

## UNIT

## 8

**Automobile Pollution****Structure**

- 8.1 Effects of automobile pollution on environment and human beings
- 8.2 Types of automobile emissions
- 8.3 Treatment of exhaust gases by using catalytic convertors
- 8.4 Exhaust gas Analyzer

**Learning Objectives**

After studying this unit the student will be able to understand the

- The effects of automobile pollution on environment and human beings.
- Types of automobile emissions
- Treatment of exhaust gases by using catalytic convertors
- Measuring of percentage of pollutants from petrol and Diesel vehicles by using 'Exhaust gas analyzers'

**8.1 Effects of automobile pollution on environment and human beings**

The major sources of automobile air pollution are the exhaust gases of the automobiles. The exhaust gases of automobiles contain severe pollutants in the form of nitrogen oxides which are toxic. The oxides of nitrogen together

with Hydrocarbons react in the presence of sunlight and form petrochemical smog. Its bad effects include crop damage.

## 8.2 Types of automobile emissions

- (i) Exhaust emissions
- (ii) Evaporative emissions
- (iii) Crank case blowy

### Exhaust emissions

The exhaust emissions contain the specific substances- Hydrocarbons (HC) Carbon Monoxide (CO) and Oxides of nitrogen (NO). Hydrocarbons are the unburned fuel vapours coming out with the exhaust due to incomplete combustion. Hydrocarbons also occur in crank case blowy and fuel evaporation. Carbon monoxide occurs only in engine exhaust . It is the exhaust of incomplete combustion due to insufficient amount of air fuel mixture or insufficient time for complete combustion. 'Oxides of nitrogen ' are the combination of nitric oxide (NO) and nitrogen dioxide (NO<sup>2</sup>) which occurs only in exhaust . At high temperatures nitrogen and oxygen heat with each other causing creation of NO.

### Evaporative emissions

These emissions take place from the fuel supply system. About 30% of the total Hydrocarbon emission occur from fuel tank, pipe lines, carburettor etc.

### Crank case Blow by

Crank case blow by means the leakage of fresh charge past the piston and piston rings form the cylinder to crank case. It is almost 20% of the total HC emissions form the engine and about 30 % if piston rings are worn. In these gases about 85% raw hydrocarbons and 15% of burnt gases will be leaked. These gases can be controlled by crank case ventilation.

From the alone process, the major pollutants are released . Those are

- (i) Carbon monoxide
- (ii) Unburnt Hydrocarbons
- (iii) Oxides of nitrogen
- (iv) Lead oxides
- (v) Sulphur dioxide
- (vi) Smoke

Of the above pollutants, carbon monoxide (CO) is most undesirable. The effect of CO inhalation are headaches, sickness or loss of mental alertness. Carbon monoxide reacts with haemoglobin (HB) in the blood to give carboxyhemoglobin (COHB) and this causes decrease of HB for oxygen transport.

A combination of strong sunshine and stagnant air allows unburnt hydrocarbons and oxides of nitrogen to combine chemically to produce 'Photochemical smog'. This causes damage to rubber, clothing, paint, and exposed surfaces.

Lead present in lead oxides in exhaust gases can be harmful particularly for children in the age group of 1 to 5 years.

Sulphur dioxide causes visibility attenuation, bronchitis and even lung cancer also.

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### **8.3 Treatment of exhaust gases by using catalytic converters**

The exhaust gases from the engine are passed through 'Catalytic convertor' which is a cylindrical unit about the size of a small silencer and is installed into the exhaust system of a vehicle between exhaust manifold and silencer. Inside the converter there is a honeycomb structure of a ceramic or metal, which is coated with alumina base materials and thereafter a second coating of precious metal like platinum, palladium or rhodium. This second coating serves as catalyst. A catalyst is a substance which causes a chemical reaction. As a result of this reaction when the exhaust gases pass over the convertor substance, toxic gases such as CO, HC and NO are converted into harmless CO<sub>2</sub>, H<sub>2</sub> and N<sub>2</sub>.

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### **8.4 Exhaust gas Analyzer**

The analysis of exhaust gases can be done with the help of infrared analyzer. The analyzer is capable of measuring the hydrocarbons and carbon monoxide. The probe is inserted into the tail pipe of vehicle and the analyzer is switched on. The exhaust sample is moved by an internal pump, through the sample line and filter. Then it is vented to atmosphere. In the sample cell, a beam of infrared light is made to pass through the exhaust sample. The analyzer then determines the quantities of Hydrocarbons and carbon monoxide with the help of processing electronics and indicates the same by moving the respective indicators. The quantities indicated are in parts per million (PPM).

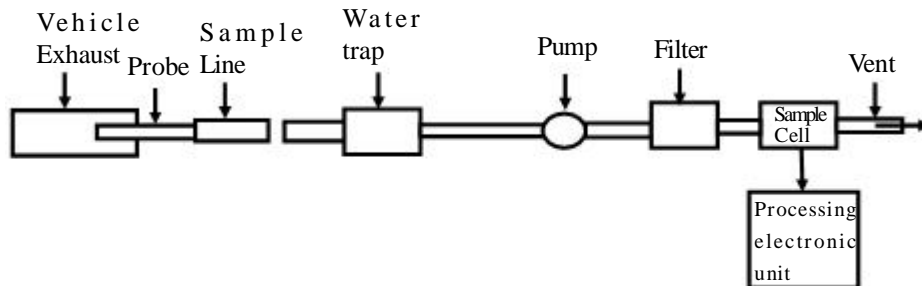


Fig 8.1 Operation of Exhaust gas Analyzer

### Specifications of a typical modern gas analyzers

CO	Ranges :	0-9.9%
	Accuracy :	$\pm 0.21\%$
	Repeatability	$\pm 2\%$ fs.
HC	Ranges	0-5000 ppm
	Accuracy	$\pm 40$ ppm at 0-2000 RPM
	Repeatability	$\pm 150$ ppm at 2000-5000 RPM
O <sub>2</sub>	Ranges	0-20.9%
	Accuracy	$\pm 0.4\%$ at 0-5%
		$\pm 1.0\%$ at 5 - 20.9%
	Repeatability	$\pm 2\%$ fs.
CO <sub>2</sub>	Ranges	0-20.0%
	Accuracy	$\pm 0.9\%$ at 0-0%
		$\pm 0.48\%$ at 10-16%
		$\pm 1.44\%$ at 16-20 %
	Repeatability	$\pm 2\%$ fs

Warm up time : 10 minutes at 20°C

Response time : 14 seconds for 90% for final reading (10 m pipe)

Operating temperature : 2°C to 43°C

Dimension	: 315 mm (w) x 282 mm (H) x 270 mm (D)
Weight	: 14.3 kg.
Power	: 200-24, v, 50-60 HZ, 100W.
Options	: (i) Printer (ii) RPM/ Oil temperature display

For Diesel engines it is also required to measure the smoke capacity and K-value for which a smoke meter is used. Main specification of a typical smoke meter (Manatec - DSM 2000) are as follows

Measurement parameters	Range	Resolution
Opacity	0-99.9%	0.10%
K- Value	0.99.9%	0.10%
Other specification		$\pm$
Linearity		$\pm$ 0.1 m <sup>-1</sup>
Repeatability		0.1 m <sup>-1</sup>
Response time physical		< 0.4 sec
Response time - electrical		< 1 ms
Warm up time		< 3 minutes
Smoke measuring call length		430 mm.

## Summary

- The major sources of automobile air pollution are the exhaust gases of automobiles.
- The exhaust gases of automobile contain severe pollutants in the form of nitrogen oxides.
- Types of Automobile emission.
  - i. Exhaust emission
  - ii. Evaporative emissions
  - iii. Crank case blow by

**Short Answer Type Questions**

1. Mention the types of automobile emission.
2. Mention the pollutant released while crank case blow by.
3. What is the purpose of exhaust gas analyzer.

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**Long Answer Type Questions**

1. Briefly explain the working of catalytic converter.
2. Explain the operation of Exhaust gas analyzer.
3. Explain the effects of automobile pollution on environment and human beings.