

A photograph of a lush green forest. In the upper left, a waterfall cascades down a mossy rock face. The surrounding area is covered in dense, vibrant green foliage, including various plants and trees. At the bottom of the image, a stream flows over dark, wet rocks, creating a smooth, blurred effect. The overall scene is serene and natural.

# Environmental Pollution - 1

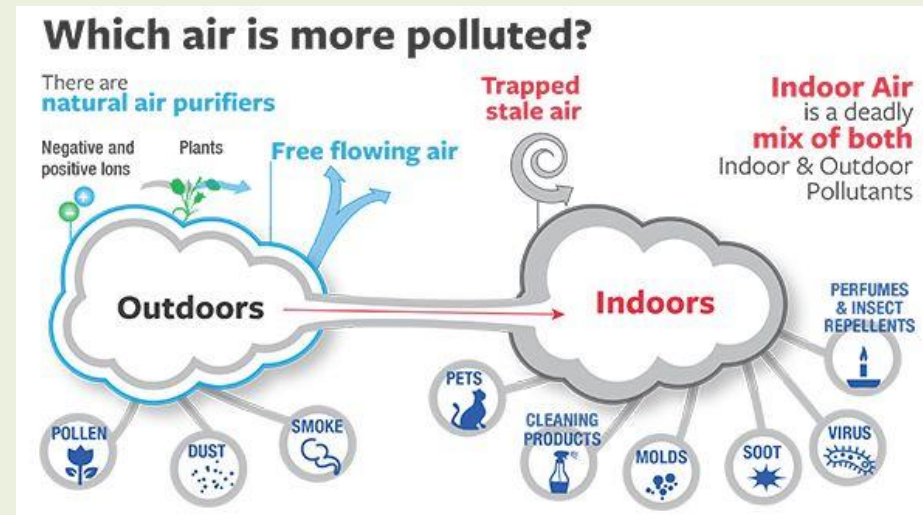
Dr. Prasenjit Adak

# Pollution

- Pollution is the introduction of contaminants into the natural environment that cause adverse change. Pollution can take the form of chemical substances or energy, such as noise, heat or light.
- Pollutants, the components of pollution. They can be either foreign substances/energies or naturally occurring contaminants.

# Air Pollution

- Air pollution Air pollution is said to exist if the levels of gases, solids, or liquids present in the atmosphere are high enough to harm humans, other organisms, or materials.
  - Indoor Air Pollution
  - Outdoor Air Pollution



# Air Pollution

- **Types of Air Pollutants**

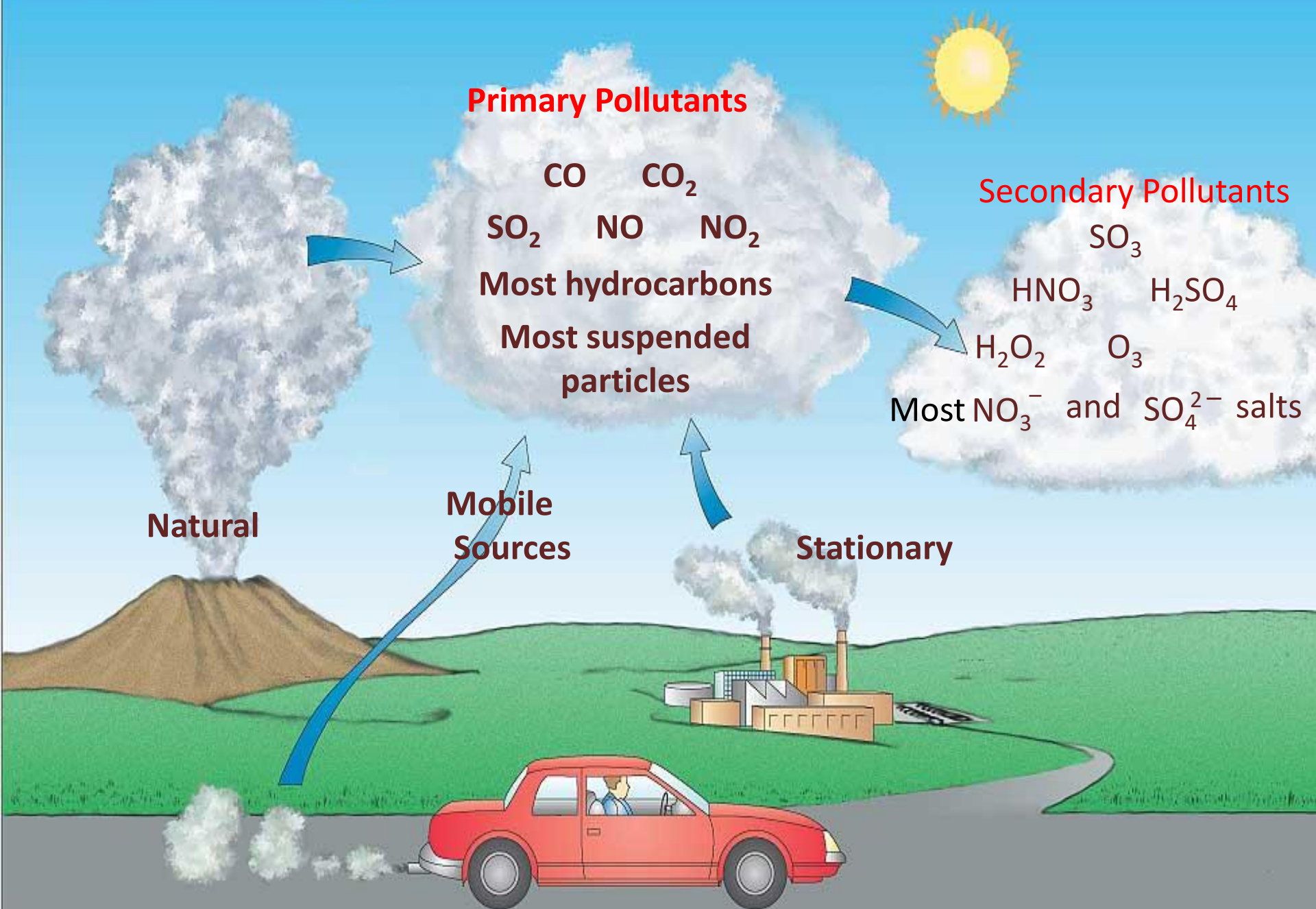
- **Primary**

- harmful chemicals that are released directly from a source into the atmosphere.
    - Examples: Particulate matter such as soil particles, lead, and asbestos, Oxides of carbon and nitrogen and sulphur dioxide, Hydrocarbons like methane and benzene

- **Secondary**

- produced from chemical reactions involving the primary pollutants.
    - Example: Ozone, Sulphur trioxide, PAN (Peroxy Acetyl Nitrate), Photochemical smog





# Air Pollution

## ■ Major Air Pollutants

### ■ Carbon Monoxide

- Product by incomplete combustion of fuel such as natural gas, coal or wood. Vehicular exhaust is a major source of carbon monoxide.
- Causes carboxyhaemoglobin

### ■ Carbon Dioxide

- A greenhouse gas emitted from combustion but is also a gas vital to living organisms. It is a natural gas in the atmosphere.

### ■ CFCs

- Source: Refrigerators, air conditioners, foam shaving cream, spray cans and cleaning solvents
- Destroy ozone layer

### ■ Ozone

- Ground level ozone ( $O_3$ ) formed from  $NO_x$  and VOCs. Ozone ( $O_3$ )
- Damages skin and many materials, constituent of smog

# Air Pollution

- Major Air Pollutants

- Nitrogen oxides

- Especially nitrogen dioxide are emitted from high temperature combustion. Nitrogen dioxide is the chemical compound with the formula  $\text{NO}_2$ . It is responsible for photochemical smog, acid rain etc.

- Sulphur dioxide

- $\text{SO}_2$  is produced by volcanoes and in various industrial processes. Since coal and petroleum often contain sulphur compounds, their combustion generates sulphur dioxide. Further oxidation of  $\text{SO}_2$ , usually in the presence of a catalyst such as  $\text{NO}_2$ , forms  $\text{H}_2\text{SO}_4$ , and thus acid rain.

- Suspended Particulate Matter (SPM)

- Particulates, alternatively referred to as particulate matter (PM) or fine particles, are tiny particles of solid or liquid suspended in a gas. Sources of particulate matter can be manmade or natural. Increased levels of fine particles in the air are linked to health hazards such as heart disease, altered lung function and lung cancer.

# Air Pollution

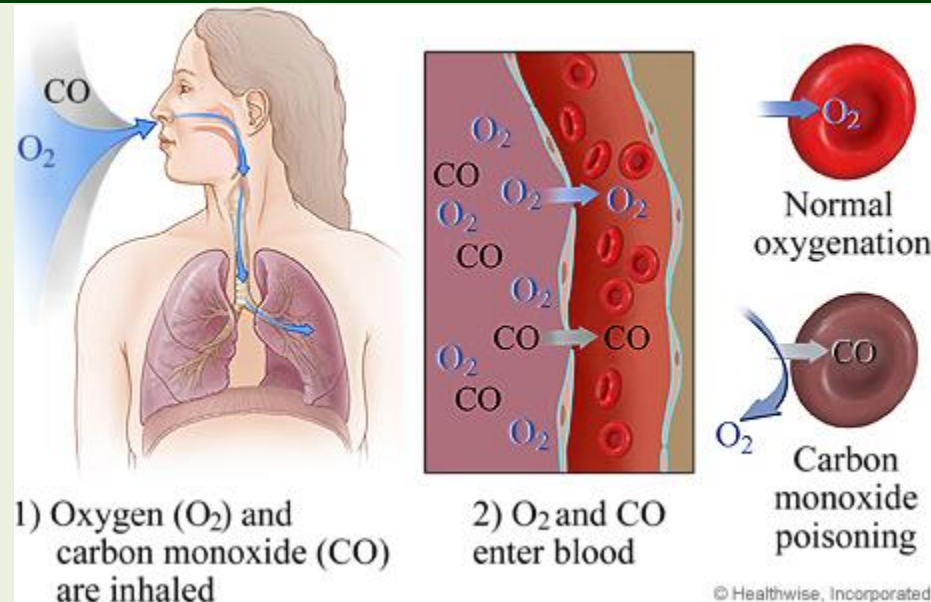
- Causes of Air Pollution
- Natural Causes
  - Natural disasters like volcanic eruption, cyclones, forest fires, microbes( $\text{CH}_4$ )
  - Natural emissions from animals, decaying organic matter
- Anthropogenic (Man made) Causes
  - Industrial emissions
  - Automobiles
  - Thermal power stations
  - Nuclear explosions
  - Nuclear power plants
  - Agricultural activities
  - Disposal of garbage
  - Mining activities





# Air Pollution

- Effects of Air Pollution
- Effects on Human Health
  - Carboxyhaemoglobin
  - Inflammation of lungs
  - Damage to respiratory system, and blood vascular system,
  - Cancer
- Effects on Plants
  - Bleaching of the leaf pigment
  - Development of necrotic spots
  - Premature falling of leaves
- Effects on Climate
  - Greenhouse effect and global warming
  - Acid rain
  - Ozone ( $O_3$ ) layer depletion



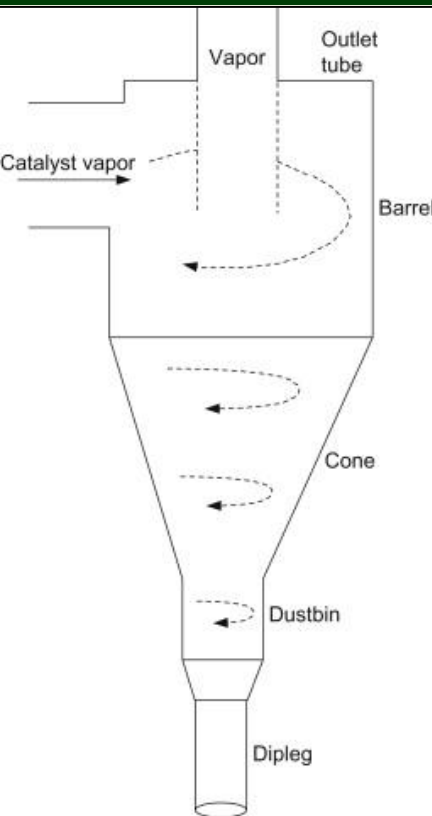
# Air Pollution

- **Prevention and control of air pollution**
  - Air pollution can be prevented by
    - Adopting cleaner technologies,
    - Reducing pollution at the source,
    - Implementing laws and regulations to make people pollute less,
    - Introducing appropriate transportation policies
    - Making cleaner and fuel-efficient vehicles
  - Air pollution can be controlled by
    - Various Air Pollution Control (APC) devices
    - Sprinkling water on soil that is being evacuated during road construction

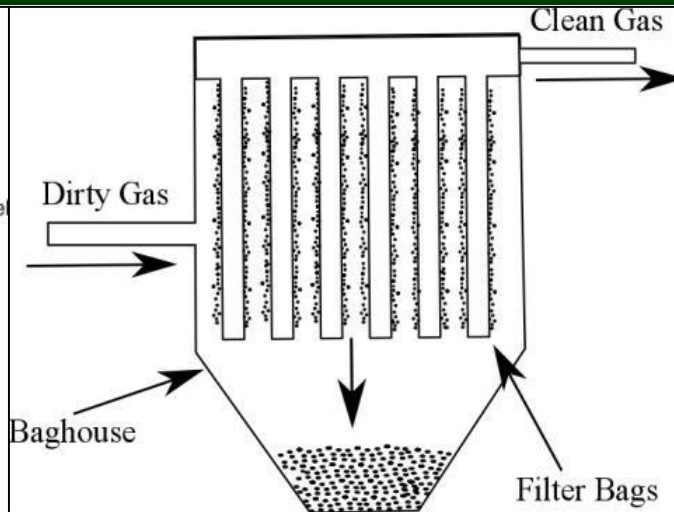
# Air Pollution

- Air Pollution Control (APC) devices
  - Particulate Matter
    - Cyclone separator
    - Bag house filter
    - Scrubbers
    - Electrostatic precipitators
  - Gaseous pollutants (Adsorption and Absorption)
    - Venturi scrubbers
    - Packed bed scrubbers
    - Spray towers

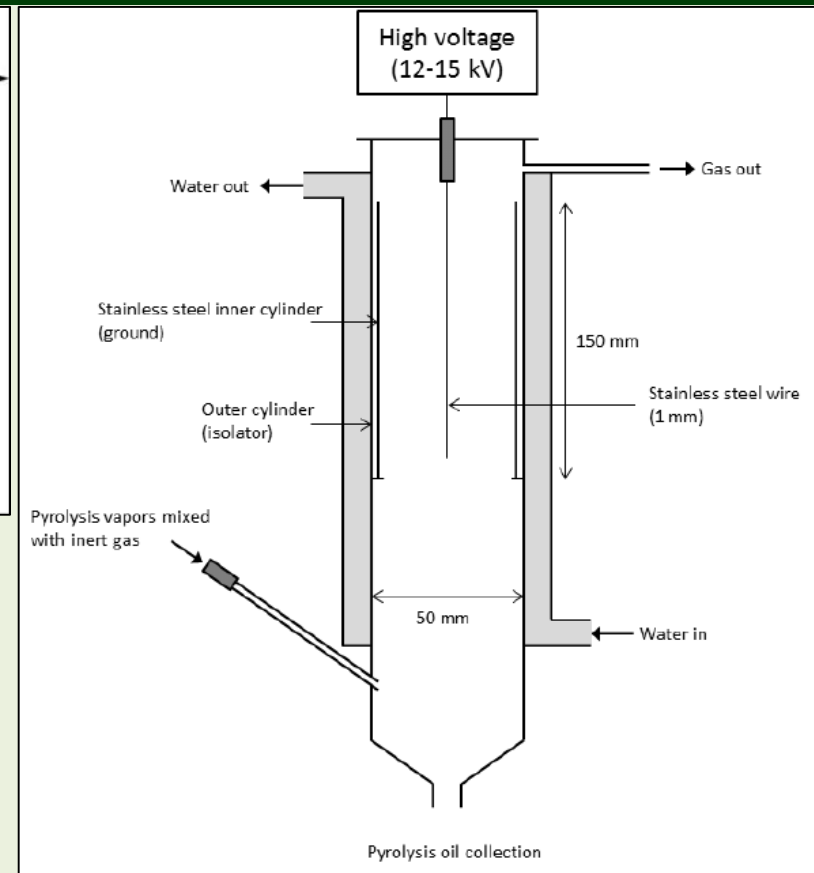
# Air Pollution Control Devices



**Cyclone separator**

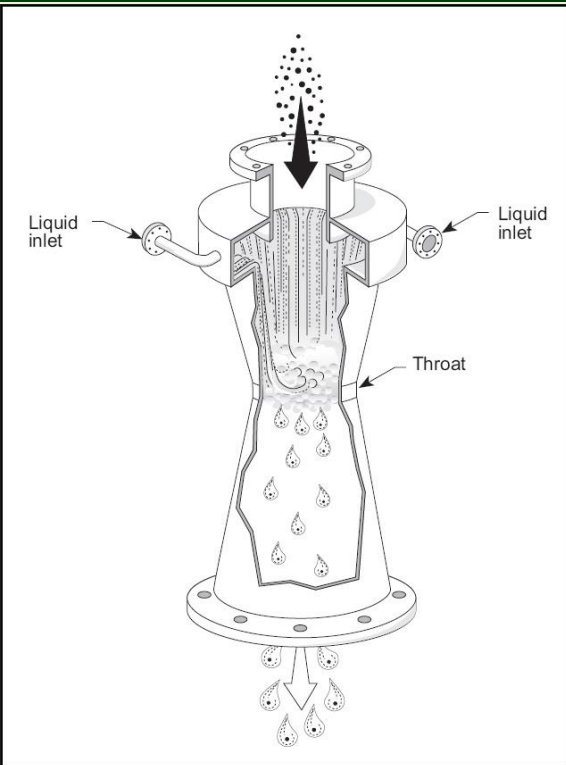


**Baghouse Filter**

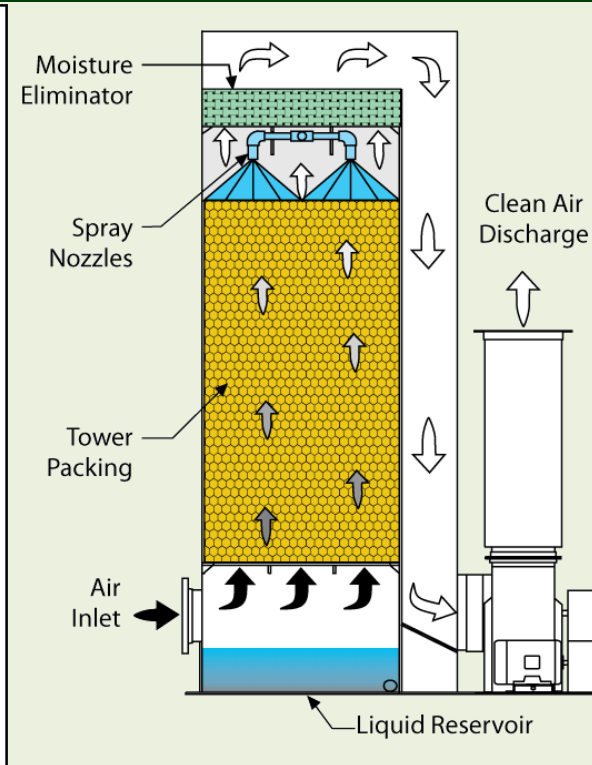


**Electrostatic Precipitator**

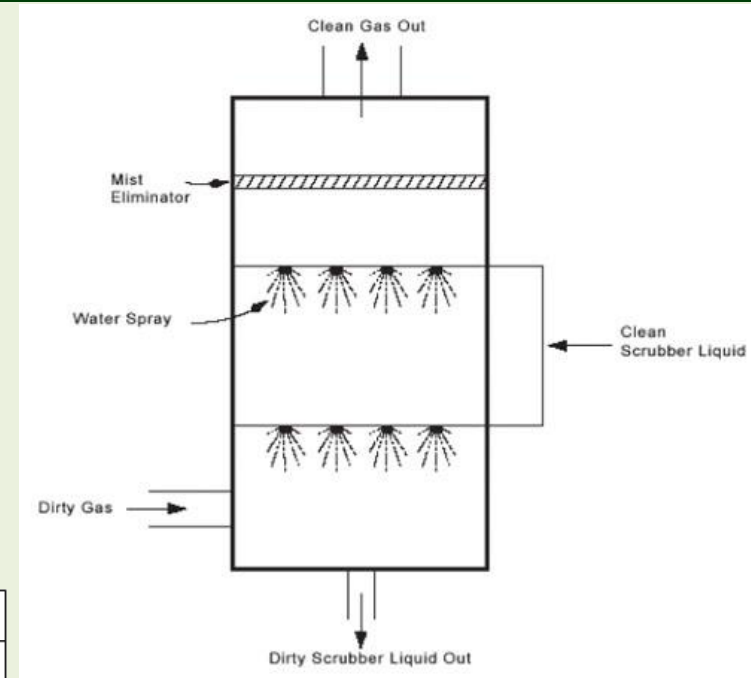
# Air Pollution Control Devices



**Venturi Scrubber**



**Packed bed Scrubber**



**Spray Tower**



# Ill Effects of Fireworks

- **Fire Hazards:** Fireworks can set fire to huts, heaps of dry grass and even houses.
- **Noise Pollution:** Firecrackers make more noise than the allowed decibel limit.
- **Air Pollution:** Components of the smog caused by firecrackers are harmful when inhaled. Such as,
  - Copper causes irritation in the respiratory tract. Cadmium causes anemia.
  - Lead in the body has a harmful effect on the nervous system.
  - Magnesium: Magnesium and zinc fumes cause metal fume fever.
  - Smokes from fireworks causes reduced visibility.

# Water Pollution

- The addition of various organic and inorganic substances that change the physical and chemical properties of water thereby leading to detrimental effects on living organisms and reducing water usability is termed as water pollution.



# Causes of Water Pollution

- **Natural Causes-**
  - Soil erosion due to rain, floods, high speed wind.
  - Deposition of dead and decaying remains of plants and animals.
- **Man-made Causes-**
  - Sewage and other wastes: Includes papers, cloth, soap, detergents, waste.
  - Industrial waste: effluents such as oil, grease, plastic, metals, acids and other toxic chemicals.
  - Agricultural waste: fertilizers, pesticides.
  - Human activities: bathing, washing clothes (use of synthetic detergents).
  - Customs and traditions: disposal of dead bodies, immersion of idols of gods.

# Sources of water pollutants

- **Point sources**

- Pollutants enter the water at a single point.  
Examples: sewage treatment plant and factories.  
These can be regulated through law.

- **Non point source**

- pollutants enter the water over large areas.  
Examples: Surface run off, mining wastes, municipal wastes, acid rain and soil erosion

# Water Pollutants and its effects

- **Sediments:** Excessive amounts of soil particles carried by flowing water, when there is severe soil erosion. Sediments cloud the water and reduces photosynthesis, destroys feeding ground of fishes, clogs reservoirs and channels.
- **Oxygen-demanding wastes (BOD and COD):** Organic waste such as animal manure and plant debris that are decomposed by bacteria, from sewage, animal feedlots, paper mills, and food processing facilities. These bacteria deplete the oxygen and causes death of fish.
- **Infectious microorganisms (Pathogens):** Parasitic worms, viruses and bacteria from infected organisms as well as human and animal wastes. They are responsible for water borne diseases.
- **Synthetic chemicals:** Synthetic chemicals from industrial effluents, surface runoff, and cleaning agents. These chemicals causes health problems for humans and harm fishes.



# Water Pollutants and its effects

- Inorganic nutrients: Substances like nitrogen and phosphorus from animal waste, plant residues, and fertilizer runoff. These nutrients causes eutrophication.
- Radioactive substances: Wastes from nuclear power plants, nuclear weapons production, mining and refining uranium and other ores. Such substances causes cancer and birth defects.
- Thermal pollution: Hot water from industrial processes. Heat lowers oxygen demand and makes aquatic life more vulnerable to diseases, parasites. Thermal shock in aquatic organisms.

# Effects of Water Pollution

## ■ Effect on human health

- Infectious diseases can be spread through contaminated water. These water-borne diseases are caused by bacteria (Typhoid, Cholera, diarrhoea etc. ) or by viruses (Infectious Hepatitis)
- Pesticides – can damage the nervous system and cause cancer.
- Mercury – Minamata disease
- Chlorides can cause reproductive and endocrinal damage.
- Nitrates – are especially dangerous to babies that drink formula milk. It restricts the amount of oxygen in the brain and cause the “blue baby” syndrome.
- Lead – can accumulate in the body and damage the central nervous system.
- Arsenic – causes liver damage, skin cancer and vascular diseases
- Flourides – in excessive amounts can make your teeth yellow and cause damage to the spinal cord.

# Effects of Water Pollution

- **Effects on animals**

- Loss of aquatic biodiversity: Harmful chemicals and pollutants in water effect survival of aquatic organisms

- **Effects on plants**

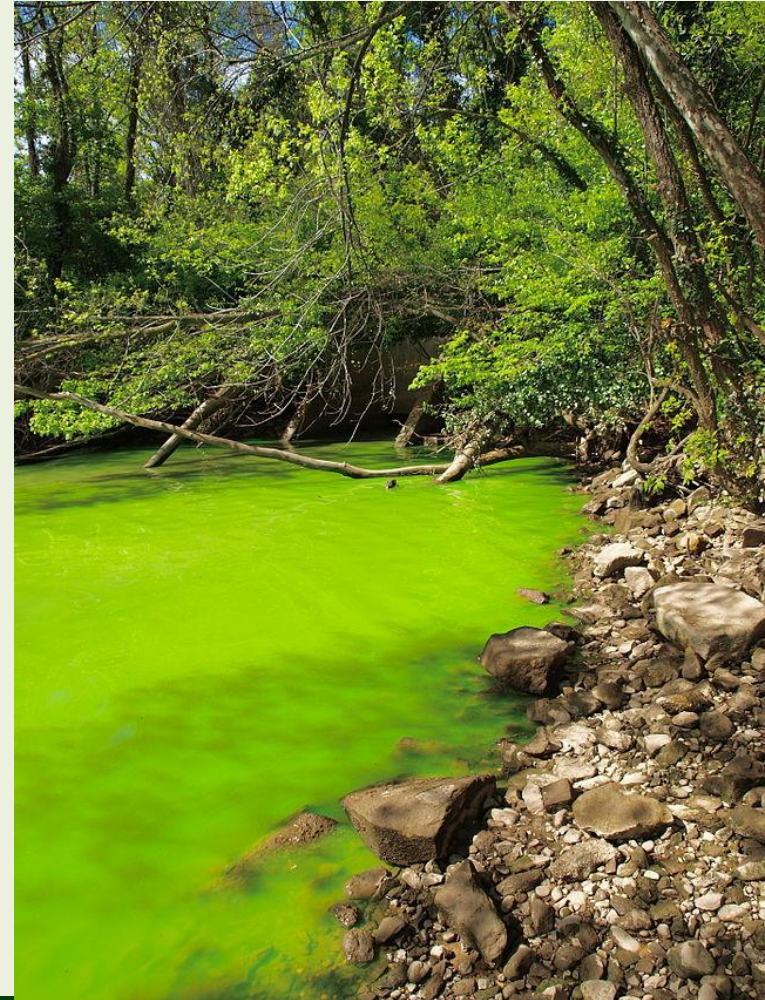
- Eutrophication of water bodies: Nitrate and phosphate fertilizer used to increase nitrogen and phosphate content of soil goes in water and increases the growth of certain plants on surface of water body.
- Polluted water contains high concentration of heavy metals becomes toxic for plants.

# Pollution of Groundwater

- Excessive extraction of groundwater leads to the natural pollution of groundwater. Examples are fluoride and arsenic contamination.
- Groundwater receives pollutants from septic tanks, landfills, hazardous waste dumps, and underground tanks containing petrol, oil, chemicals, etc.

# Eutrophication

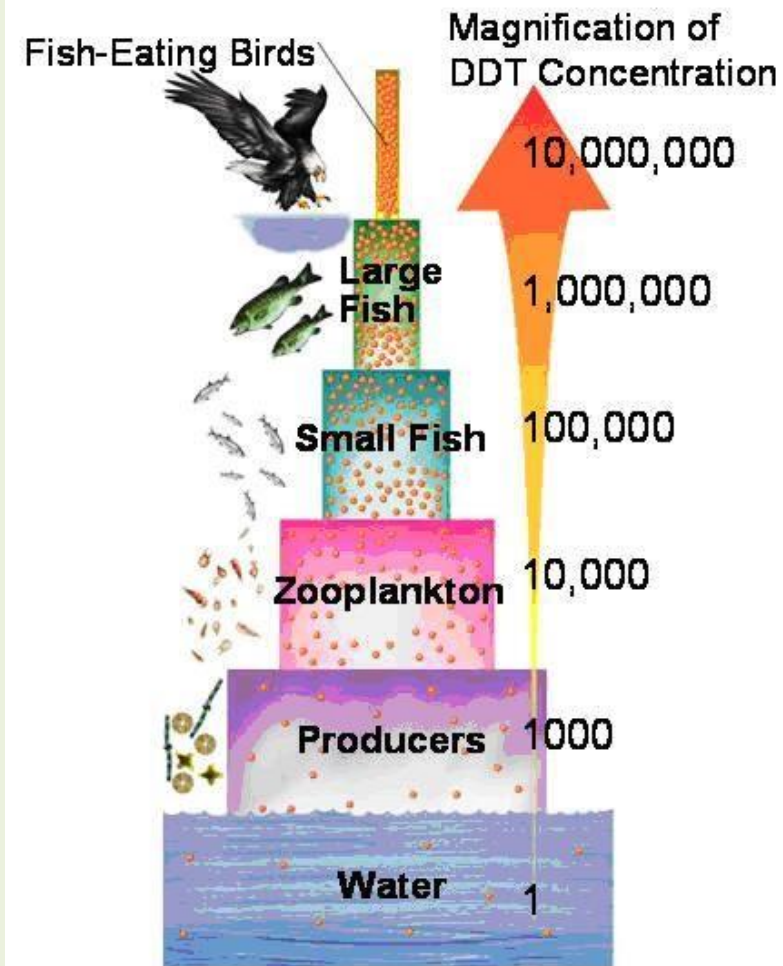
- Enrichment of a standing water body by nutrients, such as phosphorus and nitrogen.
- Increased photosynthetic activity.
- Excessive algae die, they fall to the bottom and gets decomposed. This process requires dissolved oxygen, some fish species die.





# Biomagnification

- Biomagnification is the increase in concentration of a substance, such as the pesticide, that occurs in a food chain. The pollutant enters the first organism in a food chain. When the second organism in the chain consumes the first one, the pollutant too moves into the second organism.
- As we go up the levels of the ecological pyramid, there is energy loss. Hence, at each succeeding level, the predator consumes more of the prey. As a result, the organisms at higher levels have greater concentrations of the pollutant.

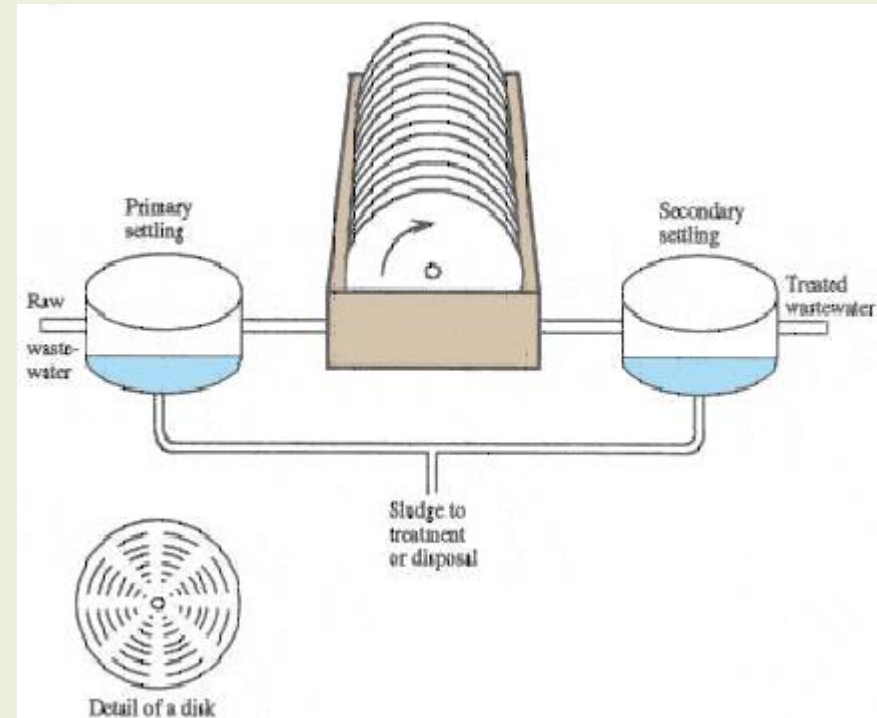


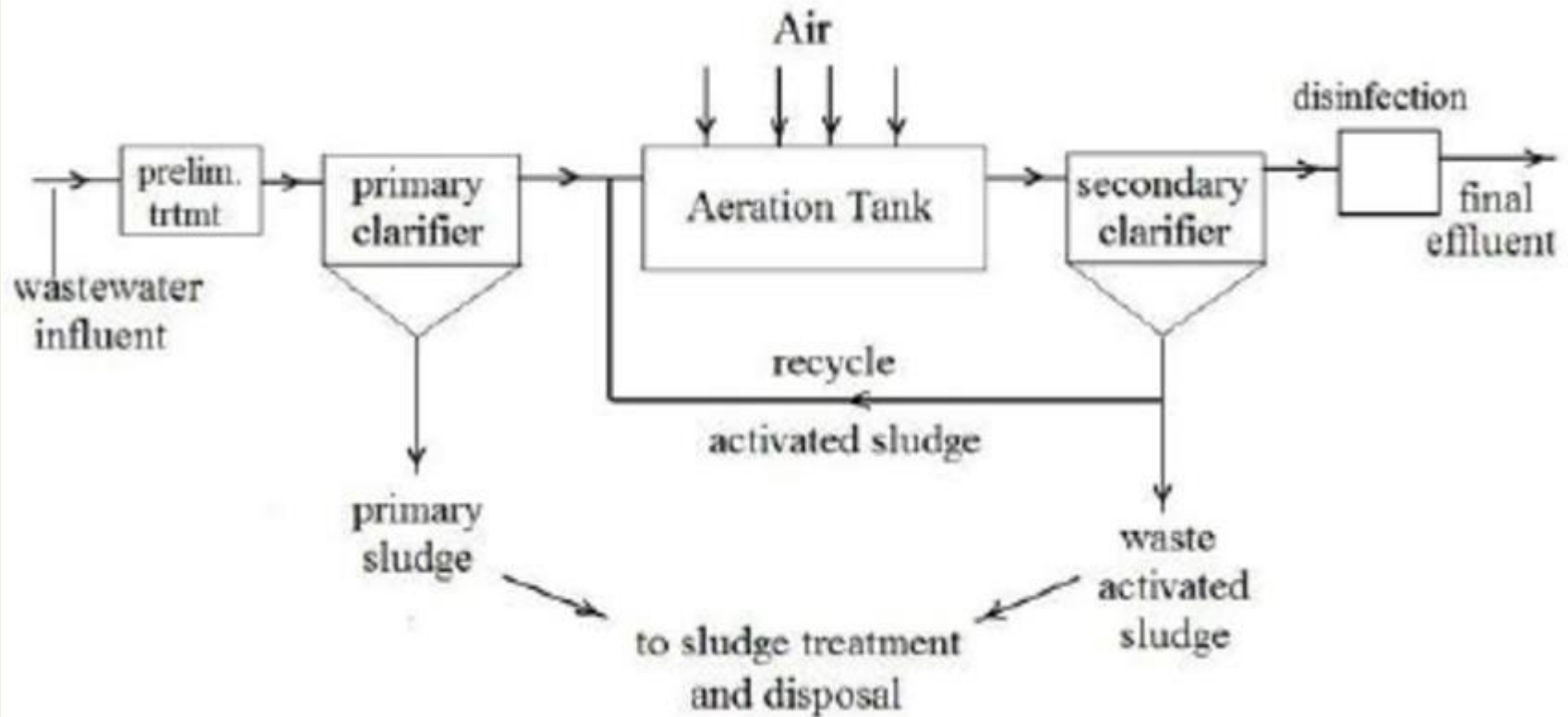
# Control of Water Pollution

- Treatment of domestic and industrial waste in order to reduce toxicity.
- Control on excess use of fertilizers and pesticides in agriculture
- Human activities such as bathing, washing ; throwing dead bodies should be stopped.
- Non- biodegradable waste material such as plastic should not be disposed in water bodies.
- Strict enforcement of rules
- Public awareness

# Waste water treatment

- **Primary treatment**
  - Grit removal
  - Sedimentation
  - Floatation
- **Secondary treatment**
  - Trickling filters
  - Activated sludge process
  - Rotating biological contactor
- **Tertiary treatment**
  - Chlorination
  - Anaerobic treatment
    - Hydrolysis, Acidogenesis, Acetogenesis, Methanogenesis





<https://www.youtube.com/watch?v=s8IVjQg7yno>

# Thermal Pollution

- Causes of thermal pollution
  - Heat producing industries (thermal power plants, nuclear power plants, refineries, steel mills etc.)
- Effects of Thermal Pollution
  - The dissolved oxygen content of water is decreased.
  - The composition of flora and fauna changes
  - Metabolic activities of aquatic organisms increase at high temperature and require more oxygen, whereas oxygen level falls under thermal pollution.
  - Toxicity of pesticides, detergents and chemicals in the effluents increases with increase in temperature
  - High temperature becomes a barrier for oxygen penetration into deep cold waters



# Thermal Pollution

- Control of Thermal Pollution
  - Cooling ponds
  - Spray Ponds
  - Cooling Towers
    - Wet cooling tower
    - Dry cooling tower

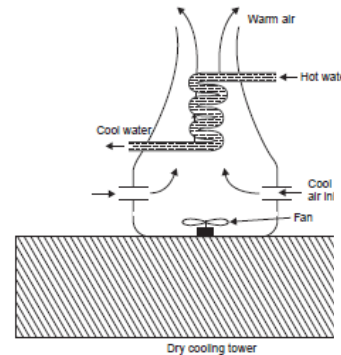
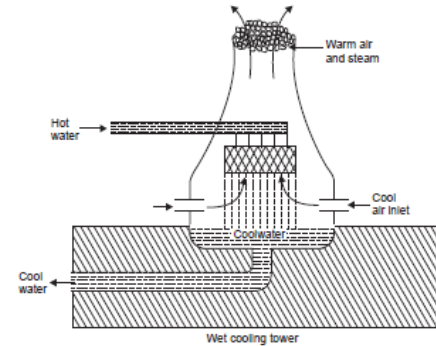
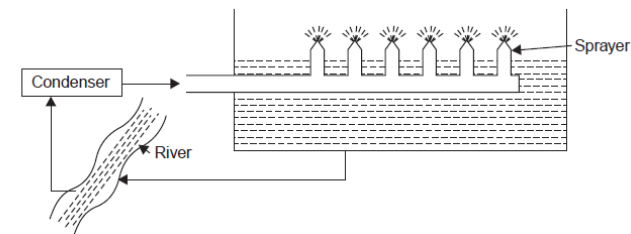
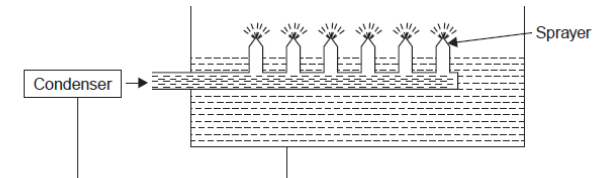
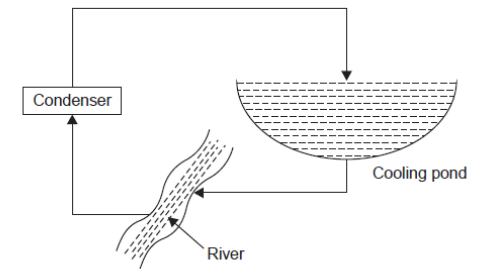
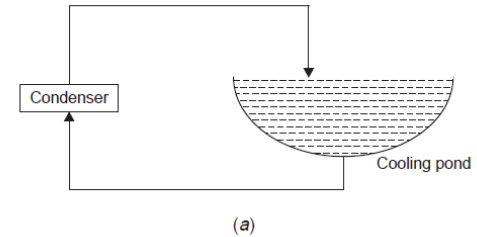


Fig. 5.4. Cooling towers: Wet and dry.



# Marine Pollution

- Sources of marine pollution
  - Rivers, Catchment area, coastline, oil drilling and shipment.
- Pollutants
  - sewage sludge, industrial effluents, synthetic detergents, agrochemicals, solid wastes, plastics, metals and waste heat



# Control of Marine Pollution

- Toxic materials from the industrial plants should not be discharged in coastal water.
- Run off from non-point source should be controlled.
- Sewer overflow should be prevented.
- Oil and grease from the service stations should be reused.
- Oil ballast should not be dumped into the sea.
- Developmental activities in the coastal region should be minimized.

# To be continued...