

Unit – III

Air Pollution

By:

Dr. Parveen Kumar

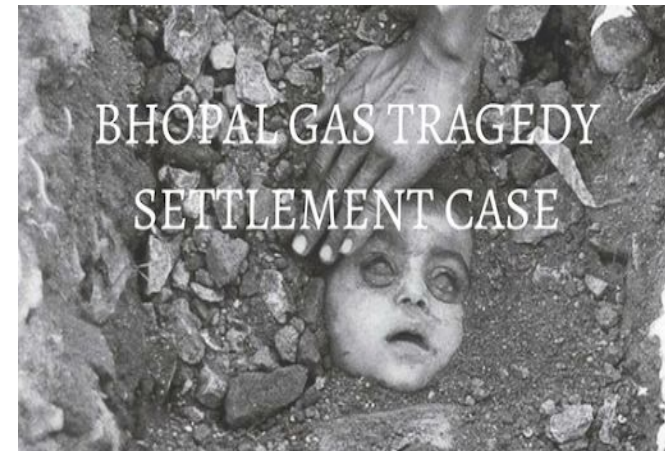
Asst. Professor

CONTENTS

- **Introduction**
- **What is air pollutants**
- **Sources of air pollution**
- **What happens to pollutants in The Atmosphere?**
- **Harmful effects**
 - ✓ **Living organisms**
 - ✓ **Plants**
 - ✓ **Materials**
 - ✓ **Troposphere**
- **Prevention & control**
- **References**

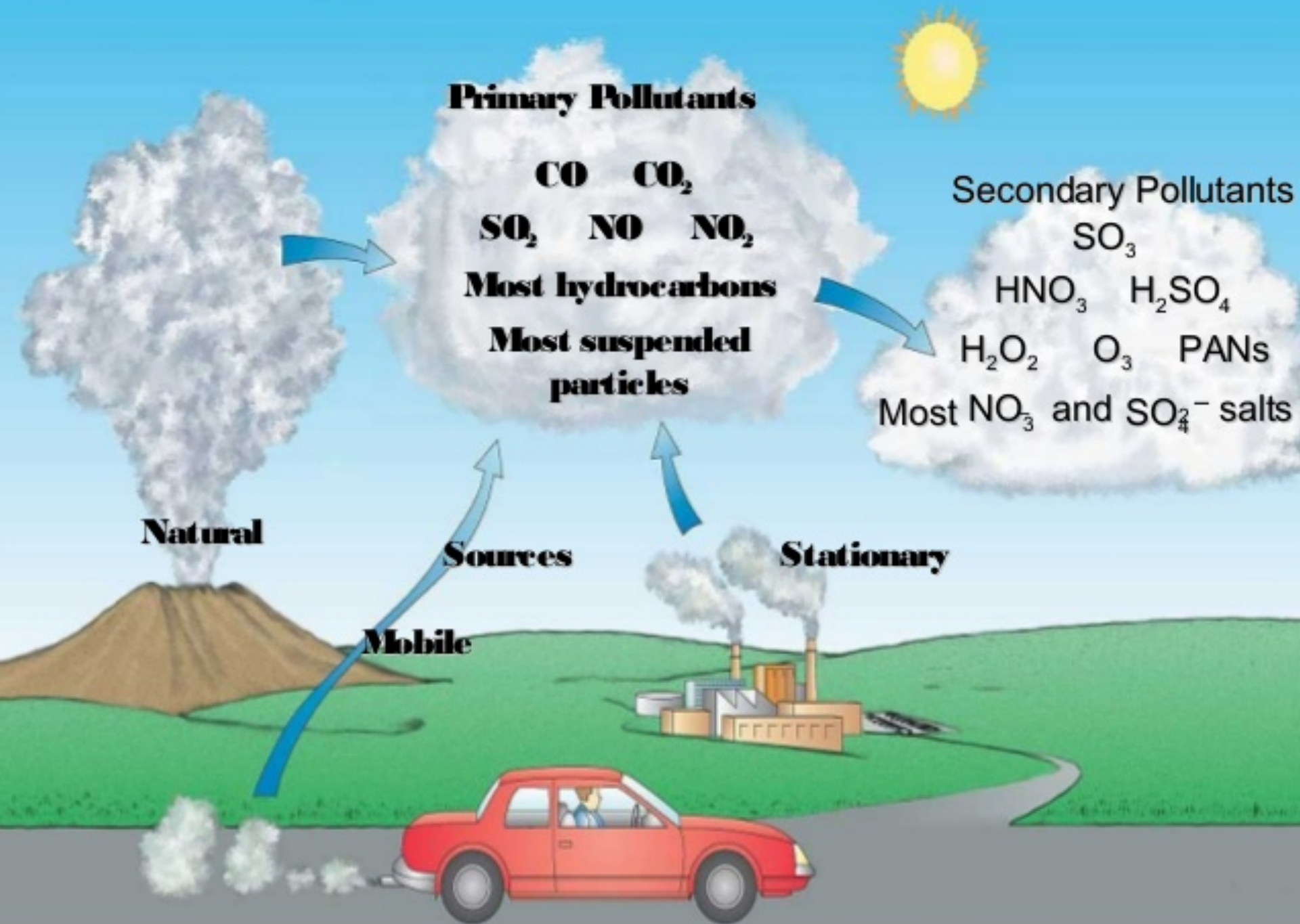
Introduction

- **Air Pollution on Earth:** Firewood use for cooking & heating
- **Hippocrates** has mentioned air pollution in 400 BC.
- **King Edward I** – **1st antipollution law (1273)** to restrict coal use.
- **Los Angeles smog (1943)** – Photochemical smog
- **London smog (1952)** – Sulphurous smog (4000 deaths/ 5 days).
- **Air Pollution Control Act (1981)**
- **Environment Protection Act (1986)**
- **Motor Vehicle Act (1988)**
- **Bhopal Gas Tragedy (3rd December, 1984)** – **Methy Isocyanide** gas leakage from **Union Carbide's pesticide plant**.



What is Air Pollution?

- **Air pollution** - presence of undesirable solid or gaseous particles in the air in quantities that are harmful to human health and the environment.
- **Causes:**
 - ▢ **Natural:** Volcanoes, dust storm, forest fires, pollen grains etc.
 - ▢ **Anthropogenic:** Pollutants from human activity – fossil fuel burning
- **Types of Air Pollutants:**
 - ▢ **Primary:** Pollutants that are emitted directly from identifiable sources i.e. dust storms and volcanic eruptions, emission from vehicles, industries, etc.).
 - Contribute about **90%** of global air pollution.
 - **CO & CO₂, NO_x, SO_x, Volatile organic compounds (HCs), and Suspended Particulate Matter (SPM).**
 - ▢ **Secondary:** Pollutants that are produced in the atmosphere when certain chemical reactions take place among the primary pollutants e.g. **sulfuric acid, nitric acid, carbonic acid**, etc.



Sources of Air Pollution

- **Carbon monoxide:** A colourless, odorless and toxic gas
 - **Produced** when organic materials such as natural gas, coal or wood are incompletely burnt.
 - **Vehicular exhausts** - single largest source
 - Poorly maintained vehicles with inadequate pollution control equipment release greater amounts of CO.
 - Natural processes can convert CO to harmless compounds.
- **Sulfur oxides:**
 - Produced when sulfur containing fossil fuels are burnt.
 - Sulphurous smog
- **Nitrogen oxides:**
 - Found in vehicular exhausts.
 - Involved in production of secondary air pollutants – O₃, Peroxyacetyl nitrate (PAN) (Photochemical smog)

● Hydrocarbons (VOCs)

- Group of compounds consisting of carbon and hydrogen atoms.
- Either evaporate from fuel supplies or are remnants of fuel that did not burn completely.
- Form secondary pollutants - Photochemical smog.
- **Control:**
 - ✓ Using higher O_2 in fuel-air mixture.
 - ✓ Using valves to prevent the escape of gases.
 - ✓ Fitting of catalytic converters in automobiles

● Particulates:

- Small pieces of solid material (smoke particles from fires, bits of asbestos, dust particles and ash from industries) dispersed into the atmosphere.
- Effects – soot, carcinogenic (cancer causing) effects.
- Accumulate in lungs and interfere with exchange of gases.

Types of particulates

Term	Meaning	Examples
Aerosol	General term for particles suspended in air	Sprays from pressurized cans
Mist	Aerosol consisting of liquid droplets	Sulfuric acid mist
Dust	Aerosol consisting of solid particles that are blown into the air or are produced from larger particles by grinding them down	Dust storm
Smoke	Aerosol consisting of solid particles or a mixture of solid and liquid particles produced by chemical reaction such as fires	Cigarette smoke, smoke from burning garbage
Fume	Generally means the same as smoke but often applies specifically to aerosols produced by condensation of hot vapors of metals.	Zinc/lead fumes
Plume	Geometrical shape or form of the smoke coming out of a chimney	
Fog	Aerosol consisting of water droplets	
Smog	Term used to describe a mixture of smoke and fog.	

- **Indoor air pollution:** infiltration of polluted outside air and from various chemicals used or produced inside buildings.
- **Outdoor air pollution:** Traffic and factories, etc.
- **Both indoor and outdoor air pollution are equally harmful.**



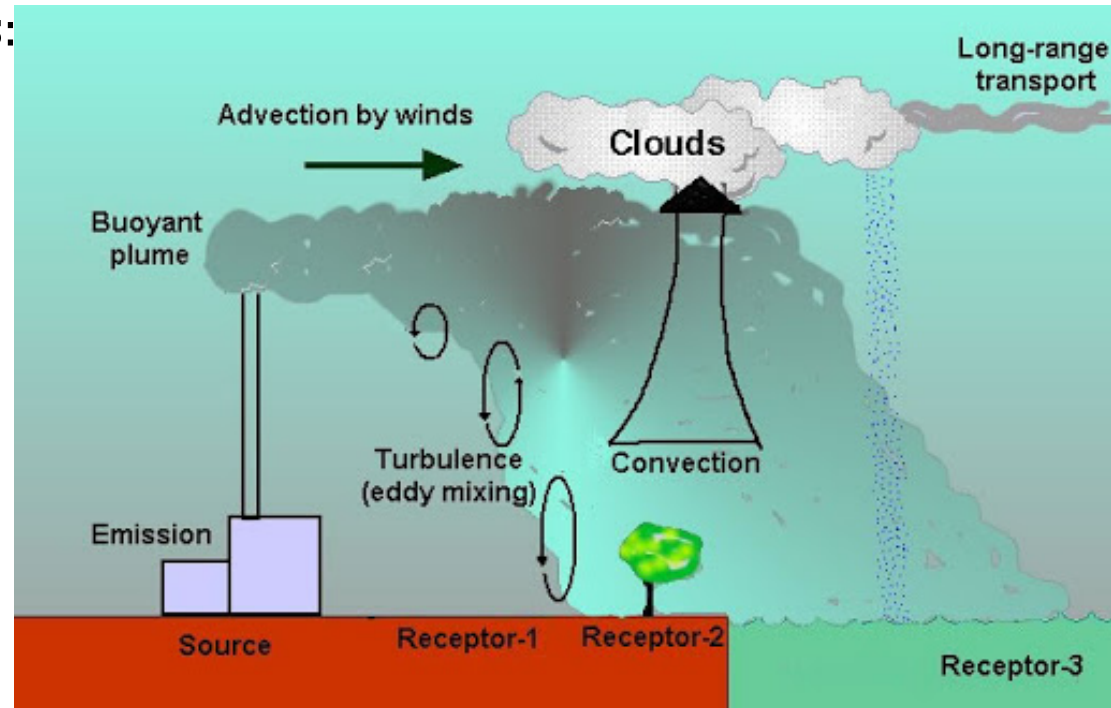
What Happens to Pollutants in The Atmosphere?

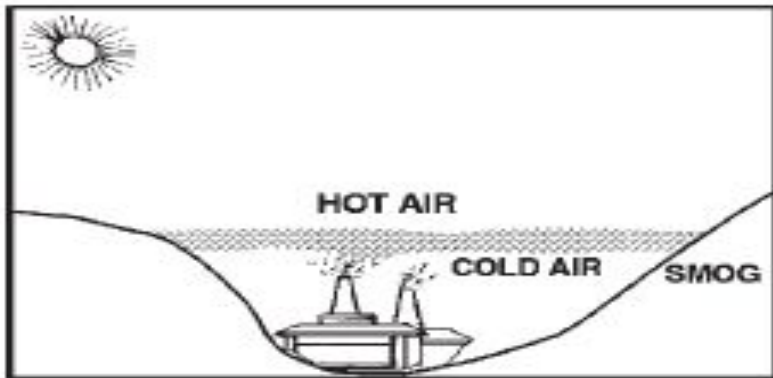
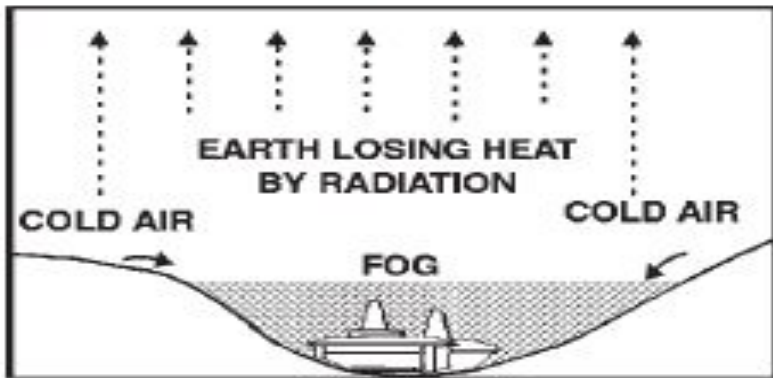
- **Once pollutants enter the troposphere:**

- ✓ Transported downwind
- ✓ Diluted by the large volume of air
- ✓ Physico-chemical transformation
- ✓ Removed from atmosphere by rain - rain or snow falls to the earth's surface.

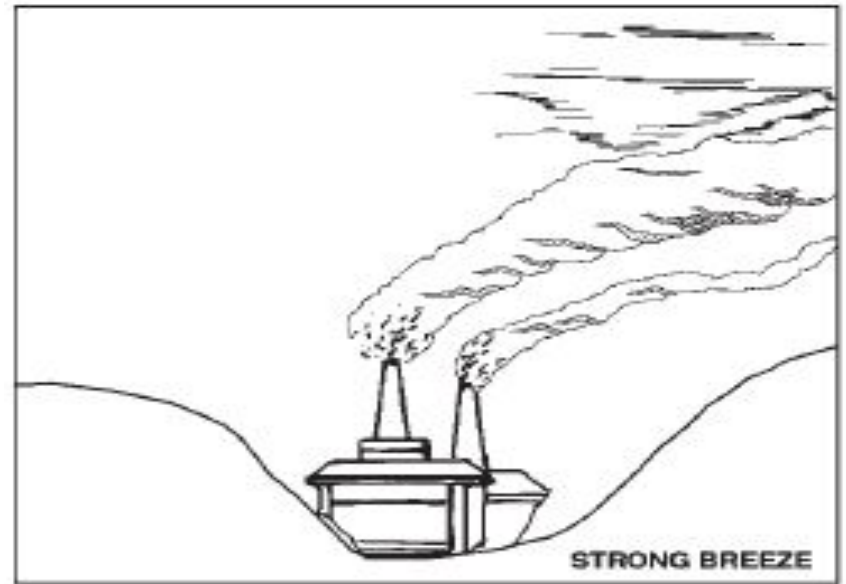
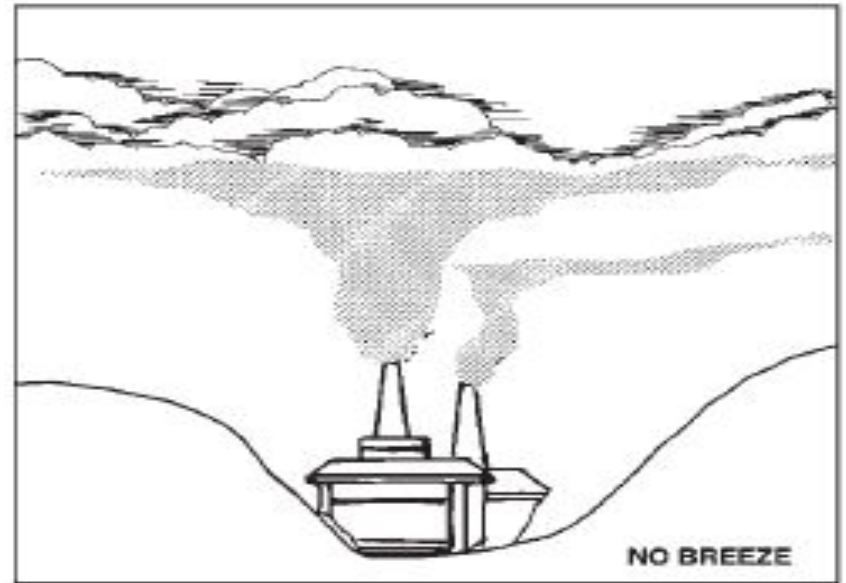
- **Meteorological conditions:**

- Topography
- Atmospheric stability
- Wind velocity





Smog Formation



Meteorology & Pollution Dispersion

Effects of Air Pollution on Living Organisms

- **Respiratory system** - breakdown **natural defenses** - lung cancer, asthma, chronic bronchitis and emphysema.
- **Elderly people, infants, pregnant women** and people with **heart disease** or **respiratory diseases** are especially vulnerable.
- **Cigarette smoking** - greatest exposure to CO. Exposure to even 0.001 % of CO for several hours can cause coma and even death (**Carboxy Haemoglobin**). Impairs perception and thinking, headaches, drowsiness, dizziness and nausea.
- **Sulfur dioxide** - irritates respiratory tissues, bronchitis, sulfur-containing acids & acidic particles which are very corrosive to lung.
- **Nitrogen oxides** - especially NO₂ irritate lungs, asthma or chronic bronchitis, respiratory infections - influenza or common colds.
- **Suspended particles** - bronchitis and asthma, Long exposure - chronic respiratory disease and cancer.
- **Volatile organic compounds** - benzene, formaldehyde, and toxic particulates (lead & cadmium) can cause mutations, reproductive problems or cancer.
- **Ozone** - a component of photochemical smog causes coughing, chest pain, breathlessness and irritation of the eye, nose and the throat.

Effects on Plants:

- Gaseous pollutants enter leaf pores and damage leaves of crop plants.
- Break down waxy coating that prevent excessive water loss and leads to damage from diseases, pests, drought and frost.
- Interferes with photosynthesis and plant growth
- Reduces nutrient uptake
- Causes leaves to turn yellow, brown or drop off altogether.
- Sulphur dioxide - flower buds become stiff, hard, and fall from the plants.

Effects of air pollution on materials:

- Break down exterior paint on cars and houses.
- Discolour monuments, historic buildings, & marble statues.

Effects on Troposphere

- **Ozone layer depletion – Ozone hole**
- **Green house effect – Global warming**
- **Climate change**
- **Acid rain**
- **Smog**

Prevention and Control

1. Preventive techniques

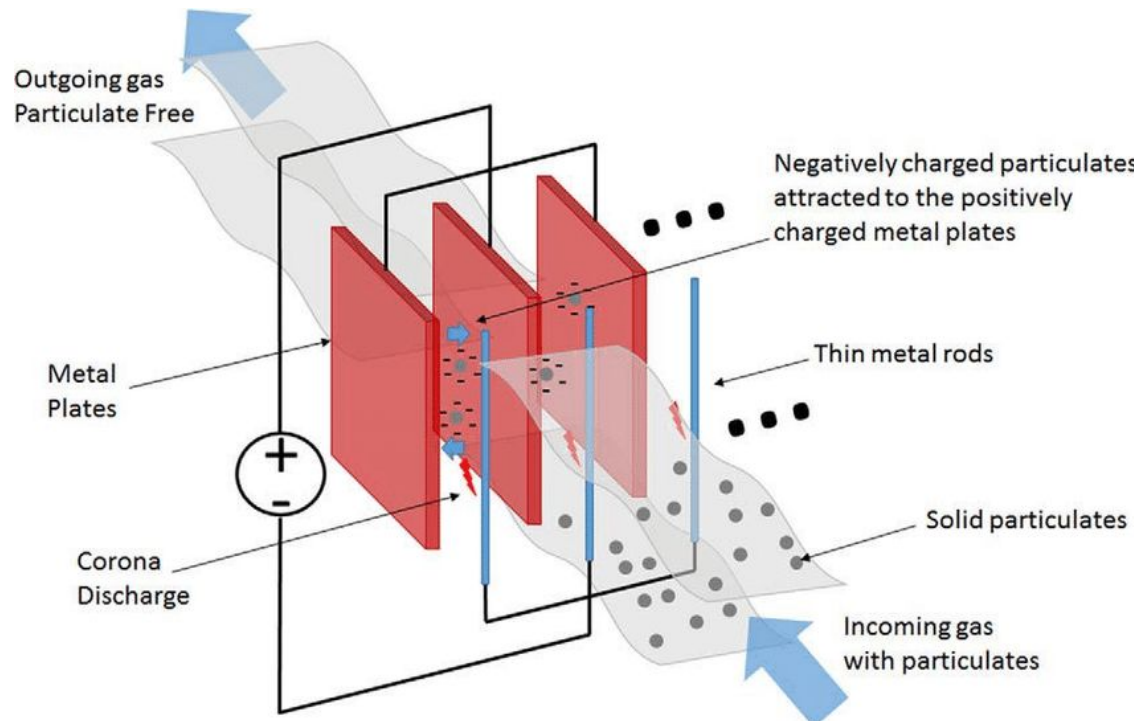
- Greater height of chimney - discharge of pollutants far away from ground.
- Industry location – as per topography & wind direction
- Substitution of raw material
- Reducing the use of fossil fuels
- Improving the quality of vehicular fuel
- Increasing the use of renewable energy

2. Effluent control - devices for cleaning polluted air

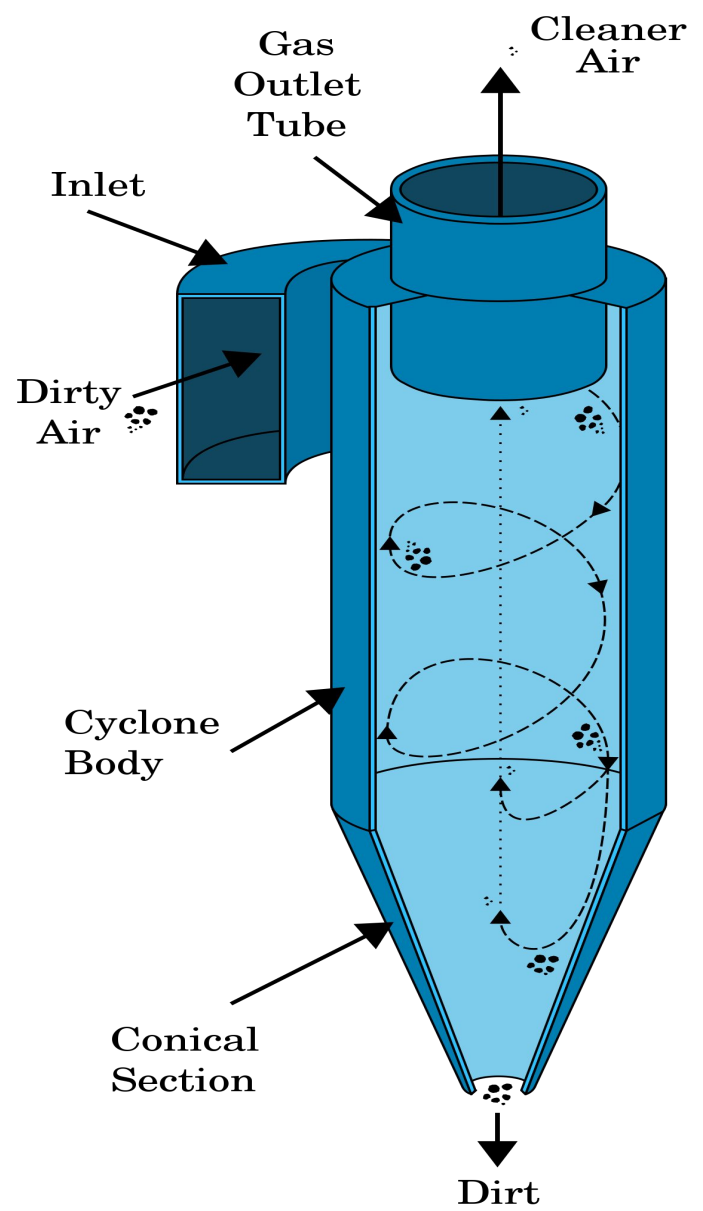
- Scrubbers – Polluted air passed through water or chemical solution
- Dry and wet collectors – spray towers
- Bag filters
- Electrostatic precipitator

Ambient air quality standards in India developed by the Central Pollution Control Board

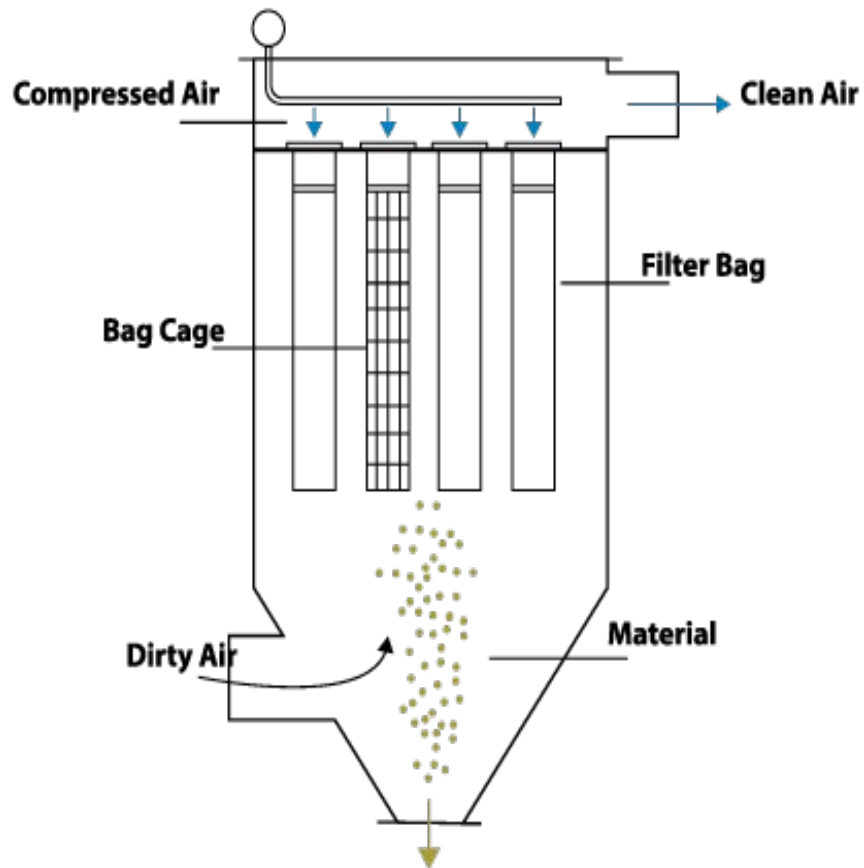
Area Category	SPM $\mu\text{g}/\text{m}^3$	SO ₂ $\mu\text{g}/\text{m}^3$	Co $\mu\text{g}/\text{m}^3$	NO _x $\mu\text{g}/\text{m}^3$
Industrial and mixed use	500	120	5000	120
Residential and rural	200	80	2000	80
Sensitive	100	3	1000	30



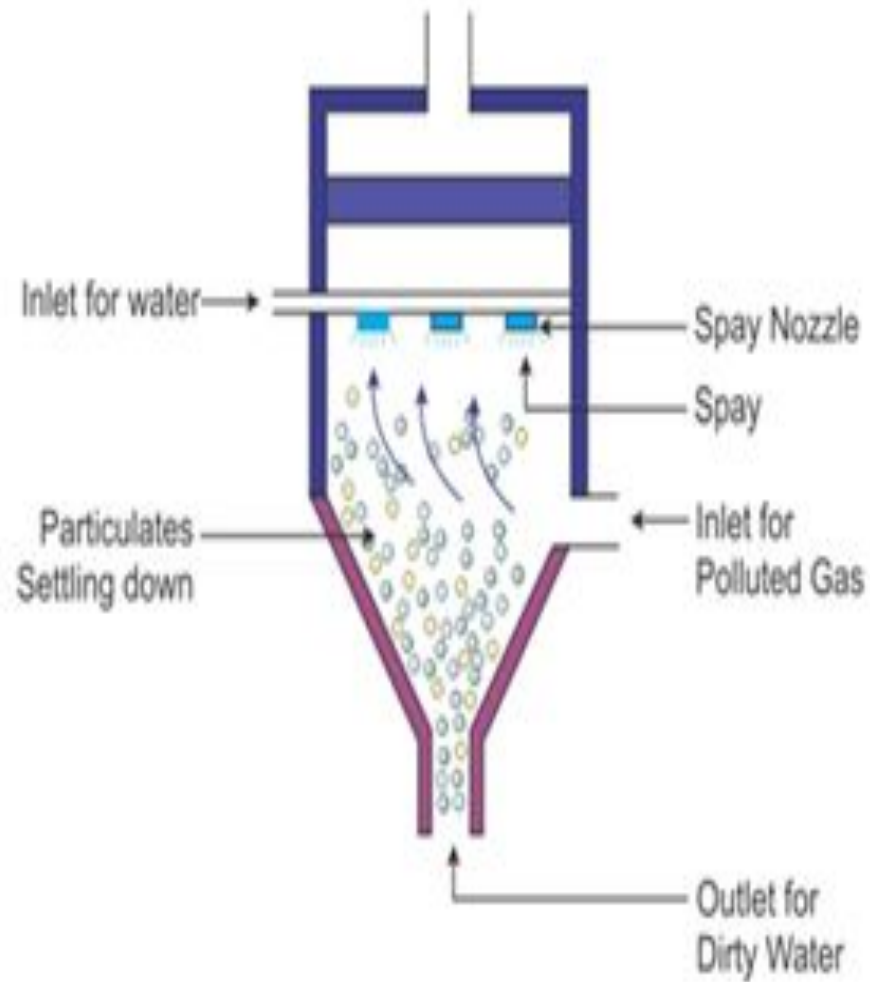
Electrostatic Precipitator



Cyclone Separator



Bag House Filter



Wet Scrubber

References

- E. Bharucha, Environmental Studies for Undergraduate Students.



Thank you for attention!!!

1. Which of the following air pollution control device has maximum efficiency?

- a) Electrostatic precipitator
- b) Dynamic precipitator
- c) Spray tower
- d) Wet cyclonic scrubber

2. Which gas is mainly produced due to incomplete burning of wood?

- a) CO
- b) SO₂
- c) NO₂
- d) NO₃

3. Which of the following is a secondary air pollutant?

- a) SPM
- b) PAN
- c) SO₂
- d) NO₂

4. The permissible limit for NO_x in residential area is..... $\mu\text{g}/\text{m}^3$.

- a) 60
- b) 30
- c) 80
- d) 90

5. Which is a Green House Gas:

- a) CO
- b) CH₄
- c) H₂O vapour
- d) a & b
- e) b & c