SB 03/10/23

Ref book:

1. Manahan, Stanley Environmental Chemistry

2. A.K.E De

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Environmental Chemistry:

Science of chemical phenomena in the Environment.

Environmental Science

Interdisciplinary science

Anthropology Archaeology

Traditionally four environmental spheres: water, air, living organism, earth

Fifth: anthrosphere (subset of living organism that specifically target human acts)

Atmosphere

200 sq miles area, 600 miles altitude

1.3 kg/m^3 → decrease w/ altitude

14.7 $lb/inch^2$ → " " "

Role of atmosphere

- supplies O_2, CO_2, N_2
- prevents harmful env. from outer space
- maintain heat balance
- carries water from sea to land

Hydrosphere

- >75% of earth's surface
- 97% water in oceans
- 2% in polar ice caps
- 1% fresh
- consumption
- world water reserves

Role of hydrosphere

- survival
- 60% body mass
- 65% of human blood
- can't run industry
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Geosphere

Earth's interior, rocks, mineral

inner core, outer core, mantle, crust

Role of Geosphere

living space

ground water

full of resources

grow plants, foods

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Biosphere

Parts of Earth where live exists (both biotic & abiotic)

Anthrosphere

Parts of the environment made or impacted by human activities.

Components of Anthrosphere

Atmosphere & human activities

Pollutant: substance that is present in higher conc. than its natural state and is causing detrimental effect.

The medium affected → receptor (soil, fish etc)

chemical medium that interacts or retains → sink

Technology & Anthrosphere

Role of environmental engineering

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★★ Impact of Technology on the Environment

Interactions between the segments of the environment

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★★ All spheres

~~Water~~ Aquatic chemistry

Atmospheric Chemistry

Geochemistry

Chemical reactions in lithosphere and their interaction with the atmosphere & hydrosphere.

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Toxilogical Chemistry

Green Chemistry

Green Chemistry VS Environment Chemistry

☆☆☆ Twelve principles of Green Chemistry

1. Prevent waste

discharge - per unit time amount of water is released

☆☆ 2. Maximize atom economy

theoretical 50g 50g → 40g

$A + B \longrightarrow C + D$

actual → 50g 50g 30g

% yeild : $\frac{30}{40} \times 100\%$

atom eco = $\frac{40}{50+50} \times 100\%$

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Twelve principles of Green Chemistry

3. Design less hazardous chemical syntheses:

4. Design safer chemicals and products
   - Less toxic to ecosystem
   - bio-degradable
   - Inherently safer to use

5. Use safer solvents & reaction conditions

6. Use of catalysts

7. Use of renewable feedstock

8. Avoid chemical derivatives

9. Increase energy efficiency

10. Design chemical & products to degrade after use.

11. Analyze in real time to prevent pollution

12. Minimize the potential for accidents.

Example of Green Chemistry Synthesis:

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Example of Green Chemistry

Lead pollution

white lead → titanium white

Chemical fire-fighting foams → Pyrocool F.F.F

Perchloroethelene (chemicals for dry cleaning) → liquid CO_2

Lec 3

Integrated waste management

waste management

collecting, transporting, processing, disposing of waste

Classification of waste

Household waste, Industrial waste, Biomedical waste/health care/hospital waste, Agricultural waste

Effects of waste if not managed properly

Challenge of managing waste

- weak regulation
- Poor/unscientific waste handling
- lack of resource
- Socio-cultural problem

IWM → waste collection, treatment, recovery & disposal method → environmental sustainability, economic affordability & social acceptance

based on three 'R's

Reduce, recycle, reusing

Solid waste management hierarchy

priority > Source reduction > reuse > recycling > resource recovery > incineration > landfilling

waste disposal

Concept of 3R's

Reduce → done by source reduction

Reuse → not need to be collected/reprocessed

Next class from recycling

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Concept 3'R's

Recycle

Examples related to 3'R's

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Evolution of Earth's atmosphere

Atmospheric composition

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Atmospheric compoition

Trace gas

~~Atm~~ Mesophere

Atmospheric pressure

exponentially drop

Importance of atmosphere

S B

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Atmospheric state variable

Pressure, temparature, density

Equation of state: Ideal gas law

Concepts of Elementary Cycles

Carbon cycle

Nitrogen cycle

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Nitrogen cycle

Air Pollution

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Sources of PM

Rough / CT-2

Impact of technology on env.

Intelligent tech applications to be used for env. probs.

Redesign of basic manufacturing processes to reduce raw material consumption, optimal energy use, lower waste prod.

Computerized control technique for optimal use of resources lowering pollutants

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industries

agricultural

oil spillage

mining

extraction of mineral resources

transportation

Green Chemistry

Sustainable, safe, nonpolluting practice of chemical science that uses ~~minum~~ minimum amount of resources and energy while producing little to no wastes.

Examples

Ibuprofen:

traditional → 6 stoichometric steps

<40% atom eco.

wastes; Al

Green Chen → 3 catalytic steps

reusable cata... employe

80% atom ~~utili~~ —

No Al waste

white paint → Titanium white

Fire fighting foam → Re-novaal FFF

Tetraethyl lead w/ safe alt. lead-free gasoline

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Rough / CT-3

Atmospheric state variables

P, T, ρ

relates by $pv = nRT$

Altitude increase → less pressure → expansion (→ doing work) → cooling

decrease → more " → compression (→ work being done on) → heating

Cycle of matter

Biogeochemical cycle

Endogenic

Exogenic

Carbon cycle

Reservoir

Atmosphere

Fossil fuels

Durable organic materials

Nitrogen cycle

Nitrification : $NH_4^+ \xrightarrow{\text{Nitrosomonas}} NO_2^- \xrightarrow{\text{Nitro Bacterium}} NO_3^-$

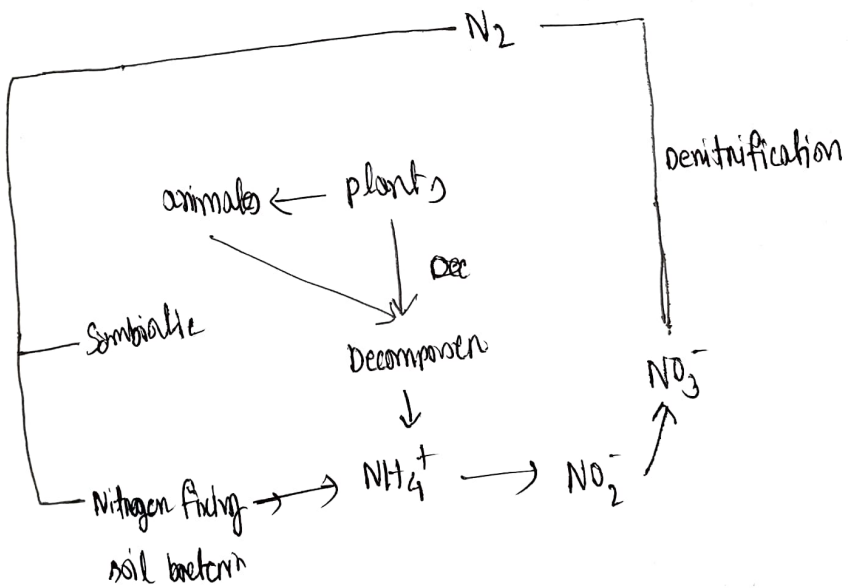
Ammonification : $NO_3^- \longrightarrow NH_4^+$

Denitrification : $NO_3^- \longrightarrow N_2$

} release

Nitrogen fixation : $N_2 + 3H_2 \longrightarrow 2NH_3$

} assimilation



$$mg/m^3 \rightarrow [ppm] \times \frac{mw}{22.4} \times \frac{273P}{T}$$

$$ppm \rightarrow [mg/m^3] \times \frac{22.4}{mw} \times \frac{T}{273P}$$