Course on Integrated Waste for a Smart City
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Module 10
Lecture No 47
Landfill Disposal (Contd.)

Okay so welcome back so today I will talk about how to predict landfill gas production, so if you remember so far in this in the landfill aspect we looked at from the very beginning in terms of liner requirement, what are the different types of liners then we talked about some of the construction issues, how the different type types of drawings are to be made, we also talked about the like a professional practice issues that are permitting and how the permit document works, how the construction supervision is done and all the QA, QC requirement associated with that.

And in the last module we covered the aspect of how to predict the leachates, because when you try to do the leachate collection system, if you remember in terms of landfill what I said in few videos back is there are several component of landfill design but the two major components are leachate collection system and the gas collection system.

So in the last video we talked about how to predict, how much leachate will be produced, because say any design you do whether if you are an engineer or even if you are not an engineer you think about anything if you want to design, we need to know what it is designed for, so what function we wants that particular system to perform.

So in that case we have a leachate collection system which is I was talked about in the previous video, we talked like went over the basic of how to predict how much leachate it will be produced. So based on the leachate production rate we can design how what is the type of pipes will be required, how what is should be the spacing of the pipe and all those requirements associated with that.

Similarly for the gas connection system which is the other big component landfill gas, so for the gas connection system here to also I have to find out how much gas is going to be produced and out so that we can design our gas collection system for to collect that particular amount of gas. So in this particular module we will focus on the landfill gas collection, so how to predict landfill gas collection we will look out to the will look into some of the very basics of landfill gas, some of the aspect that we have covered earlier in the course you will see may see same slides showing up and then just to recap so that you are you get refresh that and then we can discuss more in terms of landfill gas projection.

So because since the say you have to you cannot wait until all the landfill has been constructed you cannot you will not install and the gas start producing and as you saw earlier the gas production happens over a long period of time, so always we need to model you need to do some sort of model so that we can do some prediction and based on that prediction we can do the landfill gas collection system design.

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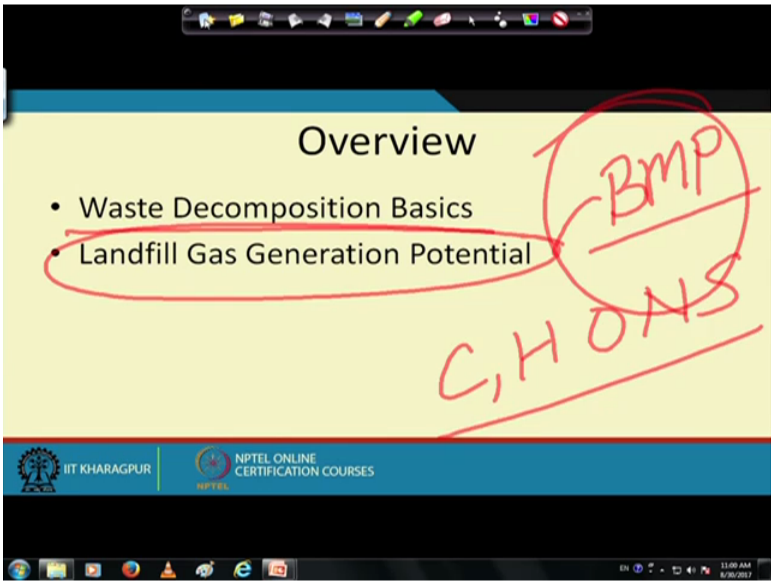

So let us talk about that, so in we focus for this particular module is predicting landfill gas generation potential. So that is what we will do, so we talk about some of the waste decomposition basics which would be kind of review of what you have already seen before. We have already looked at waste the decomposition basic so you will have some of the review of what we have done earlier and then the major is the landfill gas generation potential.

In terms of the gas generation potential, if you remember, so we also talked about the BMP test earlier. In waste characterisation chapter we had a BMP test which is the biochemical methane potential, so that is also the one way of producting, so we can take the waste and we do use the data from this kind of test in the model as a input to the model as you will see, that is one way of finding out.

Then if you have CHONS analyser, you can get the CHONS analyser then use the basic formula if you know the carbon, hydrogen, oxygen, nitrogen and sulphur of the biodegradable fraction the BVS fraction, remember that we have talked about the BVS fraction biological volatile solid. So if you have the BVS fraction if you know the formula for the BVS fraction you can always use a equation to predict how much gas will be produced, so that is the total amount of gas that you will see over there.

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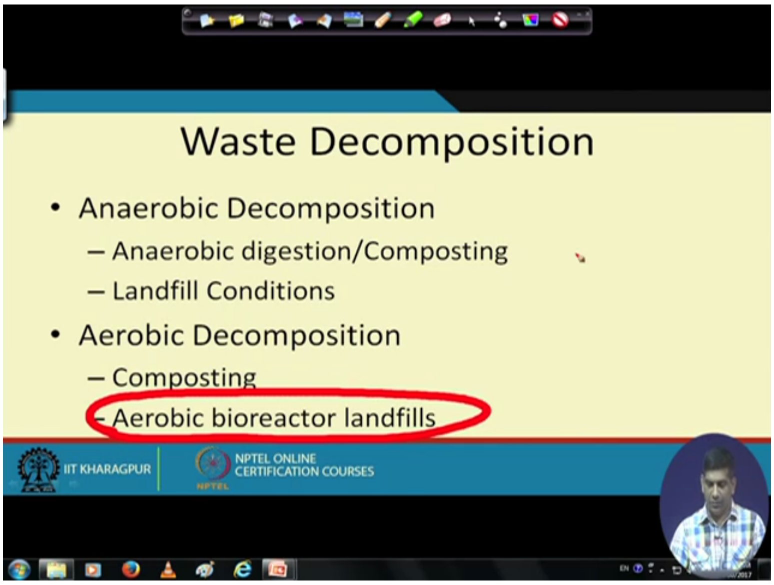

So that is in terms of those are the things we will talk about in this particular lecture, so here so in terms of the waste decomposition basics we have two we talked about the anaerobic decomposition, which is the anaerobic digestion or composting and we also talked about the landfill. So those are the two areas we have talked about and aerobic digestion is composting. So aerobic-anaerobic landfill so those are 3 in terms of like a anaerobic digestion usually sometimes some people call it anaerobic composting as well, but it is not very popular way of calling that process, composting usually we talk about the aerobic process which you see at the bottom.

So in aerobic you will have a anaerobic composting which will you will not see that much of methane but you will see so you will have anaerobic composting and also aerobic bioreactor landfill which is this is a again where you have the landfill you try to inject air to it and you improve the degradation rate of waste decomposition, so those are the things that we had talked about earlier.

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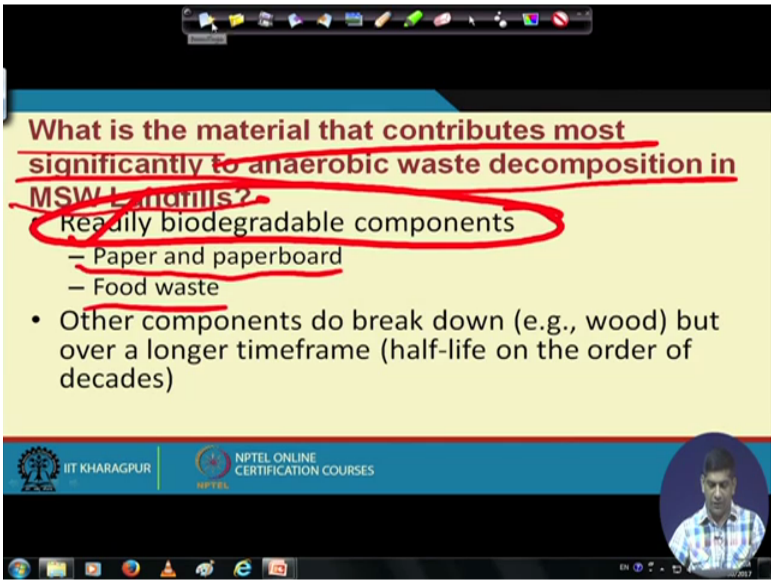

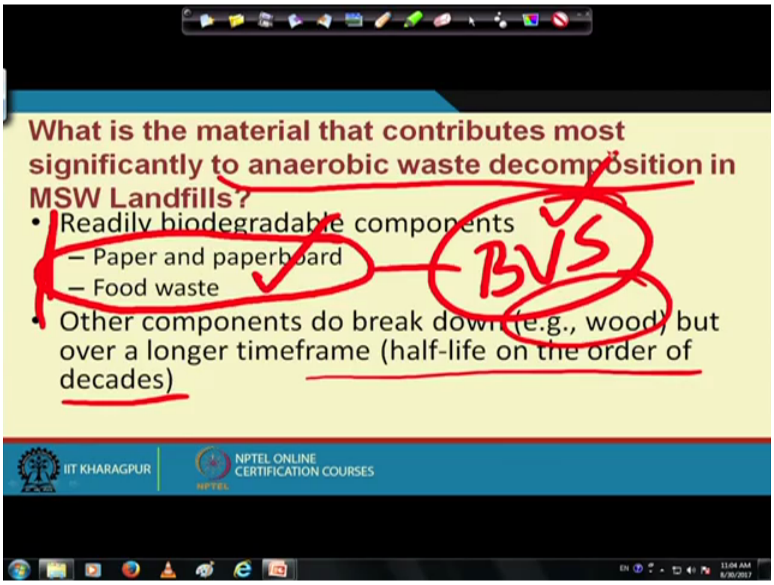

So what is the material we talked this is again, what is the material that contributes most significantly to anaerobic waste decomposition? So if you remember from the previous discussion, we had a discussion on this one, what is the material that contributes most significantly to anaerobic waste decomposition in a MSW landfills, it is the readily biodegradable components, remember if a readily biodegradable. What do you mean by readily biodegradable? Some of there are certain waste components which are biodegradable which we know like for example, wood and textile they are and to some extent rubber.

In theory they are biodegradable they will biodegrade but it takes a long period of time for it to biodegrade. Readily means which will biodegrade very faster something like paper and paperboard, food waste they degrade very faster, so those are called readily biodegradable components, so that is the term used for this kind of waste. So in terms of readily biodegradable components, paper and paperboard, food waste, so these is what you will see mostly as part of what we call BVS fraction, biological volatile solid fraction.

Then there could be other components do break down for example wood as I was talking but over a longer timeframe half-life is much higher. What is half-life? Again half-life is say if you start with X unit of that particular like if so X amount of particular fraction of something which is biodegradable in terms of right now in terms of this discussion. So half-life so after how many time period in months, minutes or years it will go to X by X by two like 0.5 of X, so that is called the half-life, that will come that concentration or the amount of that particular usually we use it for contaminant but also for say here in terms of the biodegradable components.

So biodegradable components say they are X unit of biodegradable components at what point it will become 0.5 X? So that timeframe is your half-life, so it is the half of that material is already gone. So smaller the half-life, better the degradation, it is may actually the degradation happening much quicker and that means here the gas production will be much quicker. So that is why to increase sorry to reduce the half-life and to increase the degradation we do this bioreactor landfill either air addition or anaerobic where we do the leachate addition and all that.

So that is so this in general like when you we talked about for a dry tomb landfill for any landfill it is in the terms of anaerobic decomposition this is these are the paper, paperboard, food waste they are put they are kind of part of BVS fraction so biological volatile solid. So if we know the chemical formula of these two together we are which will be kind of BVS fraction we can always use a equation and predict how much gas will be produced. So but the gas gets produce over a long period of time, so that is also we need to reaction is not very fast we need to take that thing in picture.

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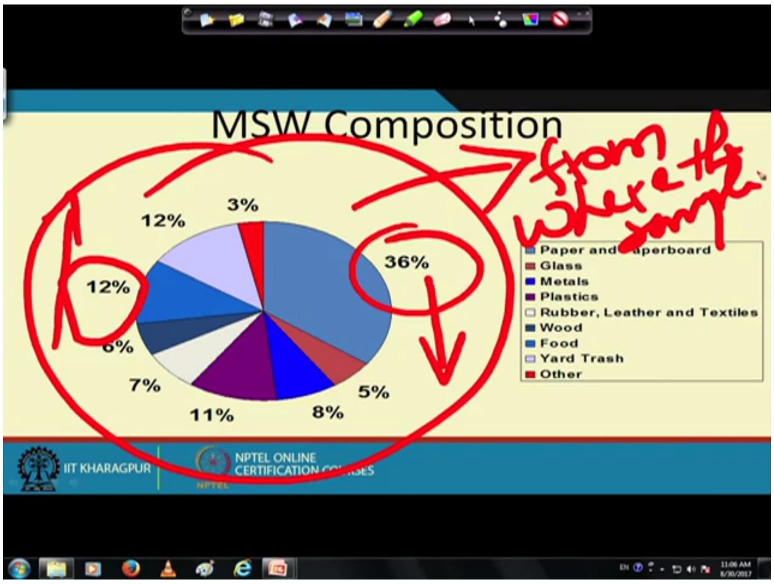

So typical MSW composition you have seen it so many times in this class so far, we have this is again coming from the western world because most of the books are written over there but in the Indian context you will see more here our food waste is which one is 12 percent and is much less but in the Indian and the paper is 36 percent which you will not see that much in the Indian context, actually the paper will be much lower and the so since the other like food waste like tends to be much higher.

Again the food waste this particular pie chart in we talked about in the class in Indian scenario this pie chart actually changing as well, because when I say it is changing as well it is changing as a function of like how the waste is moving in the collection system. So waste that I and you produced and put it on in our trashcan which goes in to that collection person, the primary collection person, who comes to your houses is a certain composition.

But when it goes to the primary collection point where it is gets dumped into the primary collection centre, cows comes in each most and other another animal may come in and eats lot of food waste and other stuff, then some cow, dog and other stuff will be there other animals will be there. Then the rag pickers will come in and take of this plastics and papers away, so that this pie chart is not a it is a dynamic pie chart in Indian context.

So it is really you need to you look at the pie chart based on from where the sample has been taken so that is very-very important. So from where the sample has been taken, so say if you talk about like if it is a existing dump site and you want to find out whether dumpsite will produce enough methane or not for doing some gas to energy project in India and like landfill gas to energy project and then you take the sample from the individual houses, that is not the correct example, because the what is coming to the dumpsite is may not be as what is your disposing off to those individual houses that is coming those like a primary collection point, because things does change and by the time it reaches to the dumpsite the composition will be very different.

In fact that it will be a very interesting study to do, where if we like some of you who are listening to this taking this course if you want to do a master thesis or a Ph.D. thesis, Ph.D. thesis will require some extra work as well. But in terms of master thesis even if somebody comes up with, how this pie chart changes as a function of waste collection system, how do it from our houses to the primary collection to the secondary collection and ultimately to the dumpsite or the treatment facility.

We can have all this 4 different pie charts for a particular city it will be really worthwhile to see like how much difference we how much difference it is showing up and I am pretty sure the difference will show up because your composition will keeps on changing, the food waste keeps on going away in terms of the food for these animals, and then the some of these recyclables which to end up in you end up in waste stream is taken away by the rag pickers, so in the percentage wise your pie chart will be much different as a function of distance.

The waste has travel basically within a city, so from the house all the way to the dumpsite presently dumpsite as per the MSW management rules we should not have we have to close those dumpsite and make a regional landfill or waste to energy or waste treatment facility, but that is but as if we can do that is actually a very good information, because what is happening in many times people are all these DPR's and other things are made based on what is being generated at home and but what we are dealing with the waste actually dealing with the waste is actually what is showing up at the dumpsite and they are different and but we can do not really can show how much they are different.

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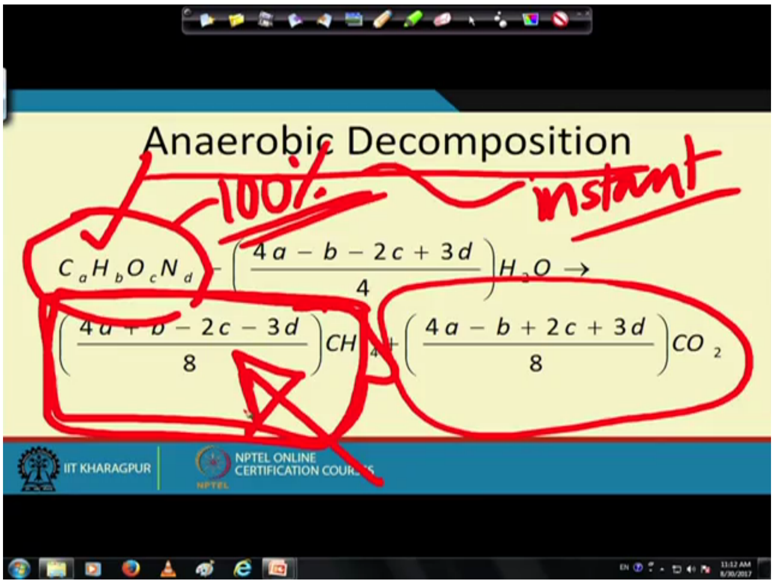

So if some of you are excited now to do that master thesis, please go ahead and do that and if you need help then contact me, I will help you, but do it will be a really good work. So once you have this BVS fraction, as I was trying to tell you earlier once you have this BVS fraction you know chemical formula either you can get if it is a standard kind of waste which people have researched on quite a bit the formula may be available in the literature we talked about that.

If you are looking at a waste stream for a particular city, you can always do this BVS like ultimate analysis or proximate analysis, get all this BVS and all those numbers. If you know the carbon, hydrogen, oxygen, nitrogen and sulphur number from CHONS analyser, you can come with this formula for that particular waste. So once you have this formula for this particular waste you can plug-in the number over here which we looked at earlier in terms of anaerobic digestion and anaerobic decomposition, so you get you know that this much methane will be produced, so this is one way of and this much of CO2 will be produced.

Now if you look at these equation, when we say that this much methane and this much CO2 will be produced, here we are assuming that the 100 percent of this is actually reacting. But this 100 percent reaction does not happen instantaneously, it is not instant reaction, it takes time, there is a kinetic, so there is kinetics involve so it takes time. So the waste will degrade, will start degrading basically theoretically if you put a waste if it is in a should it is in a favourable condition it will start degrading immediately.

So for example, if you certain food and so we people says that we should try to consume the food after it is cooked, like fresh food is better, no decomposition at that particular time, but if you just leave the food as it is and then it starts degrading and you see that, because if you have a food left over we call it, it become a stale now, stale food having some weird taste or some maybe smell there and that is because the decomposition has already started and the acids have already started being formed and that is why it leads to those peculiar taste like some taste which is not the natural taste of that particular food that is why we keep it in the refrigerator that is the whole purpose of using a refrigerator.

Many times you may not just think about it we do things mechanically where we keep the things in refrigerator at 4 degree centigrade or below 4 degree centigrade the reason for that is like below that at 4 degree centigrade and below the biological activity is 0 it is almost 0 close to 0, so that is our food does not go bad, that is why you see have the milk does not go bad when it is in the fridge except if you leave the milk, if you forget to put it in the fridge, by the evening your milk has gone bad.

So those are because of the biological activity already started on that you have that degradation already started, but if the degradation takes a period of time. So for example, if you have a certain amount of this particular waste this particular waste start degrading and ultimately it will produces much amount of methane, ultimately methane production is this much. But this methane production is not instantaneously it is not after one hour you will have this much methane coming out. This which methane will come out when this entire waste which is whatever like X mole, Y mole we put it in there, this X mole of this has entirely degraded and that takes time.

So but how to we have to produce a gas collection system, we have to install a gas collection system. So we need to see, how this waste will degrade, like a what how much waste, how much gas will be produced every day or every year. So that I know how much gas I can expect in my gas collection system, so based on that I can have this gas pipes in there, so those so we have to come up with some sort of prediction and that is what we will try to do in in remaining part of this particular module.

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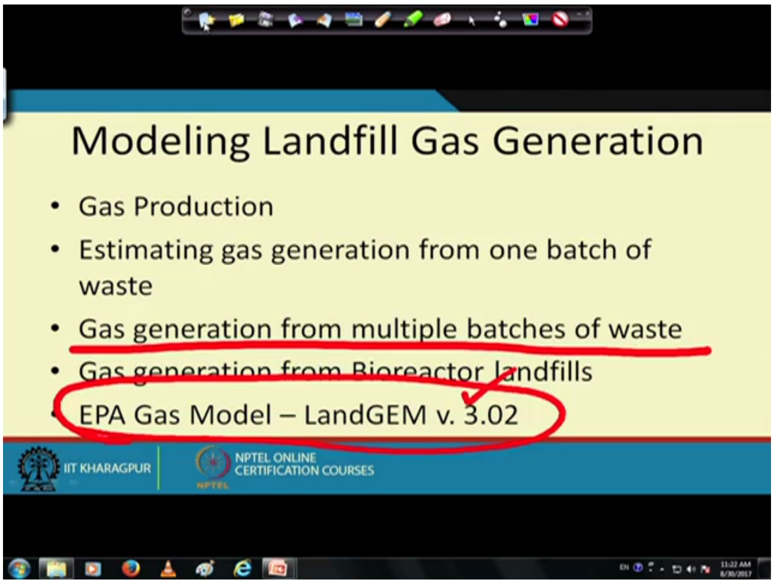

So being I think this gives you enough background to think about it, so with that information we will try to model this landfill gas generation. Now we know the gas is produced wherever the waste is there it will degrade, gas is produced. Anaerobic condition, methane will be produced and anaerobic conditions, CO2 will be produced. Anaerobic CO2 is also produced, so anaerobic both CO2 and methane both are produced.

Now in a landfill or in a landfill when we are trying to predict landfill gas production waste is coming in batches. So every day it is getting collected from the primary collection goes to the secondary collection gets into the big truck gets into the truck goes to the landfill or may go to a transfer station from there to the landfill. So finally it goes to the landfill and ones it is should be engineered landfill but once it is there it gets decomposed, it is gets dumped in to those cells, if it is a engineered landfill.

Now every day the same process is going on and on and on. So think about year 2017, now first January 2017 you had a certain amount of waste coming in, second January another amount, third January another amount, so every day you have certain amount coming in which is if it is comes from a one particular area it will be more or less similar kind of number but may fluctuate depending on the day depending on some festivals and other things happening in that area but more or less you will get the similar amount of coming in to the landfill.

Now the waste that came out in December on January first it is the amount of gas that is it is producing in the landfill started producing from the very first itself. Now on January 2 some waste new waste came in and that started producing waste some gas at from January 2, but January 1 waste is still producing gas on January 2 too as well on January 3, January 4 and it will keep on producing waste sorry keep on producing gas until the whole potential. The amount of gas that it can produce is run has run out, so the maximum amount of gas that it can produce has gone.

So the gas generation happens from this multiple batches, so we are calling it the batches. Sometimes I am I was trying to explain the batches in a day, you may take weekly batches, you may take yearly batches, as small as you take the batches better it is in terms of estimation, so those are in terms of multiple batches of waste is coming in. Now the other aspects say it so this is in terms of the general landfill that we have and will try to predict how from each batch you can basically create certain essentially what it does it creates a spread-sheet base model, which we will just will talk about it in a minute.

So before that just another aspect, we have talked about bioreactors landfill in this particular course. So bioreactor landfill is when you start recirculating leachate, the goal of the bioreactor landfill the most popular most the other way of doing bioreactor landfill as well but most popular way of doing bioreactor landfill that we know of today is wherever it is being done, whatever the leachate is produced in the landfill they are trying to put it back into the landfill, so there is a leachate recirculation system

But this leachate recirculation system does not really start on day one, so say again going back to that first January 2017 batch of waste, say it was collecting the waste. Now in first January 2020 I have started recirculating the leachate because recirculation of leachate usually will start when the landfill has reached its capacity. So you have leachate capacity, you have the top cover and then you start recirculating leachate, because and that is typically how it is done or so say (())(20:32) that happens on first January 2020 we start recirculating the leachate.

Now since we have started recirculating the leachate the waste decomposition factor which is the K-value, remember from your kinetics that K that which is the rate of reaction. So the K-value in a bioreactor landfill will be different than in a normal landfill, because the bioreactor landfill you are recirculating the leachate, more moisture, as we know moisture, microbes love moisture. So if they have a optimum moisture condition and the microbes will be really happy, they will reproduce and they will have more the family will grow and then more and more family members means more food required, so for them the is our organic waste, so they will start degrading those organic waste.

But when we say degrading, basically they are eating this organic waste as a food source, as an energy source and as a in a process they are decomposing they are creating the decomposition of this organic waste and produces different types of gas and methane being one of them in anaerobic condition. So based on but that in 2020 after we started recirculation the K-value will change initially the K-value is different, so for the first January 2017 waste like for first January 2017 waste if you call it a batch A, for this batch A of waste which was came to the landfill on January 1, 2017 it degraded from January 1, 2017 to December thirty first 2019.

Now on first January 2020 I started recirculating leachate, so the K-value that I will use from first January 2017 to thirty first December 2019 it will be different, there is no bioreactor there but from first January 2020 we can use that bioreactor K-value. Although you may argue that you will not get the moisture distribution on day one, but there is always we have to do some approximation otherwise things becomes too complex to handle.

So but there is a there will be 2 K-values, one K-value for a normal operation of the landfill, one K-value for the bioreactor landfill. As per today the model that we have this is the EPA gas model LandGEM versus version 3.02, I think the newer version is also out there but you can go and download this. Go on Google put this EPA gas model LandGEM version, LandGEM do not need to produce version, you will get the latest version anywhere and you can you will be able to download this software, it is available for free.

Again as I was telling you the other day US EPA they are very smart people, what they do? They make most of this stuff this kind of thing is freely available for everybody in the world. Why? Because if it is freely available, you will download it, you will use it, while using it you will come up with some shortcomings of this model, you will talk about this model is problematic here, this model needs to be modify and this and that and you are doing it on Indian taxpayers money or government of India is actually funding your research and what you are doing? You are helping EPA to make its model better and that is why they make everything available it is that is I have no idea why in India we have this data hated like most of the time it is very difficult to find data.

I am sitting at IIT Kharagpur, we have the Kasai river nearby or the several river basin, Suvarna rekha river and those kind of rivers, for me to get those data is much difficulty, if I want St John's river data which is in Georgia and Florida in US I can find it within 15 minutes. I can download all the data on my computer from their website in 15 minutes and I can and since the data is easily available say if I am a master's student, he has to do the thesis, he has only 6 to 8 months to work on and it just to get the data by like a banging our head on those government offices if it takes few months nobody will be interested to do that.

And then St John's river district is getting benefit of the master's student work which was done on the money spend by the government of India. So and just because the data is freely available, so everybody will use it that is the beauty like a that is why I do not understand, why in India we keep the data hidden? It is very difficult to find data, even if the data is there nobody wants to share it, people are afraid, sometimes maybe they are afraid because they are not sure, they are not confident that data is correct, maybe the data is not really correct it is could be that it is a first data it is a made up data because nobody people have gone not gone to the field they just wrote down on their book sitting in a AC room, then those things might be possible but those things should not happen.

So if we make everything and transparent in the public domain, people will be forced not to make those kind of out call mistakes, if it is actually a mistake, because essentially you are cheating yourself. So it is you are not doing your work properly you are cheating yourself, so it is a you are cheating anybody else first of all you are cheating yourself, you off course may be cheating others too. But that is in terms of so this landfill, LandGEM coming back to that I would like LandGEM model is available for free you can download and then you can play with that, you can even try to model some of the gas production in the Indian scenario, of course you have to use the data from that Indian landfill, but we can do that and if you find some problem with this LandGEM we publish a paper the EPA will look at that actually and then they will modify it, so they will get the benefit of all that we do and off course they are making it freely available so people it is easy for us as well.

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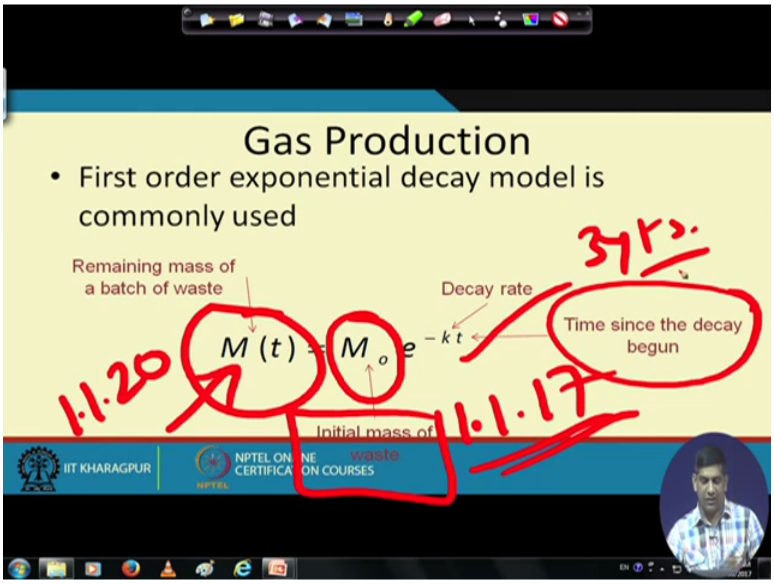

So essentially what this model does, it is a very basic this is a basic equation in the model, so mass so it is a first order exponential decay model, essentially I am assuming that first-order exponential decay. So what we are assuming is the remaining mass t, the remaining mass t at a particular point is M 0, which is the M 0 is the initial mass of the waste what we will started with. Say if this is mass t, so if you talked about that for the previous discussion that we had that 1 1 2020, so whatever the mass at t is mass 0, which will be 1 1 2017 and then with a t, so t was 3 year here.

So if I want to find out the amount of batch of waste which got decompose on 1 1 2017, what is the mass left on 1 1 2020? On like first January of 2020. So M 0 E to the power of –K, K is the decay rate and times t, t is the period which we can part based on the unit for K, we can put the unit of t and then this is the time since the decay has begun. This is how we can find out how much is the remaining mass of a certain particular batch of waste is there.

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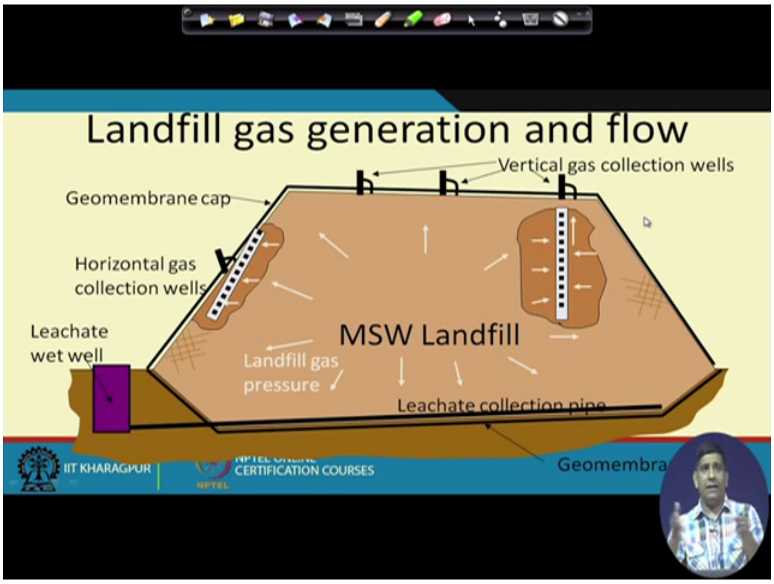

So and the landfill, when the landfill gas is generated we can we know that this is the landfill will travel in the past of least resistant, we already talked about that. This is how the landfill gas collection system looks like, you have the horizontal gas well, you have the vertical gas well, so there is a there will be pressure there will be pressure gradient things will move into wherever you create the vacuum, so this is just kind of recap of what you have already saw.

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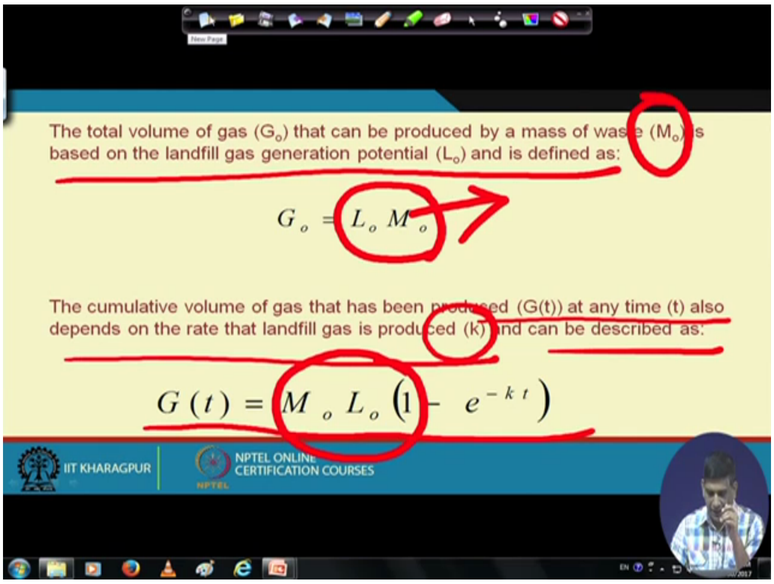

So the total volume of gas that can be produced by a mass M 0, which is the total mass which is there in the waste, the total amount of gas that is being produced is based on the landfill gas generation potential L 0. So it is L 0 times M 0, so that is the total amount of gas. Say if you have a mass M which is decomposed which was disposed on a particular day say January first

2017. The total amount of that particular this is the mass on that particular that particular batch, so the total amount of gas that it can produce is M 0 times L 0.

Now what is L 0? L 0 is the landfill gas generation potential, so that is again we can calculate it for the biochemical methane potential. So how much is the maximum methane it can produce, methane is around 50 percent or 55 percent, so based on that we can find out what is the L 0 value. So for the most of the waste stream L 0 value is already you will have the L 0 value available, so will you be given L 0 values or you can find out from the lab based experiment.

So the cumulative so if you look at the cumulative gas produced at any point the cumulative volume of gas that is produced which is G t at any time t is also depends on the rate of landfill gas. Rate at which the gas landfill gas is produced is the K-value and can be described as G t is equal to M 0 times L 0 e to the power of minus k t. Because if you look at here G 0 is this, so G t gas at a particular time t will be L 0 times whatever is the like a like mass M t which is the mass remaining at that particular point.

So mass which is already degraded before that, so this is M 0 times L 0 that is the total amount of gas minus what gas would like a it is like M 0 L 0 times E to the power of minus k t based on because mass at particular time t left is M 0 E to the power of minus k t. So from that particular mass is still the gas needs to be produced, so we subtract that part. So the total amount of gas that can be produced, so that gives has this fraction the total amount of that can be produce which is this, if I take 1 from inside the formula inside the bracket.

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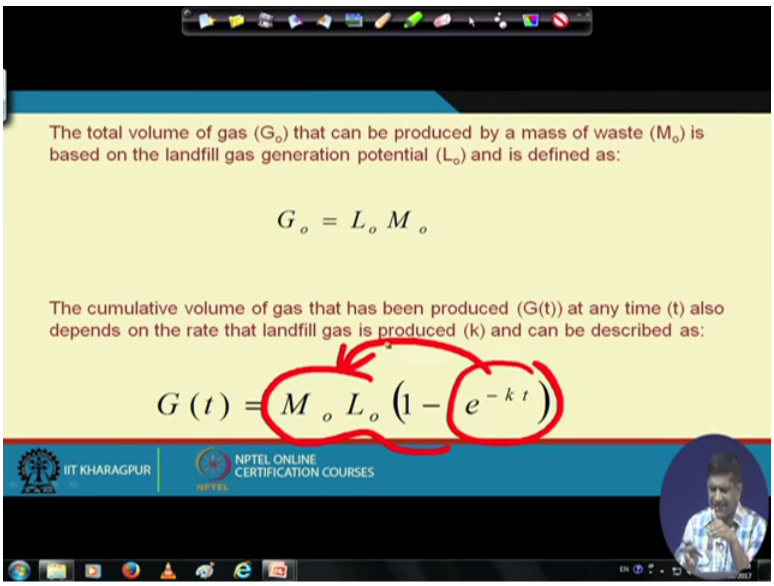

And then the other part which is the M 0 L 0 times e to the power the other when you multiply by this, so this with this one gives us what is the mass amount of gas that is still needs to be produced. So the total amount minus gas which is still needs to be produced, if you subtract that that gives you the gas which is already produced.

Again listen again I will repeat it, so that total amount of gas that can be produced minus the amount of gas that is still needs to be produced, is still will get produced if you subtract that, that is the amount of gas which is already produced. So this is the amount of gas-based on the waste which is already been decomposed. Again going back from January 2017 to January 2020, so that period the gas produced if we take t is equal to 3 years that is amount of gas will get in this particular we can get it from this particular formula.

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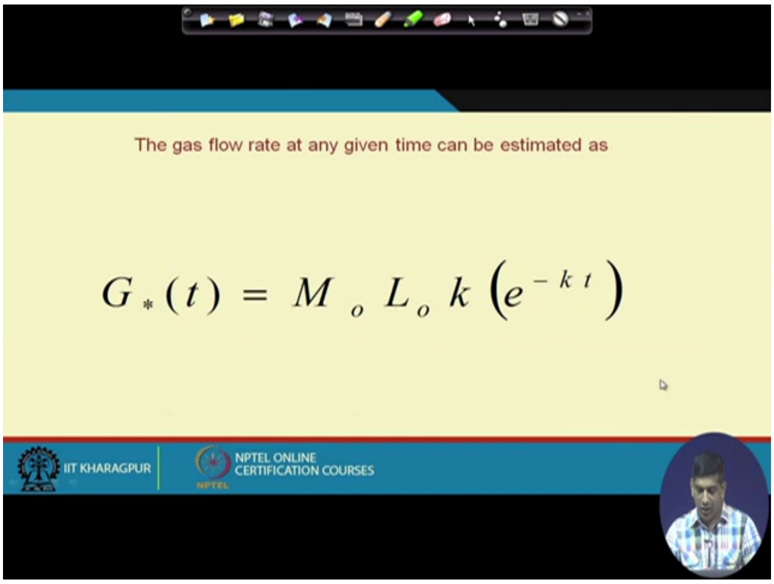

So if you know this, so that basically tells you at one particular time how much gas will be produced. You can just so gas flow rate at any given time can be estimated as, G at a particular time M 0 L 0 K and times e to the power of minus kt. So that gives you like a value for at particular at any particular time.

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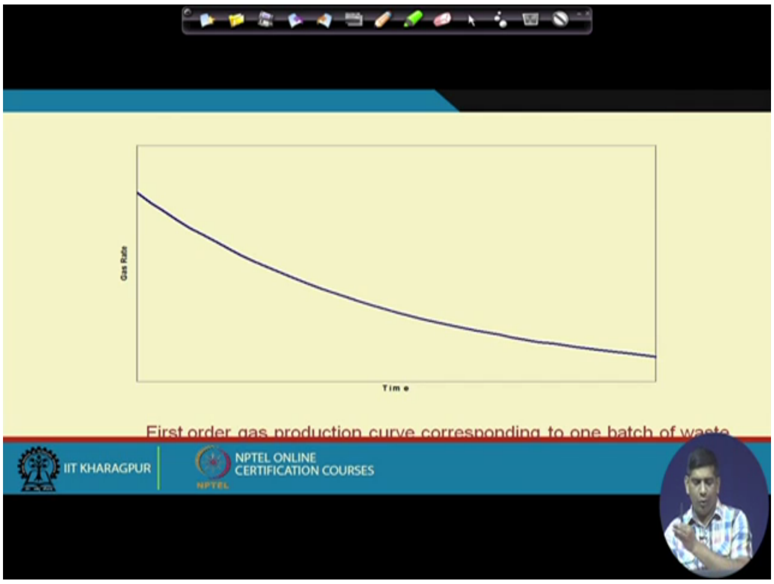

So you can plot it, so it is the first order gas production curve corresponding to one batch of waste. So this is for one batch, say January first, 2017, similarly we can have January 2, 2017, January 3, 2017, so that will be too many graphs, so what we usually try to do, we try to do it monthly. So we try to do January 2017 as one batch although we are losing some, for some we are losing some we are gaining also some. But what is coming after January 15 is also calculated as a like a whole month so it is but we do it monthly, that is the way we typically we do like January, February, March, April, for every month we will collect consider it as a one batch, so that is you can plot them.

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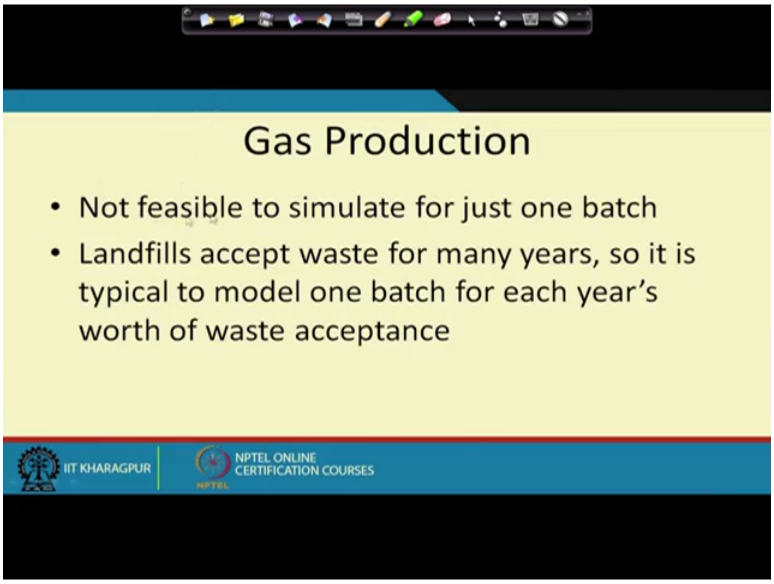

So not feasible to but this is not feasible to stimulate for just one batch, you have to do it for many other batches so landfill will accept waste for many years, so typically it is model for one batch for each year worth of waste, either I said month sometimes even you do it for year, so here it is suggesting that you do it for each year.

So usually will do it like each year will be easier for doing then month but month will be more accurate, so it is depends on how you do it. I think this model does it for every year but you can take you can whatever equation you saw you can make your own model, so you do not have to you can make your own model on the excel spread sheet and you can go even for every month to do that take calculation every month.

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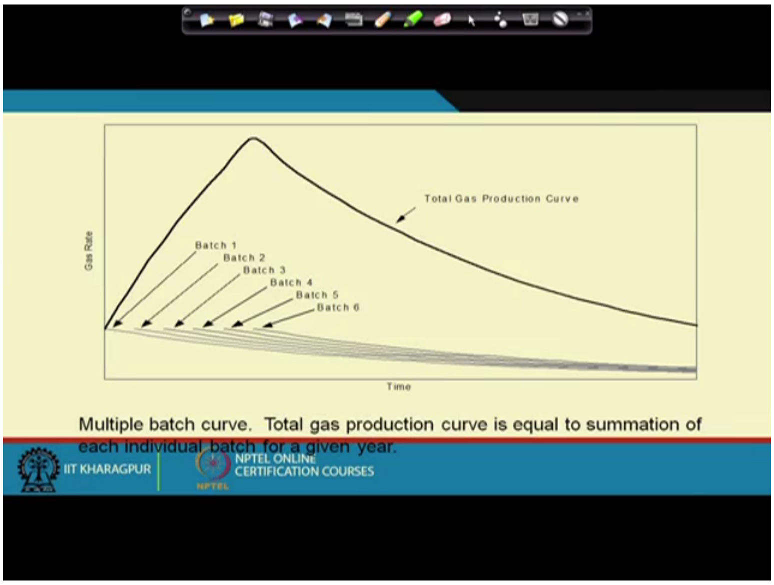

So this is how you will get, so for each batch you will get the total like a gas production from each batch, batch 1, batch 2, batch 3, batch 6 and then it will continue sorry it will continue further and so and then you will get the total gas production curve. While you basically this curve here is the addition of all these curves, when if you add all this curves so this curves all added together gives this curve, so that is how we get those number.

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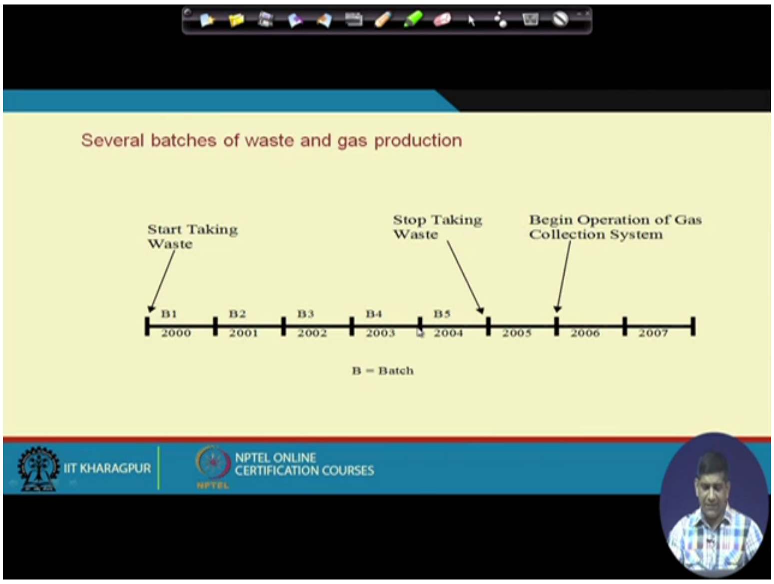

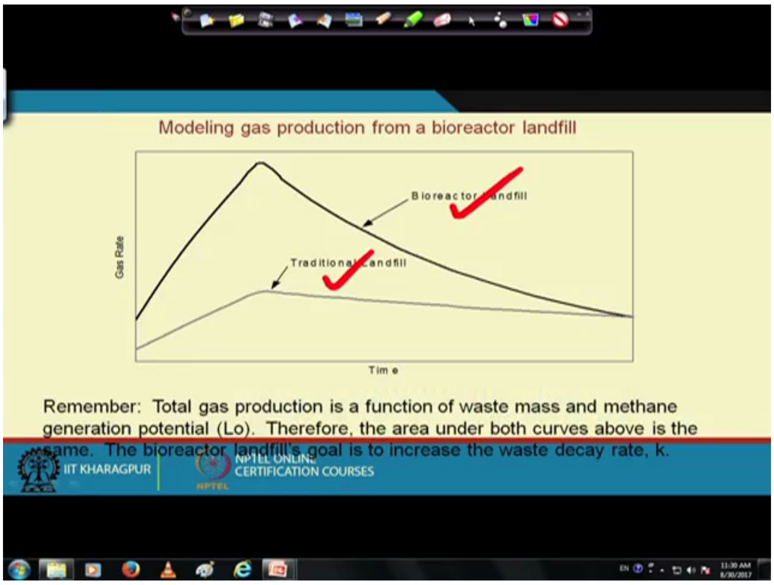

So you can take several batches of waste 2000, 2001, 2002, so you start taking the waste, here we stop taking the waste, began operation of gas collect, so we can have every batch we can put that yearly and then when we do a model the gas production. We can do the traditional landfill as well as the bioreactor landfill, here the K-values are different, for traditional landfill the K is K-value is different than bioreactor landfill. For both this traditional as well as the bioreactor landfill if you do the area under the curve it will be the same. The total amount of gas production is the same, the bioreactor it gets produce in a smaller period of time, so that is the only difference that we have.

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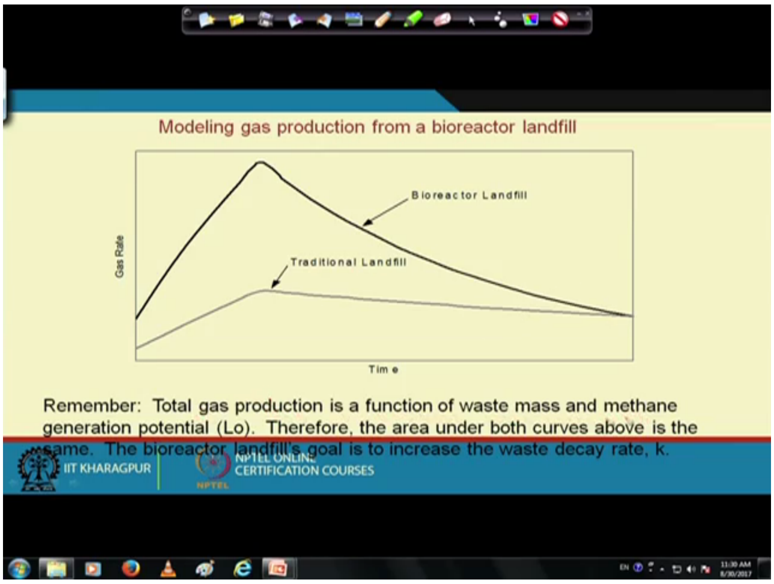

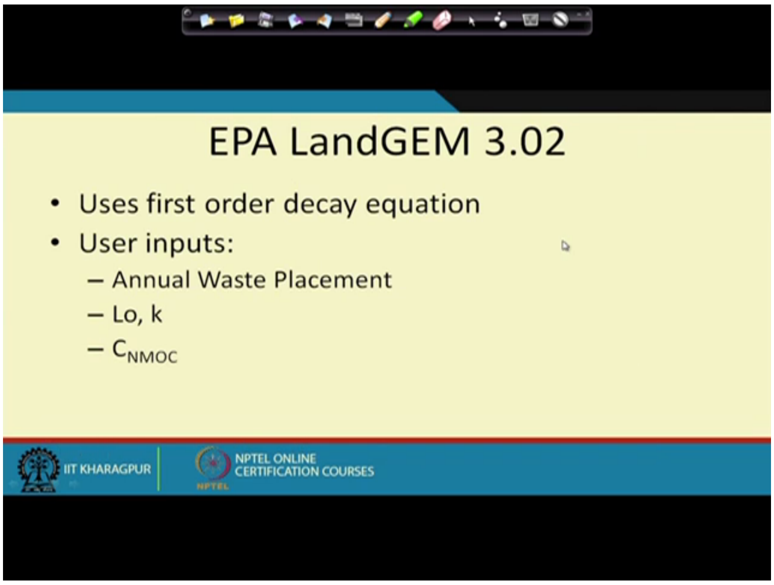

So that is so here total gas production is a waste mass and methane generation potential, therefore the area under both the curves is above the same. The bioreactor landfill goal is to increase the waste decay rate, so will have a higher rate of degradation and this is a it reduces EPA LandGEM 3.02 you can use, what we knew as a user input, animal waste placement, you need L 0 values, you need the K-values, you need the construction of anamosis what is the concentration of non-methane organic carbon you can always take some gas sample find out those values, so that is not a problem.

So that is how this LandGEM is done, so this is how the gas production model is done. So I will like this since like as I said in the very beginning of this course, this course we have not it is not we cannot go into really very depth in terms of landfill gas collection, landfill leachate collection, because that landfill design itself is a separate course, maybe if time permits in future maybe after that.

But in terms of just a big picture so that you at least you can you know how to do it, so if you are interested, download this LandGem model, play with this LandGem model, it is very easy, it is a spread sheet model and then see it if you have any questions for now, putted on discussion board, we will be more than happy to answer, but if you have questions later on you have my email address you can but during this goes please do not send email because if I have say 7000 emails it will be a problem but after the course is over in future any personal reason you can always send me an email that is a different things but actually I should not say that for in during this goes.

But for this course use the discussion board, discussion board is the way where we want to your query and I look forward to seeing your questions on discussion board. Hope you are enjoying this goes and again I will see you in the next module. Thank you.