Air Pollution

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Introduction

- Air pollution is the introduction of chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or cause damage to the natural environment or built environment, into the atmosphere.
- A substance in the air that can cause harm to humans and the environment is known as an air pollutant.

Causes of Air Pollution

- Carbon dioxide-this happens because of deforestation and fossil fuel burning.
- Sulfur dioxide –Due to the burning of sulfur containing compounds of fossil fuels (Coal & petroleum).
- Sulfur oxides- very dangerous to humans at a high concentration. Sulfur in the atmosphere is responsible for acid rain.
- Nitrous Oxide (N2O)- Fossil fuel
- Secondary Pollutants- Photochemical smog(PAN), Acid rain, O3,

SOURCES OF AIR POLLUTION

- Natural Sources
- Volcanic eruptions
- Forest Fires
- Biopollutants- Foul odours emitted by decay and decomposition of organic material
- Strong winds or storms

- Manmade sources:
- Burning of Fossil fuels- CO, CO2, Particulate matters, hydrocarbons and metalic traces
- Automobiles- CO, oxides of nitrogen (NOx), sulphur compounds, NH3 , Organic acids
- Steel plants- CO, CO2, SO2, Fluorine and dust
- Thermal power plants- SO2, dust, in form fly ash.

Effect of Air Pollution

- Cause Global warming due to excess concentration of CO2 , NOx, CFC, SO2 .
- Causes Green House Effect.
- Causes Acid rain.
- Nitrogen oxides in air cause Problems in the lungs, respiratory systems and causes asthma and bronchitis.
- Suspended particulate matter in air causes lung irritation reduces development of RBC and pulmonary malfunctioning.
- CO causes severe headache, irritation to mucous membrane, unconsciousness and death.
- Photochemical smog cause asthma and bronchitis

Major Primary Pollutant

- Nitrogen Oxides (NOx)
- Ammonia (NH3)
- Carbon monoxide (CO)
- Sulphur Oxides (SOx)
- Heavy metals (As,Cd,Pb,Hg)
- Volatile Organic Compounds

Nitrogen Oxides(Nox)

- Nitrogen oxides, particularly nitrogen dioxide, are expelledfrom high temperature combustion, and are also producedduring thunderstorms by electric discharge.
- Nitrogen oxides (NOX) are emitted during fuel combustion, such as by industrial facilities and the road transport sector. Aswith SO2, NOX contributes to acid deposition. Nitrogen Oxides (NOx) with SO2, NOX contributes to acid deposition.
- NO2 that is associated with adverse affects on health, as highconcentrations cause inflammation of the airways (windpipe,layrnx).

Carbon monoxides (CO)

- Colourless and odourless,
- toxic gas comes from the incomplete combustion of fuel in vehicles.
- can be absorbed by haemoglobin in the blood, thus blood can no longer absorb O2 Carbonmonoxide (CO)
- extra amounts of CO result in tiredness, headaches, heart damage and small amounts can be lethal

Sulphur Dioxides (SO2)

- Fuels (coal and petroleum) contain sulphur as an impurity; when fuels are burnt, sulphur is oxidised or burnt to SO2
- Emitted from volcanoes eruptions
- Irritates the eyes and causes breathing difficulties causes asthmetic problems. Sulphur-dioxide (SO2)
- In the presence of a catalyst such as NO2, forms H2SO4, and results of acid rain

Ammonia (NH_3)

- Fuels (coal and petroleum) contain sulphur as an impurity; when fuels are burnt, sulphur is oxidised or burnt to SO_2
- Emitted from volcanoes eruptions
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- In the presence of a catalyst such as NO_2, forms H_2SO_4, and results of acid rain

Heavy Metals

- The heavy metals arsenic (As), cadmium (Cd), lead (Pb), mercury (Hg) and nickel (Ni) are emitted mainly as a result of various combustion processes and industrial activities.
- These chemicals are known as toxins and are linked to thyroid disorders, cancer, women's hormonal conditions, chronic fatigue syndrome, fibromyalgia and other several illnesses & symptoms includes.
- Fatigue Heavy Metals
- Lung Cancer
- Cardiopulmonary diseases

Volatile Organic Compunds

- VOC is emitted from a large number of sources including paint application, road transport, dry-cleaning and other solvent uses.
- Methane VOC
- Non methane VOC
- Benzene Methyl Chloride
- CFCs Volatile organic compound (VOC)
- Methylene chloride is highly dangerous to human health. It can be found in adhesive removers and aerosol spray paints and the chemical has been proven to cause cancer in animals. In the human body, methylene chloride is converted to carbon monoxide and a person will suffer the same symptoms as exposure to carbon monoxide.
- Benzene, is a chemical found in environmental tobacco smoke, stored fuels, and exhaust from cars. Benzene has also been known to contaminate food and water and if digested can lead to vomiting, dizziness, sleepiness, rapid heartbeat, and at high levels, even death may occur.
- Chlorofluorocarbons (CFCs) widely used cleaning products and refrigerants. Tetrachloroethene is used widely in dry cleaning harmful to ozone layer which prevents human by having skin cancer and various skin diseases,

Secandary Pollutants

- Major Secondary Air Pollutant
- Particulate matter (PM) Particulates created from gaseous primary pollutants and compounds in photochemical smog. PM is one of the most important pollutants as it penetrates into sensitive regions of the respiratory system
- Particulate matter includes both primary and secondary PM
- primary PM is the fraction of PM that is emitted directly into the atmosphere, secondary PM forms in the atmosphere following the oxidation and transformation of toxic gases (mainly SO2, NOX, NH3 and some volatile organic compounds (VOCs).

Ground level Ozone

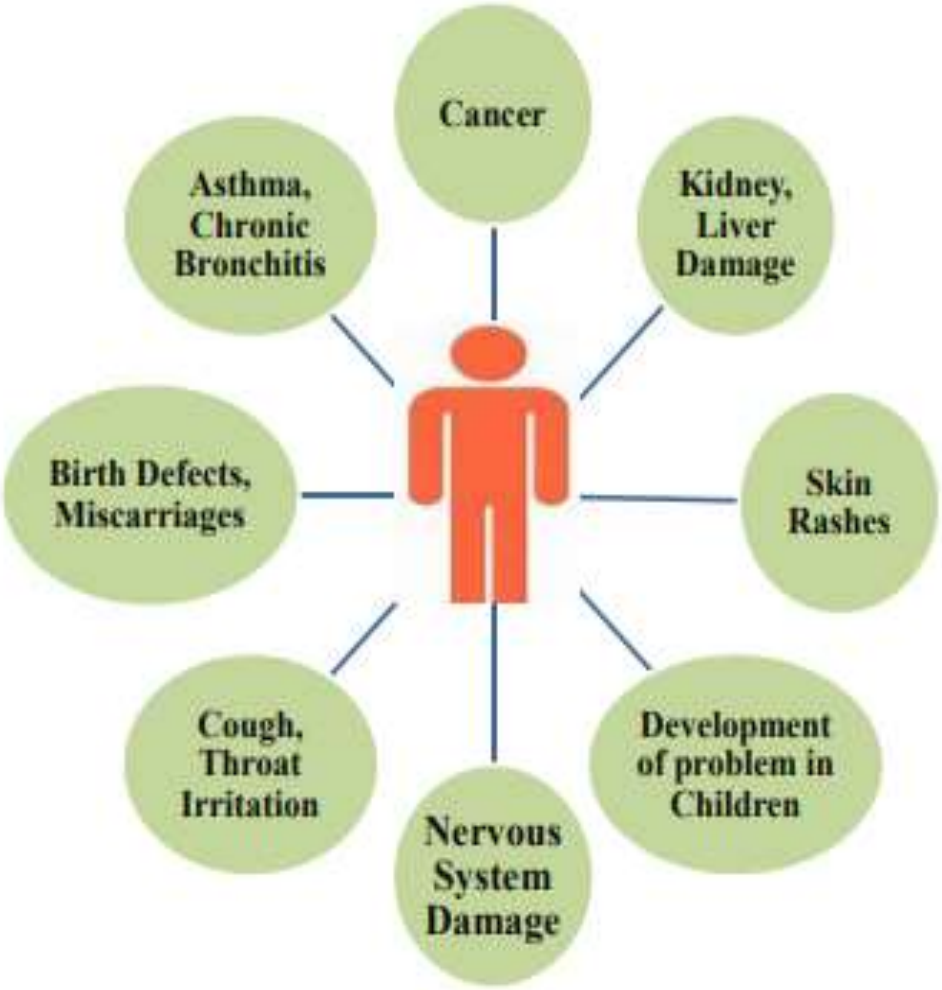
- Ground level ozone (O3) formed from NOx and VOCs.
- Ozone (O3) is a secondary pollutant and a key constituent formed in thetroposphere.
- Photochemical and chemical reactions involving it drive many of thechemical processes that occur in the atmosphere by day and by night.
- At abnormally high concentrations brought about by humanactivitiesGround level Ozone (O3)
- At abnormally high concentrations brought about by humanactivities(largely the combustion of fossil fuel), it is a pollutant, and a constituent ofsmog.
- Ozone is a powerful and aggressive oxidising agent, elevated levels ofwhich cause respiratory and cardiovascular health problems and lead topremature mortality.
- High levels of O3 can also damage plants, leading to reduced agriculturalcrop yields and decreased forest growth.

Effect of Air Pollution on Human Health

Factor affecting Human Health

- Nature of the pollutants
- Concentration of the pollutants
- Duration of exposure
- State of health of the receptor
- Age group of the receptor

Target Organ by Air Pollution



Control of gaseous pollutants from stationary sources

- pollutants is the addition of add-on control devices to recover or destroy a pollutant.
- There are four commonly used control technologies for gaseous pollutants: – Absorption, – Adsorption, – Condensation, and – Incineration (combustion)

Equipments using principles of absorption for removal of gaseous pollutants

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- Packed tower
- Plate tower
- Bubble cap plate tower
- Spray tower
- Liquid jet scrubber absorbers

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Absorption

- Effluent gas passed through absorbers (scrubbers), which contain liquid absorbent.
- Efficiency depends on
- 1. Amount of surface contact between gas and liquid
- 2. Contact time
- 3. Conc. of absorbing medium
- 4. Speed of reaction between the absorbent and gases
- Absorbents used to remove SO2 , H2S, SO3 , F and oxides of nitrogen.

Adsorption

- Surface phenomenon, require large solid surface
- Adsorption towers use adsorbents to remove the impurities from the gas stream.
- The impurities bind either physically or chemically to the adsorbing material. Adsorption
- The impurities can be recovered by regenerating the adsorbent.
- Adsorption towers can remove low concentrations of impurities from the flue gas stream.

Condensation

- Vapor to liquid. Any gas can be reduced to a liquid by lowering its temperature and/or increasing its pressure.
- Condensers are typically used as pretreatment devices. They can be used ahead of absorbers, absorbers, and incinerators incinerators to reduce the total gas volume to be treated treated by more expensive control equipment. Condensers used for pollution control are contact condensers and surface condensers.

Incineration

- Incineration, also known as combustion, is most used to control the emissions of organic compounds from process industries.
- This control technique refers to the rapid oxidation of a substance through the combination of oxygen with a combustible material in the presence of heat.
- When combustion is complete, the gaseous stream is converted to carbon dioxide and water vapor. Incineration
- When combustion is complete, the gaseous stream is converted to carbon dioxide and water vapor.
- Equipment used to control waste gases by combustion can be divided in three categories: Direct combustion or flaring, Thermal incineration and Catalytic incineration.

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