L.E. COLLEGE, MORBI

VISION

To provide quality engineering education and transforming students into professionally competent and socially responsible human beings.

MISSION

- To provide a platform for basic and advanced engineering knowledge to meet global challenges.
- To impart state-of-art know- how with managerial and technical skills.
- To create a sustainable society through ethical and accountable engineering practices.

*CO1: UNIT 2 * AIR POLLUTION*

- AIR PULLUTION
- Composition of Air & Structure of Atmosphere
- National Ambient Air Quality Standards
- Classification of Air Polluatns
- Sources of Air Pollutants (major air pollutnats)
- Effects of Air Pollutants

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The atmosphere has always been a dustbin for humans(—a place of deposition and storage —)for gaseous and particulate wastes. When the amount of waste entering an area of the atmosphere exceeds the atmosphere's ability, it produces a problem known as "Air Pollution"

Air Pollution

- *"Anything which degrades the quality of ambient air is known as Air Pollution"*

OR

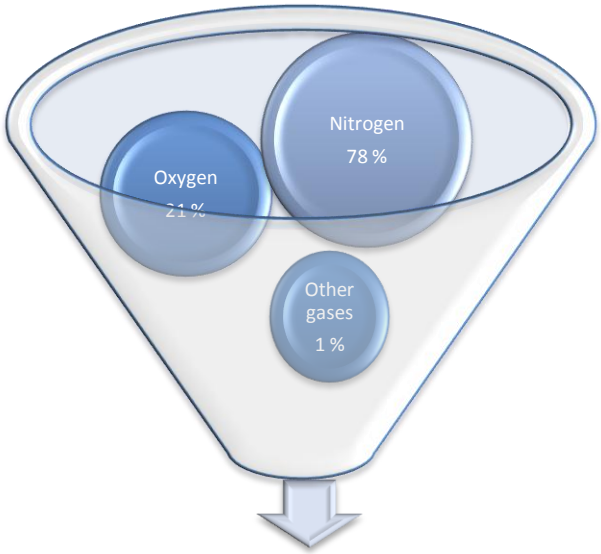
- *"Presence of unwanted and undesirable foreign particles and gases in the air which may have adverse effects on living beings and important structure is known as Air Pollution"*

- *Air pollution is the presence of chemicals and particles in the atmosphere in concentrations high enough to harm organisms, ecosystems, or human made materials, or to alter climate.*

Pollutant

- *"Any substance present in the environment in harmful concentration which Can effect the quality of environment is known as Pollutant "*

Composition of Air



Atmosphere

Nitrogen = 78%
Oxygen = 21%
CO_2 and = 1 % approx
Other gas

Other Gases or Trace gases : A trace gas is a gas which makes up less than 1% by volume of the Earth's atmosphere, and it includes all gases except nitrogen (78.1%) and oxygen (20.9%).

e.g. Water Vapours, Carbon Dioxide, Neon, Helium

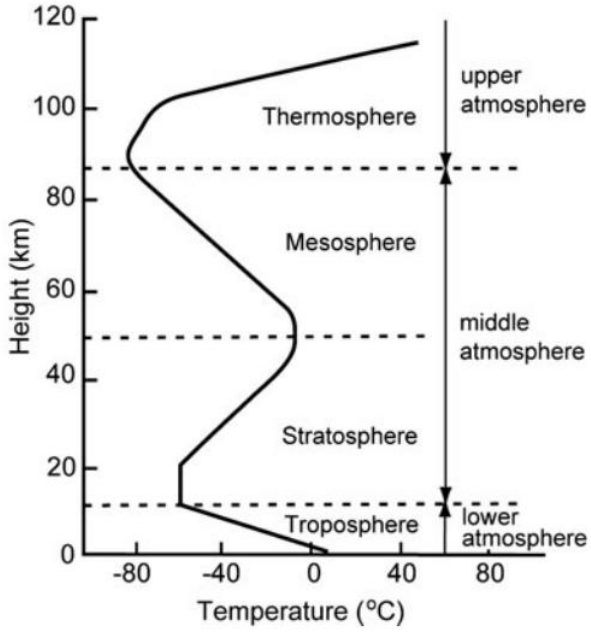
Krypton, Hydrogen, Ozone.

Structure of Atmosphere

We live at the bottom of a thin envelope of gases surrounding the earth, called the atmosphere. It divided into several spherical layers Structure of atmosphere based on Altitude vs. Temperature profile.

(1) Troposphere
(2) Stratosphere
(3) Mesosphere
(4) Thermosphere
(5) Exosphere

(1) Troposphere



About 75–80% of the earth's air mass is found in the troposphere, the atmospheric layer closest to the earth's surface, where most living organisms exist.

This layer extends only about 17 km above sea level at the equator and 8 Km kilometers over the poles

Temperature decreases with altitude, top part of troposphere is known as Tropopause. And temperature range of it 20 ℃ to - 56 ℃

(2) Stratosphere

- *A stable layer above Troposphere is called a Stratosphere, which is extends about 50-55 km above the surface of earth.*
- *It is known for presence of Ozone layer. which is found near about 20 – 25 Km above the surface of earth*
- *This layer is our protective layer which protect us from ultra violet radiations*
- *Because of absorption of ultraviolet radiation by ozone layer it raises the temperature of this layer up to -56 ℃ to -2 ℃*
- *top part of this layer is called a Staratopause*

(3) Mesosphere

- *It exists over stratosphere and in this layer, temperature decreases with altitude because of low levels of ozone*
- *It absorbs ultraviolet radiation.*
- *layer between mesosphere and thermosphere is known as mesopause.*
- *It extended up to 50 km to 85 km and temperature range – 2 ℃ to – 92 ℃*

(4) Thermosphere

- *Thermosphere extends up to 500 km above earth's surface.*
- *Temperature rises in this zone with altitude*
- *Ionization of elements like oxygen and nitric oxide take place in the upper most portion of layer. Therefore, the upper layer of thermosphere is also called ionosphere*
- *Temperature range of this layer is near about – 92 ℃ to 1200 ℃.*

- ***National Ambient Air Quality Standards***

S. No.	Pollutants	Time Weighted Average	Concentration in Ambient Air	
			Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (notified by Central Government)
1	Sulphur Dioxide (SO), µg/m^3	Annual*	50	20
		24 Hours**	80	80
2	Nitrogen Dioxide (NO), µg/m^3	Annual*	40	30
		24 Hours**	80	80
3	Particulate Matter (Size <10µm) or PM_{10} µg/m^3	Annual*	60	60
		24 Hours**	100	100
4	Particulate Matter (Size <2.5 µm) or $PM_{2.5}$ µg/m^3	Annual*	40	40
		24 Hours **	60	60
5	Ozone (O_3), µg/m^3	8 hours**	100	100
		1 hours **	180	180
6	Lead (Pb), µg/m^3	Annual *	0.50	0.50
		24 Hour**	1.0	1.0
7	Carbon Monoxide (CO), mg/m^3	8 Hours **	02	02
		1 Hour**	04	04
8	Arsenic (As), ng/m^3	Annual*	06	06
9	Nickel (Ni), ng/m^3	Annual*	20	20

Classification of Air Pollutant :

- *Air pollutants can be classified as under*
  - *Based on Origin*
  - *Based on Sates of matter*

- ***Classification based on origin of pollutants***

Depending upon the origin of pollutants, the air pollutants are classified as

1. Primary air pollutants
2. Secondary air pollutants

1. Primary Air Pollutants

- *Pollutants which are directly emitted from the sources to the atmosphere primary air Pollutants.*

e.g. Sulphur oxides (SO_X)
Nitrogen Oxides (NO_X)
Carbon Monoxide
Radio active materials
Particulate matter etc…..

2. Secondary Air Pollutants

- *Pollutants which are formed by chemical reactions among primary pollutants and atmospheric chemicals are known as Secondary Air Pollutants*

e.g. Ozone
Sulphur Trioxide
Photo-chemical smog, etc.
Petroxacyl nitrate (PAN) etc…

Classification based on States of matter

Based on states of matter air is classified in two categories

(1) Gaseous air pollutants
(2) Particulate air pollutants

(1) Gaseous air pollutants
Pollutant which are found in the gaseous state at normal temperature and pressure are called gaseous air pollutants
e.g. Carbon monoxide (CO), Carbon dioxide (CO_2), Nitrogen oxides (NO_X)
Sulphur oxides (SO_X) etc……

(2) Particulate air pollutants
Particulates are finely divided, air borne solid and liquid particles which remain for very long period of time in air.
e.g. Aerosols, Dust, Smoke, mist, fog etc……

- Aerosols : Air borne suspensions of solid or liquid particles smaller than 1 mm size

  e.g. dust, smoke, mist etc.
- Dust: It consists of small solid particles having a size of 1 to 200 mm
- Smoke : it formed by incomplete combustion of organic matter (wood)

  having a size of 0.1 to 1 micro meter
- Mist : it consists of liquid droplets of size around 0.1 t 1 micro meter

  raised due to condensation of vapours in the atmosphere

Sources of air pollutants

PM (PARTICULATE MATTER)

PM are finely divided air borne, solid and liquid particles which remains for very long time in air.
It is available in size range from 0.02 micrometer to 500 micrometer

Particulate matter (PM) is a complex mixture of suspended solid and liquid particle in semi equilibrium with surrounding gases.

Sources

- *Volcanic eruptions*
- *Dust*
- *Storms*
- *Smoke from vehicles*
- *Agriculture burning*

Particulate matter is divided in two categories

(1) Particulate Matter 2.5 ($PM_{2.5}$, size ≤ 2.5µm), fine fraction size up to 2.5µm,
(2) Particulate Matter 10 (PM_{10}, size ≤ 10µm)

NATURAL SOURCES

- *Coarse particles are produced by the mechanical break-up of larger solid particles.*
- *Windblown dust such as road dust, fly ash, soot, agricultural processes*
- *Physical processes of crushing, grinding and abrasion of surfaces.*
- *Non-combustible materials released when burning fossil fuels.*

Anthropogenic

- *Road traffic emissions particularly from diesel vehicles*
- *Industrial combustion plants some public power generation*
- *Commercial and residential combustion*
- *Non-combustion processes (e.g. quarrying)*
- *Agricultural activities*

Effects due to PM

- *Cardio-pulmonary problems*
- *Visibility reduction*
- *respiratory symptoms such as irritation of the airways, coughing, or difficulty breathing*
- *decreased lung function*
- *asthma, chronic bronchitis*
- *irregular heartbeat cardiopulmonary disorder*
- *premature death in people with heart or lung disease*

Sulphur dioxide (SO_2)

SO_2 is the chemical compound produced by volcanoes and in various industrial processes

SO_2 is colorless, nonflammable, and nonexclusive gas which may result in suffocation and it also form a H_2SO_3 in the air.

Naatural Sources

Volcanos (67%)

Anthropogenic

combustion of fossil fuel (coal, heavy fuel oil in thermal power plants, office, factories)

paper Industry

extravtion & distribution of fossil fuels

smelting of metals (sulfide ores to produce copper, lead and zinc)

Petroleum refining

combustion process in diesel, petrol, natural gas driven vehicles

Effects of Sulphur dioxide (SO_2)

Respiratory illness

Visibility destruction

Aggravate existing heart and lung diseases

Acid rain

Aesthetic damage

Oxides of Nitrogen (NO_x)

Oxides of nitrogen are a generic term for a group of highly reactive gases that contain nitrogen and oxygen in varying amounts.

NOx are emitted as nitrogen oxide (NO) which is rapidly oxidized to more toxic nitrogen dioxide (NO_2)

Nitrogen dioxide (NO_2) is a reddish-brown toxic gas with a characteristic sharp, biting odor and is a prominent air pollutant.

Naatural Sources

Lightning, Forest fires, Bacterial activity of soil

Anthropogenic

High temperature combustion (internal combustion engines, fossil fuel fired power stations, industrial)

Burning of Bio-mass and Fossil Fuels

Effects of Nitrogen Oxides (NO_x)

Irritates the nose and throat

Increase susceptibility to respiratory infections

it may affect lungs and cause bronchitis

NO_x *combine with hemoglobin and reduces the oxygen carrying capacity of blood. Reduces the visibility*

EFFECTS OF COMMON AIR POLLUTANTS

- *Carbon monoxide and nitric oxide combine with hemoglobin to form caboxy hemoglobin which reduces oxygen carrying capacity of blood.*
- *NO_2 and SO_2 causes diseases like asthama and bronchitis.*
- *Secondary pollutant can produce irritation of eyes, nose, throat and respiratory diseases.*
- *Some aromatic hydrocarbons can cause a cancer.*
- *Atmospheric dust containing silica may cause silicosis.*
- *Asbestos can causes Asbestosis .*
- *Heavy metals can effect the nervous system, damage the kidney and vision problems e.g. lead, mercury, etc…*
- *Mercury can produces minamata diseases*
- *Radioactive substances cause severe damage to body like cancer.*

MARINE POLLUTION

Marine is an adjective for things relating to the sea or ocean, so marine pollution can be defined as an introduction of substances to the marine environment directly or indirectly by humans which causes problem to human health.

Sea and oceans are one of the important resources of our mother earth. It maintain the biological and ecological balance and provide us food, commerce, adventure, transportation, industries etc..

But humans are not very fair with available nature resources, they uses marine as a disposal place for different types of waste. Sea is a major sink for all the pollutants. Pollutants can enter the sea directly from the outfalls and sometimes from coastal towns, Which rise a serious issue about quality of marine.

Sources of marine pollution

Direct discharge

Pollutants enter rivers and the sea directly from urban sewerage and industrial waste discharges, sometimes in the form of hazardous and toxic wastes.

Land runoff

Surface runoff from farming, as well as urban runoff (runoff from the construction of roads, buildings, ports, channels, and harbours,) can carry soil and particles loaded with carbon, nitrogen, phosphorus, and minerals.
This nutrient-rich water can cause fleshy algae and phytoplankton to thrive in coastal areas

Ship pollution

Ships can pollute waterways and oceans in many ways. Oil spills can have devastating effects. While being toxic to marine life, polycyclic aromatic hydrocarbons (PAHs), found in crude oil, are very difficult to clean up, and last for years in the sediment and marine environment.

Deep sea mining,

Eutrophication,

Plastic debris,

Toxins,

radioactive waste

Heavy metals,

Underwater noise