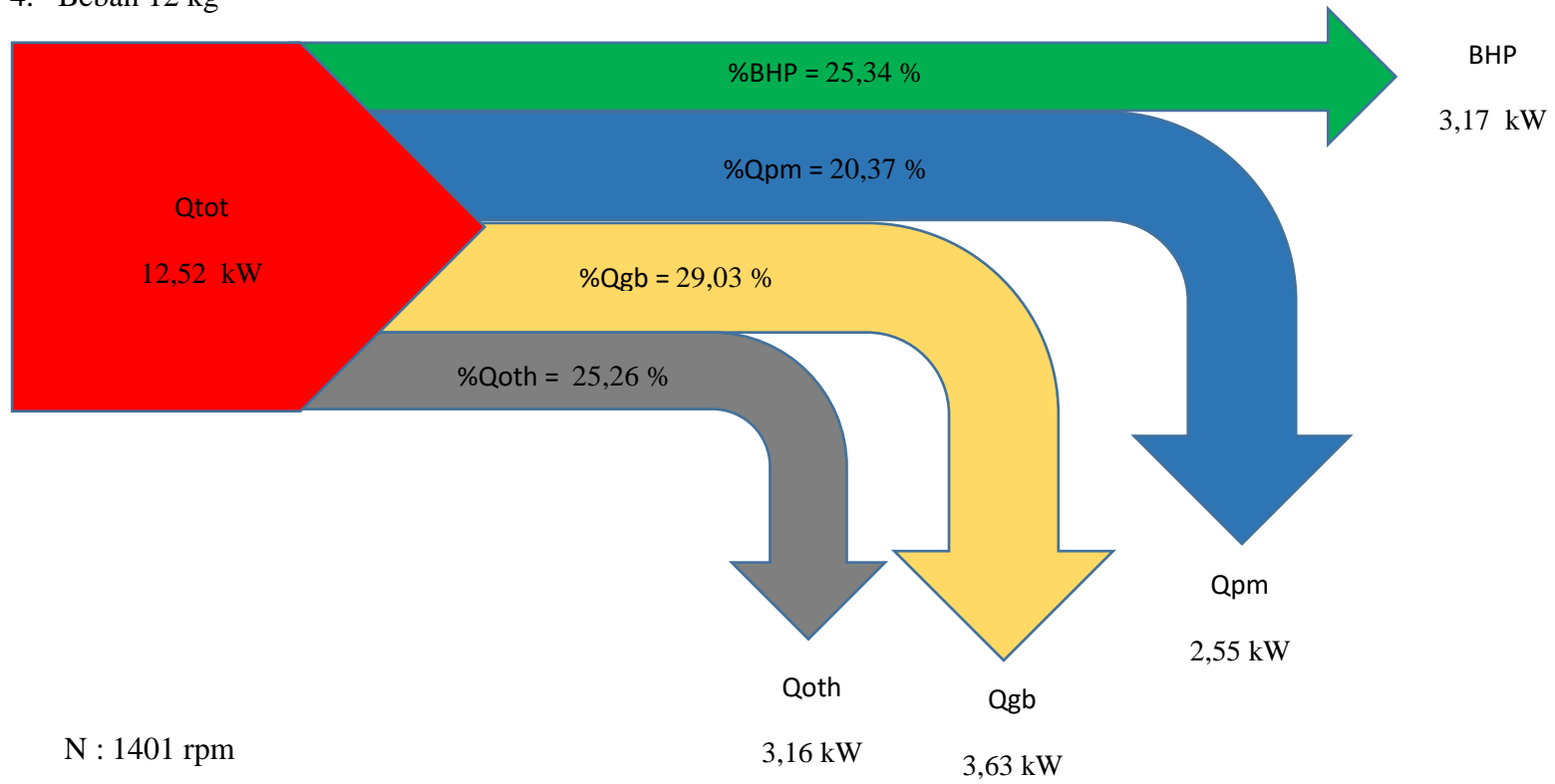


3. Beban 9 kg



N : 1456 rpm

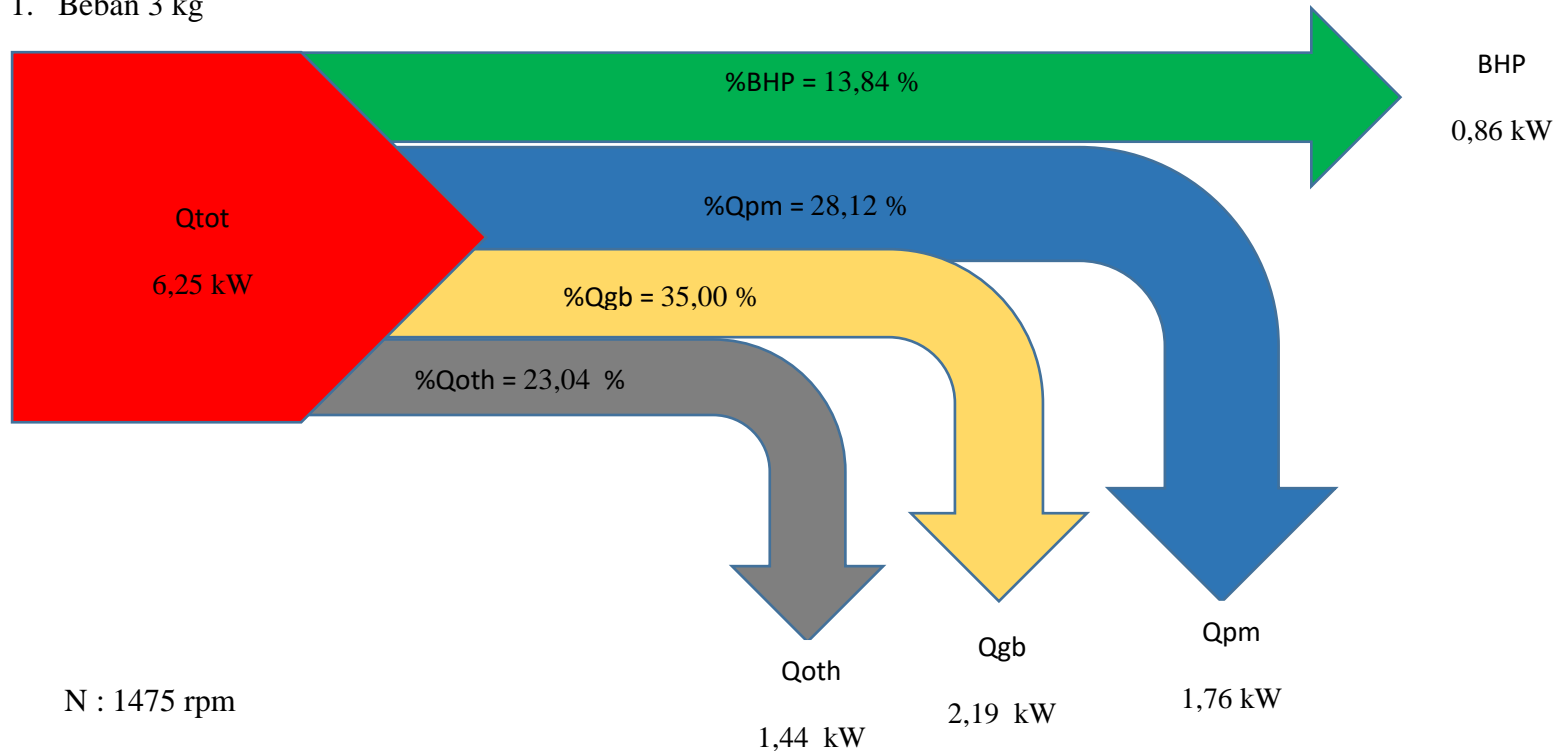
4. Beban 12 kg



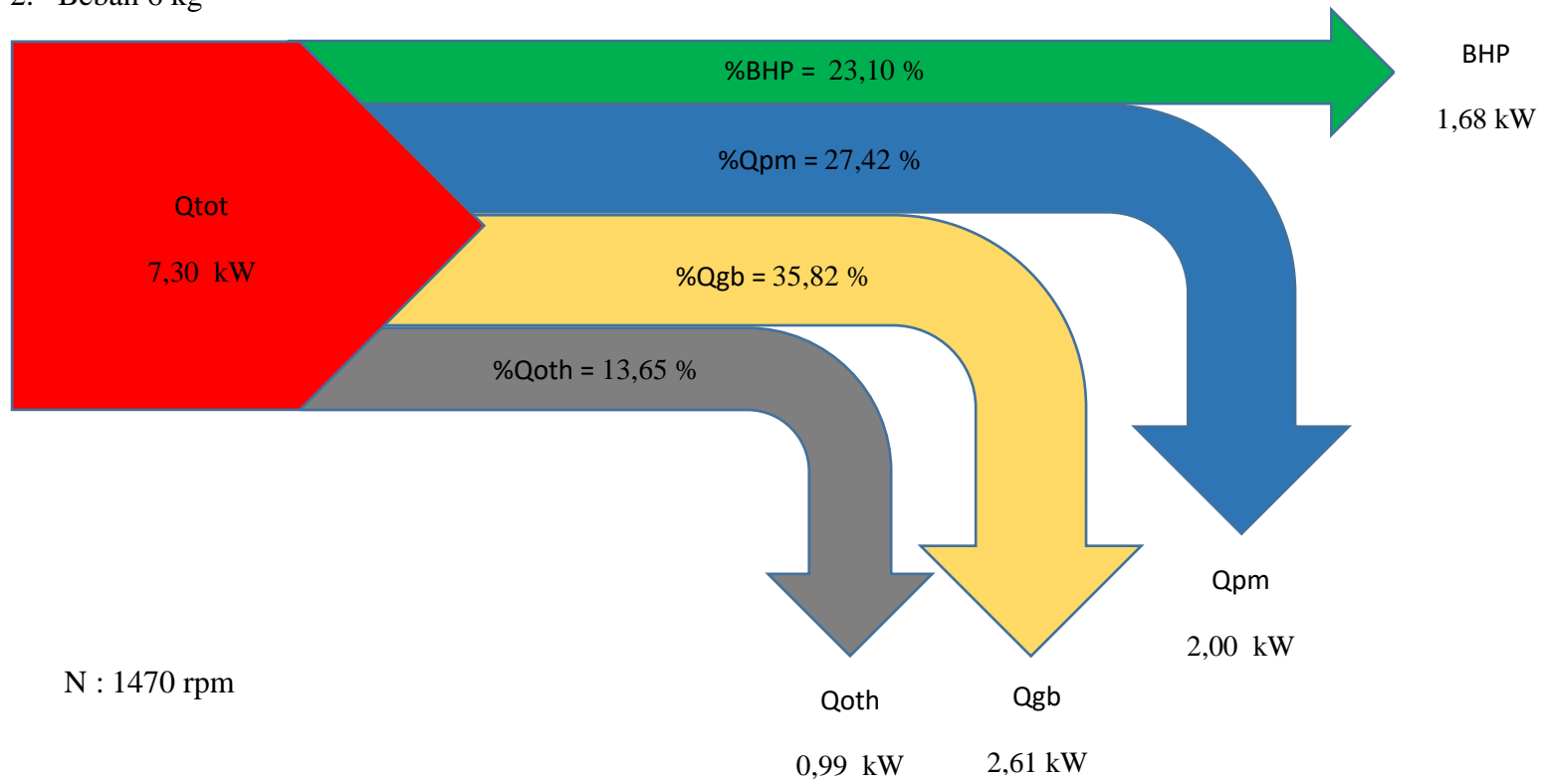


### 5. Diagram Sankay Temperatur 60°C

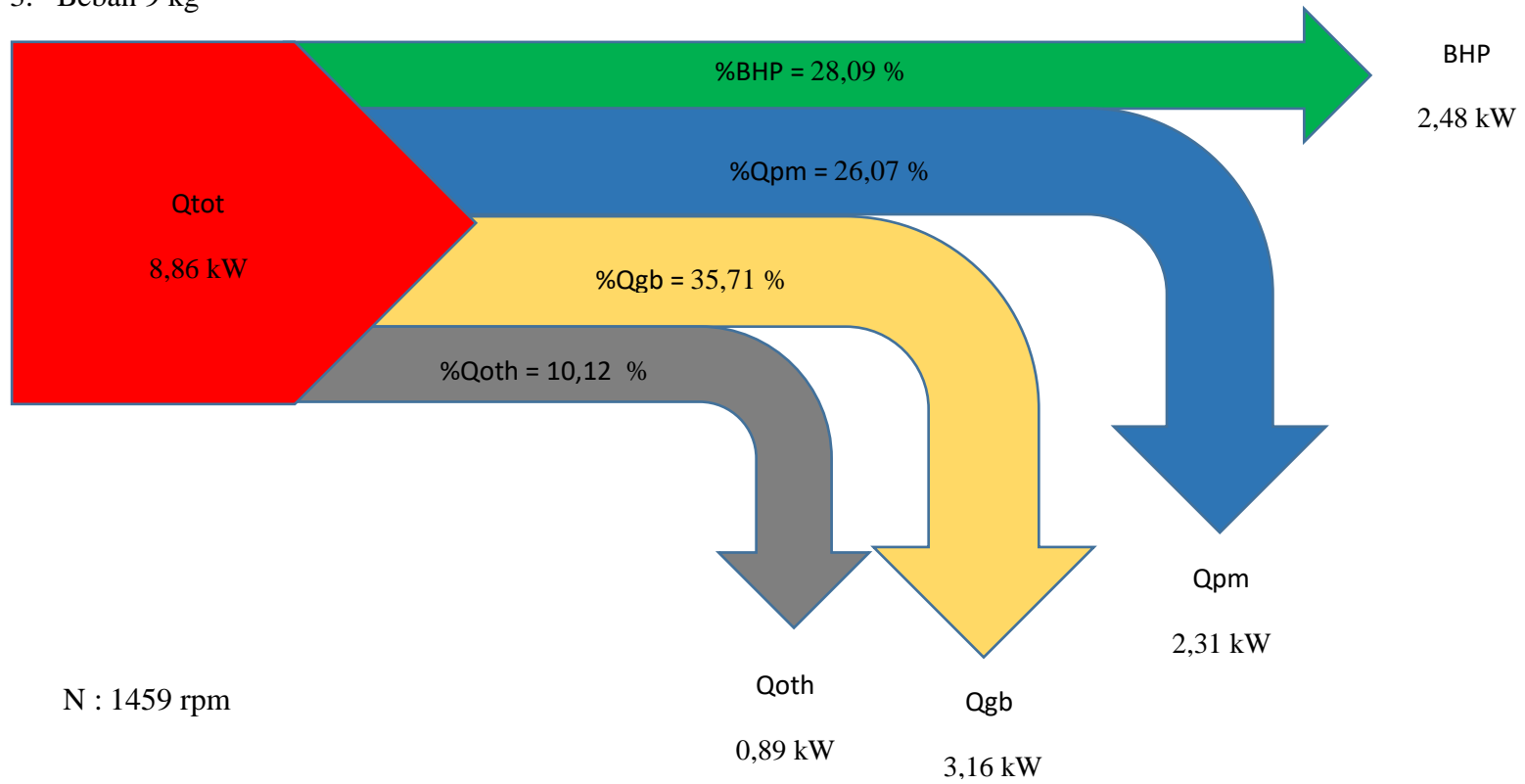
1. Beban 3 kg



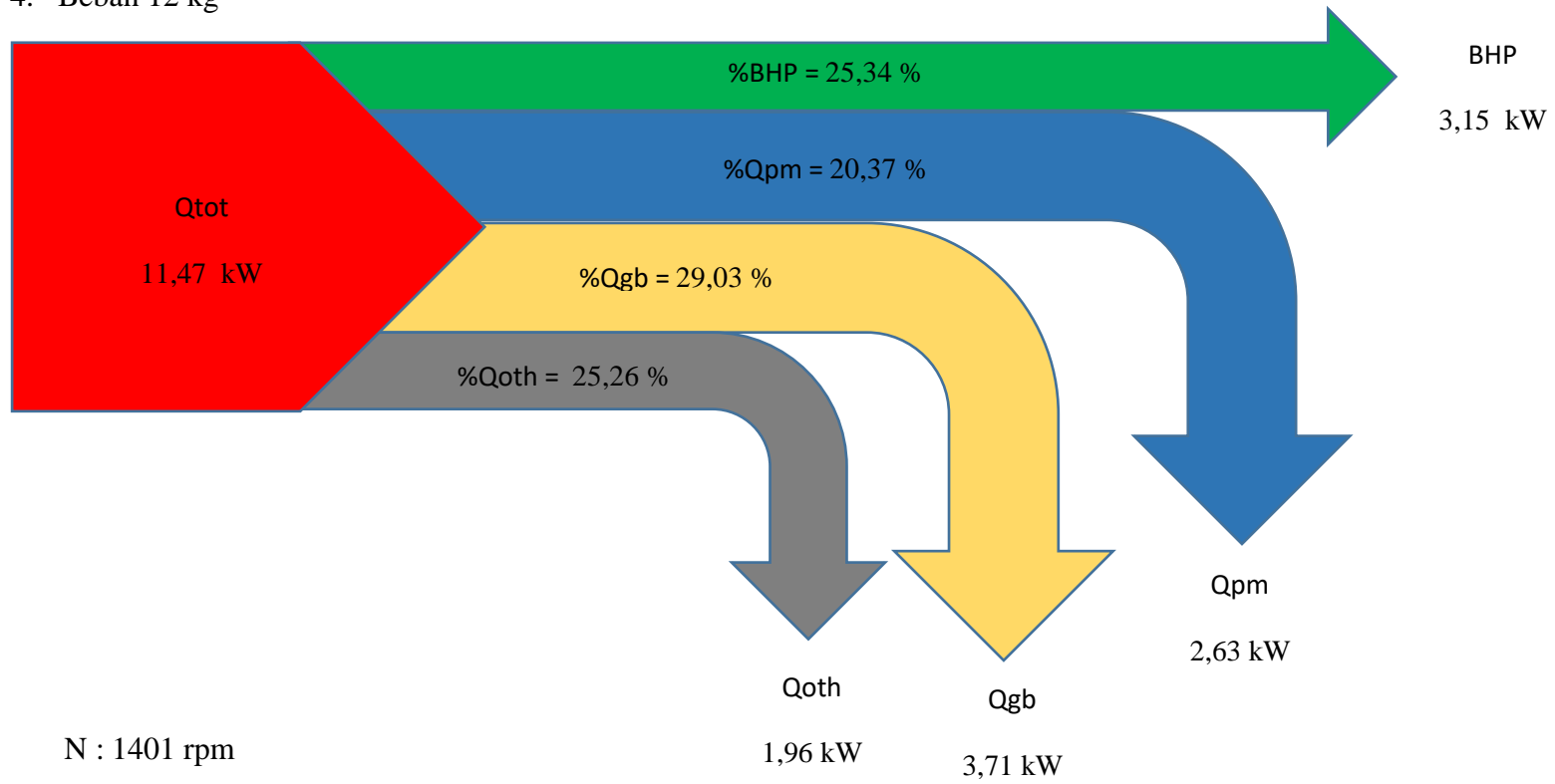
2. Beban 6 kg



3. Beban 9 kg

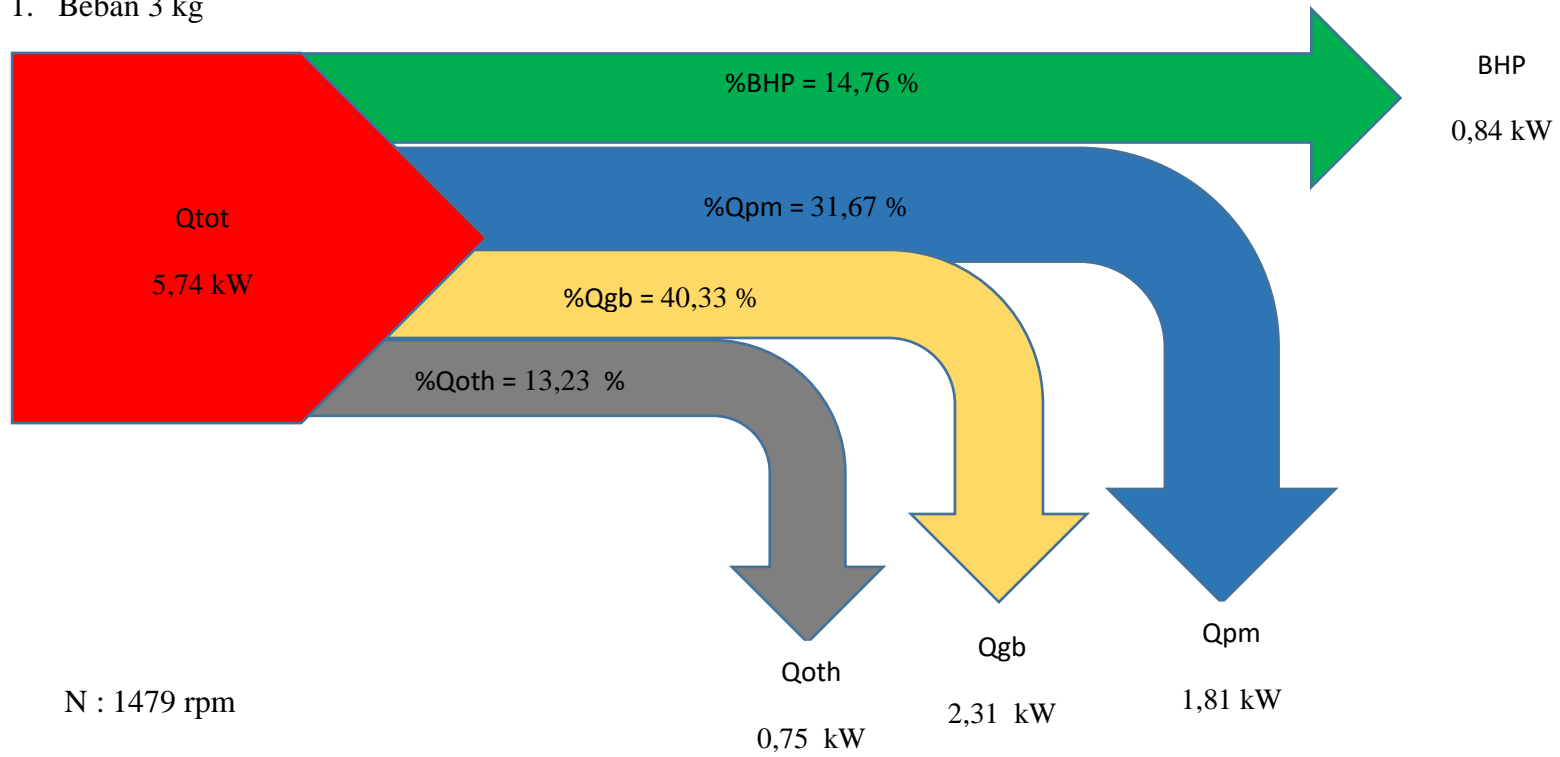


4. Beban 12 kg

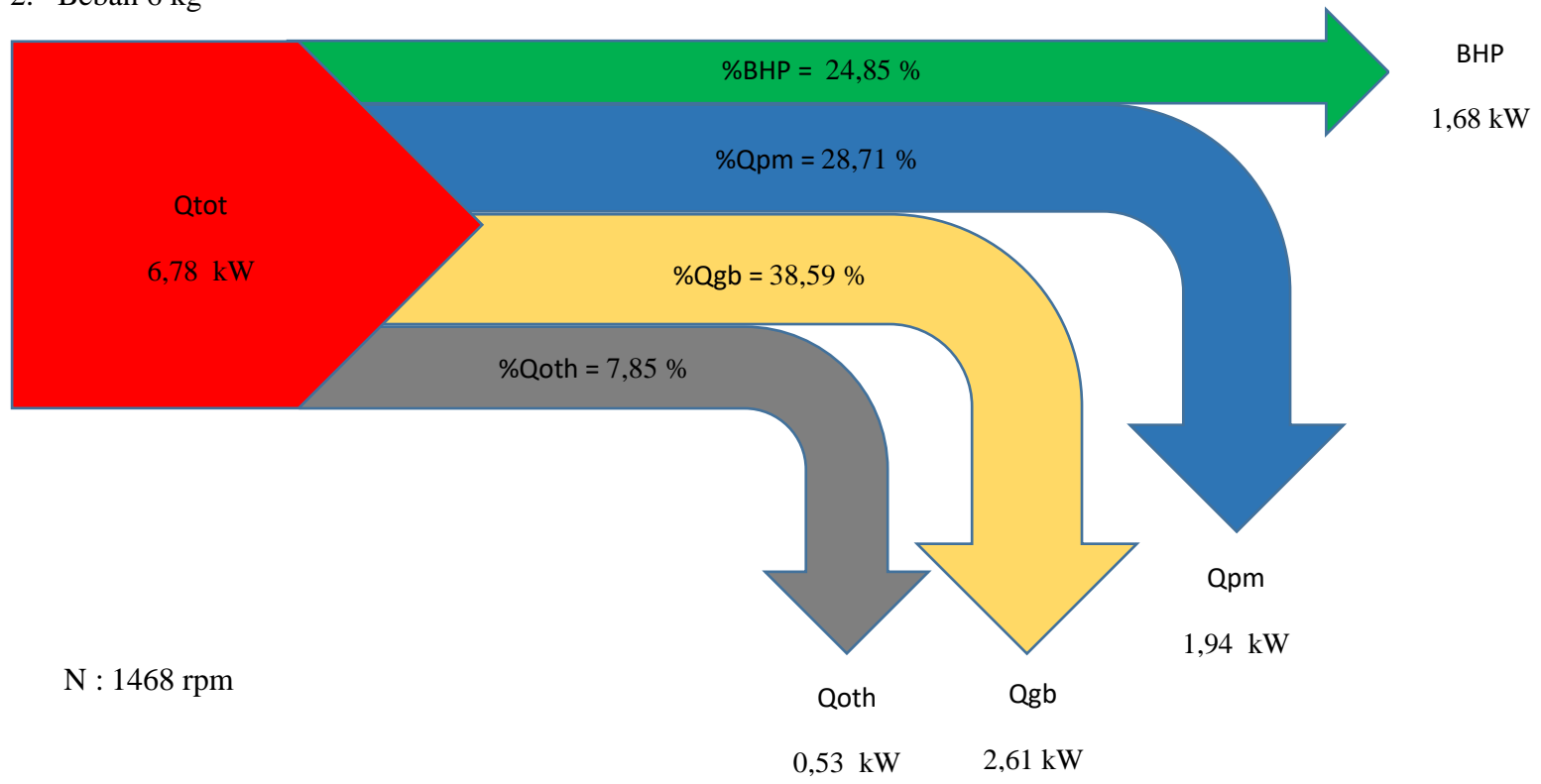


## 6. Diagram Sankay Temperatur 70°C

1. Beban 3 kg

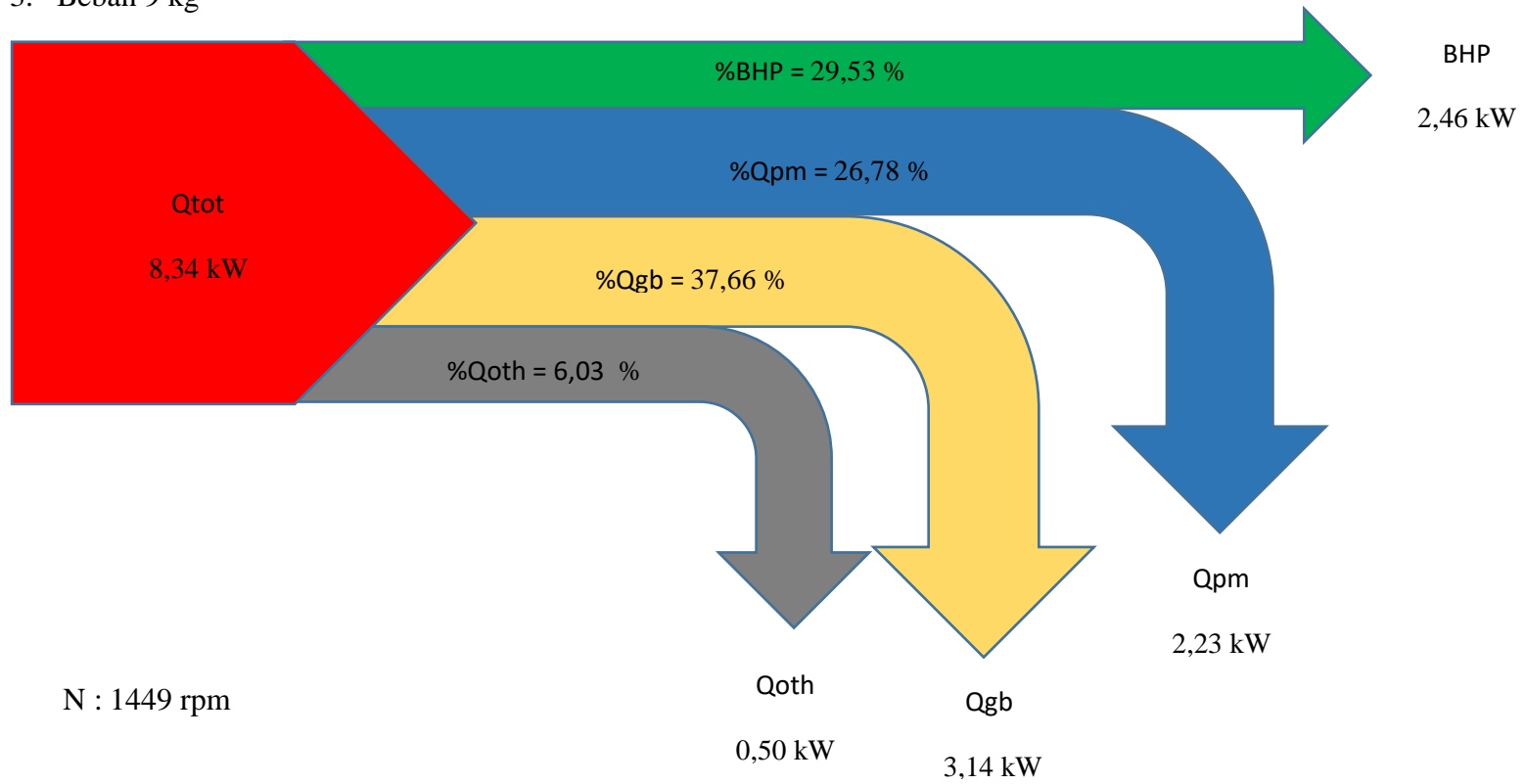


2. Beban 6 kg

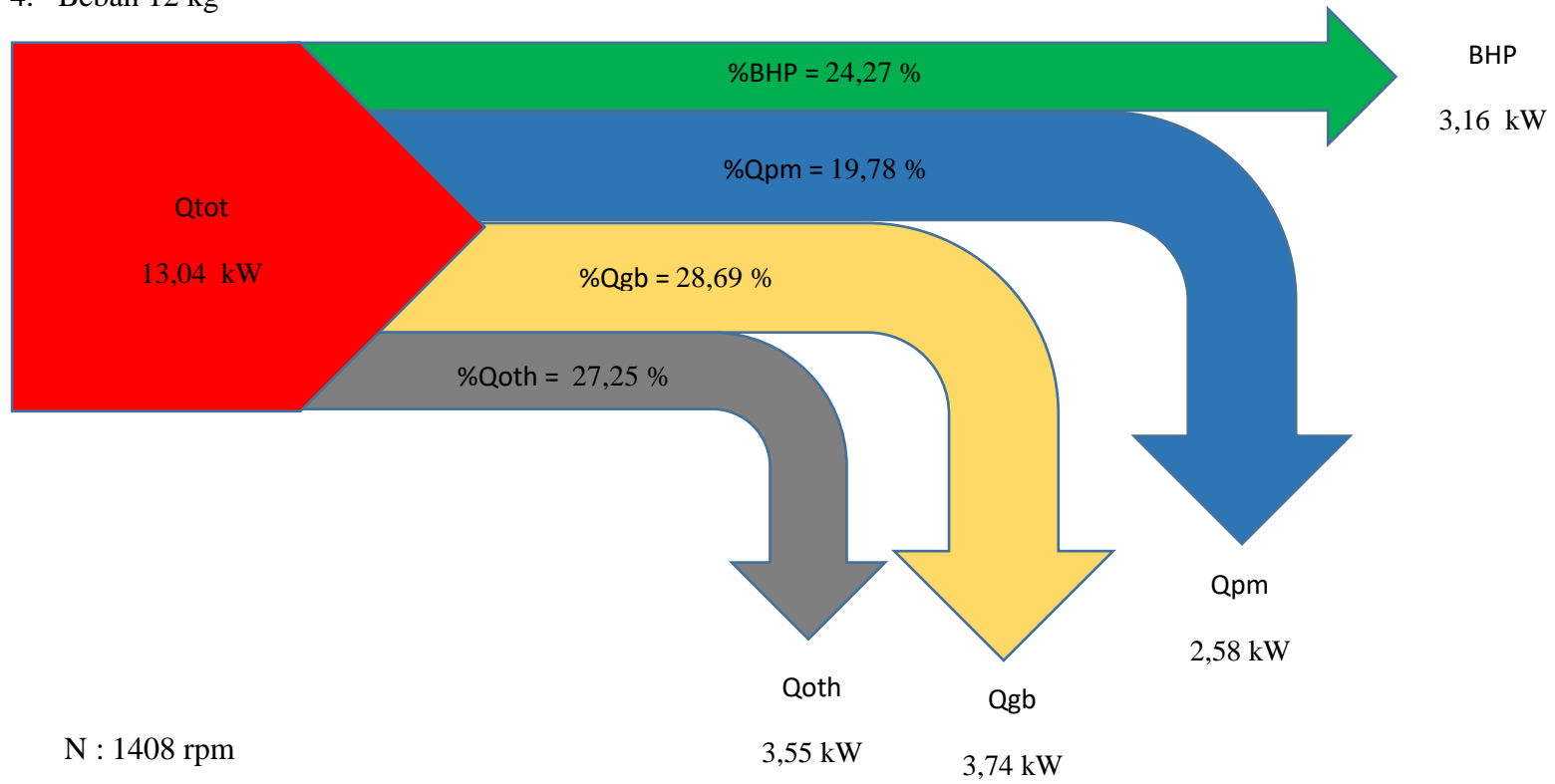


N : 1468 rpm

3. Beban 9 kg



4. Beban 12 kg





## 7. Dokumentasi Pengambilan Data

