Building Services I

Lecture 9

Incineration

Now the term Incinerates means to burn something until nothing is left but ashes. So incineration is the disposable methods by burning the solid organic waste, so it is objective compulsion so as to convert them into residue and gaseous products.

- So it is useful for disposable of residue of both solid waste and also from waste water management also
- It reduces the volumes of solid waste to 20 – 30 percent of the original volume whatever volume of waste we have it can be reduce to 20-30 percent by incineration process.
- This is how a incineration looks like, it is a unit or facility it is used to burn trash if you see here it's like an you know big size of an where you have the burning process is happening here. Now this is the burner or oil will ejected through here, the combustion air inlet is here , you have Grate here so that the residues fall down, then you have the ash door to collect the ash, now the flue gases are let out throw this way. So this will burn the trash and other types of waste until it reduced to ash.
- It is an heavy and well insulated material so the outer line if you see it is a well-insulated it does not give out whatever heat that is inside it will not give out those extreme heat,
- So now this heat as to be kept inside the furnace so that the waste is burned quickly or efficiently.
- If the heat is allowed to escape the waste will not burn completely or rapidly also, now it is also consider the practical method of certain hazardous waste material. So this incineration is a process we usually know do by assels even at home. So these dry leaves or anything like that we generally burn it so that is basically an incineration, so it's a controversial method of waste disposable because emission of gas is possible whenever you burn something smoke is going to come out, so that becomes the controversial point for in using this systems

VERMI CULTURE

- So this is like artificial rearing or cultivation of worms we cultivate the worms ourselves that is your earthworms and these worms will degrade your solid waste, so it is the scientific process so that the betterment of human beings, so that the environment is not affected in anyway
- So it is Vermi compost is the excreta of the earthworms which is rich in humus
- Have you see here this is how your vermin composting earth worms look like

- So what they do is the earthworms eat cow dung or farm yard manure along with other farm wastes and it will be pass through their bodies and then it will convert it into vermicompost, so basically it is the excreta of this earthworms
- The municipal wastes; non-toxic solid and liquid waste of the industries and household garbage's can also be converted into vermicompost in the same manner.
- So they don't not only convert the garbage into valuable manure, they also keep the environment healthy, so the excreta of this worms used as a very potential fertilizer.
- Conversion of garbage by earthworms into compost and the multiplication of the earthworms also happens there. So it is a very simple process and even farmers can handle it, so it is very localized form of solid waste disposal

Advantages of Vermicomposting

Now what are the advantages when it comes to vermicomposting,

- It's an eco-friendly natural fertilizer can be prepared from this and also biodegradable organic waste and free from any chemical inputs. We don't add anything else other than your earthworms
- It does not have any adverse effect on soil, plant and environment whatever the comes out of the earthworm also which is not harmful for the soil, environment and the plants
- It improves the soil aeration, texture and thereby reduce compaction, so there natural process of soil aeration is improved by this the texture is improved so it is very advantageous
- It improves the water retention capacity of soil because of its high organic matter content. So the water also retain its water capacity because this is again a organic matter whatever that comes out of vermicompost
- It promotes better root growth and nutrient absorption happens when it is fed as a manure
- It improves the nutrient status of soil both the macro nutrients and the micro nutrients and the whole it is the very advantageous through the agricultural people

Precautions

Precautions we have to take it even though it is very simple and easy to do

- Vermicompost pit should be protected from sun light, direct sun light should never fall on this vermicompost pit
- To maintain moisture level, spray water on the pit as an when required. So these as to be kept very watery moisture should be present in that is why we say not have direct sunlight because direct sunlight will evaporated and make it dry.

- When you have to protect the worms from ant, rat and bird you should make sure the worms are not eaten by this people.

Aerobic & Anaerobic Digestion

- Now this is the condition, this is created during the exposure of organic waste. So the organic waste are collected and when it is expose to your natural air, aerobic digestion takes place.
- It is the bacterial process in the presence of oxygen, so here you see naturally present bacteria in the air will make this process happen, it will be laid in a trench or a pit, so the waste is applied here in airs, so what happens is here the black one what you see is the older and you know the black one that is the older compose which is already been composed. So if you see this green and yellow color these are the grass cuttings and straw. So this is kept that there is easier aeration is possible and then you have a cover to keep the heat in so this also needs the heat and water has to be retention has to be there so you place the cover here so that the heat is whatever is inside that is maintain and also the water is retained. So these walls here it has a small gaps so that they allow air circulation so the air is to circulate in the entire portion so that is what aerobic digestion is main about, so the bacteria which is present in the air will eat away all this solid waste and that will come as a you know that will be the bacterial process occurring in the presence of oxygen.
- So this bacterial consumes the organic matter and convert it into carbon-di-oxide, water and lower molecular weight organic compounds. So that it doesn't harm the environment.
- So the heat produced we are maintaining the heat know will also produce some more heat it is sufficient to kill harmful bacteria and pathogens, so if you have any harmful bacteria or pathogens in the you know waste that dump there that will be held by the heat produced by this composting and these are adopted to this environmental conditions. It also supports the growth of beneficial bacteria species like psychrophilic, mesosphilic and thermophilic bacteria which thrive at the higher temperature levels. This bacteria in their also grow and multiply, so when the bacteria that grows in multiply and this types of bacteria which thrives at higher temperature so you have a better composting.

THE ADVANTAGES OF AEROBIC DIGESTION

- This occurs faster than your aerobic digestion so the capital cost of aerobic digestion are lower

- The process is usually run at ambient temperature and the process is very less complex when compared to your anaerobic digestion that will be looking into later
- This is easier to manage also

Disadvantages

The disadvantage will be like operating cost is greater, operating cost is the way you cost involved in preparing it because energy used by blowers, pumps and motors needs to add the oxygen to the process, see the aerobic digestion is bacteria thriving the presence of oxygen, so to maintain the oxygen you have to keep on using the blowers to heated or to circulate the air use pumps and motors to know retain the moisture so these are all done to add oxygen to the process that is the operating cost that we talk which will be greater because of the energy used in things

The digested sludge is relatively low in residual energy and the energy is very low and then your anaerobic digestion, what they are suggesting here is you have some energy being produced out of this process, out of this system but the energy is very low so compare to your anaerobic digestion because that energy can be which is of byproduct can be used for some other thing but in aerobic digestion that is not possible

ANAEROBIC DIGESTION

- This involves like you breakdown the organic matter into a biomass such as animal, dung, human excreta, leafy plant animals like that
- So it is done by micro-organisms in the absence of oxygen to produce biogas. So the major difference between the aerobic digestion and anaerobic is oxygen will not be present in anaerobic digestion but you have the same microorganism to compose it
- There is the by product is called biogas this is the mixture of methane and carbon-di-oxide with the traces of hydrogen sulphide.

So if we look at the picture we can understand how it works, these are the waste that you have that is the easy degradable organic matter and water is added and difficult to degrade organic matter also taken inside then you have a soluble monomers and organic acids which will convert into methane or CO_2, the water will remain as the water and this difficult to degrade and organic matter also will be converted into residual organic matter.

- So it breakdown even the non-degradable to certain level of degrading.

Advantages of Anaerobic Digestion

- The generation of biomass that can be used for various thermal applications or for power generations, so this is the main advantage going for a anaerobic digestion
- Biogas is a clean fuel as it is smokeless and thus does not cause health hazards of eye, throat and lung. Why we consider bio gas is a better product because it is very it is a clean fuel, clean fuel in the sense like it is not produced by using any renewable and non-renewable systems. So it is a clean fuel and it is smokeless and it does not also and it doesn't any health hazard though methane and carbon-di-oxide are present, it does not give any health hazards
- Digestion sludge can be used as manure in place of chemical fertilizers. So apart from biogas which is the gas that is produced another byproduct producing is a digested sludge, so this is again used as a manure in place of chemical fertilizers again leading to a better environment

Disadvantages of Anaerobic Digestion

- Small and middle scale anaerobic technology will be like is very new for like low income countries it is very still new
- Because anaerobic technology is for larger scales, so going for small and middle scale is not really is highly still not you know use to in smaller countries low income countries.
- Experts are required for the design and construction because if got add so many features to it depending on the scale the operation and maintenance cost also may go up
- Reuse of produce energy that is transformation of this fire or light, heat and power that has to be established again it's a technical process that the byproduct can be used as a another type of system.
- Its high sensitivity of methanogenic bacteria to a large number of chemical compounds, the bacteria that is being used here it is like it is very high sensitive
- Sulphurous compounds leads to odour, it also gives sulphurous compounds that will definitely create some odour in this process

BIOGAS

- Biogas which is a product of anaerobic digestion, the process is called Bio gasification or Biomethanation it is the process of conversion of organic matter in the waste it can be either liquid or solid to Bio methane so that is what we call it as "Biogas" it has a high energy density and manure by microbial action in the absence of air known as "anaerobic process or digestion". So the organic matter in the waste is converted into biogas by microbial action so that is the just of it

- Biogas is a mixture of gases what you can find is methane will be 40-70% of the volume, carbon-di-oxide will be 30-60% of the volume and other gases will be 1 – 5% of the volume also you have a hydrogen of 0-1% of volume and hydro sulphide 0-3% of the volume this is the basic composition of the biogas
- So now this originates from bacteria in the process of biodegradation of organic material anaerobic condition that is what we saw already.
- So the natural generation of biogas is an important part of the biogeochemical carbon cycle

You see the flowchart here this water is waste feed this is the material it goes to the digester and the digester will give of the gases that is your biogas that is taken to biogas storage vessel is there from there that biogas taken to your as a vehicle fuel, turbine or generator fuel, gas burner or boiler, now the other product that is your separator that will be pressed for your liquor storage and fiber that is your that is what we can said converted into manure. Now the methanogens is a methane producing bacteria it is last link in the chain of microorganisms, so this will degrade the organic material and return the decomposition products in the environment. So this biogas which is generated a renewable energy what we call.

- This can yield a whole range of benefits for their users, the society and the environment in general. So what are the benefits you get out of this biogas is production of energy like you can produce heat, you can produce light and also you can produce electricity out of biogas
- Transportation of organic waste into high quality fertilizer, the other product your high quality fertilizer
- Improvement of hygienic conditions through reduction of pathogens, warm eggs and flies. So this of producing biogas or anaerobic digestion you will not have any unhealthy conditions
- Reduction of workload in firewood collection and cooking; So when you use biogas as a fuel for your cooking you can reduce the firewood collection, the workload of the firewood in cooking, so that it's an energy friendly cooking, energy fuel.
- Environmental advantages through what you and all get it to the production of soil, water, air and woody vegetation, any other aspect if you see you have all the environmental advantages when you produce a biogas
- Micro economical benefits there will be like through energy and fertilizer substitution, additional income generation and increasing yields of animal husbandry and agriculture. So for this biogas you need cow dung and agricultural waste, so when you see the benefits of biogas it will leads to increase the yields of animal husbandry and agriculture, again the biogas generation is the additional income generation so whoever generating the biogas it can be it can substitute the fuel and this income generation, it is

also the fertilizer substitution, disposed means the sludge the comes out of it again substitute for the chemical fertilizer.

- Macroeconomic is the greater advantage is if you see decentralized energy generation, import substitution and environmental protection on larger scale you can see you have a decentralized energy generation it is not specific to one particular organization or corporation, it is a decentralized anybody can produce the biogas, it imports the substitution and environmental protection it is also environmentally protected and it import whatever you import as fuel is being substituted with the biogas.

BIO GAS PLANTS IN INDIA

Components of Biogas Plant

- It has a digester in which the slurry the cow dung whatever you have and that is mixed with water and fermented.
- It is an inlet tank that is used to mix it and feed it into the digester, so this is going to be a digester, so whatever thing you have that is feed into the digester this is the digester and then you have a dome shape like this, this is your gas holder when the anaerobic process takes place the gas will be contain in the dome shape thing and this taken out by delivery pipe and the residual sludge will be taken out through this outlet and it will be let out into the natural waters are used as fertilizer.
- The glass holder or dome where it is collected outlet tank to remove the spent slurry
- Distribution pipe that is from this dome shape thing you have a pipe that goes from that you can be distributed wherever you want
- And the manure pit, where the spent slurry is stored.

Now when we look at the Biogas plant in India, it is done in a very large scale it began in the mid 70's and the process it can be gone through in the lot of process and is when consolidated there is a separate authority like called (NPBD) National Project on Biogas Development initiated by the ministry of Non-conventional energy, so biogas is very big you know it is in a large scale in India. So when it started they had this falling objectives and it still continuing, the objectives are to provide fuel and cooking purposes and organic manure to rural households through biogas plants, so you providing fuel for cooking purposes and organic manure through biogas plants. Then mitigate the drudgery of rural women, reduce pressure on forest and accentuate social benefits. See reduce pressure on forest is like they usually firewood's they not using your LPG's and all there, so in rural areas they use firewood so that is the pressure on the forest they go and cut down trees and bring in the firewood so that is used and accentuate social benefits whatever benefits you have that is given to the society that is more enhanced. Then the other objective is to improve sanitation in villages by linking toilets with biogas plants,

so in villages if you see generally this toilets and hygienic conditions are not met up to the standards, so when you have a biogas plant it improves the sanitation so the collection happens in specific banner and it is disposed of a safer manure. So the improving sanitation is a very important objective of the biogas plant in India.

Sewage Treatment Process

This is the liquid waste, now the main contaminants in the domestic sewage are

- Biodegradable Organics
- Suspended Soils
- Pathogens

So this two the biodegradable organics and suspended solids, they are consider as the performance indicator for various treatment units because whatever sludge or sewage is collected has to be treated and this two determining deriving factors of sewage treatment.

Now in general the objective of the waste water treatment is the BOD must be less than 30 you have to bring down the BOD whatever it is there to 30 mg/L and suspended solids (SS) should be less than 30mg/L, so that the disposable when it is done to inland water it is safe and it is not any harm to the environment, so to do this we have to take up very elaborate process has to be done,

So how is the process done there is the conventional flow thing that I have shown here, here if you see so this is how generally sewage treatment plant will look like, so this is the community where it is the sewage water is collected, there will be preliminary screening and then here you will have a before reaches the Settling Tank and filter where the grit and any floatable matter will be you know screened and it will be remove then you have a primary settling tank here the sewage is collected and left down to settle down similar to your septic tank so here after it is settle down the remaining sludge will be taken to either and activated sludge process tank or it will taken to a trickling filter for the secondary process of treatment. Now whatever the sludge is settledown here that will be taken out, now this two again that is what screening, grit removal and primary settling tank this will be a first stage and followed by the aerobic biological treatment that is what your activated sludge process and trickling filter is and then you have this sludge removed from this two process that is primary and secondary process, it is followed by the anaerobic process, so from here again it is goes to a secondary settling tank so this is the primary and this is the secondary, the sludge that is collected from this two plants will be taken to your anaerobic digestion tank, Here this will be treated to your you know put your microorganismsand then it will be rented harmless and then it will be sent on to yours sand drying beds

So now this activated sludge process or trickling filters that is actually a costly process, so it can be made as a low cost treatments by dividing such as

- Oxidation ditch
- Aerated lagoon or
- Waste stabilization ponds

So why you need these devices because it obviates the necessity of some unit operations and processes like primary sedimentation and anaerobic digestion. So if you do this process if you already have this is will be a simpler and very effective process so from the pump station you have your inlet screening and primary clarifier that is your primary settling tank from there it goes to the activated sludge, now instead of this activated sludge or clarifier you can directly take it to your oxidation ponds, now this oxidation ponds will give the it will evaporate whatever it's there, in the sludge will be taken and it will be apply to the dry solid bed.

So this is the very cost effective and better solution instead of going for a activated sludge process because if we go for activated sludge process you have to go for the anaerobic process which is costlier and economically is not efficient. So this is what sewage treatment plant usually works