Municipal Solid Waste Management
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Lecture - 01
Introduction to Solid Waste

Welcome students! For the first lecture i.e., Module 1, Evolution of Solid Waste Management, one needs to first understand what is meant by solid waste. When we say waste, it is very important to understand the treatment issue or any kind of disposal issue of that waste.

Also, it is important to understand, how waste is an important issue for the residential areas or municipal areas or ULBs areas. Let's first talk about the definition of solid waste, because the problem lies in the meaning itself and is very difficult to understand.

Also, understand that the waste could be converted to compost. It is very difficult to understand, when you say any material is a waste, how you can get benefited from that waste. The name itself is very difficult to understand giving the proper information. Let's start with what do you mean by Solid Waste Management. This is our first lecture on Introduction to Solid Waste.

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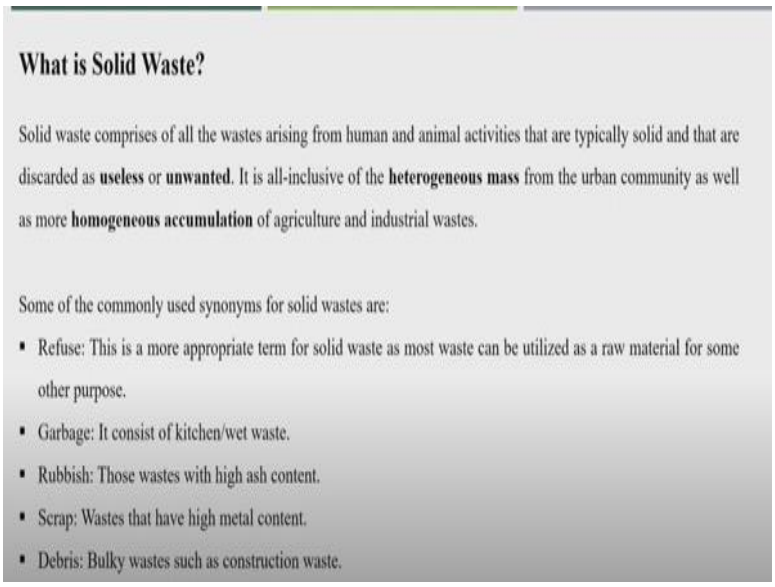

So this is the proper explanation or definition of solid waste management. So this solid waste comprises all the waste arising from the human, animal activities that typically useless and unwanted. So this is the proper explanation of solid waste. See any material could be useless or unwanted, which could be a waste material.

But when you say that is useless or unwanted for my purpose could be useful or could be helpful or could be produced some kind of wealth from that same material could be for another person. So this is the proper explanation of the waste. But when you say the waste again is very difficult to say that it is unwanted for me but the same waste is getting wealth for other some other persons or other beneficial purposes.

So the proper wording, so here this is the word called refuse. This is the proper wording of the solid waste, the refuse. Because this refuse can be useless or unwanted for somebody, but the same can be used as in some of the wealthy material can be produced either as energy or as compost or whatever could be or any kind of recycled matter. That could be possible.

So it is a normally we call as a refused management. So when you see in the US and European countries, mostly they would not talk about Solid Waste Management. They will talk about refuse management. That is why they in their country they are allowing to use the proper recycling matter to produce wealthy products like energy, like compost, or biogas production. Because in India we talked about is a waste.

Very difficult to accept this waste could convert as a very good recycling matter or could get some wealthy material out of that. So other words I think might you know about a few different wordings about Solid Waste Management like garbage; garbage, rubbish, scrap, and debris. This normally the garbage we call as in kitchen waste or wet waste. That is normally called garbage.

In India, we talked about garbage management. So this is not the proper wording about this garbage management is specially targeted to the wet waste or kitchen waste and rubbish. I think rubbish also rubbish is another management issue, where rubbish management but this rubbish is mostly targeted to the waste ash content into the waste material.

Mostly this kind of rubbish material is producing from the slum area or poor areas where still the cooking is under the simple cooking materials the wood or other materials are that is producing a lot of ash. The scrap this another word scrap that is mostly the scrap is a recyclable matter mostly is metal is included in that. And debris. Debris is mostly where the large size materials are including construction or demolition waste into that.

So this is a proper definition of solid waste. So do not get confused about wherever I think you will study that is solid waste management or garbage management, rubbish management, or scrap management or refuse management. So almost is similar. Just based on the different sources or based on the different characteristics of the name we can give it to the waste.

But normally, we call solid waste management for all kinds of different characteristics of the waste material.

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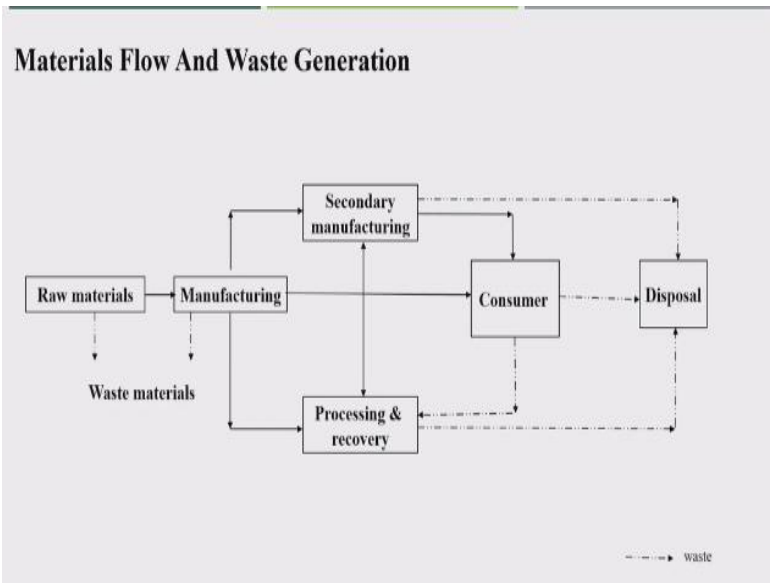

So now the very important one, the while producing the different materials or especially for the manufacturing of any material, how this is related to the waste generation that we can find. We will see with the one flowchart like suppose some raw material will take for any manufacturing of new products. The manufacturing will go maybe is a primary manufacturing, secondary manufacturing and we will get some kind of product that will go to the consumer.

And from consumers again, suppose we plan for recycling facility or recycling of the same material, it will again go for processing and recovery and go to the manufacturing process. But entire this material flow you will see the lot of waste production. So under the raw material, you see a lot of waste production, while in manufacturing, a lot of waste material will get produced.

So it is clearly explained that and again once the consumer will use that particular material again after the entire utilization of the material it will go for the disposal site. So it became a waste. So the entire flow chart is showing that if any raw material is getting manufactured and to the manufacturer to the consumers also is related to the waste generation.

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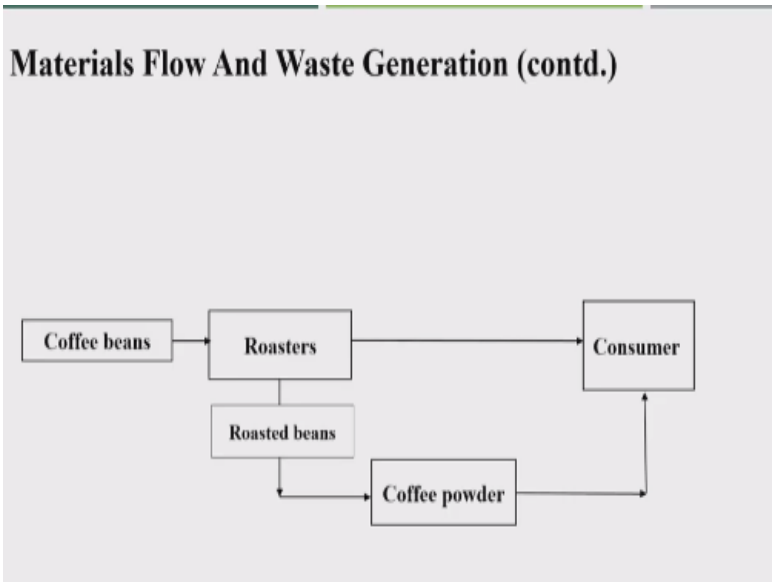

So similarly one example this we can understand by one example, by if you take the coffee beans and these coffee beans normally when you prepare the coffee that powder it will go to the roaster. And finally, after getting a roaster that goes to the consumer. But sometimes the roaster beans also become a coffee powder and will go to the consumer. This is the entire use of the coffee beans to become a coffee powder or direct roaster to the consumers.

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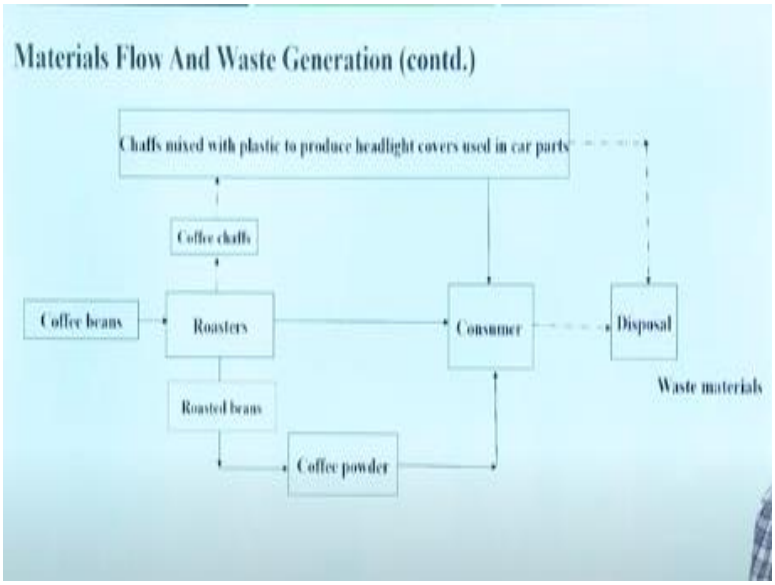

But now again from the roaster, there are a lot of coffee chaffs is getting produced as waste material. These waste material also can be utilized, can be these waste chaffs mixed with the plastic to produce headlight covers used in the car parts, is again getting utilized. So there would not be any waste material production. But again, this material is getting disposed of.

Because once you prepare the coffee that coffee powder also becomes waste material. And whatever the remained material while in the roaster that also will go to the disposal area. That ultimately entire coffee beans whatever after utilization, became the waste material finally. So it is related that for any manufacturing or for any whatever products we are using for our daily activities, so these all products including the waste generation, okay.

So is very easily understandable now waste generation is very important because whatever materials your daily activity you are using the same material will get finally getting disposed of as a waste material after the entire utilization of that particular material.

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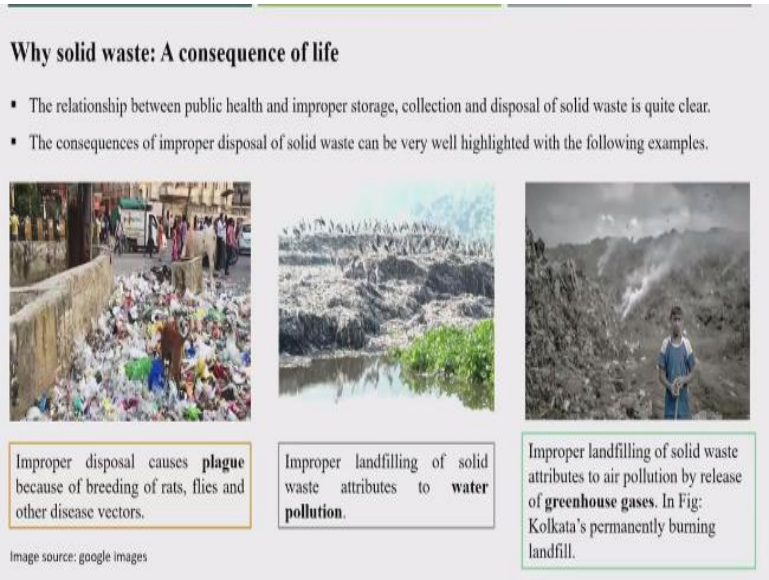

So we will see how solid waste is related to the consequences of life. You will see that this is proper disposal of causes the plague is you know the Surat plague is very well known in 1983, where a lot of people have died because of the plague issue. So that shows if you are not able to dispose of the proper solid waste, how is your life is getting affected.

You see, landfilling, the way we are disposing of solid waste becomes a very important issue for water pollution. So because of that, not only the surface water but also the groundwater is getting polluted because of improper disposal sites. And in India, mostly the waste is getting collected. Even under the Swachh Bharat Mission, the major target was to clean the city.

And from 2014 onward most of our city is getting cleaned and where the number of cities is awarded also because of cleaning. But I think we never talked about once any city is getting cleaned means entire waste is getting collected, but how best they can be disposed of? And the way the waste is getting disposed of in the low lying area in most of the cities are these kinds of issues. You have a water pollution issue.

Similarly, if you are under especially the cities like the city is very close to any water storage area or somewhere near to the wetland areas are very difficult to have the proper disposal system. See somewhere here also the greenhouse gases because once the entire mixed waste is getting disposed of one location there is not only the leachate is getting produced while degradation of biological waste.

Also, greenhouse gases will get produced. These greenhouse gases including carbon dioxide, methane, these gases will get produced and this is polluted the local area.

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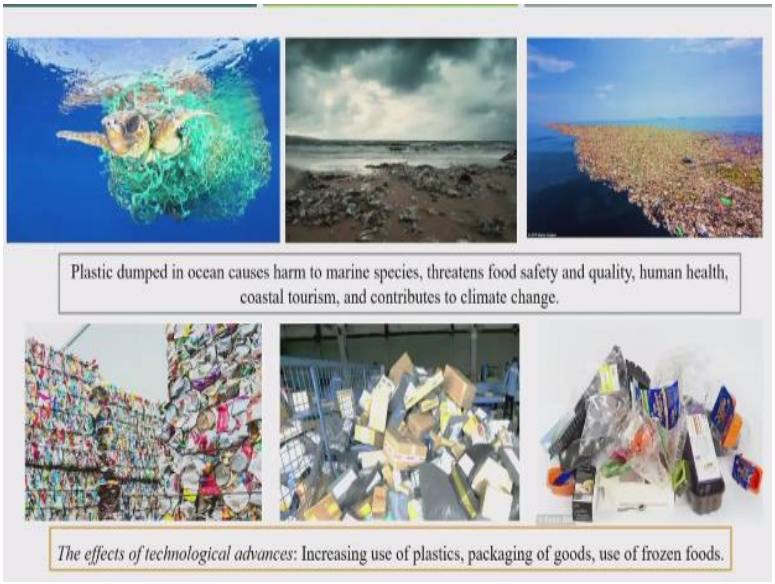

See some of the photographs are here. You saw the one photograph like the way where disposing the plastic into the sea. How these marine species are getting affected by this plastic disposal into the sea. See, this is the one photograph you can see. Because the plastic is not getting degraded and is getting floated onto the water and somewhere is getting stored in a very large quantity.

And also because of technology, urbanization. Now see the before 20 years or 15 to 20 years, India never talked about the packaging material. Now because of this online purchase, had increased a lot of waste production, that especially packaging waste. See, I still remember in our older days, when you go somewhere into the shop, we never used to get a lot of packaging material.

Most of the material is getting packed into the newspaper and easily we used to collect with the bags. But now I think the way our product is getting sold off, that is based on the package, and because of this online production, a large amount of paper, the large amount of plastic is getting included in the waste management. That is one of the important issues.

Now see earlier India always used to talk about vegetable waste, or biological waste is producing more. But now if you see the entire waste compositions, we are getting a large amount of paper and plastic that is not degradable but is more recyclable metals are coming up. another very important one, this waste is heterogeneous in nature, highly heterogeneous.

Now see you understand this heterogeneity as if you just compare with the water treatment or wastewater treatment. So water is a homogeneous material. You take the water from whether India or European countries or American country water quality is the same, except maybe some pollutants will get changed. So your treatment also will be almost the same were these all treatment facilities.

Your sewage also characterization will be the same. So your sewage treatment plant also will be a similar kind of sewage treatment plant will design. But for solid waste, now it is an entire heterogeneous mass. Even every day also your entire composition will change. So like you see your daily activity on Monday and daily activity on Sunday, both are different.

So activities are changing, your waste generation also will change. Waste generation not only the quantity will change, but also your characteristics will change. Someday you will produce a large amount of biological matter, someday you will produce a large amount of recycled matter. So it is very difficult to how one kind of proper technique or any treatment facility.

And also these characteristics are changing with the area to area and season to season. That is another very important issue. Like when you take the in India, we have three different seasons. So obviously, even your food habits also are changed with the season. Like in the summer you would not get a lot of vegetables, but in winter we will get a lot of vegetables.

So obviously your vegetable waste will be more into the winter season and your dry waste will be more on to the summer season. And again you see the monsoon. Again we have three months monsoon. So the technology should be such a way that it will is

very difficult to find a simple one technology where the dry waste wet waste different compositions can be treated at one location in a different season.

That is one of the very important issues in Solid Waste Management. But now the way our commercial or urbanization is increasing your waste generation is also changing. And whatever technology will propose that maybe after 15 years, 20 years that technology would not be beneficial. And the way our waste generation is increasing, especially from the last 5 years to 7 years is very difficult to believe that the way our waste generation is increasing.

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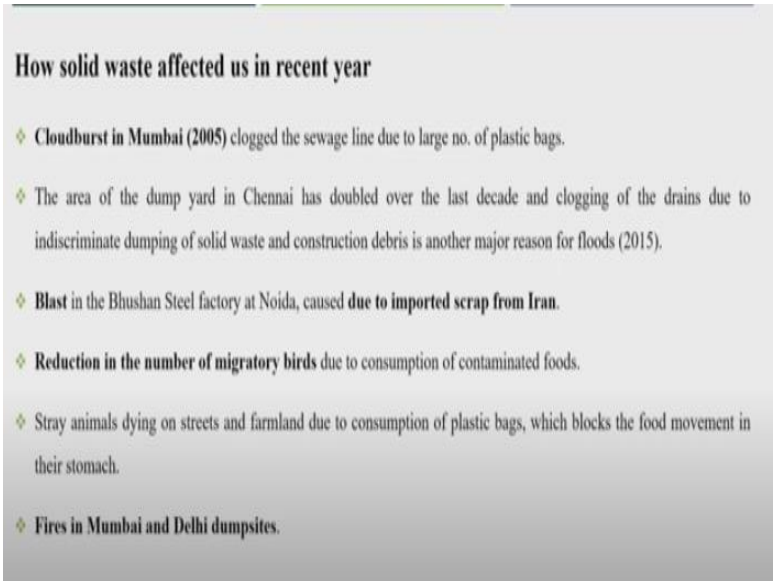

You see that I have some of the data about the cloudburst in the Mumbai 2005. And mostly we see that in Mumbai most of the sewage network especially in the monsoon season is getting clogged off and every year in Mumbai we will see the flood issue. And why the flood issue is not because they do not have proper sewer networks. But because this plastic the way we are getting disposed of that plastic is adding into the sewer networks.

And these became these plastic is getting clogged into the sewer network and is the Mumbai always is getting the flooded in every year. Like I got surprised when you say that Chennai had a flood in 2015. So was very difficult to believe that. Chennai could have the flooding. And I believe that this flooding is because of because most the sewer networks or wherever the water is going out from the city that has been clogged by the solid waste as the city becomes flooded completely.

And we normally in the urban centers also we never thought about the how benefits of the wetland and the proper space. Space is very costly in India now, the land is very costly in India. The people would not think much about the benefits or the wetlands where water is getting stored off. So there are a few more like the fire. One more the fire in the landfill area.

I think might you remember about the fire was found, I think that extended for the more than 15 to 20 days where Mumbai landfill got fired off. These firing people were talked about this firing is because of methane production from the dumping area. But also along with that not only this fire is because of methane production, but also if you see that in the dumpsite, the lighter material that paper and plastic will be always on to the top.

And always because of the entire dumpsite under the anaerobic condition. So obviously some kind of methane will get produced and this methane maybe that quantity is not very large but can get fired off. Or purposefully also many Corporation is firing the landfill to show that the entire dustbin does not have the paper and plastic waste into the waste material.

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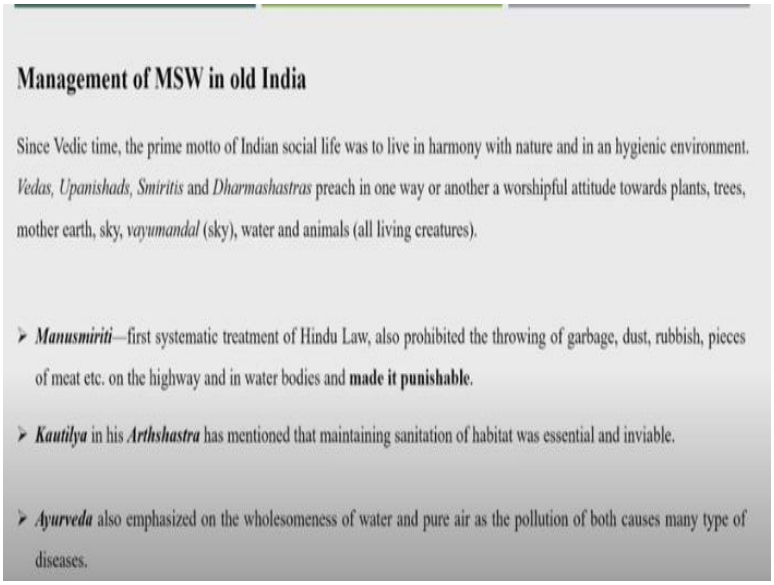

Now you see that some of the past literature in old India, since Vedic time also we used to talk about this waste management. So I have some information about the one very important document like systematic treatment of Hindu law Manusmiriti that

says that it prohibited the throwing of garbage, dust, rubbish, piece of meat on the highway, or in the water body and made it punishable.

See that was written hundreds of years before this thought was being proposed. This waste should not be disposed into the water body, should not be thrown onto the highway. And if anyone will found to get disposed of need to be punished. Another document like Kautilya's Atharveda also talked about the sanitation of habitats, which made it very essential. And also another document called Ayurveda talks about the wholesomeness of the water and pure air.

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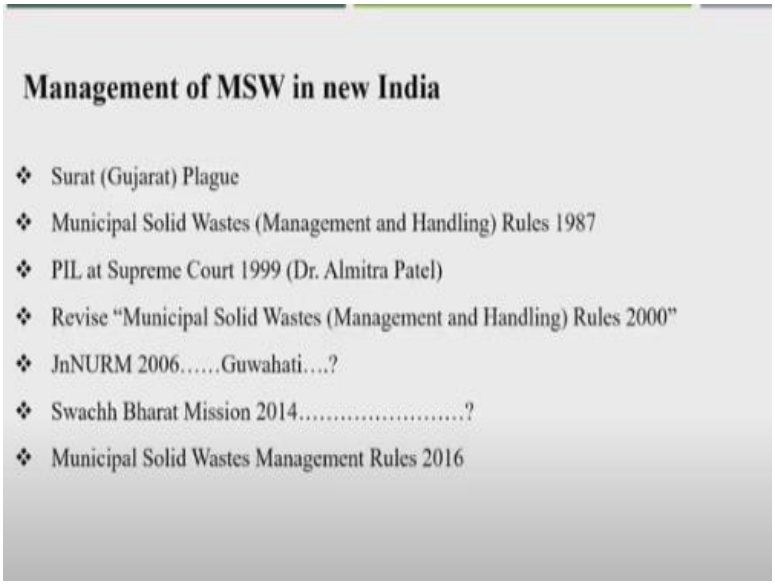

But now in the management of MSW, we will see the management in the new India, management of solid waste in new India. So I was talking about the Surat plague was the first event where we thought about or we came to know that the importance of solid waste management where a lot of people have died because of this Surat plague. Maybe hundreds of people have died because of that.

Surat known to be a textile city and the waste used to be produced by these textile industries are mostly a biological matter. And that never used to get disposed of out of the city, used to be disposed of very close to the industrial area. And these industries because of that lot of rats had been attracted to such waste because that was a very biological waste. And because of that, India thought about proposing a special rule.

That was Municipal Solid Waste Management Handling Rule 1987. So first time in 1987, the Government of India gave one of the important thought to the local bodies or Corporation area or urban local bodies, apart from water supply sewage collection, also they need to collect the solid waste. But was very difficult for the ULBs to understand that. They never thought of it sometimes, because the water supply is very easy.

You construct the pipelines and you supply the water and or you find one particular source whether is surface water, whether is groundwater, find one particular source, construct the supply lines and flow the water, was very easy. But now when this task has come up to the ULBs to collect the waste they never thought of, because your sources were thousands, lakhs of sources.

Each house was producing a good amount of waste. They never thought of when they got very surprised that whether now they have to go to each house and get collect the waste. So how best they can do it? So under this rule, what Corporation did they installed several dustbins into the city and asked the local people to get dispose of the waste into the dustbin area.

That was a simple collection system most of the ULBs have started. Had been asked the local people to dispose of the waste into those particular areas and what the Corporation used to do? They used to collect waste from those dustbins area. But was very difficult because finding a location into some low lying area outskirt of the city was transportation cost very difficult.

So most of the city was unable to extend the, extend this solid waste management or solid waste collection facility. Forget about the treatment in those days. Then one PIL has been submitted by Dr. Almitra Patel normally we called a garbage lady of India. She submitted one PIL in Honorable Supreme Court saying that ULBs or Corporation was not able to do the proper solid waste collection and treatment and was not able to dispose of the proper landfill area.

Then in 2000, in 99, Honorable Supreme Court made one special committee under the Supreme Court and they revised the Solid Waste Management Rule in 2000. And

there I think the first time the solid waste management was related to public health so that people will be easily understandable, how important is the solid waste management issue.

But still, I think again the issue was with the always because when you say the collection issue in solid waste management is a very costly process. Because I think in the initially also when we installed the different dustbin, so the collection cost was very high, very large to get collected 200, 300 number of dustbins located into the city. So the collection was a very costly process.

And once you collect also and come up to the disposal site was very difficult to have one proper treatment facility. So we do not have the proper fund, fund for the collection. Because earlier we never thought about there could be some kind of collection fee from the producers, from the household area. Then one other scheme has been proposed. I think we know that is one of the very important schemes JnNURM 2006.

Jawaharlal Nehru National Urban Renewal Mission. The target was this mission to help financial help to the ULBs by 2006, In the scheme one there were 35 cities was been selected for financing for the for not only for Solid Waste Management but especially for the communication purposes. So many cities got a water treatment facility, many cities got proper transportation facility.

Might you have seen the big buses under this JnNRUM scheme? And also some cities got a lot of funds for solid waste collection and disposal. And under this scheme only the first time we thought of the PPP projects; public, private, partnership project. Because in Solid Waste Management because the collection was a very difficult, very costly process. So Corporation was not having enough funds.

So the private authority had been asked to the private authorities to come forward to help the corporations under the PPP program and to fund the current collection and treatment facility. And why the private company was very positive about this scheme because they thought of because the waste this was not the simple waste. After all, they thought of there will be a 50 to 60% of biological waste into that.

So they will be able to produce a large amount of compost from that. And remaining that 20, 30% was the recyclable matter. And mostly the, when you talk about dry matters, was a recyclable matter. Like if you take the example of paper, plastic, rubber, leather, metal, glass, everything is recyclable matter and very costly matters.

But I think when the private company has come forward, they thought of they will get a lot of benefits from that but was very difficult because the way our collection system is a was a mixed waste collection. There was no segregation and when the private company tried to collect the waste, so same the collection system gets it and disposed of one location was very difficult to get segregated.

So they never found the proper compost production. Never found the proper recyclable matter which can be easily recyclable or which can be sold off at a very good cost. So then I would not say that this scheme has been failed off, but I think many cities got a lot of infrastructure facilities at least infrastructure facilities. Many cities got compost plant under the JnNRUM program.

Then in 2014, the Swachh Bharat Mission has been proposed or announced. So what was the major important point of the Swachh Bharat Mission was the waste segregation. And that was a very good initiative in Solid Waste Management. Because from our we saw that our history of waste collection in India that mixed waste collection was never found beneficial.

Because we are not able to produce proper compost quality, proper recyclable matter. So the under Swachh Bharat Mission the segregation was an important issue. So for every household has to be segregated into the three parts of dry waste, wet waste, and the third part was household hazardous waste. That was the third part and based on the segregation, you finalize the collection system and followed by the treatment facility.

So that was a very simple thought was being proposed under the Swachh Bharat Mission because once you can segregate at the household level or source itself so that biological waste will go to the biological treatment facility. That could be a

composting facility or biogas generation facility. And these dry waste because it was a this was not contaminated one. And mostly materials were recyclable.

So like paper, plastic, rubber, leather, metal, glass, this all goes to the recycling facility. Only 10 to 20% will have remained for the disposal area. But I think you saw that number of cities has been started the work on the proper waste collection and we saw that in Madhya Pradesh, Indore, Bhopal became one of the cleanest cities in India for the last two to three years.

And also in 2016, the rules have been modified. That is the Solid Waste Management Rule 2016. And now this rule also suggested that segregation and also proposed the first time under the rule, what kind of compost quality has to be produced. What kind of recyclable matter has to be produced. And when you go for the site a landfill, what kind of leachate are getting produced off?

And what kind of treatment facility has to be provided for that leachate treatment has been proposed into the Solid Waste Management Rule 2016, okay. So we see this Solid Waste Management Rule 2016. So under the first lecture now I think I believe that you people have understood what is Solid Waste Management and how important is Solid Waste Management to study.

So in the next lecture, I think we will talk about the functional elements. From on that functional element, we will go one by one functional element to the next lectures. So if you have some kind of questions, you can ask me or some kind of queries you can ask me. **"Professor - student conversation starts"** Sir when did this hazardous waste got included in Municipal Solid Waste Management Rules? **"Professor - student conversation ends".**

Yeah. So now actually this course is especially for the Municipal Solid Waste Management. Apart from Municipal Solid Waste Management, there are several different wastes. And in India, there are several rules for that. Hazardous waste also is another very different course. That normally in our municipal area we propose (34:23) waste management.

Although we talked about one source is a household hazardous waste, but that is not that kind of hazardous normally we included in hazardous waste. So this Hazardous Waste Management Rule also has been modified in 2016. The major sources of Hazardous Waste Management, hazardous waste, those are the hospitals and most of the industries are hazardous waste.

So normally, you ULBs would not manage the Hazardous Waste Management. ULB would not do. That is based on the company wise, based on the industry-wise, they have to manage their produced waste into industry-wise. So that is a separate course Hazardous Waste Management. So similarly with Hazardous Waste Management, we have a rule on Plastic Waste Management.

We have rules on E-Waste Management. India was the first country in 2011 we had a first rule E-Waste Management Rule in 2011, which got again modified in 2016. Similarly, we have Battery Disposal Rule. That is also modified and even that these rules I am talking about the country wise. But there are some states, they have also their own rule.

So these are the different rules that are available with us. **"Professor - student conversation starts"** Okay in 2005 in Mumbai, there is a flood that has happened. That is not the main problem. That means it is created with solid waste. So the problem is maybe from the awareness of the society. So what can we do in these areas? Yeah. Regarding the authorities, their responsible bodies in the country-wise, what can we do? Yeah, can you suggest? **"Professor - student conversation ends".**

Yeah, so I, as I talked about that the flooding in Mumbai was very surprising because the way we are disposing of the waste is not only the disposal at the dumpsite but the way we have located the dustbin, those dustbins became a dumpsite. And a large amount of waste is getting accumulated into the dustbin area. And when in especially in India when the rain started, that get continued for four days, five days for a week.

And because of that, this plastic because they are very light material that became added into the that became soluble in the water and get flowed with the water and enter into the drain. So what was the problem? Because see, until before Swachh

Bharat Mission was very difficult to understand by the local people. They never thought of and see in India people were talking about one problem like people were talking about about one problem like NIMBY. We call as a syndrome that name is Not In My (37:28) Backyard.

The people never worried about that when I am disposing the waste anywhere, this is not my problem and under Swachh Bharat Mission also that has been proposed that awareness is very important issue now. People have to understand whenever you go for any purchase or whatever activity you are organizing your house has to understand what kind of waste is getting generated and you need proper collection facility for the waste.

That is why I talked about that when you need to help the collection facility not only waste collection facility but also waste treatment facility in nearby areas. So a lot of awareness because and was very difficult in India when the household had been asked to segregate the waste, was highly opposed. When this even in 2006 when the JnNRUM scheme has been proposed off during the scheme itself, the household collection has been proposed.

But people were not ready to give the waste. That was very difficult. And forget about the segregated waste, but is good that under Swachh Bharat Mission most of the city started the segregated waste collection but again when you are segregating at the household level, you need to have proper segregated collection facility and segregated treatment facility.

That is also one very important issue. So there is a lot of awareness, but under Swachh Bharat Mission lot of our Bollywood actors also came in came front and they in lots of media also covered the Solid Waste Management. So people are getting aware of now. But again, the Corporation has to organize a lot of awareness programs, especially in schools, colleges.

So obviously, I think this course becomes very important now. And now this is a very important time to understand Solid Waste Management. Otherwise, after 20 years,

when the waste generation will increase in large quantity will be very difficult to manage.

"Professor - student conversation starts" Hello, sir. Sir, there is one question. When we talk about a smart city and a clean city, so in terms of Solid Waste Management, what are the basic characteristics or parameters that we can say which can differentiate a smart city from a clean city? **"Professor - student conversation ends".** That is also a very important one.

The clean city and smart city see when you say the clean city that mostly we talked about the waste-related issue. And a waste-related issue waste is getting collected. But when you talk about smart cities, waste is also including in that. But you need to have a proper communication facility, proper transportation facility, that became the smart city. But now I think need not say the clean city.

There is no importance to a clean city now. You will be a very clean city but if you do not have a proper communication facility, proper transportation facility, there would not be any benefit from such cities. So you need to have, you need to become a smart person or smart city which will have the proper communication, transportation facility, but also need to have a clean city.

So when you say the clean city or the smart city, you need to have a proper collection facility. Is not only the collection facility but also needs to have a proper treatment facility. So not only you just collect it, collect the waste, and get it disposed into the one location. That is what most cities are doing nowadays in India. The waste, the city is getting cleaned, but getting disposed into some low lying area.

And who are the problem people!..? The people residing in nearby those areas are unaware that their water is getting polluted. A lot of air pollution issues are creating problems in those residential areas. So I think and I believe that you become smart or many cities become (41:56) smart only and only when they have proper water supply scheme, proper sewage collection scheme, and proper Solid Waste Management.

Solid Waste Management is collection followed by the treatment and proper remained waste, which is not recyclable and not treatable. That will go to a proper landfill facility. We need to have a proper landfill for that remained waste, which is not useful for any other purpose.