

UNIT-I

ENVIRONMENTAL CHEMISTRY - INTRODUCTION

Environment the word is derived from the French word “**Environner**”, which mean encircle (or) **surrounding**.

Definition- Environment : “ Everything that surrounds or affects an organism during its life time is collectively known as environment”.

SCOPE & IMPORTANCE OF ENVIRONMENT NOW-A -DAYS :

- It deals with areas like
- Conservation of natural resources
- Ecological aspects
- Pollution of the surrounding natural resources
- Controlling the pollution
- Social issues connected to it
- Impacts on human population on the environment
- Managing waste materials & toxic substances
- Promoting safe chemicals & fertilizers
- It gives essential knowledge on the abundance of biodiversity..

IMPORTANCE OF ENVIRONMENT:

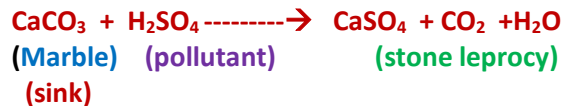
- Environment is really important for every human and species on this world.
- The environment is made up of all living things, including humans ,animals,natural flora, trees and plants, as well as weather and climate.
- The environment not only serves to keep the climate in balance, but it also provides everything required for human life.
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- Air pollution, water pollution ,soil pollution, destruction of habitat , productivity and contamination of sea, effects of the use of herbicides, insecticides and chemical fertilizers. Hence, there is a need for manpower at every level to deal with environmental problems.

NOMENCLATURE OF THE ENVIRONMENTAL CHEMISTRY:

- **A) POLLUTION:** Harmful to living organisms due to exposure to harmful substances that directly or indirectly alter the physical, chemical and biological properties of the atmosphere, air, water, land, humans, animals and plants. Such a phenomenon is known as pollution.
- **B) POLLUTANT:** Any form of a substance which causes pollution is called a pollutant. A substance which is already present in nature and its concentration increases in the environment due to natural or human activity and adversely affects the life's on earth and ecosystem is called pollutant.
Ex: i) *Deposited materials such as smoke, dust*
ii) *Metals including , Cd , Cr, Pb, Fe, Ni, Sn & Hg.*
- **C) CONTAMINANT:** a substance which is not present in nature enters newly into environment and adversely effects its environment.
Ex: chemical contaminants, MIC (Methyl iso cyanide), DDT, BHC, pesticides.
- **D) RECEPTOR :** The medium which is affected by the pollution is called receptor.
Ex: Humans, trees and animals are receptors.
- **E) SINK:** The medium which is not only affected by the pollutant but also remains there is called sink.

Ex: i) *Sea water/ trees are big sinks of CO₂..*

ii) *Tajmahal is mostly affected by acid rain. Here calcium carbonate is sink for acid rain, (H₂SO₄)*



- **F) THRESHOLD LIMIT VALUE(TLV)** : The amount of harmful contaminant that can be present in the air without causing harm to a healthy individual working there for 8 hours a day .Every pollutant has a different TLV value.
Ex: TLV of Be is 0.002 mg/ m³ & Zn is 1.0 mg/m³

SEGMENTS OF ENVIRONMENT : The environment consists of four segments.

1. Atmosphere

2. Hydrosphere

3. Lithosphere

4. Biosphere

1. ATMOSPHERE: Definition : The gaseous envelope surrounding the earth is composed of an entire mass of air containing N₂, O₂, H₂O, CO₂ and inert gases is known as atmosphere.

- It absorbs the most of the harmful radiations and maintains the heat balance of the earth.
- Different cycles those are present in the atmosphere in the form of water, oxygen, carbon, nitrogen cycle etc., related to the environment of matter been an organism and its environment.
- It acts as a source for CO₂ for plant synthesis and O₂ for respiration.
- The atmosphere transport water from ocean to land.
- **Atmosphere can be divided mainly into 5 layers: they are Troposphere, Stratosphere, Mesosphere, Thermosphere and Exosphere.**

2. HYDROSPHERE : It includes all the surface water resources such as ocean, sea, rivers, streams, lakes, reservoirs, glaciers, polar ice caps, ground water and minerals lying deep below the earth's crust.

- Earth is called blue planet because 80% of its surface is covered by water .
- **97% of the earth's water resources is locked up in the oceans and seas, 2% trapped is gaint glaciers and polar ice caps .**
- Only 1% of the total water supply is available as fresh water in the form of rivers, lakes, streams and ground water for human consumption and other uses.

3. LITHOSPHERE : The solid component of earth is known as lithosphere, it includes soil, earth, rock & mountains etc.,

- Soil plays an important role as it provides food for man and animals
- **Soil is usually defined as "any part of earth's crust in which plants root".**
- The lithosphere mainly consists three layers. Crust, Mantle, Inner & Outer core.
- **a) CRUST:** The crust is the thin layer of the earth on which we live . It varies in thickness about 8-40 km above mantle.
- **b) MANTLE:** The next layer of the earth is called mantle. It is thickest layer, almost 2900-3000 km deep. It is made up of silicates rocks with high Mg & Fe content.
- **C) INNER & OUTER CORE:** The earth's inner core is made up of Fe & Ni core. The inner core is the hottest part of the earth. At over 7200^oC , it is about as hot as the surface of the sun.

4. BIOSPHERE:

- Biosphere refers to the regions of of the Earth possessing life.
- It is one of the distinguishing features of the Earth from the other planets.
- *This segment of environment consists of atmosphere (air-O₂, N₂, CO₂), Lithosphere (Land-minerals, salts, food ,nutrients) & Hydrosphere (water- dissolved oxygen, salts) which influences and support the biotic and abiotic life systems.*

NATURAL RESOURCES: On the basis of their abundance and availability ,they as....

1.Renewable resources

2.Non-renewable resources

Renewable resources – Resources that have the inherent capacity to reappear or replenish themselves by quick recycling, reproductive and replacement within a reasonable time and maintain themselves are called renewable resources,

• **Ex: Bio-mass energy , solar energy, hydro energy, wind energy .**

• **1) SOLAR ENERGY :**

• Sun is a significant energy source. Solar energy is the we obtained from the sun.

• This is the only source that makes it possible for natural phenomena like photo - synthesis, wind and water cycles to occur.

• Solar energy is utilized to heat water , illuminate streets, pump water for irrigation of farms and prepare food using solar cookers.

• **ADVANTAGES OF SOLAR ENERGY :**

• ***It is in exhaustible source of energy.***

• ***In warm countries like ours,solar energy is available in abundance.***

• ***It does not cause any pollution. It is the best renewable energy resource.***

• **2.BIO-MASS ENERGY:**

• Bio-mass energy is produced from organic materials which come from living organisms such as plants and animals.

• Fuel that is derived from the decomposition of organic material is also referred to as biomass fuel.

• The most common bio mass materials used for energy are plants, wood and waste. Firewood is the best known and most widely used biomass fuel in the world. Burning wood to create electricity releases CO₂ into the atmosphere, but trees can re-grow and absorb the CO₂ released.

• In India and some other countries cattle dung is is burnt for cooking .

• In global scale, over 1 billion people in the world even today use wood as the primary source of energy.

• All the biodegradable materials dumped on the ground can easily be reduced by converting it into biomass.

• **ADVANTAGES OF BIO-MASS :**

• ***It is always and widely available renewable resource.***

• ***It is less expensive than fossil fuels.***

• **3. WIND ENERGY:**

• Nature is constantly producing winds.

• The windmill generates electrical energy. These windmills are typically only built in areas where strong winds prevail for the majority of the year.

• This wind energy is used to grind grain, pump water and generate electricity.

• Many windmills have been built in India, including Tamil Nadu, Maharastra, Rajasthan, Kerala, West Bengal & Gujarat.

• **4. HYDRO ENERGY:**

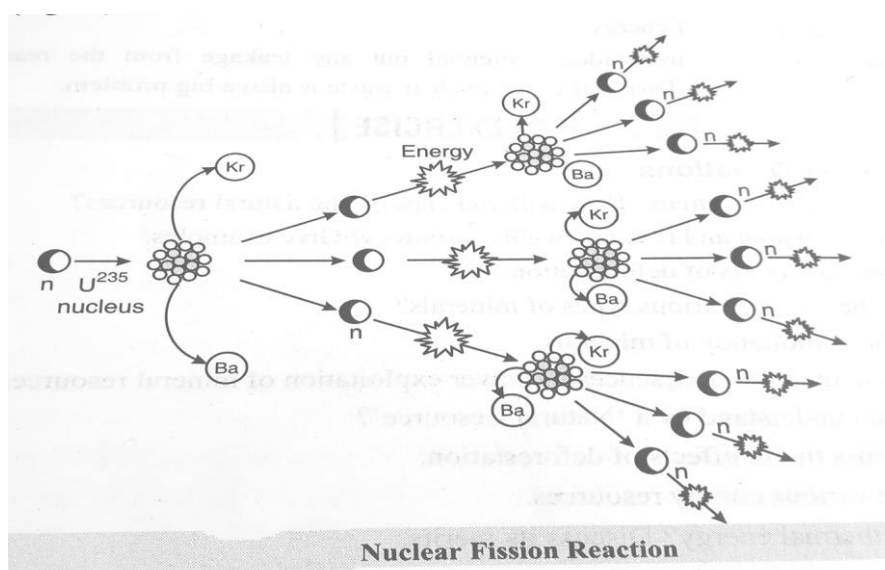
• Water is important natural resource. All living things require water to survive.

• Water is essential to humans for numerous activities, including drinking, cooking, cleaning and growing crops.

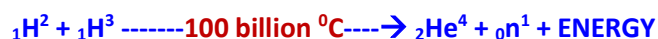
• Hydro power comes from the movement of water into rivers or the storage of that water in dams.

• Converting hydro power into electrical power is the simplest way to utilize it.

- **Non-renewable resources:** Resources that lack the ability for recycling and replacement are called Non-renewable resources.
- **Ex:** *Fossil fuels, coal, petroleum, minerals, natural gas, atomic energy .*
- **1. FOSSIL FUEL ;**
- Fossil fuels like coal and petroleum are non- renewable resources.
- They are found deep inside the earth and are made by natural processes over many centuries.
- Their quantity is limited and they take thousands of years to get renewed.
- **Examples of fossil fuel are coal, petroleum and natural gas etc.,**
- **a) COAL :** It is also called as black diamond. Coal is used as a fuel, to generate electricity in industries and steam engines.
- **b) PETROLEUM:** It is also known as mineral oil or crude oil. This liquid mineral is refined to make fuels such as petrol , diesel, cooking gas and kerosene. Plastics, cosmetics & lubricants are also products of petroleum. It is found inside the Earth or under the sea floor. It is taken out by drilling wells deep into the Earth or under the sea bed.
- **c) NATURAL GAS :** Natural gas is used as a fuel called **Compressed Natural Gas (CNG)** .Some wells dug into the earth produce only natural gas. Natural gases are a good alternative to petrol and diesel and it is used as CNG. It burns easily and produces a lot of heat. It is a good source of hydrogen.
- **2. ATOMIC ENERGY :**
- Atomic or Nuclear energy is the most powerful kind of energy known so far. A small quantity of radioactive material can produce a large amount of energy .
- For example one tone of Uranium would provide as much energy as 3 million tonnes of coal or 12 million barrels of oil.
- Nuclear energy is known for its high destructive power as evidenced from nuclear weapons. Nuclear energy can be generated by two types of reactions:
- **1) NUCLEAR FISSION;**
- In this process **U-235** hit by neutrons ,to split into two smaller nuclei (**Ba & Kr**) and 2 or 3 neutrons. These extra neutrons will hit other surrounding U-235 atoms and generate large amount of enegy by chain reaction.



ii) NUCLEAR FUSION : In nuclear fusion two isotopes of a light elements are forced together at extremely high temperature to form a heavier nucleus releasing enormous energy in the process. It is difficult to initiate the process, but it release more energy than nuclear fission.



Nuclear energy has tremendous potential but any leakage from the reactor may cause deviating nuclear pollution. Disposal of the nuclear waste is also a big problem .

REACTIONS OF ATMOSPHERIC OXYGEN : Oxygen in the troposphere plays an important role in the process taking place on the Earth surface .

1. Oxygen takes part in energy producing reaction like burning of fossil oils.



2. Atmospheric oxygen is also used by aerobic organisms in the degradation of organic material .



Formaldehyde

The formed CO_2 & H_2O in the above reaction are utilized by green plants in the process of Photosynthesis and the liberated oxygen is again returned to the atmosphere.



3. In upper atmosphere , O (Oxygen atom) , O_2 (excited oxygen molecule) & O_3 (ozone) are also present with O_2 (molecular oxygen).



(excited oxygen atom)

4. When U.V . radiation reacts with oxygen atom, oxygen ions (O^+) are formed.



O_2^+ is also formed in the ionosphere by the absorption of u.v. radiation.



5. O₃ is formed by the photochemical reactions is very important in the atmosphere, because it absorbs harmful U.V radiation and thus protect living beings on the Earth from the lethal effects of these radiations.



The absorption may bring the following decomposition



HYDROLOGICAL CYCLE / WATER CYCLE : Water plays a significant role in sustaining life and nature on planet Earth.

Evaporation

condensation

precipitation

Water -----> water vapour -----> condensed water vapour is cloud -----> rain- fall on soil.

The four main stages of the water cycle is -----

a) Evaporation **b) Condensation** **c) Precipitation** **d) Collection (stream flow , infiltration)**

a) EVAPORATION : When the sun shines, the water from the ocean or lake evaporates due to heat from the sun. When water evaporates , it turns into water vapour and goes up into the atmosphere.

b) CONDENSATION : This water vapour gets together with other water vapour and turns into a cloud.

c) PRECIPITATION : When clouds get dense, they drop the water back to Earth in some form of precipitation like rain, snow, hails.

d) COLLECTION : When the water falls back down to the Earth, they find their way on the ground surface into puddles, streams and rivers. Most will infiltrate the ground and will collect as ground water.

Again this water will evaporate and the whole cycle will start again .This cycle keeps the atmosphere of Earth's cool.

