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DEPARTMENT OF AGRICULTURAL ENGINEERING

COURSE CODE & NAME: 19AGT301 & HEAT POWER ENGINEERING

III YEAR / V SEMESTER

UNIT : IV IC ENGINE PERFORMANCE AND AIR COMPRESSORS

TOPIC 1 :Performance Parameters

Content

Performance Parameters of IC Engine

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Performance Parameters

Indicated power

The power produced inside the engine cylinder by burning of fuel is known as Indicated power (I.P.) of engine. It is calculated by finding the actual mean effective pressure.

$$Actual\ mean\ effective\ pressure,\ P_m = \frac{sa}{l}\ N/m^2$$

Where,

a = Area of the actual indicator diagram, cm^2

l = Base width of the indicator diagram, cm

s = Spring value of the spring used in the indicator, $N/m^2/cm$

For four stroke engine

P_m = Mean effective pressure, N/m^2

L = Length of stroke, m

A = Area of cross section of the cylinder, m^2

N = RPM of the engine crank shaft

n = Number of power strokes per minute

$$I.P. = \frac{P_m LAn}{60000} \quad kW \qquad where \ n = \frac{N}{2}$$

For two stroke engine

$$I.P. = \frac{P_m LAn}{60000} \quad kW \qquad where \ n = N$$

Brake Power (B.P.)

It is the power available at engine crank shaft for doing useful work. It is also known as ***engine output power.*** It is measured by dynamometer.

It can be calculated as follows:

$$\therefore T = W \times R \quad Nm$$

Let,

$$B.P. = \frac{2\pi NT}{60000} = \frac{P_{mb} LAn}{60000} \quad kW$$

W = Net load acting on the brake drum, N

R = Effective radius of the brake drum, m

N = RPM of the crank shaft

T = Resisting torque, Nm

P_{mb} = Brake mean effective pressure

Net Load W =(m_1- m_2)*g

Effective radius R = (Dd + dr)/2;

where,

m_1 is load mass in kg

m_2 is spring balance mass in kg,

Dd is diameter of Drum in m,

dr is diameter of rope in m

Measurement of Brake Power (B.P.)

The power output (B.P.) of the engine is measured by coupling a dynamometer to engine crank shaft. Various dynamometers are listed below:

1. Rope brake dynamometer
2. Prony brake dynamometer
3. Hydraulic dynamometer
4. Eddy current dynamometer

Friction Power

The piston connecting rod and crank are mechanical parts, moving relative to each other. They offer resistance due to friction. Therefore a certain fraction of power is lost due to friction of the moving parts.

The amount of the power lost in friction is called ***friction power.*** The friction power is the difference between the I.P. and B.P.

$$Friction\ power = I.P. - B.P.$$

Efficiencies

Mechanical efficiency:

It is defined as the ratio of the brake power to the indicated power. Mechanical efficiency is indicator of losses due to friction.

$$\eta_{mech} = \frac{B.P.}{I.P.}$$

Thermal efficiency:

It is the efficiency of conversion of the heat energy produced by the actual combustion of the fuel into the power output of the engine. It is the ratio of work done to heat supplied by fuel.

Indicated thermal efficiency = Indicated Power/ Heat supplied by fuel

$$\eta_{it} = \frac{I.P.}{m_f \times CV}$$

Where, m_f = mass of fuel supplied, Kg/sec and CV = calorific value of fuel, J/kg

Brake thermal efficiency = Brake Power/ Heat supplied by fuel

$$\eta_{bt} = \frac{B.P.}{m_f \times CV}$$

Air standard efficiency:

It is the efficiency of the thermodynamic cycle of the engine.

For petrol engine,

$$\eta_{air} = 1 - \frac{1}{(r)^{\gamma-1}}$$

For diesel engine,

$$\eta_{air} = 1 - \frac{1}{(r)^{\gamma-1}}\left[\frac{\rho^{\gamma} - 1}{\gamma(\rho - 1)}\right]$$

Relative efficiency:

It is the ratio of indicated thermal efficiency of an engine to air standard cycle efficiency.

$$\eta_{rel} = \frac{\eta_{it}}{\eta_{air}}$$

Volumetric efficiency:

It is the ratio of the volume of charge/air actually sucked at atmospheric condition to swept volume of engine.

It indicates breathing capacity of the engine.

$$\eta_{vol} = \frac{\text{Actual volume of charge or air sucked at atm. condition}}{\text{Swept volume}}$$

Specific power output:

The specific output of the engine is defined as the power output per unit area.

$$Specific\ output = \frac{B.P.}{A}$$

Specific fuel consumption:

Specific fuel consumption (SFC) is defined as the amount of fuel consumed by an engine for one unit of power production. SFC is used to express the fuel efficiency of an I.C. engine.

$$SFC = \frac{m_f}{B.P.}\ Kg/kWh$$

Where,

m_f = Mass of fuel consumed in kg/hr and B.P. = Power produced in kW

Thank You