Plastic Waste Management
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Lecture – 30
Use of Waste Plastics in Road Construction

So, welcome back. So, we had in this last video a last module for week 6 and in this module we will continue kind of focus on Use of Waste Plastics in Road Construction. We started that discussion towards the end of last video so we will go in more detail discussion on waste plastic in road construction. This is a very hot topic in terms of plastic waste management in India, as well as in abroad people are using waste plastic in road in quite and you will see some examples from India.

And also used in European countries and other places where people are looking at using this waste plastic. There are several benefits of doing that, there are some issues associated with doing that there are some technical challenges with that. So, we will discuss those aspect in this particular video and that will be kind of end of week 6 for us.

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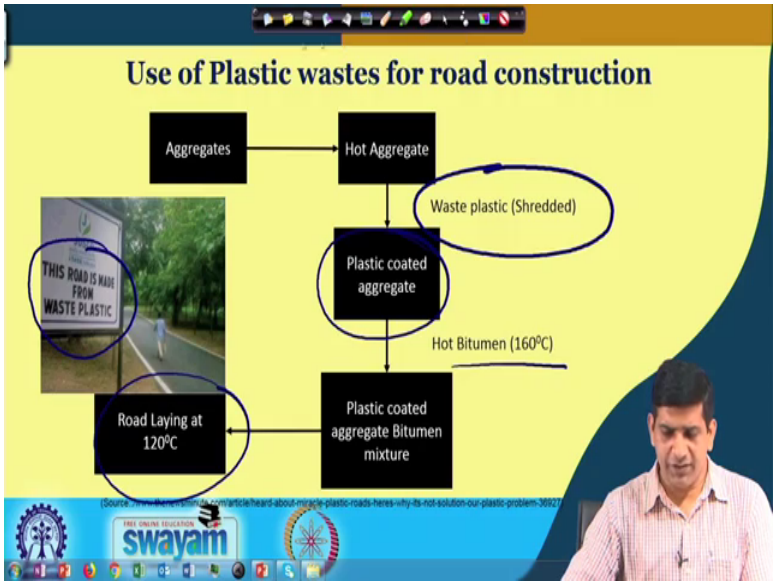

So, there are we go for plastic waste in the road construction. Any road construction you start with aggregates you will have hot aggregate and then you add plastic waste right there. We place plastic waste is added waste plastics ready they added to it that it gets plastic coated aggregate, this plastic coated aggregate with the hot bitumen. So, it gets

plastic coated aggregate bitumen mixture and then it is road is laid in around 120 degree centigrade. So, as you say in Jusco which is in Jamshedpur in Tatanagar is this a road is made from of waste plastic. So, its it is being used it is being used in many places in India and also abroad.

So, were you, but the only thing you are doing different here is you are adding waste plastic in this step and that helps in some of the plastic properties which we will see as we go over as we make progress in this particular lecture. So, as so, that is the where the waste plastic comes in and this then we will look at the whole process of how this waste plastic use in roads are done.

So, let us look at this and then we will discuss more detail about use of waste plastic in road construction and this video has an audio component. So, again I will put myself in mute as long as this video is playing. And so, you listen to this video and then we will discuss it and we will have to discuss some associated issues associated, issues associated with that.

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Plastic roads the laying procedure: the laying procedure for the plastic roads will be the same from the subgrade course to the base course like any flexible pavement.

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The waste plastic is accumulated and is sent into the shredder machine, the shredded plastic will measure between 10 to 15 millimeter.

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Fixed proportions of shredded plastic is added to the aggregate on a conveyor belt in a hot mix plant. It is then sent to the mixer where the shredded plastic melts and forms a layer on the aggregate. This process happens at temperatures between 170 to 180 degree centigrade. The plastic coated aggregate is then subjected to bitumen, plastic being a good binding material holds the bitumen together.

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The final BT mix is collected and loaded into the paver. In the final step the plastic coated bituminous mix is laid according to the alignment and is compacted as per the standard.

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Plastic roads a perfect solution.

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We are spending 4.5 trillion rupees on annual maintenance of roads and similar infrastructure. They are cost effective with nil maintenance ok.

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As you saw that the whole process in which the plastic waste was laid again it was essentially the similar process of what we do for our road construction, but again we are adding this plastic. We are adding plastic as explained in the previous slide as a first the plastic is shredded and then its added to the bitumen and mix with the aggregate first with the aggregate and then we add bitumen to it.

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So, that is a its a why it works because, plastic is a good binder. Its a helps in binding those aggregates together, it improves aggregates impact value, it increases the melting

point of bitumen. So, helps to improve the quality of flexible pavement. So, that is the reason these are the some of the salient features of why this plastic waste roads are considered better than traditional roads. And they have been found to be better as well which has been documented so, far that this plastic waste roads are actually coming out to be better than traditional road.

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So, and these are some of the reason why it does that. So, when you compare plastic roads with the non-plastic roads in both cases bitumen are there, but bitumen roads with plastic and bitumen road one just without plastic. So, what we have not found that you can see those two pictures the top one is with the plastic and the bottom one is without plastic. So, without plastic what as we all know there is a cracking, the pot holes, you will have some deformation.

And when you go for this plastic in the right proportion in right design you kind of avoid having pot holes, little less deformation, no cracking and no edge you do not have the edge flow. So, that is it helps in putting things in right like right aligned. So, this is it is a bit product as you can see from the picture it comes out to be a much better product when we use this waste plastic. And it also from a plastic waste management point of view you also see that we had its being its a plastic waste management solution as well and at the same time it is a transportation solution because, this road is coming out to be better.

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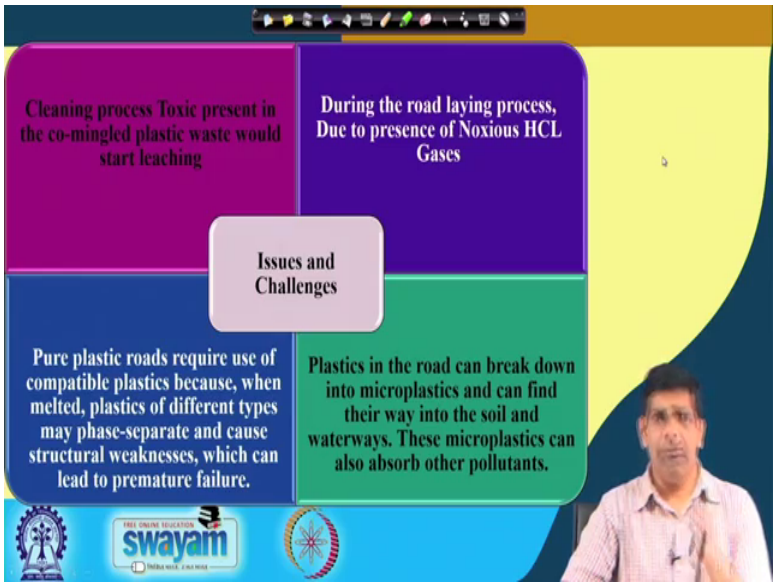

So, but always whenever we have said any process, any product anything you come up there will always be some issues and challenges because, things are all not all the are there are always some limitations there will be some challenges. So, similarly here we have to clean the plastic. Because when you use if you have too much dirt and other stuff so, you have to clean it, you can have some toxic stuff for a present there. So, toxic presence can comingled plastic waste would start leaching. So, you have that after cleaning that waste water that you have that needs to be treated so, that is an issue.

During the road laying process due to presence of noxious HCL gas because, when you have plastic there has some chlorinated salt chlorinated product is there. So, when you have chlorinated product you will have a HCL gas being formed and that becomes a problem. And when you have the pure plastic road say it requires use of compatible plastics because, when you use mix plastic they made they may have phase separation because there are different types of plastics.

So, they may have a phase separation and if you have phase separation then you will have a structural weakness and which can lead to premature failure. So, you need to have similar type of plastics. So, similar plastic types compatible plastics that needs to be used.

So, you have to make that sure and plastic waste another ratio that we are kind of worried about is these micro plastics coming out from this plastic waste although this

plastic is now encapsulated with asphalt. So, usually we should not it with the its kind of a put in a nice encapsulation, but see with the wear and tear of roads with so, much vehicles going back and forth and you have wear and tear of that road.

There will be instances of breaking down and then you will have mike you can potentially have micro plastics coming out and work making way to the soil and waterways the nearby surface water. And these micro plastics are of course, harmful by themselves, but they also acts as that sites adsorption site for other pollutant.

So, they carry other pollutants with it; so, these are says I said any anything we go further will always be some challenges. So, we need to look at these issues in detail when we go for; many times what happens is we find is something for example, this plastic road. Now, the whole industry, the government and everything things that for the management of plastic waste this is the solution and let us go and just do it.

But, before we go and make that kind of a huge claim we also have to look at what is the risk associated with that. So, that is why this beneficial reuse risk assessment. So, this use of this plastic in road construction it is a good thing to do, but at the same time these issues that we talked about these four issues that we are looking at here they and there could be some more.

But these four broader issues that we are looking here they also needs to be like looked into a bit in detail and to try to see that whether are we just solving a problem, but creating some other problem. So, that is those kind of issues usually get captured when we do this lifecycle analysis kind of calculation. These things do get captured in there because, we will be looking at the cleaning of plastics, use ratios of micro plastics coming out, the impact of micro plastics in the environment. And all that they need to be looked into and as I they went for any like a long term performance.

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Advantage of using plastic in the road the stronger road as we talked about good Marshall stability value better resistance no stripping, no pot holes. Increase binding reduction in pores in aggregate, a strength of row its a no effect of radiation like UV a strength of road, the increases. It can load withstanding property increases you can have if you have 1 kilometer by 3.75 meter road 1 ton of plastic 10 lakh carry bags is used one-third of bitumen is saved. But so, you are saving bitumen while using this plastic; cost of road construction will go down, maintenance is coming down, disposal of waste plastic is no longer a problem.

So, and use of waste plastic on road help better place than burying it in a landfill and those are. So, there are benefits of course, that is why people are looking at it throughout the world. And we are in India also doing it even the government ministry of surface transport; if I am correct I always get confused with different types of ministry where the jurisdiction of one ministry ends or where the duration of other ministry starts.

But, I think it is the ministry of surface transport which has come up with a regulation that or a guidance document which says that you need to use around 10 percent of plastic waste in the road construction. So, there are already some guidelines in place where the plastic government wants people to use this plastic waste in road construction because it has been found to be good.

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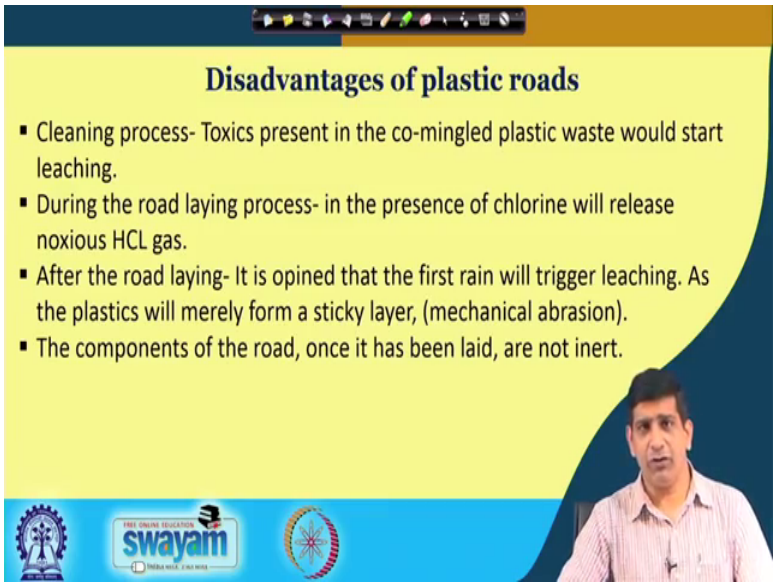

But again we have not looked at some of the issues that we talked about in terms of risk associated with micro plastics, the cleaning of plastic, the wastewater that is coming out. So, all those things have should be looked into when we look at the big picture environment otherwise see the whole purpose of this course or any other environmental course is actually looking at the overall impact of human health and environment; we should not move one problem to another problem. So, if cell solving this waste plastic by road construction, but if we clean those waste plastic and we have too much toxic wastes or toxic waste water.

And then this waste plastic problem became a toxic waste water problem, micro plastics coming out that is another problem. So, we have to look at those issues in detail before we kind of give a nice certificate to any process or any method. So, cleaning process disadvantages toxic could be present during the road length process if the chlorine will release, first rain will trigger leaching as the plastic will maybe a sticky layer mechanical aberration. So, it is then components of road when it has been laid are not inert so, it does react.

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So, as I said the government is making use of passive wastes in road construction, road developer will now have to use plastic wastes along with hot mix construction bitumen roads within 50 kilometer of the periphery of any city that has population of over five lakhs. So, any city with over five lakhs the plastic waste collected from that city part of that has to be used in road construction.

So, that too has been made mandated. So, that is already there the urban local body which are actually sort of sub can make money from selling this plastic waste to the city developers. So, they can sign a memorandum of understanding those kind of stuff.

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Then also consider using plastic waste in road construction Himachal Pradesh high court tells to a public works department. So, this is again December of last year. So, this is a hot topic as I said in the beginning this is a very hot topic in India right now of plastic waste in road. And it seems to be a good move, but at the same time we need to look at other issues associated with that many times we forget those.

Because, but we need to do that unless just to make sure what is the risk from using it and how the risk compares with the benefit; so, that is always a good thing to do. So, here the Himachal Pradesh associative secretary there enough a definite more high court there are many ways plastic items like carry bag, plastic cups, plastic packaging chips, biscuits, chocolates blah blah blah and which can be used for road construction or required to be cut in size to 2.36 mm to 4.75 mm by using studying machine.

So, again you are using energy there constant and can be used for road construction by a dry process. So, there again the high court of Himachal Pradesh they say that you should desire to use empowers plastic for road construction our examining their technical and financial aspect. So, that is needed so, some study needs to be done to make sure that we are doing correctly.

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Micro plastics we talked about issues of micro plastics in your coming out from different stuff, where we looked at micro plastics earlier in ocean. In we also here once you have this road being constructed you can have micro plastics leeching off. So, conventional wastewater treatment plant they are with primary and secondary treatment process. They can repair remove micro plastics from wastewater.

But, they were not really designed for removing emerging contaminating micro plastics and the removal is actually by chance. Despite the efficient removal final effluent can act as entrance road for micro plastics even the large volume constantly discharged into the aquatic environment, other pathways including storm water runoff, wind-blown debris, and in situ degradation of large plastic atoms. So, there are micro plastics do come into the environment.

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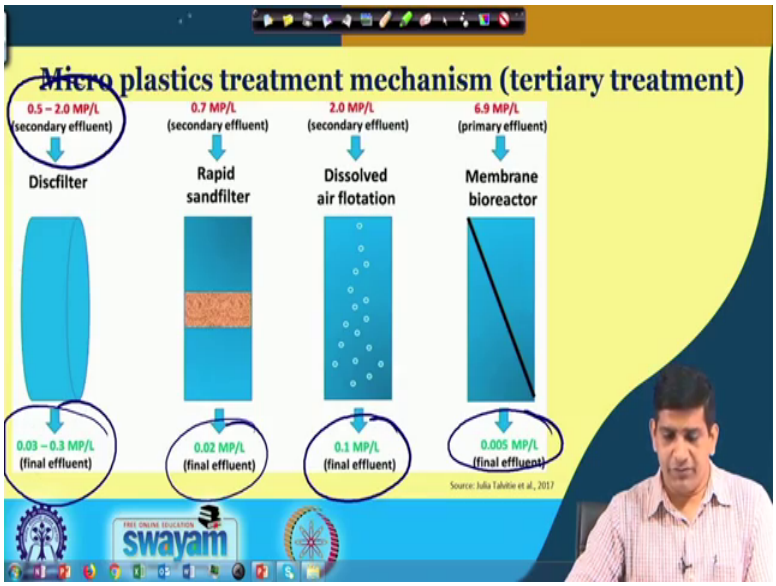

So, if you look at the micro plastics mechanism in terms of tertiary treatment. So, you can if you have micro plastics from 0.5 you look at different scenario 0.5 to 2 micro plastics per litre. So, it when it goes down to 0.03 to 0.3. So, there is some reduction in the foot to the discfilter. Rapid sand filter also you have some reduction right there, Dissolved Air Flotation; DAF also removes micro plastics, membrane bioreactor also removes micro plastics.

So, there are micro plastics does get removed in tertiary treatment, but many of the plant does not have tertiary treatment. So, they are only have primary and secondary treatment. So, you do not remove that much of micro plastics coming out from that.

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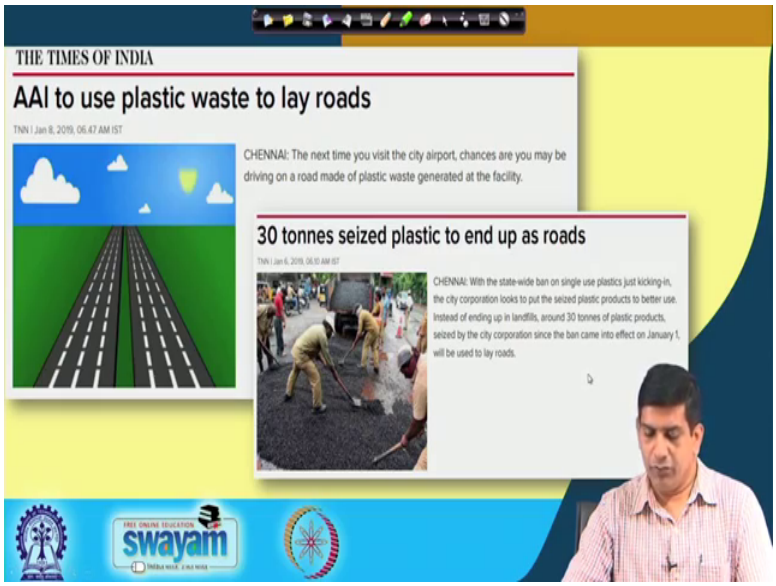

Other initiative which has been done is that the airport authority of India uses plastic waste to they want to use plastic waste to lay roads, that next time you visit city airport in Chennai there you might be driving on a road made of plastic waste; 30 tons of seized plastic to end up as road. So, when so, with the ban on single use plastic they were they found 30 tons of plastic was captured in city corporation area in Chennai and that they are planning to use it into roads, so, that is thing is there.

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So, waste plastic in Mumbai and sorry in a Bangalore also it is done Bruhat bb BBMP has used plastic on about 600 kilometers of road, including many thoroughfares and aerial roads. It is also used in plastic bends in at least 25 percent of the road laying works including the present to project to upgrade the 45. The plastic model was successful on major roads in Bangalore including Shankar Mutt Road, K H Road, M G Road, J C Nagar Road. So, there are so, these are just to give you an example, that this is already being done in India it is nothing it is not new.

So, its already being done for last several years and this is a potentially a good way of managing non-recyclable, non-energy recovery plastic rather than sending it to a landfill we could rather make a road to use it for a road construction because, it helps in making the road better, it also helps in conserving the bitumen. So, you have to use less bitumen if you use waste plastic and the issues associated with risk and other stuff in terms of micro plastics and all the toxic waste water that should be looked into to make sure we are doing everything.

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Here are some examples of outer ring road in from Mysore road junction, Bangalore University road, Pattalamma road. So, as you can see the road most of the roads has looks much like a improver improved version of the traditional road. So, they are plastic roads does seems to do better and it has been reported to do better.

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So, there are reports already out there which no its not only like it just the claim even the people have after using it for a few years people are finding it to be better than the traditional road. So, you see some examples another example this is the plastic waste road, then on the right hand side again the plastic waste road where this picture is from Jusco which is in Jamshedpur.

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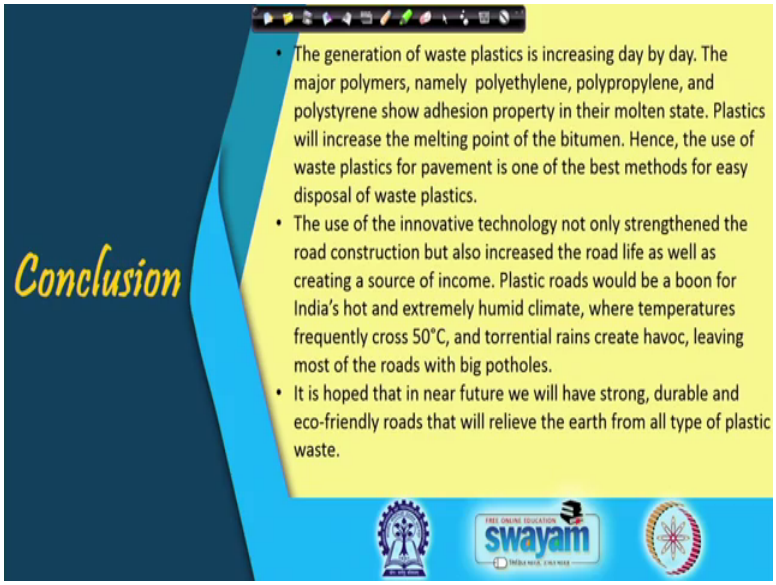

So, in terms of this particular week for what we have looked into the different aspect associated with the plastic waste management. So, plastic waste generation of waste

plastic is increasing day by day. We are having more and more plastic the being formed are being produced. Right now based on the government data different data that we have we have around 12 percent of plastic waste in municipal solid waste stream. And that number will potentially go up as a country progresses more packaging more stuff and of course, we are trying to reduce the single use plastic, but then we have other plastic items which we will keep on using. So, we will have more and more the plastics coming into the waste stream.

And when we look at the plastics it is there are like different types of polymers: polythene, polypropylene, polystyrene and all those different polymers are there. And they have good adhesion property in the molten state and when you use it in waste plastic for road it helps in increasing the melting point. So, hence the use of waste plastic is one of the best method for easy disposal or we can use it for the disposal of waste plastic.

The use of innovative technology it makes the road better, but also increases the life of the road and then creates a source of income for the ULBs, ULBs can fund now plastic waste. So, they can get the plastic waste sorted out from other waste streams and then be able to sell this plastic waste for road construction. It is a and it works its good for India's hot and extremely humid climate, temperature frequently kind of on the road temperature we are talking about.

The temperature on the road surface many today frequently crosses 50 degree centigrade. Although it may not be in the ambient temperature, but as you can feel the roads are pretty hot and torrential rain also creates havoc in India. So, this plastic waste plastic roads is helpful in reducing the pot holes. So, it is those big potholes are disappeared in many of these plastic roads we do not see those potholes. So, they are they help because of plastics they are more stable under rainy conditions. So, it is a so, in the in so, there is a hope that this in terms of managing plastic; this use of waste plastic in road construction will be a big thing and that will help in making things better in the environment.

So, overall if you look at this week we started with looking at the this whole focus of this particular week was on plastic waste management issues. So, when we say management plastic waste management we started from the recycling which is the most preferred

option. Recycling where you make you can do mechanical recycling or also do feedstock recycling.

Mechanical recycling is where you try to make a new product out of the plastic waste which is there you try to make a new product, you weigh the down cycle mostly down cycle and make new product out of that and even make the same product out of that. Then in feedstock recycling you try to go for make this pallets and then you go for pyrolysis, plasma gasification and all that.

Then we also looked at waste to energy where, if since there are several times for more both mechanical recycling as well as feedstock recycling we have to separate the different plastic based on resin type. So, dif one we cannot really mix those resin types because that becomes a problem in terms of getting the newer product out there. So, for waste to energy incineration plant we can use mixed plastic together along with other waste stream as well. Plastic has a good calorific value so, we can use it in ways to energy plant, but we have to do it in a pretty high temperature.

So, that to make sure that not in no dioxin fuel in and other contaminants are formed; even after were doing at a high temperature we need to have a proper air pollution control system. So, that was the waste to energy part, then if you cannot recycle it, you cannot do waste to energy next we said you can put it in a landfill where because the landfill at least is a secure environment. So, you are minimizing the environmental risks from there.

Now, other than so, this is the traditional way of doing it. So, there has been some other applications of plastic and the biggest one was used a plastic weighted waste in road. So, we talked about that in quite in detail, we also looked at a small video of how that process works. Then we also looked at plastic bricks use of plastic in different use of plastic in different applications.

Again if you go on Google and if you go on YouTube you will find several innovative applications that people are coming up. We looked at the bricks, we looked at a whole house made out of waste plastic. We also looked at people making tiles of waste plastic and used in different and so, there are so these are some applications there are several other applications out there which you will find.

So, again I hope this weak material was useful to you and we could looked at the plastic waste management issues of different aspects of plastic waste management. And so, if we try to cover whatever we could in a week's time for a different aspect. This is just the beginning as I keep on saying every week this is just the beginning for you, if you are really interested in this topic this course would be kind of a just a beginning step and we you need to read more about it. So, that is why the reading material is there; online reading material has been provided to you along with the slides and put things on discussion forum make it lively and ask questions there we will be happy to answer.

And of course, I hope you are enjoying the course. So, keep enjoying. So, next week so, we have 6 weeks we have completed out of 8. So now, 2 more weeks of with material left for you to go through. So, in the 7th week which we will look at what is alternative to plastic. So, what if we do not use plastic because if we started with if we ban all this plastic what are the alternatives and how good are those alternatives which is out there in the market right now. And in the last week will about the whole circular economy and all those concept associated, how plastic management is getting into that circular economy concept which is a newer concept anyway.

So, again thank you, see you again in next week.