

Unit 4

Environmental pollution

(Types of environmental pollution. Cause, effect and control of air pollution. Major air pollutants and their sources)

Learning outcomes

After completing this lecture, you will be able to understand the following:

- Student get knowledge about different type of pollutions, their effect and solutions.
- Student understand the basics Student will learn about air pollution.

Environmental Pollution

Any undesirable change in the physical, chemical or biological characteristics of any component of the environment (air, water, soil), which can cause harmful effects on various forms of life or property.

Pollutants: Components of pollution. They can be either foreign substances/energies or naturally occurring contaminants.

➤ Types of Pollution

- Air Pollution
- Water Pollution
- Soil Pollution
- Noise Pollution
- Radiation 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.



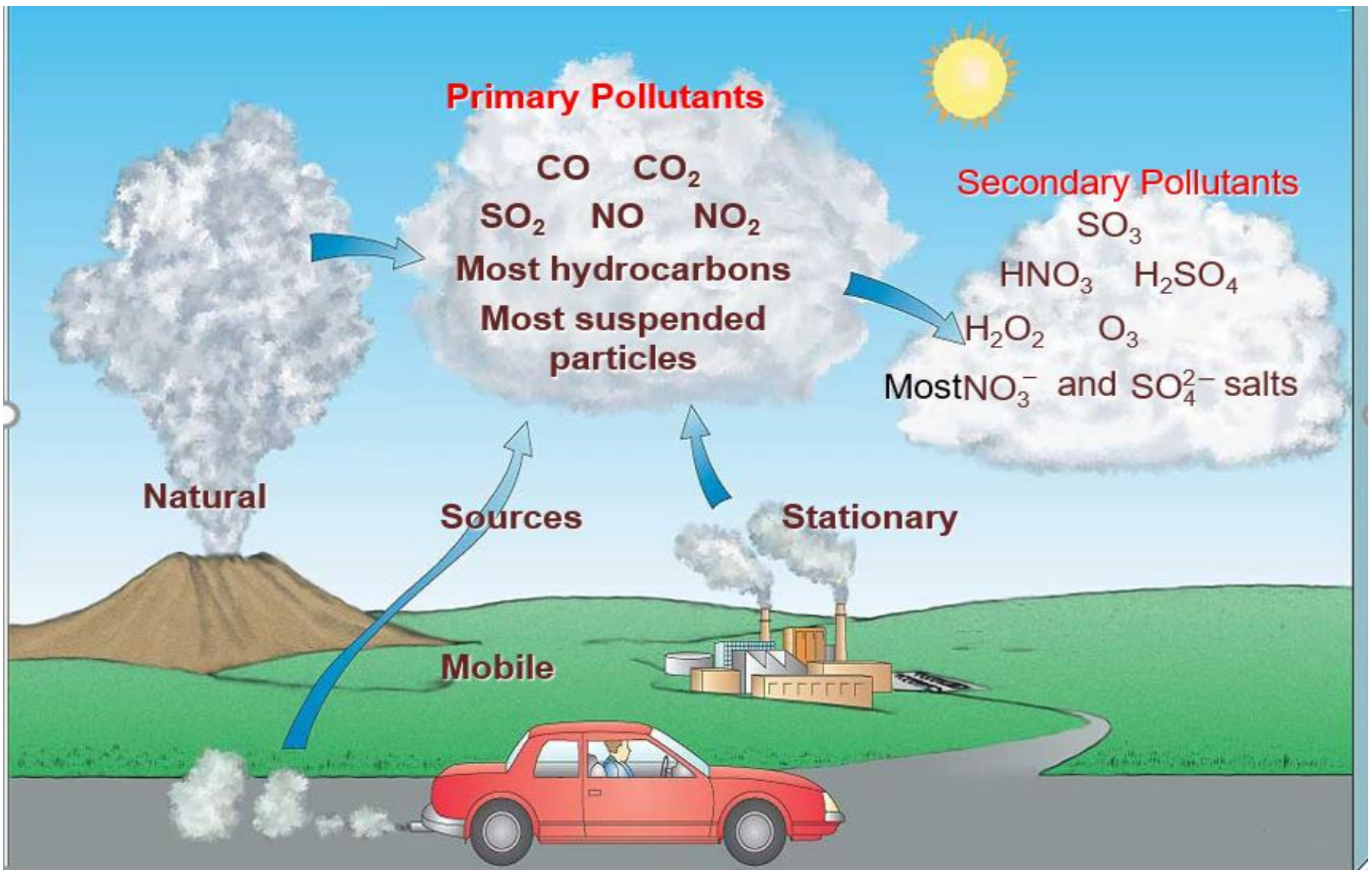
Types of Air Pollutants

Primary air pollutants: harmful chemicals that are released directly from a source into the atmosphere.

- Particulate matter such as soil particles
- Oxides of carbon, Nitrogen and Sulphur
- Hydrocarbons

Secondary air pollutants: produced from chemical reactions involving the primary pollutants.

- Sulphur trioxide (SO_3)
- HNO_3
- H_2SO_4



Major Air Pollutants

- Carbon Monoxide (CO)
- Carbon Dioxide (CO₂)
- Chlorofluorocarbon (CFCs)
- Nitrogen oxide (NO)
- Sulphur dioxide (SO₂)
- Suspended Particulate Matter (SPM)

Causes of Air Pollution

Natural Causes- Natural disasters like volcanic eruption, cyclones, forest fires.

Man made Causes-

- Industrial emissions
- Automobiles
- Thermal power stations
- Nuclear explosions
- Nuclear power plants
- Agricultural activities
- Disposal of garbage

Type of Air Pollution

- a) Indoor air pollution
- b) Outdoor air pollution



Indoor Air Pollution -Causes and Effects

- Pesticides, mosquito repellents, cleaning agents, etc., cause toxic conditions.
- Building materials like asbestos, glass fibre, paints, glues, and varnishes.
- Air-conditioned rooms and offices cause health complaints.
- Most common pollutants in urban interiors: cigarette smoke, gases from stoves, formaldehyde (from carpets and furniture), pesticides, cleaning solvents, and ozone (from photocopiers).
- In rural areas, traditional stoves that use wood, coal, or animal dung spew out poisons.
- Entry of foul air/pesticides vapours etc. from outside environment.

Effects: Sicknesses like colds, influenza, upset stomachs, eye irritations, nausea, depression, etc.,

Outdoor Air Pollution -Causes and Effects

- Burning of fossil fuels in
 - automobiles, domestic cooking and heating.
 - power stations and industries.
- Mining activities
- Burning biofuels, tropical rainforests, wastes of all kinds, etc.
- Natural emissions from animals, decaying organic matter
- Temporary air pollution due to disasters like earthquakes, volcano eruptions, dust storms, leak of gases (like the Bhopal case), and armed conflicts, etc.
- Oil spillage (Transportation accidents).

AIR POLLUTION – THE SILENT KILLER

Every year, around
7 MILLION DEATHS

are due to exposure from both outdoor and household air pollution.

Air pollution is a major environmental risk to health. By reducing air pollution levels, countries can reduce:



Stroke



Heart disease



Lung cancer, and both chronic and acute respiratory diseases, including asthma

REGIONAL ESTIMATES ACCORDING TO WHO REGIONAL GROUPINGS:



- Over 2 million** in South-East Asia Region
- Over 2 million** in Western Pacific Region
- Nearly 1 million** in Africa Region
- About 500 000** deaths in Eastern Mediterranean Region
- About 500 000** deaths in European Region
- More than 300 000** in the Region of the Americas

CLEAN AIR FOR HEALTH

#AirPollution



DEATHS LINKED TO OUTDOOR AND HOUSEHOLD AIR POLLUTION

7 million people die prematurely every year from air pollution – both household and outdoor.

Among these deaths:



21% are due to pneumonia



20% from stroke



34% from ischaemic heart disease



19% from chronic obstructive pulmonary disease (COPD)



7% from lung cancer

CLEAN AIR FOR HEALTH

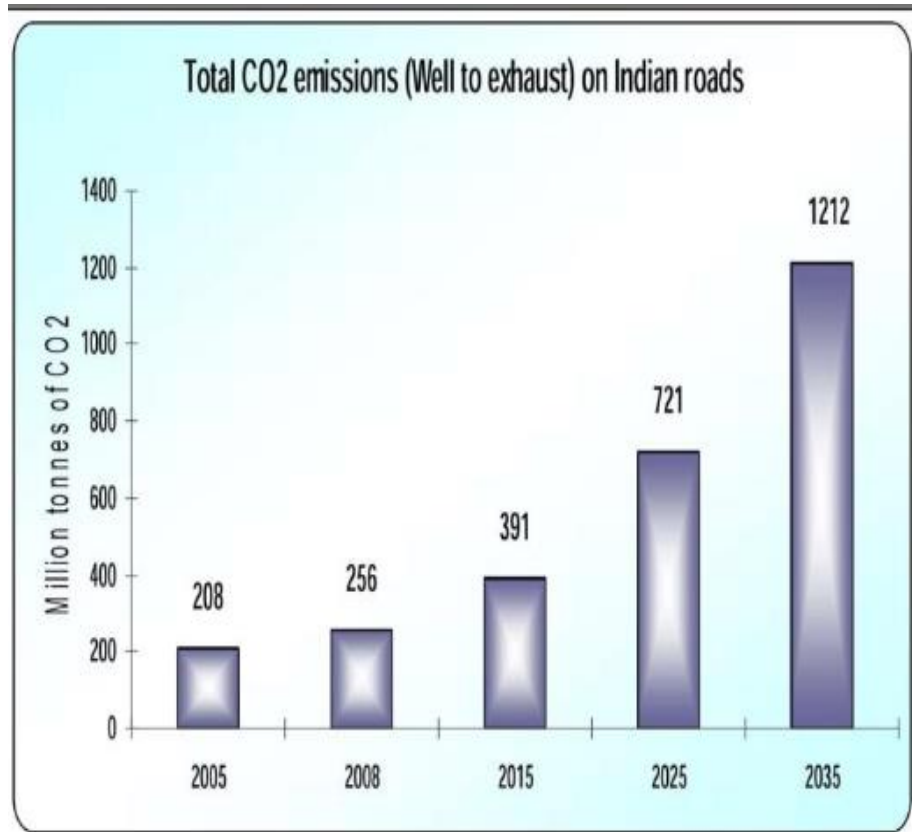
#AirPollution



Major causes of outdoor air pollution in India

- Exponential growth of vehicles, outdated vehicle technology, bad fuel quality, poor maintenance of vehicles, poor traffic management and planning
- Unwillingness on the part of vehicle owners and the auto industry to accept emission norms
- Lack of efficient public transport.
- Heavy vehicles such as Trucks and buses run on diesel, which has high sulphur content.
- Old engines emit vast quantities of suspended particulate matter (SPM).

Automobiles contribution to pollution



Source: Centre for Science and Environment, New Delhi.



Air Quality Index(AQI)











- Used for reporting daily air quality.
- EPA(Environment Protection Agency) calculates AQI for 5 major air pollutants: ozone, particulate matter, CO, SO₂ , NO₂ .

Daily AQI Color	Levels of Concern	Values of Index	Description of Air Quality
Green	Good	0 to 50	Air quality is satisfactory, and air pollution poses little or no risk.
Yellow	Moderate	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Orange	Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Red	Unhealthy	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Purple	Very Unhealthy	201 to 300	Health alert: The risk of health effects is increased for everyone.
Maroon	Hazardous	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

Air Quality Ranking

2021 AQI COUNTRY RANKING

What country has the worst air quality?

#	COUNTRY	POPULATION	2021 AVG. US AQI
1	 Bangladesh	164'689'383	161
2	 Chad	16'425'859	161
3	 Pakistan	220'892'331	156
4	 Tajikistan	9'537'642	152
5	 India	1'380'004'385	151
6	 Oman	5'106'622	146
7	 Kyrgyzstan	6'524'191	138
8	 Bahrain	1'701'583	136
9	 Iraq	40'222'503	136
10	 Nepal	29'136'808	126

Effects of Air Pollution

Effects on Human Health

- Asthma
- Inflammation of lungs
- Damage to respiratory system, blood vascular system etc.
- Different types of cancers

Effects on Plants

- Chlorosis of leaves
- Bleaching of the leaf pigment
- Development of necrotic spots
- Premature falling of leaves
- Smaller leaf size

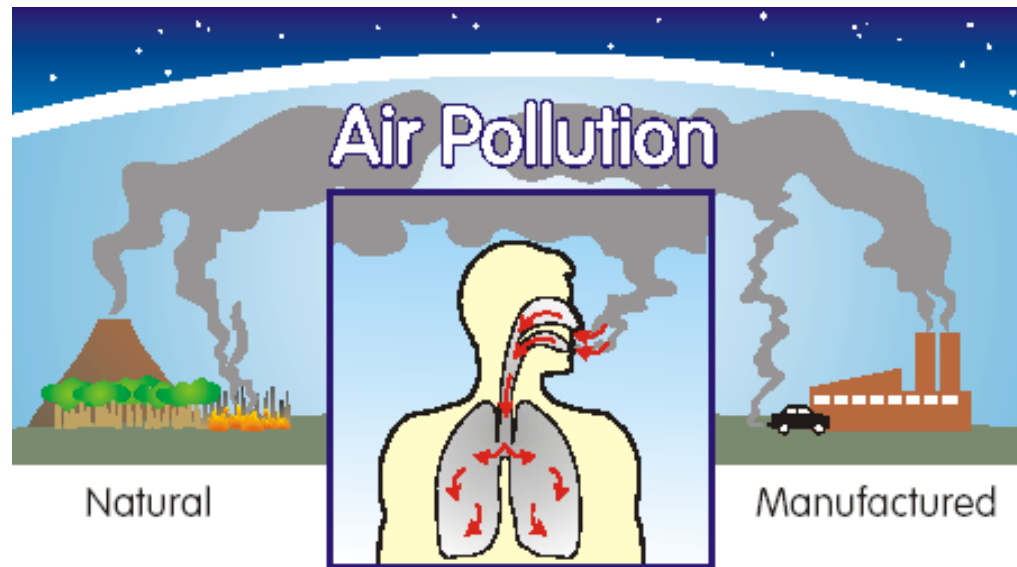
Effects on Climate

- Greenhouse effect and global warming
- Acid rain
- Ozone (O₃) layer depletion

<https://www.youtube.com/watch?v=e6rglsLy1Ys>

The story of juvenile asthma

- Many asthmatics among poor children in Indian cities.
- WHO estimate: 10-15% of Indian children in the 5-11 age group suffer from asthma.
- Strong link between air pollution and asthma.



World wide causalities/deaths related to Air Pollution

- ✓ **4.2 million deaths every year** occur as a result of exposure to ambient (outdoor) air pollution.
- ✓ **3.8 million** deaths every year as a result of household exposure to smoke from dirty cook stoves and fuel.
- ✓ **91%** of the world's population live in places where air quality exceeds WHO guideline limits.

O₃	100 µg/m ³ (8-hour mean)	
PM_{2.5}	10 µg/m ³ (annual mean)	25 µg/m ³ (24-hour mean)
PM₁₀	20 µg/m ³ (annual mean)	50 µg/m ³ (24-hour mean)
NO₂	40 µg/m ³ (annual mean)	200 µg/m ³ (1-hour mean)
SO₂	20 µg/m ³ (24-hour mean)	500 µg/m ³ (10-minute mean)

Source: https://www.who.int/health-topics/air-pollution#tab=tab_1

Air Pollution: Indian Scenario

Bad air killed 1.2 lakh across 6 Indian cities, cost the \$17.7bn: Study

TNN | Feb 18, 2021, 02:04 PM IST



An estimated 1.2 lakh deaths attributed to air pollution have been reported across six big Indian cities in 2020, with the national capital leading the table followed by Mumbai and Bengaluru. Bad air is also estimated to have cost \$17.7 billion in economic terms.

These findings are according to a Greenpeace Southeast Asia analysis of IQAir (a Swiss air quality technology company) data from a live Cost Estimator.

“To show the impact of air pollution related deaths on the economy, the approach used by Greenpeace is called “willingness-to-pay”, a lost life year or a year lived with disability is converted to money by the amount that people are willing to pay in order to avoid this negative outcome,” a

statement issued here read.

Estimated Air pollution impacts in major Indian cities (2020)

Cities	Estimated Deaths	Estimated Cost
Delhi	54,000	\$8.1 billion
Mumbai	25,000	\$3.7 billion
Bengaluru	12,000	\$1.7 billion
Hyderabad	11,000	\$1.6 billion
Chennai	11,000	\$1.5 billion
Lucknow	6,700	\$1.1 billion
Total	1,19,700	\$17.7 billion

TOI

Source: Green Peace & IQAir

Source: <https://timesofindia.indiatimes.com/home/environment/pollution/bad-air-killed-1-2-lakh-across-6-indian-cities-cost-the-17-7bn-study/articleshowprint/81087153.cms>

Air Pollution: Control

- 1. The Pollution Prevention Approach**
- 2. Technological Approach**

Automobile emissions can be reduced by:

- Making cleaner and fuel-efficient vehicles- Ex CNG and Electric based vehicles.
- Using lead-free petrol in existing vehicles.
- Introducing policies that encourage the building and use of mass transit systems and discourage the use of personal transport.
- Shifting from diesel to natural gas based vehicles.

Reducing and controlling outdoor air pollution

Outdoor air pollution can be reduced by

- Adopting cleaner technologies.
- Reducing pollution at the source.
- Implementing laws and regulations to make people pollute less.
- Introducing appropriate transportation policies.

An electric car being charged



A CNG bus

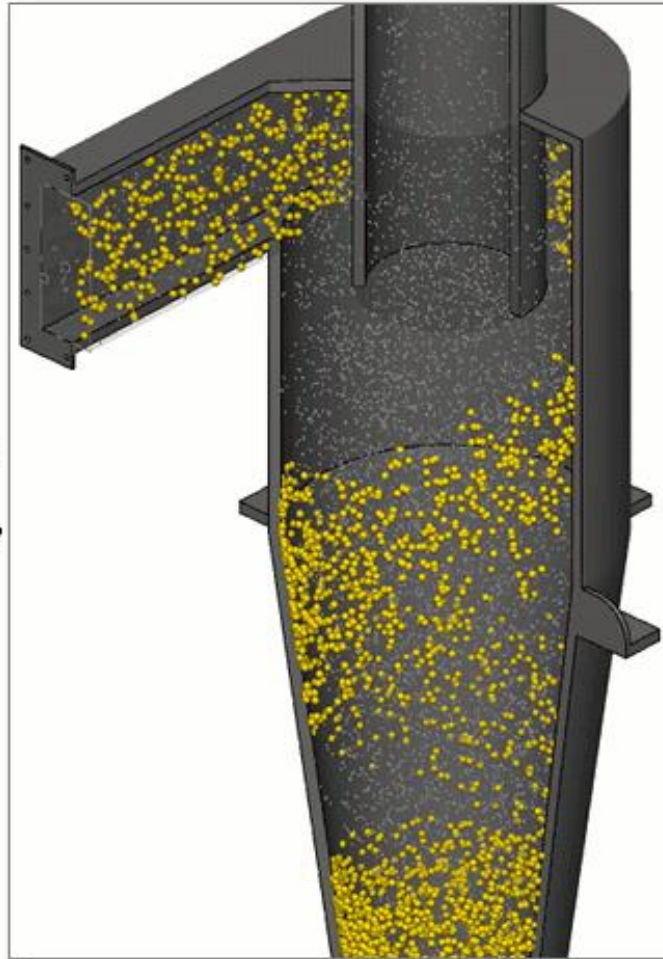


Air Pollution Control (APC) Device

Particulate matter in the air can be reduced by:

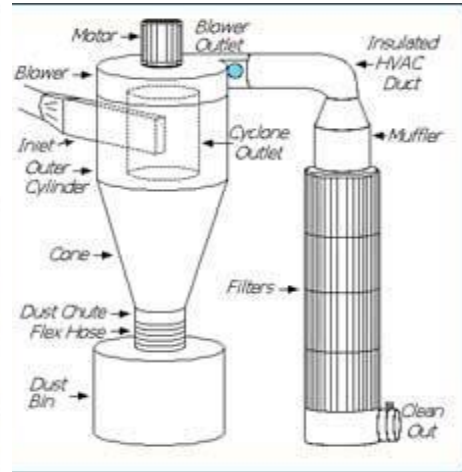
- A) Fitting smokestacks with electrostatic precipitators, fabric filters, scrubbers, or similar devices etc. Some important methods given as:
 - Cyclone separators: Cyclone separators or simply cyclones are separation devices (dry scrubbers) that use the principle of inertia to remove particulate matter from flue gases. Cyclone separators is one of many air pollution control devices known as precleaners since they generally remove larger pieces of particulate matter. This prevents finer filtration methods from having to deal with large, more abrasive particles later on. In addition, several cyclone separators can operate in parallel, and this system is known as a multicyclone.

Cyclone Separator Particles

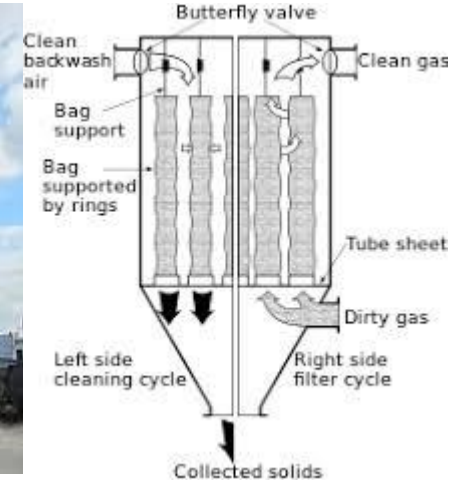


- **Bag house filters:** A **baghouse**, also known as a **baghouse filter**, **bag filter**, or **fabric filter** is an **air pollution control** device and **dust collector** that removes **particulates** or gas released from commercial processes out of the air. Power plants, steel mills, pharmaceutical producers, food manufacturers, chemical producers and other industrial companies often use baghouses to control emission of air pollutants.
 - **Wet scrubbers:** **Wet Scrubbers** are effective air pollution control devices for removing particles and/or gases from industrial exhaust streams. A **Wet Scrubber** operates by introducing the dirty gas stream with a **scrubbing** liquid – typically water. Particulate or gases are collected in the **scrubbing** liquid
 - **Electrostatic precipitators:** An **electrostatic precipitator (ESP)** is a filtration device that removes fine particles, like dust and smoke, from a flowing gas using the force of an induced **electrostatic** charge minimally impeding the flow of gases through the unit
- B) Sprinkling water on soil that is being evacuated during road construction.

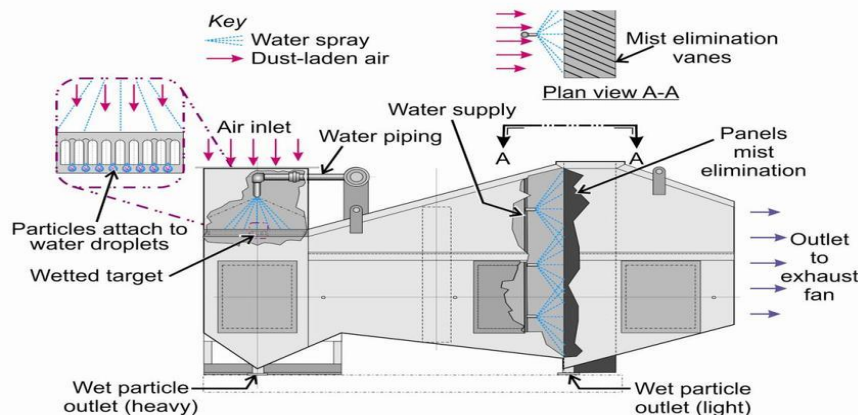
Air Pollution Control (APC) devices for Particulate matter separation



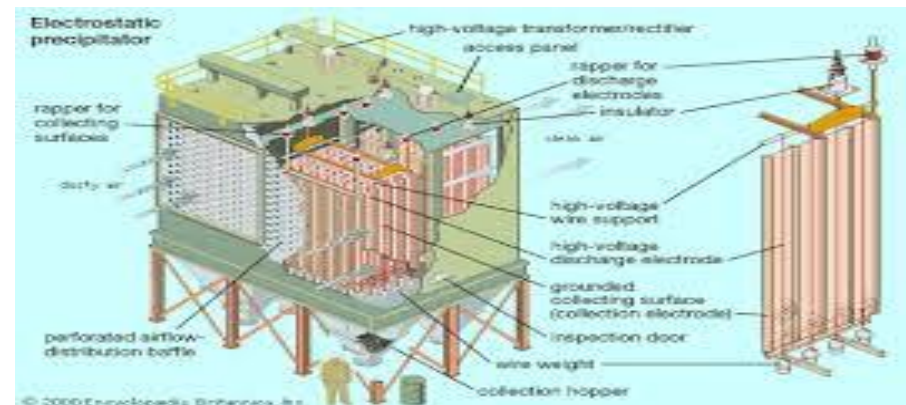
Cyclone separator



Baghouse filter



Scrubber



Electrostatic Precipitators

Unit 4

Environmental pollution

(Water Pollution:Cause, effect and control of
water,

Basic concept of Eutrophication and
biomagnification.

Learning outcomes

After completing this lecture, you will be able to understand the following:

- Student get knowledge about different type of pollutions, their effect and solutions.
- Student understand the basics about ill effect of fireworks.

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, clothing, washing.
- 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- sewage treatment plant and factory sewage outlet. These can be regulated through law.
- Non point source- pollutants enter the water over large areas--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: 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: Parasitic worms, viruses and bacteria from infected organisms as well as human and animal wastes. They are responsible for water borne diseases.

Water Pollutants (contd.)

- Organic compounds: Synthetic chemicals containing carbon from industrial effluents, surface runoff, and cleaning agents. These chemicals causes health problems for humans and harm fishes.
- Inorganic nutrients: Substances like nitrogen and phosphorus from animal waste, plant residues, and fertilizer runoff. These nutrients causes eutrophication.
- Inorganic chemicals: Acids, salts, and heavy metals like lead and mercury from industrial effluents, surface runoff, and household cleaning agents. They make water unfit for use and harms aquatic life.

Water Pollutants (contd.)

- 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-

Various diseases of CNS, damage to liver, brain and kidney.

Diseases caused by contaminated drinking water-

Leads to various waterborne diseases such as diarrhoea, typhoid, cholera, infectious hepatitis, jaundice, etc., in human beings

Bacteria—

1)Typhoid—Diarrhea, severe vomiting, enlarged spleen, inflamed intestine.

2) Cholera—Diarrhea, severe vomiting.

3) Bacterial dysentery— Diarrhea

Viruses

1) Infectious hepatitis— Fever, severe headache, loss of appetite, abdominal pain, jaundice, enlarged liver.

Parasitic protozoa

1) Amoebic dysentery— Severe diarrhea, headache, abdominal pain, fever.

Effects on animals

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

Effects on plants

- 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-- Eutrophication of water bodies
- Polluted water contains high concentration of heavy metals becomes toxic for plants.

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.

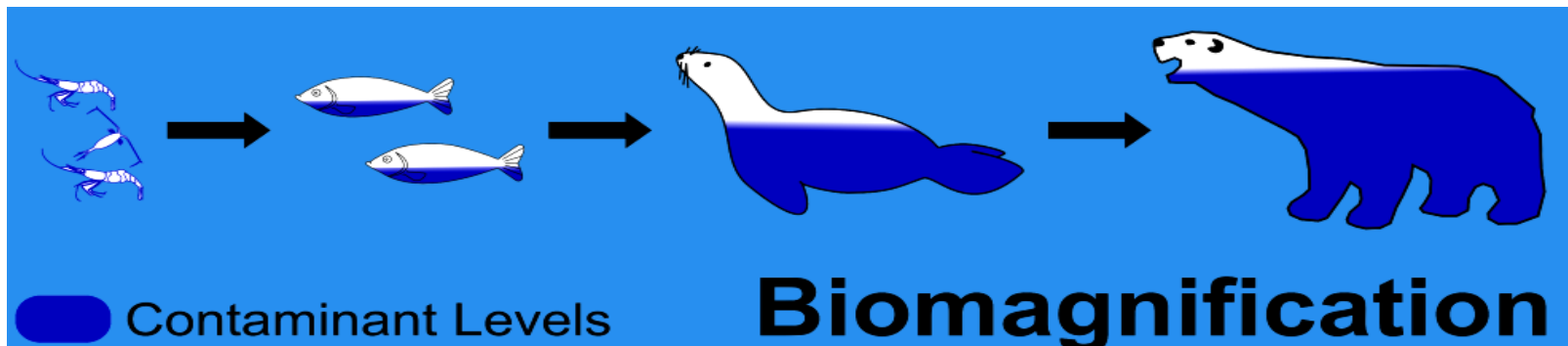


Reference Video Link- <https://www.youtube.com/watch?v=LYgKQ2noekk>

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.



Measuring Water Quality

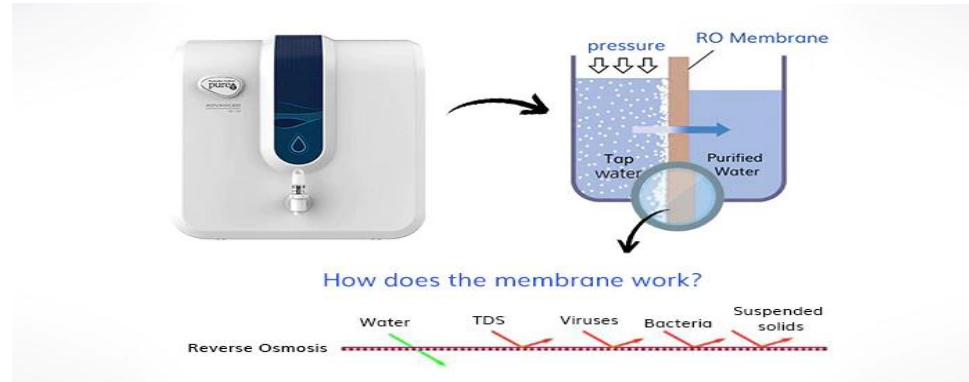
- **Biological Oxygen Demand (BOD):** This parameter measures the degree of water pollution from oxygen-demanding wastes and plant nutrients. BOD is amount of dissolved oxygen needed by decomposers to break down the organic material. Measured in ppm.
- **Total Dissolved Solids (TDS):** This is a measure of the combined content of all inorganic and organic substances contained in a liquid. TDS is measured for freshwater. Used as an overall indicator of presence of chemical contaminants.
- **Presence of disease-causing organisms:** The number of colonies of coliform (*E. Coli*) bacteria present in a 100 millilitre (ml) sample of water is one measure. There should be no coliform colonies in drinking water.
- **Chemical analysis:** The presence of chemicals like pesticides can be measured by analysis.

Table 12.1
BOD and Water Quality

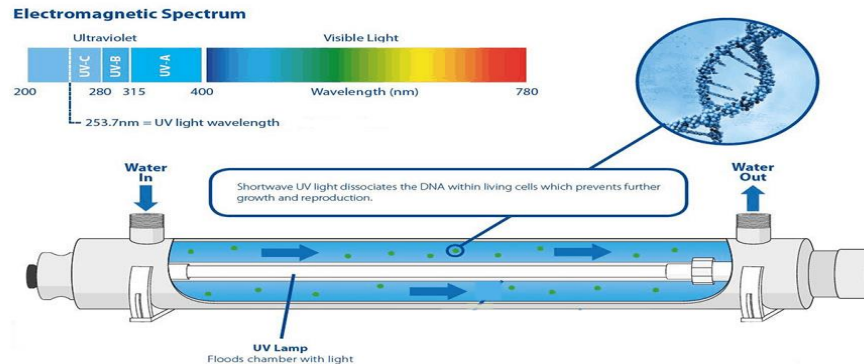
BOD Level (parts per million)	Water quality	Description
1-2	Very good	Not much organic waste present
3-5	Moderately clean	
6-9	Somewhat polluted	Bacteria decomposing organic matter present
100 or greater	Very polluted	

Methods of Removing Impurities from Water

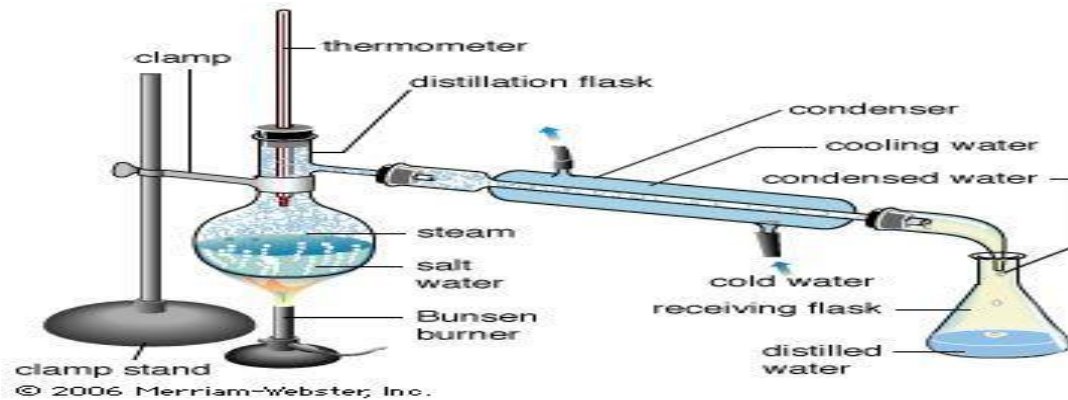
- **RO method-** Water is forced through a semi permeable membrane which filters unwanted substances. RO uses no chemicals.



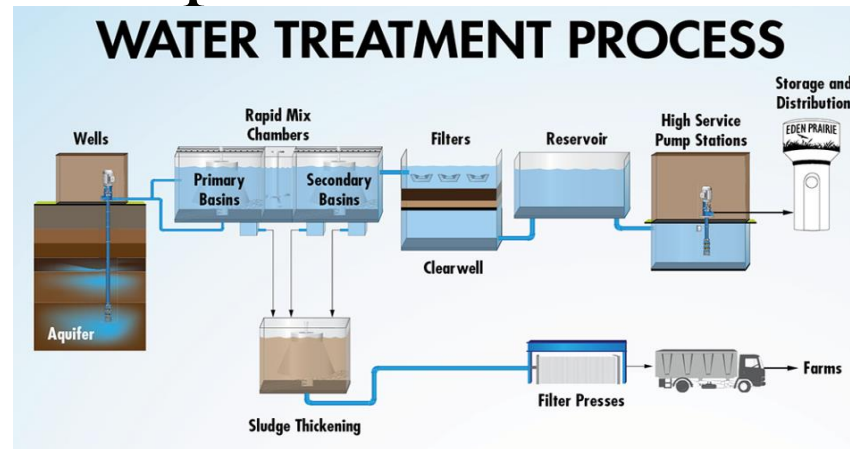
- **The UV method-** UV radiation is effective in killing bacteria, viruses, certain harmful organisms.



- **Distillation method-** Water is boiled to create steam, it condenses to water droplets, which is deposited in a container. The residual water is discarded.

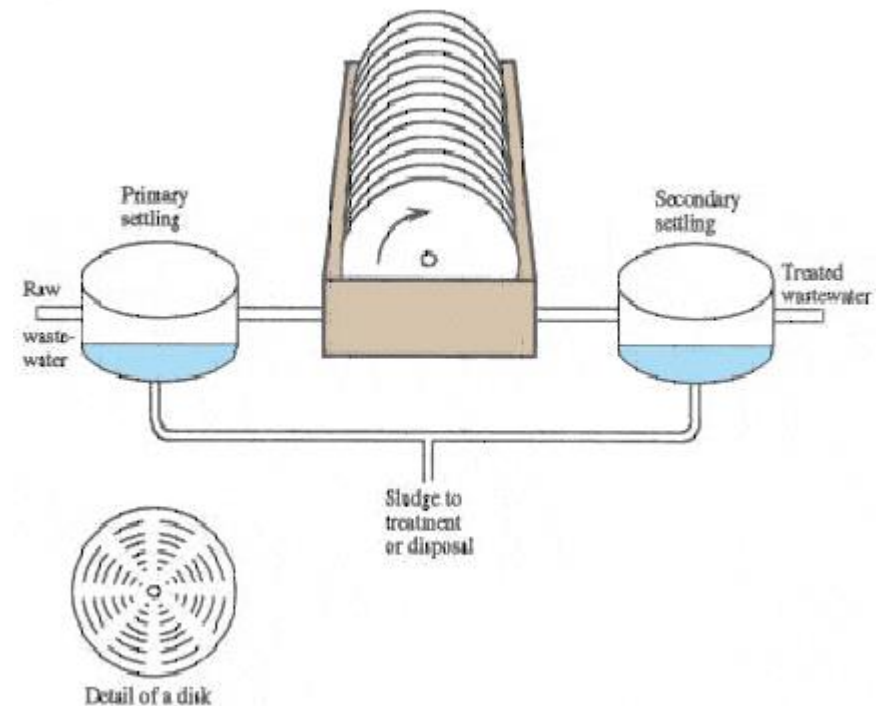


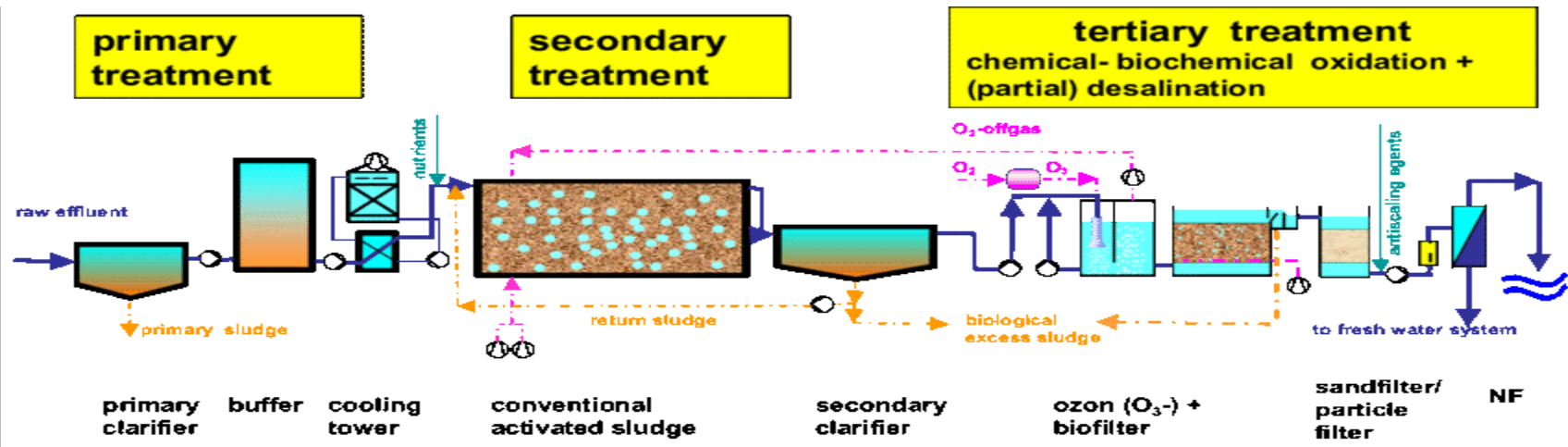
- **Water treatment process-** Used to treat sewage water.



Waste Water Treatment

- Primary treatment
 - Grit removal
 - Sedimentation
 - Flootation
- Secondary treatment
 - Trickling filters
 - Activated sludge process
 - Rotating biological contactor
- Tertiary treatment
 - Chlorination
 - Anaerobic treatment: Up-flow Anaerobic Sludge Blanket (UASB) Reactor
 - Hydrolysis, Acidogenesis, Acetogenesis, Methanogenesis





Diagrammatic representation of waste water treatment plant



Industrial Waste water treatment plant

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; immersion of idols should be stopped.
- Non- biodegradable waste material such as plastic should not be disposed in water bodies.
- Strict enforcement of rules
- Public awareness

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
- Cooling towers
- Cooling Ponds
- Spray Ponds
- Cooling Towers
 - Wet cooling tower
 - Dry cooling tower

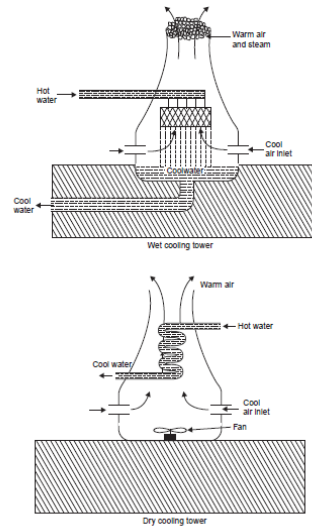
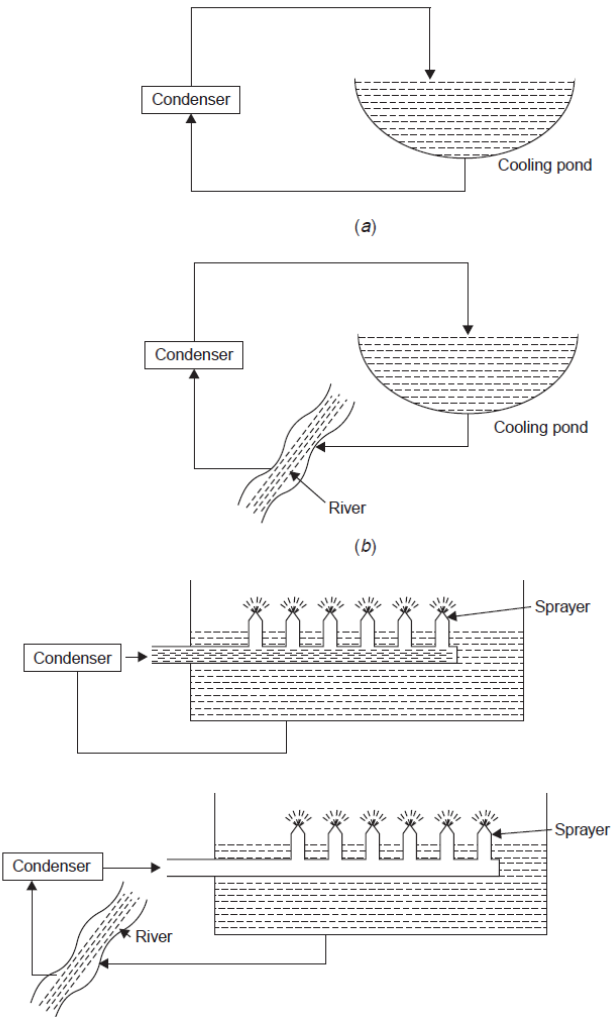


Fig. 5.4. Cooling towers: Wet and dry.



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

(i) Toxic pollutants from industries and sewage treatment plants should not be discharged in coastal waters.

(ii) Run off from non-point sources should be prevented to reach coastal areas.

(iii) Sewer overflows should be prevented by having separate sewer and rain water pipes.

(iv) Dumping of toxic, hazardous wastes and sewage sludge should be banned.

(v) Developmental activities on coastal areas should be minimized.

(vi) Oil and grease from service stations should be processed for reuse.

(vii) Oil ballast should not be dumped into sea.

(viii) Ecologically sensitive coastal areas should be protected by not allowing drilling.

Land pollution

Land pollution is the degradation of the Earth's land surface through misuse of the soil by poor agricultural practices, mineral exploitation, industrial waste dumping, and indiscriminate disposal of urban wastes .

Examples of Land pollution :

- Soil Pollution

- Solid waste dumping

Soil Pollution

Any change in the physical, chemical, and biological properties of soil due to natural or anthropogenic activities is known as *soil pollution*.

Major Soil Pollutants and their effects

- 1) Heavy Metal: Lead, Cadmium etc
- 2) Persistent organic pollutants (POPs): Dioxins
- 3) Pesticides, fertilizers and other agricultural products
- 4) Wastewater discharge

Causes of Soil Pollution

- Industrial waste – toxic, flammable and non-biodegradable substances that persist in soil and change composition of soil.
- Urbanization- Process in which large area of forest n agricultural land are utilized for residential, commercial and industrial purposes. This makes the land unfit for agriculture contributing to soil pollution.
- Mining – Process by which valuable minerals are extracted from earth. Mining leads to change in structure and composition of soil and causes soil pollution.

Causes of Soil Pollution

- Addition of radioactive material to soil. Agricultural waste- Excess use of fertilizers and pesticides degrades soil quality.
- Domestic waste and garbage- biodegradable waste such as kitchen and food waste, paper, cloth and non-biodegradable waste such as glass, plastic, metal cans etc . Hazardous domestic waste such as batteries, paints, medicines etc.
- Radioactive wastes- Nuclear power plants, nuclear testing and explosions

Effects of Soil Pollution

- Reduces the fertility of the soil
- Causes an increase in the number of mosquitoes and flies, which are vectors of several deadly diseases
- Reduces the aesthetic value of land
- Radioactive elements present in polluted soil enter human body and cause a number of adverse health effects such as cancer, deformities in bones, etc.

Reference Video Link <https://www.youtube.com/watch?v=Njx7KUZhPrQ>

Control of Soil Pollution

- Treatment of industrial waste before being disposed to reduce soil pollution.
- Garbage from urban waste should be segregated into biodegradable and non-biodegradable waste products. Biodegradable waste can be used for production of manures and biogas, non-biodegradable waste can be recycled and reused.
- Phytoremediation
- Bioremediation
- Planting of trees must be encouraged.
- Reduction in the amount of radioactive materials released in the soil
- Reduction in the use of chemical fertilizers and pesticides
- Solid waste can be used for electricity generation.

Phytoremediation

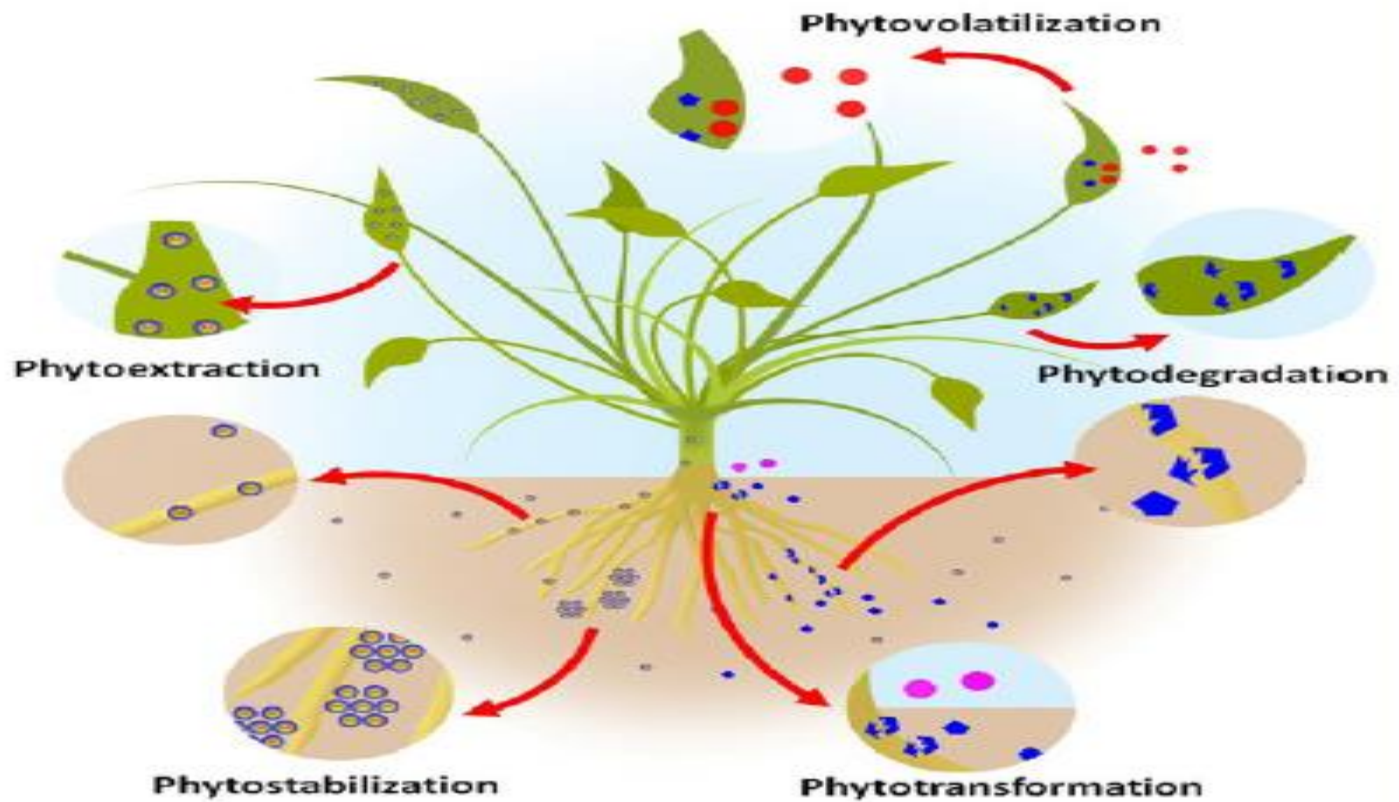
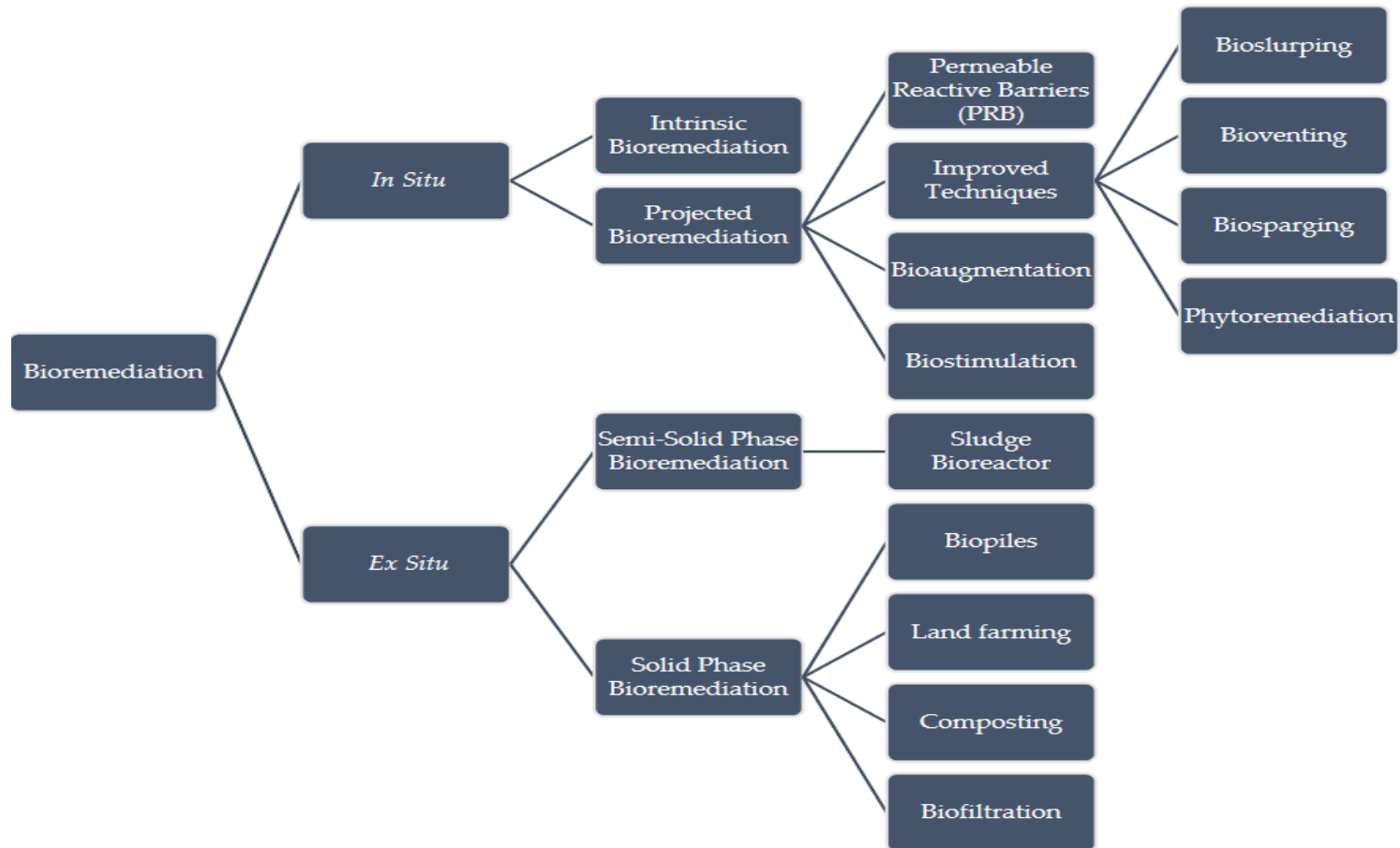


Figure 1: Schematic representation of phytoremediation approaches.

Bioremediation: Strategies



Noise Pollution

Refers to loud sound created by humans or machines that disrupts the environment and normal living standards of organism in it.

Or

The unwanted noise level into the atmosphere that leads to discomfort and health hazards is known as *noise pollution*.

Sources of Noise Pollution

- Natural phenomena such as violent volcanic eruptions, thunder, fierce storms, etc.
- Domestic appliances such as mixers, washing machines, etc.
- Industries such mills and factories
- Automobiles –music system n constant honking by drivers.
- Noise by Trains, ships, and aircrafts
- Bursting of crackers and playing loud music during social gatherings and festivals.
- Entertainment devices such as radio, television, etc.

Measurement of Sound

- Intensity and frequency are the two important properties of sound. The unit of measurement of intensity is decibel (dB)
- If we consider frequency, the human ear is known to be sensitive in the frequency range of 20 Hz to 20,000 Hz. However, human ear is more sensitive to sounds of middle frequencies, i.e. 100 Hz.
- Sound level meters used for measuring noise pollution are provided with certain weighting network, are mostly expressed in dB-A rather than dB.

FREQUENCIES PERCEIVED BY MAN AND SOME COMMON MAMMALS

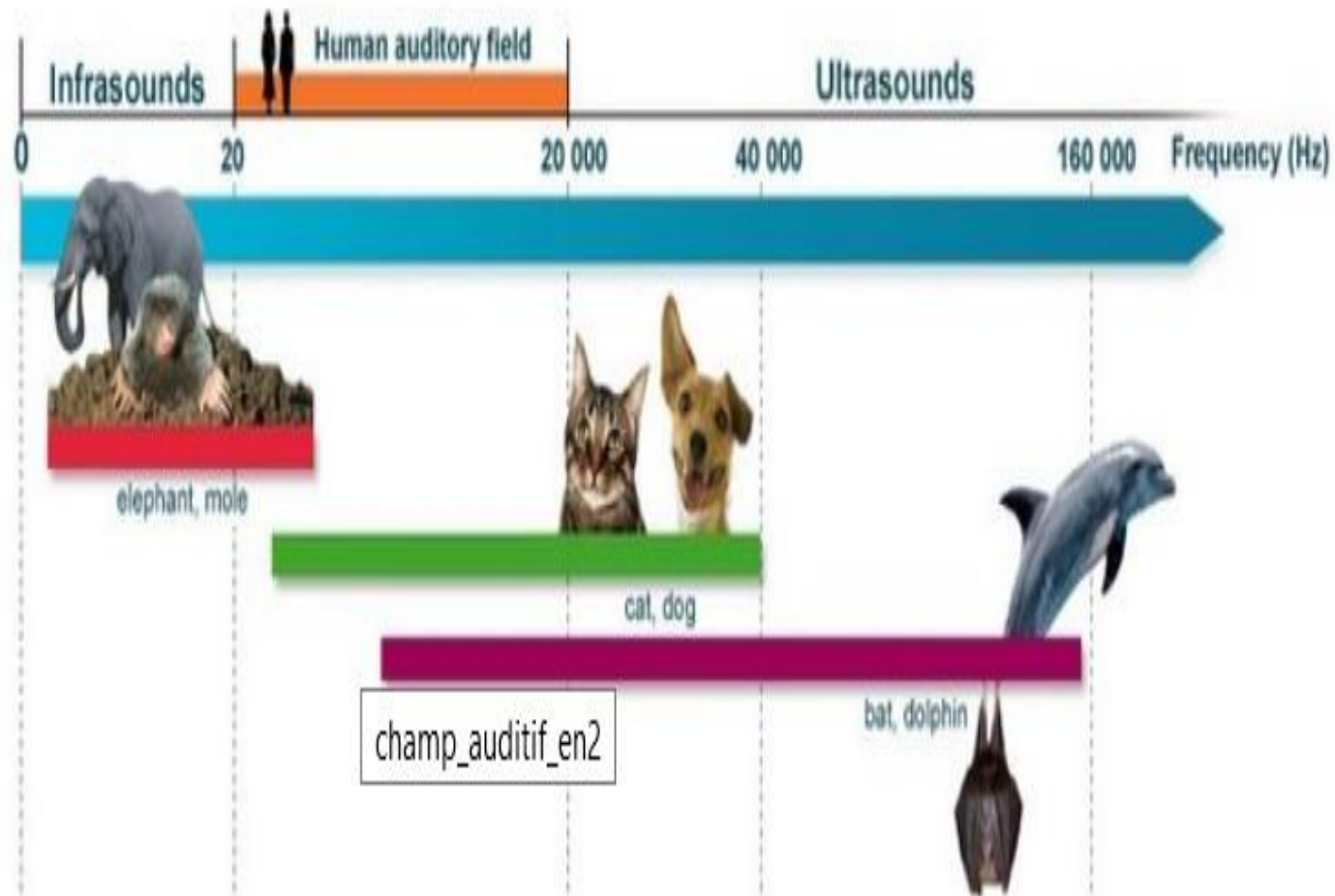


Table : Typical average decibel levels (dbA) of some common sounds
(Where necessary, the distance of the source in metres is specified.)

Source	dbA	Source	dbA
Threshold of hearing	0	Motorcycle (10 m)	88
Rustling leaves	20	Food blender (1 m)	90
Quiet whisper (1 m)	30	Subway (inside)	94
Quiet home	40	Diesel truck (10 m)	100
Quiet street	50	Power mower (1 m)	107
Normal conversation	60	Pneumatic riveter (1 m)	115
Inside a car	70	Chainsaw (1 m)	117
Loud singing (1 m)	75	Amplified Rock and Roll (2 m)	120
Automobile (8 m)	80	Jet plane (30 m)	130

Effects of Noise Pollution

Auditory effect- Exposure to high intensity sound lead to temporary deafness.

Non Auditory Effects-

Physiological disorders like anxiety, insomnia, high blood pressure, increased heart beat etc.

Psychological effect- Depression, Emotional disturbance.

- Loss of working efficiency- poor concentration and reduces ability to think.
- Decline in the number of migratory birds at noisy places

Reference video link-<https://www.youtube.com/watch?v=FmxECiGNjZs>

Q: Effect of noise pollution on blood pressure and heart beat comes under

- A. Auditory effects
- B. Non-auditory effects
- C. Metabolic disorders
- D. Permanent changes

Control of Noise Pollution

- Workers in factories should be provided with ear plugs and ear muffs.
- Vehicular noise can be reduced by keeping the engine clean/serviced.
- Industrial noise can be reduced by keeping the machines well serviced.
- Noisy machines should be placed in special glass or wooden cabins.
- Special silencing devices should be designed for aircraft engines.
- More number of trees should be planted since they are effective sound absorbers.
- Public awareness should be created.
- Stricter governmental regulations.

Acoustic Zoning

Increased distance between the source and receiver by zoning of noisy industrial areas, bus terminals and Railway stations away from the residential areas would go a long way in minimizing noise pollution

Legislative measures

Strict legislative measures need to be enforced to curb The menace of noise pollution. Some of them could be:

- i) Minimum use of loudspeakers and amplifiers, specially near silence zones.
- ii) Banning pressure horns in automobiles
- iii) Framing a separate Noise Pollution Act.

Guideline Values for Noise levels in different area/zones

Area code	Category of area/zone	Limits in dB(A) leq*	
		Day time	Night time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence zones	50	40

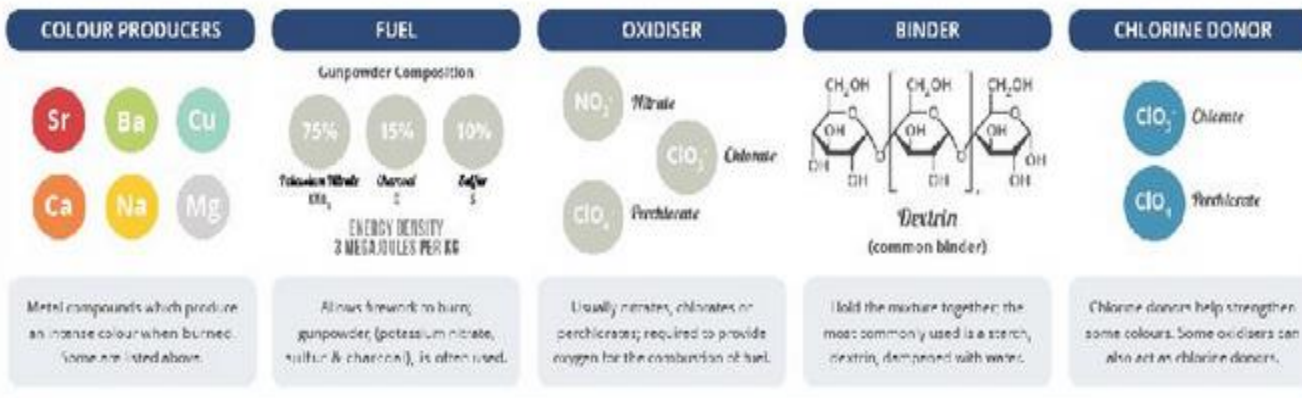
*dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing. Source: Central Pollution Control Board, India

ILL EFFECTS OF FIREWORKS

Not only on Diwali but there are several other occasions like marriages, election victory, Wining Cricket Match, that we burn crackers and express our joy. Little do we realise that there is an environmental price of playing fireworks. The red glare during a fireworks show creates patriotism and awe into the atmosphere but also fills the same atmosphere with particulates and aluminium.

Fireworks get their splendour from a variety of chemicals, many of which are toxic to humans. They often contain carcinogenic or hormone-disrupting substances. They can lead to considerable air pollution problems due to the release of lot of smoke from potassium and aluminium compounds, which are used to propel fireworks into the air. In order to achieve desirable visual and audio effects fireworks contain a number of harmful chemicals.

THE CHEMISTRY OF FIREWORK COLOURS



Effect on Human Health

According to the **CPCB report**, different chemical compounds which give firecrackers their colors includes:

- **Aluminium** compounds produce brilliant whites, **Barium nitrate** produces greens, and the addition of **Copper** results in blue light. Each of these come with their health effects.
- ✓ **Aluminium** causes contract dermatitis and bio-accumulation. It also causes bronchoconstriction in susceptible individuals.
- ✓ **Copper** compounds can cause cancer.
- ✓ **Antimony** sulphide produces toxic smoke and is a carcinogen. Barium nitrate can cause an irritated respiratory tract in addition to a possible radioactive fallout.
- ✓ **Barium** chromate was also found to be toxic to living cells and genes in the human lung cells.

The CPCB report also lists out other compounds released by firecrackers which cause health problems. **Lead dioxide/nitrates/chlorides** are poisonous. **Mercury** can cause bioaccumulation. **Potassium nitrate** is a carcinogenic which causes toxic dust. **Ozone** is a highly reactive gas and has been noted to result in small changes in airway resistance and repeated exposure to it is associated with increased asthma-related symptoms. **Strontium** compounds are toxic and can replace calcium in the body. **Nitric oxide** and **nitrogen dioxide** are highly toxic if inhaled.

The fireworks can harm the environment and human health in following ways:

Effect on Environment

Air Pollution - Fireworks lead to air pollution. In the combustion of fireworks, the main component gunpowder gives rise to the solid reaction products such as potassium carbonate, potassium sulphate and potassium sulphide, together with unreacted sulphur. Burning of fire crackers releases toxic gases and pollutants in the air like as sulphur dioxide, carbon dioxide, carbon monoxide etc.

Soil and Water Pollution- The fireworks reaction products that are emitted are deposited on the soil, crops and, in standing waters as well. It therefore leads to soil and water pollution.

Waste Generation- Fireworks release considerable amount of waste which poses serious problems. The quantity of garbage released after Diwali is very high. This garbage is hazardous as it includes sulphur, phosphorous, potassium chlorate, and burnt paper of the fire crackers.

Effect on Human Health

Accidents- Carelessly handling fireworks can lead to minor and major accidents particularly to children. Accidents can also occur if fireworks are handled incorrectly during sale and use. Every year, fireworks causing fires to shops and markets make headlines. The result is damage to property and man.

Respiratory Diseases -The SPM (suspended particulate matter) levels rise to a large extent during Diwali. It can cause throat, nose & eye related problems which can later transform into adverse health hazards. It has much more severe effects in people with heart, respiratory or nervous system disorders. It can aggravate problem for people suffering from cold, allergies or coughs and can also cause congestion of throat & chest. Fireworks can cause diseases like chronic bronchitis, common cold, allergic bronchitis, bronchial asthma, etc.

Physiological effects due to noise- Not only dust and smoke, bursting of firecrackers leads to noise pollution which is equally harmful and affect the elderly, the sick and children. Too much noise causes anxiety and corresponding stress reactions. Increase amount of noise has harmful effects on animals as well as humans.

Standard decibel level for humans is 60 dB. Increase in the sound level can lead to restlessness, temporary or permanent hearing loss, high blood pressure, anger, heart attack, sleep disturbance, etc. Noise may also lead to hyperactivity in pregnant women, children & those suffering from respiratory problems. Animals and birds are also very badly affected during Diwali by the loud sounds of crackers.

- **Chronic effects of fireworks displays:** The colourful displays by fireworks have harmful effects. For example, green light produced in fireworks displays comes from Barium that is radioactive and poisonous, blue colour produced from copper compounds comes from dioxins linked to cancer

Reference Video Link: <https://www.youtube.com/watch?v=tjSN0vuYBb4>

Control Measures to Minimise Pollution by Fireworks

In order to protect oneself from fireworks pollution and its ill effects, it is necessary to take some corrective measures and path breaking steps. We need to ask ourselves whether “Happy Diwali” is really making our Earth Happy.

Creating awareness about the perils of this careless usage of fireworks seems to be the only way to reduce the pollution. Environment departments must take initiatives to create awareness among masses by posters, pamphlets and slogans highlighting the dangers of fireworks.

Government should organize anti-firecracker campaigns and discourage people from bursting firecrackers. Parents as well as children should be educated about the harmful effects of firecrackers and environmental laws should be implemented strictly. By observing ‘Right to Sleep’ as a fundamental right, the bursting of crackers is banned between 10 pm to 6 am.

Along with above, some of the measures that can be taken are:

- Avoid bursting crackers in the building compounds, narrow lanes and congested areas.
- Persons with respiratory diseases should stay indoors to avoid inhaling smoke from outside.
- The crackers should not be lit inside the house. Open grounds must be used to light fireworks.

Radiation Pollution

- Radiation pollution is the emission of any form of ionizing (alpha and beta) or non-ionizing (gamma) radiation as a result of natural or human activities.
- Radioactive decay
 - Radioactive decay occurs in unstable atomic nuclei – that is, ones that don't have enough binding energy to hold the nucleus together due to an excess of either protons or neutrons.
- Half life
 - The term half-life is defined as the time it takes for one-half of the atoms of a radioactive material to disintegrate.
 - Half-lives for various radioisotopes can range from a few microseconds to billions of years.
 - Bismuth-209 : 1.9×10^{19} years, Uranium-235 : 2.34×10^7 years

Radiation Pollution

- **Causes**

- **Natural**

- Cosmic rays from outer space
 - Radioactive Radon-222
 - Soil, rock, water, air and food may contain radioactive materials

- **Anthropogenic**

- Nuclear power plants
 - Nuclear accidents
 - Medical X-rays, test laboratories

Radiation Pollution

- **Unit of radioactive exposure**
 - Rem (Roentgen equivalent man)
- **Effects of Radiation Pollution**
 - Somatic Effects (Change in body cells)
 - Genetic Effects (Change in DNA)

Effects of Radiation Pollution

Somatic Effects

Radiations can cause skin cancer, bone cancer, reduction of life span, premature ageing etc.

Genetic Effects- Change in DNA

Increase in the number of abnormal children and increased infant mortality.

Control of Radiation Pollution

- Dense trees should be planted around atomic power plants.
- Proper management of radioactive waste should be ensured.
- Unnecessary X-ray examination should be avoided. Lead shields should be used by workers.
- During nuclear installations, various efforts including the process of site selection, its design, construction, operation, and its short-term and long-term effects should be seriously considered to control radiation.

Case Studies on Pollution

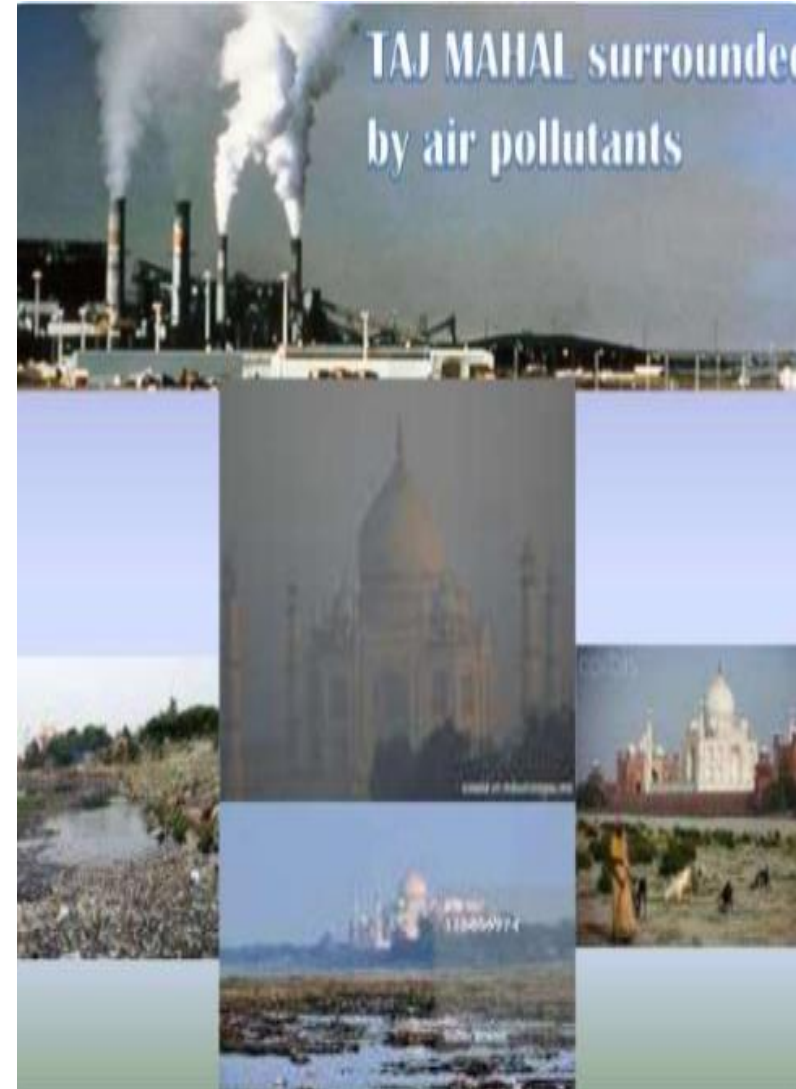
The “Taj Mahal” is the “King of Emperor” amongst world wonder. It is one of the most priceless national monuments and also a glorious reputation to the men’s achievements in architecture and “Engineering”.

The chemical industries and refinery at Mathura are source of damage “Taj Mahal”.

- ✓ SO_3 came from the industry react with moisture in atmosphere and form the “Acid Rain”.
- ✓ This will make corroding effect on clean white marble.

Control

The judgment vigorously applied the “precautionary principle” and in May 1999, the Central Government constituted the Taj Trapezium Pollution Authority.



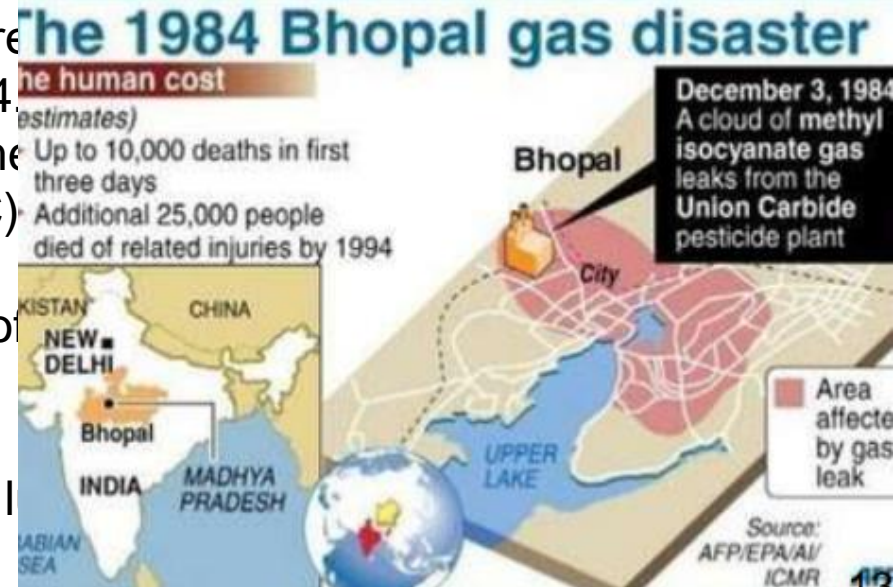
Bhopal Gas Tragedy

The world's worst industrial accident occurred in Bhopal city, M.P. on midnight of 3 Dec 1984.

- ✓ Union Carbide Limited manufacture some pesticides, using Methyl isocyanate(MIC) plant.
- ✓ The reactor exploded due to the failure of cooling system

Effects

- ✓ At lower concentration/level MIC affects lungs and cause irritation on skin.
- ✓ Higher concentration/level of MIC cause O_2 remove from lungs and cause death
- ✓ MIC spread over 40 sq.km area
- ✓ 5000 persons were killed, 65000 people suffer from eye & respiratory disorder and 1000 person became blind.



Case settlement

- UCC and UCIL agree to pay \$470m (£299m) to settle the initial fight for compensation in India's Supreme Court in 1989. As the survivors' legal representative, the government had asked for \$3.3bn (£2.1bn).
- Victims appeal, but the Supreme Court upholds the settlement in 1991 and further orders UCC and UCIL to fund a hospital for victims costing \$17m (£10.8m).
- By 2006 the Bhopal Welfare Commission, which distributed compensation, says all initial claims had been paid - counting 5,295 death and some 527,000 injury claims.
- In June 2010, the government reviews the compensation after an outcry over UCIL's former executives receiving two-year prison sentences and minor fines for their role in the disaster.
- In December 2010, India's attorney general files a petition in the Supreme Court to increase the settlement to \$1.1bn (£700m) - arguing it was based on incorrect figures and didn't include costs to clean environmental pollution. It puts the correct casualty figures at 5,295 dead, 4,902 cases of permanent disability, and 42 of severe injury.
- From 2012 government starts distributing an additional compensation to "severely affected" survivors, giving some 33,000 people 100,000 rupees (\$1,616; £1,028) each.
- Protesters say the government petition still underestimates the number of victims and the compensation did not go to many who needed it.

The government has promised to revise the numbers of deaths and injuries for which it is seeking compensation.

Mercury wastes

Mercury is a toxic metal.

- ✓ Thermometer manufacturing company releases a very small amount of mercury(0.1 mg/kg) it contaminates the soil Hindustan Lever Ltd(HLL), Kodaikanal dispose its mercury laden glass waste into near by area and create land pollution.
- ✓ By people intervention now HLL transfer large quantities of waste to USA.

Minamata Case

MinaMata is a small coastal village in japan. The “Chisso Chemical Company” which produce “vinyl polymer” The industry released the effluent into the MiniaMatta sea, the effluent contain “Mercury ion” it convert into “Methyl Mercury” High Toxic.

Effects

- ✓ The effluent observe by sea plants get transferred to human by the food chain.
- ✓ Loss of vision and hearing
- ✓ Loss of muscular co-ordination
- ✓ Cause severe headache
- ✓ Nervous disorder

Industrial pollution (Textile & dye industries)

- ✓ Around Tirupur nearly
- ✓ 500 dyeing units 95 bleaching units they consume large amount of water for processing and discharge waste water. this makes surface and under ground water not suitable for domestic purpose increase the water "PH" value.
- ✓ The rivers get polluted due to the mixing of the effluent from the industries.
- ✓ Tamil Nadu Pollution Control Board (TNPCB) Has directed all textile & dyeing industries to not allow the effluent to mix in the river system.



Chernobyl Nuclear disaster (Nuclear pollution)

In Apr 26, 1986 the melt down of Nuclear reactor, in Russia, has leaked out the radioactive rays & radioactive materials

Effects

- Nearly 2000 person were killed by the accident
- People suffer due to illness such as
- Degeneration of the cells
- Severe bleeding
- Anemia
- Skin cancer
- Animals & plants are also affect



Birth defects were the norm for years following the Chernobyl incident



Children in Belarus, Russia and Ukraine have been suffering from the effect of the radiation released in 1986. The Rechitsa orphanage in Belarus has been caring for the huge population of sick children.
Photo Credit: Julien Behar/Chernobyl Children's Project



The reactor disaster in Chernobyl took place on April 26, 1986. The reactor was encased as a temporary solution to secure the site for only 20-30 years.
Photo Credit: Julien Behar/Chernobyl Children's Project



Mentally handicapped children exposed to radiation
Photo Credit: Alex Emes/Blacksmith Institute