ENERGY RESOURCES

renewable : an energy resource that can be replenished in a short period of time.
non renewable : an energy source that cannot be replenished in a short period of time.

→ Renewable and non renewable resources can be used to produce secondary energy sources including electricity and hydrogen.

conventional : coal, petroleum, natural gas and electricity
non conventional : solar, wind, tidal, geothermal, atomic, biogas

non commercial : biofuels eg. firewood, cow dung, charcoal and agriculture waste.
commercial : coal, petroleum, natural gas, hydro electricity and nuclear energy.

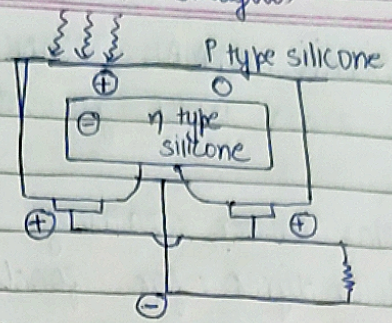
RENEWABLE SOURCES

Solar Energy

→ clean and pollution free energy
- reqrs to be converted into other forms forms of
- India recieve about 5000 trillion kWh (18) during a year
- 2 ways of using solar energy -
  1. Solar cells
  2. Solar thermal technology.

(1) Solar Cells

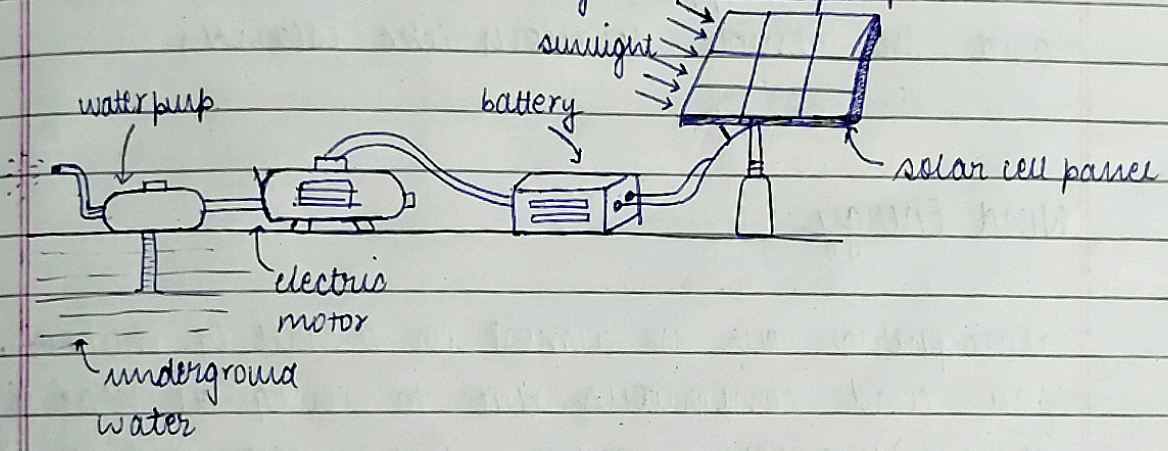
- photovoltaic cells:
  convert sunlight
  to electrical energy.



→ Solar photo voltaic (SPV) systems have emerged as useful power sources for lighting, water pumping, telecommunications and power plants.

→ cost prohibite, easy to install in villages, hospitals etc.

→ DNES: Department of Non-conventional Energy Source uses solar power in remote areas to in forms of - solar lanterns, streetlights, solar pumps.



MERITS → useful for decentralized applications
→ easy to install and maintain, not expensive
→ noiseless, pollution free, have long life

LIMITATN → initial cost of installing an SPV system is high, Si wafer (to make solar cells) and Ag (connecting solar cells)
→ DC electricity produced is stored by charging DC batteries which are first to be converted to AC.
→ low efficiency of energy conservation.

(iii) SOLAR THERMAL TECHNOLOGY

- uses heat gained directly from sunlight

1. Solar water heating
2. Solar heating of buildings
3. Solar dryer for food grains and other agriculture prod.
4. Solar distillation
5. Solar cooker
6. Solar powered vehicles
7. Solar thermal power generation.

- cleaner energy technology (solar therm. power generation)
  → replaces possil fuel based power generatn
- can operate ~~as~~ in stand alone mode in decentralized applicatns like rural electrification and in remote locations like islands.

Wind Energy

- atmospheric air is almost in a state of motion, fast and continuous. due to unequal heating of landmasses & water bodies by solar radiation.
- This kinetic energy possessed by air due to its velocity is called wind energy.
- This energy was harnessed by ~~mm~~ windmills to do mechanical work.

→ ENERGY FARM

→ Total wind power in India is 45000 MW (6000MW in Tamil Nadu, 5000 MW in Gujarat)

India's largest wind energy farm established near Kanyakumari in Tamil Nadu can generate 380 MW of energy.

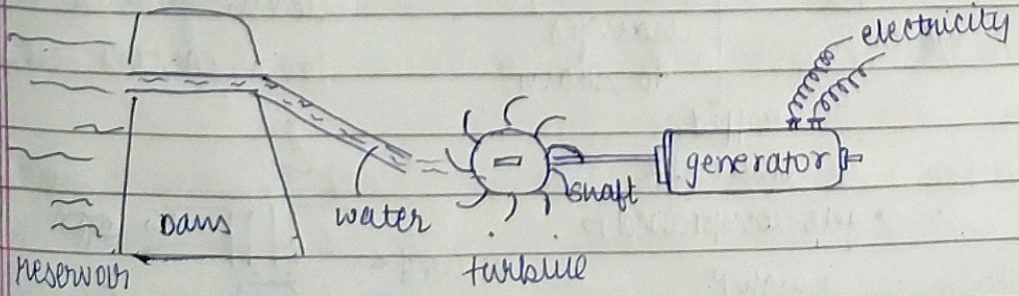
MERITS → non polluting, environment friendly and sustainable
→ low gestation period, and power generation starts immediately after commissioning a windmill
→ cheap power generation (no shortage of input - air)

LIMITATIONS → located in vast open areas with favourable wind conditions (min wind req. 15km/hr)
→ cost of construction of windmill farm is high
→ location of farms should not be in route of migratory birds.
→ backup facilities (storage cells) ~~etc~~ are needed during period where there is no wind.
→ tower and blades need high level of maintanence as they are exposed to sun, rain and storms.
→ ~~min~~

Hydro Energy

- produced from kinetic energy of flowing water or the potential energy of water at height.
- rotating water wheels and drive water mills, to ground wheat to make flour.
- 1/4 of total energy power in India
- at present 6500 MW energy energy in India

flowing waters ⇝ (turbine) → generator operates



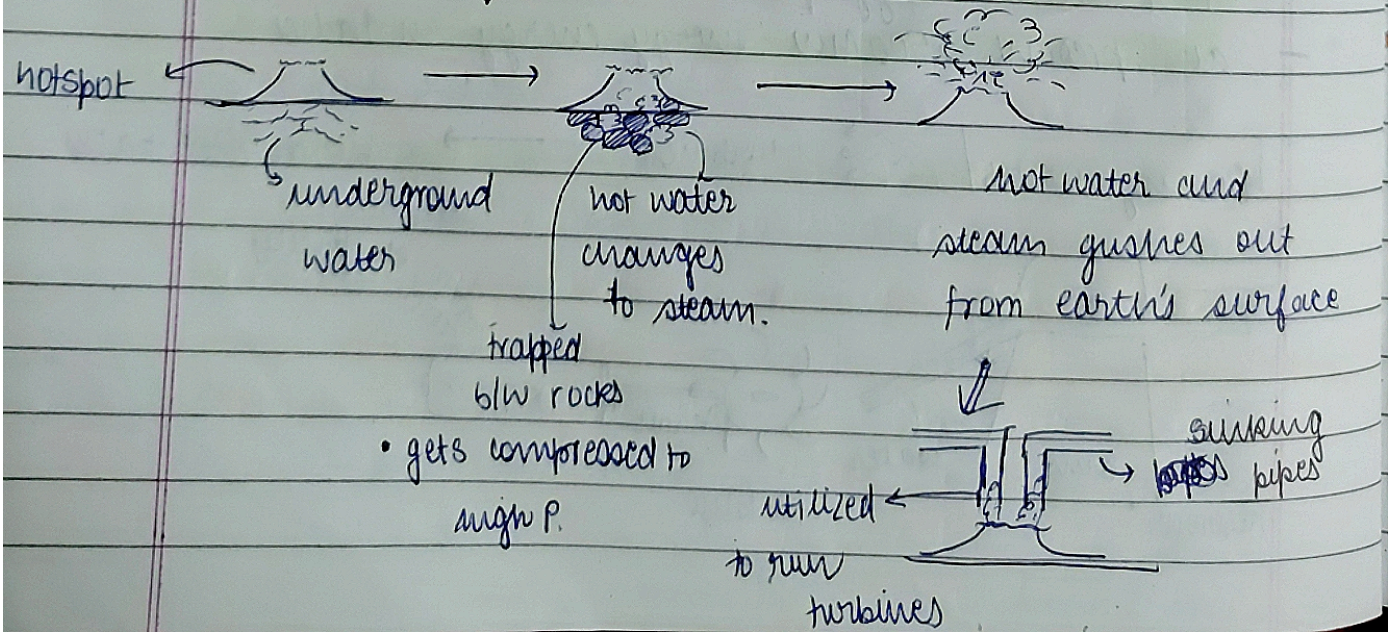
MERITS → pollution free → most versatile source of energy
→ low generation & maintainence cost
→ long life (50+ yrs) → high efficiency
→ labour intensive, reduces unemployment
→ multipurpose: irrigation, industrial, domestic use.

DEMERITS → initial investment is high
→ takes long time to install.
→ population displacement
→ damage environment and fertile land.
→ not suitable for all rivers and areas.

~~Biomass Energy~~

Geothermal Energy

- heat of the earth,
- found within rock formations & fluids held within those.
- hotspots: volcanoes, geysers & bubbling mud holes
  ↳ formed when geological changes push the molten rocks (magma), upwards where it gets settled at some depth below Earth's surface.



→ inexhaustible

MERITS → versatile → least polluting → renewable
→ inexpensive → can be harnessed for 24 hrs throughout the year
→ power generation or even heating.

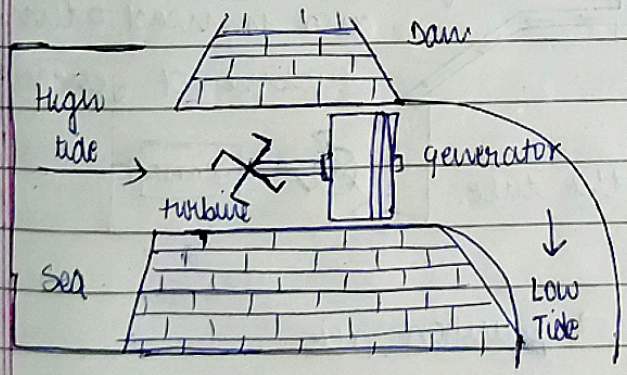
DEMERITS → geothermal hotspots are scattered
→ lower efficiency (15%)
→ ~~inexhaustible~~
→ noise pollution is caused by drilling equipments at geothermal sites

Ocean Energy

→ large water bodies covering 75% of Earth's surface

- TIDAL ENERGY
- WAVE ENERGY
- OCEAN THERMAL ENERGY

(i) TIDAL ENERGY



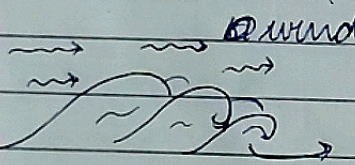
tides: ~~moves~~ up and down movement of water level (twice a day) along the coast.
→ occurs due to gravitational pull of moon on waters.

MERITS → inexhaustible → pollution free → renewable
→ independent of uncertainty of rainfall.
→ tidal plant doesn't require large area of valuable land as it is built on the bay.

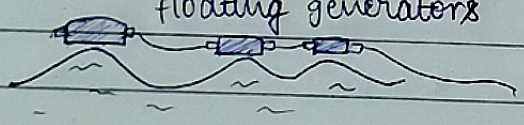
DEMERITS → power output is ~~variable~~ variable, due to variatn in tidal range
→ power generation is intermittent & not very large
→ few suitable sites are available.
→

(ii)

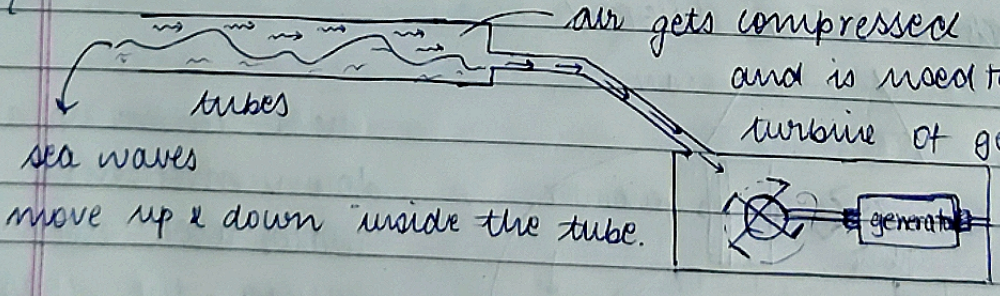
(iii) WAVE ENERGY



- wind moves the waves on water surface
→ possess kinetic energy

a) 

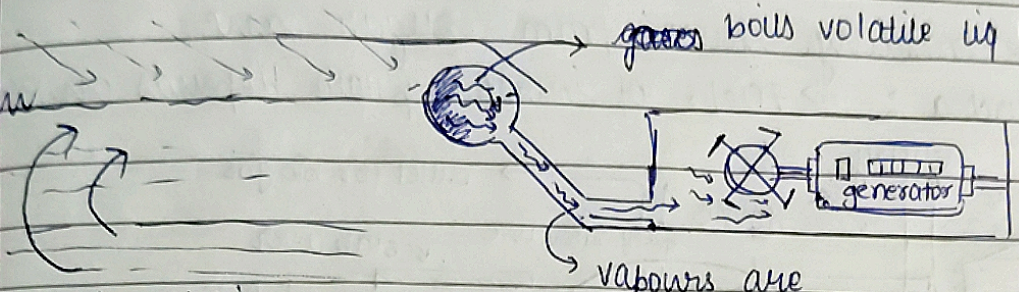
- they move up & down with the waves and generate electricity.

b) 

MERITS → free → renewable → pollution free
→ do not regr. large area or specific sites.

DEMERITS → power output is variable → expensive
→ marine life & seabirds could be affected
→ equipment must be able to withstand sea storms.

(iii) OCEAN THERMAL ENERGY



cold water is pumped up and condense vapour again to liq.

vapours are used to run turbines of generators.

OTEC: Ocean thermal energy conversn

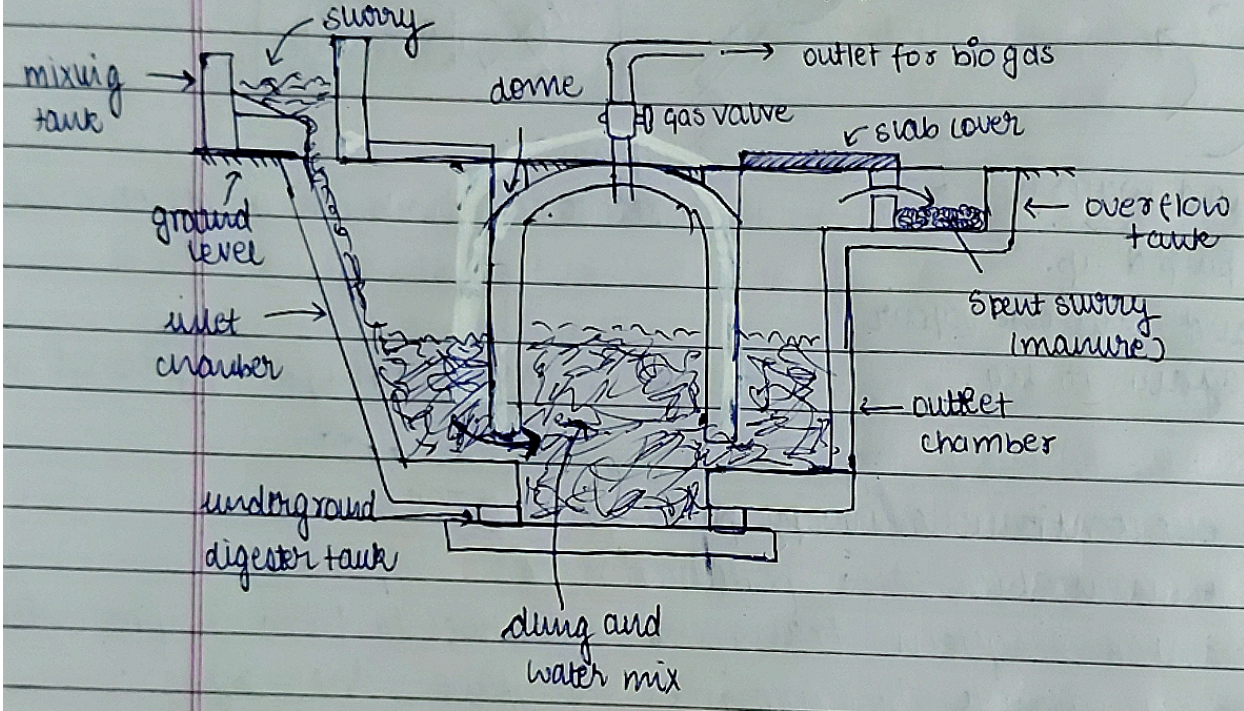
MERITS → ~~ete~~ continuous energy power from OTEC.
→ renewable → pollution free
→ these system transfers nutrients from unproductive deep waters to warmer surface thereby enriching fishing grounds.
→ OTEC doesn't have daily or seasonal variations.

DEMERITS → Requires lots of capital investment.
→ low conversion efficiency (3-4%) due to small temprature diffrence b/w surface water & deep water.

BIOMASS Energy

↳ organic matter used as a fuel to produce energy

- fuelwood, agriculture wastes like crop residues, biogasse etc. and cowdung.
  - ↳ solid residual matter left after extracting juice from sugar cane.
- India : >70% of rural populatn depends on Biomass



CARBONIZATION : The process of heating the fuel in the absence of air, to a sufficiently high temp, so that the wood undergoes decomposition and yields a residue which is richer carbon content than in original. During this process moisture content and volatile matter is removed.

NON RENEWABLE SOURCES

Fossil Fuels

→ remains of prehistoric plants and animals which got burried deep inside earth, million years ago, due to natural processes.

→ are energy rich cmpds of carbon.

(i) COAL

↳ complex mix of C, H, O & small amt of N & S cmpds

location: deep coal mines underground

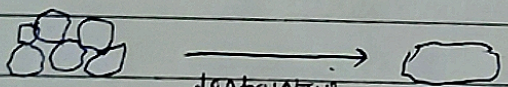
classificat": 11 % C - Peat

38 % C - Lignite } burn fast & release a lot

65 % C - Bituminous } of pollutants in atm.

96 % C - Anthracite } burns slowly & releases less smoke, more energy

(best quality coal)



COAL → destructive distillation or carbonization → COKE

- → absence of air
- → volatile matter is removed.

COKE
- → lustrous
- → dense
- → porous
- → strong

- COKE is better fuel than COAL & doesn't produce smoke on burning.

imp by products: tar, ammonia (NH_3), naphtalene

IRON & STEEL INDUSTRY } largest coal consuming sectors

CEMENT INDUSTRY

(ii) PETROLEUM

↳ rock oil, ~~mix of~~

mix of solid, liq & gas HCs mixed with water, salt and earth particles. cmpds of C containing O, N, S.

PETROLEUM —fractional distillation→ fuel oil, diesel oil, kerosene, petrol or gasoline, petroleum gas, asphalt, lubricating oil, & paraffin wax.

- thick, black liq.

(iii) NATURAL GAS

↳ mix of CH_4 (95%), C_2H_6, C_3H_8, C_4H_{10}. CO_2, He, H_2, S^{2-}, N

location: underground (near oil sources), oil wells

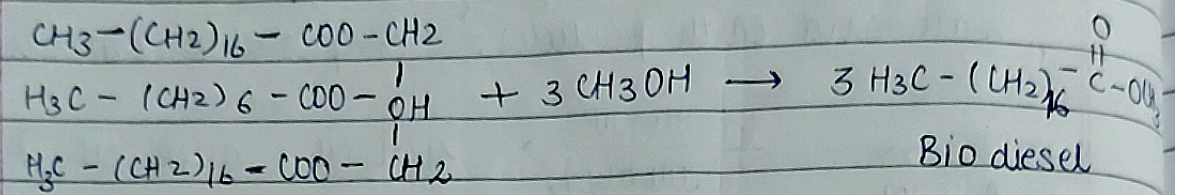
→ highly ~~inf~~ inflammable → odourless → colorless
→ cleanest burning fossil fuel.

CNG: compressed natural gas in liq form is used as a fuel in transportation.
- it reduces pollution → high calorific value 55kJ/g

Petrol : Biodiesel = 4 : 1

BIO DIESEL

- diesel obtained from vegetable oils.



Bio diesel

1895 : Rudolf Diesel invented it.
→ France : leading in biodiesel formation

1985 : India started use of Biodiesel
→ IIT Delhi Phd students used neem & mohua plants to form biodiesel

Jatropha Curcus plant — Pongamia Pinnata

grown in 18 states
→ 19 lakh medical getting employment.

ADVANTAGES
1. No sulphur, so no SOx (cause of acid rain)
2. 11% inbuilt oxygen (O_2), so burns easily
3. easy for storage and transportation.
4. has good lubricant property.
5. not a flammable liquid, it has FLASH POINT 315°F.
6. mixed with diesel in ratio 4 : 1 (diesel : biodiesel)
→ used in INTERNAL COMBUSTION ENGINES.

Diesel : ethyl alcohol C_2H_5OH = 4:1 → it has octane no. 90 (↓ anti knocking property of a fuel)

POWER ALCOHOL

knocking : when petrol/diesel is burned in insufficient amount of O_2/air in internal combustion engines, a metallic sound generated, it is knocking. → ↓ efficiency of IC engine

- PREPERATION OF C_2H_5OH

Carbonydrate (Starch) ex. sugarcane → sugarcane juice

sugarcane juice → Molasses (Brown color liquid) used for C_2H_5OH

sugarcane juice → SUCROSE (dissacharide) : crystallization of sugar

SUCROSE → glucose + fructose

Step 1: DILUTION :
→ take molasses 8-10 %.

Step 2: ADDITION OF H_2SO_4
→ maintain pH 4-5 for growth of yeast.
→ FERMENTATION process is carried out here.

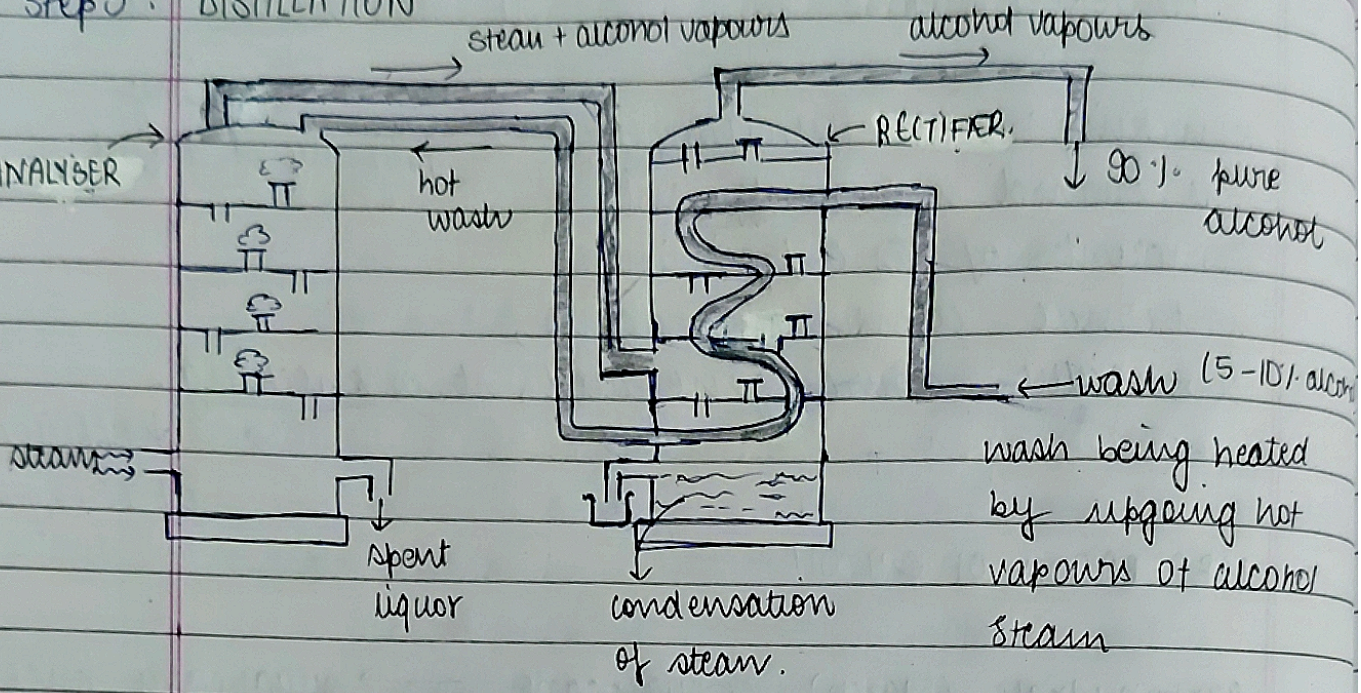
Step 3: ADDITION OF AMMONIAM SALTS
amm. nitrate $(NH_4)NO_3$
amm. phosphate
} for growth of YEAST

Step 4 FERMENTATION
COMPLEX ORG. SUBSTANCE $\xrightarrow{30^\circ C\ 2\text{-}5 \text{ drops}}$ Simple organic substance

$C_{12}H_{22}O_{11}$ (sucrose) + $H_2O \xrightarrow{INVERTASE} C_6H_{12}O_6$ (glucose) + $C_6H_{12}O_6$ (fructose)

$C_6H_{12}O_6 \xrightarrow{ZYMASE} 2\,C_2H_5OH$ (5-10% pure alcohol) + CO_2

step 5 : DISTILLATION



step 6 : AZEOTROPIC DISTILLATION

The 90% pure alcohol & add $C_6H_6 + CCl_4 \longrightarrow$ 100% pure alcohol (ABSOLUTE ALCOHOL)

(benzene) (carbon tetra chloride)

IREDA: Indian Renewable Energy Development Agency.

Page No.
Date

HYDROGEN Energy

$H_2 + O_2 \longrightarrow H_2O + 150\ kJ/g$ }
(air)

- H_2 is non polluting
  - can be easily obtained by THERMAL DISSOCIATION, PHOTOLYSIS and ELECTROLYSIS of water.

3000°C ≥T : H can be obtained from water, thermo chemically.
low temp : H produced by chemical reaction of H_2O with other chemicals in 2-3 cycles.

PHOTOLYSIS : $2H_2O \xrightarrow{\text{sunlight}} 2H_2 + O_2$ (in photosynthesis)

ELECTROLYSIS : $2H_2O \xrightarrow[\text{flow}]{\text{current}} H_2 + 1/2\ O_2$

- H is ~~HAPP~~ INFLAMMABLE & EXPLOSIVE - fuel reqrs. safe handling
- it is difficult to transport and store.
- LIQUID HYDROGEN: fuel in spaceship
- H as fuel: reduce fossil fuel consumptn, non polluting, clean

Fuel Cells

- ELECTROCHEMICAL device that convert CHEMICAL ENERGY ~~to~~ ELECTRICITY & HEAT.

→ for power generation, vehicular application, uninterrupted power supply.

PAFC : Phosphoric acid fuel cells
PEMFC : Proton exchange membrane fuel cell
SOFC : Solid Oxide fuel cell, MCFC : molten carbon ~~fuel~~ fuel cell.
DEFC : Direct Ethanol fuel cell, DMFC : Direct Methanol fuel cell

RESOURCE MANAGMENT

SUSTAINABLE DEVELOPMENT

- use of renewable and non renewable resources in a manner that satisfies our current needs but also doesn't compromise the future availability of resources.
- " meets the needs of the present without sacrificing the ability of future generations to meet their own needs."

PRINCIPLES
- Respect & care for life
- Improve quality of life
- conserve Earth's diversity
- minimize depletn of non-renewable resources
- Keep in Earth's carrying capacity
- change attitude & practice
- Enable communities to care for their own resources.
- Create global alliance

Water and sanitation
Energy
Healthcare
Agriculture
Biodiversity protection & ecosystem maugment.

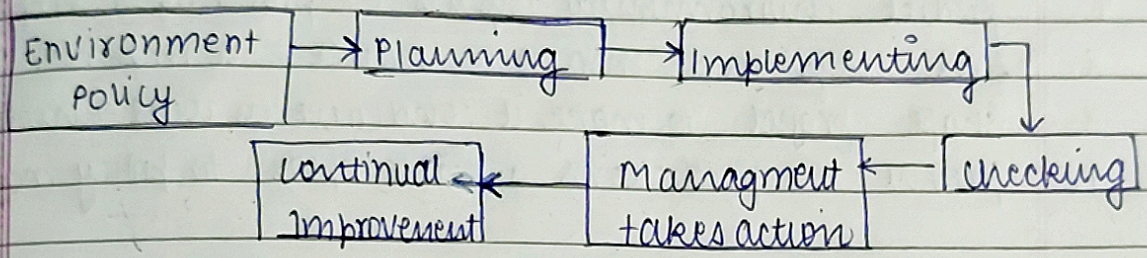
TASKS / PLANS
- Social progress which recognises needs of everyone.
- Effective environment protection
- Prudent use of natural resource
- Maintainance of high & stable levels of economic growth & employment.

ENVIRONMENT MANAGMENT SYSTEMS

- tool for managing the impacts of organisation's activities on the environment by providing a structured approach.

EMS Model

based on PDCA CYCLE (Plan, DO, Check - Act)



Plan: - Objectives and processes necessary to deliver results
DO: Implementation of plan
Check: monitor the established objectives and processes & reporting the results.
Act: action ~~to~~ for continual development.

- components of EMS

1. Environment policy (what an organisation wants to achieve for environment)
2. Environm^n impact identification/assessment
3. Objectives and Targets
4. Consultation (Staff and community consultation must be taken)
5. Operational & Emergency procedures (all procedures should be reviewed)
6. Environm^n management plan (detailed method of procedures)
7. Documentation (objectives, policies, responsibilities, procedures)
8. Responsibilities and Reporting Structures
9. Training (training to all staffs & members)
10. Reviewing audits & monitoring compliance (review audits)
11. Continual improvement

ENVIRONMENT IMPACT ASSESSMENT

- formal process used to predict the environmental consequences of any development project
- EIA takes care that potential problems are forseen and taken care at an early stage.

- IA of projects

1. predict environmental impacts of project after completn
2. find ways and means to reduce -ve impacts.
3. shape project to make it conducive in local environm^{n}
4. present the predictions & viable opt^{n}s to policy makers.

POSITIVE IMACT
- → increase in small scale industry
- → increase in employment for local people
- → improved infrastructures.

NEGATIVE IMPACTS
- → deterioratn of quality of environ^{n} (air, water, soil)
- → deforestation → soil erosion
- → disturbs ecosystem, natural flora & fauna
- → increased level of noise pollution.

DEVELOPMENTAL PROJECTS

Large scal industries (power plants, manufacturing & processing units, construcn work)

ENVIRONMENTAL PARAMETERS
- → air quality
- → land quality
- → water quality
- → public health, noise pollutn
- → flora & fauna (ecology)
- → socio economic factors (employment, rehabilitation)