

Photochemical Smog

Photochemical Smog-

- Photochemical smog is a form of air pollution that is caused by the reaction of sunlight with other pollutants such as hydrocarbons and nitrogen oxides under certain meteorological conditions.
- Photochemical smog is characterized by haze, ozone formation, eye irritation and damage to vegetation. It may be seen as brown haze over the skylines of metros/megacities and near factories.
- Photochemical smog occurs most prominently in urban areas that have large numbers of automobiles (**Nitrogen oxides** are the primary emissions).
- Photochemical smog first came into prominence in July 1943, in Los Angeles and also known as “**Los Angeles smog**”.

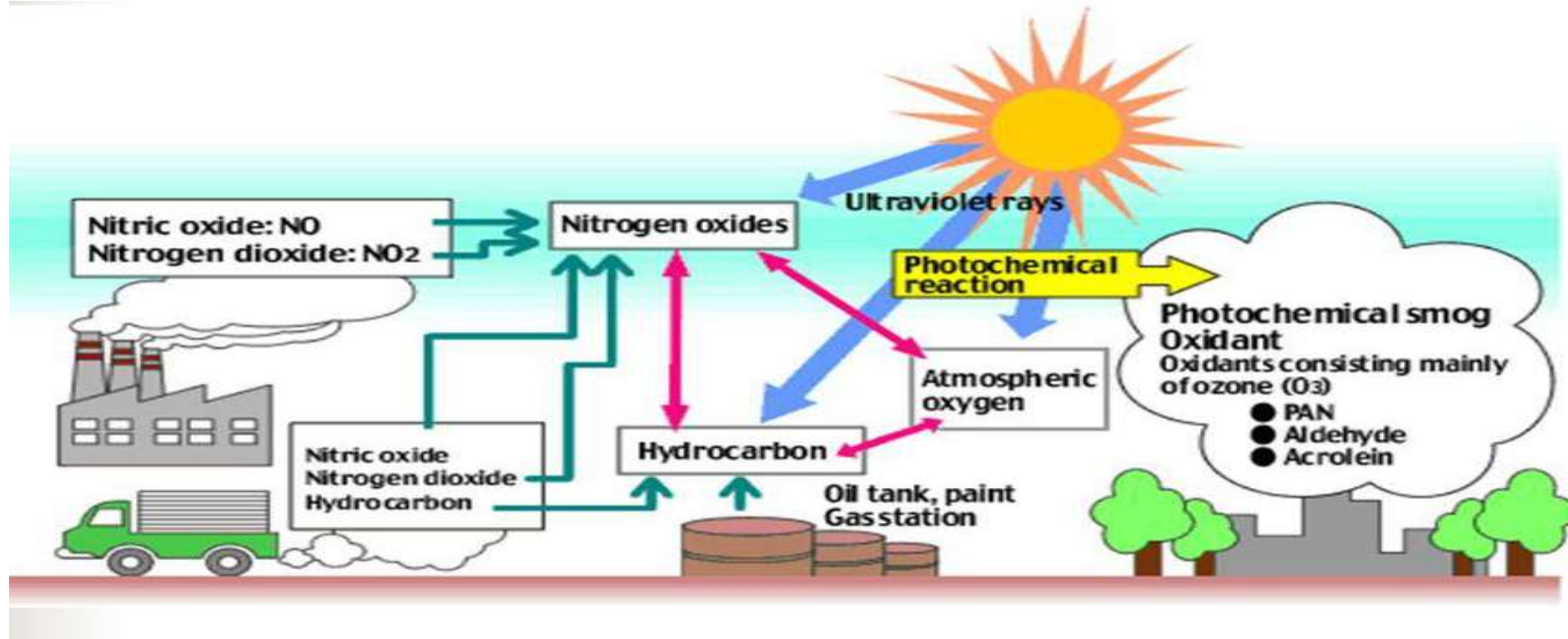
The Photochemical Smog Precursors and their Sources-

- The primary smog precursors are NO_x and volatile organic compounds (VOCs). The automobile exhausts are the principle source of these precursors.
- In addition, there are natural sources of nitrogen oxides such as lightning, microbial processes in soil, and forest fires.
- The petrol/diesel contain hundreds of different kinds of alkanes, alkenes, and aromatic hydrocarbons, etc., which are released in the atmosphere.
- Evaporation of naturally occurring compounds, such as terpenes, is an important source of VOCs. The evaporation of solvents, petrol and other organics is an important manmade source of VOCs.

Secondary Precursors-

- Secondary precursors are ozone, PAN, organics, acids and aerosols.
- The most notorious secondary pollutant is ozone. In presence of sunlight, the dissociation of NO_2 occurs and ground state oxygen atom is formed.

Formation of Photochemical smog-

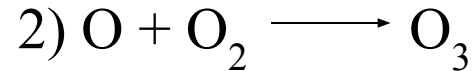


How is Photochemical smog formed?

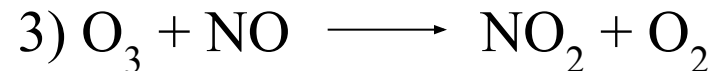
- Nitrogen dioxide (NO_2) can be broken down by sunlight to form nitric oxide (NO) and an oxygen radical (O):



- Oxygen radicals can then react with atmospheric oxygen (O_2) to form ozone (O_3):



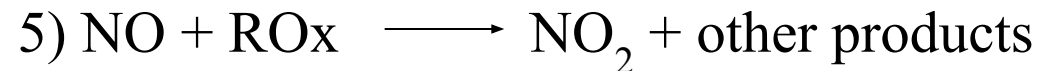
- Ozone is consumed by nitric oxide to produce nitrogen dioxide and oxygen:



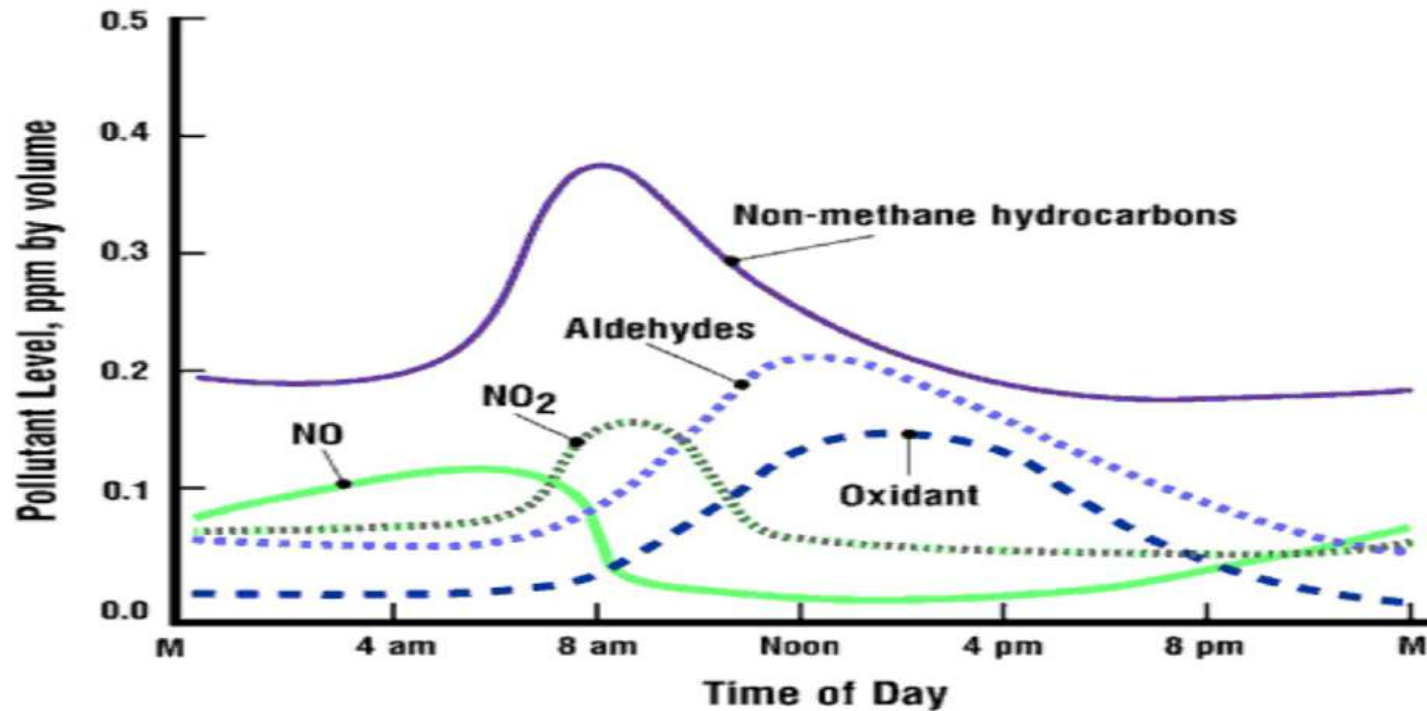
- Harmful products, such as PAN, are produced by reactions of nitrogen dioxide with various hydrocarbons (R), which are compounds made from carbon, hydrogen and other substances:



- The main source of these hydrocarbons is the VOCs. Similarly, oxygenated organic and inorganic compounds (ROx) react with nitric oxide to produce more nitrogen oxides:



The diurnal variation in the concentration of non-methane hydrocarbons, NO, NO₂, aldehydes and ozone-



Effects of Photochemical smog-

- **Effect on Vegetation:** The constituents of photochemical smog, viz., NO_x, ozone, and PAN harm plants by reducing photosynthesis. Even small quantities of ozone are harmful to plants.
- **Effect on Human Health:** NO_x contribute to damage to lungs and heart and decrease resistance to infection. VOCs cause eye- irritation, respiratory diseases; some VOCs are carcinogens.
- **PAN** causes eye-irritation and activate respiratory problems. Ozone induces coughing, wheezing, eye-irritation, asthma and other respiratory problems.
- **Effect on Materials:** Ozone being an oxidant damages many materials. It cracks rubber, reduces tensile strength of the textiles, accelerates fading of dyed clothes and discolors painted surfaces.