8/7/16. Unit - 3 Biomass Energy.

* Introduction
* Types of biomass
* DBN & WBT Process.
* Photosynthesis.
* Types of biomass plant.

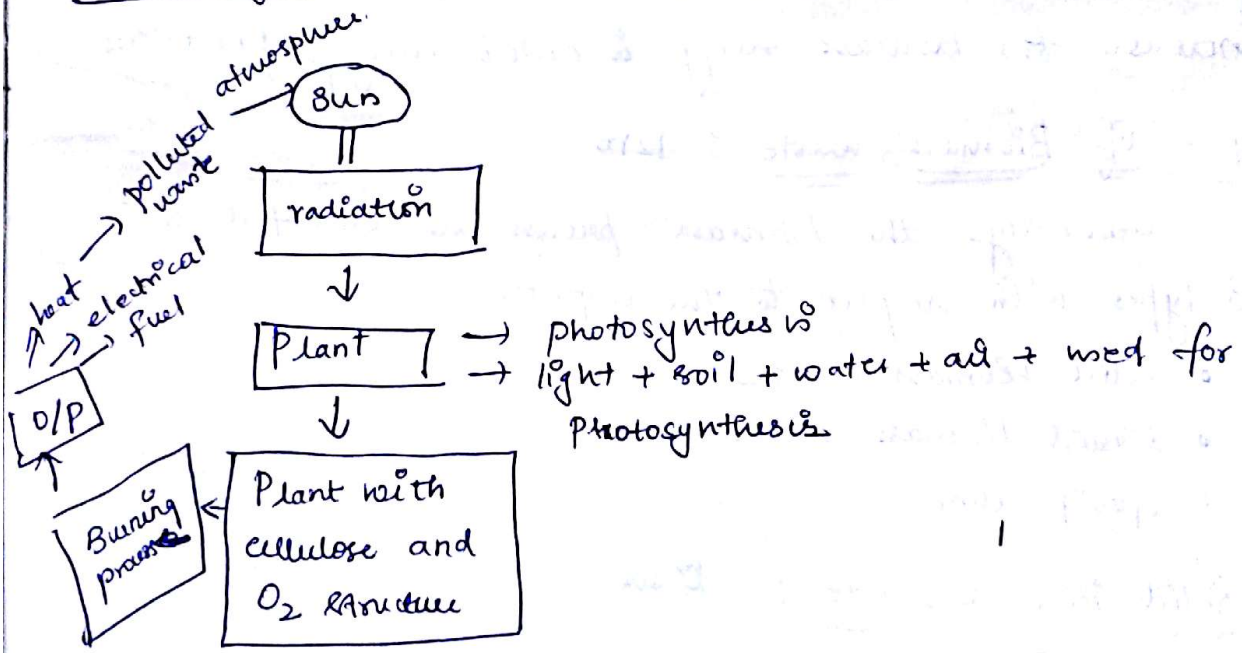
- **Biomass :**

→ organic material waste contain cellulose and O_2 is used for energy conversion is called biomass.

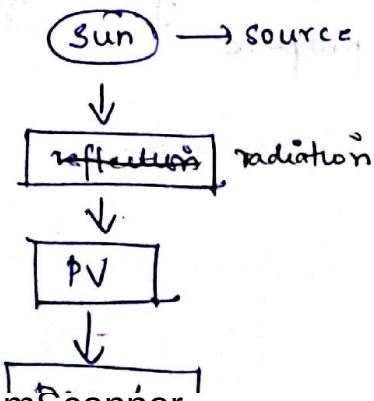
- **Why biomass ?**

* Fossil fuel takes much long time for use
* Biomass short time it can be used as fuel.

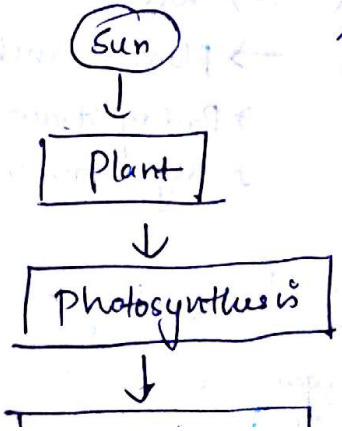
- **Biomass cycle :**



Solar energy



Biomass



Biomass is secondary version of solar energy.

- **Energy Plantation :**

The process of acquiring large amount of solar radiation from the sun towards the plant structure is called energy plantation. (2)

Explaination :

Due to the increase in residental area, the deforestation takes place because of this thing, the absorption of solar light towards the plant is reduced. Due to this there is declanation in the photosynthesis proces. This results to reduction of biomass energy. This can be compensated by increasing forest area and make agricultural activities. This increment of green structure towards the earth surface in order to increase the biomass energy is called energy plantation

- **Types Of Biomass waste :** 12m

Generally the biomass proces are classified into 3 types with respect to the output.

- solid biomass waste
- liquid biomass waste
- Gasification.

* **Solid Biomass waste :**

Solid.

Ex. → wood
→ Plant branches
→ Paddy straw
→ sugarcane waste

} Contain high cellulose and O_2. It can be directly used for build purpose.

* **Liquid Biowaste :**

→ sugarcane
→ husk mild
→ coconut shell → chemical process → liquid fuel → domestic

* Gasification :

Domestic waste, Plant waste } → Biomass plant → Process under certain condition → Gas o/p → Domestic application

(3)

* Types of Biomass Process : 12m

With respect to the practical application and output condition of biomass waste. The process are broadly classified into

* Dry process
* Wet process.

* Dry Process :

Further classified into

→ Combustion
→ Co-Generation
→ Co-firing
→ Pyrolisis
→ Garification
→ hydrogen Structure
→ steam formation

* Wet Process :

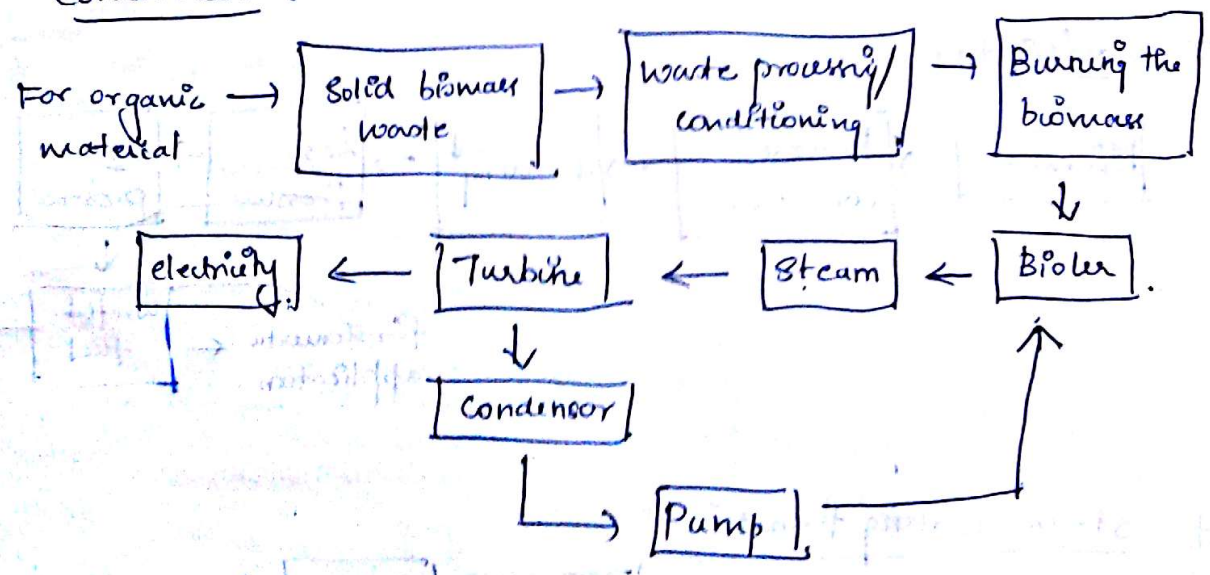
Wet process further classified into

→ Fermentation
→ chemical composition
→ Photosynthesis
→ Aerobic Process
→ Domestic and plant waste.

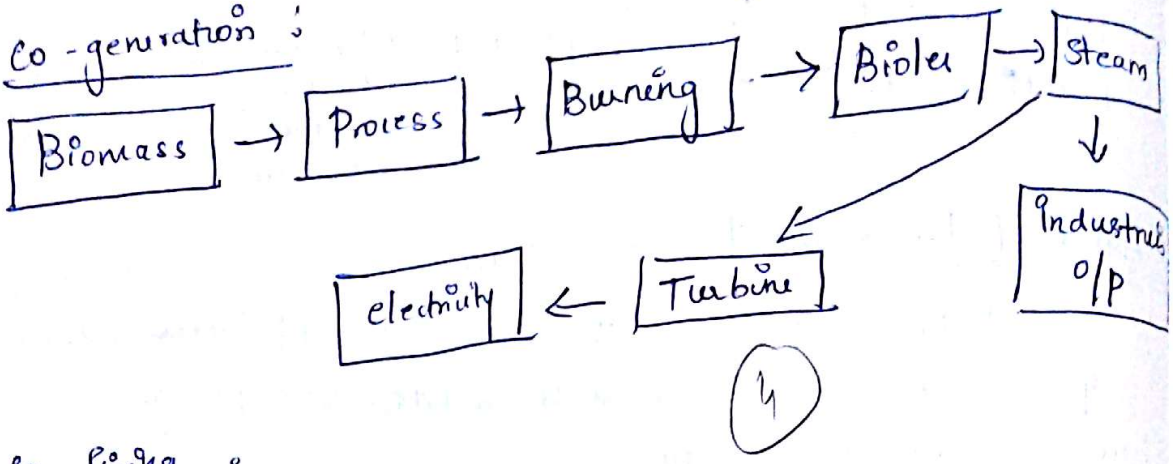
* Dry Process :

o/p is without liquid.

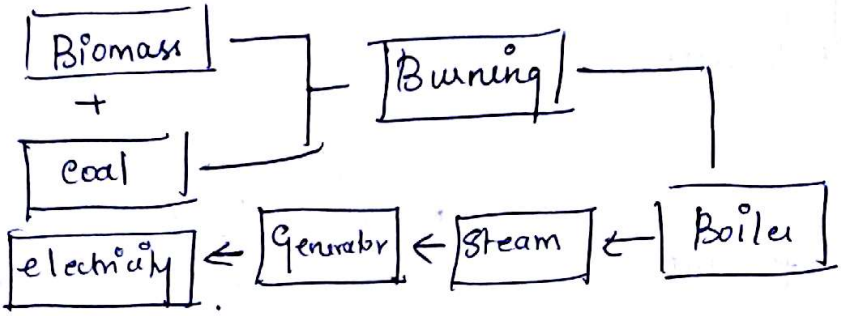
+ Combustion :



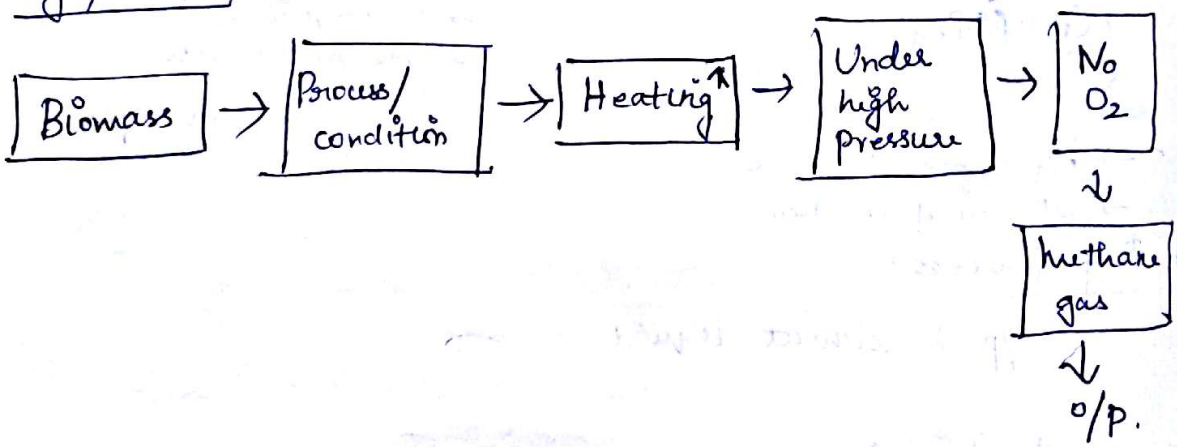
+ Co-generation :



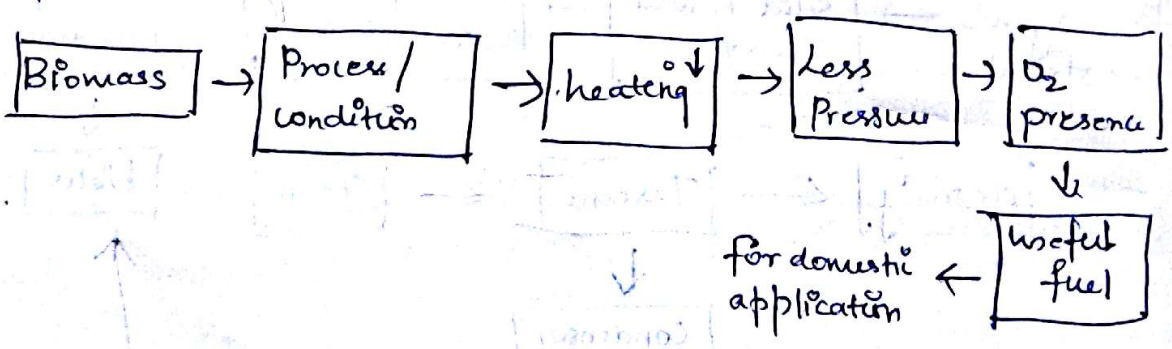
+ Co-firing :



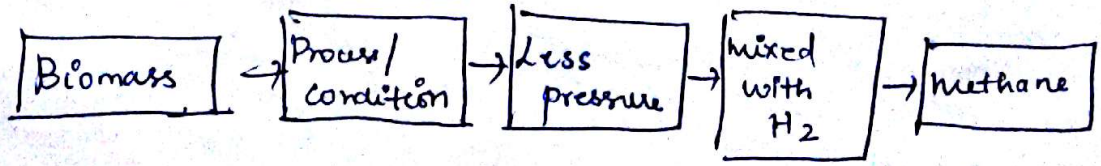
+ Pyrolisis :



+ Gassification :



+ Steam heating formation :



† Hydro structure :

Biomass → heating → high Pressure → Co → methane

• Wet Process : (5)

The process related to production of liquified o/p is called as wet process.

* main concept — decomposition.

* major — anaerobic (no O_2) — High speed → high cellulose
aerobic (O_2) → less speed → less cellulose.

* source for decomposition

↳ yeast
↳ Bacteria — good ✓
bad ✗ disease ✗

* General Block diagram :

decomposition — biomass → condition → closed vessel → Heater → Pressure

No O_2 (remove) ↑ ||

↑ ↓

Pressure ↓ o/p

Liquid o/p used for fuel. ← o/p

‡ Fermentation :

The process of splitting the complex particle into lesser one by means of ferment like Bacteria & yeast to produce ethane.

Biomass → Fermentation → Less complex molecule → heating with high pressure in closed vessel

Biomass: High solid content

Fermentation: Bacteria (good) yeast

heating with high pressure in closed vessel ↓ Water content ↓ duration → Ethane

∓ Chemical Reaction :

* It is a trial process
* under research

Biomass → heating (250°C ↑) → CO_2 → O/P

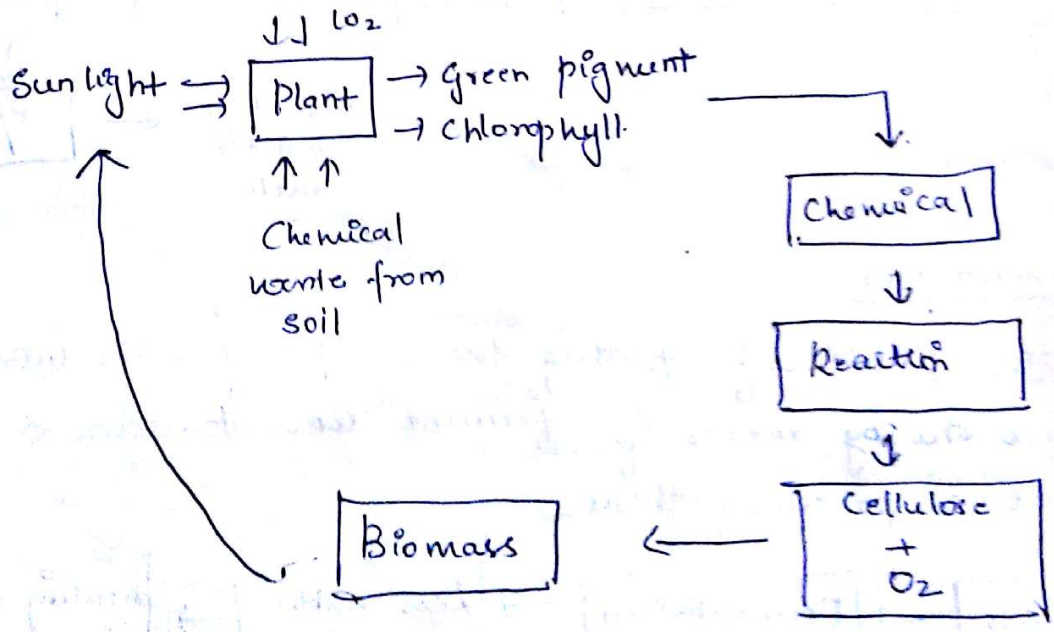
→ Biowaste
→ municipal waste
} source for wet process.

→ Generally
* home hold waste
* vegetable.
*
} All are used as source for wet process.

+ Photosynthesis : 12M

Sun light + Green pigment → cellulose + O_2 → used by living organism } Photosynthesis

cellulose → waste → Biomass



Types of Process :

* light
* dark.

General Equation of Photosynthesis :

$CO_2 + H_2O + Light + Green \rightarrow \boxed{C_6H_{12}O_6} + O_2 + H_2O$

↓
cellulose

(7)

Light Process:

* $H_2O \rightarrow H_2 + O$ → will be liberated out
↓
unknown chemical substance
under the Presence of Light

Dry Process :

H_2 and unknow chemical + CO_2
↓
Chemical Process
↓
O/P → $C_6H_{12}O_6$ → cellulose + O_2

Condition for Photosynthesis

→ Light
→ temp
→ CO_2

* Light from sun → 40 – 60% radiation
* Temp 20 – 40°c
* CO_2 from
→ Animal / human both.
→ combustion
→ vechile
etc.

16/8/11

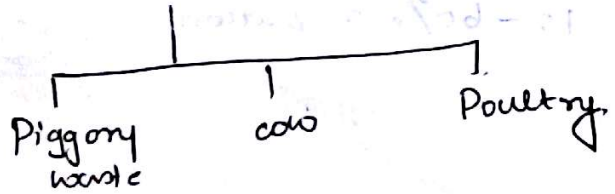
Efficiency of Photosynthesis

At sun radiation it is of → 100 %
Towards the plant it is of 50 %
during photosynthesis – 40 %
Due to many loss of the final efficiency = 23.5

Biogas Generation : 12m

The production of biogases like methane, CO_2 and unknown gases from the biomass source by means of process called as decomposition in the biogas digester plant is called as biogas generation. This kind of gases are directly useful for fuels for vechicle and domestic application. Here the methane production is under 50%. CO_2 production is 30% and the remaining 20% is the combination of unknown gases. This amount of production is determined by cellulose content present in the biowaste and it should be solid waste to the maximum. Minimum 70% of cellulose has to be present in the biowaste inorder to produce the biogases like methane, ethane etc.

* Types of waste :
  - domestic waste
  - animal waste



In this type

* Piggory. - makes the maximum of methane
* As it has more than 70% of cellolyte.

Venue :

Decomposition :

* Diggestor
* closed vessel - maintain with T & P.
* duration - 2 to 3 months.

Overall Process

• Decomposition :

* Aerobic → O_2 – slow
* Anaerobic → no O_2 – speed.

↓

Bacteria

Good Bad.

• Pyrolysis – Biomass → high pressure
• Gasification – Biomass – Low Atmospheric Pressure

* In case of biogas production
  - Enzyme formation
  - methane formation
  - Acid formation

~ Enzyme Formation :

* It is the first process of fermentation
* Here solid particle are decomposed into small particle which become less pH value
* This solves out the enzyme for acid formation
* This all can be performed by bacteria or yeast.

~ Acid formation :

* Special type of bacteria and yeast. are artificially (or) naturally feeded to the biogas plant
* This will speed up to process of methane formation.

~ Methane formation :

* This can be done by time duration,
* This time duration leads to unknown chemical reaction.
* This

Advantages :

(10)

* Less cost
* high effciency
* Less maintanice
* Green gas
* Less time.

▲ Factors Affecting Biogas Generation 12m

+ Hydrogen ion concentration present in the biogas - 6.8 pH.
+ Temperature to be maintained in the biogass plant - 35 - 38°C.
+ solid content present in the biowaste
+ loading and feeding rate
+ uniform feeding
+ diameter to depth ratio of biogas digestor.
+ $CO_2 - N_2$ ratio (30)
+ nutrition present in the biogas
+ mixing of biowaste
+ types of biowaste
+ Pressure to be maintained in biogas plant.
+ Acid and toxic formation inside the digestor.

18/8/16.

- pH value or Hydrogen ion :

Normally @ the starting of process the pH value is 3-5. After the fermentation completed it will be 6-9. We have to maintain this limit 6-9 towards the whole process in order to produce efficient output

- Temperature :

Minimum 10°c is needed to start the process. The normal temperature should be in between 20 to 35%. The maximum allowable temp 40 - 50°c.

(11)

- Solid Content :

The biowaste should consist of 30 - 40% minimum amount of solid content in it and 40% around moisture is allowable. This combination are mandatory for the production of biogas.

- Loading and feeding :

It is explained in the process of loading the biogas plant with respect to the biowaste towards per unit area. It should be constantly maintained in order to make the process continous.

- Uniform seeding :

Eventhough the bacteria and yeast is naturally developed inside the biogas that is not sufficient for production of gas. In order to speed up the gas artifical seeding of bacteria has to done to increase the effeciency.

- diameter to depth ratio of biogas digestor.

This ratio has to maintained in order to maintain P vs T ratio. When the depth increases the temp difference gets changes inturn the process maybe slow down. For this condition we have to maintain diameter to depth ratio.

- $CO_2 - N_2$ ratio :

The presence of nitrogen develops the acid formation process by increasing the bacteria so that the amount of CO_2 liberation will be very high. So if we maintain the CO_2 vs N_2 ratio we can balance the bacteria formation and CO_2 ratio

- Nutrition present in Biogas / Mixing of Biowaste

The Biowaste consists of N no. of nutrition in it. It should be properly mixed so that the pH value is maintained constant which gives rise the increased in efficiency of biogas.

(12)

- Types of Biowaste :

The choosing of biowaste is very important factor in the production of biogas.

1) Minimum 70-80 % cellulose must be there
2) Minimum 40-50 % solid content has to present
3) Generally domestic waste and animal waste are prefered

- Pressure and Acid Formation :

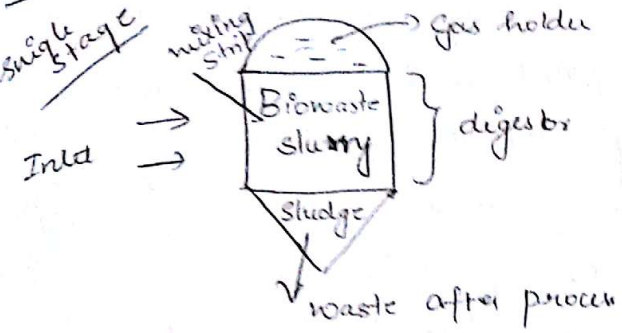
The level of Pressure determines the process of acid formation. According to the biowaste certain temperature and pressure has to maintained inturn the formation of acid increases which liberates the maximum amount of methane.

▲ Types of Biogas Plant :

* Process - Continous - single stage, double stage
  Batch.
* construction - dome, drum.
* According to gas holder - Fixed, Floating.

+ Continous Process :

Single stage

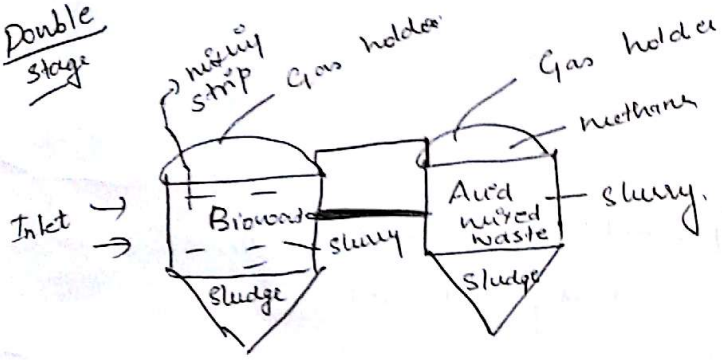


* It is a 24 x 7 process
* continous feeding & continous i/p taken will be there
* The process may stop due to cleaning / or maintance.

* ~~Here~~ here only one digester will be there
* It is a average plant
* All the 3 ~~example~~
  Enzyme, acid, methane } in one plant

13

Double stage



Batch Process :

* 40 → days } feeding
* Process will be discontinous
* Both } the i/p ~~and~~ Vs o/p will be there.

The process } splitting the ~~digesting~~ technical stages in biogas generation is called as double stage continous biogas generation plant. Here the stage 1 deals with enzyme formation and acid formation. stage 2 deals with methane formation alone. Due to this splitation the effeciency at each step increases in turn the final liberation } gas will be more. Here 2 Stages } digestor are used. The cost and the size } the plant is high compared to single stage

- Batch Process:

Here no continous feeding i/p will be there Initially the digestor is filled with biowaste and left as such for 40-50 days for the production of biogas. After the collection of gases the digestor is cleaned and the feeding is started. Here we can get the intermediate o/p. The quality of o/p is very high.

(14)

19/8/12

Dome type:

* Two type.
  - ↳ floating
  - ↳ fixed.

floating → India.
- ↳ digestor / Gas holder or separate
- ↳ it may be in underground level
  - (or)
- ↳ above the ground
- ↳ it may be of circular
- ↳ rectangular.

* digestor is made of civil construction.
* gas holder is made in MSS steel
* cost high
* exposure operator is needed.
* high effeciency.

Fixed → china
- ↳ Both — [Gas holder, digestor] are same in construction.
- ↳ Both with civil construction
- ↳ less cost
- ↳ less efficiency.

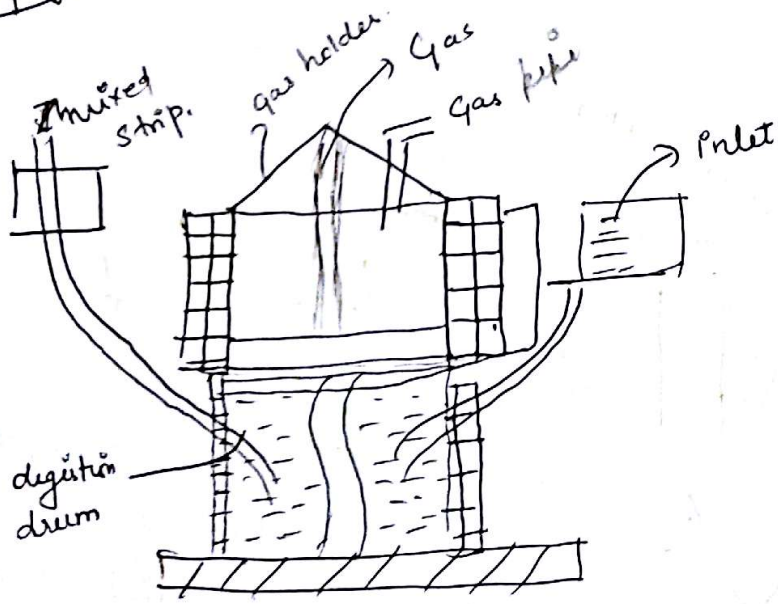
Drum

Two type.

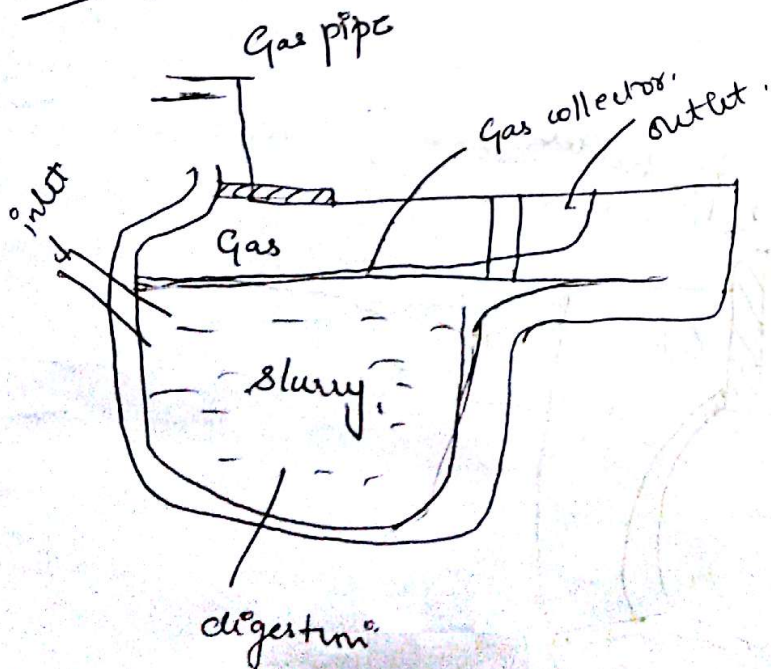
- Air tight → anaerobic
- non-air tight → aerobic.

15

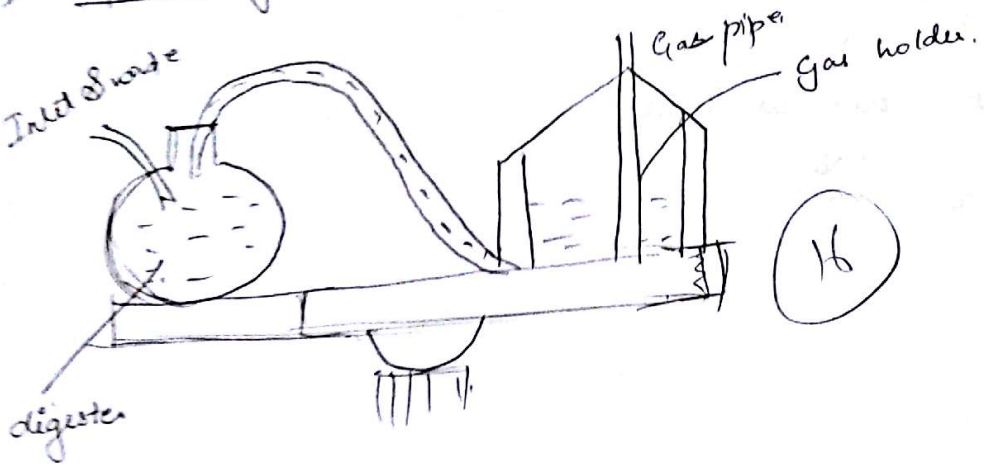
Floating type:



Fixed type

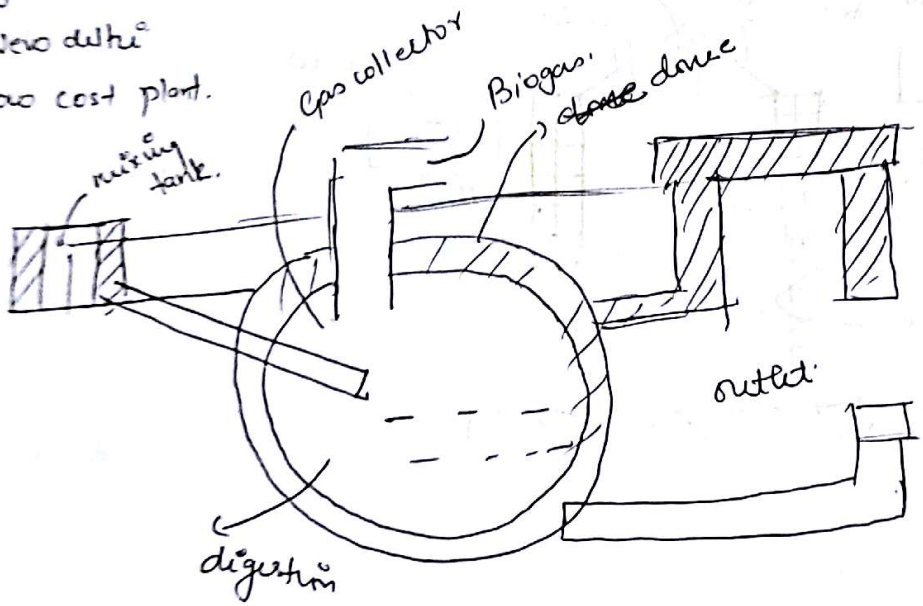


3) Seperate gas holder (Thailand).

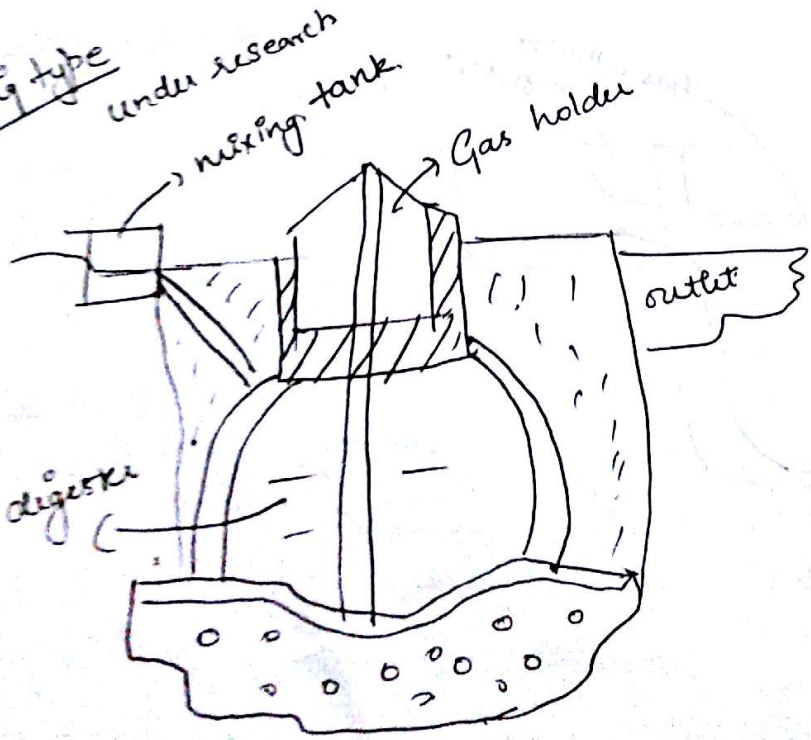


Fixed type

→ New delhi
→ low cost plant.



Floating type



Advantage & disadvantage of floating :

Advantage :

→ No Problem of Gas leakage
→ constant gas Pressure maintained
→ danger of mixing oxygen with gas to form an explosive mixture is minimized.
→ No seperate pressure equalising device is needed

Disadvantage :

→ Higher cost
→ Gas holder requires seperate maintance.
→ heat loss very high

Advantage and disadvantage of Fixed Type :

Advantage :

→ No corrosion material
→ Low cost
→ No maintance is needed

Disadvantage :

→ Less gas production
→ Vaiable Pressure

X ——— X