Plastic Waste Management
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Lecture – 26
Plastic Waste Management Practices: Recycling and Waste Plastics

So, hello and welcome back. So, we are now in week 6 of this particular course and topic for this week 6 as you as you have seen in the course outline. In this week we will be focusing on Plastic Waste Management Practices. So far we looked into what is plastic? What is plastic waste? How much is produced? What are the issues associated what with that? What are the different chemicals there? How it ends up in different whether in land, water or air? We talked about micro plastics health effect. So, now, all those background has been done.

So, now we are focusing in this particular week is; how to, what are the best practices of managing plastic waste, what are different technologies out there and we also, we will talk about using plastic waste in roads, which is getting also very popular in not in India as well as Abroad. And what are the issues and challenges with plastic waste management practices that are being used in India as well as abroad? So, that would be this particular week 6, again as you know we will have 5 videos of approximately, half an hour each and you will have a quiz as usual after every week. This week also you will have a quiz.

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So, the concept will be covered is plastic waste management practices, use of plastic waste in different application, including in roads and some of the issues and challenges associated with that.

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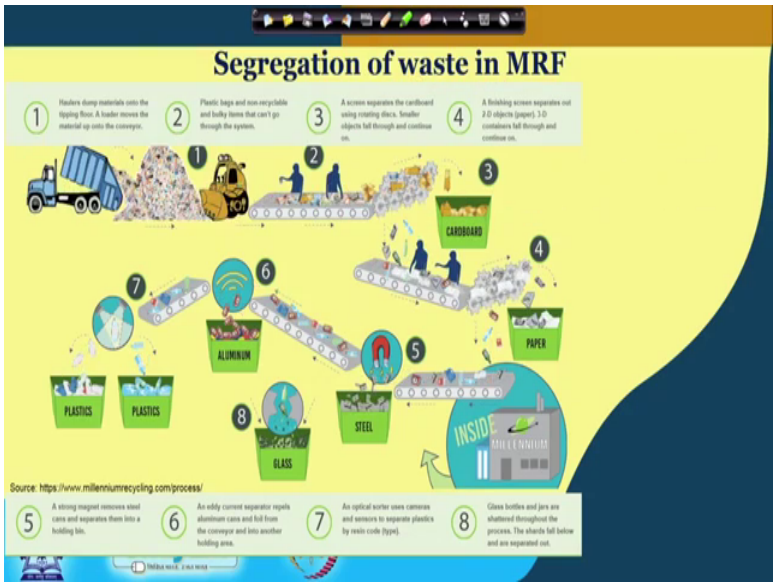

So, when we talk about this plastic waste. Plastic as you know in for most part, the plastic that we have to deal with is coming from the municipal solid waste. It is the m municipal solid waste the material recycling facility, which is also sometimes called as MRF, which is MRF as we actually stands for a Material Recycling Facility.

So, their waste comes in and it gets separated into different fraction. So, there are different steps here. Haulers will the waste will come in, where the haulers will dump the material onto the tipping floor, then plastic bags and other non recyclable bulking items cannot go through that system. So, what will happen? The screen will separate; the screen will separate the different material then screen will take the cardboard using rotating discs, smaller objects will fork, will pass through. So, cardboard will get collected and taken away then you have a finishing screen separates outs like a 2D paper, like a paper 3D containers.

So, you have a screen here, which kind of removes the paper, then you also have another screen, which kind of removes the metal. So, that you may use magnet to remove the ferrous, you do eddy current separator to remove the aluminium. Now, after doing all that what you left is essentially different types of plastic. So, here you try to, there are different technologies out there for managing this plastics, you can use there are, what is known as static technology. There are some sensors, there are based on you can have a density separation which will separate different heavy plastic versus the light plastic.

You can also have colour separation, where based on different colour of plastic, it will try to separate it out. More separation, you can do better the quality of the material and you can sell that material at a better price. So, as I said the strong magnet will remove steel, eddy current will remove aluminium cans.

Now, the optical sorter, this is what I was talking trying to say, optical sorter will remove uses cameras and sensor to separate plastic by resin code. So, if you remember we had that plastic; 1, 2, 3, 4 like different resin types, which we covered, in the one of the earlier week, where you have the P E T H D P E and different polystyrene and different types; 1 2 3 4 5 different types of plastic.

So, based so this optical sorter they can remove, they can separate plastic by resin code. So, that is, it is done at number 7. Then after that what the glass bottles and jars are also separated. So, what we are? So, for the plastic waste we are kind of looking at this particular scenario over here, but plastic waste is not in isolation. What you will see most time is plastic waste is actually part of the municipal solid waste.

So, this entire process is their, intensive in separating the different fraction and this is how typical a material recycling facility or MRF works. If you get a chance to visit, one

you should go and see one and you will see most of these essentially, it will have a, have the same layout with some modification, based on their local requirements that might be there.

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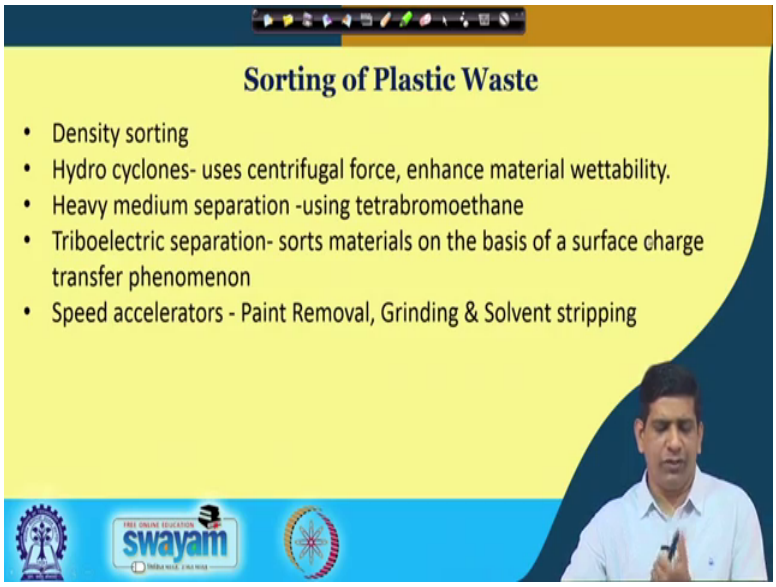

So, sorting of plastic wastes, you can do density sorting as we just talked about, you can have hydro cyclones where you can use centrifugal force, enhance the material wettability. Heavy medium separation, you can use tetrabromoethane to do the separation. Try triboelectric separation, which sorts material on the basis of a surface charge transfer phenomena. Now, you can have a speed of accelerators, we can paint remover, grinding and solvent is stripping. So, those things are used, you can also use the optical sensor that we just talked about.

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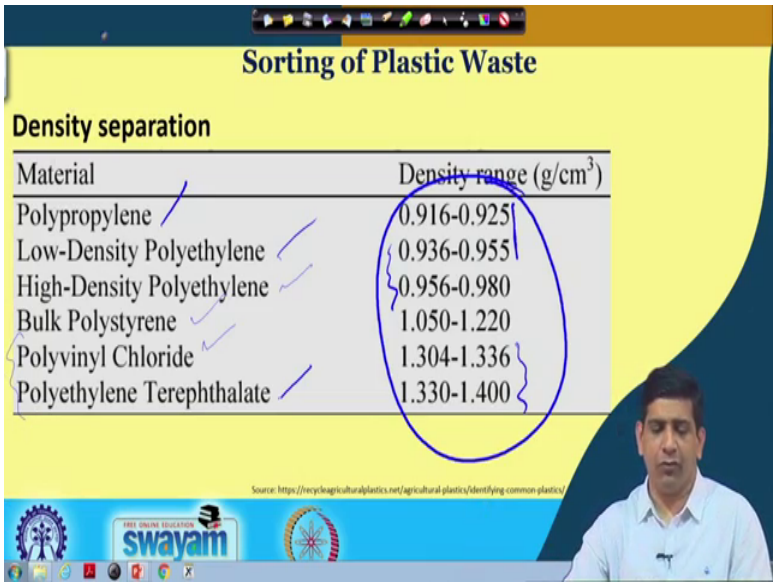

So, other than the optical sensors these are the other methods, which you can use for sorting of plastic. If density as you can see there are there are some density range dot sometimes it is not too like diverts. There are lot of overlap, because as you can see for like these two has an overlap, then these two also has an overlap and again there will be some overlap here, so, there are some overlap.

So, there is you will have issues of getting these two different types of plastic separated, but it does help in terms of at least doing the first round of separation, where you can have polypropylene separated out with maybe you will get a little bit of L D P E. So, in there then you have H D P E and bulk polystyrene, polyvinyl chloride and polyethylene, terephthalate.

So, you may see some of these overlap as well, but at least it helps you to sort it out in three four, different fractions and then you can go further and do other sorts of sorting there to remove the, to make it more purer material.

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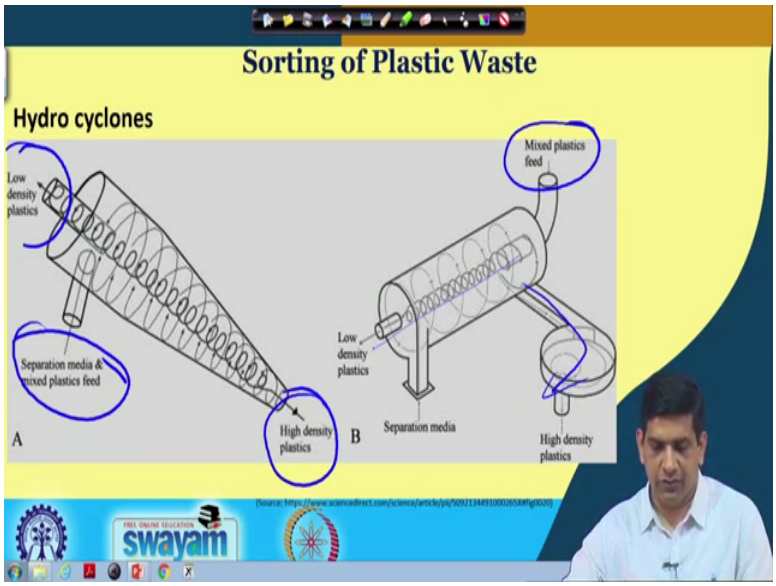

Hydro cyclone, where you can use the hydro cyclone, you can separation media and mix plastic feed. So, you can feed stuff, from here you can know, this is the feeding. This is the feeding where you can use the feed from here and you have a hydro cyclone, where low density plastic will come out on this side and the high density plastic will come out at the bottom.

So, here you can have mixed plastic feed from the top and then the low density will come out from this side and the high density will get out from this side. So, this is how you can use the hydro cyclones and to separate heavy like low density, with a high density plastic waste.

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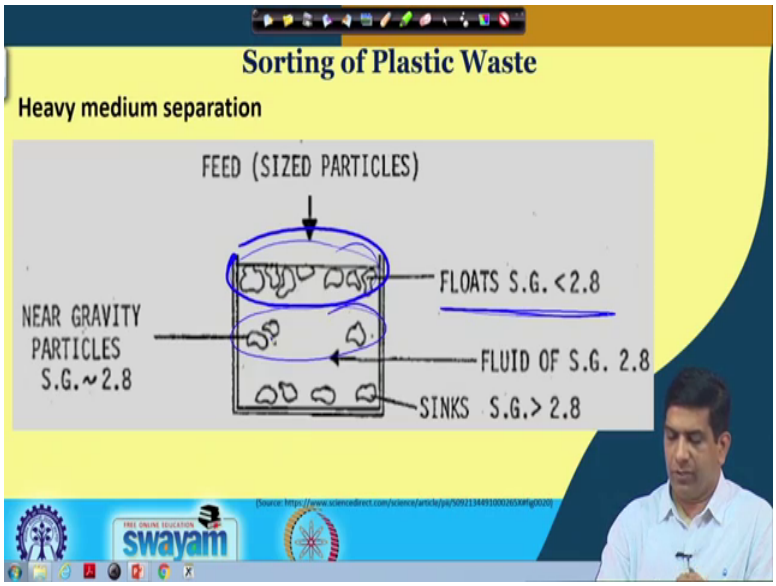

Gravity particle as well like, if you have a heavy medium separation, you can have a different feed size particle, you put it there, then there will be some particles, which will float, on top sorry.

So, you will have things floating on top and then you will have the medium fluid of so, anything less than specific gravity of 2.8, which will probably you will find it on the surface, then around 2.8, you will find in the middle and anything greater than 2.8. You see them showing up in the bottom.

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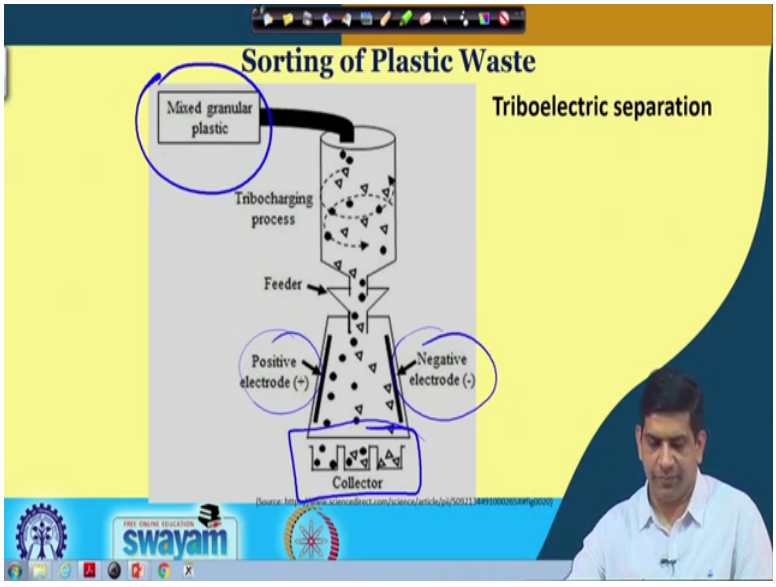

So and you can also use turbo electric separation, where you put this mix to granular plastic from the top. this turbo charging process is there which puts a charge and then based on positive electrode and the negative electrode different types of plastic gets attached, attracted to different charges and then you have the waste collect separated out by different types based on the charge.

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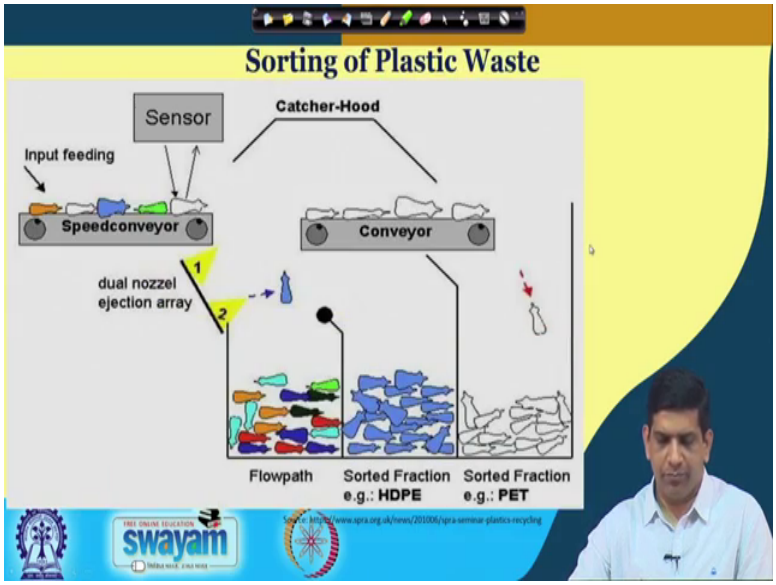

Then you have sorting or plastic waste using sensors, which is you have a input feed, which is a speed conveyor, this input feed is, getting fed in into the system, where you have this nozzle, ejection spray and this is your conveyor. So, it kind of gets blown away it is, it gets blown away from their as well.

So, it is a dual nozzle ejection array. So, if it is a heavier, it goes to like it gets blown, if it is lighter it comes over here, based on the colour, based on the sensor, different ejection is done and then it goes, gets transferred to another conveyor and then finally, goes in into this particular pile. So, here you have the sorted fraction of H D P E sorted fraction of P E T separated out by sensor using the sensor, it gets separated out.

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So, now we will have a quick look at this, the different process just I talked about we will just have a quick look at a video, which kind of explains this process a little bit in more detail. So, let us have a look and we will keep on I will try to walk you through the video as it gets you see the different process.

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So, here as you can see the mixed plastic is getting loaded. So, this is your mixed plastic the container and then it goes into a conveyor belt and so, here overawed magnet, which

will separate the any iron materials. So, as you can see the magnet is taking those iron material.

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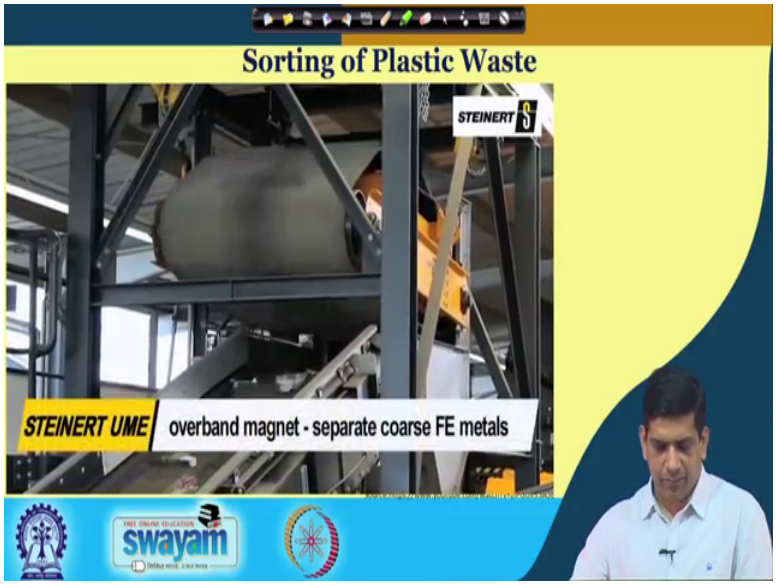

So, anything with the iron, even iron attached to plastic or plastic attached to iron, it is getting removed, then it goes further and here a many all these plants, you see lots of conveyor belt. So, you have magnetic head pulley with rare earth magnets, which is being used.

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It gets low magnetic iron material and iron compounds, so, even that is removed out. So, you see those which traces of so many times, what happens? This packaging material has mixed shear stuff. So, that is that needs to be removed. So, though becomes contaminant.

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Now, after that you have eddy current separator; eddy current separated what it does? It tries, it removes aluminium cans.

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So, as you can see things gets blown away separates aluminium parts. So, anything with the aluminium gets blown away, in this eddy current separator which so aluminium is taken out. So, that can go as a aluminium waste. So, rest is now after removing iron, removing aluminium. So, in terms of the container system, you see the mostly now, its your plastic.

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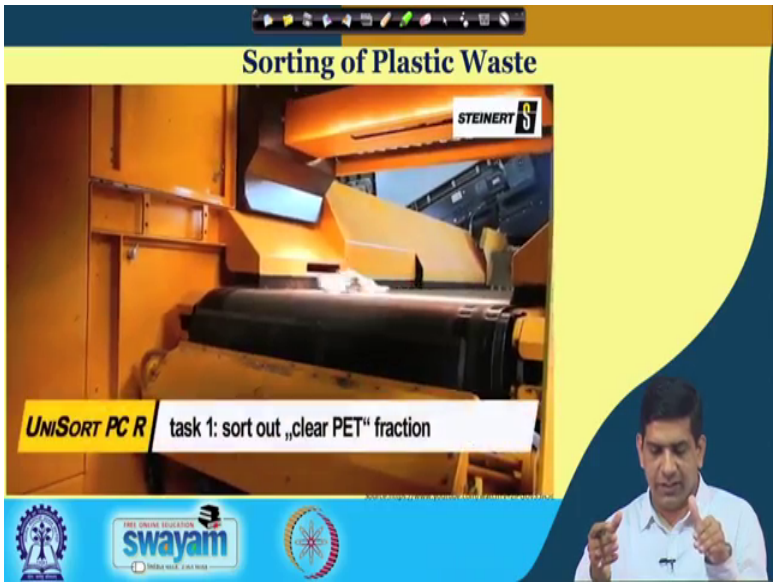

So, it is a hyperspectral sensor sorter. So, this sensor sorter what it does? As it is taking out clear P E T fraction, the first task it does; it's tries to remove this clear P E T. So, anything clear P E T bottle, it is removing that and then again it is on the conveyor belt and it will. So, these plants you see lots and lots of conveyor belts, things just moving around. Then you have another sensor sorter after removal of the P E T it will go for, I think H D P E, yes.

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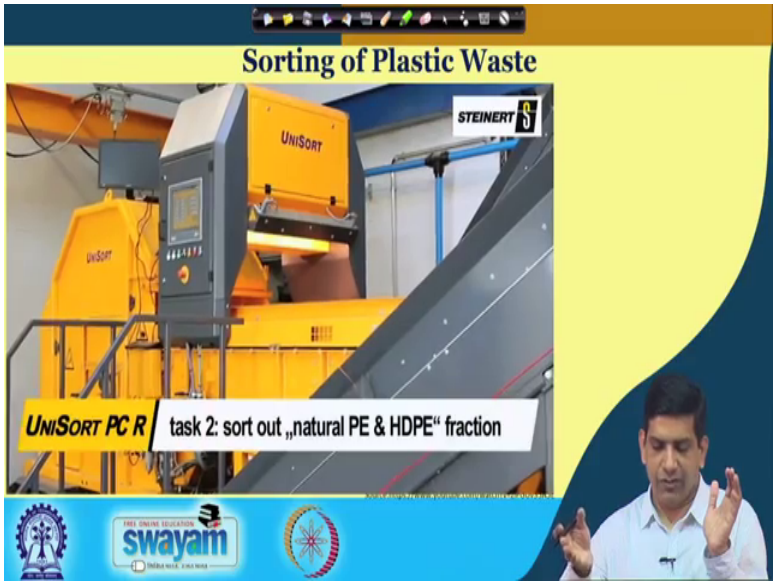

So, it will try to take natural poly polystyrene and H D P E fractions, so, they are being taken away. So, as so you get the H D P E and natural polyethylene. So, that those things have come in here.

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So, this is how things are getting sorted out then again it goes another round, which you will see here, it is trying to separate a P P fraction, which is the polypropylene fraction. So, that is coming out as well. So, it is so different fraction; we got P E T first out, we got H D P E out, now we are getting P P out.

So, it helps us to separate the different fractions of plastic. Now, whatever is the remaining again, goes back on the conveyor. So, as you can see, we have lots of conveyor belt on any material recycling facility.

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So, again it goes through that, where it tries to take out mixed colour P E T. So, earlier it was clear P E T now, it is mixed colour P E T. So, that is all, it is showing up it is getting into this particular material. Rest probably film plastics and other low quality plastic material, which is now coming out on those conveyor belts and here it is in this particular, in the sensor sorter in this particular case, it is trying to take out coloured P E and coloured H D P E.

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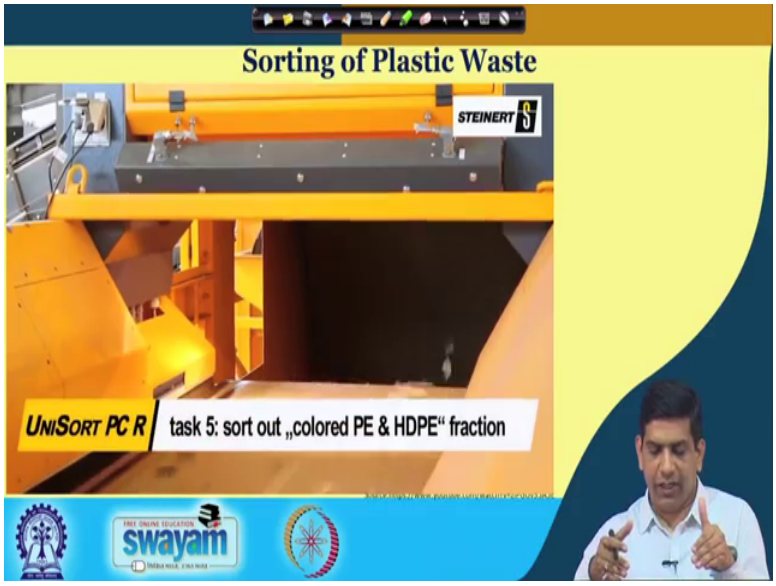

So, that is a coloured P E and coloured H D P E coming out. So, it is so that is so, we all the different fractions and there are some, there will be some contamination, there would be some other fractions, there is some errors will be there, but we this technologies are getting perfected to have minimum error.

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So, next sorting as you can see, it is again going through those sorting out here, it is taking recovered plastic fraction. So, whatever is the remaining plastic, it is just coming out there. So, this is how the sorting is done and what you saw in this? What you are looking at this? In this particular video, it is mostly it is just that container.

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So, it is not and it is not removing glass, paper. So, whatever is the residue now at the end you see that drop residue, some plastic waste, which was other type of plastic, some glass, paper. So, they are not recycled in this particular system, but there can be system in place, where you do that as well.

So, this is how the mixed plastic is sorted out and these kind of plants exist in in many, in European countries in a U S and some other countries like Australia and other places as well and so, we need to as you saw it is energy in intensive. It is mostly automatic, not much manual things were there. Everything was through the machines, those machines are costly, they are not cheap.

But if you look at long term cost, as we were talking about in the previous video, towards the end of previous video like dollar, 8 billion dollar. So, if you look at the overall long term cost, it is a will turn out to be much cheaper, when we look at the lifecycle cost of not managing the plastic waste properly. And once you separate these different types of plastic each one of those components becomes valuable. They can be recycled, they can be sold at a much better price rather than when you are trying to say sell mix plastic.

Now, many countries in the world, we it is not taking those dirty plastic as well, in India as a too very recently there was not a regulation that all the plastic solid waste import will be banned. So, which is still I am trying to whereas, the details will come out it is, it was just happened in the month of early March, late February of 2019. So, details have

needs will come out and we will know more detail, what exactly it means in terms of, I think it is being done as a preventive measure, because of the China ban that we talked about, because of China banned, India is becoming one of the destination for the waste dirty recyclable waste coming from western world to China earlier.

Now, it was one of a part of, it was also getting channel to India, but this ban I think the government has bought in to kind of prevent those dumping of those wastes, those dirty recyclable. If, but if you follow a process like this, which you just saw in this video you can have a clean recyclables. So, if you have a clean recyclables, it can we will, we should not have any problem accepting those recyclable, because we can easily recycle them. So, that is what we should look for.

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So, you saw that in terms of how the plastic can be separated. So, plastic solid waste management in terms of managing the waste. So, that was one technology; the recycling of the different, once the plastic different fraction is done you can again, you can go on YouTube and find several videos where this can be again put into a small-small flakes and you can make new bottles out of that. You can make different products out of that, which is being used in many parts of the world.

So, plastic solid waste management in it should be done in a way to reduce the pollution along the process. They may improve the efficiency of the procedure and achieve energy conservation. So, in world they, if you look at the different types of management so,

there is people are looking at mechanical recycling, which you saw a part of that. Even feedstock recycling, where you get into the like a feedstock level. Energy recovery can be used for energy recovery and when that nothing can be done land filling.

So, land filling is the last option. Land filling is essentially done to minimize actually minimize the environmental impact, because if you look at engineered landfill, they are kind of it is a waste containment system, it is a waste containment system, where you can keep the waste and try to manage it and whatever is the leachate produced it, you treated, you collect the gas. So, you are trying to control the impact coming out of from the waste. It is not that much of a treatment system rather than a containment system with the environmental protection point of view.

So, landfill many times people say that it is not a permanent solution, but since if no other technology is available to solve that problem, landfill at least helps in minimizing the environmental impact and controlling the environmental impact. So, that is what like land people usually rely on landfill for that.

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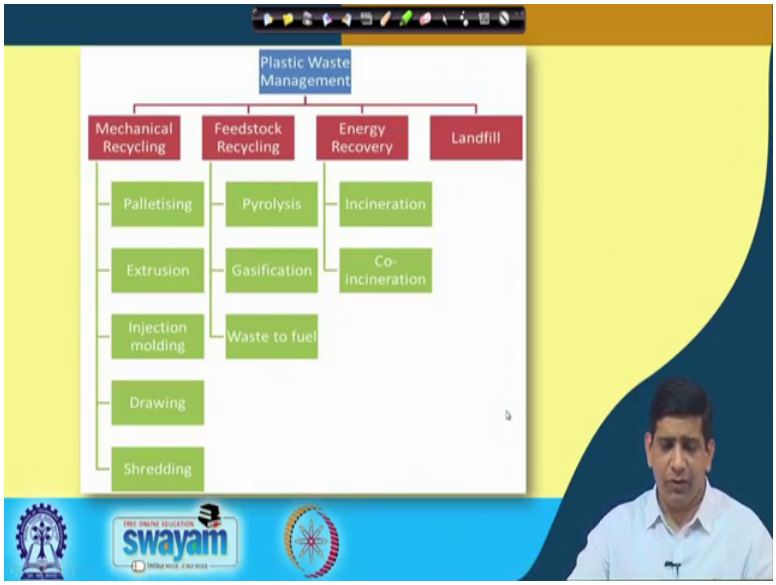

So, when we talk about mechanical recycling, we are talking what we are talking about. We are talking about palletizing? We are talking about extrusion, injection, moulding, some drawing and shredding. So, that is what we are talking about in the mechanical recycle part, then feedstock recycle, you can go for pyrolysis gasification waste to fuel.

So, that is your feedstock recycling that is let us call those aspect. Energy recovery, you can go and incineration, co incineration then finally, landfill which is just dumping the waste in a landfill and managed to impact from there. So, broadly these are the 4 major ways, which the plastic waste is managed or can be managed and many times, it is managed as part of the municipal solid waste.

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So, in terms of recycling, what we are trying to do is we try to recover or reclaim, the discarded waste, reprocess it, refine it, to yield alternative new products. So, that is what recycling is all about, trying to make new products maybe similar products, but new product after from the discarded waste.

So, that is the whole process is recycling and it is also depends on the rose resin code I am sorry. The spelling here is actually should be c o. So, spelling should be code, it is a resin code, I say no type over there.

So, it is a recycling of plastic, mainly depends on the resin code of plastic waste. So, what is the resin code of the plastic waster. So, as you know it is a 1 2 3 4 5 different numbers are there, which we will I think, we have a slide here as well and few slides down the line, we will talk, we will kind of revisit that to wreak, so that you can remember it.

So, the top priority of waste management has always been recycling it not only helps since in protecting the health of the environment, but it also contributes to reuse the waste ah. So, there if I am not increasing the space in landfill, it helps in keeping the landfill space low. So, we do not want to put waste in landfill, we should try to recycle it.

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Mechanical recycling; where you try to it is a process where you conversion of waste or scrap into a product of similar properties of the original product. So, you try to make similar properties of the original product. It's involves what you do is you recover the product from plastic scrap, you would maintain the original molecular structure of the material. So, that is the you do not mess up with the original molecular structure of the material, compared to the low cost and easy glass recycling and very productive recycling of metal materials.

Recycling or plastic is quite challenging, because apart from several technical obstacles to overcome where they have low density and the value of the material. So, plastic recycling sometimes other than P E T H D P E to some extent for other types of plastic, because of the low cost and it is not that it is, it becomes you do not get much value out of those recyclable plastic and then it becomes a challenging from an economics point of view. So, it is quite challenging from and there are some technical obstacle which we talked about.

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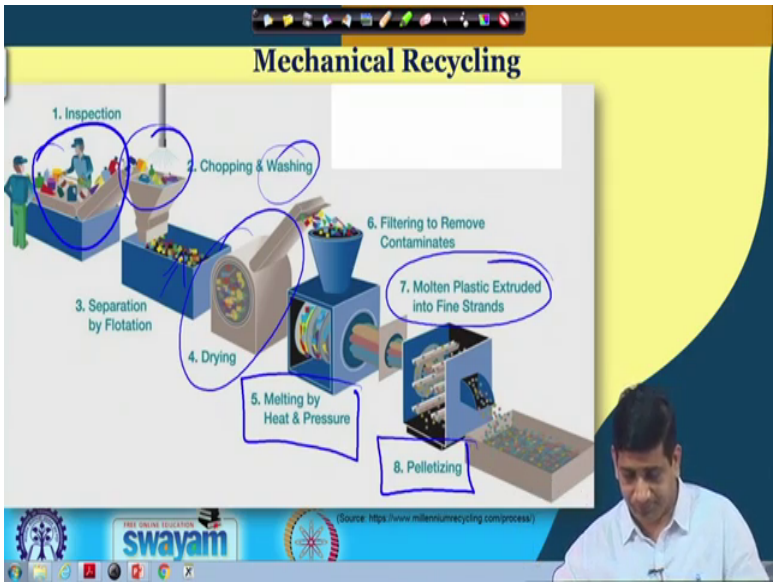

So, if you look at the mechanical recycling, you can inspect different types of plastic and then you try to separate, of course, separate it out then you have to those plastics will have a, like some dirt associated with, there will be some like things, which need to be washed out. So, you do the washing as well as chopping. So, you do the washing and chopping and after doing washing and chopping since you washed. So, it will get wet so, you put a drying method. So, you dry it dry it, then melt it by heat and pressure.

So, after melting you make, after melting it so you can filter to remove the contaminants, after it's all melted things could be filtered out to remove the contaminants and then whatever is the molten plastic that can be extruded into fine strands and after that you can pelletize it and these pallets can be used to make new products.

So, that is how typically the mechanical recycling is done. You they, you get the source separated, you get the segregated plastic from, you saw the previous video that where the plastic was segregated out. So, would that so, this flowchart will come right after the previous video where we ended. So, you have these different types of plastic already separated out, comes in, where you wash it, then chop it. So, that is gets there and washing and chopping after you, you try to separate by flotation different particle size as well and different density and then you dry, because it is since it is, was washed.

So, needs a drying, after drying you melt it to by heat and pressure, after melting you use the filter to remove contaminant and then you molten plastic, you extrude them into fine

strain and then you finally, pelletize and that palletized pass plastic could be used for production of different materials of that particular similar type or like, similar type of material from the original product. So, another like a picture kind of explaining similar stuff, not that much of a difference.

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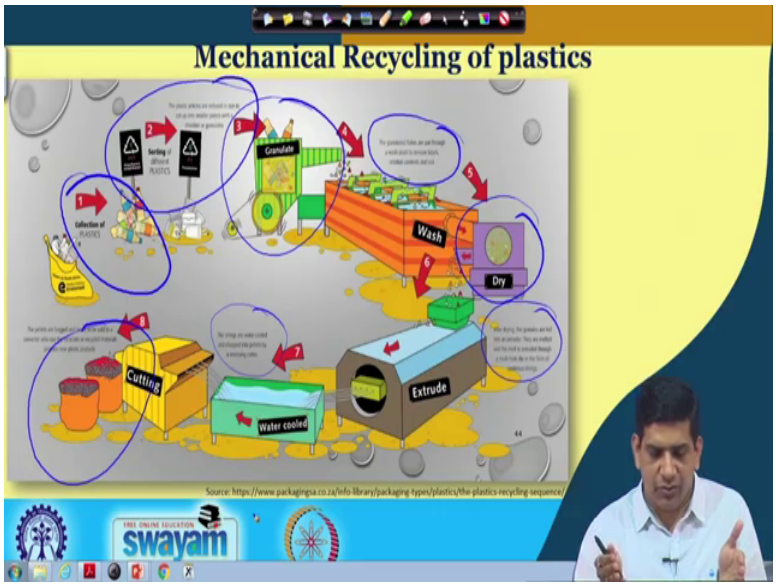

Again, you have a collection of plastic just a illustration in a different way, you have a waste plastic being collected, what you saw in that video. So, it is kind of, after that then you sort, which was done in that video, sorting of the plastic then you make granules out of that. You take it, make granules, wash the granules, when it is slightly to go through the wash plant and you remove labels, residual content and soil. After wash again, you dry as we just talked about. After drying the granules are fed into an extruder.

So, you get the extrusion done and the (Refer Time: 25:14) form of continuous string then you can use the, you can water cool it, the strings are water cooled and chopped into pallets, but evolving receiving cutter. So, you and make it a pallet, the pallets are bagged and ready to soul to a converter, who uses the recyclable or recycle material to produce new plastic products. So, this is how the whole thing works.

So, this is in terms of the mechanical recycling . So, this kind of what you, just in the previous slide and plus this part is what is done in that video, that we show earlier and then you have the other rest of the process. The so, this is how the recycling of plastic is

done in terms of what we known as mechanical recycling. Try to get the plastic, make the granules, so make a new product out of that.

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So, just another like if you look at a little bit from a city level, from a city level how it the whole system will look like? you will have consumer, which will have different types of plastic bottles, plastic containers being used, they will give it to the municipality, municipality will collect the recyclables, do the short collection sorted waste, compressed in a bail, from bail it goes into like where you have the, a different types of plastic coming in, you shred it, you clean it, you make the flakes.

So, if this is a P E T P E T flakes and pallets and then those flakes and pallets can go to textile, can go to seating material, go to, injection moulding, goes to bottles. So, in it can be used in working clothes and uniforms, can go to shirts after production of yarn and swing and all that and it can go into seats, which in vacuum model into fruit trays, moulding assembly can be used for stationary and then bottles, like you have detergent bottles for the kitchen or different types of bottle.

So, this is how the whole P E T bottle recycling to a new business sorry, to a new product is done, it is can be done. So, as you can see the technologies again are out there. Technologies are out there, which for each one of those there are even you, you when you go on Google or YouTube, you will find several-several example, several videos,

which kind of explains you in more detail in so, essentially what is happening here is; you are taking the plastic at the municipal level.

It is sorted as per M S W management rules, then plastic is sorted separated into different types of plastic, it gets bailed, goes to a plastic recyclers, where it is shredded, clean, flake is made, flake goes for either application in textile. We are talking about P E T or a making sheets out of that or injection moulding or different making bottles and that the newer product is again coming back. And this can again, once it gets discarded, it will go back here and that cycle will continue again.

So, this is how it can be recycled and recycle quite a few times and then once you cannot recycle it of course, then it has to be managed in a different way, which we will talk about in the later videos.

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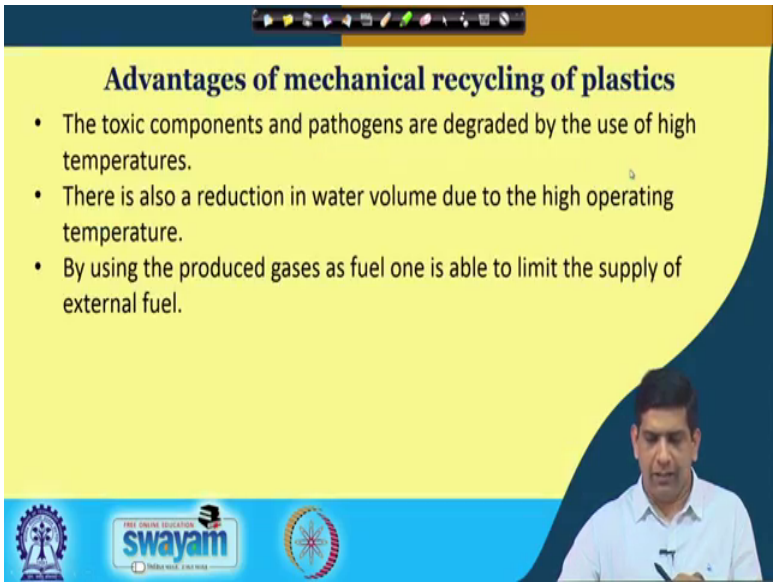

So, with this I think we can we can stop here, for this particular video. And we will continue our discussion in terms of mechanical recycling and some of the advantages and disadvantages and other stuff in the next video. So, we can person potentially start from here, in the next video.

So, thank you for like taking this course and moving along. Do not forget to take your quizzes on time and those of you registered for exam and I hope, all of you should have registered for exam, but those of you who can, who are just taking it the course for

learning that is also very good. So, take the quiz and then if you have any questions, let us know. We will be happy to answer through the discussion forum. So, thank you, see you again in the next video.