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SMOG : A HAZARDOUS AIR POLLUTANT

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The word smog is derived from two words smoke and fog to refer to smoky fog to its opacity and odour! It is a type of air itant mainly consists of gases like oxides of sulphur and nitrogen, fog, smoke or particulate matter.

culate matter are type of particles having varying size from 0.1 micron to 10 micron present in atmosphere. In general the word culate is generally used to describe the particles of colloidal dimensions present in aerosols. The particulate matter results in sphere from nature itself as well as various human activities such as metallurgical operations and combustion of coal results in ganic particulate matters, automobile exhausts are responsible for organic particulate matter, Thus smog may be smoke, fog and culate matter with oxide of sulphur and nitrogen.

In Dec. 1930 in Meuse Valley of Belgium in 1952 London smog in Donora pennsycrania, in 1950 Loc Angeles smog (ochemical smog) are some well known hazardous smog which resulted in death of thousands of people and making several sand people ill.

Beside these smog can be seen in many cities throughout the world and in winters it also appears in NCR. Out of these tioned smog London smog and Los- Angeles smog are discussed here briefly.

don Smog : This type of smog was first observed in London in Dec. 1952 so it is called London smog. The other name of this smog lassical smog, industrial smog or sulphurous smog. It was the most several air pollution in which 5000 people were killed. It was a cing smog as it chemically contains a reducing mixture of oxides of sulphur, the mixture of smoke, fog. It occurs during erature inversion . The temperature in troposphere region of atmosphere fairly decreases steadily with increasing altitude from nd temperature of 15oc to a temperature of about -56oc change of temperature with hight is called increasing altitude, it is called tive lapse rate. In tropopause (a region between10-20 km height) a transition from positive to negative lapse rate occurs which is d temperature inversion. This smog is generally worst in early morning and worsens shortly after sunrise. This is probably due to ochemically induced oxidation of So2 into So3 and subsequent combination with moisture to form acidic aerosol (Sulphuric acid sol). Particulate of smoke from coal combustion provide condensation cites to condense fog droplets. The main culprit of smog is which combines with H2S and NH3 and produce sulphites which are important toxicants of smog. Sulphate haze (Sulphate ation on synthetic deposits of varying composition containing mainly Nacl, NaNo3 were exposed to So2 air gas mixture at entration typical for heavily polluted atmosphere under haze conditions) normally considered to be a green house gas in onsible for climate cooling.

hates are found to lower the temperature in two ways-

by reflecting away the incoming solar radiation.

by boosting the number of cloud droplets it increases cloud reflectivity.

Only the regional cooling takes place as the temperature decreases due to sulphate aerosol which regional and So2 stays only e area which is engulfed by it.

chemical reactions occur in whole process can be summarized as below :

$$S + O_2 \rightarrow So_2$$

$$SO2 + \tfrac{1}{2} O_2 \rightarrow H2SO_3$$

$$So_3 + H_2O \rightarrow H2SO_4$$

$$H_2SO_3 + \frac{1}{2} O_2 \rightarrow H_2SO_4$$

$$H_2SO_4 + 2NH_3 \rightarrow (NH_4)_2 SO_4$$

$$So_2 + 2NH_3 + H_2O + \frac{1}{2} O_2 \rightarrow (NH_4)_2 SO_4$$

SO_2 in presence of sunlight or particulate matter gets converted into SO_3 which gives H_2SO_3 with moisture present in fog and rapidly in H_2SO_4 in presence of metal ions. SO_2 also combines with ammonia in moist air forming ammonium sulphate. This London Smog is an example how SO_2 is hazardous when it gets mixed with SO_3 and particulate matter.

Los Angeles or Photo chemical Smog

In 1950 a photochemical smog was experienced by people of Los-Angeles in California which was totally different from London Smog in nature and its harmful effect on living beings. It breaks in afternoon and worst in sunshine. The main components of this smog are unsaturated hydro- carbons, some sulphur compounds and oxides of nitrogen. Various inorganic and organic components present in this smog are-

(a) Inorganic gases like ozone, oxides of nitrogen (Nox), hydrogen per oxide and carbon mono oxide.

(b) Organic substances like organic per oxides, organic hydro per oxides, per oxyacetyl nitrate (PAN), per oxy benzoyl nitrate (PBN), per oxy propionyl nitrate (PPN), acetyl per oxide, ethyl hydro per oxide, per acetic acid, n-butyl hydro per oxide, ter- butyl hydro per oxide, ozone in atmosphere etc. Ozone is formed in atmosphere due to chemical reactions between pollutants like SO2, NO2 and aldehydes in presence of UV light. Ozone plays active role in photochemical smog. The following reactions take place during this process which explain the variation concentration of NO, NO2, O3 in different hours of a day. In early morning NO concentration is at peak which decreases after sometimes and NO2 concentration increases.

$$N_2 (g) + O_2 (g) \rightarrow 2NO (g)$$

The photolytic dissociation of NO2 increases NO concentration in atmosphere.

$$NO_2 \rightarrow NO + O_2$$

$$NO + [O] \rightarrow No_2$$

$$[O] + O_2 \rightarrow O_3$$

$$O + O_2 + M \rightarrow O_3 + M \quad (M \text{ may be } N_2, O_2, Ar, Co_2)$$

$$O_3 + NO \rightarrow NO_2 + O_2$$

At high concentration NO_2 causeshaze. Both NO_2 and O_3 formed above react with unburnt hydrocarbons present in air to form formaldehyde, PAN, acrobin etc.

Various organic compounds like hydrocarbons, aldehydes and ketones undergo photo chemical oxidation during photochemical smog as below:-

$$CH_4 + \frac{1}{2} O_2 \rightarrow H_3C + OH$$

$$CH_4 + OH \rightarrow CH_3 + H_2O$$

$$CH_3 + O_2 + M \rightarrow CH_3COO + M$$

$$CH_3CH = CH_2 + OH \rightarrow CH_3\text{-}CH\text{-}CH_2OH$$

$$RCHO + hv \rightarrow R + HCO$$

$$RCOR + hv \rightarrow R + RCO$$

Thus the chemical reactions occur in photochemical smog result an increase in concentration of hazardous substances, ions, free radicals in atmosphere.

Harmful Effect

Lower concentration of O3 in photochemical smog causes irritation of lungs and difficulty in breathing.

The polynuclear aromatic hydrocarbons (PAN) are carcinogenic and particulate matter (fog, mist, dust etc.) present in smog

uce visibility, damage crops and live stocks and cracking of rubber goods. It also causes corrosion of metal stoves, building terials etc.

All these compounds particularly ozone and PAN produce irritation in the eyes and also on the respiratory system causing athing problems. Irritation of eye is also caused due to formaldehyde and acroline. Ozone and Nitric oxide irritate nose and throat d their high concentration causes headache, chest pain, dryness of the throat, cough and difficulty in breathing.

ntrol To control photochemical smog formation following methods must be adopted-

In automobiles the catalytic convertors are fitted so that CO and hydrocarbons are oxidized to CO2 and H2O in presence of an oxidation catalyst (pt or pd metal).

No must be reduced to N2 by using a reducing catalyst. A dual catalyst system is provided with both types of catalyst.

Spraying certain compounds into the atmosphere to generate free radicals that readily combined with the free radicals that initiate the reaction forming toxic compounds of photochemical smog.

Certain plants such as Pinus, Juniparus, Pyrus, Vitis etc. can metabolise oxides of Nitrogen so plantation of such trees should be done.

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