Course on Integrated Waste Management for a Smart City
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Module No 07
Lecture 33: Biological Treatment of Waste (Contd.)

Hello, welcome back, so we are in week 7, we were, we are in the 3rd module now, this is the 3rd video of week 7. So we will continue our discussion on that problem which I was trying to solve in the previous video, towards the end of the previous video. So let us what I have done in this is I have gone little few slides back so that we can just quickly recap the part of the problem that they have already solved and then we go to the 2nd part which we could not solve in the previous video. So let us get started.

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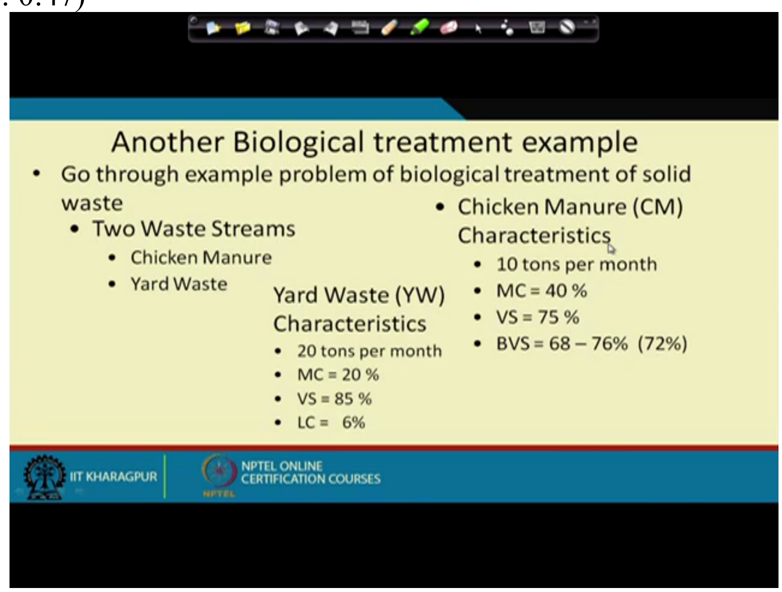

So we this was the problem we were looking at one biological treatment example where we have two waste stream as I was telling that if you are running a compost plant, its not that you will only have one waste stream to believe it. You will have multiple waste stream to deal with. Many times, to get the carbon nitrogen ratio, a good carbon nitrogen ratio, you may have to mix certain waste stream as well.

So here, we have two waste stream, one is the chicken manure which is essentially the chicken waste which is coming from say any chicken processing facility where they are like processing the chicken and getting the meat out. So you will have all the feathers and all the chicken poops and all that things will be there. So that is one, one source is this where you get this chicken manure around 10 tons per month. Moisture content is given, volatile solid and BVS, the range of BVS is given.

So we took the average of that value if you remember from the previous module that we were talking about. The other is we have yard waste which is essentially the garden waste, in the Western world, they call it yard waste because of the front yard and the back yard that most of those individual houses have. And here we call mostly garden waste or you can, yes it is mostly the garden waste.

So the data has been given to us 20 tons per month, moisture content 20 percent, volatile solids 85 percent, and then here we have been provided with Linen content. If you remember from the very, I think in the 2nd week, we were talking about that if you know the linen content, you can you can estimate the BVS because there is a relationship. Based on the research done earlier, we have a high relationship between BVS and LC content where all LC is expressed in percent.

So that is why your data has also been given in percent. So you have this 6 percent. So we will we will use that information. So these are the 2 waste streams coming to a compost plant. Now the question that was given to us is if you have to find out how much compost will be produced, so the 1st question was there that how much compost will be produced?

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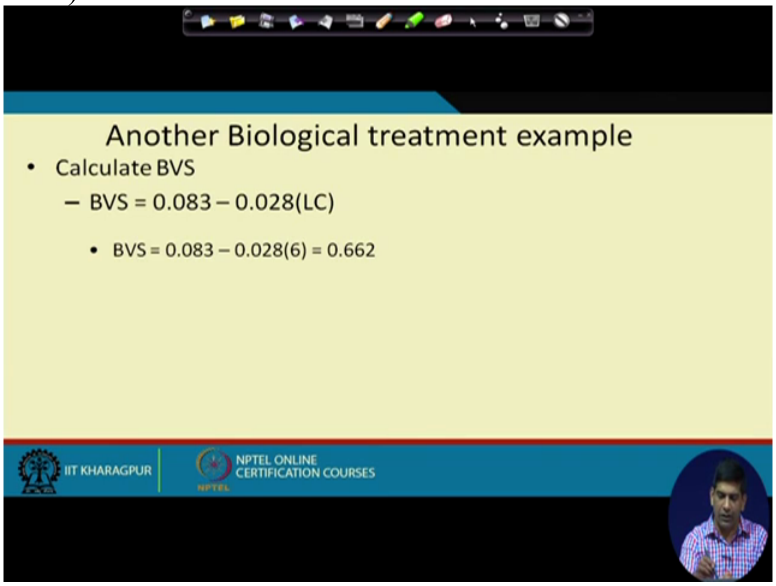

Before we go to that question, as I was telling you that if we if we know the linen content, we can find out what is the BVS faction, what is the biological volatile solid fraction. So linen content was given as as 6 percent in the previous slide which you saw, we have 6 percent linen content. So that 6 percent has been fed in here so that and if you remember, I said in this equation that 6, this LC has to be expressed in percent. So we just put 6, we do not put 0.06.

And then you do this calculation or this math and then you get your value is 0.662. So 66.2 percent is your BVS. So that is the data we know. We like we need to know for the calculation. So that is the BVS percent, so for both if you look at the both this particular this one and the previous one, if you look at this sorry, 2 waste streams, so it is a, so we have so for this slide, we have the BVS fraction already.

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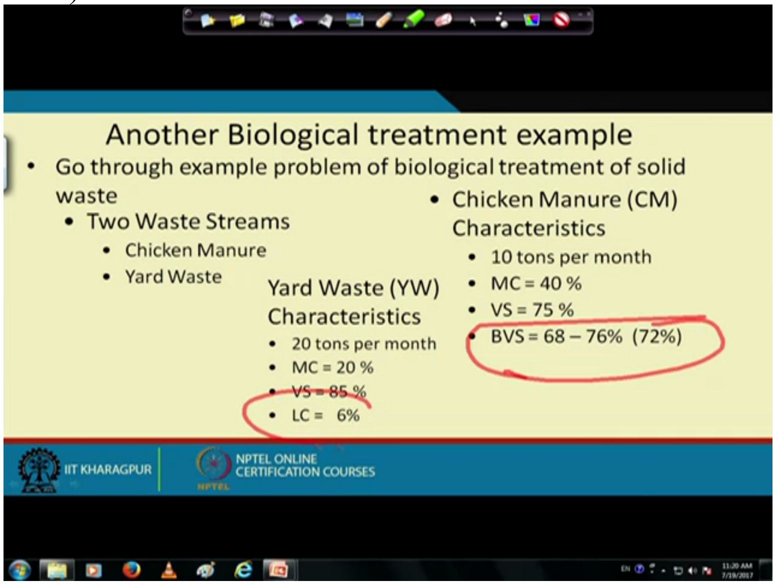

For this particular waste stream, we have this BVS fraction. We calculated that. We have this data, so we calculated that. And here we have the LC, from LC found out the BVS and that was 66.2 percent, so for both of them we have, we know the BVS content.

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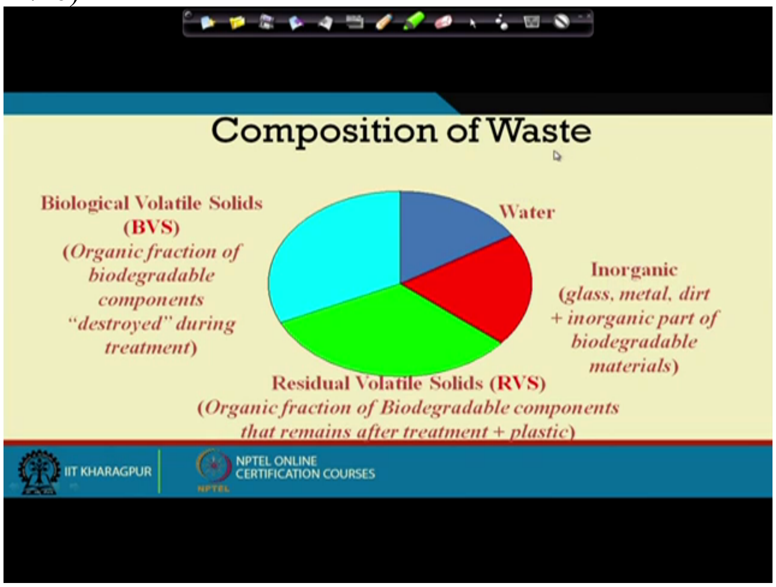

And if you remember, from that previous discussion earlier and also yesterday that we have to look at this waste in terms of this particular pie chart. So here, any any waste that you have, specially organic waste, you have some water, you have some water present, and you have some water. So we have some water, we have some water, we have some inorganic fraction, we have RVS and then we have this BVS.

So BVS is the fraction which reacts which we talked about in the organic specially in the biological treatment whether you are talking about anaerobic digester or you are talking about compost it is the BVS fraction which reacts. Not, many times not the 100 percent of the BVS reacts, you will have, you will be given a treatment efficiency of say 90 percent, 95 percent.

That means even of even out of 100 tonnes of BVS, 5 tonnes do not take part in the reaction, so that is what but theoretically we are talking about the BVS fraction. So we need to know. So if you are trying to setup a compost plant, you need to know is of the waste stream that is coming to your compost plant, what is the BVS content because that is what is going to react. Based on that BVS content, you need to come up with the design for your air injection system when you have supply the air because you need to supply oxygen.

So so for we for both of the questions we already know the BVS percentages. That is why that part was important for us.

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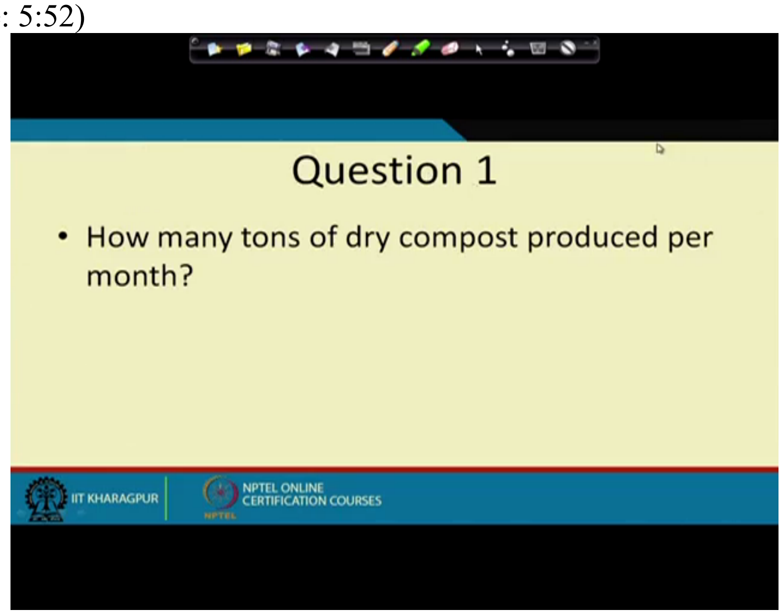

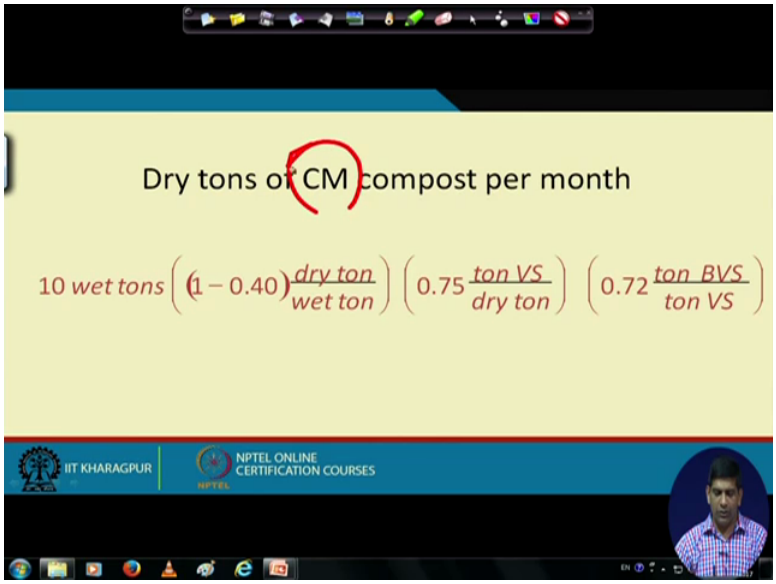

So coming to the 1st question now, how many tons of dry compost produced per month? So in terms of dry compost that can be produced, so in so we have to look at, we had 10, if you look at the chicken manure, CM is a short form for chicken manure here so that your chicken manure right there. So in terms of chicken manure, it was 10 tonnes. That means moisture content is included in that.

So if we find out in terms of the dry, 40 percent was the moisture content, so 60 percent is the dry content. So in we can write down 1 minus 0.4 dry ton per wet ton, then out of dry ton, 75 percent is VS, this VS and BVS they are always expressed in terms of the dry. So you have 75 percent ton as the volatile solids. Out of volatile solid, we have 72 percent as the BVS. So we can do this math and then we can find out what is the BVS content, BVS like how much terms of BVS out of 10 wet tons of the chicken manure.

So this BVS is the content will get reacted, they will get converted to CO2 and they will get converted to water. So this is the amount which will actually react. And that yesterday, if you remember, we used the term destroyed. It is not really destroyed, it will get converted to other form.

So it gets converted to other form and that is what, so it will it will not be there. The mass will get converted from solid to gas and liquid and then we do not have that, we we will not be looking at that particular fraction after that.

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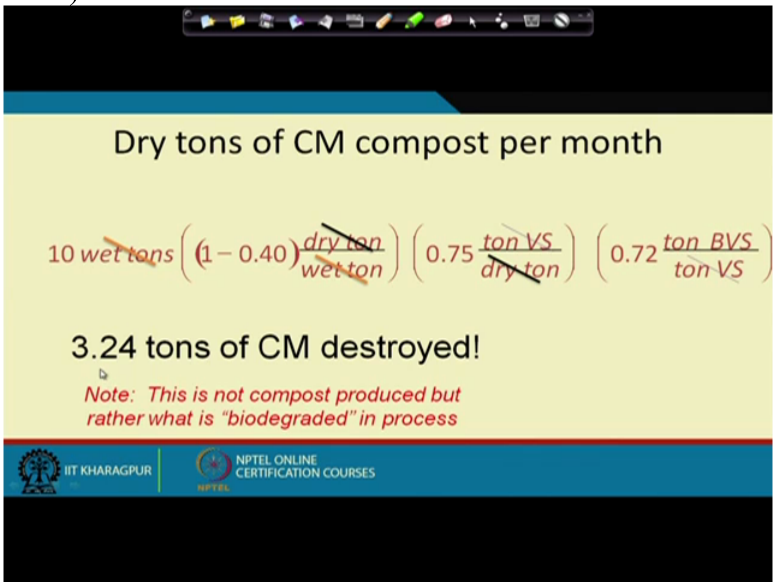

So we here did the maths, we get 3.24 tons of chicken manual which will react in this system. So this is not the compost produced but this is the amount, this is what is biodegradable and what will react. So compost will be total mass minus this. So that is what will be the compost.

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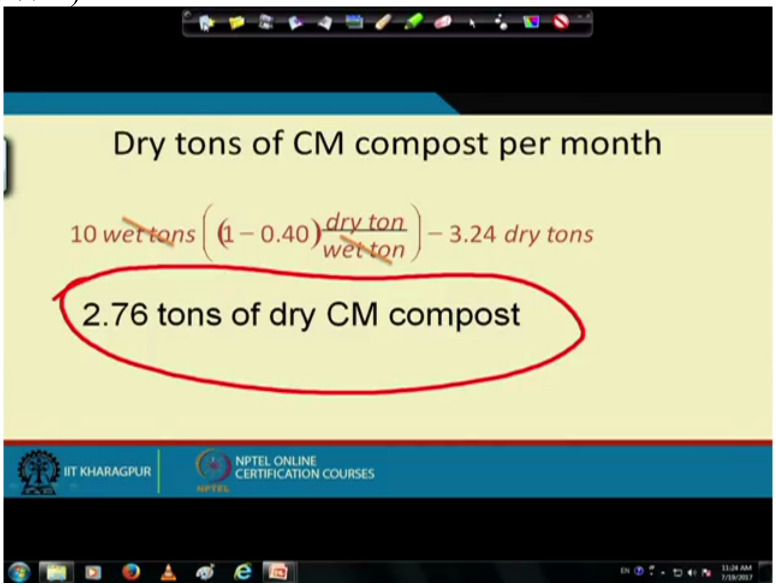

So the compost will be whatever is the total dry mass. Out of 10 wet mass, we can calculate what is the dry mass minus what is the BVS fraction which will react and go away. So you will have so you have 2.76 tonnes of dry compost which is produced from the chicken manure. Out of 10 tonnes per month, 2.7 tonnes of dry, it is the dry mass is what will be produced. So that is a part of that. That is for the chicken manure part.

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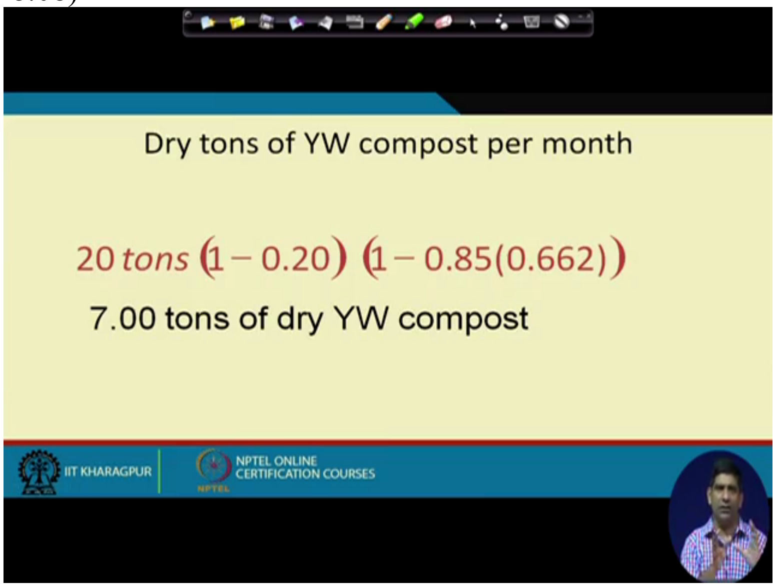

Then next is our yard waste. So similar things if you can do it for yard waste, here I have not done it that detailed step because you should be able to do it by yourself. So we have 20 tonnes, 20 percent moisture, then we put the BVS, and sorry VS and BVS, all those things together and we get 7 tonnes of dry yard waste compost which actually will come out from this. So you can do the maths and you will find out the same number. So that is the amount of compost that will be produced from the yard waste. So this particular facility, it is taking both, yard waste as well as the chicken manure.

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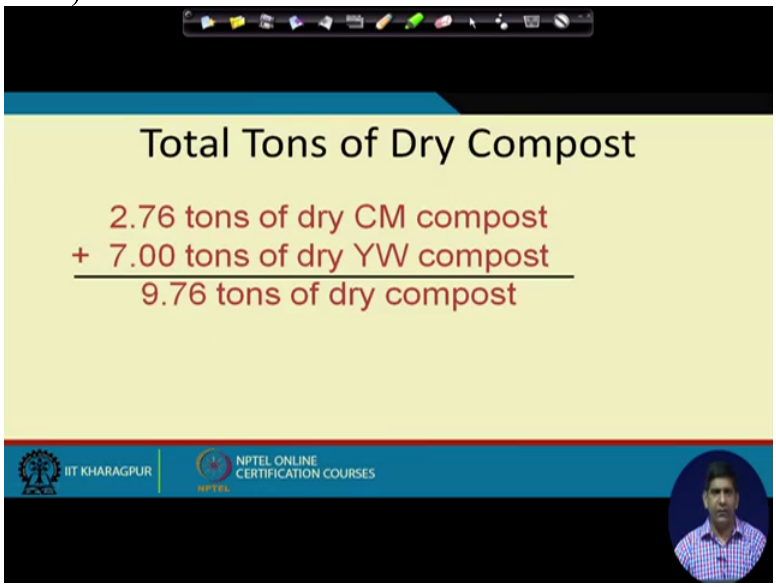

So if we add them up, it is 9.76 tonnes of dry compost. So out of 30 tonnes of raw waste coming into this facility, that is raw waste it is including the moisture content, so including the water part, if you look at the dry compost, we will have around 9.76, around 10 tonnes of dry compost. So one third mass of dry compost that would be produced from that particular facility. So that is one part of that like how much this will be produced.

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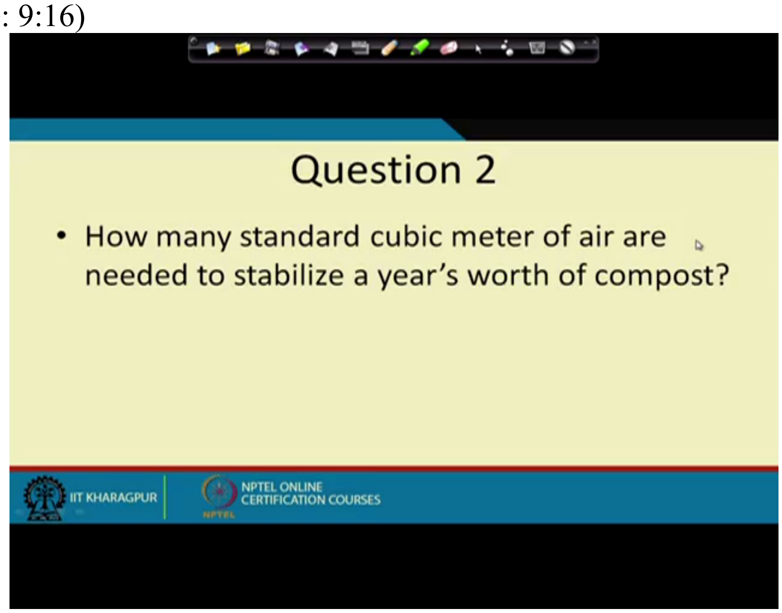

The next thing is, we look at how many, how much air we need to add, so we know that this compost will be produced, how much air we need to add say for one year worth of compost. So for the yearly run of the of the facility, how much air we need to supply? So we can do that calculation here as well.

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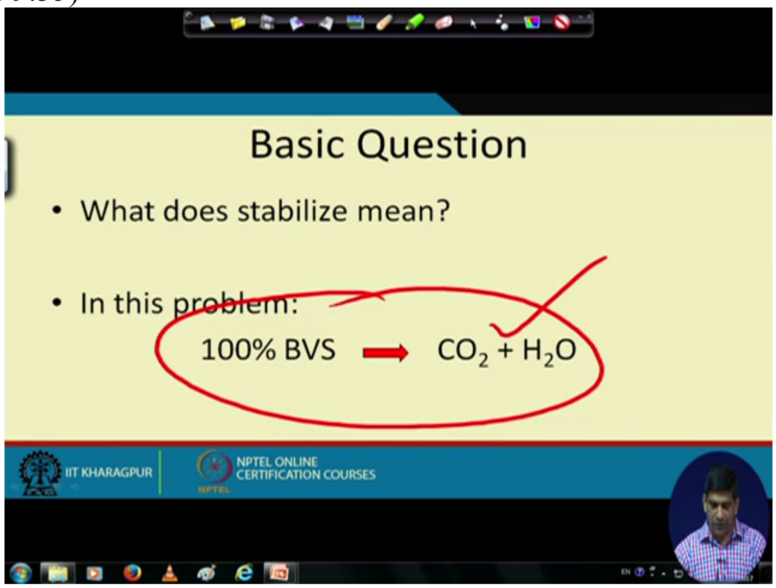

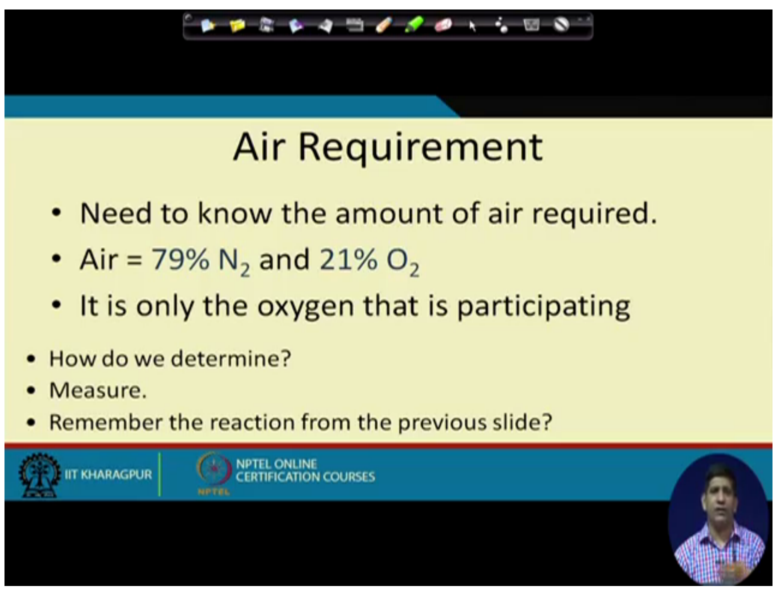

So when we say stabilisation we were talking about that yesterday and earlier as well where 100 percent of the BVS, that is what the stabilisation means, the 100 percent of the BVS is getting converted to CO2 and water so that, that is the meaning of stabilisation. So now the BVS has to converted to CO2 and water. What does that mean? That means that we need to supply air because as you know, composting is an oxidation process. We have to supply air for these reactions to take place.

So we have to find out how much air will be required to add because what is needed is oxygen. If you remember from that equation which I will show you in few slides down the line as again, that it is the oxygen which will react but we cannot just supply oxygen, we have to supply air and air is 21 percent oxygen.

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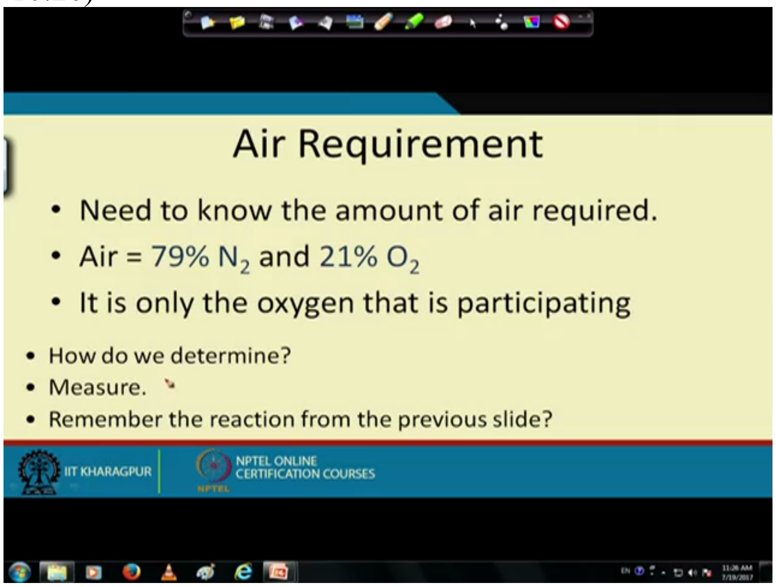

So we have 79 percent nitrogen and 21 percent oxygen. So it is only the oxygen that is participating. We know that part. So how do you determine? We can measure, we do some lab tests and measure how much oxygen is required and we do, we can do that to but we can use, use the reaction from the previous slide if it is 100 percent.

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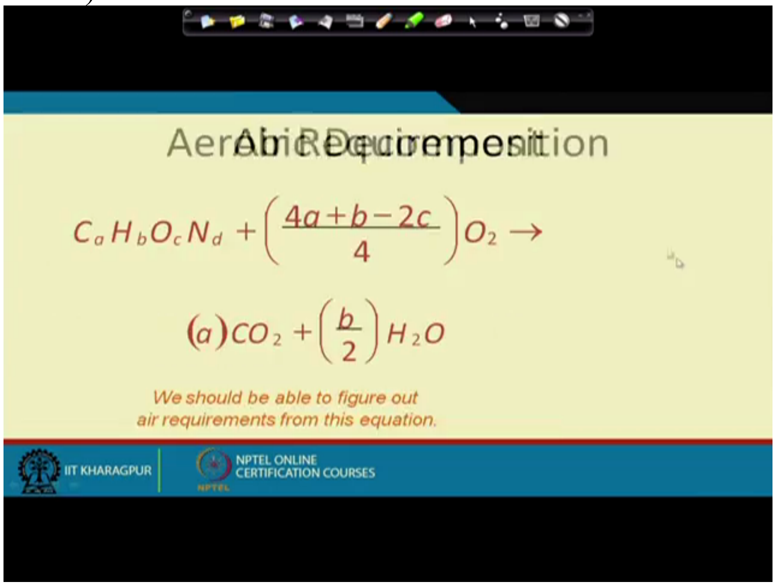

And that reaction is you remember was essentially the reaction which is shown in this particular next slide where you have, this is the waste composition and that is the BVS. This is the composition for the BVS fraction. So for the BVS fraction, if you know the equation of this, then you can plug all these A, B, C, D numbers in here and you can find out say one mole of this will require how many moles of oxygen. So that is, so for one mole of this, one mole of this BVS fraction of this waste, how many moles of oxygen is required, we can always find out using this equation and then how much CO2 will be produced, how much water will be produced, those things can be calculated as well.

So we can figure out the air, we can figure out the air requirement for this equation, from this equation. So what is, what we need for this equation? We need the formula for this, they are known, number 1 thing we need is the formula. We need the formulae for this particular waste stream. And then is it for the entire waste stream? No, it is for the BVS fraction. So we have to find out for the formula for the BVS fraction.

Why? Because it is the BVS fraction of the waste which is going to react. Other fraction is not going to react. We have talked about that several times now. Other, like inorganic and those plastics and other stuff will just go into the compost plant and it will just carried carried with the compost process. It is not going to react in in the equation.

So it is only the biologically volatile solid which is the BVS fraction which will react. So we need to find out what is the formula for that BVS fraction. So let us try to do that for these 2 particular waste stream. So once we know once we know the formula of the waste, I was telling you that once we know the formula of the waste, we can calculate how much oxygen is required.

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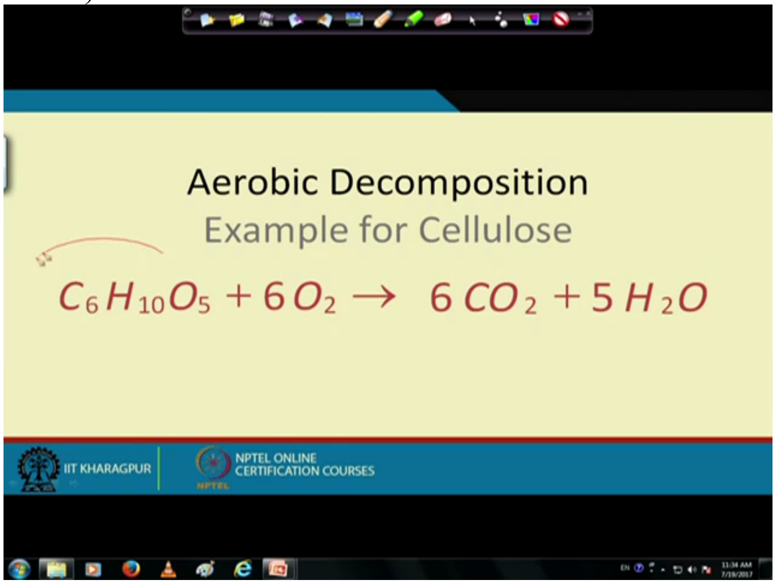

So here is one example like how we, how this is done. So here, if we have a simple and organic material, C6H12O5, its example for cellulose and then if you do the same math as we have been looking at in the previous like take this as the A value considerable value for A, this is the value for B and this is the value for C, and if you plug into those equation which was shown in the previous slide, we will get this particular number.

So what does it mean? It means that one mole of this will react with 6 mole of oxygen to this stuff. So for our interest, what is the interest? We need to actually know what is the amount of oxygen that we need to supply because once we know the how much oxygen is required, we can calculate how much air we need to supply for that as well. So lets try to do that for these 2 particular waste streams.

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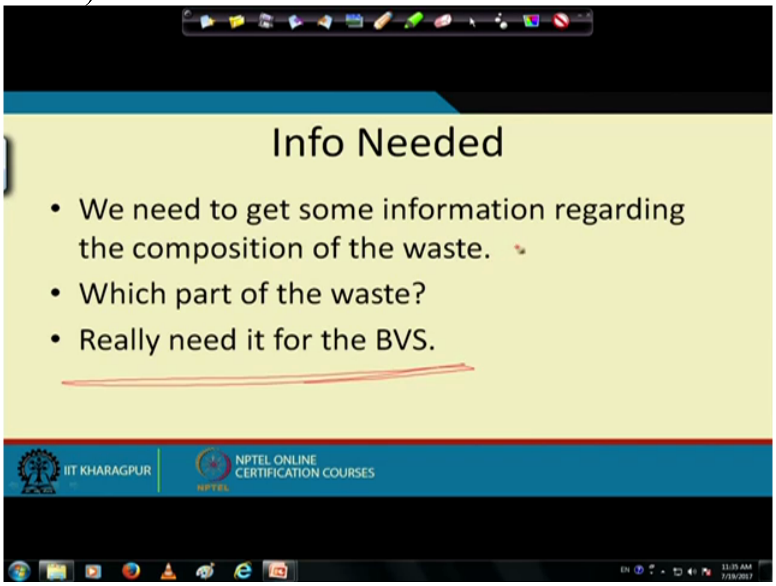

So we have to find out the for the BVS content, we need it for the BVS content, what is the formula for the waste? So we need to get some information regarding the composition. That is needed for that. Which part of the waste? Of course, for the BVS part. We have like I have, I think I have said that so many times now that you should not forget that specially if you are working on compost or working on anaerobic digester, it is the bio degradable fraction which is going to matter.

Other fraction does not matter, other fraction just takes your space and it does not so that is why the source separation. If, when we talked about so much into the source separated organics, it is just the reason for that because other other things are just taking the space. It it is not really adding any value, it is actually reducing the value of compost, so rather we don't have those, it is better for us. So look at if you look at the BVS fraction, those info is needed for that.

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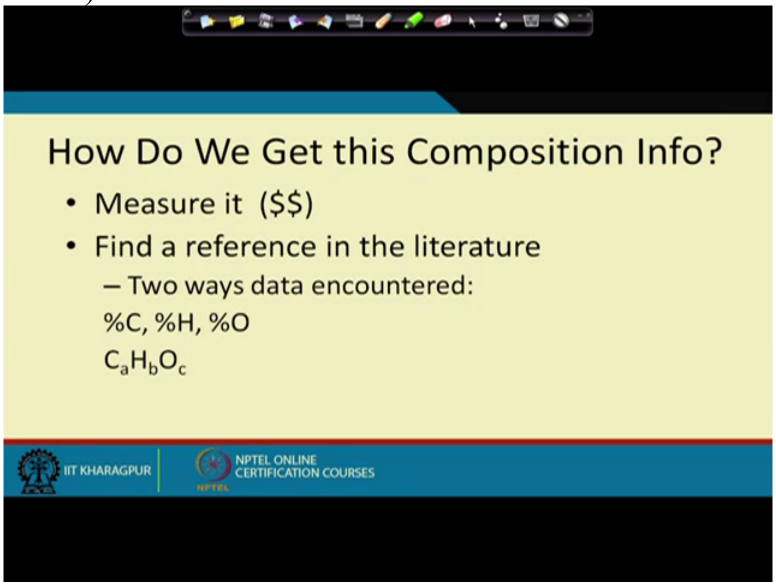

So how do we get that information? We can measure it, we can measure, we can take the Sample, you can do the CHONS analyser. That is that is what is used like you can do the CHONS analyser, so you can get all those how much carbon, how much hydrogen, how much oxygen and many labs have this kind of facility including our lab here at IIT Kharagpur. So we can measure these things and we can find out but if you have to do, as you know the waste is a heterogeneous Sample.

You have to do multiple number of samples, so these are costly exercise too. But many times we have to do it, we do not have any other option. Just because it will be costly in the beginning, that does not mean that you go and design it for something which you do not going to work later on. So we have to actually spend some money in the beginning as well to do a better design. So you measure it, so you get like there will be some money required for that but that is that is inevitable.

We have to do that. Specially if it is a waste which is kind of newer kind of place, there is no other data is available, something which is well established, for example yard waste, garden waste, flower waste, and there are certain kind of organic waste typical agricultural waste, for that, a lot of research has been done from around the world. So and their data, those kind of formulas are available in the literature. So we can take the value from there as well.

We can get either the percentage values, these are the 2 ways, you will see the values, either percentagewise, percentage carbon, percentage hydrogen, percentage oxygen or you can get directly the formula as well. So either of those can be available. So based on that, you can always calculate the formula and actually in this particular case, for just for to illustrate this point, for for the one waste stream, I have I am going to give you percentagewise data and for the other way stream, we will use the formula data so that we can see how to work our problem in either case, whether we have been given the percentage data or we have been given the formula.

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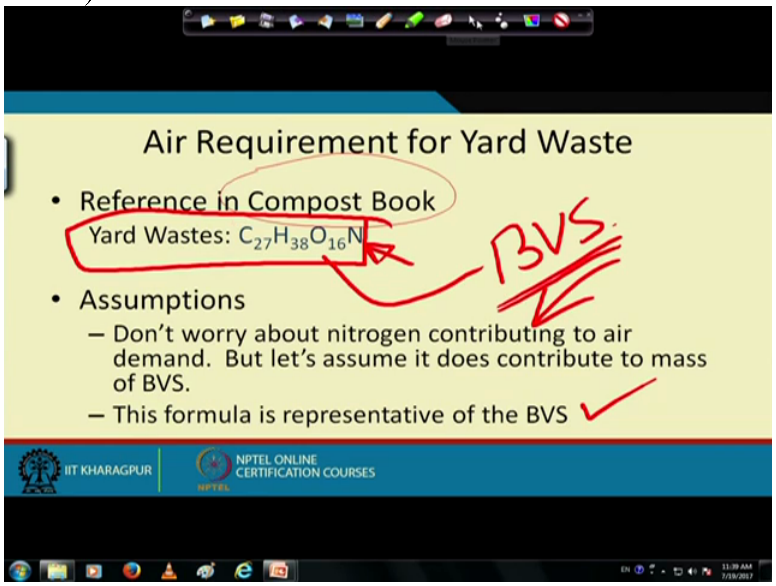

So to do that, so 4 yard waste, simple yard waste as I said, many times there are, yard waste we have been using, this has been used for composting for so long now. So there are, we can get it from a reference in compost book. There are lots of compost books also available. So you can, yard waste, typical formula is this, so we can just use the formula directly. We do not have to actually do much.

So here we do not worry too much about the nitrogen, it is nitrogen is, we do not about the nitrogen contributing to air demand but let us is in that it does contribute to the mass. So we will not take nitrogen in terms of the air contribution. So, and this formula that is provided to us, is the BVS fraction of, of the yard waste. So this is for the BVS fraction of the yard waste, so which is, we know that formula and then we can get that.

So somebody may have done the CH CHONS analyser and then they got the number. So that is based on that number we are we have come up with this formula. So if we have this, that is so one way of doing things.

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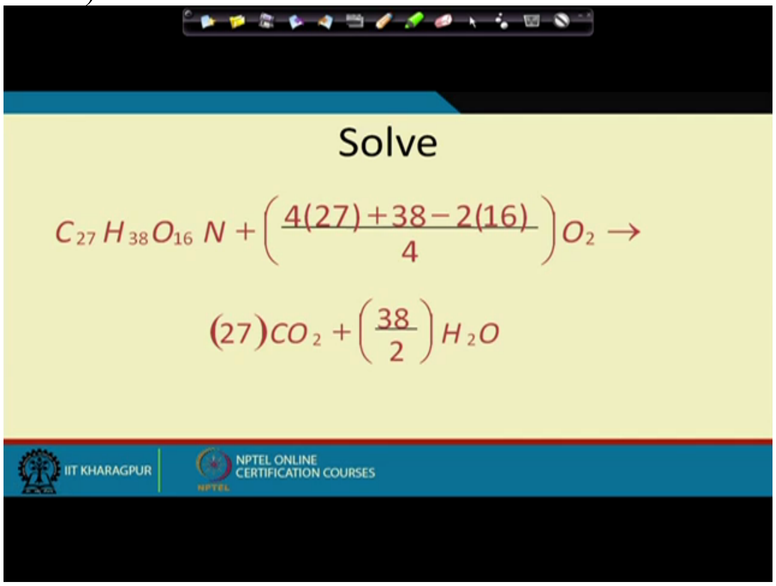

Other way of doing is, so if we have this, let us let us do this 1st then. We have this formula. So we have this A value, sorry, you have this, so you have the value for A, value for B, so that is our A, this is the value for B. We have value for C and then we can plug those equations in here, A, B, C values and we can get this much mole. So one mole of this, one mole of this yard waste requires these many moles of oxygen.

This is what has been done here. So we need 28.5 kg mole of oxygen per kg mole of the yard waste. That is again simple maths just following those steps. So once you have, you get those numbers, so you plug in these values, you get this much moles of oxygen and then how much CO2 will be produced, how much moles of water will be produced, so those things can be done. So we got 28.5 kg mole of oxygen per kg mole of the yard waste, BVS.

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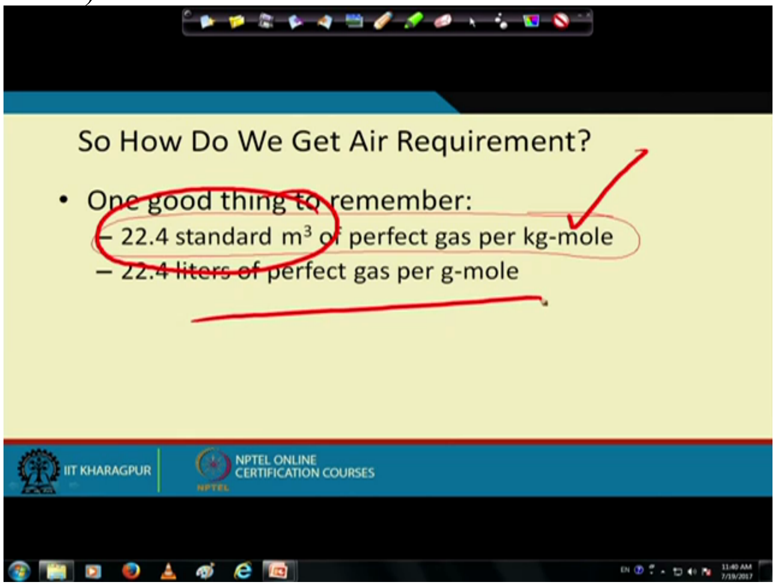

So now how do we, we have, we got the oxygen. So how we get how much air will be required? There are certain, this is at the standard temperature and pressure conditions, 24.4, 22.4 standard metre cube of air is is of gas is there per kg mole. So if we know the kg mole,, 4 per kg mole, this is the amount of gas that is the volume of the gas. Same thing for the gram mole, we can do that as well.

So 22.4 standard metre cube per kg mole. So that is the volume of air that is that will be there for per kg mole. So once we know the mole of oxygen, we can find out the mole of like a we can find out how much mole of, sorry the volume wall of that.

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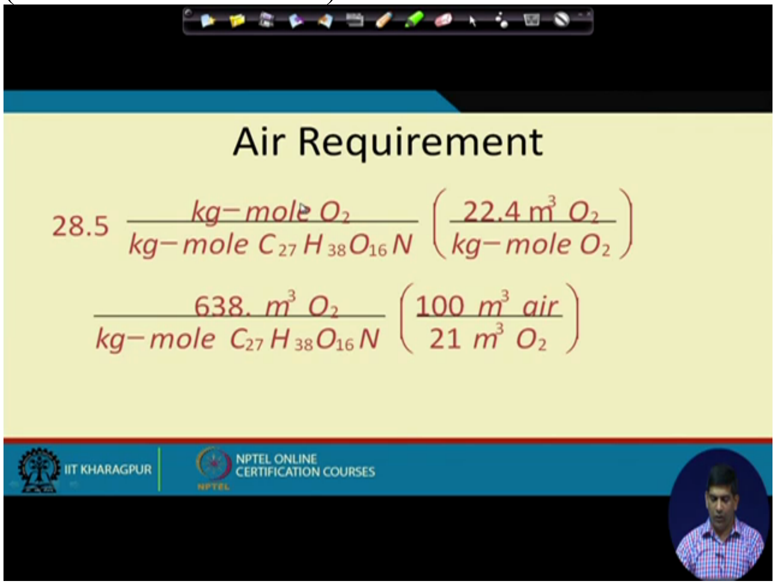

So here 28.5 kg mole of oxygen per kg mole of the BVS. So for per kg mole of oxygen the volume will be 22.4 metre cube. Now for oxygen, so we can calculate this. If we do this calculation, you get 638 metre cube of oxygen per kg mole. So here if you look at, if you do this, this kg mole of oxygen and kg mole of oxygen will cross away and then if you multiply to 28.5 times 22.4 which is coming from here, if you do this multiplication, you get this number, 638 metre cube oxygen per kg mole.

Now we know 21 metre cube of oxygen per 100 metre cube of air, so if we do that, so this, now this metre cube of oxygen and metre cube of oxygen will cross away, so you have 638 times 100 metre cube per kg mole of this particular yard waste. So these are all, we are working per kg mole right now and we had around, we know the BVS fraction which was about some amount of ton which we will see in a minute.

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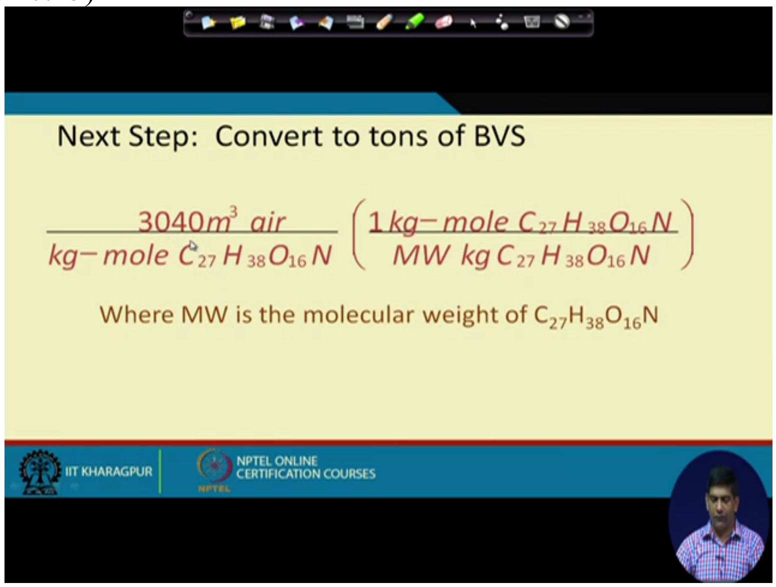

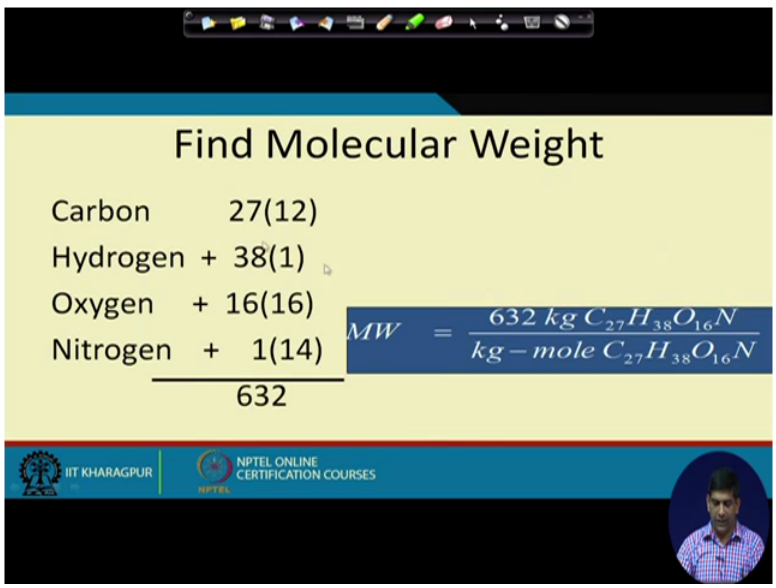

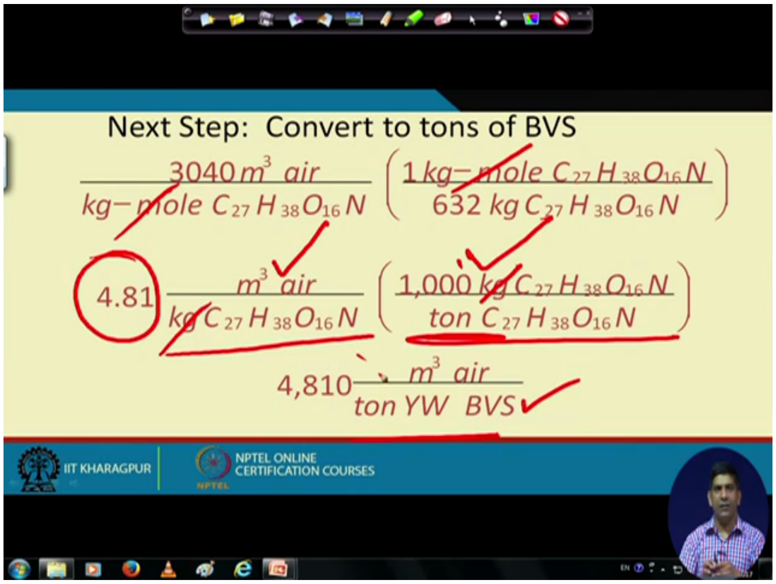

So this is next step is to convert per ton of BVS, so this is the per kg mole of this particular material. So this is what we got, 3040 metre cube of air per kg mole that came from here once should do this maths, 638 times 100 divided by 21, you get 3040 metre cube of air per kg mole. Now 1 kg mole is how much kg? It will be the molecular weight. So we need to find out the molecular weight of this particular yard waste compound.

So C27 H38, so C is 12, carbon is 12, hydrogen is 1, oxygen is 16, and nitrogen is 14. So if we take those numbers, we can calculate, we can take those numbers and then we get, we can add them up, we get 632 is 27 times 12, 38 times 1, oxygen is 16 and 16 times 16, 1 times 14, so you get 638 kg of this per kg mole. So if you use this number now, so this much air, per kg mole of this, 1 kg mole of this is 632 kg.

So now what you will get is, in this case what you will, your kg mole and kg mole will cross away. So what you will have is 3040 divided by 632 which is this number over here, 4.81 metre cube air per kg of your yard base. Now if you convert it to per tonne, in 1000 kg per tonne, so from kg, we can, so this kg and kg will go away and then we have tons now. So we have this much metre trip, so 4.81 multiplied by 1000, so it is 4810, pretty simple, straightforward.

So this much metre cube of air per tonne of yard waste BVS. So, this is per tonne of yard waste, BVS, so we got this in terms of how much metre cube of air will be required. So we are still working with yard waste, so we still have to work on on the chicken manure part. So we are halfway through the question. So we found out per tonne how much all will be required for the yard waste. So next is, we have to do the chicken manure.

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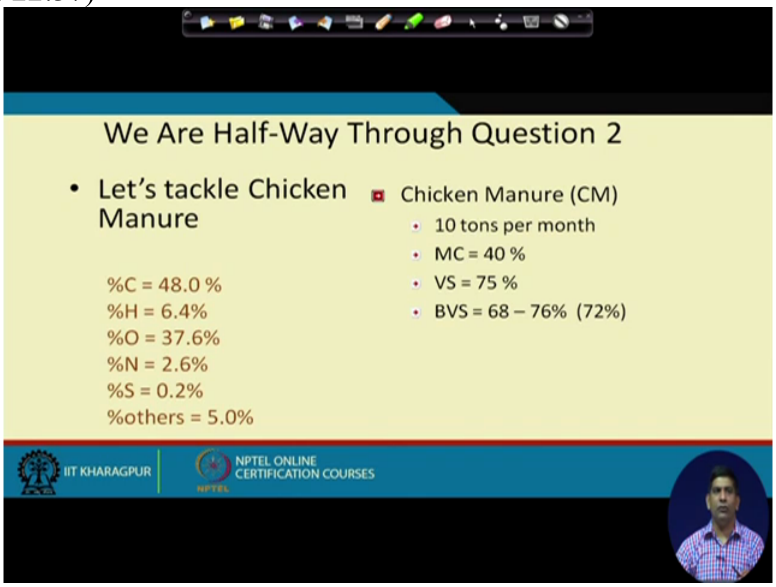

So as I said earlier, for just for the illustration say, for chicken manual also, the formula could be available in the book for just to show you how to do the maths, when formula is not given, you only know the percentage carbon, percentage hydrogen, percentage of oxygen, so in that case, how you approach the problem. So in this case, we have this data was available from before. We already had looked at it.

So we have been given data in terms of percentage hydrogen, carbon, oxygen, nitrogen, sulphur and others. So this data has been given to us. So based on these data, we have to get the formula for chicken manure BVS fraction. And this data, this data is for the BVS fraction. This data which is provided to us, is for the BVS fraction. So here, let us assume that the components minus others, so there was something others. So we will just not include that in BVS.

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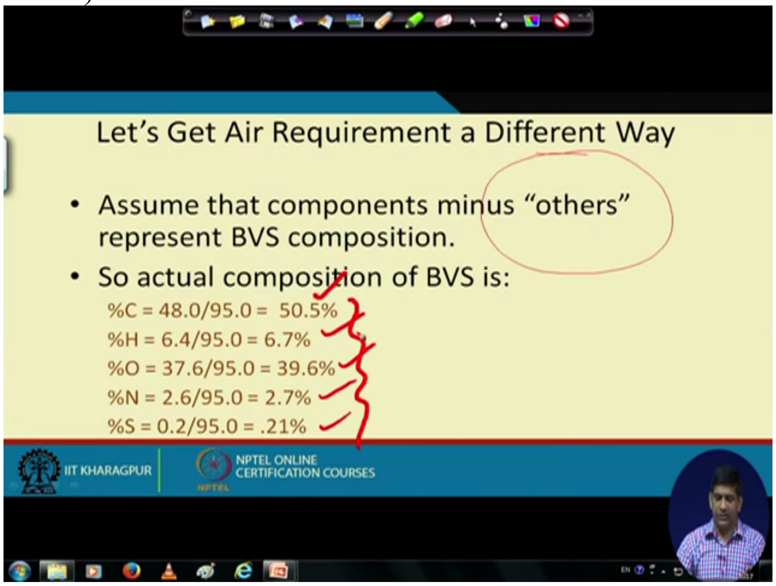

So assuming that the components minus the others because the others could be something else, so we we have assumed that that is that is not part of BVS. So actual, so if you, so it is basically we have to make everything, so if we take that 5 percent off, everything becomes with respect to those 95 percent, so for others, percentage wise will a numbers will go up. So we have increased the number like accordingly. So you have to so the total has to add up to 100.

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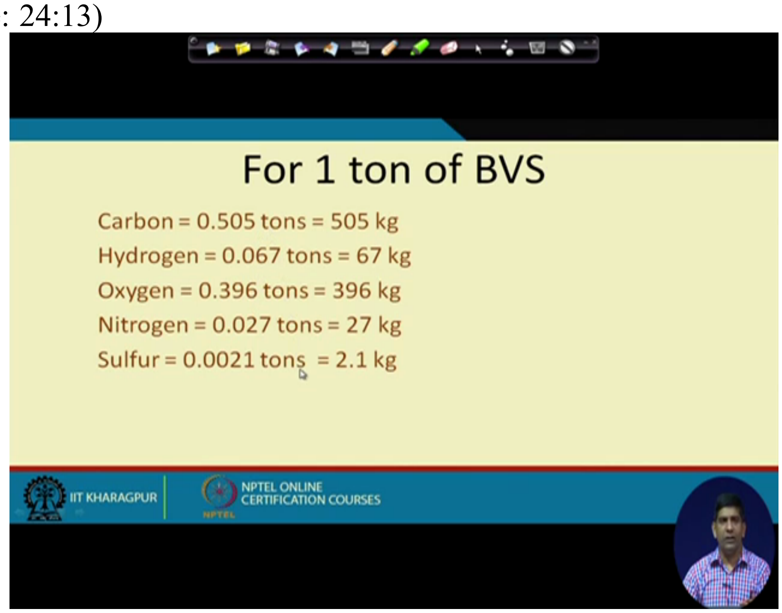

So based on that, we get the, these are the percentages of carbon, hydrogen, nitrogen and oxygen. So that is, so here so if you take 1 ton, so if you for the 1 ton, how much carbon, how much hydrogen, how much oxygen, we can find out that because know what the percentage wise. So for 1 ton, what will be the that individual elements. If we know the mass of the individual elements, what we can do?

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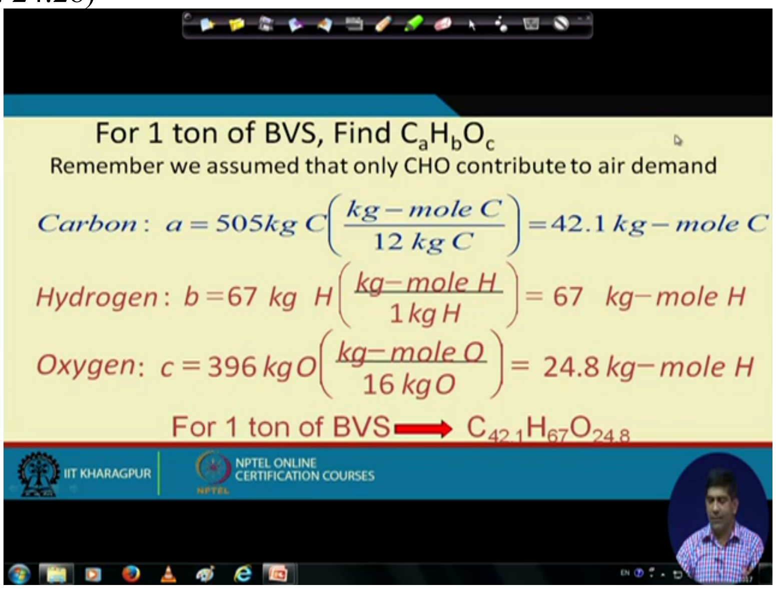

We can calculate how much moles are there. How much mole of this? So 505 kg of carbon. So carbon 12 kilogram Carbon per per kg mole, so we can get all these kg moles individually. So we can assuming that the carbon, hydrogen and oxygen, so we can find out the formula in terms of Ca, Hb and OC, so here the carbon, we got 42.1, hydrogen 67, 24.8. So for 1 ton of BVS, we can write down the formula as C 42.1, H 67 and oxygen 24.8.

So that is we get this formula for that part. So once we have this formula, what we can do is we can again use the same equation as used earlier.

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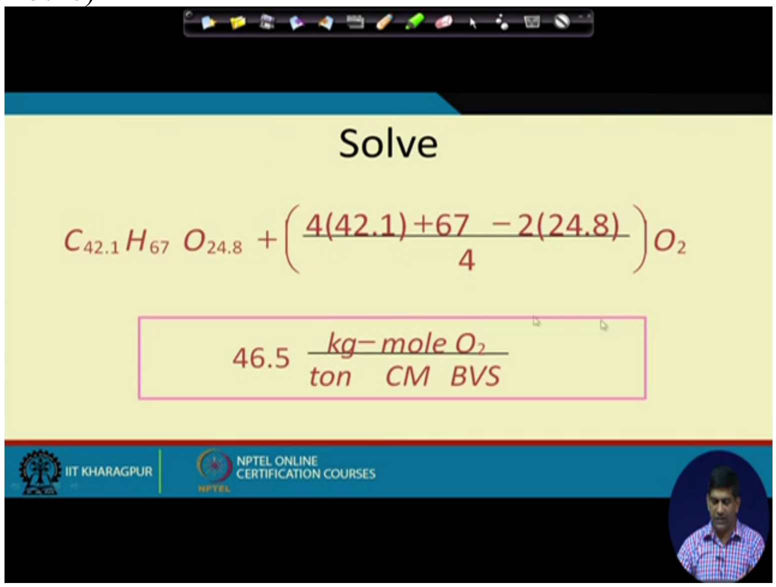

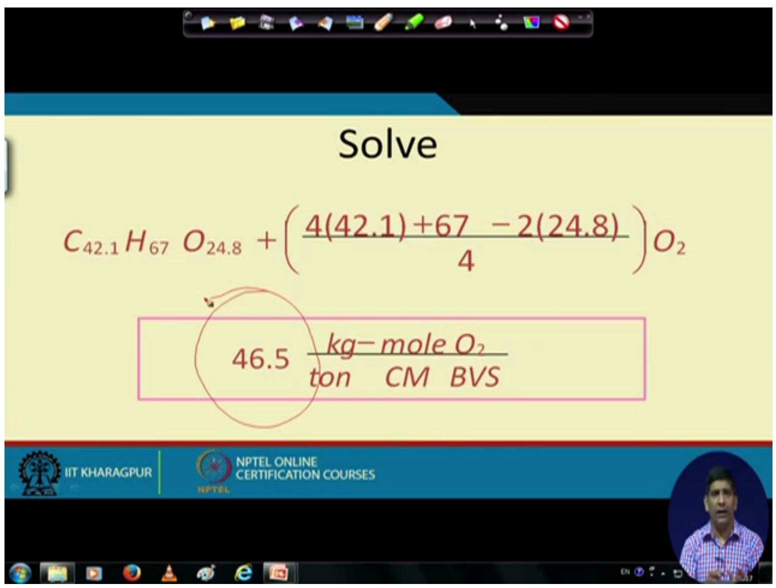

So we will use the similar approach for yard waste. So now the formula is this, so for 1 ton of CM BVS, we can put how much oxygen will be required, we get this much moles, so again here I will not, I will let you do the math details here, I will just show you the steps and then you should be able to follow it if you have followed the yard waste nicely. So you get 46.5 and I will encourage you to go back and do this math by yourself as well just to cross check whether the numbers match and that will help you to kind of if you miss some steps it will help you to understand your steps.

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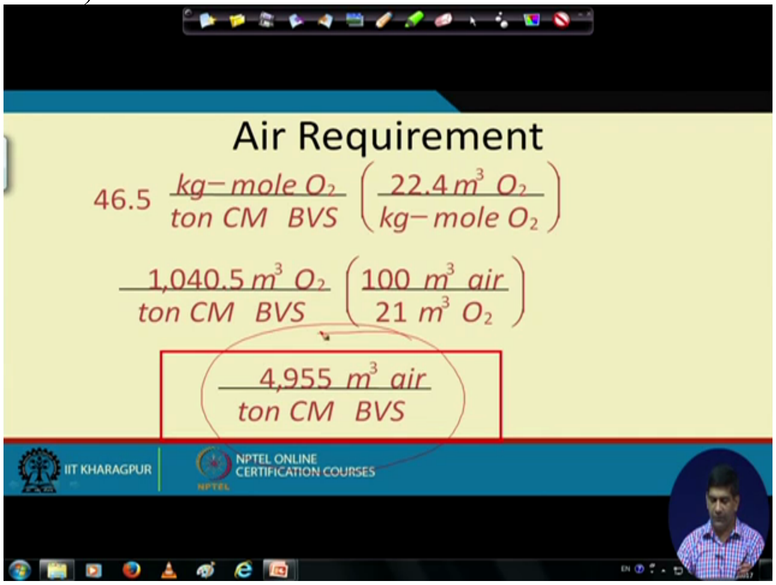

So this much kg mole of oxygen per tonne of chicken manure BVS, and then we can find out how much is the air required based on that, like this much, per tonne of chicken manure, then that ideal gas law assuming that the oxygen is behaving as an ideal, per kg mole is 22.4 metre cube, then from oxygen to, so this much from oxygen to air, so we can get, so since we started with a ton here, we all, we do not do the last step as we did for the chicken for the yard waste.

So we are getting a 4955 metre cube of air per tonne of chicken manure BVS. So that is the data we have in terms of the air requirement. So for both chicken manure as well as yard waste, we know per tonne how much the air will be required.

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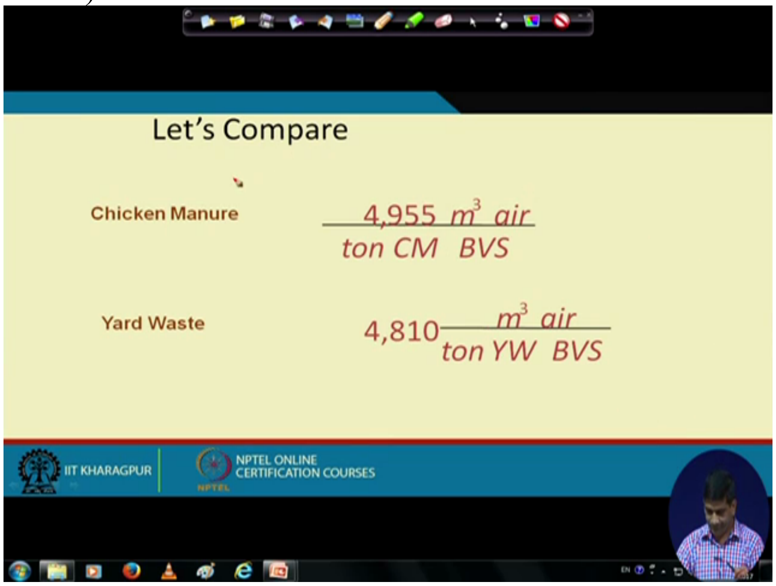

Now the thing is that if you compare chicken manure and yard waste, they are pretty much similar. Little bit chicken manure requires little bit more air than yard waste. It is probably, has like more carbon, carbon and other things are there for reaction. So these are the values for those 2 scenario.

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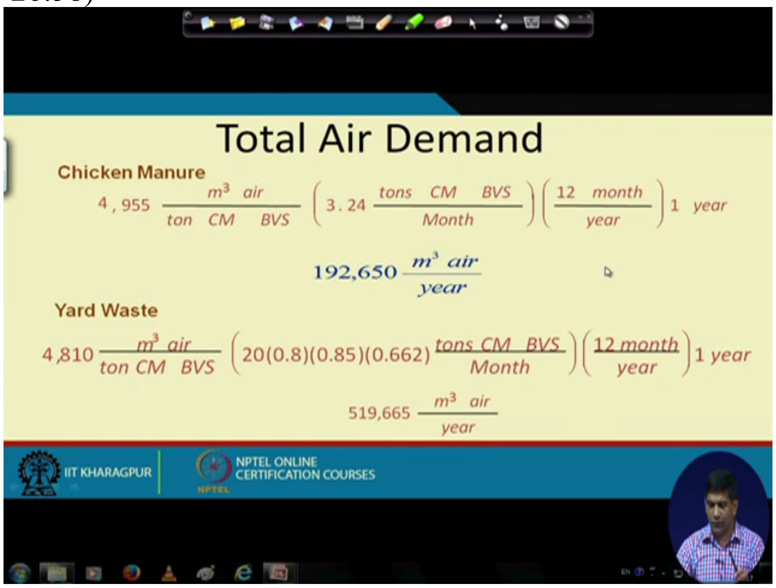

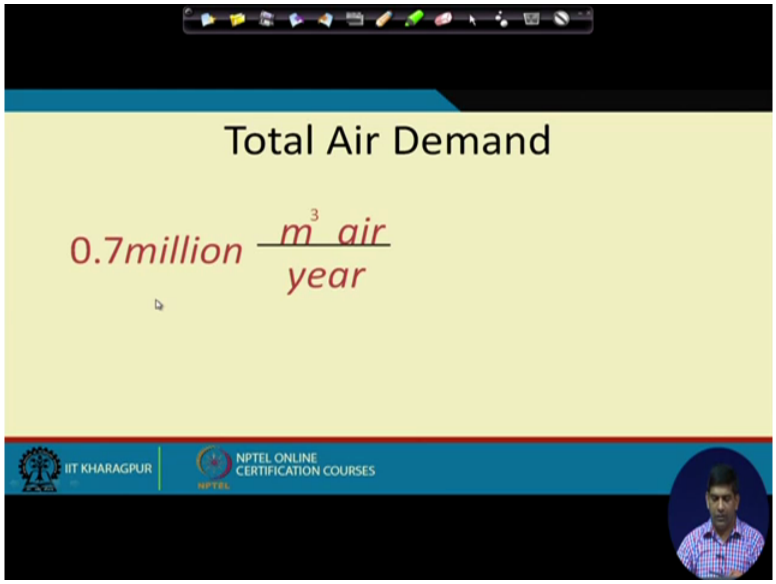

And then so the total air demand will be for chicken manure again this much metre cube of air per tonne and we know that 3.24 ton of chicken manure BVS was there per month. There are 12 months a year or so we can calculate how much for an year. So we get 192. so as you can see here, this much per tonne of BVS. This must tons of BVS, so these tons and tons actually will go away, then your month, it is 12 months per year.

So you come up with metre cube per year by year. So this is the data you get for that. Similarly for yard waste, you can do the math and then you get this much amount of air that is required. So for yard waste, we require more air because it is more mass. Is not it? Here you have 10 tons, here you have 20 tons. That is also a factor in there to start with and then there was a so based on that we can calculate how much, so total air required will be addition of these 2. So we have to add these 2 together total air required.

So that comes around 0.7 million cube of air per year. So this much air is required in a year when you add them to.

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So why we did why we need this air number? So again, again as I have been telling from the very beginning, for everything that you do, you should always try to understand why. So here, we want, why we want this air number? It is because we want to convert, we want to buy those blowers. We have to buy the, we have to know how much air we need to supply, so we need to buy the blowers, and to buy the blowers, we need how much is the air requirement.

And if you look at any blowers or the pump data sheet, they typically give the value in terms of standard cubic metres per minute or standard cubic feet per minute. So we have to convert this data for year, whatever is per year to per minute, how much is data is required per minute to when we go and we start shopping for those blowers or the pumps that we require for air addition.

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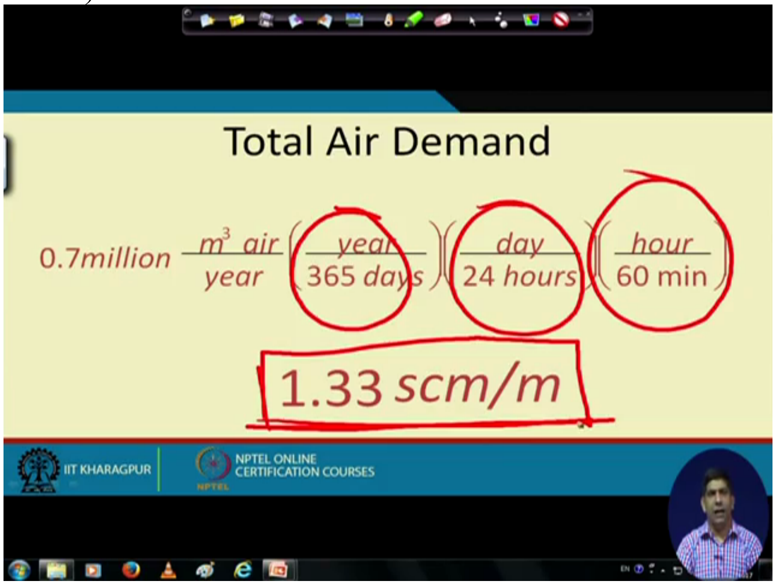

Soif you want to convert that this much air per year, one year 365 days, as you can see over here, one year 365 days, one day 24 hours and 1 hour 60 minutes, so converting this, we need 1.33 standard cubic metre per minute. So when we go out and try to buy the pump or the compressor, what do we need to do it in this we need this much. And here, one assumption is that the air requirement is uniform throughout the process which may not be true.

If you remember the other problem we did, this day 2 was the more critical. But here, that assumption is there. If the assumption is not there, we can always factor those things in (()) (29:30). So that is the requirement.

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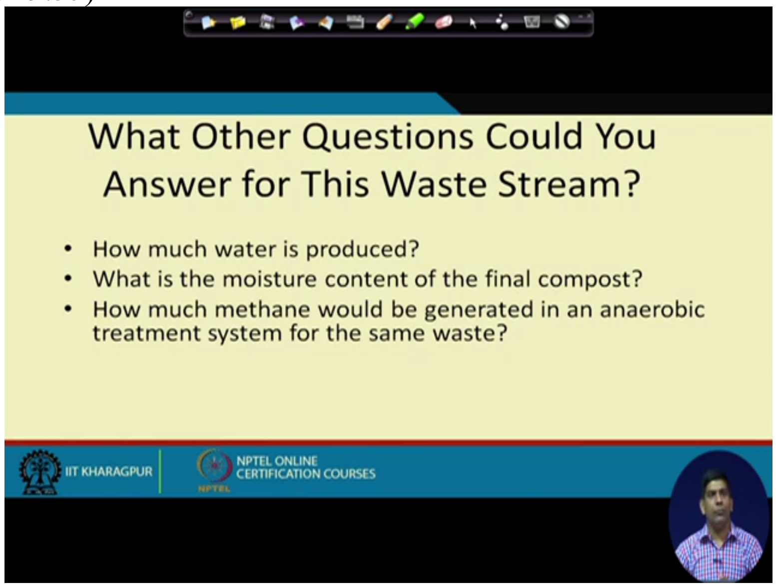

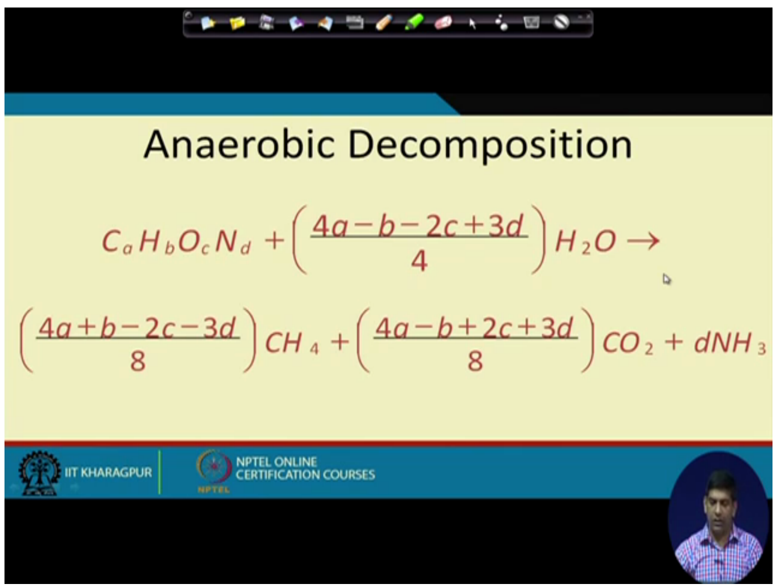

So that is how we get the air, that is why we need to get the air calculation, once you have that, you can design the compost plant, the compost design, the standard protocol is there, how to design it and of course, if you need help, people like me is always available for help. So what other questions could you answer for this question, How much water is produced? We can always find out how much water is produced.

What is the moisture content of the final compost? We can do that. How much if it is an anaerobic system, we can find out, in the anaerobic decomposition, we can find out how much methane would be generated. We did not do a math on that part. I would let you do the math. There could be a math on that part in the exam. So do not complain later on that you did not tell us earlier.

So which is, but I am telling you right now that you can use the same concept and do the maths using anaerobic digestion within this equation. So again as you if you know, if you know the amount of, if you know the the formula for waste, in this case you can also find out how much water we need to add or how much methane will be produced and how much CO2 will be produced, so these things , you can find out as well.

And how much ammonia will be produced, those things can be done in similar, similar problems can be solved and which we will talk about as like we have not done the math here but you can do those math because there could be some questions in the exam and quiz maybe.

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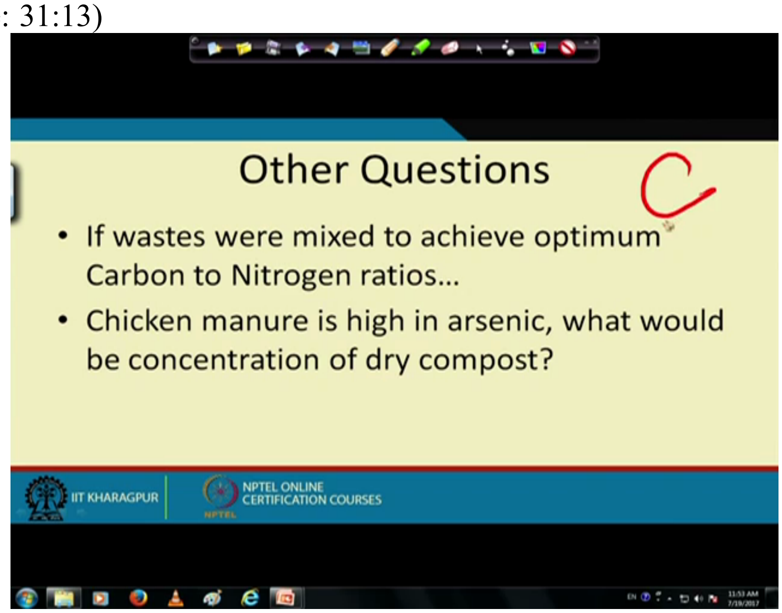

So other questions is that if the waste were mixed to achieve optimum carbon nitrogen ratio, that also we did not do any math here, we talked about that, how to get optimum CN ratio, that is again another very important concept which is also like how to get the carbon nitrogen ratio.

Carbon nitrogen ratio, it should be what we said around 25. So if I give you the carbon value, you should be able to find out the nitrogen value, if I give you the nitrogen value, you should be able to find out the carbon value. So those things are there. Many times, the chicken manure is high in arsenic. I think we talked about that in some parts of the world, they feed roxarsone which is a basically an organic compound but sometimes they does not, it does not stays A R S O N E.

It does not remain, this is A R. It does not stay within the chicken flesh. It goes out as a poop but many times it does, since it is in the poop, it does show up in the chicken manure and then if it is high in arsenic, that means the compost will have high arsenic content. So you can, if I tell, if I give you the arsenic content of the raw material coming in, you should be able to find out how much arsenic will be will be there in the compost.

So essentially, there is again a mass balance problem. We have done that similar problem very early in I think the week 2 or early part of week 3 but this again for the chicken compost also, you can do those kind of problems. So try those like if you, if you have any confusion what I am talking about, ask us question on the discussion board. We will be more than happy. So that is with this.

Let us close this particular video. So we have finished, this is the 3rd video of the week 7. And with this, we have completed the biological treatment part. So in the next video, we will go into the thermal treatment. So in the biological treatment, we focus on composting, we talked about the anaerobic digestion. We did not go into great technical details because again this course is on, in 12 weeks, we have, we are trying to cover several aspects here.

So we did not, but I did not tell you all the basic calculations that you need, how to go about design the compost plant, how to approach design of the anaerobic digester plant. So all those basic home work that you need to do has been covered. Again if you have any questions, you can feel free, to contact as to the discussion board.

For those detailed designs, sometimes through the online course, it is little bit difficult to do those detailed design kind of because what we will try maybe in later later semesters, we will try to just do a focus, like 4 weeks or 6 weeks on anaerobic digestion or just on composting just to go in more like a detailed, step-by-step design of the plant. So with that, let us close this video. Again thank you very much. Keep watching and I hope you are enjoying this course.