Municipal Solid Waste Management
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Lecture – 10
Types of Collection System

So hello students. Today we will start the next lecture on secondary collection methods of solid waste under module 5.

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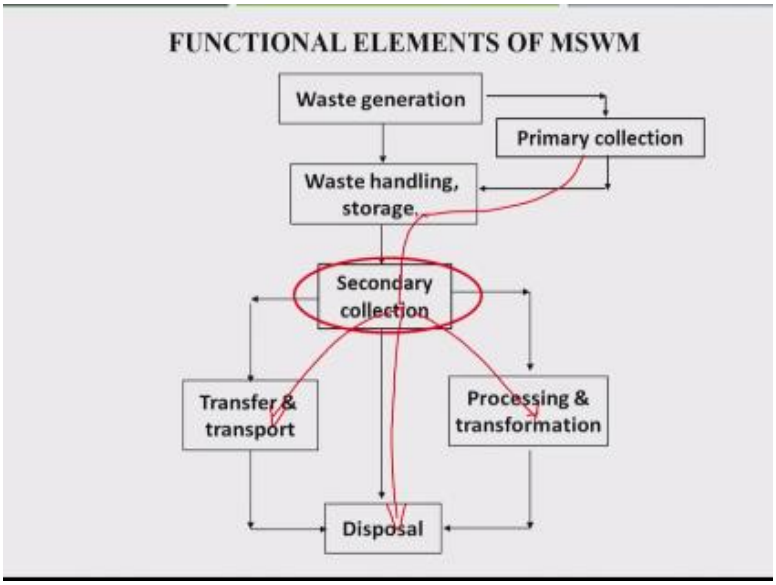

So in the previous lecture, we discussed how the waste generated is collected by the primary collection method and then transferred to the dustbin area. Now, these waste from the dustbins, through the secondary collection, either it will go to the disposal site or the transfer stations or the processing center okay. So, before starting the exact collection systems, I will just tell a few stories about old India. I think we have different changes in the collection systems.

Like the vehicles had been changed. Different vehicles have been used. So this is the different types of collection systems.

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So, in the old India before the introduction of the collection system, it was simple i.e. the old vehicles normally used to collect the waste which we normally used to call it a dumper vehicle. These dumper vehicles are generally used to carry and deposit the construction material and if such activities are not available, those vehicles can be used for solid waste collection.

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So, here this kind of vehicle which was used for the waste collection in older India. So there was no proper formulation of segregation of waste. So the entire waste was combined or commingled i.e. mixed waste used to be get collected.

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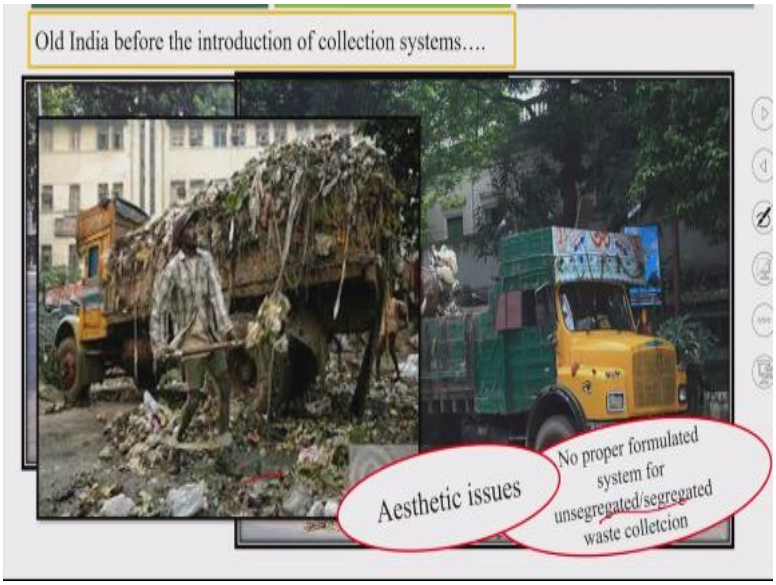

Also as you see, there were a lot of aesthetic issues earlier.

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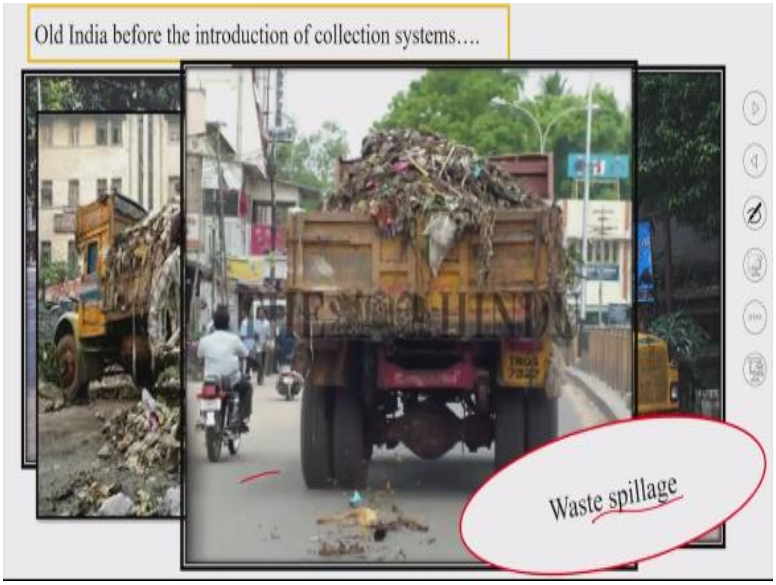

Here, we can see again, waste spillage was also another problem faced during transporting the waste.

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We can also see here that, tractors were to be used for the collection of waste from small cities.

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So the collection rate was also very low as the quantity of waste generated was also not that high. So we used to use this kind of small vehicles.

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But when the Jawaharlal Nehru National Urban Renewal Mission, JnNURM Mission had been launched in 2005, around 35 cities got a lot of money or fund for solid waste management also. And as such most of the class 1 cities, class 2 towns, etc. started the proper collection system. The major focus was given to the haul containers.

Here the idea was that initially, the waste has to be hauled into the vehicle, so the major focus was given to the haul containers in this program. It implies that the entire container used to be hauled onto the vehicle which carries the container for treatment or disposal. As you see here, these are called haul containers and the primary collection method employed was only the curb collection services.

So, the house owner was responsible to dispose of the waste inside the containers. But I think, as you can see, there are certain problems in this process. The local people never used to reach the dustbins rather they used to dispose of nearby. And again along with the vehicle, a lot of manpower used to come and help in collecting the spilled waste near the containers. And then after that, these containers used to be hauled by vehicle to the disposal sites.

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You see it here. The idea to use such kind of haul container system for the waste collection was very beneficial. But there was no segregation of the waste in these kinds of collection systems.

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See here, you can see here there are two dustbins hauled together.

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And here, hauling of the containers which is done mechanically was also an easy process. The only problem, in that case, was that the local people never used to dispose of the waste inside the container because the entire waste gets mixed into a commingled waste. And you see, the quantity of biological waste was also the very large quantity, i.e. around 50 to 60% and because of this, a lot of odor issues and spillage issues used to become up in those days. See here two dustbin container vehicles also had been used to increase the collection efficiency.

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And along with that, some cities did not start the haul container system. They were with the stationary containers only. So in that case, only the waste used to be emptied into the vehicle. So, later mechanization had been started because the time required for

loading the vehicle was very high, and these kinds of vehicles used to be on the road causing a lot of traffic problems.

So the mechanization has been started for the stationary containers also. And you see here, how these dustbins had been loaded into the vehicle. You see here, the mechanization system had been started.

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Now after Swachh Bharat Mission, this same stationary container system had been changed into the compactor vehicles. You see here some of the photographs you can see. As earlier, the vehicle volume was very small and the vehicle used to be able to collect only one ton or at the maximum two tons of waste per trip.

Also, it used to get very costly i.e. hauling the waste or the container simply without any compaction. Because 40% of the waste is a dry matter which is compacted, obviously a minimum of 20% volume will get reduced. So the mixed waste used to be compacted during the hauling process. But that too was also not found to be very beneficial.

So normally these compactor vehicles were able to carry a volume of maybe 7 tons, 10 tons of waste in every trip.

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So you see here the compactor vehicles.

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But the problem with these compactor vehicles was that, as unsegregated material was getting compacted, so obviously when it is 40 to 60% of biological content used to get compacted, obviously there used to be the release of a lot of moisture. And this spillage or leachate, whatever was coming out the after compaction of this waste used to be highly corrosive with pH normally in the range of 3 to 4 i.e. acidic.

And because of that lot of these compactor vehicles got damaged because of corrosion. But if the dry matter is getting segregated beforehand, and this dry matter if you collect with the compactor vehicle that will be highly beneficial.

Because the dry matter like paper, plastic, rubber leather, metal, glass, this could be a compact together and could be hauled. And in a single trip is possible to haul 7 to 8 ton or up to 10 tons of waste in the single trip. But the biological waste, if you use for the compaction that will never beneficial. So, that was the thought under Swachh Bharat Mission.

The segregation is one of the most important factors not only for the treatment process or disposal process but also from the collection point of view it was very important to segregate the waste.

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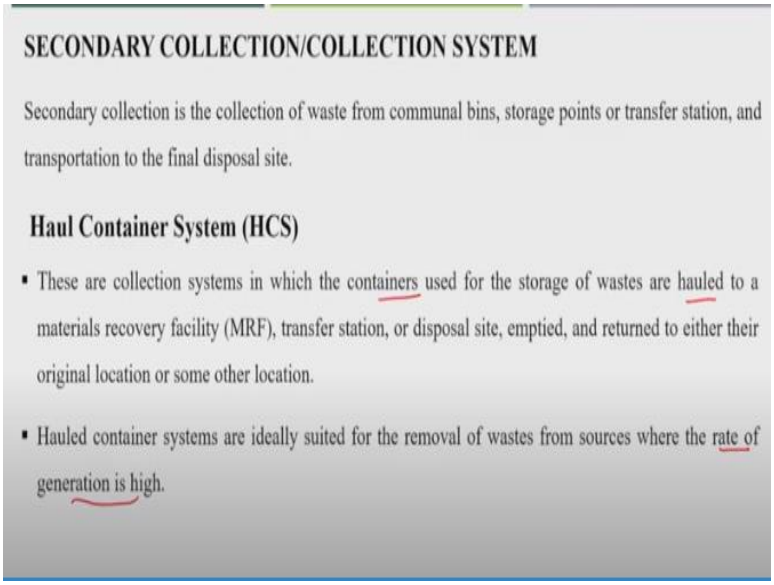

Now we will go for a different collection system employed for secondary collection. So secondary collection is the collection of waste from the communal bin in the curb areas or from any storage point from the apartment or from the transfer station to the final disposal site. So the first collection system is the haul container system i.e. HCS.

So these are collection system in which containers used for the storage of waste are hauled. Here the containers are hauled to a material recovery facility or MRF stations, transfer station, or disposal site, emptied, and returned to either their original location or some other location. So what is the haul container system?

The containers are getting hauled, which is full of waste is hauled to either disposal site or any transfer station or any treatment facility and also returned to the either in the same location or any alternate location. That was the haul container system. And

ideally, this haul container system was highly useful for where the rate of generation or waste generation is very high.

Because when you go for a stationary container system in such cases where a waste generation was very high, you will require large manpower. Also, the time requirement for hauling of that waste was very large.

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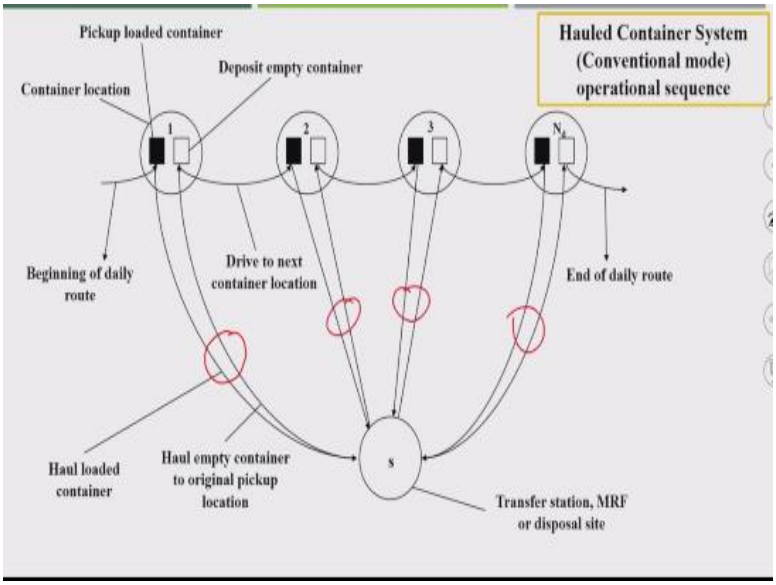

So this is one example I am giving how the haul container system will work. Suppose, you see, here are the locations. So I put the containers in the first location, second location, third, and so on. Likewise, there are "n" number of locations of dustbins or containers inside the city. So a city could have say, 300-400 different dustbin locations. And there will be a one finally where the entire waste or these containers are getting transport to either transfer station MRF or disposal site.

And somewhere in the early morning, the beginning of the daily route will get the start for each vehicle. So suppose now the vehicle will start from their location, first location. It will go to the first location. Now the container is full of waste. This will pick up the loaded container in the first location and it will haul to the disposal site or treatment facility. So that is a full container is getting hauled to the disposal site.

And again once it is getting emptied at the disposal site or treatment facility, it will go to the same location. The empty containers or dustbin will get hauled to the same location and it will deposit the empty container, okay. Now similarly it will drive to the

next container location. Now, the vehicle does not have an empty container. So it will take one full container.

It will get transported to the disposal site or treatment facility. Again it will come back to redeposit the empty container. Similarly, it will go to the next locations. Similarly to the nth location and finally, it will be the end of their daily route. Normally this total time is available that is 8 hours a day. So likewise is a haul container system where the vehicle is visiting different locations.

You see here, in this case, there is a lot of hauling, a lot of hauls. For one location there will be two times it has to be hauled from the location, container location to the disposal site. Similarly, for each location two times likewise. So it was a very costly method. Later, I will compare the haul container and stationary container and then I will explain.

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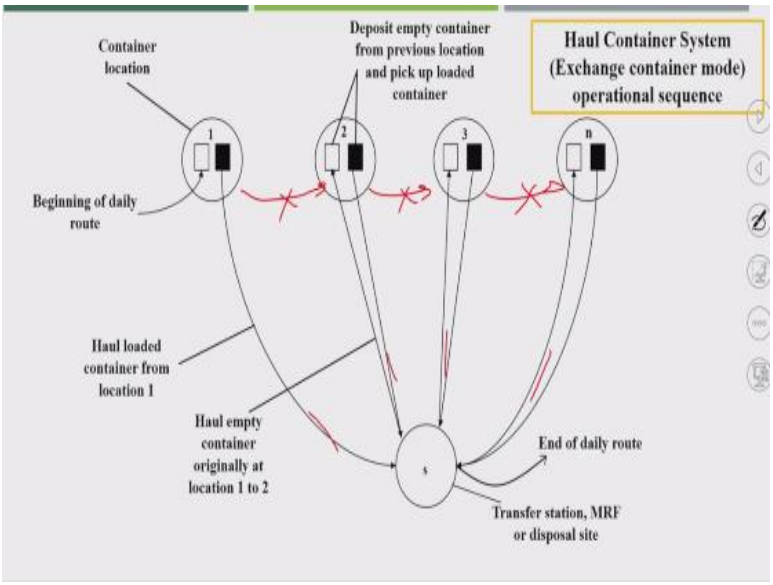

Now suppose the vehicle has one empty container. So before starting from their beginning location, they will have one empty container. So what the vehicle will do, that will go to the first container location. It will deposit the empty container and the full container will get hauled to the disposal site or recycling facility. Now the vehicle in this case again will have one empty container.

Now it will go to the next location. It will deposit the empty container and the full container will get loaded and that will go to the disposal site or recycling facility.

Similarly, nowhere again the vehicle will have one empty container with the vehicle. It will go to the next location and again it will come back with the full container.

Similarly, it will go to the nth location and finally, again the vehicle will have one empty container and it will finish their daily route. So now here you just compare both the alternatives. Here you see that in this case, when the vehicle will have one empty container along with it, the vehicle need not to travel from one location to the next location.

Now you can understand that the vehicle doesn't have any requirement for this transportation from one location to another location. So here it is possible that this entire hauling could be planned in on highways or bigger roads so that the traffic issues and the time required to reach the disposal site or treatment facility isn't very high.

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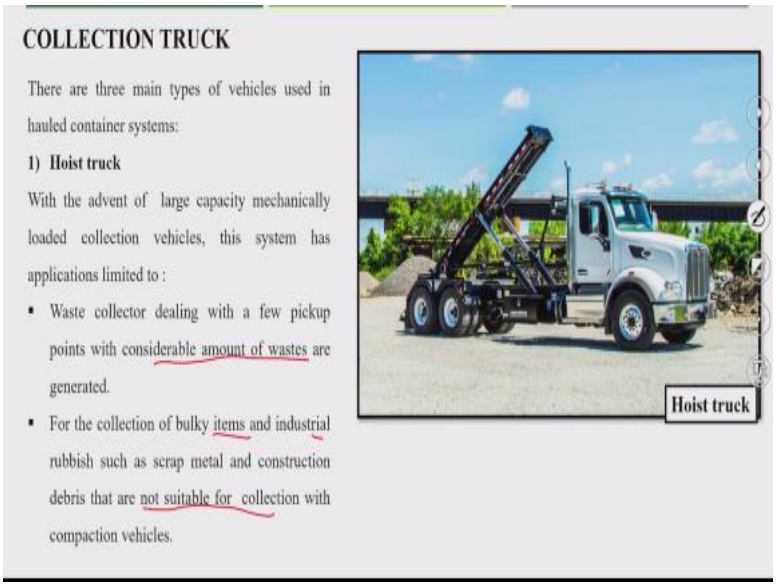

Now there are different kinds of collection vehicles used to be used for the haul container system. There are three main types of vehicles. First is the hoist truck. You see in the photograph of the hoist truck. However, the application of mechanically loaded collection vehicles with large capacity is limited for the areas where a considerable amount of waste is generated.

We can finalize the different sizes of containers in this vehicle. Like for the collection of bulky items or industrial rubbish such as scrap metal which are not suitable for collection with the compaction vehicle. So in that case, a hoist truck is more beneficial.

Or say, for hauling of large size material/ bulky materials, such hoist trucks are found to be more beneficial. Wherever the waste generation is more these kind of vehicles was highly beneficial.

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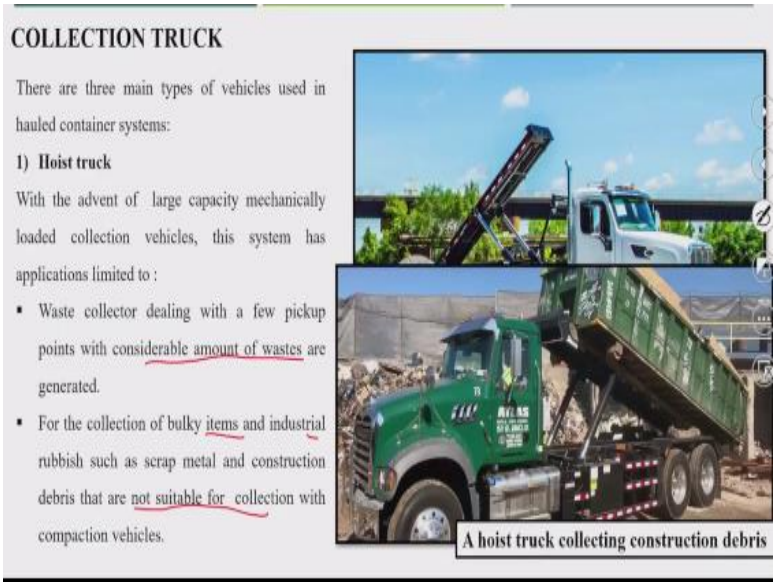

See here another hoist truck collecting construction debris.

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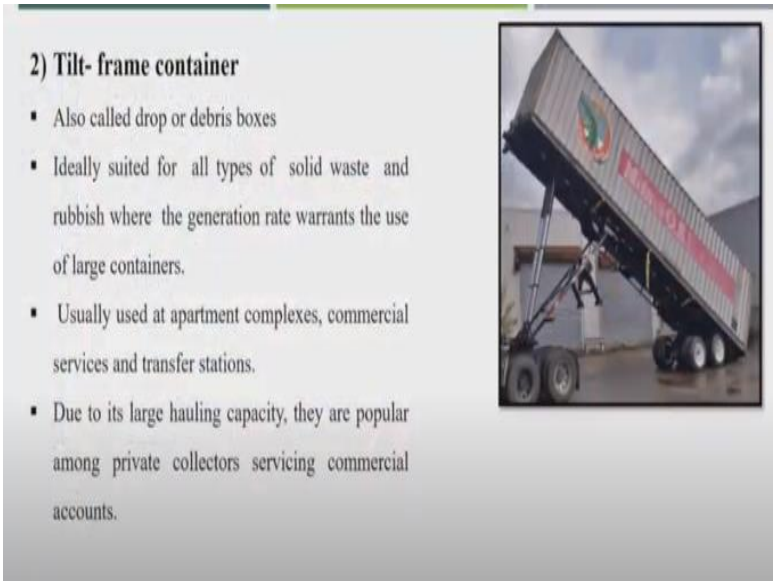

Now, this another vehicle that is called a tilt-frame container. Now, in this case, you can see the entire back frame is getting tilted. Unloading is very easy from this kind of vehicle. So, this is ideally suited for all types of solid waste, rubbish where the generation rate warrants the use of the large container. So wherever the waste generation is very large you can have this big size of the container.

And the idea is that the beneficial property of this kind of vehicle is that it has a tilt frame. So once it will reach to the disposal site or recycling facility, unloading gets very easy because of having a tilt frame. Usually, these type of vehicles is used in the apartment complex, commercial services or transfer station where different kind of waste is reaching and the quantity is also very large.

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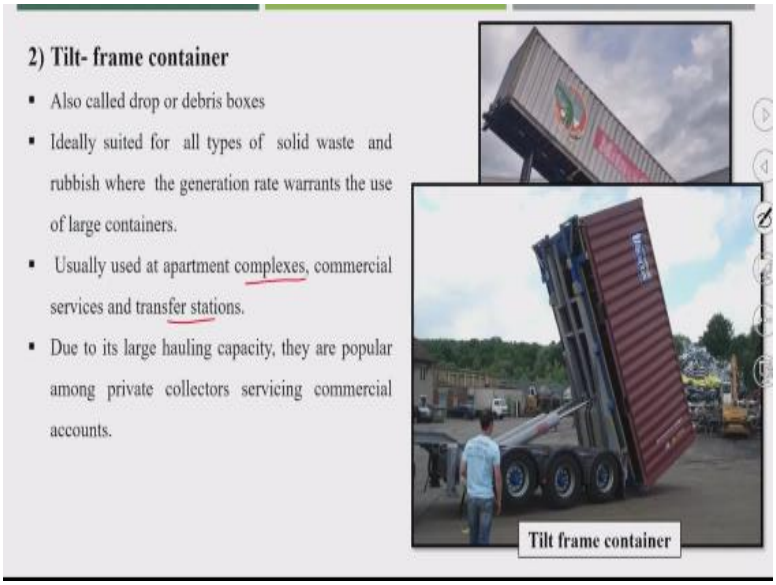

So you see. Here is a tilt frame container that can rotate up to 80 degrees angle.

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Now next is the truck tractor trash-trailer. Now here as you can see, one special trailer is available in this vehicle. So that is specially used for the heavy rubbish, large size material, the sand, timber, the metal scrap. Especially for the collection of inert material

such as soil, sand, or even construction and demolition waste, these kinds of vehicles can be used for easy transfer of waste.

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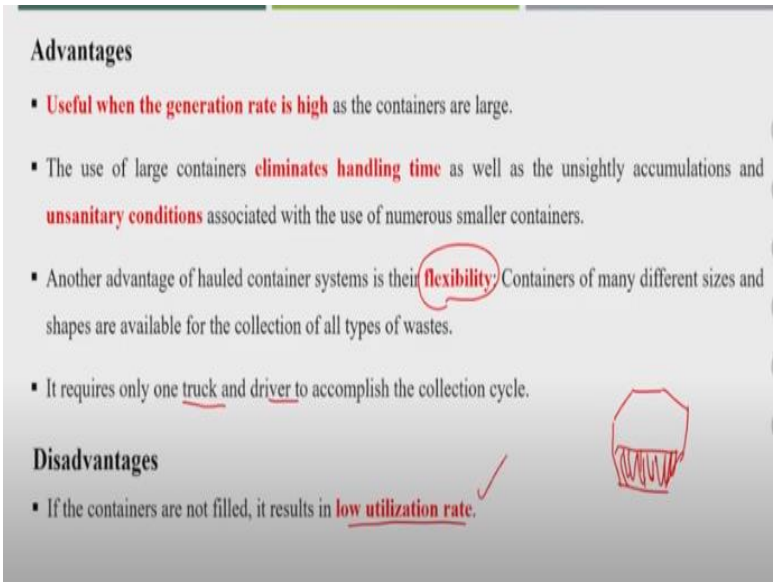

Now, what are the advantages of haul container system? So, as I was telling that when generation rate is high, these kinds of collection systems are highly beneficial.

So it is possible that the entire city if you are planning for depositing the dustbins, you know that wherever the waste generation is high especially from the commercial area or market area, wherever vegetable markets are there or other markets are available in those locations, we can plan to have haul container system. And we can have a bigger size of containers.

These containers could be hauled onto the vehicle very easily. Next, the use of large containers eliminates handling time as well as unsightly accumulation and unsanitary conditions associated with the use of numerous smaller containers. The advantage of these kinds of haul container systems is also that supposed if you are going for stationary container locations, so obviously you cannot use the big sized containers.

So you will have several locations and these locations used to be very nearby. So obviously, that would not be much beneficial because nowhere in the haul container system, the containers are getting mechanically. But in the stationary container system, even though mechanization is possible but because of the small size of container or small quantity of waste, a lot of unsanitary conditions could develop in those cases.

Now, another advantage of HCS is its flexibility i.e. the location flexibility. Now see here when you go for stationary container locations, some I think the way we are putting the containers in those locations that are almost permanent locations. And if you are putting containers, and if you are constructing some kind of constructed area, that location changing is very difficult or is impossible to change.

But now, here in the haul container system, we are using the large size of containers, the location of which we can easily change, i.e. location is flexible. So based on the experience of the local authority, from time to time they can change the locations if they have the haul container system.

Suppose somewhere, you are getting a large quantity or more volume of waste than that available in the container. And somewhere else, you are not getting that kind of waste volume, so obviously, you can change the locations in such a way that all the locations, the good amount of volume you are reaching to fill those particular containers.

So this is another advantage. And also another advantage is we need only one truck and one driver. we do not require more manpower because it is a mechanized system. So the driver alone can connect the containers to the vehicle and can easily unload onto the vehicle. So we do not require much manpower in this case.

But if you compare with the stationary container system lot of manpower is required even if you go for mechanized loading of the waste. And only one disadvantage is that low utilization rate. And this is the major issue with the haul container system. Because how the corporation is finalizing these locations? Based on their experiences, experiences from the last 5 years or 10 years.

So wherever they know that the waste generation is more or wherever the population is very large, or wherever the commercial areas are available, they thought of that, to find some locations nearby. But many places it is possible that they have the haul container facility, but I think those containers are not getting filled up properly. So suppose I think I am just making one container here so that you can understand.

So suppose this is one container, available in one of the locations. And the vehicle is coming by around seven early in the morning to pick up this container. And suppose this container is filled only half with the waste and the waste is having biological matters. So still the vehicle has collected this container. So your utilization rate is only 50% because the remaining container is not filled up.

So obviously, it will result in a low utilization rate. If you want to increase the utilization rate, you need to find out the proper locations and this is very difficult to find for the local authorities also because nobody wants these kinds of dustbins near to their house near to their locality. especially if we have schools, colleges or some civil areas, hospitals, etc. nearby, you will find it very difficult to find some suitable locations.

So obviously, the dustbin locations will be far away somewhere. And if you are providing curb collection services, people do not want to go more than 200 meters, 300 meters to deposit the waste. So, in that case, it is possible to find a lot of new unauthorized waste storage, we will find it in the local area. A lot of spillage issues will come up in that case as well.

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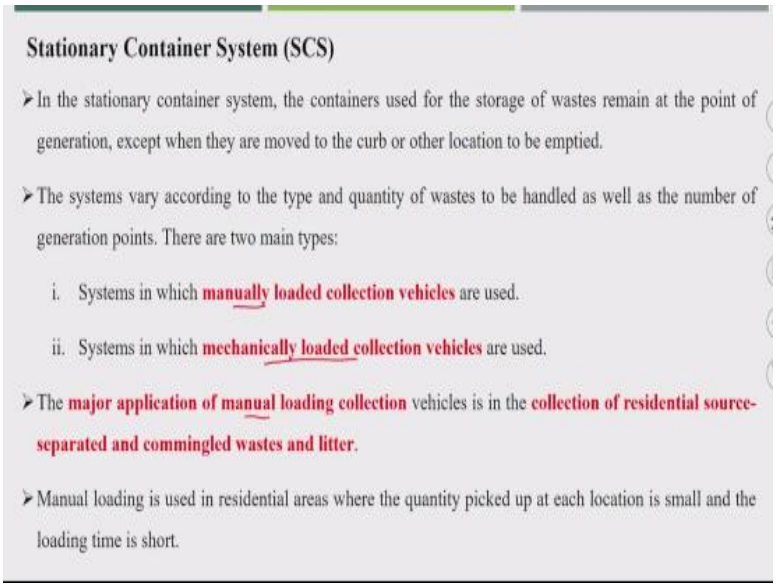

Now the next is the stationary container system. We see that the benefits of the haul container system. Now we will go for the stationary container system. In the stationary container system, the container used for the storage of waste remains at the point of generation except when they are moved to the curb or other location to be emptied.

This system may vary according to the type and quantity of waste to be handled as well as the number of generation points. So here I think I can say one of the benefits is that we need not think about the size of the vehicle and the size of the container because is a stationary one. So whatever the size of the container, whatever the amount of waste available, based on that we can finalize the vehicle and the size of its containers as well.

Normally, we will have two main types of collection systems. One is manually loaded, where the loading of waste is done manually and the other is mechanically loaded which I had shown in the compactor vehicles. The major application of manual loading collection vehicles is that- when there is a requirement of the collection of residential wastes in a segregated manner to avoid commingled waste and litter.

So I think I can say, one of the benefits of a manual loading collection system is that in this system it is possible to segregate the waste into dry waste and wet waste. Now, this dry waste and wet waste if manually loaded will be very beneficial. Because of the segregated matter itself, we can load into the vehicle in a segregated way.

But mechanically it will be very difficult to segregate the waste and then load it into the vehicle. So the manual loading is used in the residential areas where the quantity picked up at each location is small and the loading time is short. So a small quantity of waste is generated. There needs not to have a haul container system. The small residential area where the quantity waste generation is low. So obviously you will be required small and the loading time will be required.

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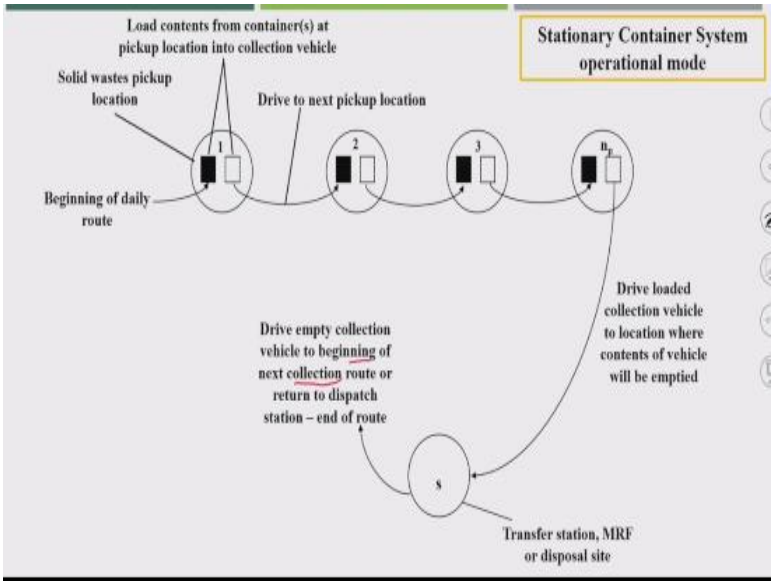

Now, another example of this stationary container system. Similarly, if we have "n" number of container locations and one disposal site or transfer station is available. Now the vehicle will start the daily route. It will go to the first location and will load content from the container at pickup location into the collection vehicle, okay. Because here container is not getting loaded.

Here the waste is getting loaded either manually or mechanically and that dustbin will be empty in this first location. It will go to the next pickup location. Again it will do the same thing. It will empty the entire waste and will be loaded into the vehicle. It will go to the next location. Similarly, it will go to the nth location or whatever location where the vehicle got full completely.

After that, it will finally empty the entire waste to the disposal site or recycling facility. And suppose that again the time permits it will start the next route. Or if the time will get over from this it will go to the same dispatch center of that particular vehicle.

So is a drive empty collection vehicle to the beginning of the new or next collection route or return to the dispatch station. That is the end of the route. So this is a collection route for the particular vehicle.

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So you will see here, a side loaded vehicle. Here loading is done manually sideways. So these containers are getting unloaded into the vehicle. We get a mixed waste here. However, even segregated waste also we can have two different locations where dry waste, the wet waste we can segregatedly we can load it into the vehicle.

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This is rear loading, the backside loading.

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Here is a manual loading or mixed waste from the rear-loaded collection vehicle. And it is having the compaction facility, the waste is getting compacted.

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Here another.

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As you can see here, the truck is getting mechanically loaded. Earlier, we saw a truck with a manually loaded facility. Now here, we can see rear-loaded mechanically loaded loading facility.

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Here side loading facility mechanically.

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Here is one of the photographs from India, Haryana.

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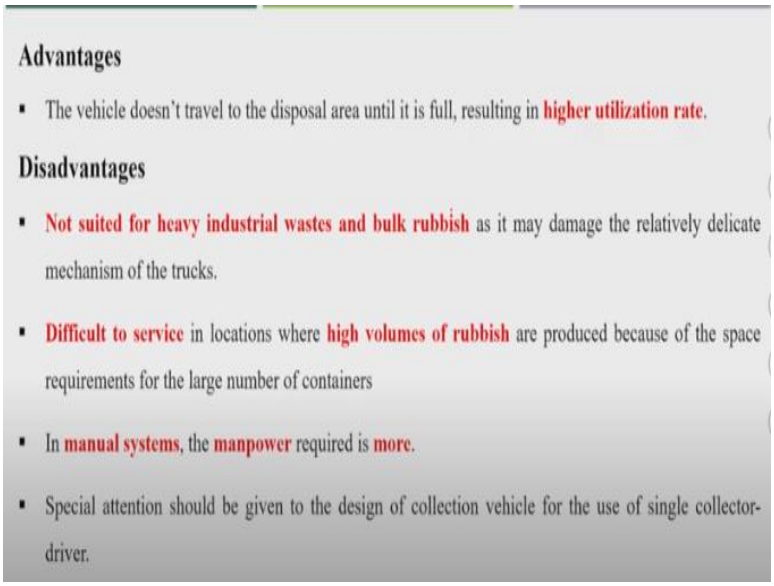

Now, what are the advantages, advantages of this stationary container system? The vehicle does not travel to the disposal area until it is full resulting in a higher utilization rate. That was one of the disadvantages of the haul container system. But here that is the major advantage of this kind of collection system. The vehicle does not travel to the disposal site until it is full.

It means, your hauling cost is very low in this stationary container system. So because of that only, in India, most of the city still uses the stationary container system because hauling is not that much. Because of that, this is more economical compared to the haul container system.

But there are a lot of disadvantages, which I already talked about some spillage of the waste. So it is not suited for heavy industrial waste and bulk rubbish that could damage the vehicle. Even compactor vehicles also cannot be used for industrial or bulky rubbish or especially construction and demolition waste. In that case, we need to have a haul container system.

Next is difficult to service in the location where a high volume of rubbish is produced. This stationary container is beneficial for a small quantity. A small residential area is possible, where the time of collection also is not that high. And in the manual system, the manpower required is more. When you go manually that is beneficial for the segregated waste collection, but the manpower requirement is more in this case.

And special attention should be given to the design of the collection vehicle for the use of a single collector driver. So if you go for a mechanical collection system mechanized one needs to have the proper driver or proper manpower for such purposes.

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Representative data on the capacities of containers available for use with various collection systems

Vehicle	Container Type	Container capacities (yd^3)
Hauled container systems		
Hoist truck	Used with stationary compactor	6-12
Tilt-frame	Open top, also called debris boxes Used with stationary compactor Equipped with self-contained compaction mechanism	12-50 15-40 20-40
Truck- tractor	Open-top trash trailers Enclosed trailer-mounted containers equipped with self-contained compaction mechanism	15-40 20-40
Stationary container systems		
Compactor mechanically loaded	Open top and enclosed top and side loading	1-8
Compactor, manually loaded	Small plastic or galvanized metal containers, disposable paper, plastic bags	20-55(gal)

Now here, one more comparison can be made among the containers available for use with the various collection system. As you can see, I have assigned different types of containers for different types of vehicles. These three are for the haul container system. And these two are for stationary container system. So here see the capacity. Here especially the tilt-frame, the capacity is very large.

And if you see the stationary container system in both the cases whether you go for manually loaded or mechanically loaded, both the cases the capacity is less. Even if you go for truck tractor, here also you can feed more quantity for the capacity vehicle. So there will always be a discussion on when to go for haul container system, when to go for stationary container system.

The basic explanation of both the container systems is both are highly beneficial. The major idea is that when the waste generation is very large and the bulky items, construction, demolition waste for that, in that case, go for haul container system. And such residential areas where waste generation is low and you can have the manual or mechanical, i.e. both facilities could be possible.

Therefore, the places where the manual collection is possible and the quantity of waste is less, you can use the stationary container system. This is the simple way in which we can finalize and one city could have both the collection systems. It is not necessary that the entire city must have the haul container system.

Actually, what has happened in JnNRUM program 2005, 2006 when the 35 cities got a good amount of funds, they started the haul container system for the entire city. And they never thought of the utilization rate. Some of the location they were very happy because their large amount of waste is getting generated. But most of the locations where a waste generation was low there unnecessary they were hauling that entire container to the disposal site.

That distance used to be 15 kilometers, 20 kilometers. So large amounts of fuel cost used to get added up to the whole collection of such kind of containers which are partially empty. So, it is possible that for some locations we can have a haul container system, and for some locations, we can have a stationary container system, okay. And in the next lecture also we will go for some examples.

Haul distance means the distance from the location of hauling to the disposal site or recycling facility. Based on that how best we can finalize the benefits of haul container system or stationary container system that will go in the next lecture. Thank you.