

## Unit - VIII

### \* Air Pollution:-

- Air is defined as the elastic, invisible and tasteless mixture of gases that surrounds the earth.
- Air pollution is an environmental evil when the balanced among the air components is disturbed, air is said to be polluted.
- A/IS.I, air pollution is the presence of ambient atm. of substances, generally resulting from the activity of man, in sufficient concentration, present for a sufficient time.

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### \* Effects of Air Pollution:-

1) On certain materials:- Affect by five ways:

- (a) abrasion (b) deposition & removal
- (c) direct chemical attack
- (d) indirect chemical attack
- (e) Corrosion

Fluor

cause

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can

acute

2) On Plants:- Air pollutants affecting are:

- (a) Sulphur dioxide (b) hydrogen fluoride
- (c) hydrogen chloride (d) chlorine (e) ozone
- (f) Oxides of nitrogen (g) ammonia

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air components  
polluted.

presence of  
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(h) mercury (i) ethylene (j) hydrogen sulphide  
(k) PAN etc.

• The most obvious damage caused by air pollutants to plants and vegetation occurs is the leaf structure.

• Intake of  $CO_2$  is reduced and affects photosynthesis.

13) On animals:- takes place in two steps:

(i) accumulation of air pollutants in the vegetation, plants and forage

(ii) subsequent poisoning of the animals when they eat the contaminated vegetation.

Imp. contaminant that affect the live stock are (a) fluorine (b) arsenic & (c) lead.

five ways:  
ial

Fluorine causes lack of appetite, arsenic causes poisoning of cattle, salivation, thirst and lead causes paralysis.

fecting are:  
ioxide

(e) Ozone  
a

4) On human health:- The adverse effect can be divided into two classes: acute effects and chronic effects.

Acute effects manifest themselves immediately upon short term exposure



to air pollutants of high concentration while chronic effects become evident only after continuous exposure to low levels of air pollution.

(a)  
(1)  
(2)  
(3)  
(4)

Following is a list of health effects of air pollutants:

- (i) Eye, nose and throat irritation
- (ii) Irritation of respiratory tract
- (iii) Odour nuisance
- (iv) Chronic pulmonary diseases
- (v) Cancer (vi) Respiratory disease

(b)  
(1)  
(2)  
(3)  
(4)  
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5) On physical features of the atmosphere :-

- (i) Effect on visibility
- (ii) Effect on Urban atm & weather conditions
- (iii) Effect on atmospheric constituents.

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### ✱ Air Pollution dispersion

• Get dispersed into various directions depending upon prevailing winds, temp and pressure conditions.

• Following are the meteorological parameters that influence air pollution dispersion.

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low levels

(a) Primary Parameters:

(1) Wind direction and speed

(2) Temperature

(3) Atmospheric stability

(4) Mixing height

effects of

stratification

in the tract

(b) Secondary Parameters:

(1) Precipitation

(2) Humidity

(3) Solar radiation

(4) Visibility

in the

atmosphere

(1)

• The morning air is known as wind.

• The movement of air is caused by the unequal distributions of atmospheric temp. & pressure over earth's surface

and is largely influenced by rotation of earth.

• The temp. & pressure gradient are caused due to differential solar heating of the Earth's surface.

• The direction & speed of the surface winds govern the drift & diffusion of air pollutants discharged near the ground level.

directions

of temp.

physical parameters

dispersion

$$U = U_0 \left[ \frac{z}{z_0} \right]^{1/4} \quad \text{or} \quad U = U_0 \left[ \frac{z}{z_0} \right]^{1/4}$$



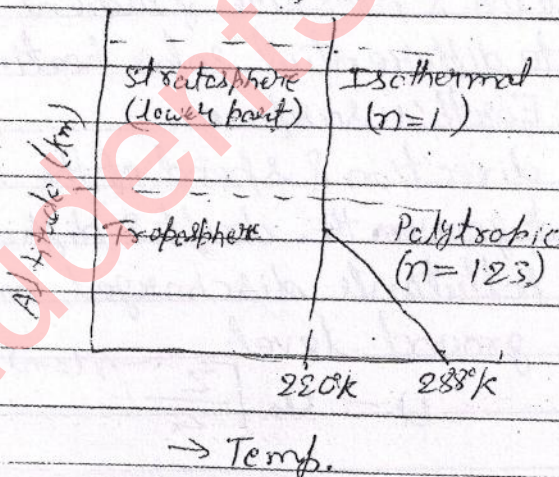
- 2) Atmospheric Stability & temp. inversions :-  
 In well mixed air which is dry, for every 1000 m increase in altitude, the temp. decreases by about  $6.5^\circ\text{C}$ . This vertical temp. gradient is known as lapse rate expressed by

$$\frac{dT}{dz} = -\frac{n-1}{n} \cdot \frac{g}{R}$$

$R$  = Gas constant for air  
 upto about 10 km, the environmental lapse rate (or normal lapse rate) is found to be  $6.5/1000\text{ m}$ . Hence for polytropic model,

$$\left(\frac{dT}{dz}\right)_{\text{env}} = -\frac{6.5^\circ\text{C}}{1000\text{ m}} = -\frac{n-1}{n} \cdot \frac{g}{R}$$

$n$  comes out to be 1.23 & is only applicable for troposphere. Above it  $n=1$





inversions  $\Rightarrow$   
 xy, for every  
 temp.  
 vertical  
 rate

### Dispersion Equations:

If  $K_x$ ,  $K_y$  &  $K_z$  are eddy diffusion coefficient in 3 directions,  $C$  is the concentration of pollutant and  $V_x$ ,  $V_y$  &  $V_z$  are the resp. vel. components, then from continuity principle,

$$\frac{\partial C}{\partial t} + V_x \frac{\partial C}{\partial x} + V_y \frac{\partial C}{\partial y} + V_z \frac{\partial C}{\partial z}$$

$$= \frac{\partial}{\partial x} \left( K_x \frac{\partial C}{\partial x} \right) + \frac{\partial}{\partial y} \left( K_y \frac{\partial C}{\partial y} \right) + \frac{\partial}{\partial z} \left( K_z \frac{\partial C}{\partial z} \right)$$

conventional  
 to) is found  
 hydropic model,

$$= \frac{n-1}{n} \cdot \frac{g}{R}$$

This is for Eicks law  
 And by Gaussian

$$C_{x,y,z,H} = \frac{Q}{u \sigma_y \sigma_z} e^{-\frac{1}{2} \left( \frac{y}{\sigma_y} \right)^2} e^{-\frac{1}{2} \left( \frac{H-z}{\sigma_z} \right)^2}$$

only applicate  
 $n=1$

where,  $C$  = Concentration of pollutant ( $g/m^3$ )

$Q$  = Pollutant emission rate ( $g/s$ )

$u$  = mean wind speed  $m/s$

$h_s$  = Ht. of stack

$H$  = Eff. ht. of stack (m)

$x, y$  = downwind & cross-wind hor.

distances (m)

$z$  = level of computation of concentration (m)

$\sigma_y$  = plume's std. deviation in hor. dir.

$\sigma_z$  = plume's std. deviation in vert. dir.



### \* Air Pollution Control Methods & Equipment :-

- (1) Proper planning of industrial area like zoning
- (2) Dilution of source discharge by use of tall stacks
- (3) Using source correction methods through
  - (i) raw material changes
  - (ii) process. changes, and
  - (iii) equipment modification or replacement
- (4) Reduction of pollutant discharge at source by use of controlling equipments.

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### \* Causes of air pollution :-

1) High rate of population growth:  
Consequent to high population density, there is higher rate of fuel consumption

2) Rapid industrialization:

This is one of the major causes.

- The smokes from factories, coke oven and furnaces, steam engines; exhaust fumes from power plants etc.; chemical fumes from oil refineries, zinc refineries, chemical industries etc. are common sources of atm. pollution

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3) Transportation facilities:

Intensive increase in transportation services such as motor vehicles, rail-trains, aeroplanes etc. throughout the world is



8 & Equipment →  
area like zoning  
use of tall stacks  
is through

or replacement  
age of source  
vents

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from oil  
chemical industries  
atm. pollution

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rains,  
world is

another major causes of air pollution.

#### 4) Radioactive Substances:

Evolution of radioactive gases and suspended radioactive dusts from atomic explosions and accidental discharges from nuclear reactors are very dangerous sources of air pollution

#### 5) Natural Causes:

The natural sources which cause air pollution include the organic compounds from vegetation, ground dust, salt spray etc from natural sources

These natural sources are beyond the control of man.



#### Primary air Pollutants: →

These are those which are emitted directly from identifiable sources. The atm. contains hundreds of air pollutants from natural or from anthropogenic sources.

All such pollutants are called primary pollutants.

Important pollutants are:



(i) Particulate matter	*	Aerosols
(a) Coarse particles ( $\geq 10.0 \mu$ )		Aerosols
(b) finer aerosols, including particles of metal, carbon, tar, resin etc.		or lig in ge st car
(ii) Sulphur oxides & Sulphur compounds		in al
(iii) Nitrogen oxides		and
(iv) Carbon monoxide		lique
(v) Hydrocarbons		Tybe
(vi) Organic compounds		(a) di
(vii) Radioactive compounds		
(viii) Photochemical compound oxidants	*	Toxic
		It is
Secondary air pollutants :-	excm/h	Can be
These are those which are formed in the atm. as a result of interaction b/w two or more primary pollutants or by reactions with the normal atmospheric constituents, with or without photoactivation.		of t and
These are therefore chemical substances which are often more harmful than the original basic chemicals that produce them. Examples	*	Varia
(i) Sulphuric acid or acid mist	⊗	Car
(ii) Ozone		Adi -
(iii) Formaldehyde		(2)
(iv) Photochemical smog.		(3)
		(4)



\* Aerosols (Particulates) :-

particles of  
etc. :

compounds

Aerosols refer to the dispersion of solids or liquid particles of microscopic size in gaseous media, such as smoke, fog. It can be defined as a colloidal ph system in which the dispersion media is a gas and the dispersed phase is a solid or liquid.

Types:-

(a) dust (b) smoke (c) mists (d) fog (e) fumes

oxidants

\* Intensity of rain:-

in the

two

by reactions  
restituents

mm/h

It is denoted by  $R_i$ , the value of  $R_i$  in mm/h can be worked out from the rainfall records of the area. It depends upon frequency and the duration of the storm.

\* Variation in sewage flow rate:-

substances  
than the  
produce

\* Conservancy System:-

At:- (1) The system is unhygienic since they every thing is visible

(2) Water Consumption is small

(3) No technical persons required

(4) Initial cost is small

of mist



### Disadvantages:-

- 1) Due to putrefaction, there is a lot of foul smell
- 2) Compact house design is not possible
- 3) Large labour force is required.
- 4) Acute pollution problem.

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### Water Carriage System:-

#### Advantages:-

- 1) No foul smell
- 2) Compact design is possible
- 3) Labour force is negligibly small
- 4) Rare pollution problems

Substratant

#### Disadvantages:-

- 1) The system is hygienic
- 2) Requires high water consumption
- 3) High initial cost
- 4) Technical persons required for operation & maintenance.

The tank digests ex from a ga sup up of 1 fin dig (i)