2016

Topic :- Biological Nitrogen Fixation

ASSIGNMENT

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Index

Introduction

Nitrogen is available in atmospher in high amount (78%) in the form of gas. It is converted into combined form of organic compounds by some prokaryotic micro organisms through biological reactions. The phenomenon of fixation of atmospheric nitrogen by biological means is known as 'diazotrophy' or biological nitrogen fixation' and these prokaryotes as diazotrophs or nitrogen fixers. For the first time Beijerinck (1888) isolated Rhizobium from root nodules of leguminous plants. There after, in 1993. S. Winogradsky discovered a free-living nitrogen fixing bacterium, Clostridium pasteurianum. Then a large number of nitrogen fixers were discovered from different sources and associations. For example, Frankia from nodules of non-legumes, Nostoc from lichens, Anabaena from Azolla leaves, and coralloid roots of Cycas. The diazotrophs may be in free living or in symbiotic forms.

Refference Books

Textbook of biotechnology. R.C. Dubey 442-459

Soil Microbiology - N.S. Subba Rao

A Non-Symbiotic Nitrogen Fixation

1. Diazotrophs

Microorganisms which pass independent life and fix atmospheric nitrogen are known as free living diazotrophs. There are two groups of such microorganisms e.g: bacteria and cyanobacteria. Based on the mode of nutrition. Bacteria are divided into (i) aerobic bacteria (Azonomas, Azotobacter, Beijerinckia, Mycobacterium, Methylomonas), (ii) facultative anaerobic bacteria (Bacillus, Enterobacter, Klebsiella, etc), (iii) anaerobic bacteria (Clostridium, Desulfovibrio, etc.) and (iv) Photosynthetic bacteria (Rhodomicrobium, Rhodopseudomonas, Rhodospirillum, chromatium, chlorobium, etc.)

Among cyanobacteria, both heterocystous and non-heterocystous forms fix atmospheric nitrogen, for example, Anabaena, Anabaenopsis, Aulosira, ~~Calot~~ Cylindrospermum, Oscillatoria, Trichodesmium, etc.

2. Ecology of Diazotrophs

Free living bacteria and cyanobacteria prefer a variety of habitats with varying degree of nutrients, pH, oxygen, etc. Photosynthetic nitrogen fixing bacteria are divided into: (i) non-sulfur purple, (ii) Purple sulfur and (iii) green ~~sa~~ bacteria. Since water is a major components of cytoplasm, adequate amount of water must be required for their vegetative growth. The amount of water governs the concentration of oxygen; therefore, oversupply of water limits gas exchange, lowers the available supply, and finally creates anaerobic condition. Due to water-logging conditions.

Environmental factors which influence number, community size, vegetative growth and activity of microorganisms are temperature, organic matter, pH, inorganic fertilizers, light, oxygen, season, soil and depth. In water-logging fields such as flooded soils, lakes, ponds, rice fields, etc. non-sulfur bacteria grow luxuriantly. Some times ~~there~~ their numbers increase from 10^4 to 10^5 cells/g soil.

3. Special features of Diazotrophs.

a) Sites of N_2 fixation

Sites of N_2 fixation vary in different microorganisms as given below.

(i) Cyanobacteria

Many cyanobacteria capable of fixing nitrogen are filamentous and contain pale and thick walled cell called heterocyst. These are the sites of nitrogen ~~of~~ fixation. Heterocysts are formed in the absence of utilizable combined nitrogen, such as ammonia, because it inhibits heterocyst differentiation and N_2 fixing enzyme, the nitrogenase. Some strains, high light intensity inhibits N_2 fixation. Heterocyst lacks oxygen evolving photosystem II, ribulose biophosphate carboxylase and may lack or have reduced amount of photosynthetic bioproteins. Chlorophyll-a is present in the heterocysts. Wall of heterocyst contains O_2 binding glyco which, together with respiratory consumption. maintain the anaerobic conditions necessary for N_2 fixation In contrast, in vegetative cells adjacent to heterocysts, both photosystem I and II are present.

In other groups of cyanobacteria such as Lyngbya, Oscillatoria, Plectonoma, and bacteria where heterocyst does not develop, N_2 fixation process takes place in internally organized cells. having reduced levels of oxygen.

(ii) Bacteria

Root nodules developed by Rhizobium and actinorhiza formed by Frankia are the site of nitrogen fixation. However lichens are the site of N_2 fixation in lower group of micro organisms.

b) Presence of Nitrogenase and Reductants

All diazotrophs possess an enzyme nitrogenase which helps in conversion of N_2 & to NH_3. Structure of nitrogenase. ~~is give~~ It consist of two brown metalloproteins whose joint action is essential for reducⁿ of N_2 to NH_3

* Component I

Component I i.e, molybdo-ferro-protein (Mo-Fe protein) which is also known as nitrogenase has a molecular weight of about 22×10^5 Dalton. It is a tetramer and made up of two sub-units i.e. α_2 and β_2. Two metal co centres are present on this sub-units i.e, P centre (P cluster pair) and M centre Fe_4S_4 centres. are found from A to P cluster. One Mo-Fe-cofactor subunit contains 1 Mo, 7 Fe, 9 S and one homocitrate, Thus, it is organised as 2 Fe; 4 S and Mo:3Fe:3S cluster. It is a larger unit than component II and non-sensitive to cold but losses activity at $0^\circ c$.

* Component II (Fe-protein)

It is also called dinitrogenase reductase. It has molecular weight of about 5×10^4 Dalton. It consist of iron and sulphur and has one iron-sulphur cluster. It is less the Stable than the component I. The Fe-S cluster acts as redox site. The nucleotide-binding sites are situated at the margins of two subunits.

Thus, nitrogenase is an equilibrium mixture

$$\text{Mo-Fe-protein} + 2\,(\text{Fe-protein}) \rightleftharpoons \text{Nitrogenase.}$$

In addition to nitrogenase, the N_2 reducing system requires Mg ATP as a source of energy and a reductant.

B. Symbiotic N_2 Fixation.

There are some microorganisms which establish symbiotic relationship with different parts of plants and may develop special structure as the site of nitrogen fixation Non-nodule forming diazotrophs, for example, Azotobacter, Beijerinckia, Derxia are known to be intimately associated with the roots of certain plants Azotobacter paspali is restricted to the roots of the tropical grasses, Paspalum notatum and rare to other species of Paspalum or other genera. Beijerinckia shows host specificity with sugarcane root. On the other hand, Azospirillum is known to be associated with the roots of corn, wheat, sorghum. Digitaria decumbens, Panicum maximum and Melinis multiflora, and a ~~he~~ large number of mono- and dicot plants.

Azospirillum is Gram-negative aerobes: it is curved and rod shaped and has polar flagellum. Bacteria are associated with the grass roots in such a way that a gentle washing do not dislodge the nitrogen metabolizing activity. Based on acetylene reduction it has been ~~et~~ calculated that A. paspali. Azospirillum increases yield of cereals amounting to a saving of fertilizer nitrogen equivalent to 20-40kg/ha

In addition to these bacteria, Frankia, Rhizobium sp. and cyanobacteria undergo symbiosis by getting established inside the plant tissues and may or may not develop special symbiotic structures.

Nitrogen fixing bacteria (diazotrophs).

Association with host	Major characteristics
Free-living diazotrophs	
Azotobacter chroococcum	obligate aerobe, heterotroph.
A. vilandii	Obligate aerobe, heterotroph
Azospirillum lipoferum	obligate aerobe, heterotroph
clastridium pasteurianum	obligate anaerobe, heterotroph
Desulfovibrio desulfuricans	obligate aerobe, heterotroph
Derxia gummosa	obligate aerobe, heterotroph
Klebsiella pneumoniae	Facultative anaerobe, heterotroph
Enterobacter sp.	Facultivate anaerobe, heterotroph
Methanobacterium formicicum	Obligate anaerobe, heterotroph
Nostoc, Anabaena, Gloeocaps	obligate aerobe, photoautotroph
Rhodopseudomonas	Photosynthetic anaerobe.
Symbiotic nitrogen fixers	
Rhizobium	Legume symbiosis, forms root nodules which are the site of N_2 fixation, ~~hetero~~ heterotroph.
R. leguminosarum	Symbiosis with pea
Bradyrhizobium japonicum	Symbiosis with soybean
Azorhizobium caulinodans	stem nodule in Sesbania
Mesorhizobium ciceri	Symbiosis with black-gram
Actinomycetes, Frankia sp.	Root nodules Non-leguminous angiosperms, eg: Alnus, Casuarina Myrica, Discaria.
Cyanobacteria	
Anabaena, Nostoc & Lichens	Ascomycetous
A. cycadae coralloid roots	Gymnosperms : cycas.

1. Establishment of Symbiosis

Establishment of Rhizobium inside the host root and development of nodules are a complex process which follow many events such as recognition and infection of host root, differentiation of nodules, proliferation of bacteria and conversion of into bacteroids in nodules.

a) Host specificity and curling of Root hairs

A variety of microorganisms reside in close vicinity the rhizophere, of roots, Depending on environmental conditions and host susceptibility, the phenomenon of host recognition by the specialized microbe is achieved. The level of specilization for symbiosis differs in different microbial group and even in the same group of as well.

Host plant secretes exudates in rhizosphere; subsequently compatible strains of rhizobia are stimulated over the other microbes in soil. Root exudates contain growth stimulating substances like biotin, thiamine, amino acids, etc. Bacteria grow near the root surrounded by mucigel. Mucigel denotes microbial cells and their products together with associated microbial cells and mucilages, organic and inorganic matter in the rhizosphere of root region.

b) Infection of Root Hairs

Rhizobial aggregates have been observed at distinct sites are curled root hairs. Nutman (1956) has suggested that the infection thread is formed by a process of invagina" of the hair cell walls in the region of curling. This process of ~~in~~ until it develops a tube like structure. Following the penetration, a hypha like infection thread is formed. The infection threads resemble to invading fungal hyphae. It is a unique structure which contains a cellulose sheath deposited by the host cell enclosing a strand of hemicellulosic substance in which the bacteria are embeded.

c) Nodule formation

As the infection thread continues to grow through the ~~most~~ root tissue, inner cortical cells are stimulated by bacteria through growth hormone to divide and form an organized mass of infected plant tissue which protrudes from the root surface as a visible nodule. Rhizobia are released from the infected threads, within some of the cortical cells of nodule and multiply thereby rapid cell division, and ultimately occupy the major central portion of root nodule. In morphology ~~bacteria~~ bacteroids appear as swollen, irregular, star shaped, club-shaped, branched or Y-shaped structures. Size and shape of the bacteroids vary in different species of Rhizobium.

2. Factors Affecting Nodule Development.

There are many factors which affect formation and longevity of nodules in roots of leguminous plants. These are (i) concentration of inorganic nutrients (ii) soil temperature (iii) light and shading (iv) CO_2 concentration (v) addition of nitrogen and ~~(vi) rhizosphere microorgan~~ (vi) rhizosphere microorganisms.

3. Mechanism of Nitrogen Fixation in Root Nodules.

A characteristic feature of the healthy root nodules of leguminoids plants is the presence of a special pink or red pigment like haemoglobin often known as leghaemoglobin (LHb)

a Importance of Leg haemoglobin.

LHb has characteristics similar to myoglobin or a variety of haemoglobin found in animal. It is red in colour due to presence of iron. For the first LHb was isolated and crystallized from soyabean root nodules.

LHb is found only in healthy nodules. The unhealthy plants or white nodules donot develop LHb; therefore, N_2 fixation does not takes place in such nodules. Recent studies suggest that the peribacteroid membrane may separate the bacteroids from the oxygen buffering system. LHb regulates O_2 concentration as bacteroids are aerobic and consume O_2.

Oxygen levels above 0.5 atm. inhibit N_2 fixation due to inactivation of nitrogenase by excessive oxygen.

LHb combines with O_2 to form oxyleghaemoglobin (OLHb) and makes it available at the surface of bacterial membrane where O_2 is diffused into it under low concentration of O_2 in root nodule.

$$O_2 + \text{leg-haemoglobin} \rightleftharpoons \text{oxyhaemoglobin}$$

LHb is found only in root nodules of legumes. It is not found in actinorrhizic nodules formed by Frankia in roots of non-leguminous plants.

b) How Does Nitrogenase Work ?

Both the metalloproteins, nitrogenase (Mo-Fe protein) and nitrogenase reductase (Fe-protein) are essential for nitrogenase activity. Fe-protei interact with ATP & Mg^{++}, and Mo-Fe protein catalyses the reduction of N_2 to NH_3, H^+ to H_2O acetylene to ethylene. The reduced ferredoxin or flavodoxin serves as a source of reductant electron transfer during N_2 fixation.

$$N_2 + 16ATP + 8e^- + 10H^+ \xrightarrow{Mg^{++}} 2NH_4^+ + H_2^+ + 16ADP + 16Pi$$

4. Energy and Oxygen Relation in Symbiotic Association.

- Energy is required for the relation of N_2 fixation and host plant supplies the energy. The rhizobia use photo-assimilated carbon via the Krebs cycle and generate energy as ATP. Therefore, rhizobia are a carbon drain on their host. In return plants gets fixed nitrogen. For eg. one third of the net photosynthate can be derived in pea through phloem to the root nodules.

2017

ASSIGNMENT

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TOPIC

CONSTRUCTION OF BIOGAS PLANT AND METHANOGENESIS.

INTRODUCTION

Worldwide energy consumption and demand are continuously growing up. But most of the resources used like petroleum, natural gas, coal are not sustainable sources of energy. Biogas technology seems promising to attain sustainable energy yields without damaging the environment only when it is produced through anaerobic digestion (AD) and recovered properly. It is composed of methane, carbon dioxide, nitrogen, hydrogen etc. Animal wastes, food processing waste and other organic matter are decomposed anaerobically and to produce the biogas.

In 1776 an Italian physist volta demonstrated the presence of methane in marsh gas. Marshy-gases are generated from the decomposition of organic material in the bottom sediments of ponds and streams under anaerobic condition. It was seen that the major composition of marsh gas is methane, hence they are also referred as marsh gases. Biogas is also used for cooking & lightening purpose in rural sector. It have a devoid of smell and burns with a blue flame.

FEED STOCK MATERIAL

They are two source of biomass. That is plant and animal for biogas production. In most biogas plant cattle dung is used for the biogas production.

BIOGAS PRODUCTION- ANAEROBIC DIGESTION

Anaerobic digestion is carried out in and-airtight cylindrical tank, which is known as digestor. A digestor is made up of concrete bricks and cement or steel. It has a side opening (charge pit) into which organic materials for digestion are-incorporated. They lies a cylindrical container above the digestor to collect the gas.

In biogas plant a concrete tank is buildup which has the concrete inlet and outlet basins.

Fresh cattle dung is deposited into a charge pit which leads to the digestion tank. Dung remains in digestion tank after 50 days, sufficient amount of gas is accumulated in gas tank, which is used for household purposes. Digested sludge is removed from the basin and is used as fertilizer. Usually digester are burried in soil, inorder to benefit from insulation provided by soil.

Anaerobic digestion is accomplished in 3-stages.

(i) Solubilisation
(ii) Acidogenesis
(iii) Methanogenesis

(i) SOLUBILISATION

It is the initial stage when feed stock is solubilised by water and enzyme. The feed stock is dissoved in water to make slurry. The complex polymers are hydrolysed into organic acids and alcohol by hydrolyting fermentative bacteria, which are mostly anaerobics.

(ii) ACIDOGENESIS

During this stage the second group of bacteria, that is facultative anaerobic and hydrogen producing acidogenic bacteria, convert the single organic material via oxidation or reduction reactions into acetate, hydrogen and CO_2.

(iii) METHANOGENESIS

This is the final stage of anaerobic digestion, where acetate, H, CO_2 are converted by methane-producing bacteria (methanogens) into methane, CO_2, H_2O and other products. Acetate is one of the substrate of methanogenic bacteria. Hydrogen and CO_2 are general substrate for methanogenesis. Number of these bacteria differ with type of substrates.

FACTORS AFFECTING METHANE FORMATION

(i) Slurry:- proper solubilisation of organic material (the ratio between solid & water) should be 1:1

(ii) Seeding:- In the begining seeding of slurry the small amount of sludge of another digester, active methane evolution. sludge contain acetogenic & methanogenic bacteria.

(iii) pH:- optimum pH of digester should be maintained between 6-8 as the acidic medium lowers methane formation.

(iv) Temperature:- Fluctuation in temperature, lower methane formation because of inhibition in the growth of methanogens. In case of mesophilic digestion - temperature should be between 13-14°c, but in the case of thermophilic, it should be between 15-16°c.

(V) Nitrogen concentration:- Excess amount of nitrogen inhibites growth of bacteria, and there by lowers methane production. Therefore use of such material should be discouraged.

(VI) Carbon - Nitrogen Ratio:- Maximum digestion occurs when C:N (30:1) arrangement of N/C substrate should be done exogenously. According to chemical nature of substrate used in fermentation.

(VII) Creation of Anaerobic condition:- It is obvious that methane production takes place in strictly anaerobic condition. Therefore the digesters should be totally air tight. In Indian condition digestors are burried in soil.

The methane gas is also called as gobar gas, cowdung gas and sewage gas and it is also known as biofuel. Bioenergy and fuel of future about 90% energy of substrate is retained in methane. Biogas is used for cooking and lightening purpose in rural sector.

2018

ASSIGNMENT

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Submitted To:-
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Human Immunodeficiency Virus

HIV is a virus that damages the immune system. Untrea ted HIV affects and kills CD4 cells, which are a type - Immune cell called T cell.

Overtime, as HIV kills more CD4 cells, the body is more - likely to get various types of conditions and cancers.

HIV is transmitted through body fluid that include,

* Blood
* Semen
* Vaginal and rectal fluids
* breast milk.

The virus is n't transfered in air or water, or through casual contact.

Because HIV inserts itself into the DNA of cells, it's a lifelong condition and currently there's no drug that eliminates HIV from the body. However, with medical care, including - treatment called antiretroviral therapy. It's possible to mana- ge HIV and live with the virus for many years without - treatment, a person with HIV is likely to develop a - serious condition called the Acquired Immunodeficiency - Syndrome, known as AIDS.

At that point, the immune system is too weak, to success - fully respond against other diseases, infections and conditions.

Untreated, life expectancy with end stage AIDS is about 3 years with antiretroviral therapy.

AIDS

AIDS is a disease that can develop in people with HIV. It's the most advanced stage of HIV. But just because a person has HIV doesn't mean AID will develop.

HIV kills CD_4 cells. Healthy adults generally have CD_4 count of 500 to 1600 per cubic millimeter. A person with HIV whose CD_4 count falls below 200 per cubic millimeter will be diagnosed with AIDS. A person can also be diagnosed with AIDS if they have HIV and developed an opportunistic infection or cancer that's rare in people who don't have HIV.

If AIDS does develop, it means that the immune system is severely compromised, that is weakened to the point where it can no longer successfully respond against most diseases and infections.

That makes the person living with AIDS vulnerable to a wide range of illness, including.

- → Pneumonia
- → Tuberculosis
- → oral thrush, a fungal condition in the mouth or throat
- → cytomegalovirus (CMV), a type of herpes virus.
- → cryptococcal meningitis.
- → Toxoplasmosis, a brain condition caused by a parasite.

- cryptosporidiosis, a condition caused by an intestinal parasite.
- cancer.

The shortened life expectancy linked with untreated AIDS isn't a direct result of syndrome itself. It's a result of the disease and complications that arise from having an immune system weakened by AIDS.

cases of HIV progress through 3 stages:-

stage 1 → Acute stage, the 1st few weeks after transmission

stage 2 → clinical latency or chronic stage.

stage 3 → AIDS

Some of the ways HIV is transferred from person to person include:-

→ By sharing needles, syringes and other items for injection drug use.

→ By sharing tatto equipment with sterilizing it between uses.

→ During pregnancy, labour or delivery from a pregnant person to their baby.

→ through exposure to blood, semen, vaginal and rectal fluids and breast milk of someone having HIV, such as through a needle stick.

Tests For detection of HIV Infection

Antibody / Antigen test

Antibody / antigen tests are the most commonly used tests. They can show positive results typically within 18-45 days after someone initially contracts HIV.

These tests check the blood for antibodies and antigens. An antibody is a type of protein the body makes to respond to an infection. An antigen, on the other blood, is the part of the virus that activates the immune system.

Antibody test check the blood for antibodies. Between 23 and 90 days after transmission, most people with develop detectable HIV antibodies, which can be found in the blood or saliva.

Nucleic acid test (NAT)

This expensive test isn't used for general screening. It's for people who have early symptoms of HIV or have a known risk factor. This test doesn't look for ~~antibiodies~~ antibodies, it looks for the virus itself. It takes from 5 to 21 days for HIV to be detectable in the blood. This test is usually accompanied or confirmed by an antibody test.

Early symptoms of HIV

The 1st few weeks after someone contacts HIV is called the acute systems infection stage. During this time, the virus reproduces rapidly. The person immune systems respond by producing HIV antibodies, which are proteins that take measure to respond -

against infection.

During this stage, some people have no symptoms at first.

Early symptoms of HIV can include:-

→ fever
→ chills
→ swollen lymph nodes
→ general aches and pains
→ skin rash.
→ sore throat
→ head ache
→ Nausea
→ upset stomach.

Non-specific symptoms

- swollen lymph nodes
- pneumonia
- Recurrent fever
- Night sweats.
- Fatigue.
- Nausea.

Symptoms of AIDS

- Recurrent fever.
- chronic swollen lymph glands, especially of this armpits, neck ~~and~~ g
- chronic fatigue.
- Night sweats.
- Dark splotches under the skin or inside the mouth, nose or eyelids

Rapid weight loss

Sores, spots or lesions of the mouth and tongue, genital or anus.

Memory loss, other neurological problems.

Anxiety and depression.

HIV medications

Many antiretroviral therapy medications are approved to treat HIV. They work to prevent HIV from reproducing and destroying CD4 cells, which helps the immune system generate a response to infection.

Antiretroviral medications are grouped into six classes.

- Nucleoside reverse transcriptase inhibitors.
- Non-nucleoside reverse transcriptase inhibitors.
- protease inhibitors.
- Fusion inhibitors.
- CCR5 antagonists, also known as entry inhibitors.
- Integrase stand transfer inhibitors.

HIV Prevention

There's currently no Vaccine available to prevent the transmission of HIV.

The most common way to HIV to be transferred is through anal or Vaginal sex without any barrier method.

- Avoid sharing needles or other paraphernalia.
- consider PEP. A person who has been exposed to HIV

should contact their healthcare provider about obtaining post-exposure prophylaxis. It can reduce the risk of contracting HIV.

→ consider PrEP - A person has a higher chance of contracting HIV should talk to their healthcare provider about pre exposure prophylaxis. If taken consistently, it can lower the risk of acquiring HIV.

2019

Assignment

Topic: Construction of Biogas plant & Methanogenesis

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Date of submission: 31/03/2021

INDEX

INTRODUCTION

Biogas, which is increasingly used as an alternative source of energy, in today's world where there is crisis of energy. Human civilization has been using energy in different form from the very first day of their existence. Most of this energy comes from fossil fuels, which supply nearly 75% of the world's energy. Biogas plant is one of the alternatives which are efficient, cost effective and hygienic.

Biogas

Biogas consist of methane and CO_2 in the ratio 2:1. The microbial Conversion of biomass into methane was first discovered by Volta in 1776. The biogas is also known as mash gas. It is also known as gobar gas, clar gas and will-of-wisp. Biogas consist of 65% of methane, 30% of CO_2, 1% H_2S and 4% remaining Compounds like oxygen, hydrogen, Nitrogen and CO etc. Biogas is produced by the fermentation affected by aerobic bacteria Called Methanogenes.

Characteristics of Biogas

- Biogas is the Colourless mixture of gases.
- It is a odourless gas which burnt to give blue flame.
- Do not release Smoke while burning
- Do not release kitchen refuce while burning
- Burn with high energy

Production of Biogas

It involves the following steps:

1) Selection of feed Stoke

Organic waste that used in fermentation is Called feed stoke. Generally cattle dung excrete of

Pollutory goat are used as feed stoke for the Production of Biogas. straw, fish waste, plant wast etc are feed stock.

2) Selection of methanogenes

Microorganism which produce methane under aerobic condition are called methanogens.

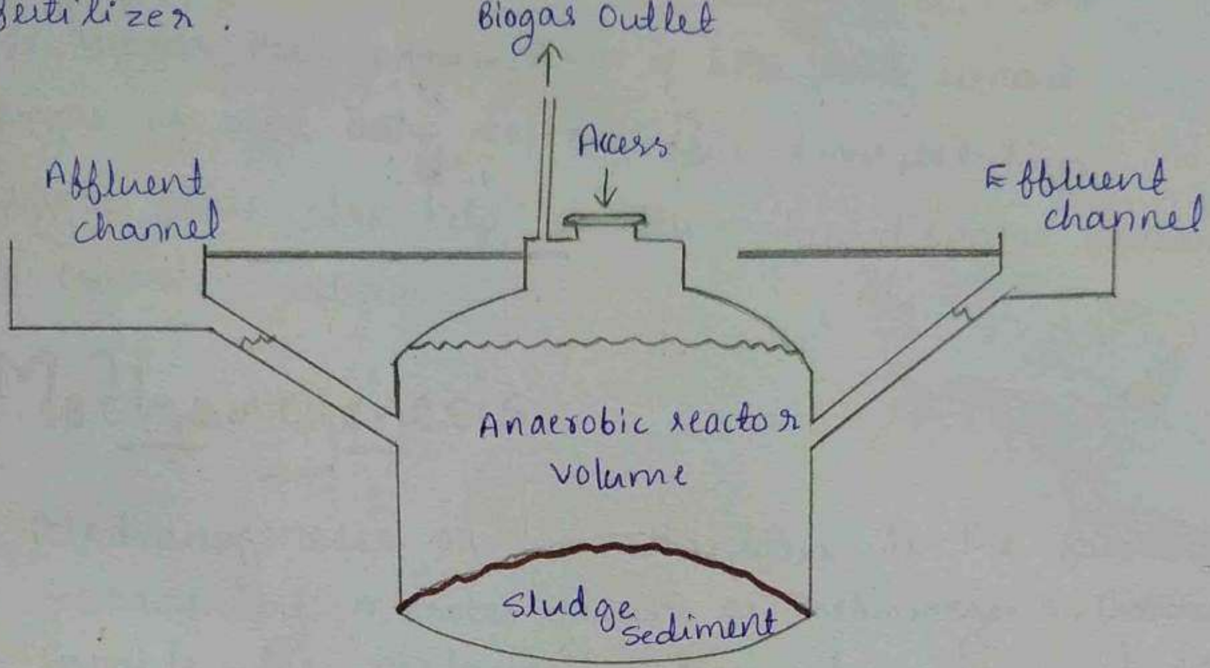
Eg: Methanococcus, Methanobacter, methanospirullum etc.

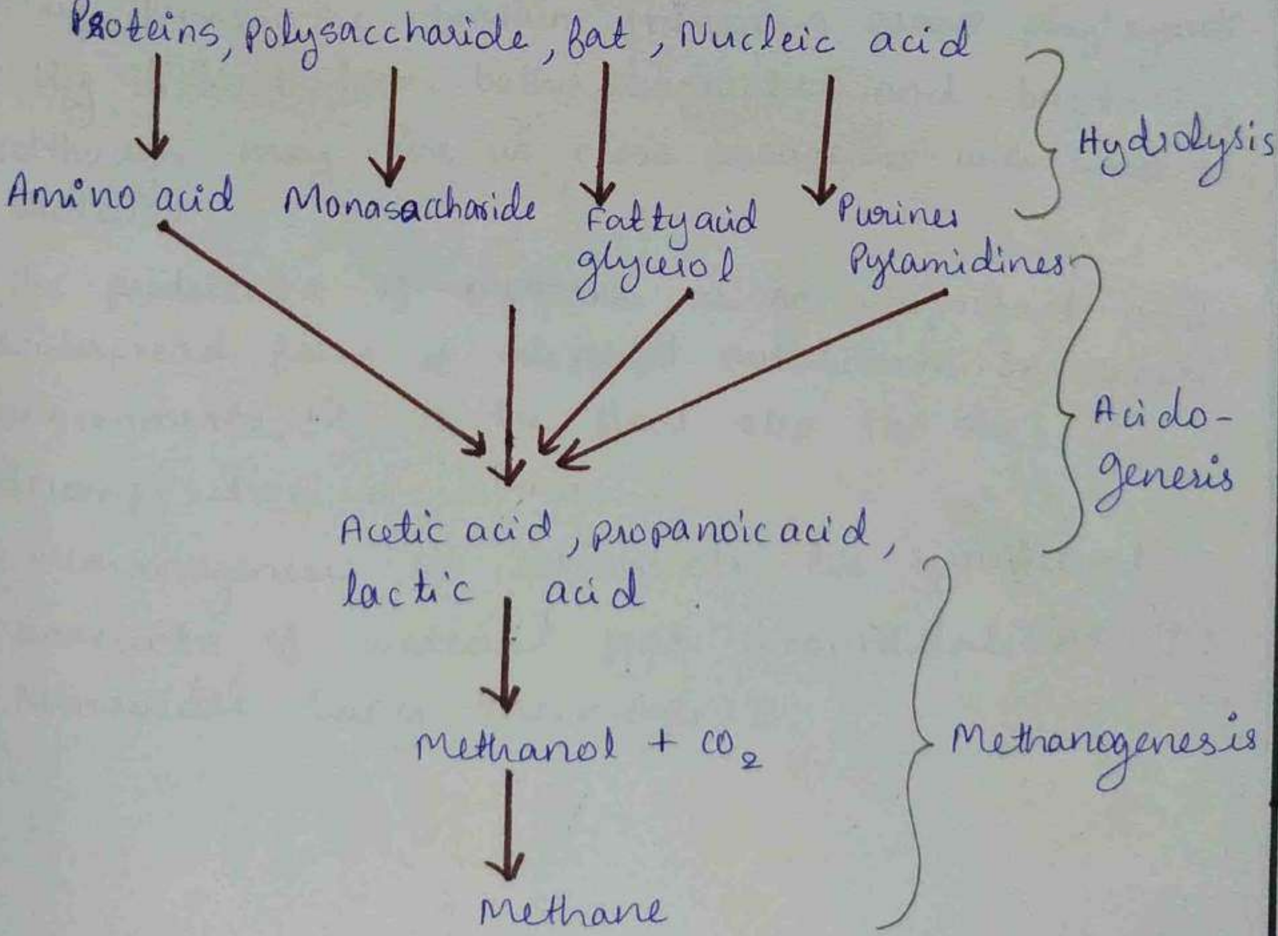
Construction of Biogas plant

- A typical Biogas plant consist of a digestor, gas holder, inlet and outlet.
- Usually the fermentor are a concrete cylindrical tank half immersed in the soil. The digestor is connected to the inlet and outlet provision.
- The feed stocke is converted into a slurry in the inlet in the concentration of 1:1 ratio.
- The slurry is pushed into the digestor, in the digestor anaerobic decomposition of the organic material take place resulting in the release of gases such as methane and CO_2.
- This gases move upon and is collected in the gas holder. This gases are then release through the pipe connected to the gas holder. The remaining sludge after digestion is collected through the sludge outlet.
- A small amount sludge is retained back which

act as a starter for the fresh feed stocke.

• The sludge taken out is dried and used as a fertilizer.





Uses of Biogas

* Biogas is used in house as a fuel gas.
* It reduces the consumption of LPG and wood.
* Biogas is also being tested for transportation.
* Biogas plant also help to reduce the disposal problem of organic matter.

Methanogenesis

Methanogenesis or biomethantion is the formation of methane by microbes known as methanogens. Organisms capable for producing methane have been identified only from the domain Archaea, a group phylogenetically distinct from both eukaryotes and bacteria, although many live in close association with anaerobic bacteria.

- The production of methane is an important and widespread form of microbial metabolism. In anoxic environments, it is the final step in the decomposition of biomass.
- Methanogenesis is responsible for significant amounts of natural gas accumulations, the remainder being thermogenic

CONCLUSION

With the increasing demand of energy biogas demand has also increased. Biogas will soon replace fossil fuels as a source of energy. With this global warming and greenhouse effect will also reduce in the coming years. Awarness and education will most assuredly continue to be the most important ways to spread use of Biogas.

Biogas is a clean source of energy. Biogas Plants have been in operation for a long Period of time, especially in rural areas around the globe. The research organizations should focus on newer efficient low cost designs.

REFERENCE

• www.polyinform.com

2020

ASSIGNMENT

Topic : construction of Biogas plant & Methanogenesis

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Introduction

The chapter concerns with the construction of the commercial biogas plant as well as the small and house hold units. Further more the chapters aims at providing a clear description of the structures and constructions of the anerobic digesters and the used building materials ultimately. The chapter answers an important question:

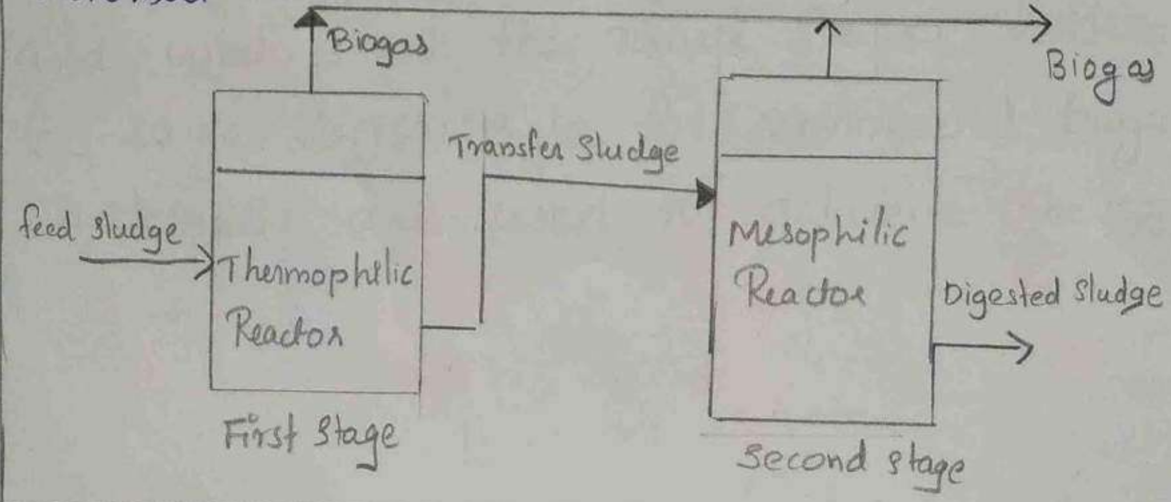
how to buid a commercial biogas plant a household unit, and whar are the construction steps.

Construction Steps

Facility layout

The anerobic digestion can be accamplished in one digester, and thus the facility is called 'single-stage biogas facility'. In other facility layouts, the anerobic digestion can be carried out in two stages. ie, In two different tank in order to optimize the operating conditions, and thus the facility is called 'two stage biogas facility'

Subsequent to the site investigations such as the soil specifications ground water level, the facility layout should be planned. The commercial biogas plant consists of a fermenter and a secondary fermenter or so called "follow-up fermenter" where both have Identical dimesions, usally as follows height of 6m, internal diameter of 23m and external diameter of 23.70m



Dimensions Mating

The marshing of dimensions for biodigester unit should be performed prior to start of excavation work. The marshing is considered as preparation for excavations and construction works. An operational area of 3m width around the digester should be considered, where the workers will use this area to achieve the construction works around the tank base in order to prepare the the structure of the concrete base. ie, the bottom of the digester.

Excavation works

The depth of digging depends on the specifications of the soil. The inclination of the sides should be 30cm for each meter depth for the cohesive soil, 60cm to one meter for the light soil, and 90cm for the sandy soil. The bottom of the pit should be concave, where the center of the digester should be the most concave. A string is linked to the post and used to set the round shape of the pit. for large digesters ie, for commercial biogas plants buldozers are used to achieve the excavation

Preparation of the digester bottom

The pits bottom should be cleaned, and the dridiron is buit using a ~~per~~ pre-selected type of Iron rods as either 606 m^{-1} or 608 m^{-1} Susbsequently the concrete mixture is poured. The water cement ratios is 0.53L kg^{-1} and the cement sand: gravel mass ratio is 1:2:2:3:7 The Thickness of the concrete base ranges between 10-25cm depending on the soil's specification and the ground water level.

Building The digester

In case of commercial biogas plants, The digester is huge as its diameter may reach 25 m.; There fore the concrete structure should be reinforced Hence the iron rods are used to build 2 iron grids to reinforce the digester wall starting from the digester bottom plate. The Standard length of Iron rods is 12m. The Standard Iron rods are cut to shorter Iron rods, and they are then used to build up the tank.

subsequently, either wood panels or pre constructed metal sheets are used to enclose the Iron grids and to from a container for the fluid concrete-when the digester wall is built, about one third of the onternal wall of the tank is covered by a protection layer in order to protect the internal face of the wall against corrostion

In case of house hold unit, burnt clay bricks are used to build the digester and they should be albe to tolerate a pressure up to 100 kg cm^{-2} owing to the fact that the walls of the digester are exposed to the Presure of the soil and the moving equipment near to the digester.

Integrating the heating tubes

Building the digester is associated with integrating the heating tubes. Building the wall starts with struturing the non grids which will be encased by wood panels or pre constructed metal sheets, and before pouring the concreate, the heating tube should be integrated. The water temperature is either 35°c or 55°c depending on the used bacteria as eith mesophilic of thermophilic bacteria respectively.

Building the gas holder

A wood or steel structure in form of umberlla is buit, and then a mesh network is relayed on the umbrella structure. The air supported double membrane cover, which includes the gas holder, is mounted over the structure. The flexible membrane of the gas collector ie, holder, moves up and down as a function of the gas pressure.

The technology That should be installed includes the filling indicater tuber, measuring devices and meters the electrically network, filter cables... etc. Networks The gas collecter should be installed as well as the micro and low presure safeguard and the air Support fan.

Installing The Insulation

This is the process of lining the digester by mortas or using sheets of foam. This is one of the most important construction steps and should be carefully and accurately achieved in case of lining, The process is performed using mortas containg 17 silica. After the completion of the lining, The digester is painted using the petroleum Albumen. on other degins. The walls are heat insulated with a clad with non - corroding and weather - proof aluminium trapezoidal ponels.

Methanogenesis

Methanogenesis or biomethanation is the formation of methane by microbes known as Methanogens. organisms capable of Producing methane have been Identified only from the domain Archaea, a group phylogenetically distinct from both eukaryotes and bacteria, although Many live in close association with anaerobic bacteria. The Production of methane is an important and widespread form of microbial Metabolism. on anoxic environments, It is the final step in the decomposition of biomass. Methanogenesis is responsible for significant amounts of natural gas accumulations, the remainder being thermogenic. Methanogenesis is an anaerobic respiration that generates methane as the final product of Metabolism. on aerobic respiration, Organic Matter such as glucose is oxidized to CO_2, and O_2 is reduced to H_2O. In contrast during hydrogenotrophic Methanogenesis H_2 is oxidised to H^+ and CO_2 is reduced to CH_4.

Methane is produced on the rumen and hindgut of animals by a group of Archaea known collectively as Methanogens, which belong to the phylum Euryarcheota.

Among livestock, methane production is greatest in ruminats, as Methanogens are able to produce methane freely through the normal process of feed digestion.

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Physics

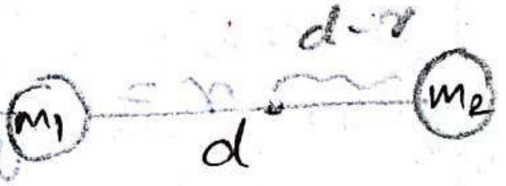
Assignment
Book

(5th sem)

Potentials & fields

1. Two bodies of masses m_1 & m_2 are placed at a distance d apart. S.T. at the position, where gravitational field due to them is zero, the potential is given by

$$V = -\frac{G}{d}\left[m_1 + m_2 + 2\sqrt{m_1 m_2}\right]$$



Ans: At the point gravitational field is zero.

i.e, $-\frac{GM}{r^2}\hat{r} = 0$

Potential, $V = -\frac{GM}{r}$

Let the gravitational field be zero at a point distant r from mass M_1. Then the distance of the same point from the mass $M_2 = d - r$. At the point under consideration, the field due to M_1 and M_2 is zero, ie,

$$\frac{-GM_1}{r^2} = \frac{-GM_2}{(d-r)^2}$$

ie, $\frac{(d-r)^2}{r^2} = \frac{M_2}{M_1}$

$$\frac{d-r}{r} = \sqrt{\frac{m_2}{m_1}}$$

$$\frac{d}{r} = \sqrt{\frac{m_2}{m_1}} + 1 = \frac{\sqrt{m_2}+\sqrt{m_1}}{\sqrt{m_1}}$$

~~$d\sqrt{m_1} = r(\sqrt{m_1}+\sqrt{m_2})$~~

$$r = \frac{d\sqrt{m_1}}{\sqrt{m_1}+\sqrt{m_2}}$$

$$d-r = d - \frac{d\sqrt{m_1}}{\sqrt{m_1}+\sqrt{m_2}} = \frac{d\sqrt{m_1}+d\sqrt{m_2}-d\sqrt{m_1}}{\sqrt{m_1}+\sqrt{m_2}}$$

$$d-r = \frac{d\sqrt{m_2}}{\sqrt{m_1}+\sqrt{m_2}}$$

∴ Therefore, potential at the point is

$$V = -\frac{GM_1}{r} - \frac{GM_2}{d-r}$$

$$= -\frac{GM_1}{d\sqrt{m_1}}(\sqrt{m_1}+\sqrt{m_2}) - \frac{GM_2}{d\sqrt{m_2}}(\sqrt{m_1}+\sqrt{m_2})$$

$$= -\frac{G}{d}\left[\frac{m_1}{\sqrt{m_1}}(\sqrt{m_1}+\sqrt{m_2}) + \frac{m_2}{\sqrt{m_2}}(\sqrt{m_1}+\sqrt{m_2})\right]$$

$$= -\frac{G}{d}\left[\sqrt{m_1}(\sqrt{m_1}+\sqrt{m_2}) + \sqrt{m_2}(\sqrt{m_1}+\sqrt{m_2})\right]$$

$$= -\frac{G}{d}\left[m_1 + \sqrt{m_1 m_2} + m_2 + \sqrt{m_1 m_2}\right]$$

$$= -\frac{G}{d}\left[m_1 + m_2 + 2\sqrt{m_1 m_2}\right]$$

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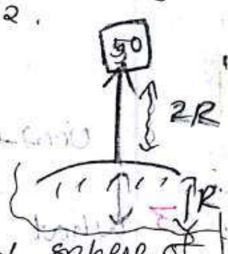
2. If a mass 50 kg is raised to a hight 2R from earth's surface, calculate change in potential energy. $R = 6.4\times10^6$ m, $g = 9.8\ m/s^2$.



Ans: $M = 50kg$

$h = 2R$

~~At earth~~

Potential energy of mass m distance r from a solid sphere of mass M will be given by

$$U(r) = \text{Potential} \times m = -\frac{GMm}{r} \quad (1)$$

(zero potential energy at infinite distance)

$$g = \frac{GM}{R^2} \quad (2)$$

$U(r) = \frac{gR^2m}{r}$ $V = -\frac{GM}{r}$

$GM = gR^2$

Difference of potential energy of mass m between the points at r_1 and r_2 is

$U(r_2) - U(r_1) = -\frac{gR^2m}{r_2} + \frac{gR^2m}{r_1}$.

Here $r_1 = R$ and $r_2 = 2R + R = 3R$

ie, $U(r_2) - U(r_1) = -\frac{gR^2m}{3R} + \frac{gR^2m}{R}$

$= gRm - \frac{gRm}{3} =$

$U(r_2) - U(r_1) = \frac{2}{3} gRm = \frac{2}{3} \times 9.8 \times 6.4 \times 10^6 \times 50$

$= 2.091 \times 10^9$ Joules

3 What is potential energy of a mass of 1 kg on the surface of earth refered to zero potential energy at infinite distance (ii) calculate also its potential energy at a distance of 10^5 km from centre of earth.

Ans: In case of earth (solid sphere) potential energy is given by

$U(r) = -\frac{GMm}{r}$ $m = 1\,kg$, $r = 10^5\,km$

(i) At the surface, $r = R$

$U(r) = \frac{-GMm}{R} = -\frac{(6.67 \times 10^{-11}) \times 5.98 \times 10^{24} \times 1}{6.37 \times 10^6}$

$U(r) = -6.262 \times 10^7\,J$

ii) when $r = 10^5\,km = 10^8\,m$

$U(r) = -\frac{(6.67 \times 10^{-11}) \times 5.98 \times 10^{24}}{10^8}$

$= -3.989 \times 10^6\,J$

4 If a body is to be projected vertically upwards from earth's surface to reach a height of 10R, how much velocity should be given?

Ans: $r = 10R + R = 11R$ from the centre of earth.

If u is the initially given velocity,

$KE = \frac{1}{2}mu^2$

Increase in potential energy

$$= -\frac{gR^2m}{r_2} + \frac{gR^2m}{r_1}$$

$$= -\frac{gR^2m}{11R} + \frac{gR^2m}{R} = \frac{10}{11}mgR$$

$$\frac{1}{2}mu^2 = \frac{10}{11}mgR = \frac{40}{11} \times$$

$$u = \sqrt{\frac{20}{11}\frac{mgR}{m}} = \sqrt{\frac{20gR}{11}}$$

$$= \sqrt{\frac{20 \times 9.8 \times 6.4 \times 10^6}{11}}$$

$$= 10.6 \times 10^3 \, m/sec$$

5. For the earth-sun system, calculate (i) KE and (ii) work which will have to be done in doubling the radius of the orbit of earth.

Ans. For earth-sun system, the KE is

centripetal force for its rotation is given by the gravitational force.

i.e., $\frac{mv_e^2}{r} = \frac{GM_sm_e}{r^2}$ —— ①

$mv_e^2 = \frac{GM_sm_e}{r}$ —— ②

(i) $\times \frac{1}{2} \Rightarrow \frac{1}{2}mv_e^2 = \frac{1}{2}\frac{GM_sM_e}{r} = KE$

$\therefore$ Total energy of earth = $KE + PE$

$$= -\frac{GM_sm_e}{r} + \frac{1}{2}\frac{GM_sm_e}{r}$$

$$TE = -\frac{GM_sm_e}{2r}$$

Earth is bound with sun with this energy, hence -ve sign

$\therefore$ Binding energy $= \frac{GM_sm_e}{2r} - \frac{1}{2}M_ev^2$

② $\Rightarrow$ $= \frac{1}{2} \times M_e \times r^2 \omega^2$

Here $r = 1.5 \times 10^{11} m$ & $\omega = \frac{2\pi}{365 \times 24 \times 60 \times 60}$ rad/sec

$$BE = \frac{1}{2} \times 5.98 \times 10^{24} \times \left[\frac{1.5 \times 10^{11} \times 2 \times 3.14}{365 \times 24 \times 60 \times 60}\right]^2$$

$$= 2.668 \times 10^{33} J$$

When radius of earth's orbit it is doubled, then the final binding energy will be:

$$BE = \frac{GM_sM_e}{2(2r)} = \frac{1}{2}\frac{GM_sM_e}{2r}$$

$$= \frac{2.668 \times 10^{33}}{2} = 1.334 \times 10^{33} J$$

∴ Amount of work done in doubling the radius of orbit

$$= 2.668 \times 10^{33} - 1.334 \times 10^{33}$$

$$= 1.334 \times 10^{33} J$$

6. An artificial Satellite is revolving around the earth at a distance of 620kms. Calculate minimum velocity and period of revolution. Radius of earth is 6380 km; $g = 9.8 m/s^2$.

Ans: $r_0 = 620$ kms.

$R = 6380$ km.

$$\text{velocity} = \frac{1}{2} m v^2 = \frac{1}{2} m r^2 \omega^2$$

$$= \frac{1}{2} \times m (620 \times 10^3 + 6380)^2 \times \frac{2 \times 2\pi}{365 \times 24 \times 60 \times 60}$$

$$\frac{mv^2}{r} = \frac{GMm}{r^2}$$

$$v^2 = \frac{GM}{r} ; \quad v = \sqrt{\frac{GM}{r}}$$

Radius of earth's satellite orbit r

$$= 6380 + 620 = 7000 km = 7 \times 10^6 m/sec$$

$$R = 6380 \times 10^3 m$$

$$\therefore \text{Period } T = \frac{2\pi r}{R} \sqrt{r/g}$$

$$= \frac{2\pi \times 7 \times 10^6}{6380 \times 10^3} \sqrt{\frac{7 \times 10^6}{9.8}}$$

$$T = 5826.30 \text{ sec.}$$

$$\text{Orbital velocity, } v = R\sqrt{g/r}$$

$$= 6380 \times 10^3 \sqrt{\frac{9.8}{7 \times 10^6}}$$

$$v_0 = 7.55 \times 10^3 m/sec.$$

$$\frac{GMm}{r^2} = m\omega^2 r$$

$$\omega^2 = \frac{GM}{r^3}$$

$$\left(\frac{2\pi}{T}\right)^2 = \frac{GM}{r^3} ; \quad T^2 = \frac{4\pi^2 r^3}{GM}$$

$$g = \frac{GM}{R^2}, \quad T^2 = \frac{4\pi^2 r^3}{gR^2} ; \quad T = \frac{2\pi r}{R}\sqrt{\frac{r}{g}}$$

7. Calculate the hight of equitorial satellite which is seen to be over the same point of earth's surface ($T = 24 hrs$).

Ans: Let h be the height of eq. satellite so that the eq. satellite seems over the same point of earth's surface, ie, angular velocity of satellite = that of earth.

Angular velocity of satellite $\left(\frac{2\pi}{T}\right)$

$$= \frac{2\pi}{24 \times 60 \times 60}$$

$$\omega = 7.27 \times 10^{-5} \; sec^{-1}$$

$$\frac{GMm}{r^2} = mr\omega^2$$

$$\frac{GM}{r^2} = r\omega^2$$

$$r^3 = \frac{GM}{\omega^2} = \frac{6.66 \times 10^{-11} \times 5.98 \times 10^{24}}{(7.27 \times 10^{-5})^2}$$

$$= 75 \times 10^{21}$$

$$r = 4.2 \times 10^{7} \, m$$

$$h = r - R = 4.2 \times 10^{7} - 6.4 \times 10^{6}$$

$$= 3.58 \times 10^{7} \, m$$

8. Calculate gravitational self energy of earth. How many calories of heat must have been produced during gravitational condensation of earth from dust particles per gas cloud.

Ans: The Gravitational self energy of the earth is given by

$$U_s = \frac{3}{5}\frac{GM^2}{R} = -\frac{3}{5}\frac{(6.67 \times 10^{-11}) \times (5.98 \times 10^{24})^2}{6.37 \times 10^{6}}$$

$$= -2.247 \times 10^{32} \, J$$

If H be the amount of heat produced in calories during gravitational condensation of earth from the gas clouds or dust particles

$H = \frac{W}{J} = \frac{2.247 \times 10^{32}}{4.2} = 5.35 \times 10^{31}$ Calories

(4.2 Joules $= 1$ calorie)

9. In case of moon, radius $= 1.7 \times 10^6 m$

Mass $= 7.3 \times 10^{22}$ kg.

find (i) The gravitational attraction at surface of the moon.

(ii) Escape velocity from moon.

Ans: $F_g = -\frac{GMm}{r^2}\hat{r}$ $\quad r = 1.7 \times 10^6 m$

$M = 7.3 \times 10^{22} kg$

$g = E = \frac{GM}{r^2} = \frac{6.67 \times 10^{-11} \times 7.3 \times 10^{22}}{(1.7 \times 10^6)^2} = 1.68 \times 10^{12}$ m/s²

ii) Escape velocity, $v_e = \sqrt{\frac{2GM}{R}}$

$= \sqrt{\frac{2 \times 6.67 \times 10^{-11} \times 7.3 \times 10^{23}}{1.7 \times 10^6}} = 7.569 \times 10^3$ m/s.

10. Two particles of masses m and M are initially at rest ~~and~~ at infinite distance apart. S.T. their velocity of approach at any instant under gravitational attraction is $\sqrt{\frac{2G(M+m)}{d}}$ where d is separation at instant.

Ans: From conservation of mechanical energy,

Decrease in PE = Increase in KE

$\frac{GMm}{d} = \frac{1}{2}\mu(v_r)^2$ $\quad \mu = \frac{M \cdot m}{m + M}$; deduced mass

$v_r \rightarrow$ Relative velocity of approach.

$v_r = \sqrt{\frac{2GMm}{\mu d}}$

$= \sqrt{\frac{2GMm}{\left(\frac{M \cdot m}{M+m}\right)d}}$

$v_r = \sqrt{\frac{2G(M+m)}{d}}$

11\. Explain why there is rarity ~~of~~ the atmosphere at the moons surface

Ans. * Moon is relatively close to the sun. This reason is tied closely to the moon having weak gravity. The solar wind from sun helps strip away a weak atmosphere. Earth and Venus do not suffer the same fate since the gravity is high enough to hold the atmosphere in place.

* The value of acceleration due to gravity on the surface of moon is very small (1.68) And hence escape velocity is also very small. The molecules of the atmospheric gases on the surface of moon have thermal velocities greater than the escape velocity. That is why all the molecules of gases have escaped and there is no atmosphere on moon.

12\. Deduce Newton's Law of gravitation from Kepler's Laws.

OR

S.T. Keplers 3rd Law provide evidence that force b/w planet and sun obeys inverse square law.

Ans. Planet P moving in an elliptical orbit around the sun, the sun being at one of the focci. S of the ellipse. Let P be the position of the planet at any time t and Q at the time $(t+dt)$.

Area covered by the radius vector SA in time dt is equal to area ΔSPQ.

i.e, Area = $\frac{1}{2} SP.PQ = \frac{1}{2} r \cdot r d\theta = \frac{1}{2} r^2 d\theta$

∴ Radial velocity of radius vector

$$V_r = \frac{1}{2} r^2 \frac{d\theta}{dt} \longrightarrow (1)$$

By 2nd Law of Kepler, Areal velocity

$$\frac{da}{dt} = \frac{h}{2},$$

i.e, (1) ⇒ $\frac{r^2}{\frac{d\theta}{dt}}$ $r^2 \frac{d\theta}{dt} = h$ —— (2)

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By 1st law, the force is acting radially. Hence the acceleration is radial acceleration.

ie, $a_r = \frac{d^2r}{dt^2} - r\left(\frac{d\theta}{dt}\right)^2$;

Component a_r, along radius vector.

The transverse acceleration of planet (Component a_t)

$$a_t = \frac{1}{r}\frac{d}{dt}\left(r^2\frac{d\theta}{dt}\right)$$

by ②,

$$r^2\frac{d\theta}{dt} = h = \text{constant}$$

Hence $a_t = 0$.

Thus planet has only radial acceleration and no transverse acceleration.

ie, force on planet is directed towards the sun.

$$\frac{d\theta}{dt} = \frac{h}{r^2} \; ; \; \text{ie } r = 1/u.$$

$$\frac{d\theta}{dt} = hu^2$$

$$\frac{dr}{dt} = -\frac{1}{u^2}\frac{du}{dt} = -\frac{1}{u^2}\frac{du}{d\theta}\frac{d\theta}{dt} = -\frac{1}{u^2}\frac{du}{d\theta}hu^2$$

$$= -h\frac{du}{d\theta}$$

$$\frac{d^2r}{dt^2} = -h\frac{d^2u}{d\theta^2}\frac{d\theta}{dt} = -h\frac{d^2u}{d\theta^2}hu^2$$

$$\frac{d^2r}{dt^2} = -h^2u^2\frac{d^2u}{d\theta^2}$$

ie, ~~$a_r = -h^2u^2\left(u + \frac{d^2u}{d\theta^2}\right)$~~

$$a_r = -h^2u^2\frac{d^2u}{d\theta^2} - \frac{1}{u}(hu^2)^2$$

$$a_r = -h^2u^2\left[\frac{d^2u}{d\theta^2} + u\right]$$

We have equation of conic section

$$\frac{l}{r} = 1 + \varepsilon\cos\theta \;/\; lu = 1 + \varepsilon\cos\theta \quad \text{③}$$

diff with θ

③ ⇒ $l\frac{d^2u}{d\theta^2} = -\varepsilon\cos\theta$ — ④

~~Comparing ③ & ④~~

③ ÷ ④ ⇒ $l\left[u + \frac{d^2u}{d\theta^2}\right] = 1$ — ⑤

ie, $a_r = -h^2u^2 \times \frac{1}{l} = -\frac{h^2}{l}\cdot\frac{1}{r^2}$.

$\frac{h^2}{l} = \text{constant} = K$. $\quad l \to$ latus rectum, $\varepsilon \to$ eccentricity

ie, $a_r = \frac{-K}{r^2}$; ie, $a_r \propto \frac{1}{r^2}$.

ie, acceleration and the force acting on the planet inversely proportional to square of it's distance from sun.

Time period $T = \frac{\text{area of ellipse}}{\text{areal velocity}}$

$T = \frac{\pi ab}{h/2} = \frac{2\pi ab}{h}$

$T^2 = \frac{4\pi^2 a^2 b^2}{h^2}$

we have $\frac{b^2}{a} = l$; $b^2 = la$

ie, $T^2 = \frac{4\pi^2 a^2}{h^2} \cdot la \Rightarrow \frac{4\pi^2 a^3 l}{h^2}$ $\left\{ k = \frac{h^2}{l} \right.$

ie, $T^2 = \frac{4\pi^2 a^3}{k}$

According to Kepler's 3rd law, $T^2 \propto a^3$

Attractive force on the planet by the Sun ; $F = -\frac{km}{r^2}$ — (a)

Attractive force of planet ;

$\Rightarrow F' = \frac{KM}{r^2}$

By 3rd law of Newton

$F = -F'$ or $\frac{km}{r^2} = -\frac{KM}{r^2}$.

$\frac{k}{M} = \frac{K}{m} = G$ $\therefore K = MG$

(a) $\Rightarrow F = -\frac{GmM}{r^2}$

13. S.T for an elliptical orbit,

$\varepsilon = \frac{r_{max} - r_{min}}{r_{max} + r_{min}}$

Ans: $F = -\frac{GMm}{r^2}\hat{r}$ — (1)

$F = ma_r\hat{r} = m\left[\frac{d^2r}{dt^2} - r\left(\frac{d\theta}{dt}\right)^2\right]\hat{r}$ — (2)

Comparing (1) & (2)

$L = mr^2\omega$

$\frac{L}{m} = r^2\omega = h$

$\Rightarrow \frac{d^2r}{dt^2} - r\left(\frac{d\theta}{dt}\right)^2 = -\frac{GM}{r^2}$

$\times r^3 \Rightarrow r^3\frac{d^2r}{dt^2} - r^4\omega^2 = -GMr$

$r^3\frac{d^2r}{dt^2} - h^2 = -GMr$ — (3)

Put $r = \frac{1}{u}$; $\frac{dr}{dt} = -\frac{1}{u^2}\frac{du}{d\theta}\cdot\frac{d\theta}{dt}$

$= -\frac{1}{u^2}\frac{du}{d\theta} hu^2 = -h\frac{du}{d\theta}$.

$\frac{d^2r}{dt^2} = -h\frac{d^2u}{d\theta^2}\frac{d\theta}{dt} = -h^2u^2\frac{d^2u}{d\theta^2}$

(3) $\Rightarrow \frac{1}{u^3}\left[-h^2u^2\frac{d^2u}{d\theta^2}\right] - h^2 = -\frac{GM}{u}$

$-\frac{h^2}{u}\left[\frac{d^2u}{d\theta^2} + u\right] = -\frac{GM}{u}$

$$\frac{d^2u}{d\theta^2} + \left(u - \frac{GM}{h^2}\right) = 0$$

ie, $\frac{d^2u}{d\theta^2}\left(u - \frac{GM}{h^2}\right) + \left(u - \frac{GM}{h^2}\right) = 0$

$$u - \frac{GM}{h^2} = A\cos\theta$$

$$u = A\cos\theta + \frac{GM}{h^2}$$

$$\frac{1}{r} = A\cos\theta + \frac{GM}{h^2}$$

$$\frac{h^2}{GM}\frac{1}{r} = \frac{h^2}{GM}A\cos\theta + 1$$

From equation of Conic section,

$$\frac{l}{r} = \varepsilon\cos\theta + 1 \quad \text{——— (4)}$$

$l = \frac{h^2}{GM}$; $\varepsilon = A\frac{h^2}{GM}$.

Total energy $E = \frac{1}{2}mv^2 - \frac{GmM}{r}$ (KE - PE)

~~$E = \frac{1}{2}\frac{L^2}{mr^2}$~~

$KE = \frac{1}{2}m\cdot\left(\frac{L}{mr}\right)^2$

$\therefore E = \frac{1}{2}\frac{L^2}{mr^2} - \frac{GMm}{r}$

$v = \frac{rd\theta}{dt} = r\omega$

$\frac{L}{m} = h$

$v = \frac{h}{r} = \frac{L}{mr}$

If minimum and maximum distances of the planet from the origin are r_{min} and r_{max} respectively.

$$E = \frac{L^2}{2m}\left(\frac{1}{r_{min}}\right)^2 - \frac{GmM}{r_{min}}$$

$$E = \frac{L^2}{2m}\left(\frac{1}{r_{max}}\right)^2 - \frac{GmM}{r_{max}}$$

from (4), $\frac{1}{r_{max}} = 1 - \varepsilon$ and $\frac{1}{r_{min}} = 1 + \varepsilon$ ——— (5)

r_{min} and r_{max} corresponding to $\theta = \pi$ and $\theta = 0$ ($\cos\theta = -1$ & $\cos\theta = 1$)

ie,

(5) ⇒ $$\varepsilon = \frac{r_{max} - r_{min}}{r_{max} + r_{min}}$$

$\varepsilon = 1 - \frac{1}{r_{max}}$

$\varepsilon = \frac{1}{r_{min}} - 1$

$\frac{r_{max} - 1}{r_{max}} = \frac{1 - r_{min}}{r_{min}}$

$r_{max}r_{min} - r_{min} = r_{max} - r$

* Let us assume that the orbit of a planet around the sun in a circle of radius R, then by using Newton's law of motion, centripetal force acting on planet is given by

$$F = \frac{mv^2}{R} = \frac{m(R\omega)^2}{R} = mR\omega^2$$

m → mass of the planet

ω → angular velocity

$\omega = \frac{2\pi}{T}$ T → time period of revolution

$$F = mR\left(\frac{2\pi}{T}\right)^2 = \frac{4mR\pi^2}{T^2}$$

By Kepler's law

$T^2 \propto R^3$ $T^2 = KR^3$.   K → const. of proportionality

$$F = \frac{4\pi^2 mR}{KR^3} = \frac{4\pi^2 m}{KR^2}.$$

$\frac{4\pi^2}{K}$ = a const.

$$F \propto \frac{m}{R^2}$$

$F \propto m$ and $F \propto \frac{1}{R^2}$.   R → distance from sun

but force of attraction is mutual and directed along the line joining the planet and sun, Thus force of attraction is also $\propto^{to}$ mass of sun.

i.e, $F \propto \frac{Mm}{R^2}$ or $F = \frac{GMm}{R^2}$.

G → universal gravitation const.

The above relation show that Kepler's 3rd law of planetary motion provides evidence that force b/w a planet and sun obeys inv. sq. square law.

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English Assignment

19/02/2020

Submitted by :
Arjun Haridasan
Microbiology
Roll no : 34

Sunita Narin is a Delhi-based envionnmentalist and author. She is currently the director general of Centre of Science and Envionnment (CSE) and editor of the fortnightly magazine, Down To Earth. She was born in 1961.

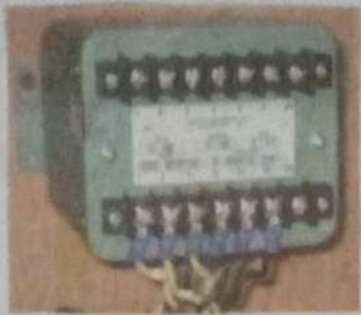
She began working with the Centre of Science and Envionnment in 1982, working with the founder Anil Agarwal, while completing her studies at the University of Delhi. In 1985 she co-edited the State of India's Envionnment report and then went on to study issues related to forest managment. For this project, she travelled across the country to understand people's managment of natural resources. In 1989 Narain and Anil Agarwal wrote 'Towards Green Villages' on the subject of local democracy and sustainable development. In her years at the centre, she has studied the relationship between envionnment and development and worked to create public consciousness ~~and worked~~ about the need for sustainable development. In 2012, she wrote the 7th state of India's Envionnment

Reports, Excreta Matters, an analysis of India's water supply and pollution.

Over the years Narain has also developed the managment and financial support systems needed for the centre, which has over 100 staff members and a dynamic programme profile. In the early 1990s, she got involved with global envionnmental issues and she continues to work on these as researcher and advocate. Her research intrests are wideranging - from global democracy with a special focus on climate change, to the need for local democracy, within which she has worked both on forest-related issues. Narain remains an active participant, both nationally and internationally, in civil society. she is currently in charge of the centre's managment and plays an active role in a number of research projects and public campaigns

she serves on the boards of various organisations and governmental committees and has spoken at many forums across the world on issues of her concern and expertise. In 2008 Narain delivered the KR Narayanan Oration on "Why Environmentalism Needs Equity:

Learning from the enviornmentalism of the poor to build our common future. Narain recived many awards for her contributions to the people and country. She recived the chameli Devi Jain award for outstand Women Mediaperson; In 2004. she was given Padma shri by the Government of India in 2005. she was also awarded a honorary Doctor of Science by the University of Calcutta in 2009. In 2016 Narain was named to Time Magazine's list of 100 most influential people.



SEMINAR PAPER

TOPIC: TRANSDUCERS AND MICROPHONES

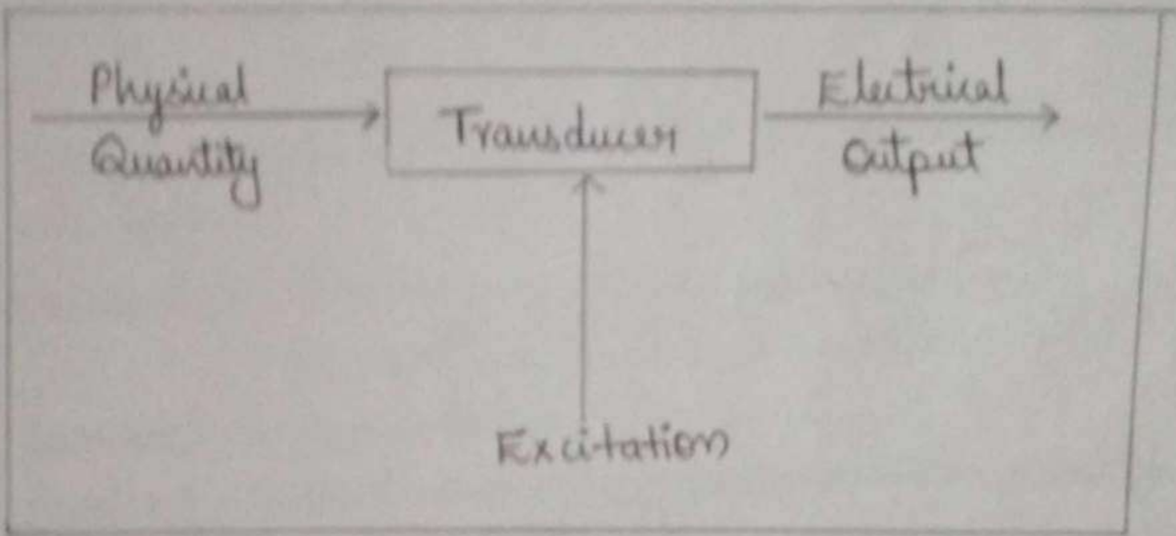
good

Submitted by: Arshitha Vijayan
Ist Bsc. Physics
Roll No.: 4407

Referred book: Basic Electronics
Author: B.L. Theraja

What Is A Transducer?

→ In general terms, a transducer may be defined as any device that converts energy in one form to energy in another form. Most of the transducers either convert electrical energy into mechanical displacement and/or convert some non-electrical physical quantity to an electrical signal.



- The 2 functions of a transducer are:

(i) to detect or sense the presence, magnitude and changes in the physical quantity being measured.

(ii) to provide a proportional electrical output signal as shown in the above figure.

Classification Of Transducers

Transducers may be classified according to their applications, method of energy conversion, electrical measuring principle involved, nature of output signal and so on.

Transducers may be classified into the following groups:

1. Passive transducers – they require an external power supply and their output is a measure of some variation in a physical parameter such as pressure, resistance and capacitance etc.
2. Self-generating transducers – they do not require an external power source. However, they provide an electrical output when stimulated by some physical forms of energy.

A very useful listing of different transducers is given below:

1. Mechanical – strain gauge type for measuring force, torque and pressure etc.
2. Thermal – thermistors, thermocouples
3. Optical – photoconductive, photoemissive and photo-voltaic (solar) cells
4. Acoustical – Microphone
5. Magnetic – LVDT, permeameters
6. chemical – pH and conductivity cells
7. Nuclear – Geiger-Muller tube, ionization chamber
8. Biological – electrocardiograph & electroencephalograph (EEG)

MICROPHONES...

Microphone is an acoustic transducer which converts a sound wave (acoustic energy) into a varying electric current (electrical energy) that can be further amplified and transmitted to distant places by telephone lines or radio. At the receiving end, the electric currents are converted back into sound waves by loudspeakers or headphones. Hence, a microphone plays an extremely important role in broadcasting recording and telephony etc.

• Microphones may be of the following types:

1. Carbon microphone
2. Ribbon microphone
3. Moving-coil microphone
4. Crystal microphone
5. Ceramic microphone
6. Capacitor microphone
7. Electret microphone etc.

1. CARBON MICROPHONE

Carbon when in solid state is a fairly good conductor of electricity. But when packed in the form of powder or fine granules, it offers appreciable resistance which depends upon the closeness of the granules. If pressure is increased on loosely-packed carbon granules, then due to the increase in the contact area of the granules, the resistance is decreased on the other hand, the resistance would increase if the carbon granules were to move apart due to decrease in pressure.

2. RIBBON MICROPHONE

- When sound waves fall on the metallic ribbon, it moves in and out of the magnetic field. Due to the cutting of the magnetic flux, an induced emf is produced in the ribbon whose frequency corresponds to that of the incident sound. Thus, acoustic energy is converted into electrical energy.
- Also known as velocity microphone.
- only sensitive to sounds coming from the front or back but not from sides.

3. MOVING COIL MICROPHONE

- When sound waves fall on it, then due to variations in the pressure of the waves, the diaphragm moves in and out. Since the diaphragm is light and highly flexible, its vibratory motion is more or less faithful reproduction of the sound waveform.
- Both ribbon microphone and moving coil microphone are dynamic microphones.

4. CRYSTAL MICROPHONE

- The action of such microphones depends on the piezoelectric effect exhibited by crystals of quartz, tourmaline and Rochelle salt. Such crystals develop a potential difference across their opposite faces when subjected to mechanical deformations such as squeezing, twisting or bending. The magnitude of the voltage developed is proportional to the extent of the deformation produced and its polarity is reversed when the direction of the deforming force is reversed.

- When sound waves fall on the diaphragm, it vibrates to and fro thereby subjecting the crystal to mechanical stress. Hence, an alternating voltage is developed between the opposite faces of the crystal. This is picked up by the metal plate electrodes and then taken out for further necessary amplification.

5. CERAMIC MICROPHONE

In this microphone, the transducer element has piezo electric properties. Hence, it is just like a crystal microphone.

6. CAPACITOR MICROPHONE

- When sound falls on such a capacitor, its movable plate vibrates to and fro. As it moves inwards, capacitance C increases and hense increases its charging ability. Opposite condition prevails when the plate moves outwards. The voltage variations can be amplified to a level high enough to supply sufficient current for recording.

7. ELECTRET MICROPHONE

It is similar to a capacitor microphone except that it does not require a polarizing voltage for its capacitor. Its transducer element is a self-polarised capacitor called electret capacitor.

ASSIGNMENT

TOPIC:- METALLIC BONDING

Meghasukumaran
Ist MSc. chemistry
Gurudev arts and science college, Mathil.

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CHEMISTRY

Assignment
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AISHWARYA.R
II-CHEMISTRY

(2)

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Seminar

Submitted by,
Shreya. S. Babu
I MA English
Submitted to,
Sruthi Miss

Renaissance Writers

Renaissance (14th c - 17th c)

- Renaissance means 'rebirth' of 'revival'
- The period served as a bridge between medieval and modern western Europe
- It began with the rediscovery of Greco-Roman civilization which had been neglected during the middle ages.
- It emphasised reason, questioning attitude, experimentation and free inquiry
- Featured great achievement in literature, art and science
- It refers to the period of European civilization that was marked by a revival of of classical learning and wisdom.
- Focused attention upon secular society rather than the medieval preoccupation with the church and religious affairs
- It had been the centre of Greco-Roman culture, Italy contained sculpture, building, roads and manuscript

• The Renaissance period can be divided into 4 categories

i) Early Tudor Period (1485-1550)
ii) Elizabethan period (1558-1603)
iii) Jacobean Period (1603- 1625)
iv) Caroline period (1625- 1649)

Early Tudor Period

The Tudor period coincides with the dynasty of the House of Tudor in England whose first monarch was Henry vii.

Elizabethan Period

The Elizabethan is the epoch in the Tudor period of the history of England during the reign of Queen Elizabeth I. Historian often depict it as the golden age in English history.

Writers

William Shakespeare

William Shakespeare (1564- 1616) was an English playwright, Poet and actor widely regarded as the greatest writer in the English language and World's greatest dramatist. Shakespeare also

Spelled Shakespeare byname, Bard of Avon. He also known as England's national poet. His extant work, including collaborations consist of some 39 Plays, 154 Sonnets, two long narrative poem, and a few other verses. At the age of 18, he married Anne Hathaway, with whom he had 3 Children : Susanna and twins Hamnet and Judith. Shakespeare produced most of his known works between 1589 and 1613. His early Plays were Primarily comedies and histories and are regarded as some of the great work produced in these genres.

Works

Poems

i) The Lover's Complaint
ii) The Phoenix and the Turtle
iii) Sonnet 29
iv) Sonnet 71
v) Sonnet 55
vi) Solitary Reaper

Plays

Hamlet - 1603
Romeo and Juliet - 1597

Macbeth - 1623
Othello - 1622
A Mid Summer Night's Dream - 1600
Julius Caesar - 1599
King Lear - 1606
The Tempest - 1623

Christopher Marlowe

Christopher Marlowe (1564-1593). also known as Kit Marlowe. He was an English playwright, Poet, and translator of Elizabethan era. Some Scholars also believe that he greatly influenced William Shakespeare, who was baptised in the same year as Marlowe, and later succeeded him as the Pre-eminent Elizabethan playwright. Themes found within Marlowe's literary work have been noted as humanistic with realistic emotions.

Works

Poems

The Passionate Shephered to the Love
Hero and Leander

Plays

Doctor Faustus - 1604

Tamburlaine - 1590
Edward II - 1592
The Jew of Malta - 1592

Edmund Spenser

Edmund Spenser (1552-1599), was an English poet. He is recognized as one of the premier Craftmen of nascent Modern English verse, and is often considered one of the greatest poet in the English language. He was related to a noble Midland family of Spenser, whose fortune had been made through sheep raising. From May 1569 Spenser was a student in Pembroke Hall (now Pembroke College) of the university of Cambridge. He received a Bachelor of Arts degree in 1573. His knowledge of the traditional forms and themes of lyrical and narrative poetry Provided foundations for him to build his own highly original composition.

Works

The Faerie Queen
Prothalamion
Epithalamion
Complaints

Thomas kyd

Thomas kyd (1558- 1594) Was an Playwright, most imp figure in the development of Elizabethan drama. kyd anticipated the structure of many Plays, including the development of middle and final climaxes. He was educated at the Merchant Taylor School in London. Evidence suggested that in the 1580s kyd become the important playwright, but little is known about his activity.

Works

The Spanish Tragedy - 1592

Arden of Faversham

Sir Philip Sidney

Sir Philip Sidney (1554-86) Was a courtier, Soldier, Poet and was educated at Oxford. He is considered an ideal Englishman. He defended of Poetry against the Puritans in An Apologie for Poetry. He was the friend of Spenser and is represented by him as Sir Calidore in his legend of Courtesy in the Faery Queen.

Works

- Arcadia
- Apology For Poetry
- Astrophel and Stella

Sir Walter Raleigh

Sir Walter Raleigh (1554-1618) born in Devon, educated at Oxford and Studied in London. Chief prose works are The Discovery of Guiana, History of the World etc. He is the mixture of Poet, Scholar and adventure. He is the restless spirit of the Elizabethan age personified.

Works

The Nymph's Reply to the Shepherd

What is our Life

PHYSICS

SEMINAR PAPER

Submitted by :-
Mishkha
Bsc. Physics

2016-17

TOPIC :-

Galileo Galilei & His Contributions

GALILEO GALILEI

- 1564 Born, Pisa, Italy
- 1589 Becomes Proffessor of Mathematics at Pisa University.
- 1609 Makes his first telescope.
- 1610 Publishes The Starry Messenger.
- 1632 Publishes Dialogue, explaining the two theories of the universe.
- 1633 Sentenced by the Inquisition.
- 1642 Dies under house arrest at Arcetri, Italy.

GALILEO GALILEI

Introduction :-

The Italian scientist Galileo Galilei was one of the greatest astronomers and physicists of all time. He was the first person to use a telescope to look at the heavens. He started a branch of physics called mechanics, showing that nature obeyed mathematical rules. His belief that science should be based on observation made him one of the first modern scientists. It also led him into trouble, because his views about the Solar System went against those held by the Roman Catholic Church.

Early life :-

Galileo was born in Pisa, Italy, in 1564. After school he went to the University of Pisa to study medicine. But Galileo was more interested in Mathematics and Physics, and left without a degree. By the time he was 25, he was back at the university as professor of mathematics.

Telescope :-

In 1609, Galileo heard of the invention of the telescope and made one of his own. He used it to look at the heavens and made many astronomical discoveries. He noticed that the planet Venus has phases like the Moon. This gave support to the theory of Nicolaus Copernicus that the planets went around the Sun.

Milky Way :-

In 1610, Galileo built a telescope that could magnify 1000 times. It enabled him to see thousands of stars that no human being had ever seen before. He trained his new telescope on the Milky Way and found that it was a vast collection of stars, clustered together in groups of various sizes.

Planets and moons :-

Through his telescope, Galileo saw what he first thought were two small moons orbiting the planet Saturn. He drew these "moons" in his notebooks. Later observations by Christain Huygens identified these as Saturn's rings. Galileo also discovered the four moons that orbit the planet Jupiter, and was able to examine the craters on our own Moon.

The Starry Messenger :-

In March 1610, Galileo published many of his discoveries in his book, The Starry Messenger. The book also showed that Copernicus was right to say that the Earth moved around the Sun, and that the Roman Catholic Church's idea of an unmoving Earth at the centre of the Universe was wrong. The Starry Messenger infuriated many churchmen.

Gravity :-

Galileo showed that all objects fall at the same speed no matter what their weight. Previously, people had believed that heavier objects fell faster.

Inquisition :-

Galileo's support for Copernicus's idea outraged the Catholic Church because the priests thought that the Earth should be at the Centre of the Universe. In 1633, the Church called Galileo to appear before its court, or inquisition, in Rome. The court ordered him to deny his beliefs under threat of torture. Galileo was forced to agree that Earth was the centre of the Universe, but was heard to mutter, "Yet it does move".

Conclusion :-

Its all about the scientist Galileo Galilei and his contribution. Thanks to Neepa Miss for giving me such an opportunity.

References :-

- Shastra Kouthukam
- Shastra Logam
- Eminent Scientists
- Encyclopedia

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PHYSICS ASSIGNMENT

Submitted by :-
Malavika. V. P
IInd Bsc. Physics
(3)

2017 - '18

Topic

Symmetric operations in crystal

Point groups and Space groups

Crystal Symmetri

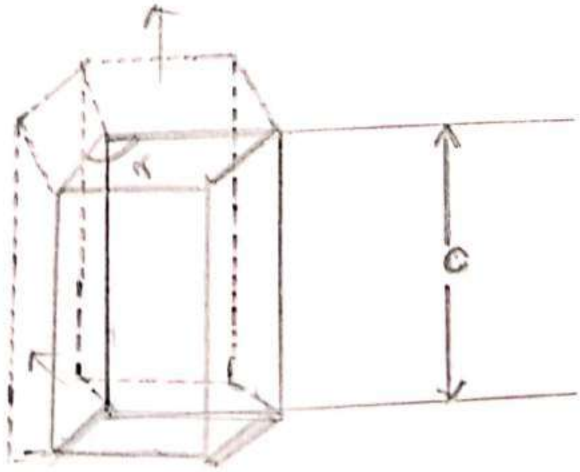
(Symmetry Elements in crystals)

A definite orderd arrangement of the face and edges of a crystal is known as crystal symmetry. A sense of symmetry is a powerfull tool for the study of the internal structure of crystals. Crystals posess differend symmetries or symmetry elements.

Symmetry operations performed about a point or a line are called point group symmetry operations and symmetry operations performed by transilations as well are called space group symmetry operations.

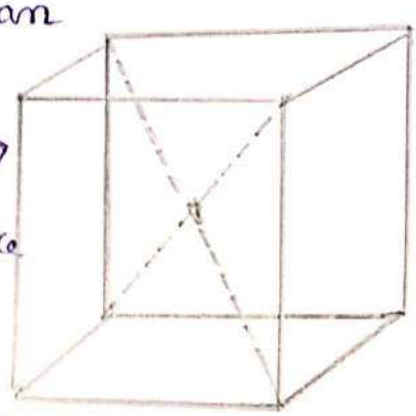
A symmetry operation is a transformation performed on the body which leaves it unchanged or invariant. the following are the type of different point group symmetry elements exhibited by crystals.

- Centre of symmetry
- reflection symmetry
- rotation symmetry



A cube possesses three such pairs of parellel and opposite faces. Hence a cube is said to show a centre of symmetry. this centre of the cube is a centre of Symmetry. This centre lies at equal distance from various symmetrical positions. Centre of Symmetry is also known as inversion centre.

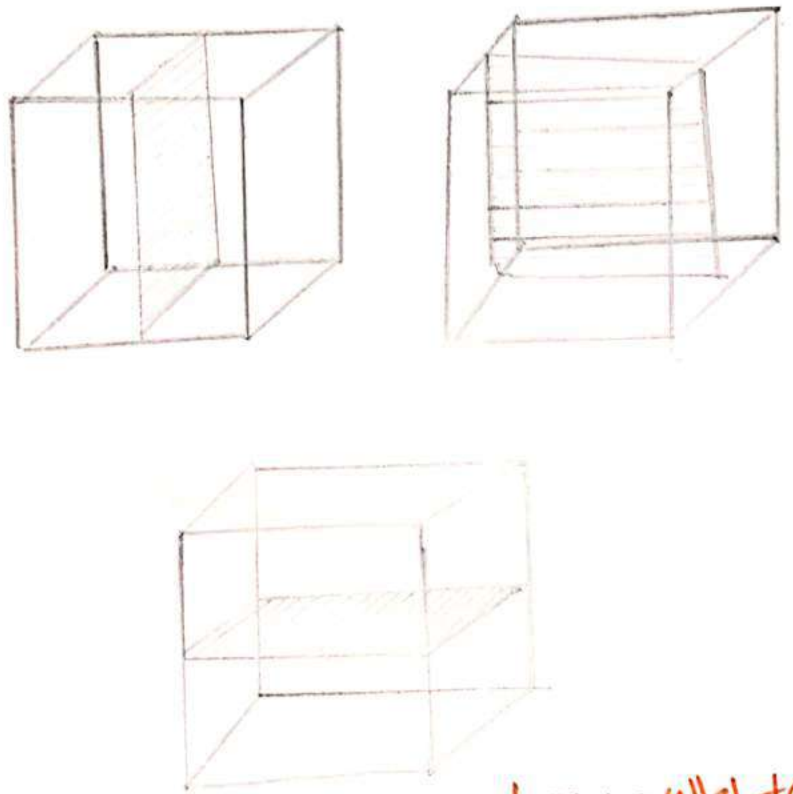
A crystal will possess an inversion centre if for every lattice point given by the position vecter $\vec{r}$ there will be a corresponding lattice point at the position $-\vec{r}$ thus, inversion is a symmetry operation in a crystal equivalent to reflection through a point.



Centre of inversion of a cubic crystal

The second kind of symmetry element in a crystal is a plane of symmetry or reflection symmetry. A crystal is said to possess reflection symmetry about a plane if it is left unchanged in every way after being reflected by the plane. Heighly regular crystals may be bilatterally symmetrical about several planes cutting them in different directions.

The important charecteristic, however, about a crystallographic plane of symmetry which differenliate it from our ordinary conception of a plane of geometrical symmetry, that not only must the plane be such that it devides the crystal into 2 equal portions, but these 2 portions must be so situated that they are mirror images of each other with respect to the plane.



The three planes of symmetry pavellel to the face of the cube

The next kind of symmetry elements is the symmetry - about a line, known as axis of symmetry or rotation axis The axis of symmetry that be defined as a line such that the crystal assumes a congruent position for every rotation $\left[\frac{360^\circ}{n}\right]^\circ$.

Translation Symmetry elements

The translation symmetry elements exhibited by crystals are Glide plane and skcrew Axis.

Glide plane :-

when a mirror plane is combined with a samultanious translation operation in a crystal, one gets a glide plane. The glide plane in crystal is always parellel to the mirror plane

screw ~~pla~~ axis

Just as it is possible to combine the proper rotation with an inversion to produce a hybrid roto-inversion axis. It is possible to combine a proper rotation with a translation parellel to the rotation axis coupled with the translation parellel to the rotation axis will give rise to a new symmetry element called the skrew axis.

A screw axis is usually represented by the symbol. n_m This is performed by a rotation axis will give rise to a new symmetry element called the skrew axis. And also performed by a rotation of $\left[\frac{2\pi}{n}\right]$ and translation of $\left[\frac{m}{n}\right]$ times.

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