21CYM101I: ENVIRONMENTAL SCIENCE

M.Tech Sem: 2 ; Batch: 1

By Dr. Dipankar Das, SRMIST, Chennai

22.03.2022

Photochemical Reactions

$$NO_{2(g)} \xrightarrow{h\nu} NO_{(g)} + O_{(g)}$$

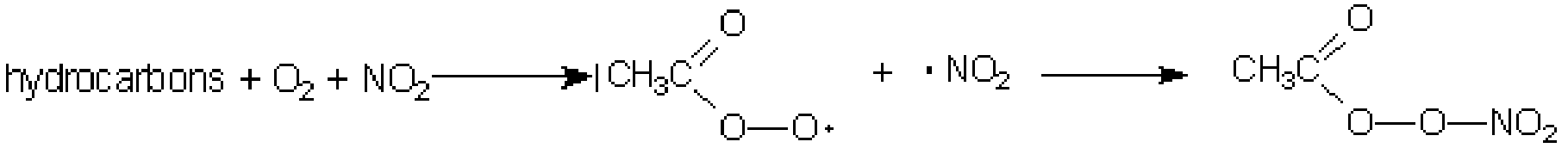
Nitrogen dioxide — Nitric oxide

$$O_{(g)} + O_{2(g)} \longleftrightarrow O_{3(g)}$$

$$O_{3(g)} + NO_{(g)} \longrightarrow NO_{2(g)} + O_{2(g)}$$

$$3CH_4 + 2O_3 \rightarrow 3CH_2{=}O + 3H_2O$$

Formaldehyde



Peroxyacetyl nitrate (PAN)

Lead (Pb)

- It is a solid, toxic metal, it can emit particulates.

Human sources

- Paint, storage batteries, petrol etc.

Health effects

- Damage brain and whole nervous system, mental retardation, digestive problems, cancer.

Environmental effects

- Wild life destruction.

ACID RAIN

- Normal rain water is always slightly acidic in nature because of the fact that CO_2 present in the atmosphere gets dissolved in it and produces carbonic acid, H_2CO_3.

$$CO_2 + H_2O = H_2CO_3$$

- Because of the presence of SO_x and NO_x gases as pollutants in the atmosphere, the pH of the rain water is further lowered.

- This type of precipitation of water is called ACID RAIN (or) ACID DEPOSITION.

Formation and causes of Acid rain

- Acid rain means the presence of excessive acids in rain water.

- The thermal power plants, industries and vehicles release nitrogen oxides and sulphur oxides into atmosphere due to burning of coal and oil.

- When these gases react with water vapour in the atmosphere, they form acids and descend on to the earths acid rain through rain water.

$$SO_3 + H_2O \longrightarrow H_2SO_4$$

$$NO_2 + H_2O \longrightarrow HNO_3$$

EFFECTS OF ACID RAIN

- Increases the acidity of rain-water.
- Damages fresh water life.
- In the form of mist it causes direct damage to plants.
- Causes irritation to eyes and mucus membrane.
- Accelerates the rate of corrosion of metals.
- Causes damage of building block.
- Dissolves salt in soil like $CaCO_3$, $MgCO_3$ and metal, which passes into ponds lakes river and cause toxic effect to aquatic life.

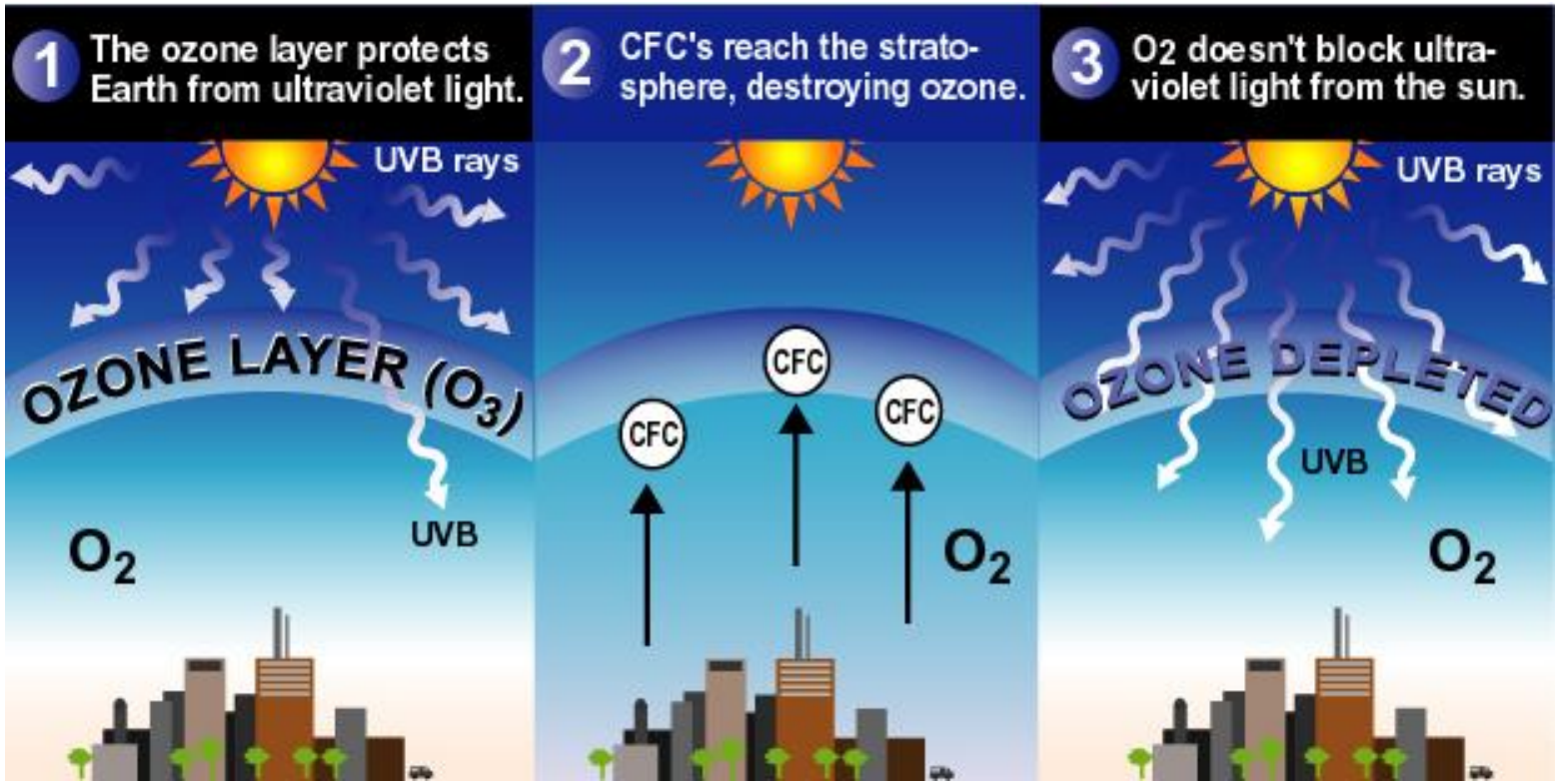
Effects of Acid Rain

- Acidification of bodies of water
- Damage of vegetation
- Damage to building materials, statues, etc.

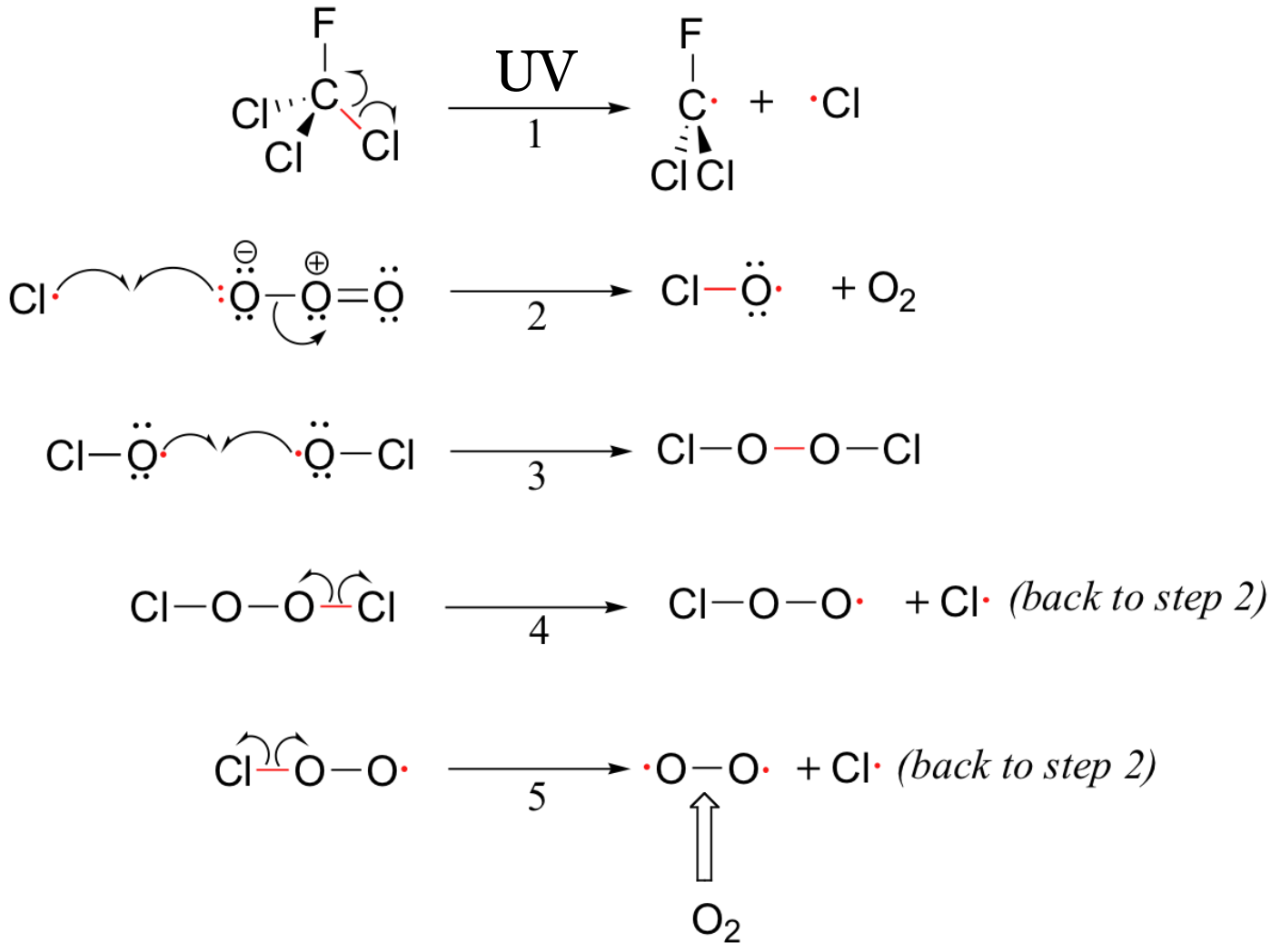
Ozone layer depletion: Chlorofluorocarbons

- A group of chemicals called chlorofluorocarbons (CFCs e.g., Cl_3CF, Cl_2CF_2) were once commonly used in air conditioners, in aerosol spray cans, and for cleaning machine parts.

- In the London Agreement 1991, more than 90 countries banned the production and use of CFCs except for limited medical uses.



Chlorofluorocarbons (CFCs) and Ozone Depletion



GREENHOUSE EFFECT

The trapping of heat by gases in the atmosphere.

- **Naturally occurring greenhouse gases:**
  - *Water vapor*
  - *Carbon dioxide*
  - *Methane*
  - *Nitrous oxide*
  - *Ozone*

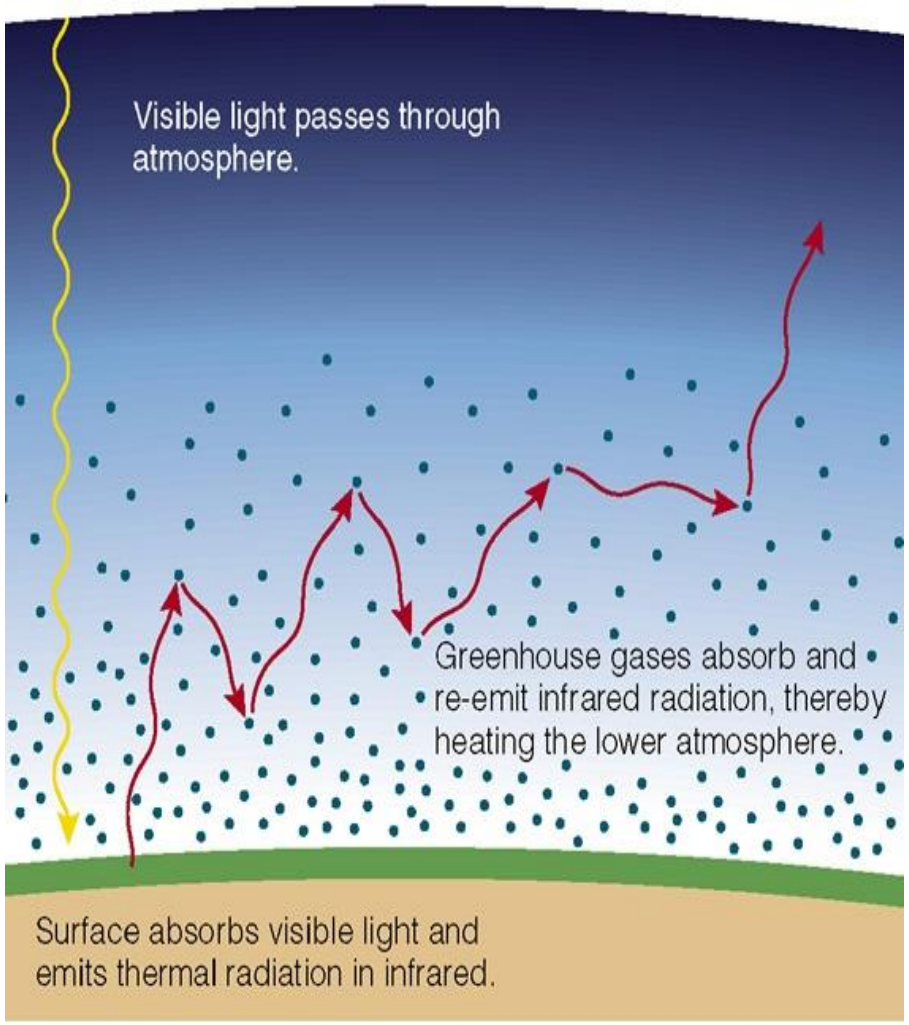
- **Greenhouse gases that are <u>not</u> naturally occurring**
  - *Hydrofluorocarbons* (HFCs)
  - *Perfluorocarbons* (PFCs)
  - *Sulfur hexafluoride* (SF_6)

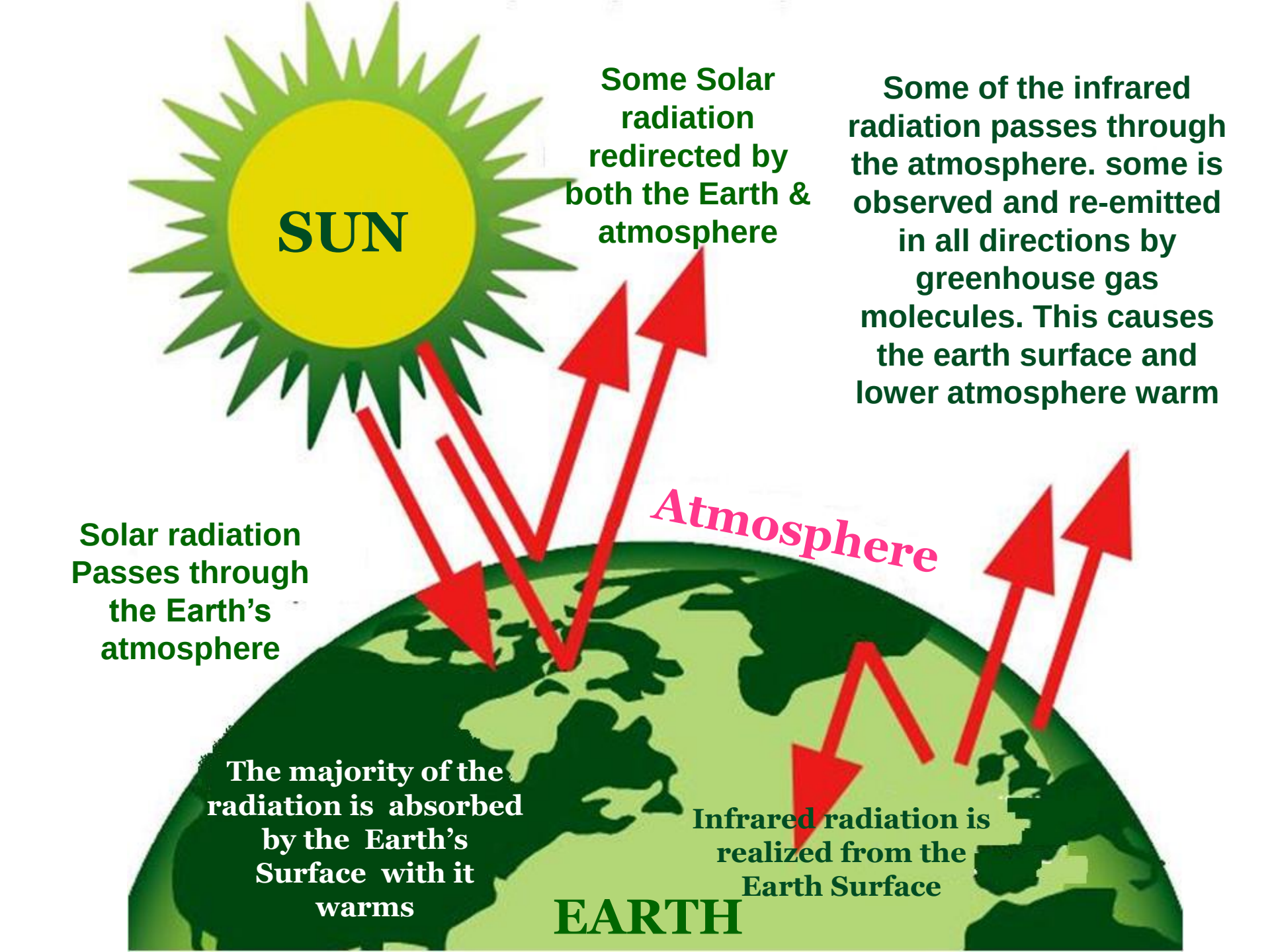
Generated in a variety of industrial processes.

The Greenhouse Effect on Earth

Earth's atmosphere is slightly warmer than what it should be due to direct solar heating because of a ***mild case of greenhouse effect…***

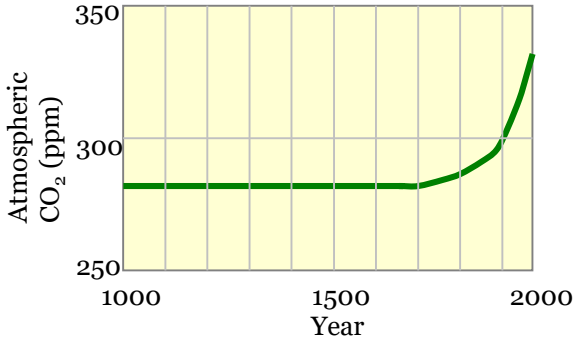
- The earth surface is heated by visible and (some) infrared light from the Sun.
- The heated surface emits infrared light.
- The majority of Earth's atmosphere (N_2 and O_2) are not good greenhouse gas.
- The small amount of greenhouse gases (H_2O, CO_2) traps (absorb and re-emit) the infrared radiation, increasing the temperature of the atmosphere…




SUN
Some Solar radiation redirected by both the Earth & atmosphere
Some of the infrared radiation passes through the atmosphere. some is observed and re-emitted in all directions by greenhouse gas molecules. This causes the earth surface and lower atmosphere warm
Atmosphere
Solar radiation Passes through the Earth's atmosphere
The majority of the radiation is absorbed by the Earth's Surface with it warms
Infrared radiation is realized from the Earth Surface
EARTH

Greenhouse Effect

- FACT: 15% increase in [CO_2] in last 100 years
- **Cause**:
  - Change from agricultural to industrial lifestyle
  - Burning of fossil fuels (petroleum, coal)
  - Increase CO_2 emissions (cars, factories etc)
  - Deforestation.



- **Effects:**
  - Global warming
  - Melt polar ice caps → flooding at sea level
  - Warming oceans → more powerful storms

Control measures of Air pollution

Source control:

1. Use only unleaded petrol.
2. Use the fuels with low ash content and Sulphur content.
3. People should be encouraged to walk and drive cycle.
4. Plantation of trees, can absorb the carbon dioxide.
5. Industries and waste disposal should be treated.
6. Emission of carbon dioxide and hydrocarbons should be catalytically controlled.
7. Secondary pollutants O_3 and PAN are controlled by their primary precursors.
9. Development of pollution-free power sources to internal combustion engine.
10. Acid and chemical fumes may be treated before release.

POLLUTION CONTROL EQUIPMENTS

They are generally two types:

1. Control devices for particulate contaminant.
2. Control devices of gaseous contaminant.

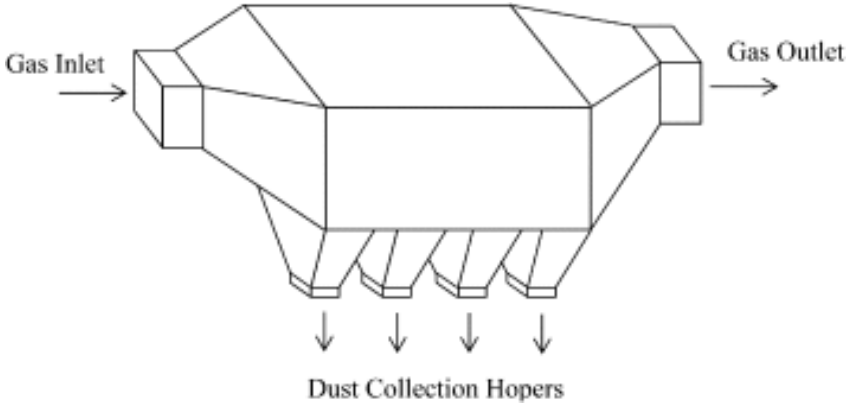
The choice of the equipment depends upon a number of factors such as:

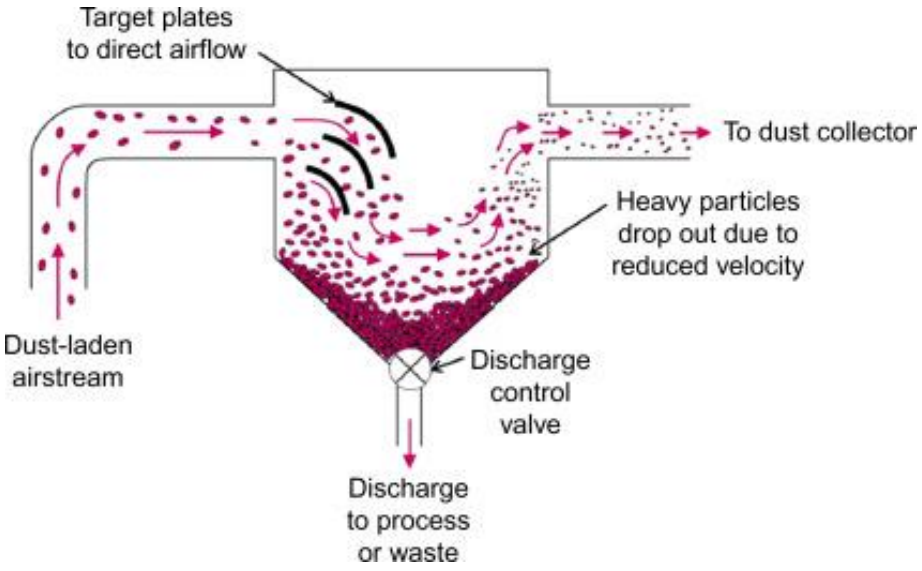
1. Physical and chemical properties of the particles.
2. Particle size, concentration, volume of impurities.
3. Temperature, Humidity of the medium.
4. Efficiency required.
5. Economic considerations.

CONTROL DEVICERS FOR PARTICULATES

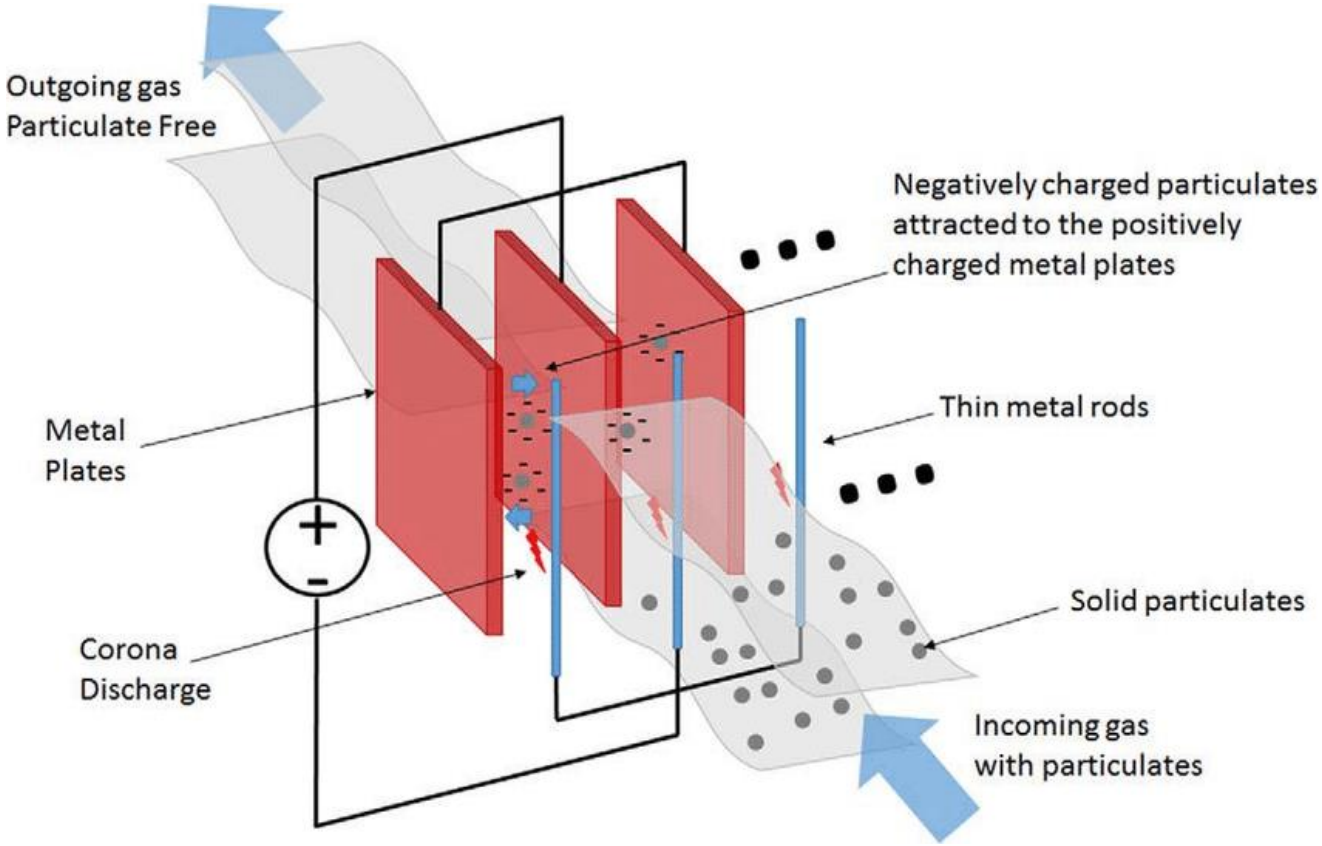
1. GRAVITATIONAL SETTLING CHAMBER
2. ELECTROSTATIC PRECIPITATORS
3. BAG HOUSES OR FABRIC FILTERS
4. CYCLONE SEPARATOR
5. WET SCRUBBERS

GRAVITATIONAL SETTLING CHAMBER



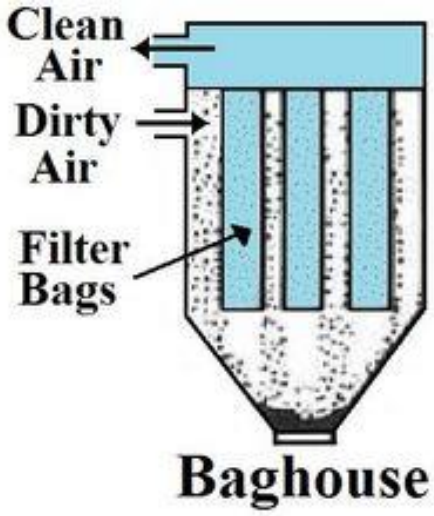


PICTURE OF ELECTROSTATIC PRECIPITATORS



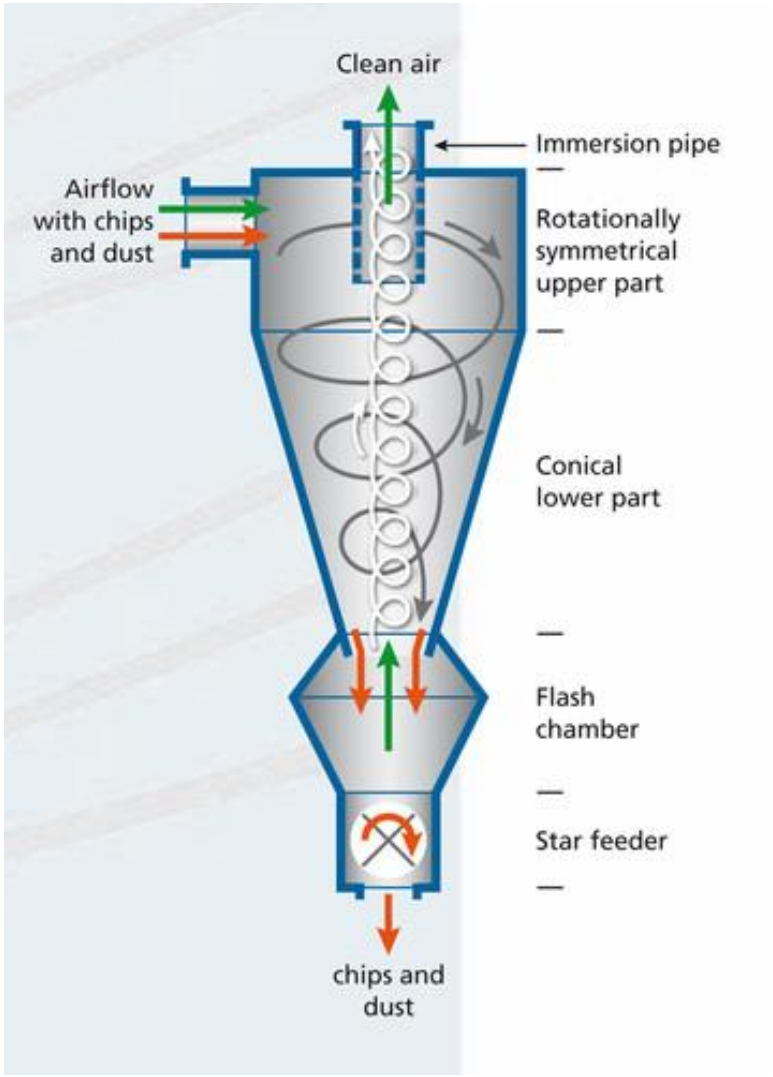
BAG HOUSES

- Dry particulates are trapped by filters made up of cloth.
- During shaken of the filter all the paper or similar materials blown from the filters down into the hopper.
- They are used to control air pollutants from steel, furnance etc.



CYCLONES SEPARATOR

- It produces a centrifugal force.
- Dust containing gas is whished very rapidly inside a collector shaped like cylinder.
- The spinning motion creates centrifugal forces causing particles to be thrown against the walls of the cylinder, drop into the hopper.
- They are used in cotton gins. Rock crushers and some industrial process.

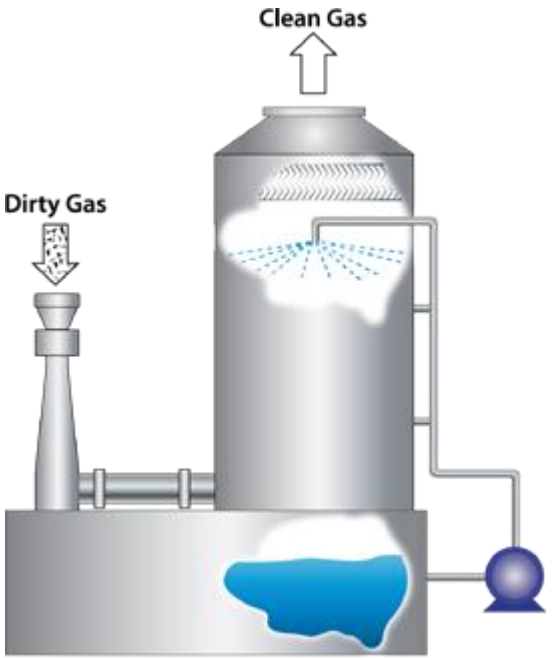


WET SCRUBBERS

- Wet scrubbing is particularly useful for simultaneous removal of reactive gases and fine particulate matter from exhaust gases.

- Particulates, vapours, gases are controlled by passing the gas stream through a liquid solution.

- They are used on coal burning power plants. Concrete plants etc.



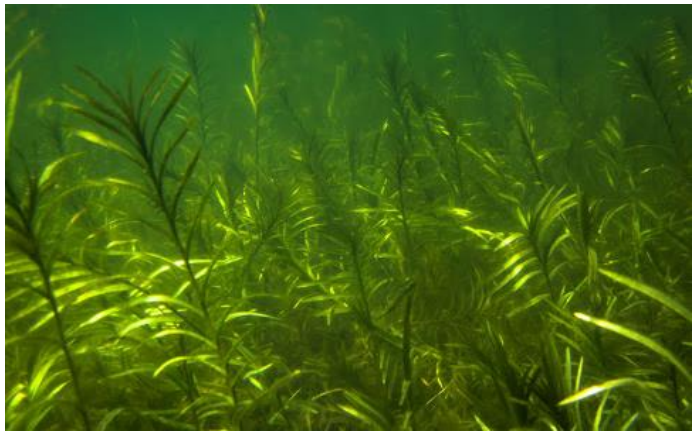
Water pollution

Water Pollution can be defined as the presence of some foreign substances or impurities (organic, inorganic, radiological, biological,) in such a quantity which is harmful for organism and environment, and making it unfit for use.

The sign of water pollution

- The bad taste of drinking water.
- Offensive odors from lakes, rivers and oceans.
- Unchecked growth of aquatic weeds in the water bodies.
- Decreases in the no.of fishes in fresh water.
- Oil and grease floating on water surfaces.






Sources of Water Pollution

- Soil erosion due to rains, deposition of dead and decaying matters of plants and animals, food etc.
- Waste water release from domestic, commercial, municipal, institution are grouped as Sewage.
- The discharge of waste from various industries is termed as Effluents (e.g., inorganic, organic materials like salts, dyes, oil, metals, solvents).
- Usage of synthetic organic substances, pesticides, insecticides used for agricultural purpose.
- Radioactive substances from mining, nuclear power plants.

Classification

- **Chemical pollution**

Variation of pH (Acidic, basic): Organic compounds like carbohydrate, fats, polymers, biodegradable wastes causes depletion of dissolved oxygen.

- **Physical pollution**

Change of color, odor, taste, turbidity, thermal properties due to impurities.

- **Biological pollution**

Mainly caused by discharge from feedlots, cowsheds, excretory products from mammals, wild and domestic animals, bacteria, protozoa, viruses, algae etc. makes water unfit for mankind.