EXH velocity

Sessional 1

→ Renewable & Non Renewble Sources

→ what is Viscosity

→ Dimension unit

→ fossial fuel

→ $\eta$ Numerical

→ Production of Bio-gas

→ Advantages & Dis-advantage Biological Solar energy.

→

Energy Science & Engineering DATE - 27/01/20

UNIT :- 04

## * Conventional & Non-Conventional Energy Source *

* Energy :- Energy Play a vital Role in our daily life. Energy is avaliable in different forms like electrical energy, Mechnical energy, chemical energy, Heat energy Nuclear energy etc.

Day by Day the energy Conjunction is increasing Very Rapidly. So the world fossil fule supply (Coal, Paterolium & Natural Gas) will be depleted in a few Hundred years.

The Rate of energy Conjuction is increasing, Supply is depleting Resulting in inflation & energy crisis. this is called energy Storage.

Ulternate or Non-Conventional or Renewable energy Resources are very essiencial to develop for future energy Requirment.

## Conventional & Non Convent...

Date:-30/01/20

### Conventional Energy Sources
or
### Commercial energy Source
or
### Non - Renewable Sources

Coal, oil & gases are Commonly Known as Conventional Energy Resources.

As the Population is increasing More energy Needs will be in future. the energy demands throw Conventional Resorces is limited. due to their insefficient availablity. There fore, A large Amount of energy Can be derived from non- Conventional Resources or Non- Commertial / Renewable Resources: for Example – Agricultural ~~Sou~~ waste, firewood, Solar, wind etc.

The % Use ~~to~~ of Various Sources for the total energy Consumption in the world is given By :-

Coal — 32.5 %
Oil — 38.3 %
Gas — 19.0 %
Branium – 0.13 %
Hydro — 2.0 %

} 92 %

Wood — 6.6 %
Dung — 1.27 %
Waste — 0.3

} 8 %

The most Significant Aspect of the Current energy Comsumption Pattern in Many developing Counteries is that Non-Conventional Sources such as firewood, animal dung and Agricultural waste

In Some developing Countries Non-Conventional or Non- Commertial are the significance of total Resources.

### * Non- Conventional Sources
or
### Renewale Sources.

Energy generated by using wind, Solar, geo-Thermal And Bio-Mass including farm & Animal waste as well as Human excreta is Known as Non- Conventional Sources. All these Sources are Renewable or inexhaustive & do not couse enviromental Pollution. More-over they do not Require Heavy expenditure.

Example of Non- Convention Sources
or
Renewable energy Sources

1. Biomass
2. Bio - Gas
3.
4.
5.
6.
7.
8.
9.

Note! Coal, Petrolium, Natural Gas — fossel fuel.

Biological Energy Source & Fossil fuels.

Bio Energy And BioMass :-

Biomass is a organic Matter from Plants, animals & Micro organism grown on land & Water & their derivatives.

Biomass is considered as a renewable Source of energy Because the Organic Matter is generated every day.

The Biomass Measured in, $Kg/m^2$ or $lb/Ft^2$.

" Biomass is Organic, Meaning it is Made of Material that comes from living organisms, such as Plants & Animals the Most common Biomass Material used for energy are Plants, wood & waste. these are Called Biomass feed stocks!"

Biomass Is Organic Matter Produced by Plantes.

~~Both~~

Both

Terrestrial (those grown on land)

Aquatic (Those grown in water)

And derivatives.

## Biomass Resources

Classified in three groups.

1. * Biomass from cultivated field
   * Crops
   * forests)
2. * Biomass Derived from Wastes like Mulcipal waste, Animal Dung etc.
3. * Biomass Converted into liquid fuel

### * From 1

The Biomass is directly Converted into Energy By Burning the Biomass.

### * from 2

The Biomass is ferented Anaerobically/Aerobically to obtain Gasies fuel like Biomass

### * From 3

The Biomass is Converted into liquid fuel like ethenal, Methenal.

## Production of Biomass

Biomass Can be Considered As a Renewable energy Sources Because Plant life Renews & adds to itself every year

It Can Also be Considered in a form of Solar energy As be used to grow these Plants by Photosynthesis.

Biomass Means organic Matter ~~or~~ & Photochemical Approach to harness Solar energy by Photosynthesis. Solar energy is Store in the form of chemical energy.

Solar energy ~~Photosynthesis~~

Solar Energy $\longrightarrow$ Photosynthesis $\rightarrow$ Biomass $\longrightarrow$ energy generation.

& the Photosynthesis Can be represented

$$6CO_2 + 6H_2O + \text{Light} \longrightarrow$$

## Availability of Biomass

Biomass is derived from the Planet, foresh Resideue and animal dung etc. the total terrestrial Crop is

the terestrial Crop include suger crops, Harbaceous Crops, Siviculture Crop (forestry) the terrestrial Crops have an energy Potential $3 \times 10^{22}$ Jule. the efficienty of solar energy use in this Process of Photosynthsis is 0.1 — 2.0%.

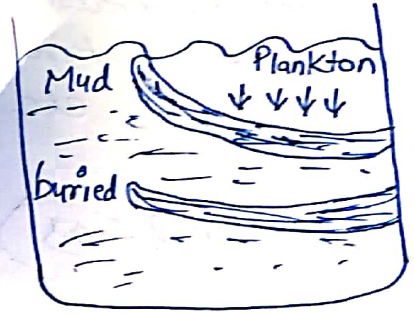
The Biomass

The energy equavilent of annual biomass groth is $3 \times 10^{21}$ Jule.
At Present 1% of world biomass is use for energy Conversion. for use of biomass As energy fast growing trees, sugar, starch, oil Containing Plants can be cultivated.
The cultivated Biomass is also include Sweet sorghum (मीठे चारे वाली फसल)
Suger beets (
cerals (गेहू, चावल) Herbaceous Crops, a quatic grown in fresh water, Sea water
~~Nit~~ Muddy water etc.

## Oil

Oil was form from Plants Called "Plankton". whe the Plankton dies it sinks in the Bottom of the sea & his "Buried" under layers of sands & Mud. when these Plankton is Mixed with Mud it turns into a Hard Row, But when Baltria ate the Plankton, it turn into ooze (चिपचिपा पदार्थ) which is Now oil.

ocean or lake




* How is oil Use as a fossil fuel *

(i) Use fuel for lamb, fertilizers, Car ga

### Natural Gas

Naturas Gas is the Mixture of Gases wh are rich in hydrocarbons. All these ga (Methane, Nitrogen, $CO_2$ etc) are Natur found in atmosphare.

Natural gas accer with Petrolium

Natural gas Resurve are deep inside the earth ~~Ea~~ near other Solid & liquid Hydro-Carbon like Coal & Cruied oil.

Natural Gas is Nat used in its Pure form, it is Prosidue & Converted into cleaner fuel for Conjumption. Many By Products are extracted while Processing of / Natural Gas like Propane, Ethane, $CO_2$, $N_2$ etc. which Can be further use.

# (Main Components of Natural Gas)

- Methane
- Ethane
- (Havier Hydrocarbons)
  - Pentane
  - Propane
  - Butane

The Typical Makeup of Natural gas before it is refined.

| Name | formula | % |
| --- | --- | --- |
| | | |

# Fluid Dynamics

Date :- 15-02

## * Fluid

- Static (Rest with Respect to Container)
- Dynamic
- Surface/Viscosity

## * Ideal fluid

↓

(Liquid + Gases)

$P = \frac{F_{\perp}}{A}$

where F is ⊥.

### Properties

1. Incompressible (fixed Volume) density, Constant)
2. Non-Viscous (There is No tangential fource among liquid layer (No fraction).

$1\ atm = 1.013 \times 10^5$ Paskal

$1\ Bar = 0.1\ atm$

$1\ bar = 10^5\ N/m^2$

$1\ atm = 760\ mm$ of Hg

$1\ atm = 760$ torr

$= 76\ cm\ Hg$

$1L = 10^{-3} m^3 = 10^3 cm^3 = 1\ dm^3$

## * Kinematics of flow

Kinematics is defined as the Branch of Science which deals the motion of the Particials without considering the forces Causing the Motion.

## * Fluid *

A Substance which is capable & deform contineously under the action of shear stress.

### * Types of fluid

a. Liquid → Incompressible, Molecule close
b. Vapour → } Compressiable
c. Gas → } → P T ↑

### * Types of fluid

a. **Ideal fluid** :-

(i) Incompressible
(ii) Not having Viscosity & surface tension
(iii) Imaginary fluid

Ex: there is No such fluid available in Nature

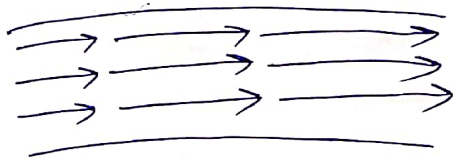
## Defination of fluid - flow

Displacement of any Quantity from one Place to another Place "in a given time" or the Moment of Particiles of fluid is called fluid flow.

Unit - $M^3/hr$.

* Types of fluid flow

(i) Laminar flow: The Moment of Indevisual Particules of fluid are Parralel to Pipe Surface.



(ii) Turbolant flow

(iii) Steady flow

In which fluid Parameters (velocity, density, Pressure) at any Point do not change with time.

$$\frac{dv}{dt}=0, \frac{d\rho}{dt}=0, \frac{dP}{dt}=0$$

(iv) Un-steady flow

In which fluid Parameterd (velocity, density, Pressure) at any poind change with time.

$$\frac{dv}{dt} \neq 0 \quad \frac{d\rho}{dt} \neq 0 \quad \frac{dP}{dt} \neq 0$$

## Uniform & Non Uniform flow

* Uniform:- The flow in which the Velocity of fluid does not change with space.

$$\boxed{\frac{dv}{ds} \neq 0}$$

* Non-Uniform: The flow in which Velocity change with

*** In-Compressible flow or fluid**

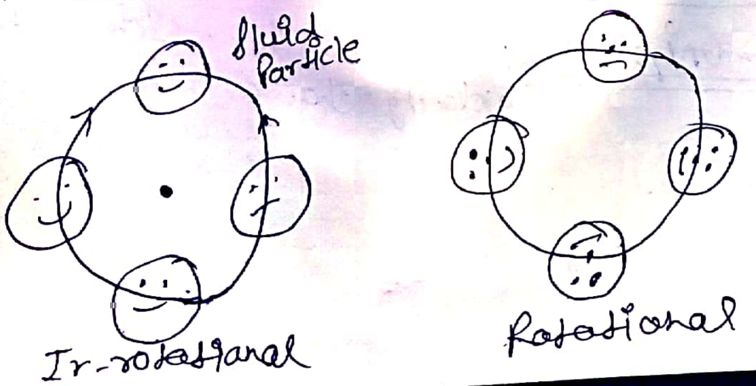
The type of flow ~~the~~ In which the density is Constent at any Point.

*** Rotational Flow**

Rota. flow is that type of flow in which fluid Particle follow Stream line Path & also Rotate about their own axis.

**Ir-rotational flow**

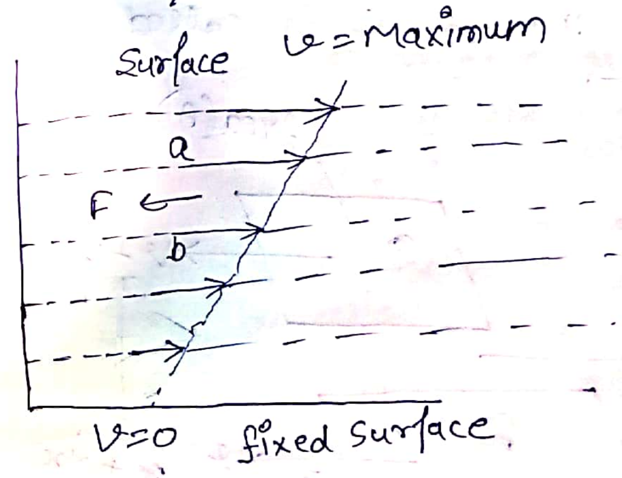
Ir-rotational Is that type of flow in which fluid Particle follow steam line Path & does't Rotate about its own axis.




**Viscosity**

Viscosity is the Property of fluid. by virtue of which and internal force of friction comes into Play when a fluid is in Motion & which appoash the Relative Motion in b/w the diff. layers.

The Backword dragging force called Viscus drag or Viscus force, act tengencilly on the layers of the fluid in motion & tends to destroyed its Motion.

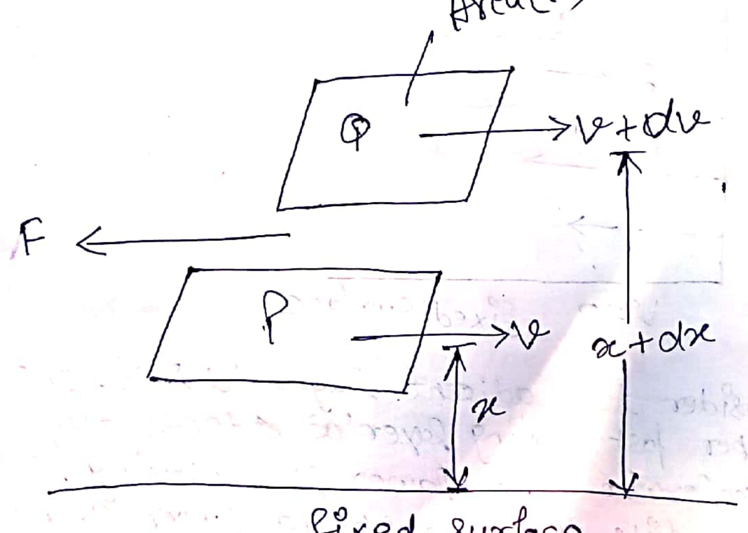



Consider two adjsent layer 'a' & 'b'. the upper fast Moving layer 'a' tends to accelerate the lower slow Moving layer 'b'. while the slow Moving layer 'b' back dragging tengencially force called viscus drag. Comes into Play which tends to dystroyed the Motion.

## Cofficient of Viscosity $\eta$

Suppose a liquid is flowing steadily in the form of Parallel layer on a fixed horizental surface. Consider two layers P & Q at distance $x$ & $x+dx$ from the solid surface & Moving with velocity $v$ & $v+dv$ respectively.

The $\frac{dv}{dx}$ is the Rate of change of Velocity with distance in the direction of increasing distance & is called velocity gradient.




According to Newton, a force of viscosity is acting tengencely b/w two layers is—

(i) Purpotional to the Area 'A' to the layers in Content

$$F \propto A$$

(ii) Purpotion to the b/w the two layers

$$F \propto \frac{dv}{dx}$$

$$F \propto A \frac{dv}{dx}$$

$$\boxed{F = -\eta A \frac{dv}{dx}}$$

where $\eta$ is the cofficient of viscocity it is depend on the Nature of the liquid & gives a Measure of Viscosity.

Negative sign show the viscus force $\times$ in the direction opp. of the direction of the liquid.

if $A = 1$ $\frac{dv}{dx} = 1$

then $\boxed{F = \eta}$

Hence, cofficient of viscosity of liquid May be defined as the tengential force to required to maintain a unit velocity gradient b/w its two Parrell layers. each of unit area.

## Dimentional of $\eta$

$$\boxed{\eta = \frac{F}{A} \cdot \frac{dx}{dv}}$$

$\boxed{ML^{-1}T^{-1}}$

**UNIT** →

C.G.S → $\eta$ – $g\,cm^{-1}s^{-1}$ & is called Poise

S.I Units

$\eta$ → $kg\,m^{-1}sec^{-1}$ & is called ~~det~~ decapoise / Poiseuille.

## Effects of Pressure

(i) In case of water, viscosity decreases with the in

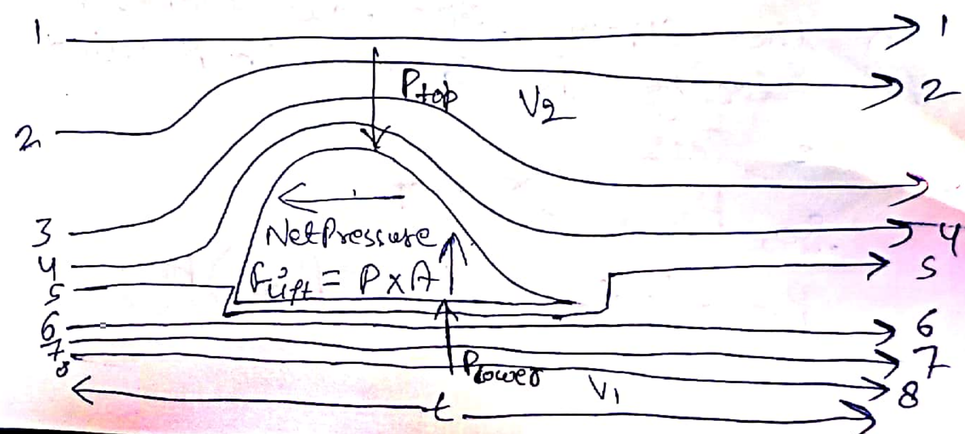
(ii) the viscosity of gases is independent of Pressure.

## Dynamic Lift

Dynamic lift is the force that acts on a body, such as aeroplane wing, a hydrofoil or a spinning ball by vertue of its motion throw a fluid. it is responsable for the curved path of a spinning ball ~~&~~ the lift on an ~~e~~ aircraft wing

$\left\{ \begin{matrix} V\uparrow\ P\downarrow & P\text{-Pressure} \\ P\uparrow\ V\downarrow & V\text{- Velosity} \end{matrix} \right\}$

for Example



* All Particule in L.H.S {1,2,3,4,5,6,7} take Same time (t) to reach in RHS (1,2,3,4,5,6,7)

* The Order of the Particle does't disturb for that Crossing the wing.

* for 4,3,2,1 particle taken More distance to Reach in R.H.S but timing is Same (t) rather than 7,6,5.

* So, the Particle (4,3,2,1) Moves facter than 5,6,7 (but timing is Same)

So, $V_6$ has lower velocity
& $V_4$ has Higher Velocity

So, top Moleder have higher Velocity & bottom Moleculer have lower Velocity

* $V_4 > V_6$

* But according to bernolius Principle in the Stream line flow whenever the Velocity is large, the Pressure Become less

So, $P_{lower} > P_{top}$

$$\text{force (lift)} = (P_{lower} - P_{top})\ \text{Area}$$

~~Force~~ ~~Lift~~

According bernolius Principle or theorem

$$\frac{P}{\rho} + \frac{1}{2} v^2 = \text{Constant}$$

or

$$\frac{P_1}{\rho} + \frac{1}{2} v_1^2 = \frac{P_2}{\rho} + \frac{1}{2} v_2^2$$

&

$$\frac{1}{\rho}(P_1 - P_2) = \frac{1}{2}(v_2^2 - v_1^2)$$

$$\Delta P = \frac{1}{2}\rho(v_2^2 - v_1^2)$$

$$\Delta P \times A = \frac{\rho}{2}(v_2^2 - v_1^2) A$$

$$\boxed{F_{lift} = \frac{1}{2}\rho A (v_2^2 - v_1^2)}$$

this is the formula for force of lifting

in terms of distance

$$\boxed{F_{lift} = \frac{1}{2}\frac{\rho A}{t^2}(d_2^2 - d_1^2)}$$

## Wind Energy or Power in the wind

Wind mills Convert the Kinetic energy of the wind into Machinical Energy.

The Total Power of the wind stream in equal to the time rate of kinetic energy.

$$K.E = \frac{1}{2} m v^2 \quad \text{—— (1)}$$

The Amount of air passing in unit time, through an Area 'A' with Velocity

$$\boxed{v = Av}$$

$$\rho = \frac{m}{\text{Volume}}$$

$$m = \rho . \text{volume}$$

$$m = \rho A v$$

Mass $M = \rho A v$

So, the Kinetic Energy

$$\boxed{K.E = \frac{1}{2} \rho A v^3}$$

$$\boxed{\text{Total Power} = \frac{1}{2} \rho A v^3} \ \text{Watts} \quad (2)$$

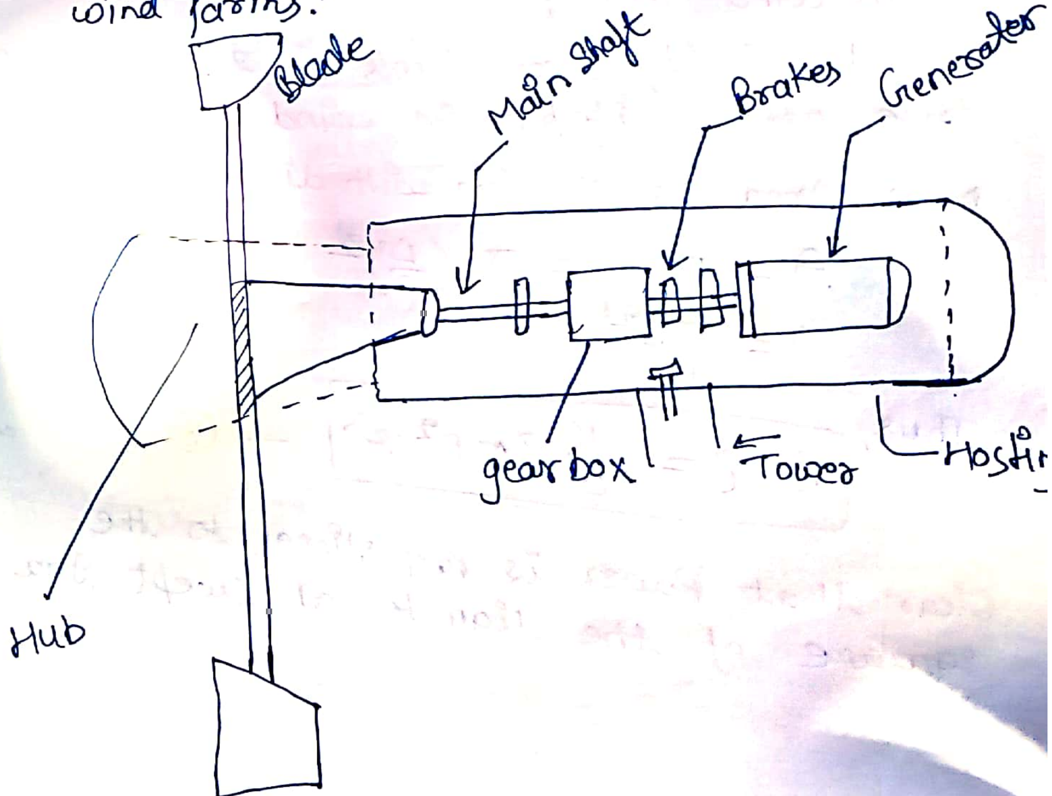
where $\rho$ is the dencity of the air & $v$ is the velocity of the wind.

"Wind energy is used to generate electricity by wind turbing Blowing wind spins the blades on a wind turbines. the blades of the turbines are Attached to a hub that is mounted on a ~~turbine~~ Turning shaft."

The shaft goes throw a gear transmission Boss where the Turning speed is increase the Transmission is Attached to a high speed shaft which turns a generatter.

If the wind get too fast the turbine has a 'Brake' that will keep the blades from Running to fast & being damaged.

"A large No. of wind turbine are grouped together to form a wind Plant or known as wind farms."




Constructios of W

Now, from eq$^n$ 2 it is clear the all this Power Can Not be extracted. Because power output ~~with be~~ of a wind mill varies as cube of the wind Velocity, directly Propostional to wind density & directly Propostional to area of stream A.

$P \propto \rho$, $P \propto A$, $P \propto v^3$

So, wind mill Produce Max$^m$ Power at High wind Velocity.

wind velocity below 5 m/s & 25 m/s above are Not Suitable for wind turbine.

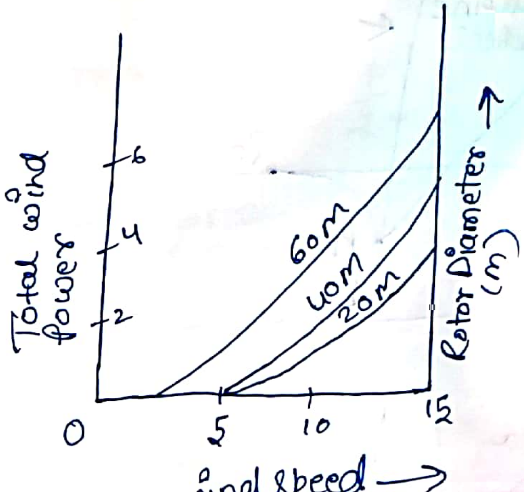
Now, Area is circular with diameter D.

$$A = \pi r^2 = \pi \left(\frac{D}{2}\right)^2$$

$$A = \frac{\pi D^2}{4}$$

Thus, $$\boxed{P_{total} = \frac{1}{8} \rho \pi D^2 v^3} \quad — (3)$$

Clear that Power is Propostional to the square of the diameter of swept Area.




Most commonly used wind Turbine is Horizontal access. let us consider this type of wind Turbine

$P_i \rightarrow$ Incoming wind Pressure (up stream)

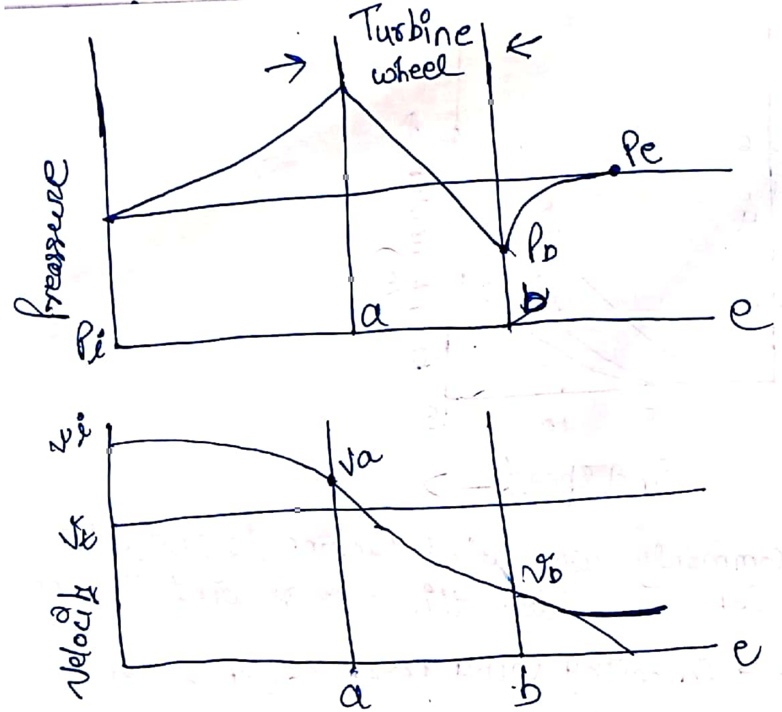
$v_i \rightarrow$ Incoming wind Velocity (up stream)

$P_e \rightarrow$ Pressure at downward stream

$v_e \rightarrow$ Velocity at downward stream

$\rho = \frac{1}{v}$ (Specific density)

Scanned with CamScanner




Here, we see that incoming Air between i & a an a thermodynamis & assuming that

air density = Constant

& Potential energy is zero.

So, the general energy eq$^n$ is only in terms of K.E & flow energy terms only.

if. for incoming side or Inlet

$$\frac{P_i}{\rho} + \frac{v_i^2}{2} = \frac{P_a}{\rho} + \frac{v_a^2}{2}$$

or,

$$P_i + \frac{1}{2}\rho v_i^2 = P_a + \frac{1}{2}\rho v_a^2 \quad \text{—— (4)}$$

Similarly for outlet area:-

$$P_e + \frac{1}{2}\rho v_e^2 = P_b + \frac{1}{2} v_b^2 \quad \text{—— (5)}$$

So,

$$\left.\begin{aligned} v_i &> v_a \\ v_b &> v_e \\ P_a &> P_i \\ P_b &< P_e \end{aligned}\right\} \quad \text{—— (6)}$$

Subtract (5) − (6)

$$P_a - P_b = \left\{P_i + \rho\frac{v_i^2 - v_a^2}{2}\right\} - \left\{P_e + \rho\frac{v_e^2 - v_b^2}{2}\right\} \quad \text{—— (7)}$$

Assume exit end away from the turbine

So, $P_e = P_i$

& $v_t = v_a = v_b$

As the blade width ab is very thin as compaired to total distance so we can assume that the velocity within the turbine does'nt change much.

$$P_a - P_b = \rho\left\{\frac{v_i^2}{2} - \frac{v_e^2}{2}\right\} \quad \text{——— (8)}$$

if $A \rightarrow$ is Projected Area of wind mill $\perp^{r}$ to the wind turbine, then axial force is

$$F = (P_a - P_b)A$$

$$F = \rho A\left\{\frac{v_i^2 - v_e^2}{2}\right\} \quad \text{——— (9)}$$

$F = ma$

$m = \rho A v t$

$a = \frac{dv}{dt}$

$a = \left(\frac{v_i - v_e}{dt}\right)$, $dt \rightarrow 1$

$a = v_i - v_e$

$$\boxed{F = \rho A v_t (v_i - v_e)} \quad \text{— (10)}$$

$$\rho A\left[\frac{v_i^2 - v_e^2}{2}\right] = \rho A v_t (v_i - v_e)$$

$$\frac{v_i^2 - v_e^2}{2} = v_t (v_i - v_e)$$

$$\boxed{v_t = \frac{v_i + v_e}{2}} \quad \text{— (11)}$$

this is the Condition for Max$^m$ Power.

$V_e$ opt is the optimum exit velocity.

Put this value in eq$^n$ $P = \frac{1}{4} \rho A (v_i + v_e)(v_i^2 - v_e^2)$

$$\boxed{P_{max} = \frac{8}{27} \rho A v_i^3}$$

The Max$^m$ efficiency also Calculated

$$\eta_{max} = \frac{P_{max}}{P_{total}} = \frac{\frac{8}{27} \rho A v_i^3}{\frac{1}{2} \rho A v_i^3}$$

$$\eta_{max} = \frac{16}{27} = 0.59 = 59\%$$

$$\boxed{P_{max} = 0.59\, P_{total}}$$

## Geo-Thermal Energy (GTE)

19/feb/20

Geo-thermal Energy is a Energy Source that can be 'harnessed' for Power generation. GTE is Natural. Heat generated from within the earth.

"The Steam & hot water Comes Naturally to the surface of the earth at some location."

"The Main Source of geothermal energy is 'Magma'!" the extraction of heat from earth interior Needs a Natural or Artificial Heat exchanger.

Geo-thermal → Geo(earth) + thermal (heat)
→ Mean heat of earth.

### GTE Sources

→ Hydro-Thermal Convective System
- Vapour-dominated or dry system field
- Liquid - dominated system or wet steam
- Hot-water fields

→ Geo-Pressure Resources

→ Petro - thermal or Hot dry rocks (HDR)

→ Magma resources

Hydro-thermal Conductive System are best Resources for geo-thermal energy at Present.

## * Hydrothermal Convective System

### Vapour dominated System (Dry Steam field) (filter used)

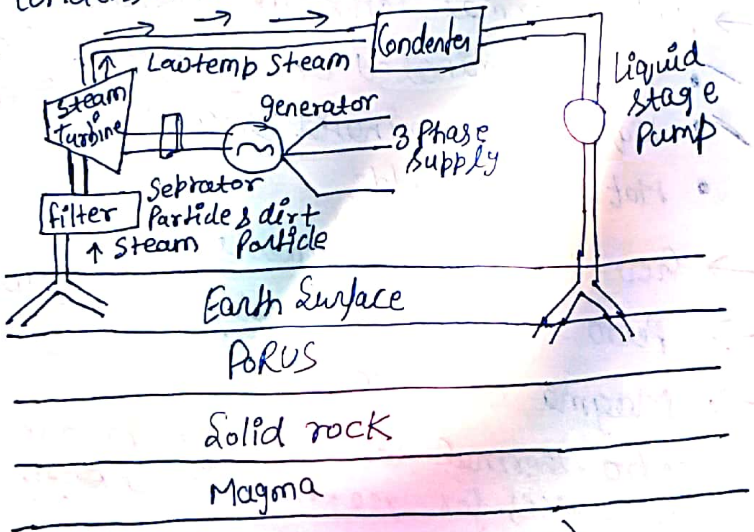
In this System, Steam from the well (Production) is Collected, filtered to Remove Particle & passed through the Steam turbine Couples to the electric generator.

| |
|---|
| Surface |
| PORUS |
| Solid Rock |
| Magma |

Steam from the Reciver flow to the Separator (filter) through the Production well.

the Separator Remove the impurities from Steam. the Steam goes into the Steam turbine where a generator is Connected & we can get electricity.

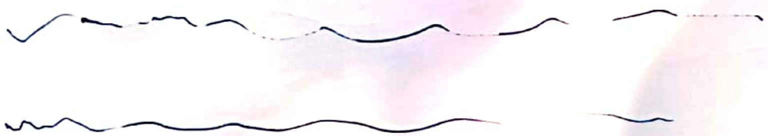
The low Pressure steam is Condensate in the Condenser & Re-injaticed into the earth.



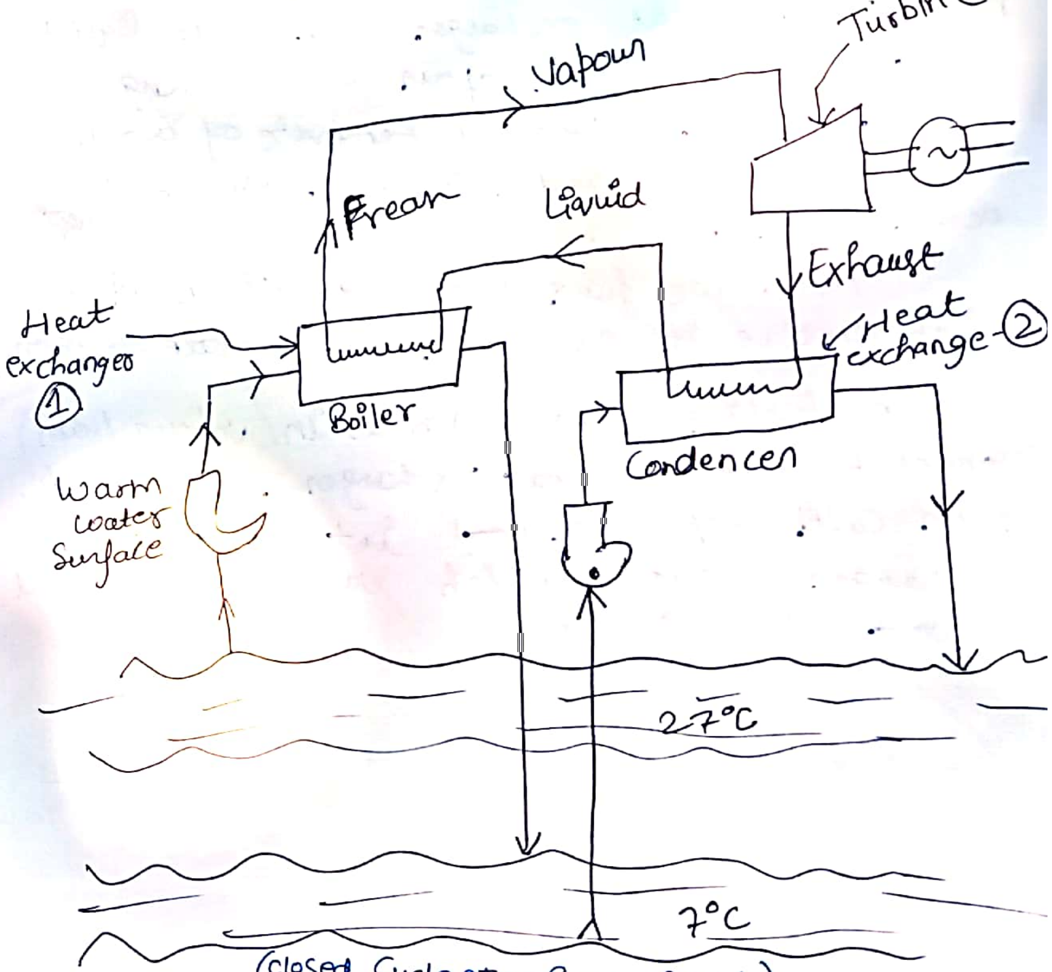

(Dry steam field)

## * Liquid - dominated System (wet Steam)

## * Open Cycle System



## * Closed Cycle System (OTEC)




(closed Cycle OTEC Power Plant)

In the closed cycle systen. law boiling liquid such as freon or amononic is the working fluid.

In closed cycle system the working fluid is fream or ammonia because it has law boiling point and easily canvert to vapour.

first at all, we put worm water through Pump in heat exchange 1. freon or Ammonia Present in heat exchanger which is in liquid form converted into Vapour with exchange worm water. Now the temprate of worm water decrease and imidiately Put it in the ocean depth (7°C).

Now. we have a working fluid in vapour from andue it is turbine to generate electricity.

The turbine outlet which is in vapour from connect to another heat exchanger-2. using Pump, Pour ~~Cold~~ Cold deep water ~~cool~~ into the Heat exchanger-2 due to which vapour form of fluid convert into liquid