التجربة رقم (3)

ا-اسم التجربة: Efficiency and Power Estimation of I.C Engine

ب -الغرض من التجربة:

To estimate the efficiency of I.C engine by using the measured vales of Torque and R.P.M

جـ -وصف الجهاز:

Test bed connected to an air-cooled, 4-stroke compression ignition engine.

د- خطوات العمل: وتشمل

1. Theory: The tests on I.C engines can be divided into two types:

a) Tests at variable speed (automotive and marine engines)

b) Tests at constant speed varying the load (generator and pump drive engines).

With full load, the variable speed tests are used to determine the maximum power and maximum specific consumption at each different speed. While the constant speed test is chiefly held to determine the specific fuel consumption.

2. Variable Speed Test: The test is at (25%) throttle and the lowest desired speed is maintained by the brake or external load adjustment. The engine is run for a period of time until the water and lubrication oil has been brought to definite operating temperature.

When engine operates in approximate temperature equilibrium, the test is started by the match governing fuel consumption test has been completed. During this interval of time, the average speed, breaking torque, fuel mass flow, and time are recorded. Recorded items include all data necessary to calculate the required results as well as all data to produce the test.

After the completion of this run, the brake or load is adjusted until the speed has changed by the desired amount. The procedure of the preceding paragraph is repeated.

نموذج القراءات:

Bore (cm)	Stroke (cm)	No of Cylinders	Compression ratio	H_L $\left(kJ/kg\right)$	Fuel used
8.2	6.8	1	18	42700	Light Diesel

هـ ـ الحسابات:

1. **Torque:** The measurement of the torque delivered by the engine takes place by the dynamometric unit and according to the following relationship:

$$T_q = k.R \qquad (\text{N.m})$$

Where: k = constant of the dynamometric unit (k = 1.2)

R = value which obtained by the dynamometric unit.

2. **Brake Power** (P_b)**:** The brake power can be calculated by using the following equation:

$$P_b = \frac{2.\pi.n.T_q}{60000} \qquad (\text{kW})$$

3. **Brake Mea Effective Pressure (**$bmep$**):** It is the average pressure in the engine cylinder during a complete engine cycle, which converts to usable power. It can be determined by using the following relationship:

$$bmep = \frac{4.\pi.T_q}{V_D} * 10^{-5} \qquad (\text{bar})$$

4. **Rate of Fuel Consumption ($\dot{m}_f$):** The interval of time required for the consumption of volume (V_f) of fuel is calculated by the following relationship:

$$\dot{m}_f = \frac{3.6 V_f}{t}.\rho_f \qquad \left(\text{kg}/\text{hr}\right)$$

Where: V_f = Diesel fuel volume = 10 cm^3

ρ_f = Specific gravity of diesel fuel = 0.85 g/cm^3

t = measured time (s)

5. **Specific Fuel Consumption (s.f.c):** It can be calculated since both brake power and fuel consumption are known:

$$s.f.c = \frac{\dot{m}_f}{P_b} \qquad \left(\text{kg}/\text{kW.h}\right)$$

6. **Air Consumption ($\dot{m}_a$):** The orifice meter is used to determine the air consumption. The orifice has a diameter (d_o) fitted to the air box. By observing the differential head (h_o) [$mm\,H_2O$] of the water manometer, the following expression can be used:

$$\dot{m}_a = 0.33\sqrt{\frac{h_o.P_1}{T_1}} \qquad \left(\text{kg}/\text{h}\right)$$

7. **Volumetric Efficiency** (η_V)**:** It is the ratio between the mass flow rate of the intake air and the theoretical mass flow rate that calculated according to the engine displacement and its rotation speed in standard air conditions.

$$\eta_V = \frac{m_a}{m_{th}} * 100\%$$

$$where:$$

$$m_{th} = \frac{120.V.n.\rho_a}{S} * 10^{-6} \qquad \left(kg/h\right)$$

Where:

$S = \text{no. of strokes} = 4$

$\rho_a = \text{density of air} = 1.181 (\text{kg/m}^3)$

8. **Mechanical Efficiency** (η_m)**:** It is the ratio of the brake power of the engine to its indicated power.

$$\eta_m = \frac{P_b}{P_i} * 100\%$$

$$where: \quad P_i = P_b + P_{friction}$$

9. **Brake Thermal Efficiency** (η_b)**:** It is the ratio of the brake power of the engine to the theoretical power available from the combustion chamber of the fuel.

$$\eta_b = \frac{P_b}{\dot{m}_f.H_L.V} * 100\%$$

10. **Water Flow Rate** ($\dot{m}_w$)**:** The time (t) required for circulating at known volume of water (V_m) is measured by a stop watch.

$$\dot{m}_w = \frac{0.0036.V_w.\rho_w}{t} \qquad \left(kg/h\right)$$

where:

ρ_w = water density = $1000(\text{kg/m}^3)$

V_w = water volume (cm^3)

$t = time\,(\text{s})$

Discussion:

1. Discuss the obtained results.
2. In the engine used in experiment, the bore is greater than stroke, what this means? And how it effects on the engine performance?
3. What are the main characteristics of the test bed used?