Course on Integrated Waste Management for a Smart City
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Module-02 Lecture-08
Municipal Solid Waste Characteristics and Quantities

So let us now continue in our discussion, this is the week, this is week second third module. So we will talk about, we were talking about the characterization of waste. In the just previous module, we looked at the regulatory characterization, how to classify waste to be hazardous waste or not not a hazardous waste. So we will continue that discussion and look at some of other ways of characterizing the waste.

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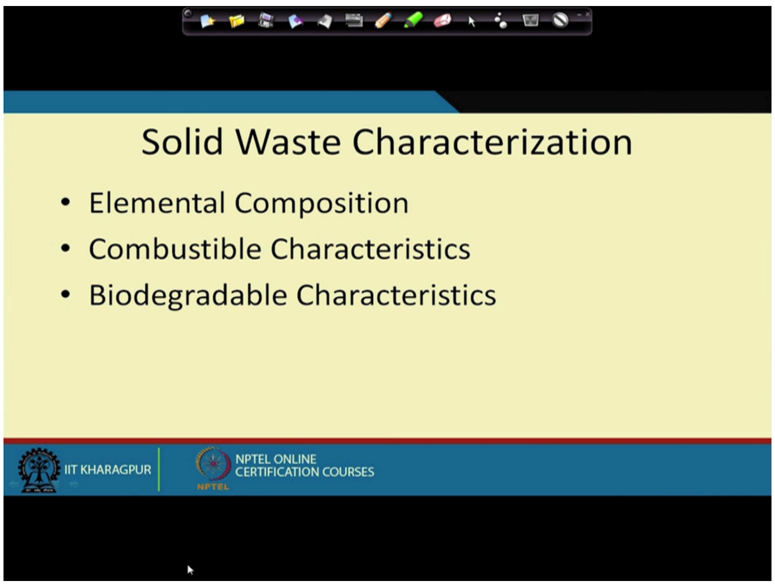

And so in this particular module, we look at how we do the elemental composition, how we characterize in terms of what are the elements present and what is in terms of the combustible and if possible, we will look at the biodegradable characteristics or we will cover that in the next module. So in terms of the elemental composition, again when we say elemental composition it is what are the different elements present in the waste because that is important.

When we say elements, we are talking about the things, which is on the periodic table. If you, I am pretty sure you have looked at periodic table in your high school and in colleges. In terms of different elements present, how much carbon, how much hydrogen, how much oxygen with a nitrogen, phosphorus and what are different heavy metals, what are the different elements present in terms of in solid waste characteristics. And also, and first we will look at in terms of the elements whether in and leave it on a broader scale as well whether it is a paper, plastic, all those kind of stuff.

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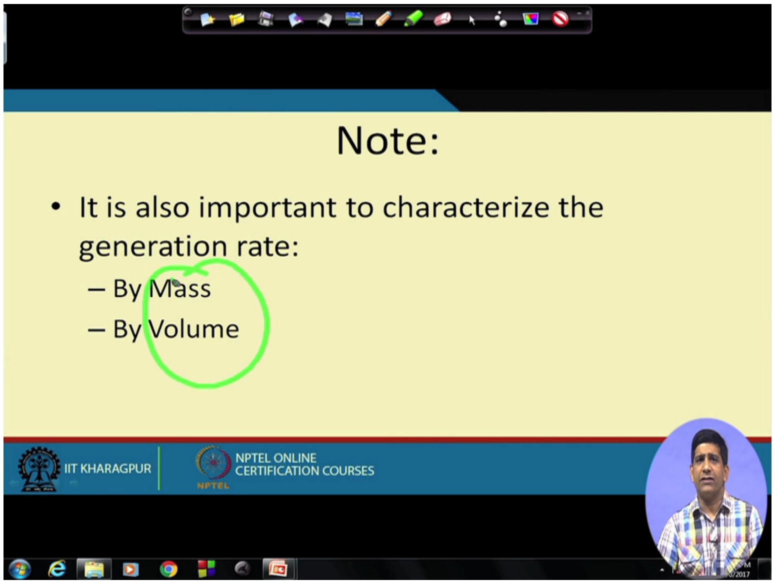

Then, we also try to look at whether it is the mass and volume, what is the, and we look at in terms of the generation rate by mass or by volume. This, in terms of the solid waste field, one of the important thing in the solid waste field is to always try to understand the relationship between the mass and volume. Why mass and volume? We just finished in the first module of this week talking about landfills. When we talk about the landfill space, we always talk about the volume, volume of the landfill, how much garbage we can put in there. But when we (weigh), when the truck comes in or when we talk about this much waste is being produced, we talk about in mass. We say 0.6 kg per person per day, that is the as per CPHEE queue manual for solid waste (genera), for the municipal solid waste generation rate.

In urban areas in India, the rate is taken as 0.6 kg per person per day. So here we are talking about 0.6 kg and that is the mass or the weight. And but when we talk about the landfill, we usually talk about the volume, volume of landfill because that is where the space we are talking about. So there is a relationship between the mass and the volume and we do change, we have many times, we have the mass, we convert that to volume and the vice versa. So there the density of the garbage also becomes important because you need to know density to convert from mass to volume or volume to mass. And so that is, we will talk about those aspect.

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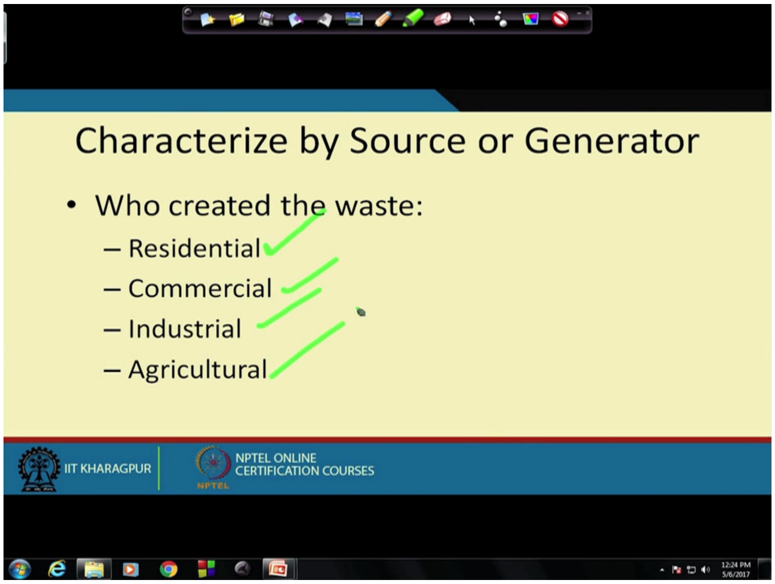

And then also how the waste is generated, who created the waste, whether, what is the source of the waste, whether it is coming from the residential area, whether it is coming from the commercial area, whether it is the industrial, residential, commercial, industrial or; so depending on whether it is a residential waste, commercial waste, industrial waste or it is agricultural waste, so these are the four broader categories. And then things, list can be on and on. Mining, other stuff could be there, but this is who created? Based on if it is residential waste, we know there could be some harmful chemicals there because in our houses also there are, we do use certain harmful chemicals. Nail polish remover, for example has lot of volatile stuff in there.

So that is, and if you are, if you do some oil stuff for your bike or for your car, there is some organic chemicals present there as well. So those are, that may come from the residential waste. But if it is a commercial, more chances of getting these chemicals, metals and other things coming in there. Industrial, even more; industrial, more chances of even having a hazardous waste there.

Commercial, we are talking about say in a institute like this, this is a commercial establishment, so here the type of waste may be little bit different. In terms of recyclables, we will probably see more paper, more plastics being generated here than in a household from a per person basis.

Agricultural, nature of the waste changes. So based on from where the waste is coming from, the nature of the waste will be different. So we have to kind of be careful along that line as well.

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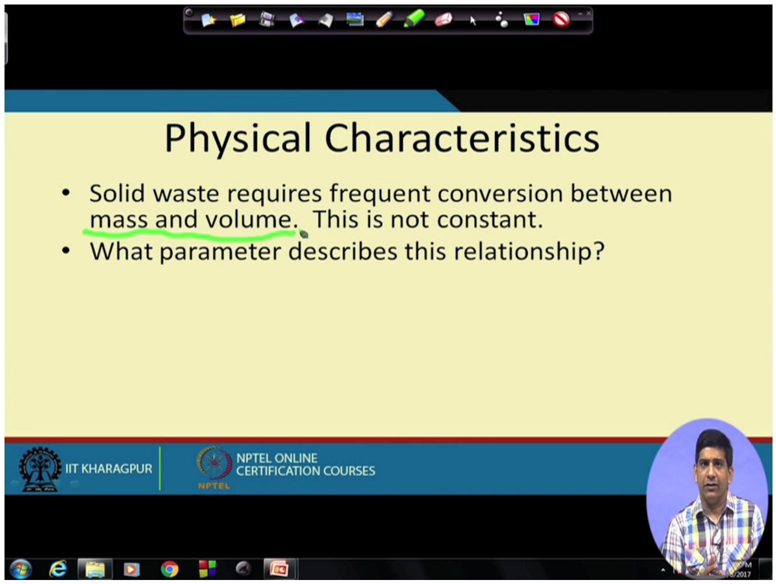

So in terms of the physical characteristics, we, as I told you earlier, we do change between mass and volume. We do have to do many times relationship between mass and volume. And this is not constant because remember we talked about in the first module of this week that when the waste degrades, it produces either leachate or gas. So this will, gas escaping from the landfill, leachate also escaping to the leachate collection system and going out of the landfill. So, the mass is changing.

So if the mass is changing and the volume is the same, the density will change, is not it? So there is the, mass and volume relationship will be there. But what parameter describe the relationship? In fact, I just mentioned to you that, it is the density. So density of the garbage is also very important. We do may, you will see that things being used in terms of the density of the garbage.

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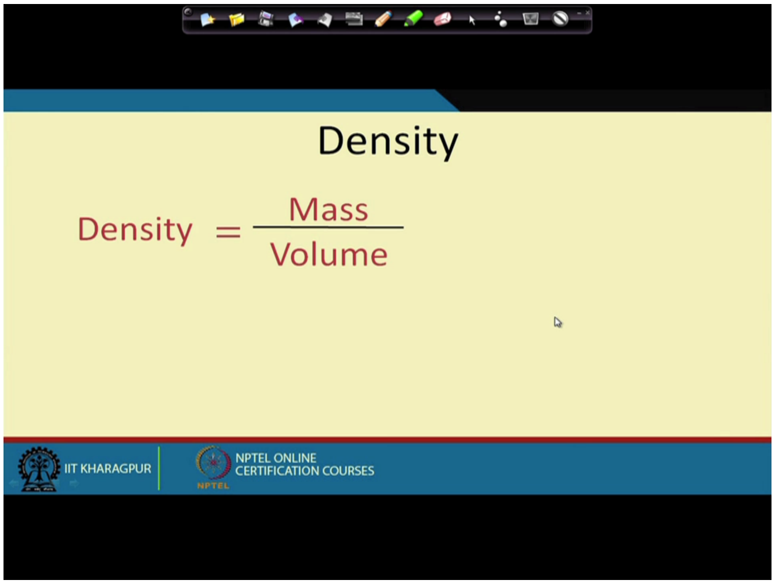

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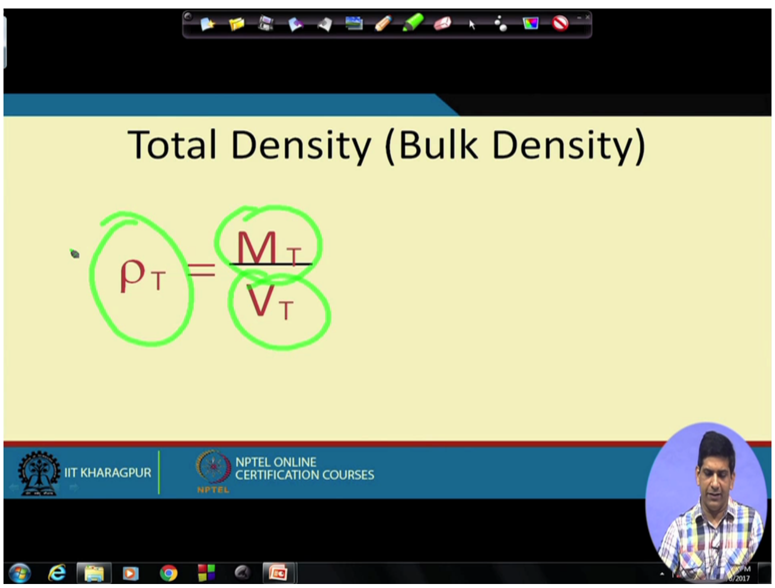

We all know density is mass upon volume. So, we define certain terminology in the waste management system and we will, I will go over some of these terminology. These are very simple, easy stuff. Only problem I have seen, I have been teaching municipal solid waste management or the waste management course since 2008, so this is almost 10 years now, and I have seen the students making mistake only in terms of the unit conversion.

These, the problems of these type of questions are not very difficult, they are pretty straightforward, pretty simple. As long as you follow the language of the question, problem that

I, issue that I see is when we convert from one unit to another unit. That is where the most of the students mess up. So you need to be careful with the unit. As long as you are careful, you will be fine, especially for those of you who are planning to take an exam or of course for your assignments too.

And as you know, every week, you will have an assignment. So we do define certain terminology and this terminology is similar to soil mechanics. If you have taken a soil mechanics class, it is similar to soil mechanics but at some points there is certain differences which I will highlight. So in terms of one of the parameters that we initially define is bulk density which is a total density as well. And what is the total density? It is the total mass upon total volume. So we do a total mass total divided by the volume total and that is we call it the total density or the bulk density. It is straightforward, no problem. So it is a total mass by total volume, that is our bulk density.

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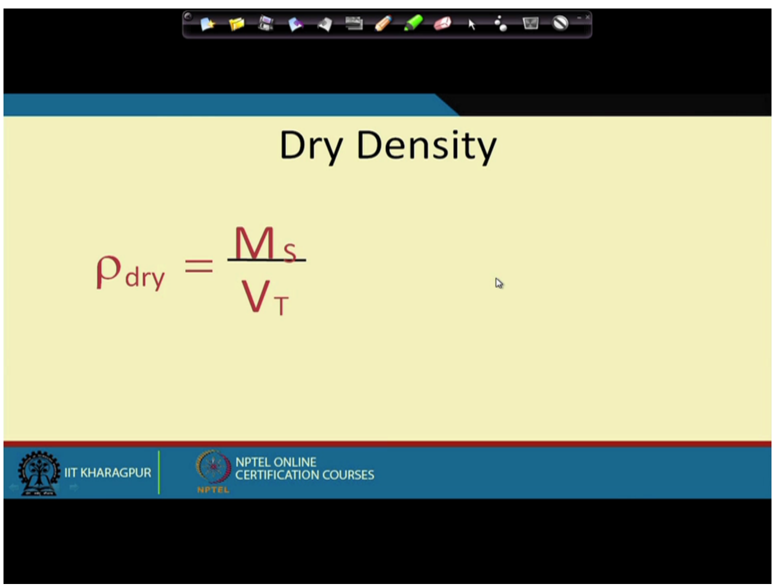

Then we have a terminology, dry density. Again, similar to soil mechanics. The dry density as the name suggest dry, dry means what? We will exclude the moisture. So mass of solid divided by the total volume. Density is mass upon volume, so mass of solid because solids are dry, we are excluding the wet part, we are excluding it, so mass of solid divided by the total volume, that gives you the dry density. So that is dry density of the waste. Why dry density is important? Because again, when we kind of get some idea of, we can, how to exclude the moisture. If you know the dry density and so you can find out, other than water, what are the, after the water has been taken out, what is the waste amount will be left?

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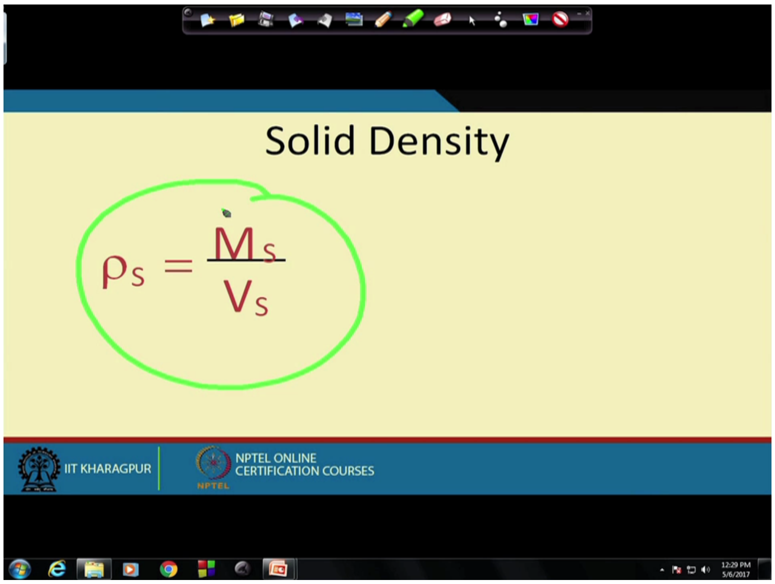

Then there is a term called solid density. Solid density as the name suggest, mass of solid here divided by the volume of solid, it is not the total volume. Mass of solid divided by total volume was dry density. Mass of solid divided by the volume of solid is the solid density. So that is another term used. So do remember this terminology because we will be, when we will be trying to do some math, I will be doing some math as part of the lecture and then we will have some tutorials as well where we will do some math problems in terms of different components of design like a basic stuff in terms of the waste management characterization, design, composting, those kind of stuff.

So there we will use this terminology: solid density, dry density, total density, bulk density. So you should have understanding of that and it is pretty straightforward. Solid density, mass of solid, volume of solid, so that is your solid density.

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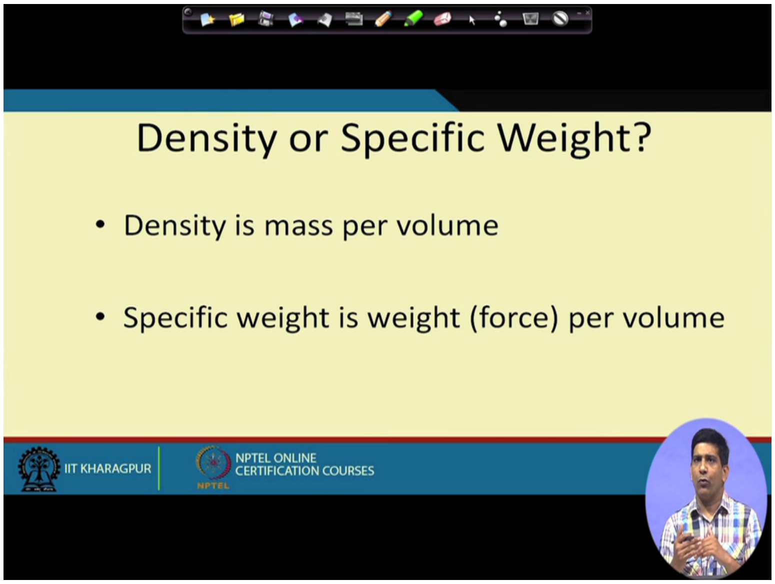

And excuse me, so then we have density or specific weight, there is a difference between density and specific weight. Density is what? Mass per volume. When we talk about mass per volume, that is the density. Specific weight is weight per volume. When we talk about weight, we have that acceleration due to gravity, the g part gets added. So it is, when we talk about mass, we are talking about m. In weight, it is mg, is not it? So that is why weight, it is weight per volume is the specific gravity and mass per volume is the density. So there is a difference between that.

Now why density is important? We talked about, again it is in the landfill setting, it is the mass and volume relationship is there. We do compaction of garbage which we talked about earlier as well. The garbage is compacted in a landfill. So when the garbage is compacted in the landfill, again that is your, it is we look at up to what should be the like a target density, target density for that particular garbage. So that is again, the density is important there. So that, density is term is used a lot in waste calculation, especially when you are trying to convert from mass to volume or volume to mass.

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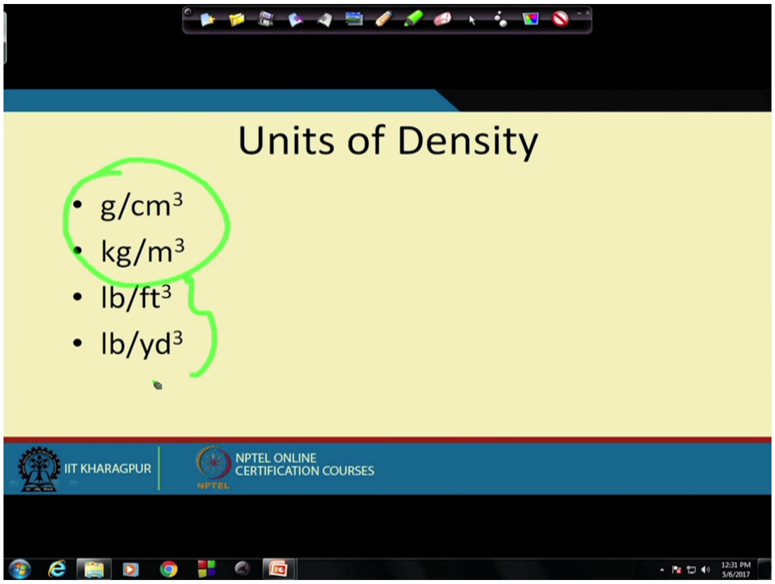

There are different units of density. The first two is the SI units and that is what we will be using. We will be using gram per centimeter cube or kg per meter cube. In most of the books for waste management or in general, many of the books are written in North America especially in US. And if you have a US book where if they have not converted that to SI unit yet, you will see these two units being used as well. First one is pounds per feet cube, other one is pounds per cubic yard.

And I would, you do not have to worry too much about these units but in case you are referring to a book, you should be able to convert from pounds per feet cube to gram per centimeter cube and those conversion I will let you understand, try to figure it out, it is not difficult to do that. If you again, if you are stuck on any of these, discussion forum is where you need to go to and we will be, we will keep an eye on that and you will get response like a within, in a regular interval like a daily response actually coming out there. But these are pretty straightforward stuff, you should not have problem with these.

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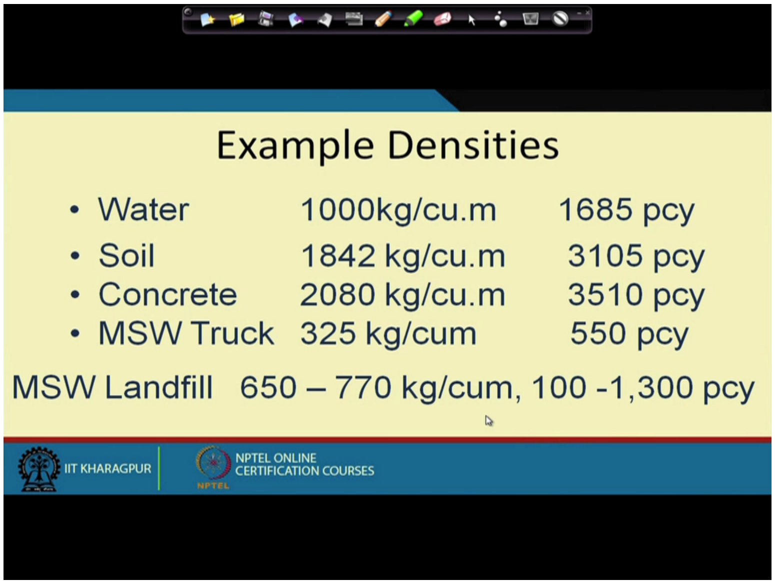

So units of density, then if you look at some of the example density how they are compared and here I put both the units just for you to kind of, if you are looking at some (north) especially US written books which you because most of the books are actually coming from there. So in terms of water, it is a 1000 kg per cubic meter is what is the density, we know that 1 gram per cc or 1000 kg per cubic meter. And if you convert to pounds per cubic yard, that is kind of gives you around 1.68 times. So that is the conversion factor also from kg per cubic meter to pounds per cubic yard. And for soil, is heavier than water. Concrete, again much heavier.

If you think about garbage, it is lighter. It is like a garbage when I say MSW truck, I am not talking about the density of the truck, I am talking about the garbage in the truck. So the municipal solid waste which is being collected and being dumped into this truck, it is that the garbage density, it is garbage density in the truck. So it is the weight of garbage divided by the, mass of garbage divided by the volume of garbage. So that is around 325 kg per cubic meter.

When the same garbage goes to MSW landfill, when we compact it using those compactor with the density it kind of doubles, it is around 650 to 700, 770 kg per cubic meter. This should be 1,100 not 100, there is a typo over there. That should be 1,100 to 1,300 pounds per cubic yard. So this is 650 to 770 kg per cubic meter is what this like a typical density of a garbage in a landfill. So if you look at the garbage of a density like the garbage density in the landfill, that is around 70 percent of what is the water density is. So it is pretty heavy in terms of compacted garbage in a landfill.

That is why when we go to the landfill chapter, we will talk about the bearing capacity of the soil, very similar to foundation design, soil settlement, how much soil can handle, what should be the height of the landfill because the garbage is heavy and it is all compacted garbage is pretty heavy.

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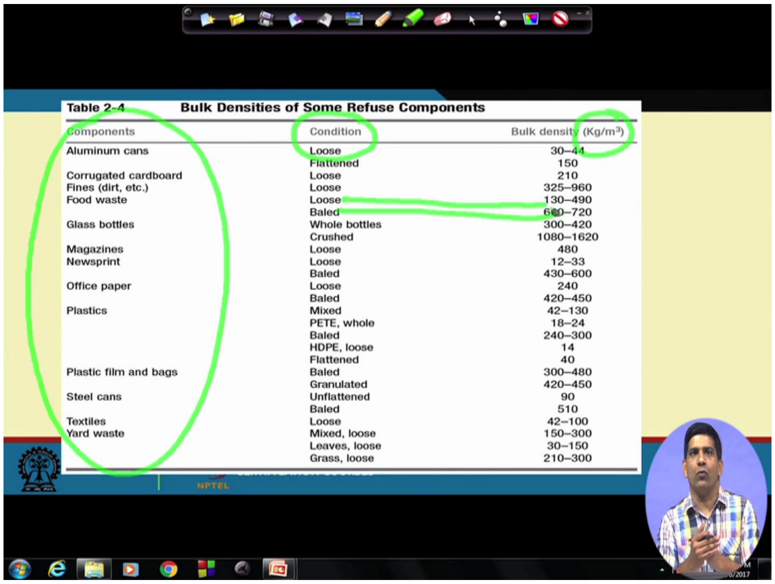

Components	Condition	Bulk density (Kg/m³)
Aluminum cans	Loose	30–44
	Flattened	150
Corrugated cardboard	Loose	210
Fines (dirt, etc.)	Loose	325–960
Food waste	Loose	130–490
	Baled	6[illegible]0–720
Glass bottles	Whole bottles	300–420
	Crushed	1080–1620
Magazines	Loose	480
Newsprint	Loose	12–33
	Baled	430–600
Office paper	Loose	240
	Baled	420–450
Plastics	Mixed	42–130
	PETE, whole	18–24
	Baled	240–300
	HDPE, loose	14
	Flattened	40
Plastic film and bags	Baled	300–480
	Granulated	420–450
Steel cans	Unflattened	90
	Baled	510
Textiles	Loose	42–100
Yard waste	Mixed, loose	150–300
	Leaves, loose	30–150
	Grass, loose	210–300

So here in this table, there are some bulk density of the some refuse components have been presented here. When we say refuse component, it is basically the waste components and on the left, in the column here as you can see left, these are different types of components: Aluminum cans, all the way to the yard waste. Yard waste is all the green waste after a storm or if you have tress, part of the trees, branches and all those things, that is your yard waste.

So and if you look at here, they have a, this column says condition. Condition means whether it is a loose or whether it is a compacted, whether it is flattened. So based on that, the density will change. Because if it is flattened, say aluminum cans, if it is a can by itself, if it is not the compressed one, the density will be different because there is no, the compressed one, the air has been taken out. So the volume will go down, the weight will pretty much stays the same because air does not have much weight. So, if you look at, that is why how the bulk density and here the unit is kg per meter cube. So for aluminum cans which is 30 to 44 kg per meter cube and if you flatten, it is 150 kg per meter cube. So what does that tells us? Just a simple example.

Say you have to transport this aluminum can, as a waste management system you are running a recycling center, you have to transport this aluminum cans from say from that recycling facility to a processing facility or to somewhere. And then this, if you take this aluminum can just by itself without flattening it, without compressing it, your (30k) 30 to 44, so let us take 40 kg per meter cube. So in 1 meter cube space of a truck, you can only fit 40 kg of aluminum. Now if you compress it, you can put 150 kg of aluminum there.

So you can put almost five times more aluminum cans over there. And what does that means? More like five times you are putting in the same truck, same space 1 meter cube; so you are saving the fuel cost. But you have to set up a system where this aluminum can be compressed, you need to have a system there where this aluminum can mechanical system.

So you can look at the pros and cons, if should I transport it as it is without compressing it or if I am compressing it, since the density will go to 150, nearly five times, I can transport five times more. But to do that, if I need to set up this like aluminum can like flattening device and that will require some money, but you can do your cost analysis and the environmental benefit analysis and all that, health kind of, LCA kind of exercise as well.

But basic component was to have this density information. So that is why when I say that density is very important in the waste management decision making, this is one example. You will have severals of examples like that when you look at how density plays a role in terms of waste management calculations. So similar things can be talked, think about like corrugated cardboard, say if you look at food waste, here we have food waste.

If you have loose food waste, that is what 130 to 490. But if it is a bailed, bailed means again you have a compressed one, 600 to 790. So it is again you have more, it is compressed one, so you can transport it because the collection and the transportation of garbage, that is actually one of the most costly part of waste management system. So if you can reduce the collection cost, that actually helps a lot in terms of waste management system. And by compressing things, that is why we have this, we use this like a bailing device, flattening device and for all that. Glass bottles, if you have the whole glass bottles, 300 to 420 kg per meter cube. And if you crush it, almost three times, three to four times more.

So in the crushed glass it can work out, we will be able to transport, we will be able to fit that more in that particular space. And also, the space in terms of how much space is there in your facility because everything, space is money, the land cost is money. So all that particular adds up. So, similar stuff is given for magazines, newsprints, office paper, plastic, plastic film, steel cans. We can have similar discussion on all that. So this gives us some idea about the bulk density of several refuse components.

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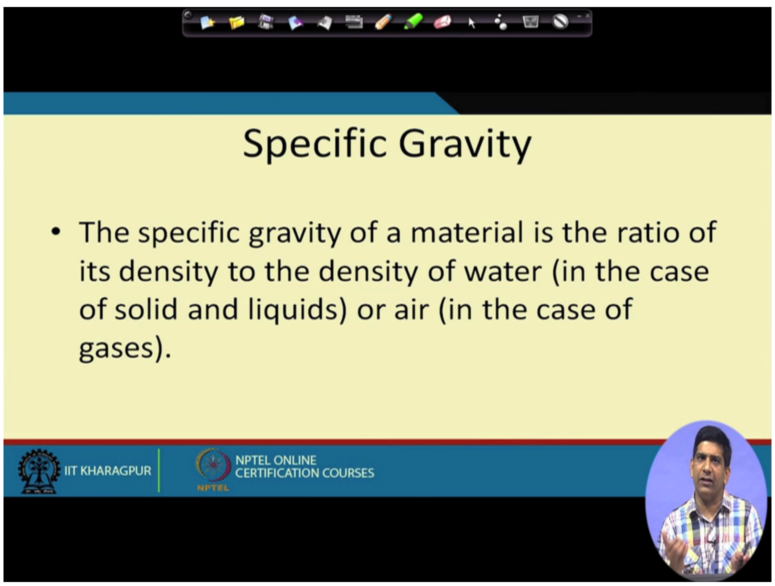

Now the specific gravity, specific gravity is a term used when we talk about, specific gravity of material is the ratio of the density, of its density to the density of water. And we know the density of water, in terms of for the solid and liquids, we compare it with the density of water. For air, we compare it with the density of, sorry for the gas, we compare it with the density of air. So it is a ratio. If it is a ratio, that means what? Will there be any unit? There should not be any unit, is not it? Because it is the ratio of two densities. So whatever is the density unit, is in the top as well as in the bottom. The specific gravity is the unit less number. And if you know the specific gravity, you can find out the density, so that is, because we know the density of water, we know density of air.

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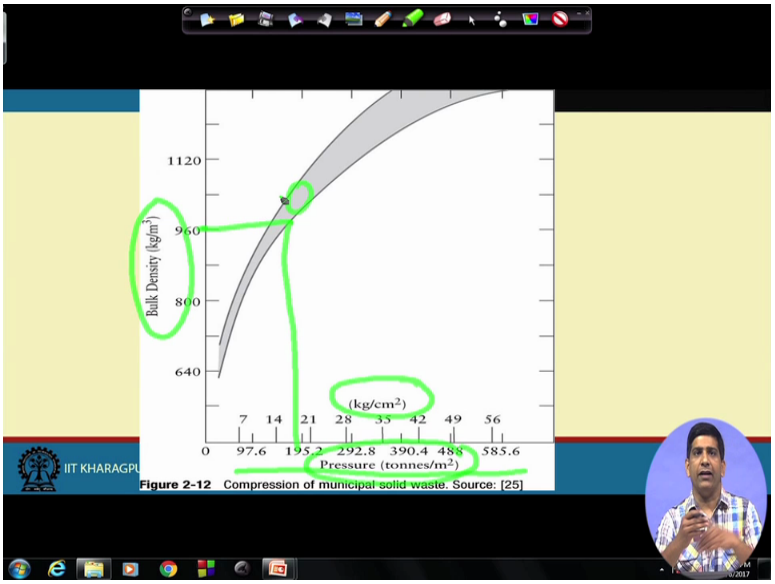

So this like bulk density, in terms of if based on the compression, like this graph shows us how the bulk density changes with respect to compression. So this is a bulk density in kg per meter cube and here the compression and pressure were kg per centimeter square or tonnes per meter square. Two scales have been provided to us, so why, what is this, what is the importance of this graph in terms of the waste management system?

We are setting up certain compression device and we want to achieve certain bulk density, so that we can reduce the transportation space requirement. So to find out what should be, in terms of say if I want around 960 as my bulk density, I have to apply a pressure of something around 190 or 195 tonnes per meter cube. So I can find, so we can find out. We can go and speak out my compression device based on how much will be needed. And here you see two lines because waste is not homogenous. So it is, there will be, this is a range. So you have a lower range and the upper range and that is what it is being shown here. So we can use, so anything between this range is what we are looking at, the number will vary in that particular range.

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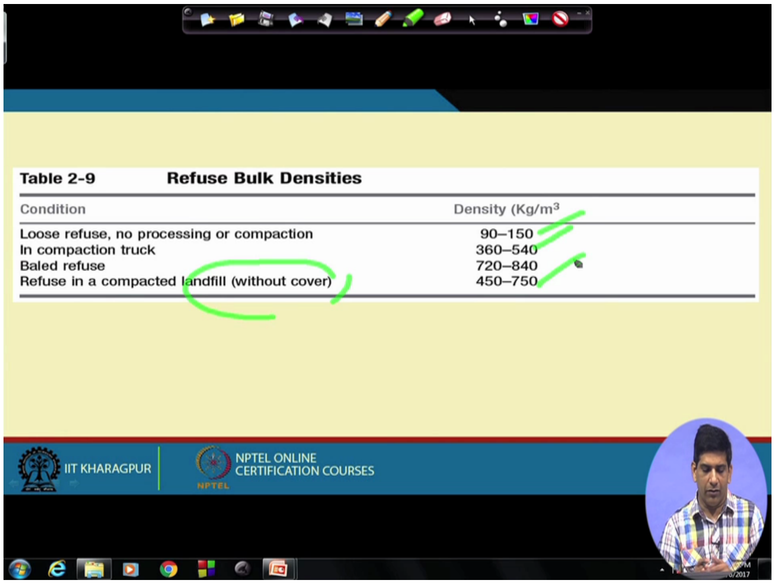

So if you look at some of these bulk density numbers, we already talked about in terms of the different components. So refuse bulk density, refuses the (gar), it is basically the waste in Australia, New Zealand, those places they call it more as a refuse rather than, even the garbage can you will see the tag will be refuse rather than calling it a garbage, with a different terminology being used at different places.

But here if you look at in terms of the bulk density, if it is loose refuse, no processing, no compaction, it is 90 to 150 kg per meter cube. If it is a compaction truck, these days many times you will see some trucks which has a compactor built in. Many of these big cities now, even in India even I am talking to you from IIT Kharagpur, Kharagpur city recently bought a garbage truck which has a compactor in there too.

So in this compaction truck, we are looking at this loose, loose means it is in the garbage can, 90 to 150 kg per meter cube. The garbage can which you and I will use at our home but once it goes to the truck, it is around 360 to 540. So compaction, the density does keep on changing. And if it is a bailed where you do the bailing, bailing in the last week, towards the last week last module we talked about the (bail) bailer where the bailer is used to compact different types of garbage.

If you have watched that movie WALL-E, that WALL-E that is, it is a garbage compactor. Actually, that is a bailer as well. He is making bails of different waste components. So, that is the bail refuse, again the density goes up. It is essentially what we are doing; we are actually, whatever is the entrapped air, we are removing it. And as we are removing the entrapped air, air is going out. So the volume is, effective volume is coming down and the mass is going up. So, essentially it is a same. When it goes to a landfill where cover is not there yet, we have around 450 to 750 kg per meter cube. So that is where different categories of how the density of the garbage keeps on changing depending on where they are.

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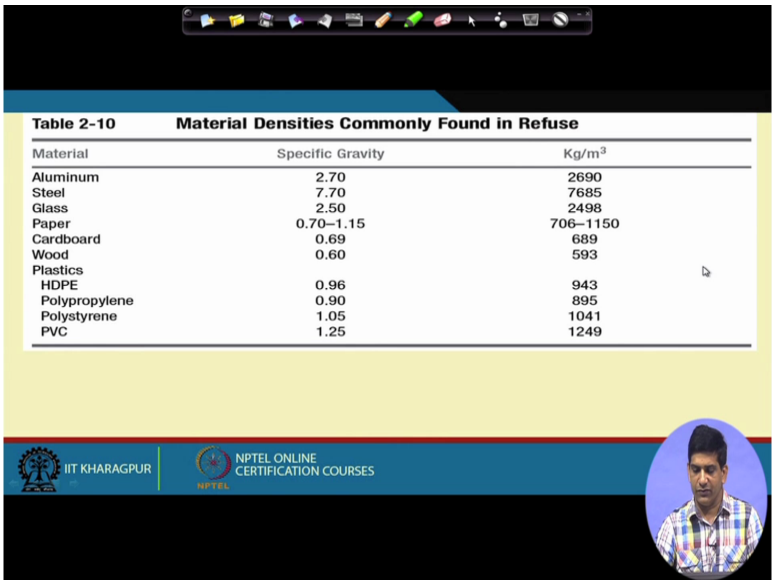

Table 2-10 Material Densities Commonly Found in Refuse

Material	Specific Gravity	Kg/m^3
Aluminum	2.70	2690
Steel	7.70	7685
Glass	2.50	2498
Paper	0.70–1.15	706–1150
Cardboard	0.69	689
Wood	0.60	593
Plastics		
HDPE	0.96	943
Polypropylene	0.90	895
Polystyrene	1.05	1041
PVC	1.25	1249

So density, it is, we already kind of, it is material density commonly found in refuse. Aluminum has, if you just have the aluminum, it is 2,690 kg per meter cube. So if you look at the different components, steel of course is the heavier part. Then, aluminum and glass, kind of the similar weight. We have paper, cardboard, wood. Then there are different types of plastics and a specific gravity is also given for all those different type of components out there. So that is kind of just a typical number in terms of the material density which we use for different calculations.

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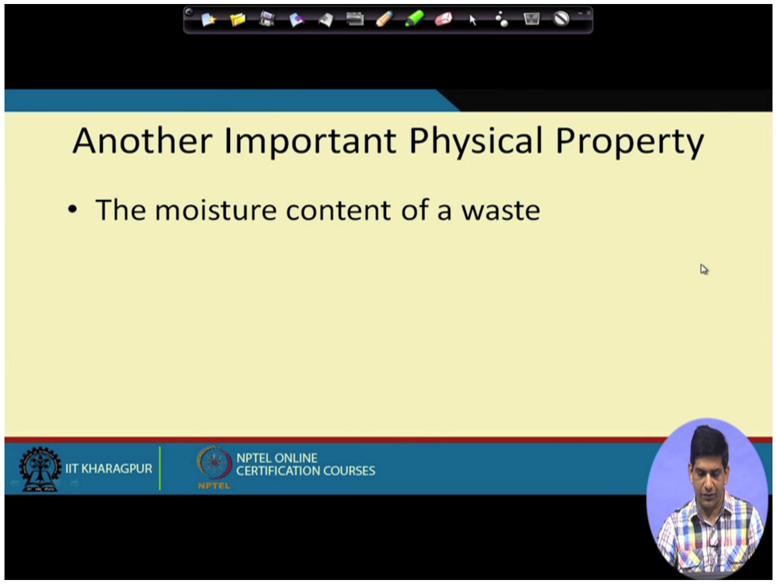

Another important, so we kind of covered quite in detail about the density and how they are being applied, how they can be used. Now the other important physical parameter is the moisture content. Moisture content is, we talked about in the first video of this particular week that moisture content is important in terms of the leachate production.

Moisture content is also needed when we are, we talk, what we said? We said that it is the microbes which does the degradation of garbage. If you the, for the microbes to work, it has to be wet. If the condition is not wet, the microbes do not work, they do not like dry stuff. I think I may have told you that we were working on a project and I think that was in 2004, 2005 and it was in Panhandle Florida which is one of the part of Florida. It does not matter which were part but there we were actually, there was some problem with the liner system, that was not a like 100 percent engineered landfill, that was a very old landfill. So we are moving that garbage from one location of the landfill to another cell and which was, has a proper engineered landfill control in terms of the leachate collection system, liner and all that.

So when we are moving the garbage, what we saw is there was a newspaper with Ronald Reagan and Margaret Thatcher picture on it. And Ronald Reagan, Margaret Thatcher means early 80s, that is at that time they were both President of United States and Prime Minister of Britain. So that almost 20 years old newspaper was in a readable form. I could read that newspaper, I can flip through the newspaper and read it just because it happened to be in a dry part of a landfill.

So that is why if it is, if there is not enough moisture, the waste did not, the microbes do not, are not happy, they do not do their stuff, waste do not degrade. So that is why the moisture content is very, very important and even the distribution of moisture inside the landfill is very important. When we talk about bioreactor landfill, we will discuss that in more detail.

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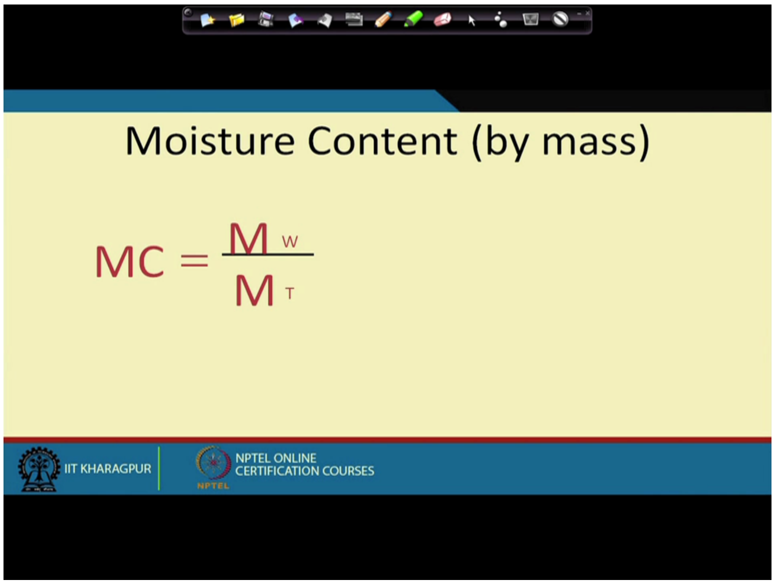

So in terms of the moisture content of waste, moisture content as again very similar concept as we were being talking about in soil mechanics class. If you, I am assuming that most of you have taken soil mechanics. Even if you have not, does not matter. Moisture content as you know is mass of water divided by the total mass of any media we take, is the mass of water divided by the total mass is the moisture content.

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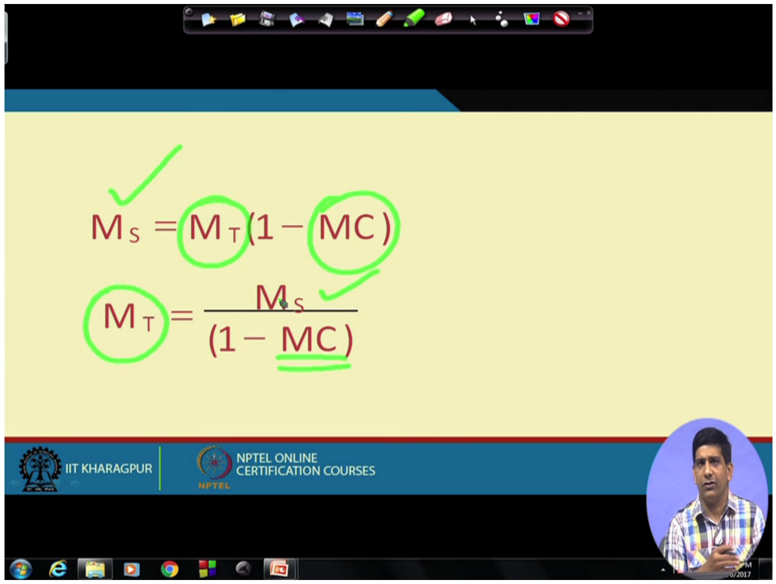

And if you know the moisture content, if you know the total mass, this MC, MC here is the moisture content where that is the moisture content. If you know the moisture content and if you know the total mass, you can find out mass of solid. If you know mass of solid and you know moisture content, you can find out, sorry, if you know the total mass and you found out, you know the moisture content, you can calculate mass of solid. So it is, can be done either way. So that is the moisture content is very, very important in terms of, and you will see. When we solve some of this problem which will happen towards probably end of this module or maybe in sorry, end of this week or maybe early next week, you will see how these numbers are used in a real problem.

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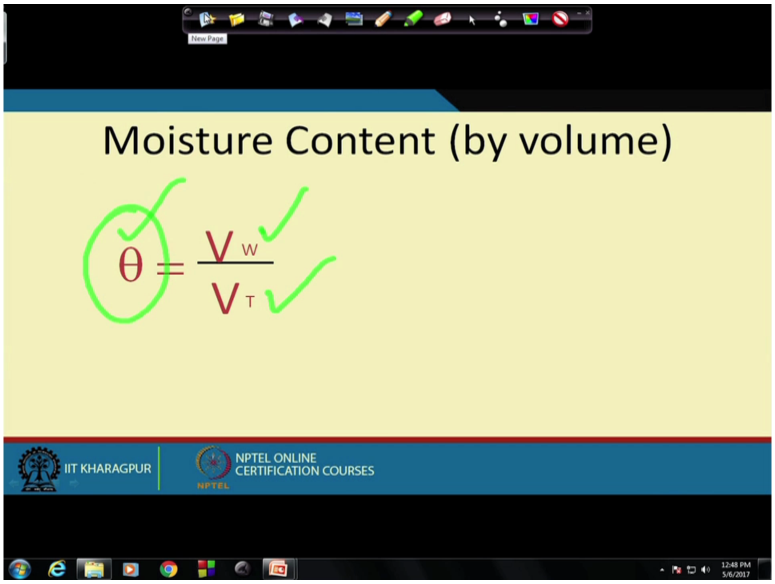

And then there is another way of expressing moisture which is known as moisture content by volume which is, we express that as theta. And that we will use in the landfill chapter actually. We will talk about the some of those equations, we use theta which you will see in the landfill calculations. So what is the moisture content by volume? As the name suggest by volume, means what? Volume of water divided by total volume, so that will be the moisture content by volume. So again do not memorize, try to understand. So it is moisture (cont), which is the volume of water divided by the total volume. So it is pretty straightforward if you just try to understand it rather than trying to memorize this stuff.

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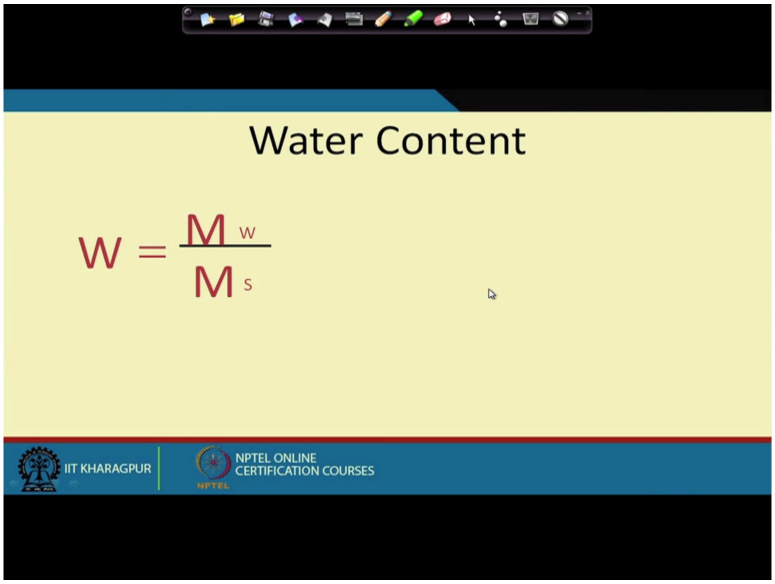

Then there is a term called water content. It is also used in soil mechanics but it is used a lot in our let us say, what I say, in solid waste stream where we talk about the water content. Water content is mass of water divided by the mass of solid. So it is not the total mass, it is the mass of solid that we are worried about, it is the water content is mass of water divided by mass of solid. And water content is also used a lot in the waste water system where we talk about the sludge where the sludge has a certain water content which we worry about the water content of the sludge and then we talked about the solid contents as well. So this water content and solid contents are used in the waste water field too.

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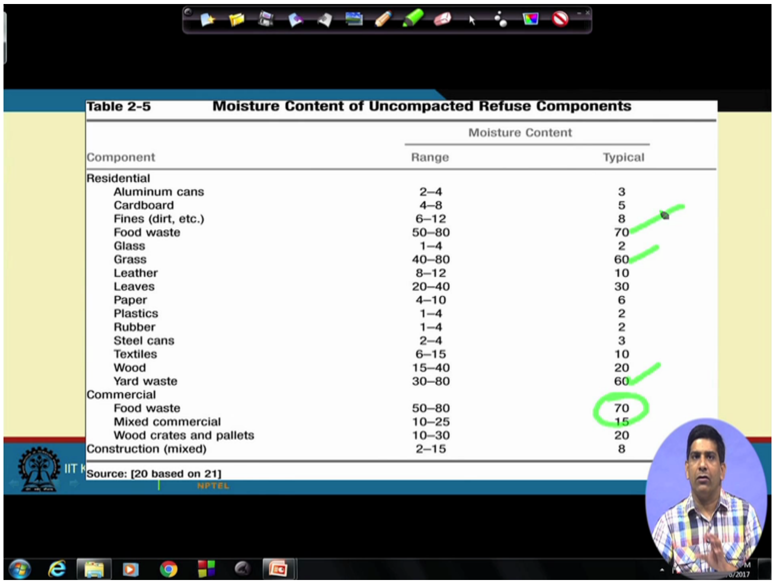

Table 2-5 Moisture Content of Uncompacted Refuse Components

Component	Moisture Content Range	Moisture Content Typical
Residential		
Aluminum cans	2–4	3
Cardboard	4–8	5
Fines (dirt, etc.)	6–12	8
Food waste	50–80	70
Glass	1–4	2
Grass	40–80	60
Leather	8–12	10
Leaves	20–40	30
Paper	4–10	6
Plastics	1–4	2
Rubber	1–4	2
Steel cans	2–4	3
Textiles	6–15	10
Wood	15–40	20
Yard waste	30–80	60
Commercial		
Food waste	50–80	70
Mixed commercial	10–25	15
Wood crates and pallets	10–30	20
Construction (mixed)	2–15	8

Source: [20 based on 21]

So these are the, so here are some of those typical moisture content of certain uncompacted refuse component that we will be talking about. So this is, if you look at the moisture content, as we know for a typical garbage, moisture content typically is very high for food waste. And if you look at the food waste, the moisture content is nearly 70 percent. Yard waste which is our leafs, things from the trees, they also have high moisture content.

Then we have grass, again high moisture content. Food waste, we kind of talked about that as well, the moisture content is pretty high. In Indian scenario, in terms of our municipal solid waste, we have, we do not have that much of paper, plastics going into our waste stream because the paper and plastic usually is taken care of by the kabadiwalas and other staff, they come to our houses and collect it.

So our most like a predominant component in our waste stream is the food waste. So we do tend to have higher moisture content. That is the reason why when we talk about waste-to-energy plant, we have to be really careful because of the high moisture content. High moisture content means low calorific value and we will talk about those. That is why again the, these are the some of the reason why moisture content is important. Because you need to, moisture (cont), high, good moisture content is needed for waste degradation.

Otherwise if it is a dry, I talked to you about that Margaret Thatcher, Ronald Reagan newspaper, it will not degrade, waste will not degrade. And other thing is that if moisture content is too high, not a good candidate for waste-to-energy plant because you remember that latent heat of evaporation, lot of energy will go into taking care of this water getting converted from liquid to gas. So that will be an issue. So in that scenario it is very, very important to know the moisture content of the garbage and how much leachate will be produced. Those are again another, so that is the reason why these parameters are important. So that is in terms of this table shows you the different moisture content.

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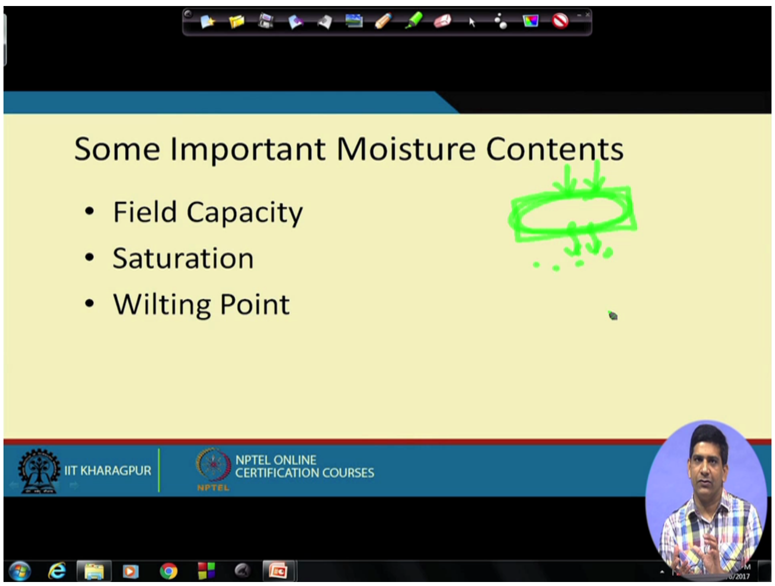

So other some important moisture content terminology, one is called field capacity. Now what is field capacity? Field capacity is a term used, if you have a, if you are having a particular media where you have, so if you are looking at just a particular media, I am talking at a two-dimensional but it is a three-dimensional stuff and then you keep on adding water to it. So what is the moisture content that particular media can hold against gravity? So how we will find that out?

So when you start seeing first drop of water coming out here, that means that is the amount of water does that media can hold before you see first drop of water coming out. That is called the field capacity. And that field capacity depends on the porosity. Based on how much porous the media is, the water will fill up all those pore spaces. And once the all pore spaces are filled up, you will start seeing water to come out. That is kind of similar, you will see that field capacity.

And field capacity, sometimes that is you would, if you take a sponge kind of thing, we add water. Lot of water gets hold up in there, is not it? That is the, so spongy kind of stuff, more the field capacity. And once the field capacity is reached, water cannot be hold anymore, it will start flowing down. And similar concept is your saturation where all these pores have been filled up with water, that is your saturation limit.

Another term wilting point, wilting point is not that common. We will not use it in a solid waste terminology. Wilting point we use more in agricultural area, it is the minimum amount of moisture which is there for roots, minimum amount of moisture which is there in the soil which roots can uptake for their like a day to day operation of the plant. So that is the wilting point.

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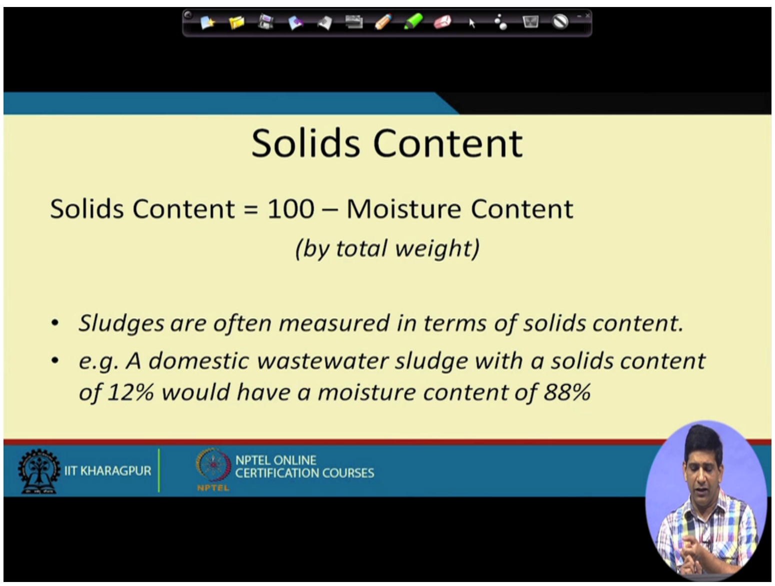

There is another kind of, this is the, we will look at the solid content and then we will kind of close this particular video. In terms of the solid content, because the moisture content and solid contents are related, so solid content is what? It is 100 minus- moisture content. So, 100 minus-moisture content is your solid content by the total weight. So when we, mostly we use it for sludge, bio solids.

Sludge are often measured in terms of solid content, sometimes you will hear in the waste water class as well. We will say that this particular sludge has a solid content of 12 percent or 15 percent. So when we say 12 percent, 15 percent, that means it has 88 percent moisture. It is much more moisture than the food waste. Food waste has 70 percent moisture, so 30 percent solid content. So that is how we define it.

So let us kind of this, we will conclude this particular video where this, in this particular module we looked at two very, very important parameters in terms of the waste characterization. One is the density, the relationship between mass and volume. The other is the moisture content. And I tried to give you some examples of why these two parameters are very important. Later on, when we solve some problems on this, you will see again how they are being applied. So with this, let us stop here and we will look at some of the other characteristics in the next video. So thank you and keep enjoying this course and any question, do let us know on the discussion forum.