Municipal Solid Waste Management
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Lecture - 02
Functional Elements

Hello students! So, in the previous class, I had talked about the definition of solid waste, which I properly explained about the waste is called an unless and unwanted. And also what are the different issues and some issues related to solid waste management especially in India. And also talked about the different rules about Solid Waste Management, only a few issues.

So, today we will talk about we will just continue the same discussion about functional elements. This is one of the very important lectures, the next lectures will be extended based on today's discussion.

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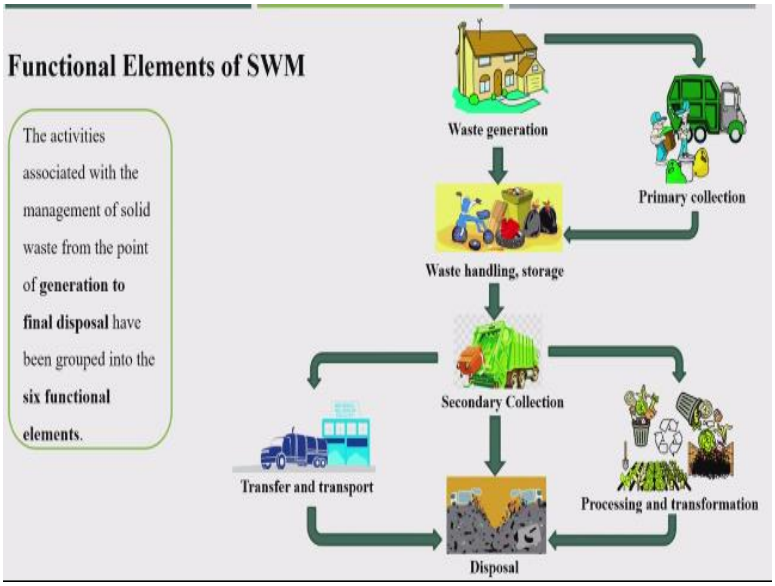

So what are the functional elements? So these, this is the entire activities about Solid Waste Management. We started from the generation to the final disposal, which is the entire activities including from the generation to the disposal site, which includes which grouped into the six functional elements, the first functional element will be the waste generation. This is one of the important functional elements.

Is very important to know about the different sources of waste generation. I just gave one example of the house or household waste. There will be different sources of solid waste and different compositions of different characterizations. This is the very important one to know about how much quantity is getting generated and what kind of characteristics are getting generated.

I will take two lectures on the waste generation because the quantity is also very important called knowing the quantity and volume generated in a particular locality or one particular city or particular country. So then after that once is getting generated at the source, it will get stored at dustbin.

Normally in India, we talked about there are several dustbins is located by the local authorities or ULBs or Corporations very nearby to your house where the households are they need to dispose of the waste into those storage areas that normally we called in the technology is onsite storage of the solid waste. And the third functional element is a collection.

This is one of the very important functional element or one of the important service or system for the solid waste management which includes I think I here put it the two types of collections with the primary collection now under Swachh Bharat Mission in 2014, most of the cities have started house to the house collection system.

So somebody one of the crew members from the corporations or someone from the NGOs, they are coming to your house and collecting the waste that we normally called is the primary collection and they primary collection crew will dispose of the waste into the dustbin area. And from the dustbin the bigger vehicles that can take one ton, two-ton or three tons of waste from those storage areas which will transport or dispose of the disposal area.

And the next functional element is processing and transformation. Now once the waste is getting collected from the dustbin area, the waste will go for the processing or recycling process. A lot of materials like paper, plastic, or recyclable matter that will go for processing and transformation. Another transformation is nothing but the treatment because the biological waste will go for biological treatment.

The dry waste can go for combustion, incineration process, or waste to energy process or RDF process. The other functional element which is connected with the collection that is transfer and transport, because the collection the waste is collected from the dustbins which are located in the entire city. So the vehicle the size of the vehicle will be very small.

Can take one ton, two-ton of waste, but suppose the disposal site is far away maybe around 20 kilometers, 30 kilometers from the particular location. So the cost of hauling of waste, so far the area is very high cost will be required. So for that, we will require one transfer station where the smaller vehicle will load the waste into the transfer station and again reloaded onto the bigger vehicle.

These bigger vehicles can take 10 tons or 50 tons of waste and it will go to the final to the disposal site, where the entire waste is getting disposed of. So if you see the entire functional element is linked together linked to every functional element. So that is what this course called as a Solid Waste Management course.

Is not only the like if you take about in environmental engineering, but we also talked about water treatment, we talked about wastewater treatment. Also, we talked about air pollution or air treatment process, but we never talked about the solid waste treatment. Because treatment is known about only the processing and transformation. But for this treatment, you require a very special kind of collection system.

You will be required a special kind of and for that collection, you need to know the proper generation. So is all the functional elements are related together. Is not only the treatment process, so it required the entire management. So if you want to go for treatment, you need to know the or need to provide the proper collection system also for such kind of waste.

So what I will do now I will go for one by one functional element. I will just give a brief idea of each functional element.

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So first we will start with the waste generation. Now I put it some of the photographs to understand what kind of waste is getting generated. Now, this functional element is a very important functional element to know about the different types of waste or the type of waste generated and also the what are the different sources. So the one photograph is showing the vegetable waste the biological waste.

So obviously this kind of waste the collection system will be different for such kind of a waste because this waste is normally biodegradable. So once it will get stored for the longer period it will produce odor, it will produce a lot of leachates. So a lot of issues will be created from such kind of waste. So should have the proper collection system and should provide for the biological treatment process.

Like remaining the other photograph is showing a lot of plastic and dry matter which is easily recyclable matter and which could be easily possible to get recycled. Also, these kinds of waste can produce a lot of energy or we can have the proper incineration or waste to energy plants. So in these functional elements, we will talk about not only the different sources of different composition also need to know the different characteristics of the waste.

Because of the same waste once it will go for the transformation process or treatment process you need to know a lot of physical, chemical, and biological different characteristics. So based on this characteristic, we can propose a different kind of treatment process before it is going to the disposal area. And also need to know the

total quantity production. And to design the disposal site or landfill site we also need to know how much of the volume of waste is getting generated.

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So once you know the proper generation of the waste we will go for the waste handling and storage that onsite storage. So we would have these kinds of container might in your city also in your urban locality you found similar kinds of photographs, where the corporation is provided such kind of containers. Normally these containers are dustbins called a haul container.

Why haul container? Because this entire container is getting hauled into the onto the vehicle along with the waste. This is the one kind of storage on-site storage. Another kind of storage is a stationary container where containers are not getting hauled off but only the waste is getting hauled off into the vehicle. So here the permanent kind of location. Haul container locations could be a flexible location.

From time to time we can relocate the positions of such kind of containers. But most of the cases if you see in India we have the stationary kind of containers. But now because a lot of money has put a lot of funds also is available with the Corporation.

So now Corporation also because the collection system is cheaper, more easily if you have the stationary container system, which I will talk about the talk on to them when we go for the onsite storage, why it is the very cheaper process or very economical process.

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So now time to time will convert the dustbins like this mechanical dustbin stationary. Now, in this case, waste is getting hauled off, but the entire reloading of the waste from the dustbin is a mechanical one. So because of that the time required for stationary containers also is less and more economical because of having the mechanical collection system.

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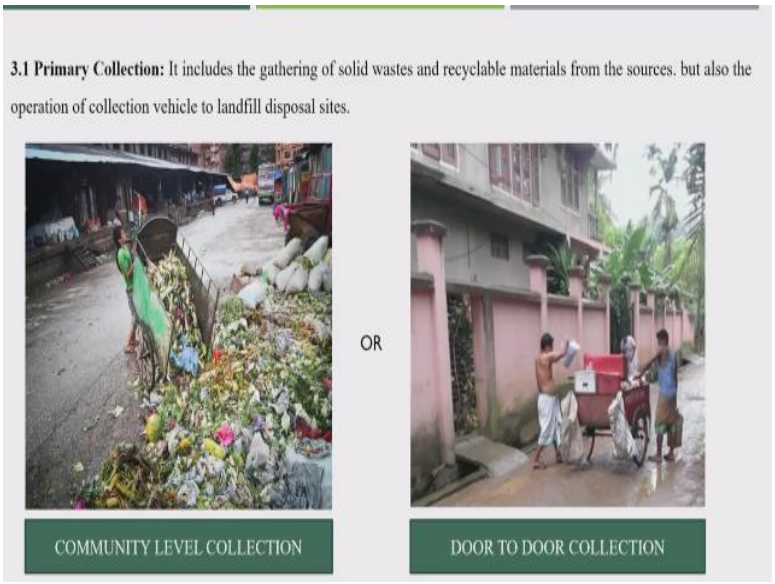

Now the next that the primary collection. It includes the gathering of solid waste and recycled matter from the source. So here I put it two kinds of photographs where we have two types of collection systems. Now if you see these kinds of the house to house collection systems under Swachh Bharat Mission, which has been started. So this is a these are the collection services.

Somewhere in some of the cities, you will find the house to the house collection system. Somewhere you will find where households are responsible to dispose of the waste in some nearby localities. That is a primary collection. So here in this functional element, we will have two to three lectures where we will talk about the different collection services, what are the important issues about this when you finalize any collection services.

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Now the secondary collection will have two types of collection systems. When you go for the stationary container system we will normally find this kind of collection system by the dumper vehicles. And in India earlier I think when we started the waste collection is mostly from the stationary container system because it was a very cheaper process. So waste handling also from the dumper kind of vehicle.

But now because the house to house collection has been started and our collection system is more mechanical way now. So this kind of collection container hauling also has been started. This kind of facility is very good especially the container hauling facilities are very beneficial for where the waste generation is very large. The large quantity and large size of waste are getting produced off.

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So once the entire waste is getting collected, will go for processing and transformation of solid waste. This is one of the most important functional elements in Solid Waste Management where India needs to, India or most of the developing countries need to be more work on these functional elements.

Now here I put it two kinds of photographs where one photograph is showing that because of the waste if you see our waste characterization, we produce a lot of dry matters. And the dry matters are mostly are paper, plastic, rubber, leather, metal, and glass. These all kind of dry matters are easily recyclable, easily we can recycle, but only the problem is that it has to be segregated properly.

Without that is very difficult to get recycle or except glass and metal, this entire like paper, plastic, rubber, leather are highly combustible one. So when you plan for waste to energy plant, need to understand the proper what kind of waste is getting segregated and where. Now, what is happening currently in India where entire waste is coming to the one disposal area and now they are planning for the segregation one.

Was very difficult because any location, if there are 500 to 1000 tons of waste, is coming is very difficult to segregate once it will be mixed with the wet waste. So for wet waste, if it is getting segregated very easily, we can easily go for biological treatment. I put it one photograph which showing the Windrow composting facility.

Now, what is happening in India because we do not have proper segregation at the source so what entirely mixed waste is coming to the treatment facilities or recycling and transfer facility? So what we find we heard a lot of Windrow composting plants in India but was very difficult to run such kind of composting plants. We failed, were not able to produce more amount of or very good quality of compost.

And which was not very sellable also such kind of compost and because of that, I think most of our compost plant have been failed up and was not able to get sustainable for the longer period because the quality was very poor and you know in India, the farmers are getting a lot of chemical fertilizer very easily in the cheaper cost, the cheaper cost with the high nutrient value.

But the production of very good quality or high-quality compost is also very difficult once such kinds of recycling plants are getting mixed waste. So what was has been finalized under the Swachh Bharat Mission in 2014, the waste has to be segregated at the source. So once it is getting segregated at one location like at the household level, there itself we have to finalize the proper collection system.

So your dry waste is getting segregated specially and which is going to the recycling facility and the wet waste is getting separately getting collected and going for the composting plant. So likewise. So in this particular functional element, I will have six to seven lectures or where I will talk about first I will talk about the dry waste. Because India also now discussing waste to energy.

In the 90s, when India thought about waste to energy plants, none of the waste to energy plants was very successful in those days. Because the waste the way we are producing waste does not have a large amount of heating value or calorific value, which was not able to get easily combustible. So the power production also was very difficult from such kind of mixed waste.

But now because our commercialization is increasing more commercial facilities and more amount of dry waste is added into the with the time in India. So now because cities like Delhi, Mumbai, and Kolkata, megacities are producing more than 2000,

3000, or 4000 metric tons of waste per day. And just to have the compost facility is very difficult to depend on to the only composting facility.

The Indian waste or Indian waste is having more amount of wet waste, 50 to 60% wet waste is there. We can have a composting facility. We can produce good quality compost once it is getting segregated but we need to also talk about the recycling or waste to energy or RDF of plants.

In earlier days, I think a lot of RDF plants has been come up in India, but the acceptability of such kind of a waste for as an RDF plant or recycling material is also not so not that acceptable one. So let us see here. I will talk about waste to energy for dry waste. And I will talk about the biological treatment for the wet waste as the segregated waste. And I will give some examples of mixed waste also how best we can go for the treatment of the mixed waste having the composting facilities.

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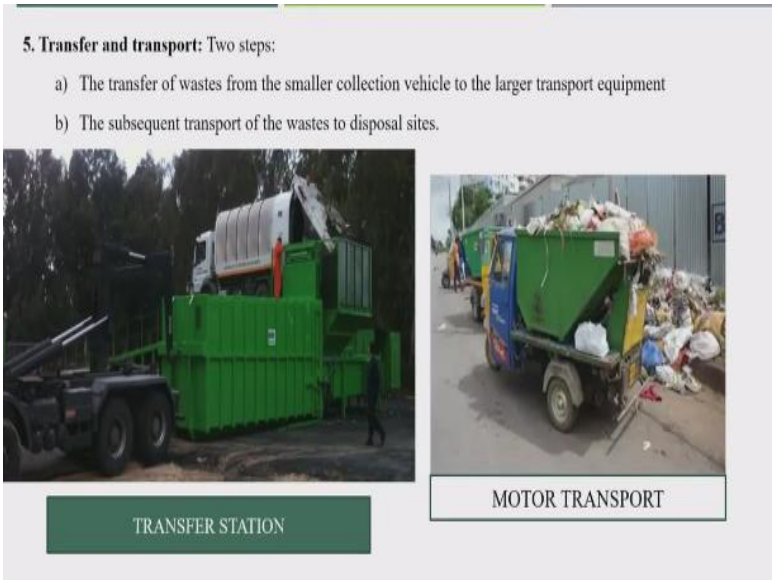

So the next functional element is the transfer and transport, which I already talked about while discussing the flowchart. Because now the cities are growing and the size of the city also is very increasing. So now the location of the disposal site also is far away. So the city like Mumbai, Delhi, Kolkata, Chennai, Hyderabad, Jaipur, Bangalore such cities is located that the disposal area has to be located 40 kilometers away.

So now the current collection system having the smaller vehicle which can take one ton, two-ton of waste is not that economical, because for once you are finalizing for haul container system, wherefrom each location the vehicle has to run from the one dustbin location to the disposal site for 40 kilometers is a very costly process.

So what was the idea about that if you relocate few transfer stations inside the city or some of the outskirts of the city where these smaller vehicles will collect the waste from the dustbins area and will get disposed into the transfer stations. Having this kind of collection we can have the from the smaller vehicle, even the auto tippers, which can take 200, 300, or 500 kg of waste, which are collecting from the household area that also can be disposed into the transfer station.

And from this transfer station, the smaller vehicle will unload the waste into the bigger container and with this bigger container, the waste is getting transported into the disposal area or treatment facility. Now in India also where we are talking about more kinds of transfer stations and under Swachh Bharat Mission and 2016 Solid Waste Management Rule is proposed.

The cities in Indian cities can have the transfer station where because our 90% of the cost is for the collection system only. So how best we will be able to collect the waste, able to collect the waste, based on that we can have the proper treatment facility and proper disposal facility. And there are different ways of waste collection. Could be of motor transport.

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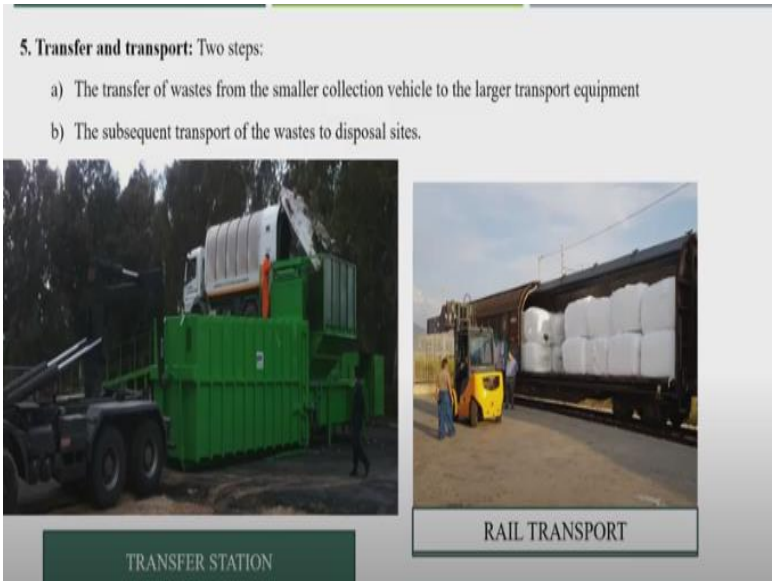

Could have rail transport. Some of the countries have rail transport where waste is getting transported to 200 kilometers, 300 kilometers. Currently, India does not have such kind of collection system, but also in the future when any city is thinking about to relocate the disposal area or treatment facility far away, maybe 200 kilometers, 300 kilometers we can have the rail transport.

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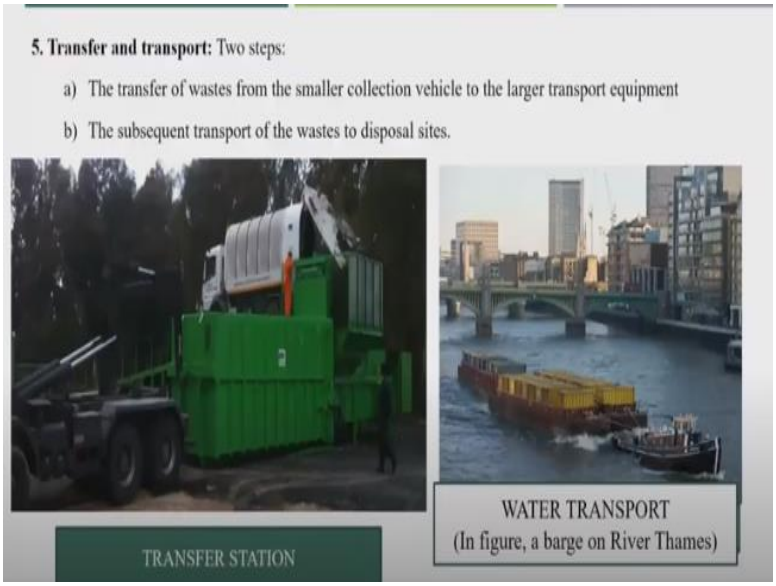

Also water transport. Some of the countries do not have proper the large area of land available and their landfill also or treatment facility also is relocated to some other part of the sea. So has to be transported from water transport.

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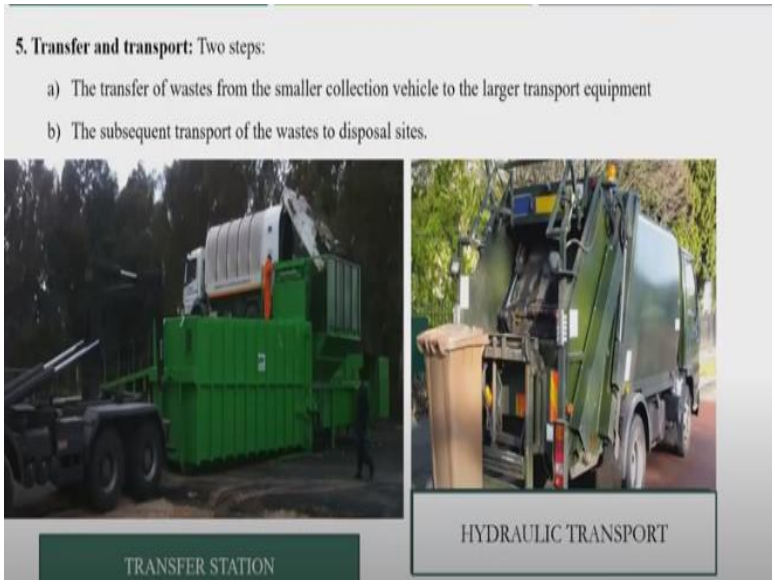

Now because the collection is the most important functional element, so the hydraulic transport also or hydraulic collection system also has been started, which I already talked about the stationary container system. Earlier the entire collection system was manual, but now in India using a lot of different kinds of vehicles where we required the hydraulic system and can collect a large amount of waste through such kind of vehicle.

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Now other pneumatic collection systems, but currently do not have in India pneumatic or diffuse collection system. But in the future some of the localities we can have such kind of collection system.

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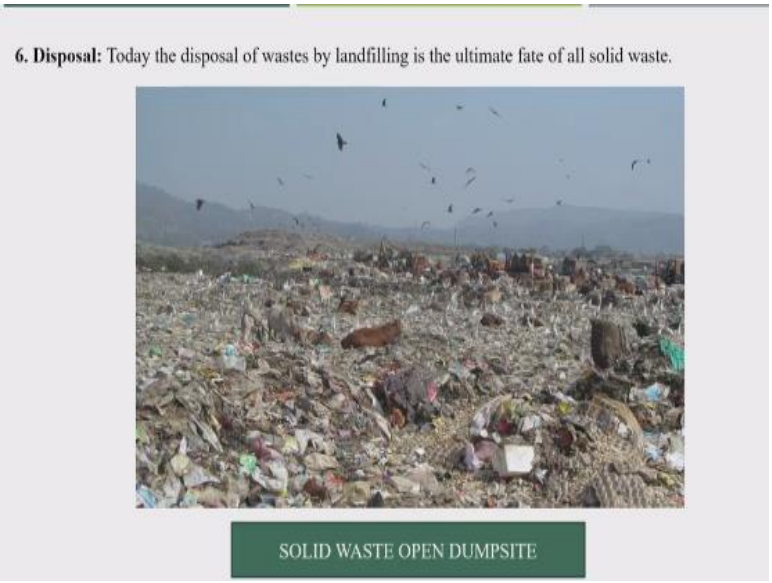

Now, this is the final one. So where waste is getting in the open dump yard. So most of our cities have such kind of dump yards. Normally is very difficult to call them as a landfill and I talked about the different functional element and I was talking about more on to the collection. And most of the Corporation do not have proper financial support.

And they mostly targeted how best they will be able to collect waste from the city. So most of the funds maybe I can say that 80 to 90% of the fund is allocated only for the collection facilities. And to have the proper treatment facility it required proper technology. We have the technology but without having the proper segregated collection system such kind of treatment facility, an operation is very difficult.

We tried a lot of compost plant from last 20, 30 years where we installed some compost plant, but not a current today also we cannot say the not a single compost plant is running very well or getting sustainable for 10 years or 15 years because our collection still we believed that our collection system in the mixed way bases.

But now is good under Swachh Bharat Mission, it was proposed that the waste has to be segregated at the source or the household area and this segregated waste has to be collected very well and get it properly treated and then only it should go for the disposal site. Now I think if you visit most of the city we have the dumpsite in such cases. But now the many cities how started the biomining of such disposal sites.

Recently very successful biomining study has been done in Indore, which became one of the cleanest cities and one city also I remember that in Kumbakonam in Tamil Nadu they have, they have also started the biomining. And now a lot of projects are getting accepted for the biomining of such kind of dumping area. Now because of such kind of disposal system only because a lot of biological waste also added into such kind of waste.

So these biological waste will get degraded. So because of degradation and because of precipitation, rainfall, a large amount of leachate is getting produced off. And this leachate, once it is going to any surface wetland or once it with this leachate, is going to the groundwater is very difficult to treat such kind of water sources. And we believe that the groundwater is one of the purest water is available with that.

So once this leachate is entered into the groundwater is very difficult to treat such kind of pollution in the groundwater.

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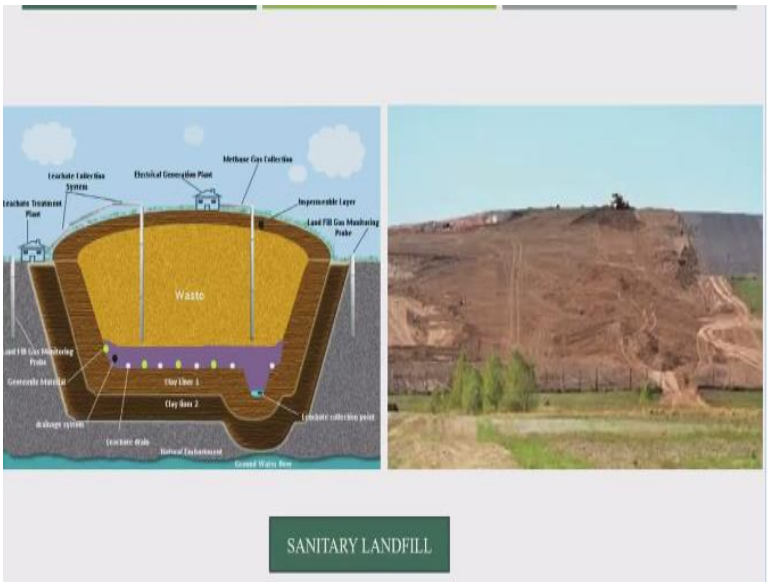

So normally we propose these kinds of sanitary landfills. So once we have the proper segregation in a sanitary landfill, the waste is getting disposed of. And there are two major issues with the landfill area. One is leachate production, the other is the polluted gas production. So leachate is getting properly collected having the clay liner in the bottom and leachate is getting collected and treated properly.

That is one good facility and for whatever gas is producing, so majorly because the entire waste is under the anaerobic condition. So the anaerobic condition the major gases are carbon dioxide and methane. This methane also can able to produce electricity or power from this kind of having a sanitary landfill. And if you see another photograph once you go for proper sanitary landfill and proper lining system, so we would not see the solid waste disposal area.

Once you finally once you close the entire dustbin we will cover with the soil will look this landfill also will look like of proper hill area. So this is all about the functional elements of solid waste management. From the next lectures, we will talk about the one by one functional element. We will start from the waste generation followed by storage, collection, processing, treatment or transformation, transfer and transport, and finally disposable. Thank you.