ME3475: IC Engine Lab

Experiment 3

ME21BTECH11001

Abhishek Ghosh

Aim:

Performance Study of Port Fuel Injection (PFI) engine.

Procedure:

1. Start the engine.

2. Set the dynamometer load to 1 N, 4 N, and 9 N for additional experiments.

3. After adjusting the dynamometer load to the desired level, manipulate the fuel consumption rate by using the knob to regulate the throttle valve.

4. Ensure the RPM of the engine remains constant at 1800 RPM for each load by adjusting the throttle valve.

5. Measure the fuel consumption rate from an 12-cc tube using a stopwatch.

6. Organize the collected data into a table and compute Fuel consumption rate, Brake power, specific fuel consumption, brake thermal efficiency, and volumetric efficiency.

Formulas used:

1. ***Brake Power (BP):***

$$BP = \frac{2 \times \pi \times N \times T}{60 \times 1000} \text{kW}$$

$$where\ \boldsymbol{T} = Torque = Load \times (Armlength), \qquad \boldsymbol{N} = Rotationalspeed(rpm).$$

2. $\boldsymbol{Fuel\ Consumption}(\boldsymbol{FC})$:

$$FC = \frac{x}{t}(mL/s) = x \times 3600 \times \frac{\text{Specific gravity of petrol}}{1000 \times t} (\text{Kg/hr})$$

3. $\boldsymbol{Specific\ Fuel\ Consumption}(\boldsymbol{SFC})$:

$$SFC = \frac{FC}{BP}$$

4. $\boldsymbol{Brake\ Thermal\ Efficiency}(\boldsymbol{\eta_{BP}})$:

$$\eta_{BP} = \frac{BP}{FC \times CV}$$

$$where\ \boldsymbol{CV} = Calorific\ Value\ of\ the\ fuel.$$

5. $\boldsymbol{Volumetric\ Efficiency(\eta_{vol}):}$

$$\eta_{vol} = \frac{\text{Air Flow} \times 100}{N/2 \times V_s \times \rho_{\text{air}} \times 60}$$

Tabulation:

S No.	Load (Kg)	T (Nm)	Air Flow Rate (kg/hr)	Speed (N)	Time for rise of fuel (s)	FC (Kg/hr)	BP (KW)	SFC (Kg/ KW hr)	η_{BP}	η_{Vol}
1	1	2.29	7.54	1800	118	0.271	0.432	0.626	14.01%	17.244%
2	4	9.18	9.68	1800	92	0.348	1.729	0.2	43.71%	22.138%
3	9	20.65	10.62	1800	78	0.41	3.892	0.105	83.38%	24.288%

Calculation:

$\boldsymbol{Given\ Data}$

- $\boldsymbol{Load\ Torque\ (T)} = 2\ Nm$
- $\boldsymbol{N\ (RPM)} = 1800$
- $\boldsymbol{Calorific\ Value\ of\ Fuel\ (CV)} = 41000\ KJ/kg$
- $\boldsymbol{Specific\ Gravity\ of\ Fuel} = 0.74$
- $\boldsymbol{Bore} = 87.5\ mm = 0.075\ m$
- $\boldsymbol{Stroke} = 110\ mm = 0.11\ m$
- $\boldsymbol{Arm\ Length} = 234\ mm = 0.234\ m$
- $\boldsymbol{Air\ Density} = 1.225\ kg/m^3$

$\boldsymbol{Brake\ Power\ (BP)\ Calculation}$

$$BP = \frac{2\pi NT}{60 \times 1000} = \frac{2\pi \times 1800 \times 9.18}{60 \times 1000}$$

$$= 1.729\ kW$$

$\boldsymbol{Fuel\ Consumption\ Rate\ (FC)}$

$$FC = \frac{12 \times 3600 \times \text{Specific Gravity of Fuel}}{t \times 1000} = \frac{12 \times 3600 \times 0.74}{92 \times 1000}$$

$$= 0.348\ kg/hr$$

$\boldsymbol{Specific\ Fuel\ Consumption\ (SFC)}$

$$SFC = \frac{FC}{BP} = \frac{0.348}{1.729}$$

$$= 0.2\ kg/kW\ hr$$

$\boldsymbol{Volume\ Displaced (V_s) Calculation}$

$$Vs = \frac{\pi \times d^2 \times L}{4} = \frac{3.14 \times (0.0875)^2 \times 0.11}{4}$$

$$= 0.000661\ m3$$

$\boldsymbol{Brake\ Thermal\ Efficiency (\eta_{BP})}$

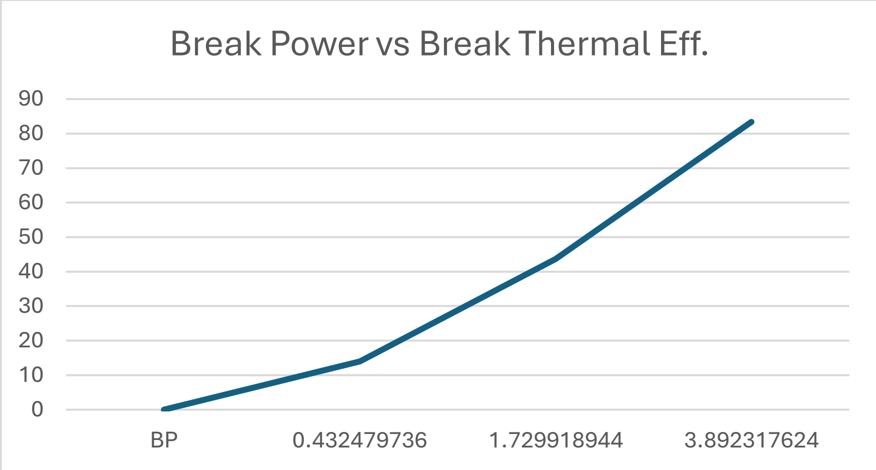
$$\eta_{BP} = \frac{BP \times 3600}{FC \times CV} \times 100 = \frac{1.729 \times 3600}{0.348 \times 41000} \times 100$$

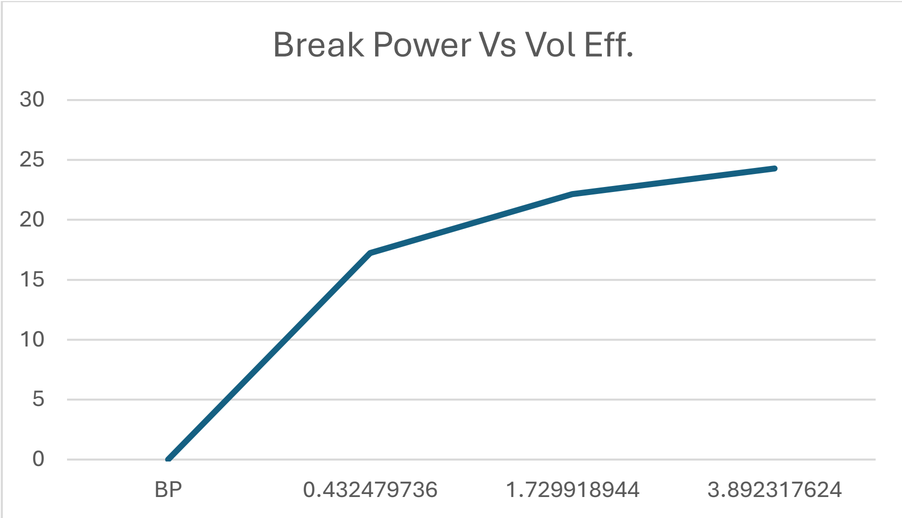
$$= 43.71\ \%$$

$\boldsymbol{Volumetric\ Efficiency (\eta_{vol})}$

$$\eta_{\text{vol}} = \frac{\text{Air Flow Rate} \times 100}{V_s \times N/2 \times \text{Air Density} \times 60} = \frac{9.68 \times 100}{0.000661 \times 1800/2 \times 1.225 \times 60} = 22.138\ \%$$

Graph:





Conclusion:

1. The data analysis shows that the fuel consumption rate increases as the load increases. This is due to the higher fuel requirement to maintain the desired RPM at greater loads.
2. Based on the calculations and graphical analysis, it is evident that both thermal efficiency and volumetric efficiency improve as the load increases.