AIR POLLUTION FROM AUTOMOBILES:

- The air pollution from automobiles may be highly significant particularly in congested & poorly ventilated roads. Congestion intensifies air pollution problems, increase communicating times & raises vehicle operating costs. Poor maintenance of vehicles is a major factor for automobile pollution.
- The major pollutants generated by the automobiles are :
  i. Hydrocarbons (HCs)
  ii. Oxides of nitrogen (NO_X)
  iii. Carbon monoxide (CO)
  iv. Particulates including lead (PM)
- On an average basis, the transportation contributes more than 50% of the total pollutants emitted into the atmosphere.

MAJOR AUTO POLLUTANTS:

1. HYDROCARBONS:

- HCs are the chemical products of combustion in the exhaust gases.
- The contribution of HCs from various parts of the gasoline based motor vehicles is as follows:
  i. Evaporation losses from tank & carburettor (20%)
  ii. Crank case blowby (25%)
  iii. Exhaust (55%)
- The imp. HCs present in the exhaust are
  i. paraffins
  ii. Olefins (particularly low mol. wt. mono & diolefins)
  iii. aromatics (mostly benzene & toluene) &
- Though, a total of more than 80 compounds have been identified from the auto-exhaust only olefins & polycyclics are of major concern
- Olefins play an imp. role in the formation of photochemical smog, while polycyclics are the potential carcinogenic compounds.

2. NO_X:

NO_X are generated mainly by the chemical combination of nitrogen gas & oxygen at high combustion temp.

3. CO:

CO is the major pollutant from the exhaust gases which comprises about 50% of the total wt. of pollutant. It is the chemical product of combustion in the exhaust gases.

4. PARTICULATES:

- Particulates from automobiles include salts of lead, alkaline earth compounds, iron oxides, soot, carbonaceous material & tars
- The particulate material may vary in size from large flakes to submicron particles.
- Though the total weight of the particulate is comparatively low, considerable significance is given to auto-exhaust particles due to presence of lead & carcinogenic compounds.
    - Lead added in the form of tetraethyl lead to the gasoline as a anti knocking agent.
    - Lead appears in the atmosphere as a decomposition product in the form of
        - Lead chloride
        - Lead bromide
        - Lead sulphate
        - Lead oxide &
        - Lead phosphate
    - Lead is an accumulative nerve toxin & may cause hypertension & heart attacks. It has been estimated that, a reduction of lead in gasoline to 0.1 gm/gallon in USA will prevent 1.8 million cases of hypertension, 5000 heart attacks & 1000 strokes. A short term survey carried out by the National Institute of Occupational Health, Ahmedabad indicates that, the lead in the blood & urine of policemen & roadside shopkeepers remain particularly high as compared to the unexposed persons.
    - Switzerland was the 1st country in Europe to introduce lead-free petrol. Great Britain, USA, Japan & USSR have also completely banned lead in petrol. In India, these days only unleaded petrol is sold.
    - Out of the several polycyclic particulate compounds, one of the most potent carcinogen is benzo (α) pyrene. It is usually present in high conc. in auto-exhaust & is the product of high temp. combustion of carbonaceous matter.

DIESEL VS. PETROL FUELED AUTOMOBILES W.R.TO AIR POLLUTION

Diesel engine:

- It produces much less CO, fewer HCs & no lead but considerably higher amount of NO_X & organic acids are released mainly because of the high temp. combustion.
- Diesel exhaust is usually more odorous than others.
- High carbon load in diesel exhaust comes from unburnt carbon & higher SO_X as a result of greater Sulphur content of the diesel.
- Particulates in diesel exhaust are as high as 10 times to that of petrol exhaust.

Petrol engine:

- It produces considerably higher quantities of CO & HCs than the diesel fueled automobiles.

AIR POLLUTION BY AIR CRAFTS:

- Air planes both jet & piston types are also significant producers of air pollutants. However, this source of air pollution is more imp. at airports & the vicinity.
- On a nationwide basis, the aircrafts contribute only a very small percentage to the nation's air pollution problem.
- Jet planes are of more concern in producing automobile pollution because of relatively fewer no. of vehicles.

AUTOMOBILE POLLUTION & CLIMATE:

The pollution problem by automobiles may be aggravated in hot climate. Consequently, there is an urgent need to study the effects of automobile pollution in relation to hot tropical climate where till recently a little work has been carried out.

CONTROL OF AUTOMOBILE POLLUTION:

1. ROLE OF LEGISLATION:

Enforcement of laws is an imp. tool in curbing automobile pollution. The auto emission standards can be promulgated at two stages i.e.at manufacturing & at road level. At manufacturing stage, the emission of various pollutants like CO, HCs, NO_X & Particulates is checked at the std. test condition. A national level legislation on this subject has come into force after the amendment of the Motor Vehicles Act.

2. ROLE OF CONTROL DEVICES:

i. CRANKCASE EMISSION CONTROL BY PCV:

The pollution caused by crankcase is result of the leakage of HCs & other gases between piston ring & cylinder wall which are then released out into the atmosphere through a vent. A complete check on such emissions has been brought by a device called positive crankcase ventilation (PCV), which provides return of crankcase blowby to the engine for burning again, instead of venting them out to the atmosphere.

ii. CONTROL OF EXHAUST EMISSIONS USING VAPOUR-LIQUID SEPARATOR:

Devices have also been developed for controlling the evaporative losses of fuel from the storage tank. One such device is an attachment of a vapour-liquid separator to the tank which return liquid back to the fuel tank & releases vapours into a canister containing activated carbon. The stored vapour in this canister are then purged into the combustion chamber (cylinder) for burning.

iii. CONTROL OF EXHAUST EMISSION USING

a. CATALYTIC CONVERTERS:

Use of catalytic converters in two stages helps in eliminating pollutants from exhaust gases before they are discharged into the atmosphere.

In the 1^{st} converter (NO_X) is reduced to N_2 ($+NH_3$) in the presence of finely divided Pt, as catalyst & the reducing gases CO & HCs. The production of NH_3 is kept at a minimum under carefully controlled conditions.

In the 2nd converter, air is introduced to provide an oxidizing atmosphere for complete oxidation of HC & CO into H_2O & CO_2 in the presence of finely divided Pt catalyst. One problem of the Pt catalyst is that, it is liable to be poisoned by heavy metals (e.g. Pb) present in gasoline itself. Hence Pb-free gasoline must be used for proper function of catalytic converters.

b. STRATIFIED CHARGE ENGINE:

Honda Corporation of Japan has recommended this engine as an alternative to catalytic converters. It contains an extra combustion chamber where a fuel-rich mixture is introduced & ignited with a spark. This sets in combustion at a relatively low temp. as a result of which NO_X formation is minimized. The burning mixture is then fed into the large main chamber where it gets mixed with a lean fuel mixture (which contains excess air). The combustion proceeds to completion without stalling the engine. The presence of excess air ensures complete combustion of HC & CO but the temp. remains low enough to limit the build up of NO_X.

3. ROLE OF SUBSTITUTE FUEL:

Natural gas in both compressed (CNG) & liquefied forms (LNG) has been used as fuel. Although it is an attractive pollution free fuel, there are problems of steady supply & economic storage. Alcohols are other substitutes, but their combustion products, aldehydes are eye irritants.

4. ROLE OF ALTERNATE POWER SOURCES:

The fourth possible solution to automotive emission problems is alternate power sources e.g. steam, electric & gas turbine engines but none of these are economically viable as compared to gasoline.