ME401A – Energy Systems II

Experiment 4: IC Engines

Department of Mechanical Engineering

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Group No: **F4**

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Objective

Performance Study of a Single Cylinder 4 Stroke Diesel Engine

Introduction

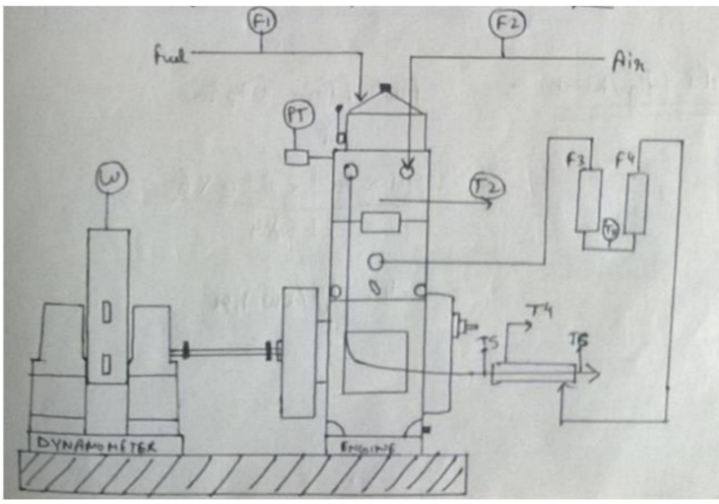
Four stroke cycle engine: In four-stroke cycle engine, the cycle of operation is completed in four strokes of the piston or two revolutions of the crankshaft. Each stroke consists of 180° of crankshaft rotation and hence a cycle consists of 720° of crankshaft rotation.

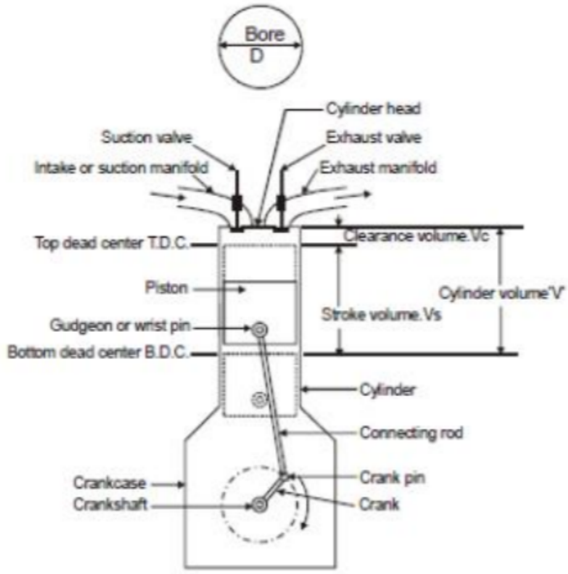
The series of operation of an ideal four-stroke engine are as follows:

1. Suction or Induction stroke: The inlet valve is open, and the piston travels down the cylinder, drawing in a charge of air.
2. Compression stroke: Both valves are closed, and the piston travels up the cylinder. As the piston approaches top dead centre (TDC), ignition occurs. In the case of compression ignition engines, the fuel is injected towards the end of compression stroke.
3. Expansion or Power or Working stroke: Combustion propagates throughout the charge, raising the pressure and temperature, and forcing the piston down. At the end of the power stroke the exhaust valve opens, and the irreversible expansion of the exhaust gases is termed 'blowdown'.
4. Exhaust stroke: The exhaust valve remains open, and as the piston travels up the cylinder the remaining gases are expelled. At the end of the exhaust stroke, when the exhaust valve closes some exhaust gas residuals will be left; these will dilute the next charge

Experimental Setup:

The setup consists of a single cylinder generator diesel engine with a dynamometer attached to it. The dynamometer, which has an arm length of 185 mm, is used to increase the load on the engine. The speed of the engine at different loads is measured with tachometer. The engine has a variable compression ratio. It is cooled using water. The piston of engine has a bore of 87.5 mm and a stroke of 110 mm. The orifice diameter is 20 mm with a coefficient of discharge equal to 0.60. The following parameters are measured and studied during the experiment: Speed of the engine, Load on the engine, Air flow rate, Fuel flow rate, etc





Engine details:

- Water cooled
- VCR (Variable Compression Ratio)
- Bore D = 87.5 mm
- Stroke L = 110 mm

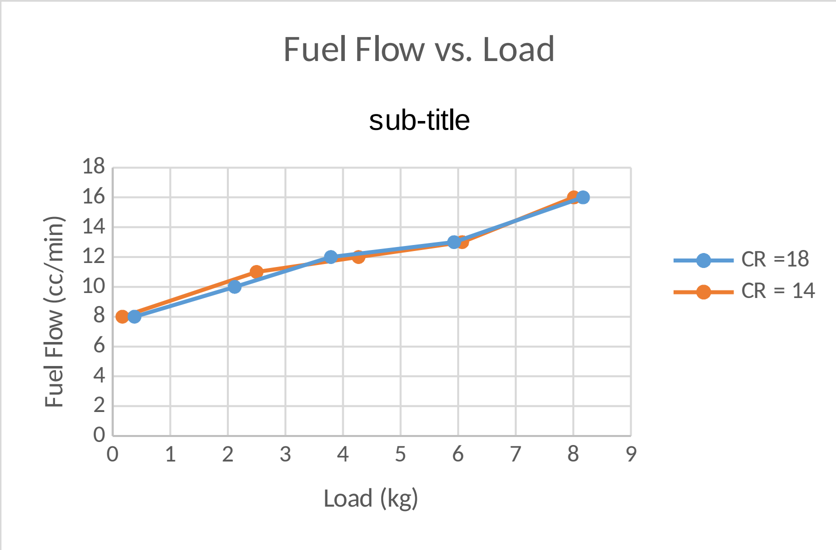
Combustion Parameters:

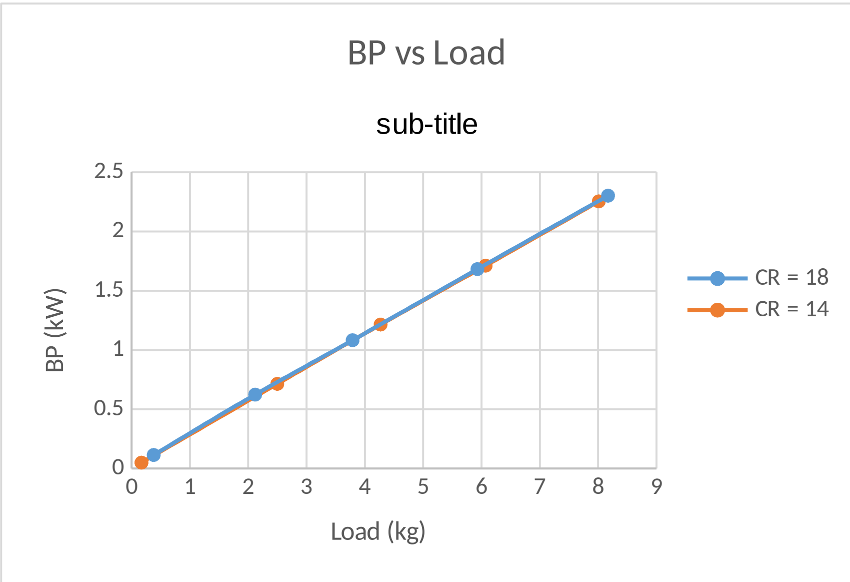
- Specific gas constant = 1 KJ/Kg K
- Specific heat capacity of water = 4.18 KJ/Kg K
- Air Density = 1.17 kg/$m3$

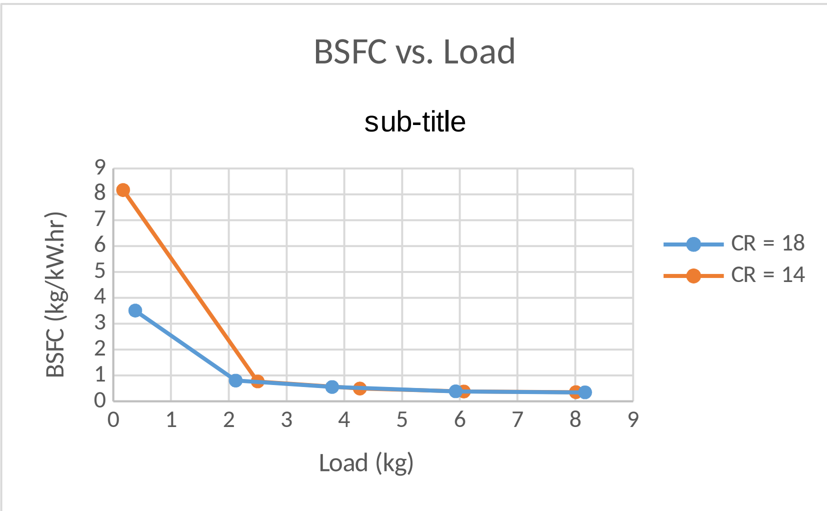
Performance Parameters:

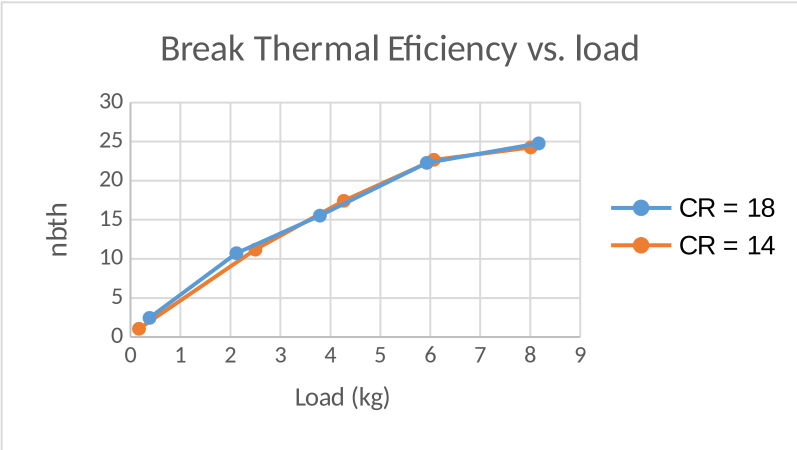
- Orifice diameter = 20 mm
- Pulses per revolution = 360
- Fuel density = 830 kg/$m3$
- Fuel Pipe diameter = 12.40 mm
- Orifice coefficient of discharge = 0.60
- Dynamometer arm Length = 185 mm
- Calorific value of fuel (CV) = 42000 KJ/Kg

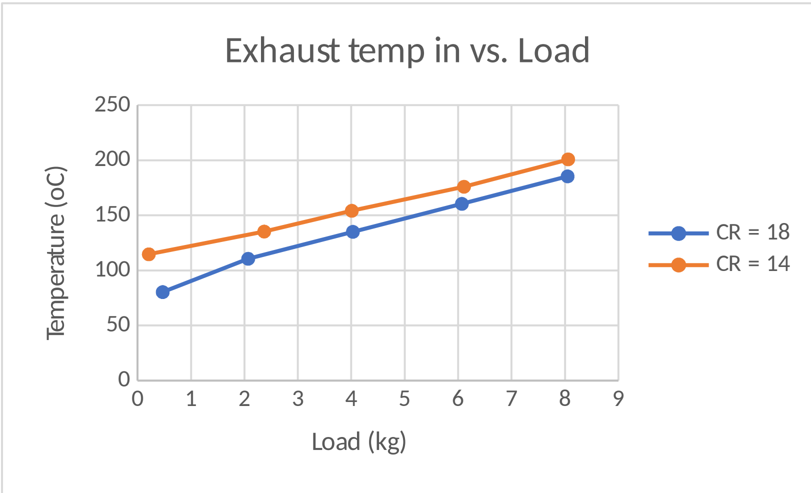
Result and Discussions:

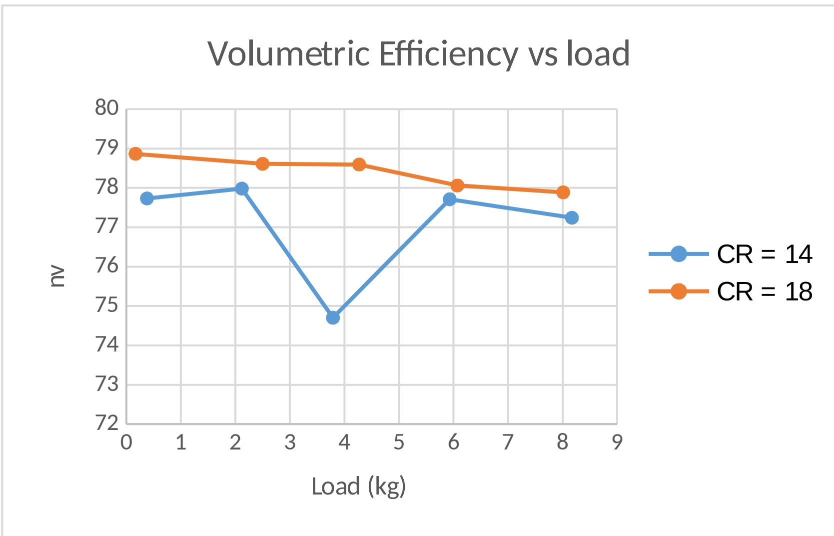

Fuel Flow vs. Load
sub-title
Fuel Flow (cc/min)
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
8
9
Load (kg)
CR =18
CR = 14

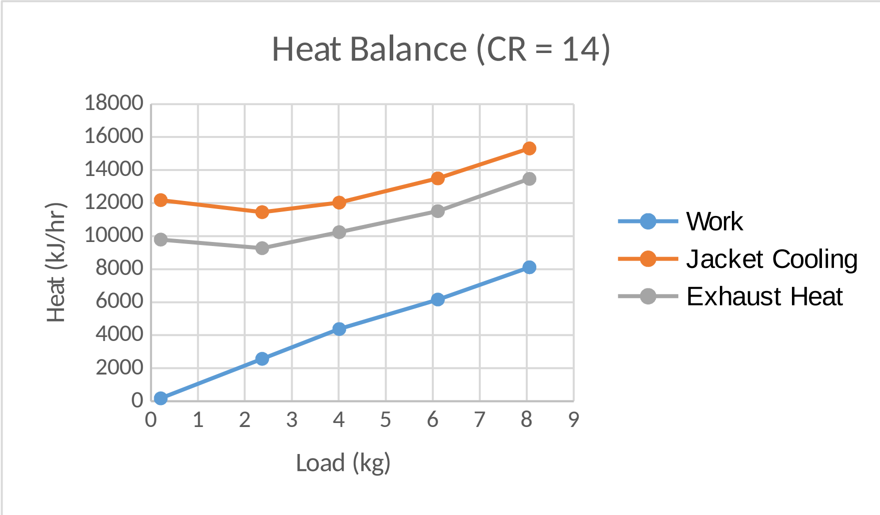

BP vs Load
sub-title
BP (kW)
2.5
2
1.5
1
0.5
0
0
1
2
3
4
5
6
7
8
9
Load (kg)
CR = 18
CR = 14

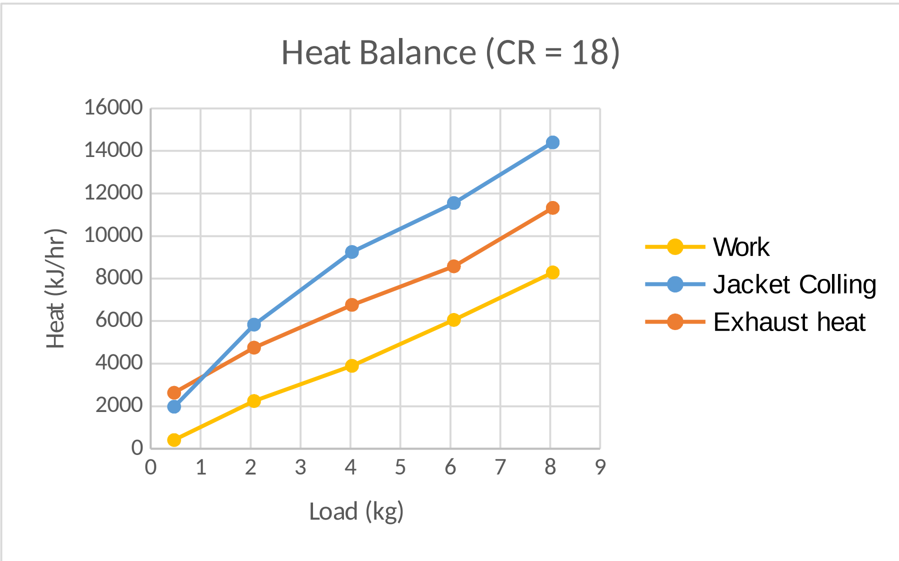

BSFC vs. Load
sub-title
BSFC (kg/kW.hr)
9
8
7
6
5
4
3
2
1
0
0
1
2
3
4
5
6
7
8
9
Load (kg)
CR = 18
CR = 14


Break Thermal Eficiency vs. load
nbth
30
25
20
15
10
5
0
0 1 2 3 4 5 6 7 8 9
Load (kg)
CR = 18
CR = 14


Exhaust temp in vs. Load
Temperature (oC)
250
200
150
100
50
0
0 1 2 3 4 5 6 7 8 9
Load (kg)
CR = 18
CR = 14


Volumetric Efficiency vs load
nv
80
79
78
77
76
75
74
73
72
0 1 2 3 4 5 6 7 8 9
Load (kg)
CR = 14
CR = 18





Precautions:

- Before stating the engine check all the systems such as cooling , lubrication and fuel system
- Ensure oil level is maintained in the engine upto recommended level always. Never run the engine with insufficient oil.
- Never run the engine with insufficient engine cooling water and exhaust gas calorimeter cooling water.
- For stopping the engine, load on the engine should be removed.

Conclusions:

- Break Power increases with increasing load.
- Volumetric efficiency remains almost constant and Break thermal efficiency increases with increasing load.
- Exhaust temperature of both input and output increases with increasing load.
- HE work is increasing in both CP 14,18 with increasing load. But there is variation in trend of HE of jacket cooling and exhaust gas with increasing load. But both are greater from their initial value.
- BSFC continues to decrease with increasing load
- Fuel flow increases with increasing load. But there is variation in the plot of CP=14 because of some error during engine controlling