Urban Services Planning
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Lecture 44
Special Waste Management Part I

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Welcome back in lecture 44, we will cover Special Waste Management. And this is part 1 of the lecture.

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The different concepts that we will cover are special waste including domestic hazardous waste, special waste management rules, then we will talk about plastic waste and the different issues in India, plastic waste management rules 2016. Then we will talk about the

responsibilities and functions of local bodies in regards to plastic waste management and then we will talk about plastic waste management then, we will also touch upon single use plastics and overall plastic recycling plastic reuse.

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So, when we talk about, we have already discussed about special waste and some of this waste is hazardous and we are mostly concerned with the domestic hazardous waste. Now, there are also hazardous waste generated by the industries or specialized units that we will touch upon some of that, but in most cases, the industries and those units will be responsible for the management as well as their for their, for their processing or transporting them to the processing facilities and eventual disposal.

So, in we are mostly concerned with the municipal waste stream and whatever amount of waste that is generated in the municipal area, that is what we are concerned about. So, usually industrial there are there may be some industry some sort of you know smaller units which are there in urban areas, but bigger industries we are not concerned about. So, special waste requires special handling and disposal that is why we call it special waste and this is primarily the special handling is required because we want to protect human health and environment.

And so, because we want to protect human health and environment from this waste, we have to be extra careful and we will this will also include the domestic hazardous waste as well. So, both is covered in this particular lecture. So, this waste are not actually dealt together with the other municipal waste streams that we have discussed earlier like wet waste stream or the dry stream. So, this this is kept separate from both of those particular waste streams

and why we do that, so, that it does not each, because this kind of waste will contaminate those other waste streams and there may be issues in their recycling.

Now, why this waste we are calling them special because they are more harmful than the other kinds of waste. So, basically their quantity is one issue. So, their quantity is one issue, usually they are in lesser quantities, then their concentration, their physical, chemical or biological properties, which are different from the other waste that we usually collect in urban areas.

So, what we are going to cover, we are going to cover plastic waste, we are going to cover biomedical waste that is generated within urban areas by different generators of biomedical waste, slaughterhouse waste, electric and electronic waste to certain extent, waste tires and battery waste. So, these are the different kinds of special waste that we are going to cover there are other special waste as well which is not covered in this particular lecture.

So, we are supposed to segregate at our household and at different establishments or institutions, but usually in many urban areas in India we are yet to do proper segregation or sometimes even though we ask people to segregate, they the eventual waste that comes out may be partially segregated, but still we have got a lot of mixed waste. So, a lot of mixed waste streams comes in so, there is a need to do further processing or taking out this kind of waste out of the standard municipal waste stream. So, that those waste streams are not contaminated.

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So, when we deal with this kind of special waste, we have to be aware of the different rules that are there, which governs how we should deal with this particular waste. So, particularly for plastic we have the plastic waste management rules 2016. There is another rule set of guidelines which is in regards to the extended producer responsibilities in regards to plastic waste that we will discuss later. And then there is guidelines for recycling of plastics, which are the Indian standards 14534, and this was made in the year 1998. And then there is guidelines for Co-processing in cement, powder and steel industry for plastic waste.

So, these are the three guidelines which have been which are there which we can follow while determining how we should manage plastic waste in urban areas. Then for biomedical waste, we have the biomedical waste management rules 2016 for E-waste, we have E-waste management rules 2016. For battery waste, lead acid batteries, we have battery management and handling rules 2001. Then for hazardous waste, we initially had hazardous waste management and handling rules 1998. And eventually now, we are using hazardous and other waste management and transboundary movement rules 2016. So, this is what governs how we should deal with hazardous waste.

Now, overall goal is to as we have learned about the integrated solid waste management that overall goal is to minimize the generation of this kind of waste minimization could be done at the consumption side or even at the production side like we replace this kind of waste by something which are more sustainable and so, on. Or we can in general reduce the quantity of production or use of this kind of waste by the you know, the households or the institutions which uses this kind of waste they can go for alternative waste instead of using alternative you know products instead of using these products which generate this kind of special waste. Then, one is waste minimization and reduction this other parties of course, whatever we consume, that has to be reused or recycled to the greatest extent possible.

So, this is these are the two targets of what we should try to achieve to overall reach sustainable development for an urban area. So, two kinds of waste what we have discussed till now, that is slaughterhouse waste and biomedical waste, these two are cannot be recycled, you can understand why. So, usually, we are thinking more about how to process this waste further, so, that when they are disposed, they do not create any kind of problems.

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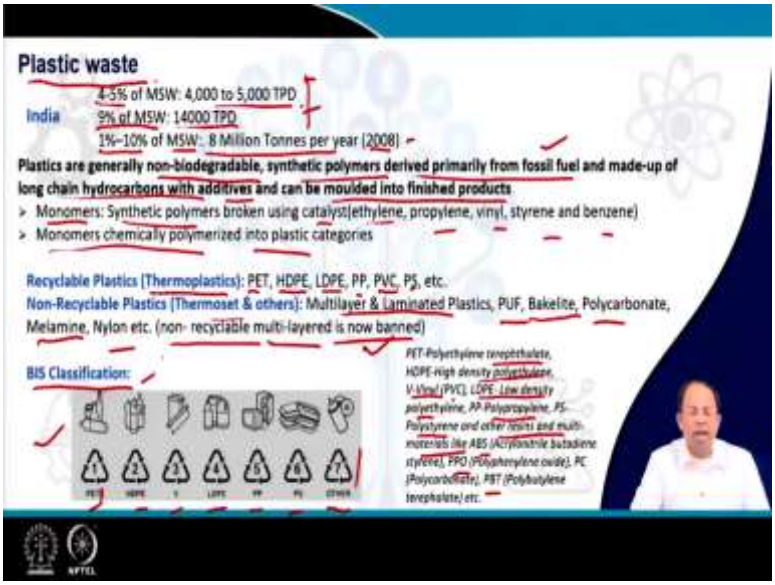

So, we will first start with plastic waste, now, the plastic waste generated in India we get different figures from different sources. For example, this estimate ranges from 1 to 10 percent of municipal solid waste is plastic. So, what it means is that different urban areas based on their characteristics, we will find different percentage of plastic content in the waste that has been collected. So, for example, a urban area where there are a lot of recyclers informal recycling happening you will find very little amount of plastic waste because that is not part of the municipal waste because people sell it directly to the recyclers.

But in other areas where this kind of recycling activity is not there, you may find more, but in other things is based on lifestyle based on size of city the consumption of plastic is also or consumption of packaged materials is also different and accordingly you will find less amount of waste there. So, the estimate is around 0.8 million tonnes of waste is generated per year and this figure is from 2008 which is pretty, you know, almost 14 years back.

So, now, this figure has in of course increased beyond that. So, we get other estimates something like 9 percent of MSW and around 14,000 tonnes of waste is generated per day, another publication to show it talks about 4 to 5 percent of MSW and 4000 to 5000 tonnes per day, it depends on where the study has been conducted or which cities have been considered while generating these kind of figures.

So, now to define what a what is plastic waste, plastics are generally non-biodegradable synthetic polymers derived primarily from fossil fuel. So, this is the second part of it and made up of long chain hydrocarbons with additives and can be moulded into finished

products. So, plastics most of the plastics are generated from fossil fuels, and these are made into finished products by moulding them by you know pouring molten plastic inside a mould and eventually we get the product out of that particular mould. So, there are two kinds of plastic one is monomer and then, then there are polymers also.

So, monomers are basically when synthetic polymers are broken using catalyst, we get monomers which are like ethylene, propylene, vinyl, styrene, benzene. Now, monomers when chemically polymerized becomes the different kinds of plastic categories that we are actually working with. For example, we from synthetic polymers, we first break it down we make the monomers. Now monomers are again combined together and in whatever monomers we want to be combined to reach that desired quality of plastic which is actually utilized. Now, in general, there are two kinds of plastic one is recyclable and the others are not.

Now, thermal plastics are the ones which are recyclable and non-recyclable at the thermosets and some other plastics. Now some of these you may have heard like PET, you have heard of PET bottles like the plastic bottles in which we have water and so on. PET it is polyethylene terephthalate, we have discussed this earlier in the case of Panaji, where PET bottles are recycled and all.

Then HDPE, high density polyethylene, v-vinyl this is PVC then LDP is low density polyethylene, PP is polypropylene, PS is polystyrene and so on. And you can also get other kinds of plastic material like ABS which are ABS you know is used in car bumpers and a lot of these hard plastics and all these are actually you know mixed with polystyrene and some resins and other multi materials like multiple materials are mix to create these kinds of materials such as ABS or PPO or PBT and so on.

Now, this non-recyclable plastics are multi layered and laminated plastics, this is not a single layer plastic these are multi-layer we will define this what does multi layered plastic means, later on. These other terms which you may be aware of like Bakelite, puff, polycarbonate, melamine, nylon. So, these are all different kinds of non-recyclable plastics or thermosets, which are actually a mixture of other materials as well. And these are non-recyclable and also multi layered. So, now, in today's context as per the, this plastic management rules this kind of plastics are banned, the reason they are banned is because they are not, we are not able to recycle them.

Now, this BIS classification talks about seven categories of plastics out of that you find first is PET bottles, HDPE, V for PVC, LDPE, PP, PS and other everything else falls into the other category. So, this is the seven kind of plastics which have been categorized under BIS classification system.

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Now, why are we concerned with plastic waste, now, quantity of plastic waste in a city actually varies and it is connected to the lifestyle of the people the socio-economic conditions of the people, it depends on other aspects as well but more or less these are the two major things which decide on what quantity of plastic is generated by an urban area. Then plastics result in littering which it gives, you know, pretty bad aesthetic, you know, look for that particular area. So, it is a big concern for Indian urban areas primarily, we see our roads littered with plastics and so on.

Clogging of drains resulting in flooding, plastic goes into the drains people dump the plastic into the drains and the drains get clogged and that is resulting in flooding, animals choke from eating plastic bags, this plastic bags not only for urban areas and also in semi urban rural areas, you will find this plastic bag litter all around and you find cattle grazing on some green fields or even from garbage some, sometimes you find animals seating. So, you will find that they sometimes eat up this plastic and they can choke, and they die.

Thin plastic waste is a big issue. The reason thin plastic is a problem because these are too light to be recycled. When you measure when you weigh them it does not have any kind of weight. So recyclers are not interested because you can only sell things which have a certain

weight then you will get paid based on the weight or the other thing is it be it can fly around and it will spread and it is difficult to store or recycle them so that is why thin plastic bags is a big issue.

Littered plastic in agricultural fields and gardens block germination and prevents recharge of groundwater, because of obvious reasons that consume the water cannot penetrate through the plastic. Plastic sachets for storing packing and selling gutkha, tobacco, pan masala this causes a lot of litter and now these are big banned.

So, we are usually concerned about the post-consumer plastic waste that is being generated that is once a consumer consumes that plastic then whatever waste is generated we are concerned about that. So, pre consumer plastic is also there that is where industries or producers or brand owners, they are actually using plastics to make something so that is pre consumption plastic use.

So, we are mostly concerned with the post consumption use because that is where we can actually control the waste, that means once the waste is generated, then we will manage the waste, but sometimes we can take measures for reducing plastic use at the pre stage as well. So, within this waste that is generated after post consumption we will find thermoplastic is around 80 percent which is recyclable and thermosets around 20 percent which are not recyclable.

Now you have to understand one thing, even though we are saying that thermoplastics are recyclable that means we can recycle this plastic or taking certain measures of first collecting them and store you know storing them and then finally you know as per the different categories of plastics, we can recycle them, but the problem is each recycling cycle will reduce the strength and utility of that plastic.

So, that means, you cannot use the same plastic for manufacturing the exact same thing. So, either you can reduce that content in the next iteration, or you will make something else with this plastic and different kinds of plastics cannot be recycled together each plastic is different and each plastic has to be dealt separately. So, when recycling is not possible, that means, in many cases you will find that it has there is no further recycling is possible for this kind of plastic and so, on. In that case, we will put plastics for energy recovery that means, we will put them for co-processing maybe in cement plants or other line cleans and so on. So, when plastic is used as a fuel.

Plastic is an alternative to bitumen in road construction. So, nowadays we have developed the technology so, that plastics could be used instead of bitumen and bitumen as you know is the binder for construction of roads with aggregates and all. So, that is where also plastics can be utilized. The disposal system finally, once we have utilized explored all options for recycling and reuse and all then we can dispose the plastic finally, and we can do it using different ways first of all, we can there are some experimental techniques which are there such as plasma pyrolysis and production of liquid fuel.

So, using the pyrolysis technique, we see, we have learned earlier that we can generate some amount of oil or some amount of you know liquid fuel also can be generated. So, which could be further used for energy generation and so, on or we can directly incinerate it and also landfill it as part requirements.

Now, another issue with plastic is single use plastic that means, plastic this is from the behavioural side if we in many cases we use materials which are made of plastic we use it once and then we throw it away, because plastic is cheap, we use this kind of plastic material, so, that it is only utilized for once and then we can get rid of it, such as plastic bags, straws, coffee stirrers, soda and water bottles and food packaging. So, this has to be reduced, if we can reduce this automatically the burden from plastic waste will get rid of that particular you know huge amount of plastic that has been generated.

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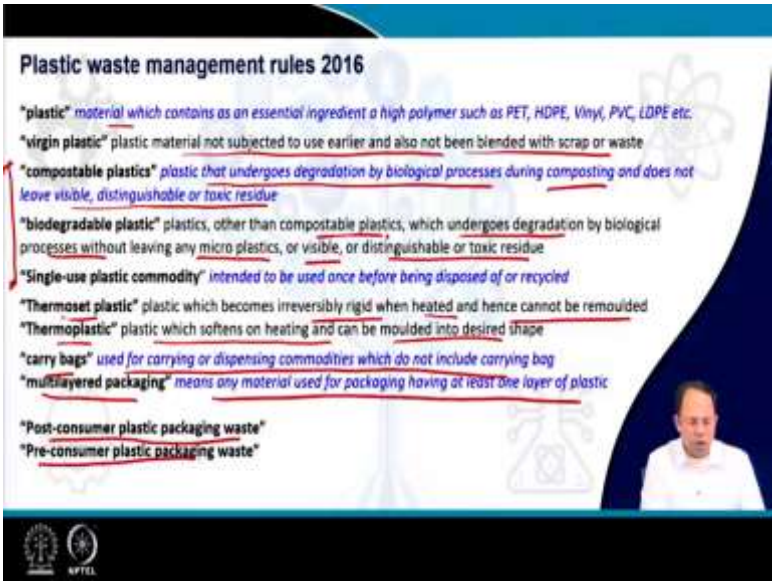

So, now, we will talk about the plastic waste management rules 2016 and these are some of the definitions. So, more or less we have learned what is plastic, then virgin plastic is the

plastic material not subjected to use earlier and also not been blended with scraps or waste or other materials. So, that means virgin plastic is the raw material which is coming for the first-time for making of plastic. Compostable plastic is plastic that undergoes degradation by biological processes during composting and does not leave visible distinguishable or toxic residue.

So, these are new kinds of plastic which are coming which are which would be compostable, which are compostable and which that means that they will not think we can utilize them without any concern that this plastic will remain in the environment and for the next 100 or 50 years. Whatever the case may be with the standard plastics.

For biodegrade, then there are biodegradable plastic which are plastics other than compostable plastic, but which also undergoes degradation by biological process without leaving any microplastic or visible or distinguishable toxic residue. So, both these two kinds of plastic are plastics which are sustainable we can use them and then we can allow it to degrade.

Then thermoset and thermoplastic we have discussed earlier, thermoset is plastic which becomes irreversibly rigid when heated and hence cannot be remoulded further. Thermoplastic is plastic which softens on heating and can be moulded into desired shape. Then, we come across the term carry bags multiple times in plastic waste management. So, these are used for carrying dispensing commodities which do not include a carrying bag with themselves and multi-layered packaging, this is also we have heard earlier, this means any material used for packaging having one layer at least one layer of plastic.

So that means multi layered could be multiple types of plastic together or it could be plastic with some other material like paper and so on. And we have also talked about post-consumer plastic packaging waste and pre consumer plastic packaging waste as well.

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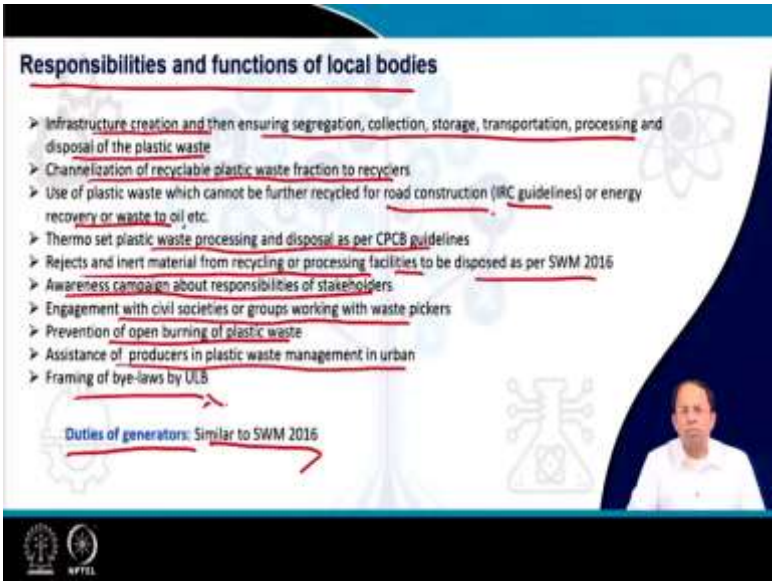

Now, as per the rules laid out in the plastic management rules 2016, there are several responsibilities and functions of the local bodies which are being listed and in addition to that, there are duties of the plastic waste generators, which is more or less similar to solid waste management rules 2016 that plastic waste generator should actually dispose it properly, they should segregate it and all these different rules which are similar to solid waste management rules 2016.

But for responsibilities of the local bodies, in regard to plastic waste, there are some new things that also are there. So, such as infrastructure creation, and then ensuring segregation, collection, storage, transportation, processing and disposal of plastic waste. So, this is one of the primary rules that is there in regard to plastic waste management, then channelization of recyclable plastic waste fraction to recyclers.

Now, as we discussed earlier, plastic waste cannot be mixed together and even within plastic also, we have to segregate it as per the categories based on what can be recycled and what cannot be not all plastic can be recycled. Similarly, same kind of plastic cannot be recycled using the, other plastics cannot be recycled using processes for other kinds of plastic. So, every plastic type has a separate process for recycling.

So, we can use plastic waste for road construction as per IRC guidelines or energy recovery or waste to oil that we have learned. Thermoset plastic waste processing and disposal should be done as per CPCB guidelines. Then in addition to that, whenever we are doing recycling and all rejects and inert material from recycling and processing facilities should be also done

as per solid waste management rules 2016. So, that means we have to take these rejects and dispose it to the landfill site and so on.

Then for plastic waste management, awareness campaign is a big deal and we have to discuss about the responsibilities of the different kinds of stakeholders through these campaigns. Then we have to engage civil societies or groups are working with waste pickers. So that plastic waste can be collected, segregated, sorted and so on.

And we have to prevent open burning of plastic waste which leads to a lot of toxics you know, smoke and all which is very harmful for human health and assistance of producers in plastic waste management in urban areas. So, and framing of bylaws by ULB So, these are the other responsibilities. So, framing of bylaws is creation of laws or fines and all these things by the ULB so that people will actually stick to proper plastic waste management practices.

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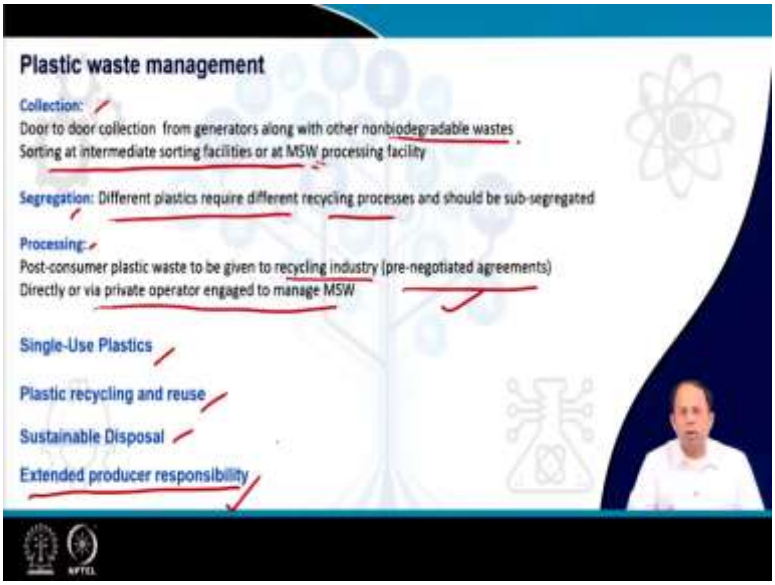

Now, overall, when we talk about plastic waste management, the first the three parts of course collection, segregation and finally processing. So, when we talk about collection door to door collection from generators along with other non-biodegradable waste, that is what we do and then sorting should be done at intermediate sorting facilities or at MSW processing facility this we have learnt earlier as well, then segregation has to be done as per different plastics types care subcategories are plastic, because each are follows different recycling process. And final processing is post-consumer plastic waste to be given to the recycling

industry at pre negotiated agreements and directly or via private operator engage to manage municipal solid waste.

So, either the municipality can or call you will can do it on its own or via the operator who collects the waste in that particular area, they can give this or transport this processed waste or sorted waste to that recycling industry. So, these are the general you know stages that we have followed for any kind of waste management. So, the same is also done for plastic. But in addition to that, we are more concerned with single use plastics, plastic recycling and reuse to certain extent, sustainable disposal of plastic and finally, extended producer responsibility in regards to plastic waste.

Now, extended producer responsibility is very very important for plastic because until unless we change the kind of products that we are selling or improve the quality of the products or that degradability of those particular products people will keep on using because plastic is very very convenient plastic is cheap. So, it is very difficult to change behaviour instead we should change the supply. So that is where this extended producer responsibility comes in and also, we can change certain amount of behaviour like people can recycle, people can send some amount of plastic material back to the producer so that they can utilize it and so on.

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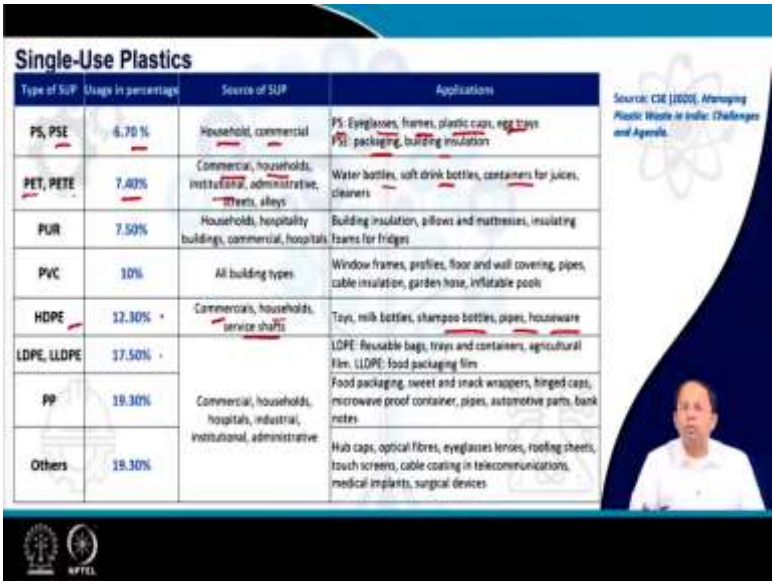

So, when we talk about single use plastics, we already said that we use many plastics once and throw it away. Like for example, like eyeglasses, frames, plastic cups, egg trays. These are made up PS and packaging and building insulation. These are made of PSE, this cans this is about 6.7 percent of the overall plastic waste that is being generated and usually these are

generated from households and commercial establishments. Similarly, water bottles, soft drink bottles container for juices. These are either PET bottles or PETE bottles, and then these are 7.40 percent 7.4 percent of the waste and these are generated in commercial establishment households institutions and so on.

So, similarly, you can find HDPE, which is like shampoo bottles, pipes, housewares, so, the all the pipes and all our HDPE pipes. So, you find them in service shops, households, commercial areas and so on. So, all these different categories of plastics these are being listed over here, this shows us that what percentage of plastic, what type of plastic we are generating, and this can help us in understanding where we can take some measures so, that we can reduce this particular single use plastic and replace them with materials which are either non single use or totally alternative materials for that matter. So, that will reduce the overall plastic waste that will be generated.

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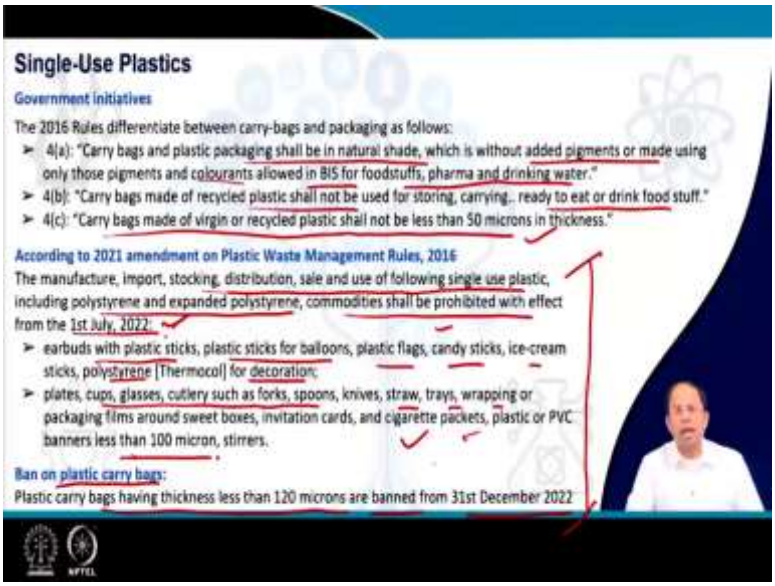

Then, government is also taking some initiative in regards to reduction of plastic waste. For example, government has said that carry bags and plastic packaging should be made in natural shade, which is without added pigments are made using only those pigments and colours allowed by BIS for foodstuff, pharma and drinking water because people store food materials and all this thing in plastic. So, we have to be careful and recycled plastics cannot be used for storing or getting ready to eat food and drink because those may be contaminated and all carry bags made of virgin or recycled plastic shall be less than 50 microns in thickness, which is absolutely necessary.

So that the thin plastic menace is actually reduced. Then in addition to that, in in not only for production, but also plastic is imported from outside lot of material that we import from outside contains plastic within them. So, the manufacturer imports talking distribution sale and use of single use plastic, including polystyrene and expanded polystyrene commodities shall be prohibited with effect from first July 2022.

So, this is a new rule that has come up and you can see that all these earbuds with plastic stick plastic stick for balloons, plastic flags, candy sticks, ice cream sticks, polystyrene thermocol for decoration, all this thing has to be banned. And then plates, cups, glasses, cutlery, such as forks, spoons, straws, trays, wrapping and all these things that are less than 100 microns and also PVC banners which are less than 100 microns, these are shall, this commodity shall be prohibited from this particular date.

So, we have to go for alternative materials, instead of using these existing materials which are made of single use plastic. So, also there is a ban on plastic carry backs, plastic carry bags having thickness less than 120 microns are banned from 31st December 2022. So, these are the latest notifications that has come from the government which are in regard to single use plastic and as you can understand this will have a significant impact on our lifestyle on the different kinds of products that we use and even on the pricing of alternatives, because plastics are so popular because they are cheap. Instead of this if we go for alternatives of course the price will increase but at the same point of time the overall cost to society will definitely reduce.

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Now what are the alternatives there are some of the alternatives which should replace the ones which you see earlier in the earlier slide are bioplastics, biodegradable plastic, compostable plastic. So bio-plastics are plastic made from organic materials such as corn-starch, and often made up poly lactic acid and can be decomposed. Biodegradable plastics referred to petroleum based plastics but which can break down quickly and compostable plastics undergo degradation by biological processes during composting and does not leave visible distinguishing distinguishable or toxic residue.

So, you can see that this is one of the one kind of plastic cup which is made of, which is 100 percent compostable and 100 percent biodegradable. So, some of the other concerns regarding alternative plastics. So, of course, these are alternative plastics, they will they are made of different materials and so on. But the problem is these alternatives can be issued in regions where basic source segregation is not followed because they are mixed with other kinds of material and plastics. And when they are mixed with conventional plastic, they are difficult to distinguish and to segregate them from mixed sources would be difficult.

So we even though these are compostable, we cannot because it is mixed with other kinds of plastic which are not compostable, and that is a big problem. So, this is what we have to that means we have to make some, you know, markings on them and so on. So, that we know that what kind of plastic is this and accordingly we can take some measures.

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Now, once we are once the plastics, we can reduce from single use by we can change the material of plastic that is, we can change the actual source where plastic is being generated or

we can change the nature of the material that we are using. But at the same point of time we have to do plas, for there will be remaining other kinds of plastics which we are using those would remain. So, we have to go for their recycling and reuse.

The two primary reuse that we have discussed is refused derive fuel or co-processing in thermal and cement industries. And we have if you remember from our earlier lecture, we have discussed the case study of Jabalpur Municipal Corporation and the ACC Holcim plant where plastic waste is actually recycled or used as a refused derived fuel.

So, we have done a detailed case study on that. The other is it could be a substitute for bitumen in road construction. So, shredded garbage, we have to first shred the garbage plastic garbage such as carry back, chip bags, chocolate bar wrappers, plastic bags, bottled leads, and so on. And this will be shredded and then we can use it for production up bitumen alternatives and this is now made mandatory by government order.

So, this use of plastic in road construction or as an alternative to bitumen improves the wear and tear quality of flexible pavements, it improves the aggregate impact value, it is improved the resistance from rain and cold water, at the same point of time, it does not allow leaching from through that particular surface, road life increases, no leaching of plastics and no effects of radiation like ultraviolet radiation.

So, this is why we can we have already done a lot of work in this particular area. One of our IIT Kharagpur professors has done a lot of work in this area. And this is where we have we say that this kind of techniques can be actually beneficial not only for road construction, but also for recycling or of plastic as well. Now, the process is first we have to shred the plastic then we have to this is used as an aggregate mix with bitumen and this is done at 160 degrees centigrade for good binding.

Now for one kg of stone (())(32:30) segregate 50 grams of bitumen is required. Now we can replace 1/10 of that which is 5 grams. A bitumen can be replaced with plastic waste, so it is not a big amount, but still, it is quite if you take the entire country it is a huge amount of plastic which could can go for this kind of production. Now, Himachal Pradesh government has used polyethylene for metaling around 250 kilometres of road as a pilot case study which has been done.

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Now, we can also recycle thermocol or Styrofoam, Styrofoam as well because as you know that these are used extensively in packaging as packaging material, and it is also used in the construction industry as insole, it is a good insulator and also used in the decoration industry for making the thermocol decorations and so on. So, when we recycle thermocol we can grind it and then mix it with new thermocol bits because before we press them into new thermocol sheets or it could be shredded into a fine powder, it could be reduced via the volume of that could be reduced by a certain kind of solvents.

And some example technology demonstrators have been already done in this regard such as in Pune's Science and Technology Park plant has been set up and it said Ranjan Gao, this is a 10 TPD transport date thermocol waste management plant that means it takes around 10 tons per day of thermocol waste and they recycle them into furniture. So, these are cheap durable and also this is furniture that has been produced is cheap, durable and also fireproof.

Now, because the other problem with thermocol is thermocol is very light, it is also not dense. So, there is a need for specialized thermocol compactor so that we can reduce the overall bulk before we further process it for transportation and for recycling. So, for that we have specialized some of the compactors and this could be utilized for processing and recycling of thermocol.

Now, the final project that we will discuss is conversion of plastic waste into liquid fuel. It is of course a pyrolysis project; it is a pyrolysis technique is utilized. So, it is a pilot project has been done in Nagpur Maharashtra and the process adopted is the random de-polymerization

of plastic into liquid fuel in presence of a catalyst and it is done in closed reactor vessels where it is heated to 270 to 300 degrees centigrade and the plastic turns into a liquid vapor state.

So, then in the condensation chamber similar to pyrolysis if you remember then if we allow it to condense it, it when it allows to condensate, it becomes liquid fuel and this tarry liquid and some other organic material, this could be some other, which and organic gases also are generated, which could be vented and the gas can be used for electricity generation from this particular plant. So, this kind of you know this kind of conversion could be also evaluated directly for in detail for technical, environmental and financial feasibility of this kind of projects.

So, this is a pilot project, but further feasibility analysis needs to be done in this regard, but this is an alternative which we can also explore. And the one example of utilization of this is something like a general pool residential accommodation complex of the Ministry of urban development in New Moti Bagh Delhi around 50 kg, they have set up a 50 kg per batch handling plant for plastic waste into liquid fuel and the product of that has been utilized for creating this kind of here they are using that for you know, in this particular accommodation complex.

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So, other some other examples of plastic recycling and reuse conversion of PET bottles into textile products. It is a case from Pune, and it is a petrochemical company they have installed some reverse vending machines at various locations where people can put in their PET

bottles, and these are colour these are recycled and used to make fabrics for bags, T shirts, garments, but they mix it with some amount of cotton wool and so on.

The other example is conversion of plastic bag into paver tiles. It is a case from Hyderabad where Bamboo House India in collaboration with Hyderabad Municipal Corporation greater Hyderabad Municipal Corporation are creating paver tiles for roads made from this use poly bags and other plastic wastes like polybag, chip packets, plastic bottles, bottle caps and so on. So, that is what you can see over here.

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So, these are some of the references you can study.

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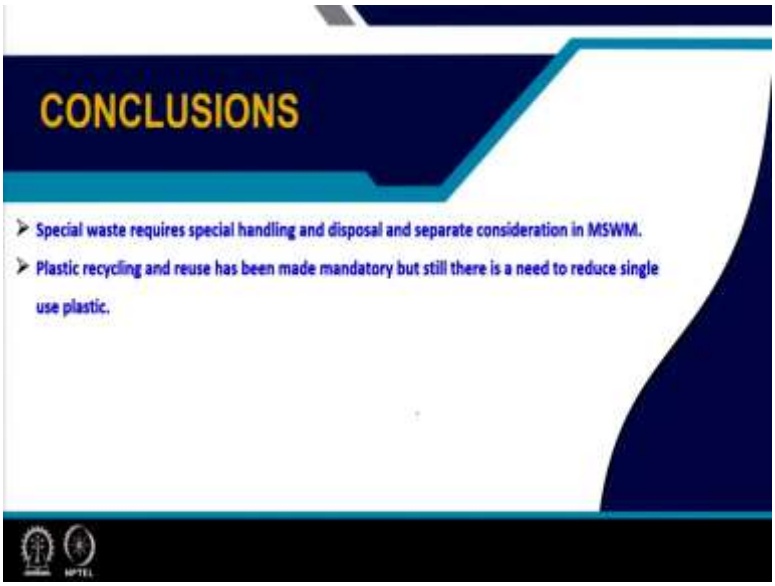

And to conclude, special waste requires special handling and disposal and separate consideration and municipal solid waste management and plastic recycling and reuse has been made mandatory but still there is a need to reduce single use plastic. Thank you.