**ME 2041 – ADVANCED IC ENGINES**

**UNIT III**

**ENGINE EXHAUST EMISSION CONTROL**

1. **What are the major exhaust emissions?**

The major exhaust emissions are

a. Unburnt hydrocarbons (HC) b. Oxides of carbon (co and co2)

c. Oxides of nitrogen (NO and NO2) d. Oxides of sulphur (SO2 and SO3)

e. Particulates f. Soot and smoke

**2. What are the causes for hydrocarbon emission from S.I engine**

The causes for hydro carbon emission from S.I engine are

1. Incomplete combustion.

2. Crevice volume and flow in crevices.

3. Leakage past the exhaust valve.

4. Valve over lap.

5. Deposits on walls.

6. Oil on combustion chamber walls.

**3. What are the reasons for incomplete combustion in SI engine?**

Incomplete combustion is due to

a. Improper mixing due to incomplete mixing of the air and fuel. Some fuel particles do not find the oxygen to react with this cause the emissions.

b. Flame quenching: As the flame goes very close to the walls it gets quenched at the walls leaving a small volume of unreacted air fuel mixture.

**4. What are the reasons for flame quenching?**

The reason for flame quenching is the expansion of gases.

(i) As the piston moves down from TDC to BDC during power stroke, expansion of the gases lowers both pressure and temperature within the cylinder. This makes combustion slow and finally quenches the flame and causes the emissions.

(ii) High exhaust gas contamination causes poor combustion and which in turn causes quenching during expansion.

(iii) As the flame goes very close to the walls it gets quenched at the walls leaving a small volume of unreacted air-fuel mixture.

**5. How the oil consumption increases in IC engines and what are the effects**

Often as engines ages, due o wear, clearance between the pistons and cylinder wall increases. This increases oil consumption contributes to increases in the emissions in three ways.

**a**. There is an added crevices volume.

**b.** There is added absorption – desorption of fuel in the thicker oil film on cylinder walls

**c.** There is oil burned in the combustion process

**6. Write a short note on carbon monoxide emissions**

Carbon monoxide is a colourless and odourless but a poisonous gas. It is generated in an engine when it is operated with a fuel rich equivalance ratio. Poormixing, local rich regions, and incomplete combustion will also be the source for co emissions.

**7. What is photochemical smog?**

NOx is the primary causes of photochemical smog, Smog is formed by the photochemical reaction of automobiles exhaust and atmosheric air in the presence of sunlight.

NO2 + energy from sunlight  NO + O +smog

**8. What are soot particles?**

Soot particles are clusters of solid carbon sheres. These spheres have diameter from 9nm to 90nm (1nm = 10-9). But most of them are with in the range of 15 – 30nm. The spheres are solid carbon with HC and traces of other components absorbed on the surface. Single soot particles may contain up to 5000 carbon spheres.

**9. Which is the most effective after treatment for reducing engine emissions**

The catalytic converter is the most effective after treatment for reducing engine emissions found on most automobiles. Co can be oxidized to CO2 and H2O in exhaust system and thermal converters if the temperature is held at 600- 700C. If certain catalysts are present, the temperature needed to sustain these oxidation processes is reduced to 250 - 300C, making for a much more attractive system.

**10. What is a catalyst?**

A catalyst is a substance that accelerates chemical reaction by lowering the energy needed for it to proceed. The catalyst is not consumed in the reaction and so functions indefinitely unless degraded by heat age contaminants or other factors.

**11. List the materials used as catalyst**

The catalyst materials most commonly used are,

**a**. Platinum

**b.** Palladium

**c.** Rhodium.

**12. Why catalytic converter called as three way converters**

Catalytic converters are called as three way converters because they are used to reduce the concentration of CO, HC and NOx in the exhaust.

**13. What are the types of ceramic structure used in catalytic convertor?**

Inside the container is a process ceramic structure through which the exhaust gas flows.

a. The ceramic is a single honey comb structure with many flow passages.

b. Some converters use loose granular ceramic with the gas passing between the packed spheres.

**14. List out the drawbacks of catalytic converters**

**a.** Sulphur offers unique problems for catalytic converters some catalyst promote the conversion of SO2 to SO3 which eventually converted to sulphuric acid. This degreds the catalytic convertor and contributes to acid rain.

**b.** Catalytic converters are not very efficient when they are cold. When an engine is started after not being operated for several hours it takes several minute for the converter to reach an efficient operating temperature called as cold start up problem.

**15. What are the methods of catalytic converters preheating?**

The methods of catalytic converters preheating included the following

a. By locating the converters close to the engine

b. By having superinsulation

c. By employing electric preheating

d. By using flame heating

e. Incorporating thermal batteries.

**16. List the invisible and visible emission**

**Invisible emission:** Water vapour, carbon dioxide, oxides of nitrogen, unburnt hydrocarbons, carbon monoxide, aldehyes.

**Visible emission:** Smoke, particulate.

**17. What are the methods of measuring the following emission?**

**a.** Oxides of nitrogen = CHEMILUMINESCENCE ANALYZER

**b.** Carbon monoxide = NON DISPERSIVE INFRARED ANALYZER

**c.** Unburned hydrocarbons = FLAME IONIZATION DETECTOR (FID)