**Urban Service Planning**
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**Lecture 22**
**Primary and Secondary Waste Collection Part II**

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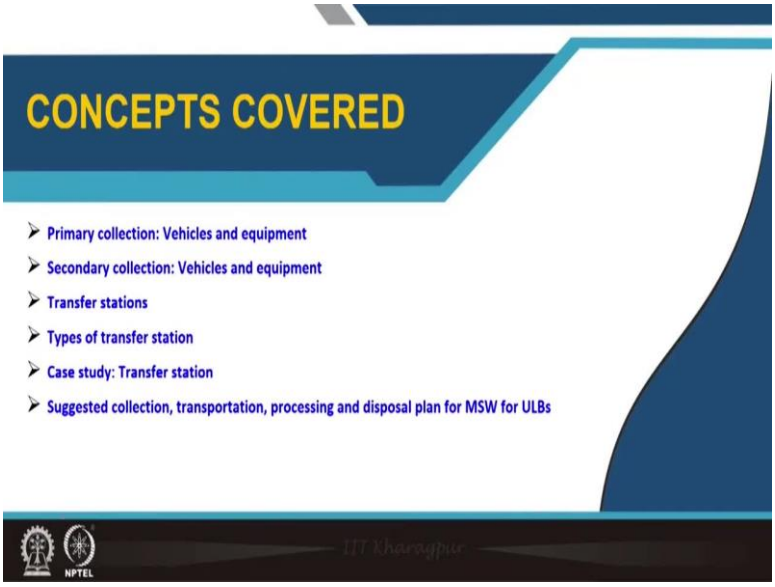


Welcome back. In lecture 22, we will continue with primary and secondary waste collection. The different concepts that we will cover are for primary collection vehicles and equipment required, secondary collection vehicles and equipment, then we will talk about transfer stations, types of transfer station, some case studies on transfer station and finally suggested collection transportation processing and disposal plan for MSW for ULBs as per CPHEEO guidelines.

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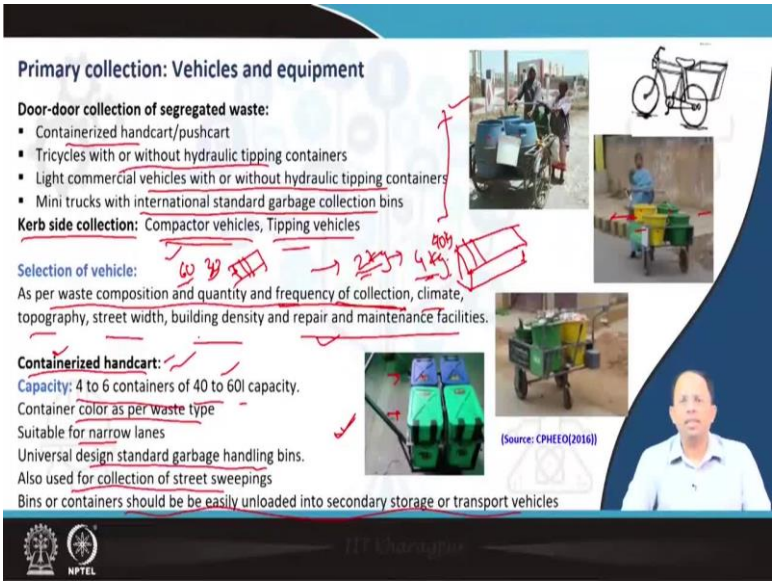


So, as we have already discussed that door to door collection or general primary collection, we go for different kinds of collection systems one of them is of course, door to door collection within primary collection and door to door collection usually takes place for segregated waste and there are different types of vehicles which are utilized for this.

Either we can go for containerized handcart, or tricycles with or without hydraulic tipping containers, that means tricycles but at the same time they can tip or they may be just fixed containers. Light commercial vehicles with or without hydraulic tipping containers or mini trucks with international standard garbage collections.

So, again mini truck is a little bit maybe have larger size than the light commercial vehicles and also they have got instead of this tipping containers they have got separate bins within that and then the bins is gets filled as for different kinds of segregated waste.

Now, this is for door to door collection, but for Kerb side collection if there is that kind of a system then compactor vehicles are utilized. Some tipping vehicles can be utilized or if like door to door collection or block collection we can go for this kind of vehicles for Kerb side collection we can go for this kind of vehicles. Even for community bins collection also we can go for this compactor vehicles or tipping vehicles.

Now, selection of vehicle, as we have discussed earlier as per waste composition and quantity and frequency of collection, climate of that area, topography of that area, street width, building density and of course repair and maintenance facilities for those kind of vehicles. If

this repair maintenance facilities does not happen is not there, then there is no point of buying that vehicle.

Similarly, the frequency of collection, we have to may actually make a choice on how frequent we should collect and also the vehicle design this should go hand in hand. For example, if I tell you that I collect waste every two days, that means obviously the waste content would be doubled.

So, that means if a normal household generates 2 kilograms of waste, then if it collects every two days it will become 40 kilograms of waste then what happens now suppose the capacity of that particular vehicle is 50 kilograms or 40 kilograms suppose.

So, that is after 10 houses this vehicle will get filled, because each house is generating 4-4 kilos then it has to again transport take this vehicle back to the secondary storage and unload the vehicle and then again come back. If the distance of the secondary storage is too far away, then you lose a lot of time.

Instead, if you could have done daily connection, then there are 2 kilograms of waste per house. So instead of 10 houses you will be able to collect from 20 houses. So, in that case, the time spent on collecting waste is more than the traveling time of the vehicle from that particular area to the transfer station.

So, we have to make these choices right what should be the frequency then the other problem is waste that is generated like organic waste, maybe 60 percent the inorganic waste maybe only 30 percent the rest is hazardous waste or mixed waste.

So, in this case, the organic waste is double. So, if I design a vehicle which has got to equal divisions the two equals one segregation in between that container, then of course the organic waste part will get filled faster, because it is double that the inorganic sorry than the you know non-biodegradable part.

So, this all this needs to be considered right. So accordingly we have to take a call on what how many divisions I need to make, what should be the design of that container and so on. So usually we see that for containerized handcart when we use handcarts, we go for containerizing it or we put multiple containers.

Now, if the waste is 50-50 that is organic waste and biodegradable waste and non-biodegradable waste is 50-50 then we can put 2 containers of biodegradable waste 2 containers of this non-biodegradable this, but if it is not 50-50. In that case accordingly we have to design or we have to select that so, many containers of organic waste so, many containers of non-organic waste right?

So, in roughly what we see in containerized handcart usually 4 to 6 containers or 40 to 60-liter capacity is actually utilized. So, container color is as per the waste types as you can see in this image is all these images you can see like over here there are 3 blue containers over here there are 2 yellow to green in this case yellow is actually green is for organic yellow is for this was earlier than before the rules came in.

So, then in this municipality body they used to have green and yellow, then the current rule states that we have to have non-biodegradable in blue and biodegradable in green accordingly this is the final specification, but earlier we used to have this kind of colored containers. But you can see that there are 4 containers some places there are more than four.

So, we have to decide on how many containers of what size and so on and that size should be such that a person can easily handle that that means he can usually be lifted by his hand or we have to design the countenance in such a way so that those would be mechanically lifted. So suit the containerized handcarts are suitable for narrow lanes.

The design of standard garbage handled the garbage bins should be standard sizes so that they could be handled by mechanical systems. And also this could be used for collecting street sweeping. So we can use this kind of handcarts for also collecting the street sweeping waste that is generated. Bins for containers should be easily unloaded into secondary storage or transport vehicles.

So, these are some of the criteria for determining what should be the design of a container is handcart should be.

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Then comes try cycles. Now, as you understand this could be a little bit bigger in size, because here we are using a mechanical system, so that people can pedal and can carry it. So instead of pushing it, so here the size of the vehicle is a little bit larger and also the amount of load you can carry is also a little bit larger. So 6 to 8 containers or 40 to 60 liters capacity, these are faster than handcarts, sorry, handcarts and allows carrying of larger quantity of waste to for a longer distance.

So if the transfer station is a little bit far away, then probably will go for this kind of handcarts and this kind of tricycles and of course, here what happens there is a person who will drive the tricycle and then there is another person who facilitates the collection of waste from the door to door and then putting it back right so or even that maybe 2 persons collecting and one person driving the vehicle.

Whereas for the handcart there could be only 1 or just 2 persons, so that means as per the vehicle the manpower also changes. So sometimes these tricycles can have a hydraulic tipping container, instead of just standard bins and also like you can see over here there is a hydraulic tipping container instead of just simple bins or usually the containers were made a mild steel, they are epoxy painted.

And size of is something around 350 liters, which carries around 140 kilograms of waste per trip, what that means in the normal handcarts, maybe we can carry around 78-80 kilograms of waste. Whereas over here, we can carry a little bit larger, which is 140 kilograms of waste.

Then comes LCVs many trucks with hydraulic tipping containers or they can be without tipping containers as well, but usually we design it so that they could be easily unloaded and all. Again this kind of vehicles can only work at least 5 meter road with is there if it is less than that we will possibly go with tricycles.

Capacity is much larger than tricycle 600 to 900 kg per trip unlike 140 kg per trip so that you can understand that you can cover many, many buildings and all or many collection points. So what it means is that if the density is low, then probably it is better to go with LCVs because that there is significant travel involved in between the collection points.

Or suppose you are collecting the garbage from community bins then also probably LCV is better than a tricycles. But usually when we collect from garbage bins we usually send even larger vehicles. So size up to 3 meter cube capacity, load height is load it is very important because if it is too high then it is very difficult for people to throw the garbage inside.

So load it is around 1500 millimeters from the ground level some people also say 1.6 meter is the maximum height container is mild steel body with drainage tube and plug to prevent leak because it is a container, the moisture is there moisture will try to come out during transport. So, there has to be some sort of system. So, that eventually this will be drained out when it is taken to a cleaning facility or to the final storage facility.

So, that is why our drainage tube as well as a plug is there to prevent leakage along the way. The tipper is attached to the chassis and 4 openings as you can see over here, there are 4 openings on 4 sides. And this actually helps to usually pop this usually facilitates people to put in the waste directly and central removable partition which is first.

So that waste to be segregated, waste could be carried like dry waste and wet waste would be carried in different partitions. So, this is how this kind of system looks like and you can see over here this auto rickshaw or this with this small, this lifting this particular hydraulic tipping container is over here and it is directly the waste is put and the design it says that the waste would be directly transported into the metal container or this secondary storage container.

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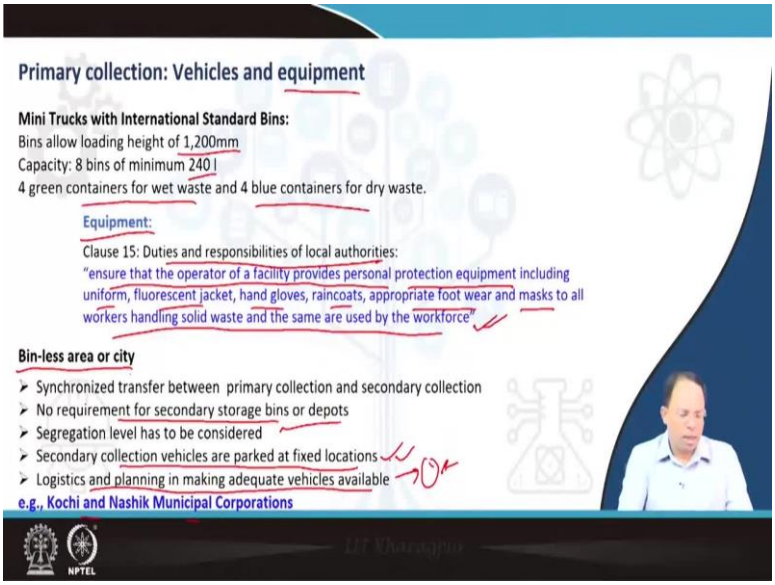


So, then also we can go with mini trucks with international standard bins. So, the loading height is even lower over here because we are using bins and capacity of bins is 8 bins a minimum 8 to 40 litres sizes and 4 green containers for wet waste for blue for blue contains for dry waste again this could be as per the kind of waste that has been generated in that area.

Now coming to equipment for primary collection or just for this kind of systems not only vehicles we have to also think about equipment's as per clause 15 of MSW rules duties and responsibilities of local authorities. It says that ensured that the operator of a facility provides personal protection equipment including uniform, fluorescent jacket, hand gloves, raincoats, appropriate footwear and mask to all workers handling solid waste and the same are used by the workforce.

So, this kind of equipment has to be mandatorily provided as per MSW rules 2016. Now, when we talk about this primary collection, there is one concept called bin less area or city that means as we are discussing all in the previous lecture, then we can synchronize that transfer between primary and secondary collections. So that there is no requirement for secondary storage or secondary storage bins right or secondary storage depot.

Now, why that means the primary collection vehicles will come as I was showing you in the last slide that the primary collection try this auto rickshaw will come they will till the garbage directly into the bin and the bin would be taken away by the waiting vehicle. So, so, that

means there is no requirement for secondary storage, secondary storage collection vehicles are parked at fixed locations.

So they are waiting and logistics and planning and making adequate vehicles available. That is the biggest challenge that means, we have to have a lot of secondary storage vehicles available all the time and we have to really plan that that is when the garbage is going to come from primary collection and what is the timing of the secondary storage vehicle to come over here. So all this logistic planning has to be done.

So, some cities have tried this like Kochi and Nasik Municipal Corporation has tried this but obviously this will increase the size of the secondary collection fleet. Now, that is not good because secondary collection vehicles are larger more you know you have compactor vehicles and other kinds of expensive vehicles.

So it will increase the cost of waste collection. So that is another thing that we have to be considered about but the benefits are obviously there is no spillage, there is no unsightly areas, everything looks nice and there is no contamination of any kind. So, that improves the health of the urban area, segregation level also has to be considered.

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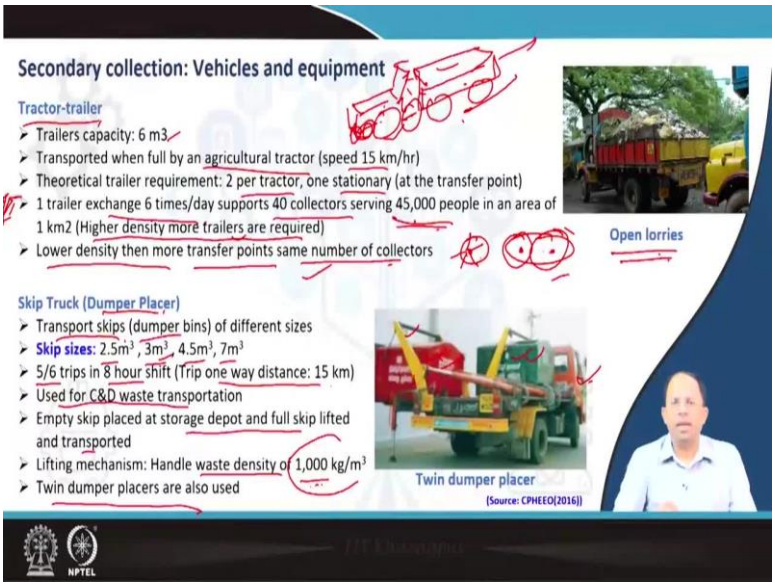


Now coming to secondary collection vehicles and equipment of course these are larger, vehicles. The basic system is a tractor trailer system which is still found in many, smaller cities or many semi rural areas where usually we have a agricultural tractor, as we know that

it has got 2 wheels and this tractor is employed there sorry, the wheel comes over here and then there is a trailer at the back.

This trailer is loaded and for every tractor there could be multiple trailers that means one trailer is remains waiting at the secondary storage point. And this tractor comes in, puts the empty trailer and takes the loaded trailer to the landfill site unloads it and again brings back the empty trailer so that that is what goes on.

So, usually trailer capacity is around 6 meter cube transported when full by when full the when the trailer gets full it is transported by a tractor speed is something around 15 kilometer per hour because tractors are not designed for traveling fast, but they can use usually landfill sites in this kind of areas they are more very undulating terrain and all so attracted can easily negotiate that.

Theoretical trailer requirement is 2 per tractor one stationary at the transfer point as we have just discussed and the other is in the travel other is actually being transported to the landfill site. One trailer by this can vary, but we can say that one trailer can be exchange 6 times a day it can support at least 40 collectors, waste collectors from the primary collection, serving around 45,000 people in an area of one square kilometer.

So, this is just, this is a very specific case you can take it as a case study. So, for 45,000 people 40 waste collectors are required, all this waste collectors bring the waste to the secondary storage area, which is a trailer with a waiting trailer and the trailer is exchange 6 times a day. And if the density increases, of course, that means more amount of waste will be generated.

If that is the case, then one trailer is not good enough, we have to add further trailers. Whereas if the density is low, then that means we have to have multiple transfer points that means if same number of people live in this area and the same number of people live in this area of course, here we are putting a transfer point over here because the rest is collected via primary collection from the surrounding area.

But because this area is very sparsely developed, so, we have to have two transfer point one for this area and one for this area. But the number of collectors will remain same because we are increasing the transfer points but the number of collectors will remain same and we may have to increase the number of trailers as well.

So, these are basic systems which you can see in some areas, but usually as per MSW rules also we have to move beyond this and we have to move to more better vehicles better systems. We also see this kind of open lorries in some urban areas as well, but again we this is a as per MSW rules is a banned you have to have covered containers, covered vehicles, so that waste does not spill.

So earlier used to see this kind of vehicles, but now we see other kinds of vehicles like we have discussed this skip trucks or dumper placer that means we have this kind of, garbage bins at different locations at secondary storage or community bins and so, on this truck this skip trucks transport the skips which are nothing but the dumper bins of different sizes.

The skip sizes could be 2.5 meter cube 3 meter cube 4.5 meter cube 7 meter cube according to the vehicle sizes also will vary. Five usually this kind of crafts can make 5 to 6 trips in 8 hour shifts provided the trip one way distances around 15 kilometers away. This could be also used for C and D waste transportation, this C and D waste could be also stored in this kind of containers and then transported.

Empty skips placed at storage depot and full skip lifted and transported. So, if the same system we keep the empty container at that storage depot and the other the filled container is being transported on the way so, the vehicle is utilized continuously whereas it can bring in the empty container and take the filled container. And if possible the same vehicle can serve multiple sites as well.

Lifting mechanism should be such like as you can see over here there is a lifting mechanism handling this can handle waste of 1000 kg per meter cube density. So, as per the volume and the density the weight of waste will vary. Accordingly, this has to have the capacity to lift waste of this kind of density for whichever size of vehicle we are considering. Twin dumper placers are also used like over in this image you can see twin dumper placer that means 2 containers can be lifted into this particular vehicle.

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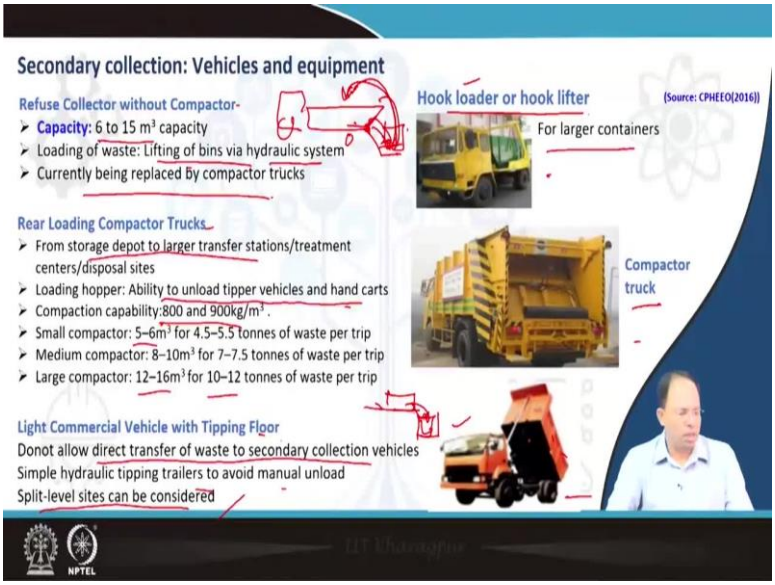


Then refuse collector vehicles are also other kinds of vehicles which can be without and with compactors, compactor means there is a mechanical like over here this is a compactor truck at the back of the vehicle you can see that there is a mechanism which pushes using a hydraulic system it pushes on the waste end compresses it right, so that is a compactor truck so that air is moved out and because air is removed then we can store more amount of waste.

But there are also vehicles which are without compacted systems. So, in this case what happens this kind of vehicles are of capacity 6 to 15 meter cube varying sizes vehicles are there. Lift the bins could be directly loaded via this hydraulic system if you remember from our previous module there was we have shown an example on those things, the vehicle comes in it leaves it attaches to that particular this is the vehicle.

Sorry, that it has got a loading arm you put in it you fit the container over there, it lifts over here puts the garbage inside and again place it back over here. So, currently, so, this kind of vehicles are now being currently replaced by compactor trucks and lifting is done via a hydraulic system.

And similar sorry I missed on this, this is a hook loader or hook lifted same as the previous one where we were using the skip loaders and all this is the same thing, but for larger containers, we use this kind of a chain kind of system for loading or you know lifting this kind of this garbage containers into the vehicle.

Then comes the real loading compactor trucks as you can see in this image, there are different varieties of these different sizes of this from storage depot to this kinds of trucks are used to transfer garbage from storage depot to larger transfer stations or treatment centers or disposal sites. This loading hopper this has the ability to unload tipper vehicles and handcarts.

So, as we are discussing over here, there is a loading hopper. So, this the handcarts or tipper vehicles can unload their garbage over here and this actually is loaded into the vehicle and compaction then there is a compactor inside which can compact the garbage to 800 to 900 kilograms per meter cube.

Then there are different sizes of these vehicles small ones, medium ones and large ones as you can see that it can have starts from 5 to 6 meter cube, which comes to around 4.5 to 5.5 tonnes of waste per trip to around 12 to 16 meter cube or 10 to 12 tonnes of waste per trip. So, as per the requirement or as per the requirement for carrying waste we will decide on which kind of a compactor we will use.

Then sometimes we can also use light commercial vehicles with tipping load or it could be also larger vehicles as well. Problem is they do not allow direct transfer of waste to secondary collection vehicles. In case of MCVs that we have learned earlier. Sometimes they do sometimes they do not do simple hydraulic tipping trailers to have this is only helps in manual by automatic unloading. But of course, if they unload it in the ground manually, we have to load it to the next vehicle or to the compactor unit or wherever it is.

Split in case of split level sites that means where the vehicle unloads their waste at one level and the waste falls to another level, maybe your container or another vehicle at a lower level there if you know this waste is being unloaded like this, there probably this kind of system would be beneficial. So we will show in some examples.

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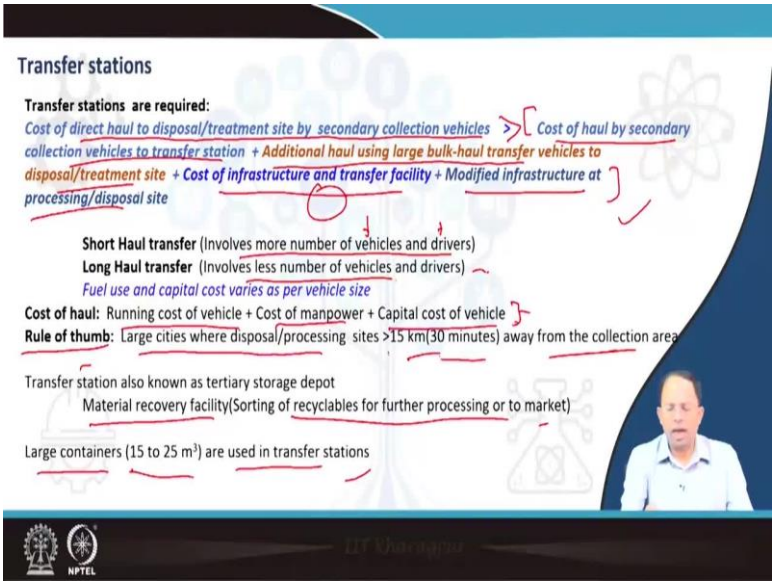


Now, coming to after vehicles, then we are we will talk about transfer stations that is we have talked about in tertiary collection systems where we have to provide transfer stations if the distance of the final disposal site or the waste processing centers are far away from the collection points right or the secondary storage points.

So transfer stations are required when cost of direct haul to disposal or treatments side by secondary collection vehicles is greater than cost of haul by secondary collection vehicles to transfer station because the alternative is we have to use some of these vehicles to carry it faster transfer station plus additional haul using large bulk haul transfer vehicles to the disposal and transfer treatment side.

So, in the second stage, we obviously will use larger vehicles to consolidate on the waste. Cost of infrastructure and transfer facility you have to set up a transfer station and a lot of infrastructure for that and modified infrastructure at processing and disposal site to handle this new large bulk transport vehicles.

So, if both this cost is justified then only we will go for a transfer station that is if this additional cost is justified then only we have to go to a transfer station. Now why the cost would be different? For short haul transfers that means if I do not use this, transfer station. This will require more number of vehicles and drivers and we have to pay salary of drivers and each of these vehicles will cost money plus the fuel they will consume.

Similarly, for long haul transfers this will involve less number of vehicles and drivers, but fuel use and capital cost varies as per vehicle size. So, we cannot exactly say that which system will consume less fuel or which system will cost less because, maybe one large vehicle will cost more than 2 small vehicles or how many large vehicles are required. So, first this should be determined then only we can determine the final cost.

So, cost of haul is running cost of vehicle plus cost of manpower plus capital cost of vehicle. So, using these 3 criteria we have to determine which system is big is beneficial. And rule of thumb is large cities where disposal processing sites is greater than 15 kilometers or 30 minutes away from the collection up setup transfer station.

So, again, this is a rule of thumb, but that does not mean that we have to follow it, you can actually do this cost calculations and we can determine. Transfer stations are also known as tertiary storage depot. And sometimes they also include material recovery facilities. So, sorting of recyclables for further processing or for sending to the market could be done at this transfer stations because this is where all waste is coming.

We can do sorting and all these things and again, we can send the sorted waste as part we can send them to the market we can send them to some waste processing facility or we can send them to the final landfill site. So, it is a transfer station is a suitable area where we can do this. And usually we use larger containers in transfer stations.

So, that container size ranges from 15 to 25 meter cube and as you understand this is bigger than the compactor trucks that we have discussed earlier. And so, we use a different sort of larger trucks or larger containers for hauling for this sort of large bulk haul transfers.

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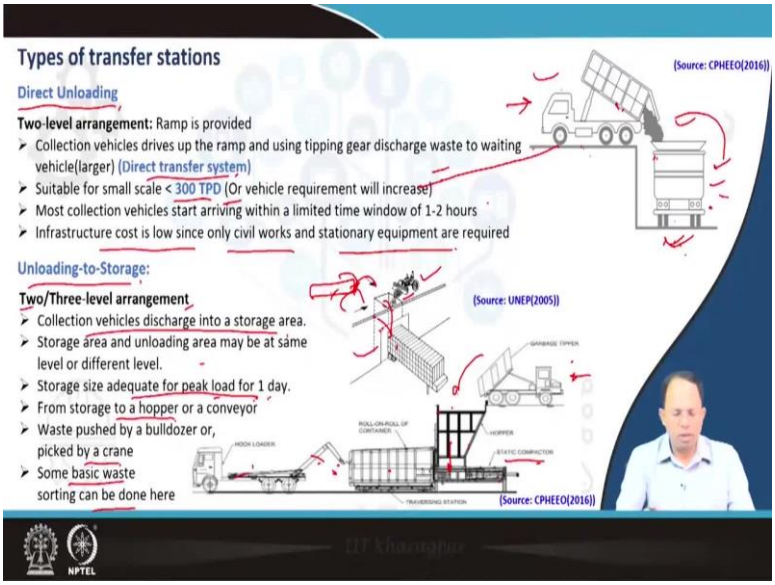


So, there are two types of transfer station based on the way the loading unloading arrangement is done. As you can see, the first one is known as direct unloading. It is a two level arrangement and there is a ramp is provided like over a QC. This is a vehicle which is brought in the waste, it says got this treating mechanism, it is putting the waste into the waiting vehicle over there or this waiting container or that this may not be the vehicle this may be just the container and then the container will be lifted into a vehicle that can happen.

So, let us assume that this is the vehicle this vehicle has gone above how it has gone of course, it has used a ramp to go to this particular spot. So collection vehicles drives up a ramp and using tipping gear discharge waste to a waiting vehicle which is larger in size and this is known as the direct this is the direct transfer system, directly I am loading into this particular vehicle.

And usually this kind of system is suitable for small scale which is less than 300 tons per day. Otherwise what happens because this is a direct transfer that means these vehicles are waiting why these vehicles are the smaller vehicles are coming and these vehicles are waiting. So this vehicle will wait till it gets spit.

So when all this small vehicles come at a single point of time, suppose waste collection starts at 8 o'clock in the morning, and then by 11 or 12 o'clock, this vehicle starts coming, you will see that the maximum peak hour happens for only one or two hours. And that is around 12 o'clock or one o'clock, something like that.

So all we require a lot of these larger vehicles during this time. So that is a inefficient way of working right because for the other times of the day, these vehicles would be not utilized. So we have to use only in case a very small load volumes, this is fine, because in that case, a couple of vehicles will be able to take care of the entire load. A few vehicles will be able to take care of the load.

But when the load volume increases, we really need to optimize this particular system. Most collection vehicles start arriving within a limited time window of 1 to 2 hours. So that is the problem and that is why you need to have these vehicles walking, but the benefit of this system is infrastructure cost is low since only civil wars as stationary equipment are required. So, that is the benefit of this particular system.

Now, the second system is unloading to storage system as you can see that it could be a two or three level arrangement right I will show you a three level arrangement later on in the next slide. But in this two level arrangement, collection vehicles discharge into a storage area suppose collection vehicles comes and they discharge into this particular area.

And then storage area and unloading area may be at the same level or different level, the storage area this is the storage area where garbage is stored and the unloading area may be at the same level that means physically have to lift it into the vehicle or it could be at or we can use some bulldozers or something to lift the garbage into the vehicle or it could be at a different level like we can push the garbage using this kind of loaders into that particular container which is at a lower level. So this kind of system can be there.

Storage size. adequate for peak load for one day. So, that was the storage area for we have to provide some storage area for waste and that has to take care of peak load for one day from instead of directly putting it into the container we can first put it into a hopper or a conveyor and then as per the requirement when this container is comes in after delivery, maybe the container returns or the vehicle returns, then we can place the container open the hopper on the conveyor and then can carry the garbage and load the garbage into this particular vehicle.

So, waste could be either pushed by a bulldozer into this particular hopper or this particular conveyor belt or it could be picked up by a crane and also put inside this particular container. Some basic waste sorting could be done in this particular collection system. So, as you can see over here the garbage tipper has come it usually it puts the garbage into this particular hopper the hopper is stop.

And then this is a compactor where, this is a steady compactor, where the garbage is compacted first, this hopper allows the waste to go down it compacts and then loads it into this particular container, which is eventually taken up by this hook loader in using hook loader we loaded into this particular truck and then the truck carries on to the landfill site. So, this is the basic system.

So, this is a we are directly putting it into the hopper or in some case we can push use this kind of low bulldozers to push the garbage into the hopper or we can use cranes to lift the garbage it all depends on how you are doing the loading unloading arrangement.

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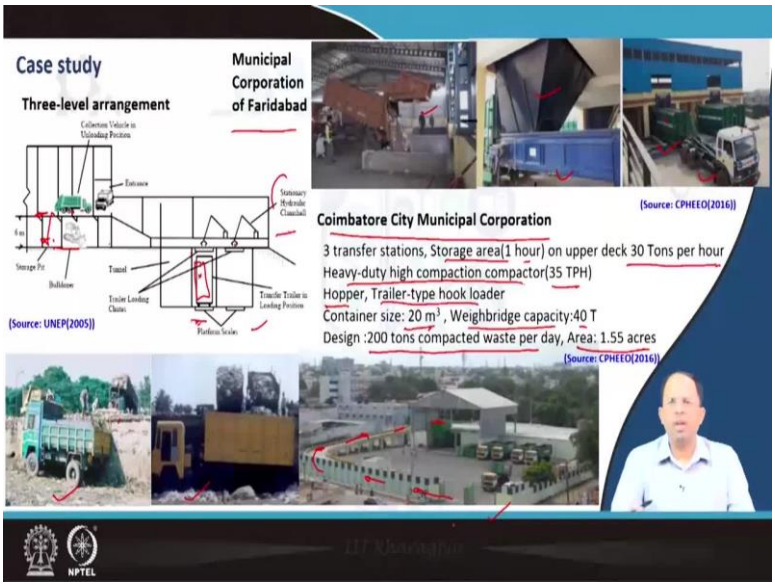


So, in 2 level system, we have to use a crane or a bulldozer, but in 3 level system like over here you can see that the waste is loaded over unloaded at this particular level and it falls to this particular level this is a storage pit from here I can push the garbage or using conveyors I can send the garbage to this area and then you can see that there are this cranes over there which is lifting the garbage.

And then putting it into the waiting container which is over here right and this this also has got weighing bridges we can wait how much amount of waste is being loaded and accordingly once the load is filled, we can set the vehicle to the landfill site. So this is a three level arrangement. And we can go both for two level and three level arrangements.

So these are some images from the Municipal Corporation of Faridabad, but you can see that this is how the garbage is being unloaded into the hopper and this is the way this is how the

hopper looks, this is the compactor below it and then this is the vehicle which is bringing out this vehicle means the container which is being loaded by this particular compactor and this is being lifted into this particular vehicle and then carried forward to the landfill site.

Now, the second case study is about Coimbatore city municipal cooperation here in Coimbatore, they have set up 3 transfer stations. And the storage area that they have created in this transfer station is for 1 hour peak hour of course, on the end, it is on the upper deck at so it is a split level site, and it is on the upper deck and the capacity is 30 tons per hour. So, that is the area of storage.

So, as you can see that this is a ramp this is a converter station, this is the ramp the vehicle goes up. So, this at the top there is this platform where you store garbage right and then there is a heavy day there is a compactor 35 tons per hour capacity compactor is there and a hopper is there and this compactor pushes the waste from the hopper into the container.

The size of the container is 20 meter cube and this could be lifted by a trailer type hook loader into the vehicle. And weigh bridge is also there which is of capacity 40 tons that can weigh the weight of that particular container in the vehicle. And the overall design is for design for 200 tonnes of compacted waste per day and the area required for this site is around 1.55 acres.

And as you can see earlier the site loop used to look like this again people used to use a split level system but it used to look very ugly aesthetically or hygienically not good at all as this was the situation earlier and this is the current situation which has made the entire operation very very efficient.

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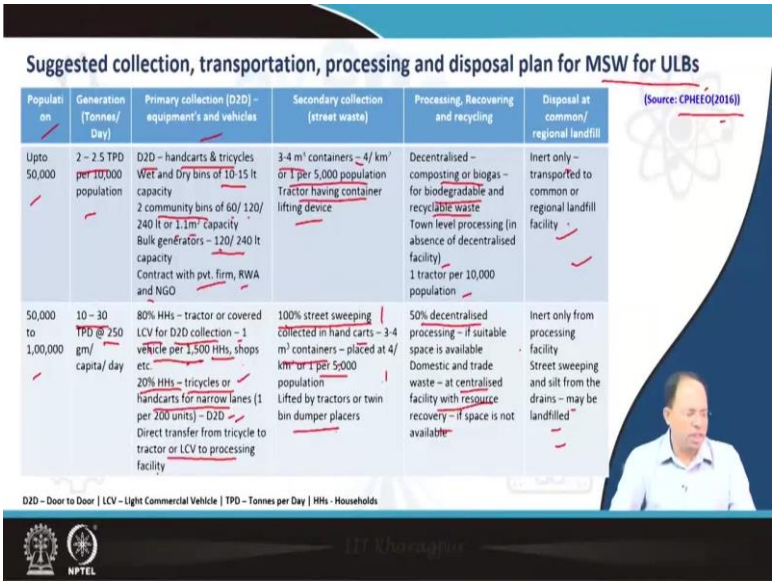


So then coming to certain suggested collection transportation processing and disposal plan for MSW for ULBs, this is a game given by CPHEEO aggregate I mean these are suggestions given it is I mean either you plan your own system you can do all the calculations on your own or these are very good suggestions which agreement but again, if you are there is a lot of difficulty in collecting data lot of difficulty in manpower to do these kind of calculations and all. At least to set up a basic system you should follow these kind of rules.

So, here first based on different population sizes are different ULB categories like municipal council, Municipal Corporation and so on, we can decide on what sort of system we will add up. For example, for our population of 50,000, which generates around 2 to 2.5 tons per day apart 10,000 population This is the waste generated part per day, we can go for D to D collection using handcarts and tricycles and bin size could be 10 to 15 liters community bins of 60-120-240 liters and 1.1 meter cube capacity could be provided.

Bulk generators, capacity of bins should be 120 to 240 liters and contract will be given to private farms resident welfare associations or NGOs. And similarly, for secondary collection. So, this is our primary collection for secondary collection, 3 to 4 meter cube containers 4 per square kilometer that for every square kilometer there are 4 such containers or 1 per 5000 population and tractors having container lifting devices could be also utilized.

And finally, we can go for decentralized composting or biogas for biodegradable and recyclable waste and town level processing in absence of decentralized facility and one

tractor per 10,000 population for transporting this waste and only inert waste is transported to the regional landfill facility. So, that is how that is a suggestion given for smaller towns of around 50,000 capacity.

For a little bit larger town 50,000 to 100000 we see that waste generated increases to 10 to 30 tons per day ideal is 250 grams per capita per day generally you multiply you get this kind of figure. 80 percent of household should be covered by tractor or LCV for D to D collection. So, either a tractor trailer can come door to door or a LCV can come to door to door collection and one vehicle per 1500 people and for all households or shops and so on. So, these are the different generators.

So, we can decide on so many LCVs per, so many households are so many collection points. And 20 percent of the households should be covered by tricycles or handcarts. Why because not everywhere, this kind of LCVs or trailers, tractor trailers can go so that is when this tricycle says to go. So that is an assumption that 20 percent would be adequate for the size of a city. And direct transfer from tricycle to tractor or LCV to processing facility.

So that means the LCVs or the tractor trailers directly take the waste to the processing facility and then this D to D system of your handcarts and all will transfer the waste to this particular vehicle. And for secondary collection 100 percent street sweeping collected in handcarts, 3 to 4 meter cube containers placed at every 4 kilometer square or 1 per 5000 population lifted by tractors a twin bin dumper placers.

So, that means that street sweeping waste and all these things that again taken from this community bins are these bins that we place at certain parts of the city directly to the final disposal points or to the processing centers. Whereas for door to door collection and household waste is directly taken by LCVs and all from these areas to this particular disposal points. 50 percent decentralized processing if suitable space is available domestic and trade waste at centralized facility with resource recovery spaces not available.

And inert waste and street sweeping and silt from drains also goes to landfill. So that is a little bit different from the initial system that has been proposed.

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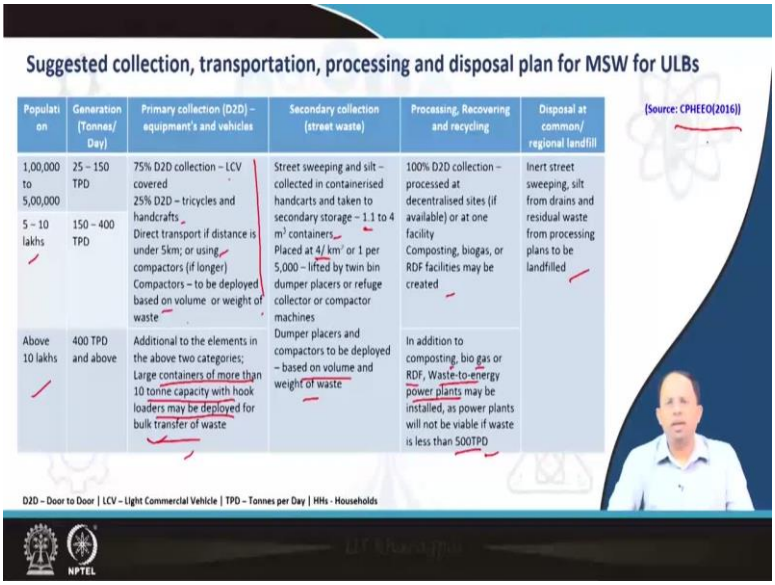


| Population | Generation (Tonnes/ Day) | Primary collection (D2D) – equipment's and vehicles | Secondary collection (street waste) | Processing, Recovering and recycling | Disposal at common/ regional landfill |
|---|---|---|---|---|---|
| 1,00,000 to 5,00,000 | 25 – 150 TPD | 75% D2D collection – LCV covered<br>25% D2D – tricycles and handcrafts<br>Direct transport if distance is under 5km; or using compactors (if longer)<br>Compactors – to be deployed based on volume or weight of waste | Street sweeping and silt – collected in containerised handcarts and taken to secondary storage – 1.1 to 4 $m^3$ containers<br>Placed at 4/ $km^2$ or 1 per 5,000 – lifted by twin bin dumper placers or refuge collector or compactor machines<br>Dumper placers and compactors to be deployed – based on volume and weight of waste | 100% D2D collection – processed at decentralised sites (if available) or at one facility<br>Composting, biogas, or RDF facilities may be created | Inert street sweeping, silt from drains and residual waste from processing plans to be landfilled |
| 5 – 10 lakhs | 150 – 400 TPD | | | | |
| Above 10 lakhs | 400 TPD and above | Additional to the elements in the above two categories;<br>Large containers of more than 10 tonne capacity with hook loaders may be deployed for bulk transfer of waste | | In addition to composting, bio gas or RDF, Waste-to-energy power plants may be installed, as power plants will not be viable if waste is less than 500TPD | |

Now if I go to larger cities of one to five lakhs or even five to ten lakhs, you see that 75 percent D to D collection is where LCVs, 25 percent is where tricycles and handcarts and direct transport if distance is lesser than five kilometers, so here there is option earlier it was direct transport. Here, it is not direct transport.

If it is less than five kilometers it is direct transport or using compactors if longer comparators could be deployed based on volume or weight up waste, right. So that is how it has been decided. Street sweeping and silt collected in containers handcarts and take into secondary storage 1.1 to 4 meter cube containers.

And again placed at 4 per square kilometer same rules are there and 100 percent D to D collection process that decentralized sites composting biogas and RDF facilities may be created for this urban areas. And for same the inert waste street sweeping waste silt goes to the final landfill site and above 10 lakhs more or less everything is same.

Only large containers of more than 10-10 capacity with Hook loaders may be deployed for bulk transfer of waste. So that is addition in addition to all this, this is extra. And dumper placers and compactors to be deployed based on volume and weight of waste. And finally, in addition to composting biogas, we are proposing RDF facilities waste to energy facilities, power plants may be installed for converting from waste to energy as because power plants are only viable about 500 tons per day.

So, this is we will discuss what sort of causing facilities in our later modules, but at least this is one solution, which is given by CPHEEO for setting up a basic waste management system for different urban areas.

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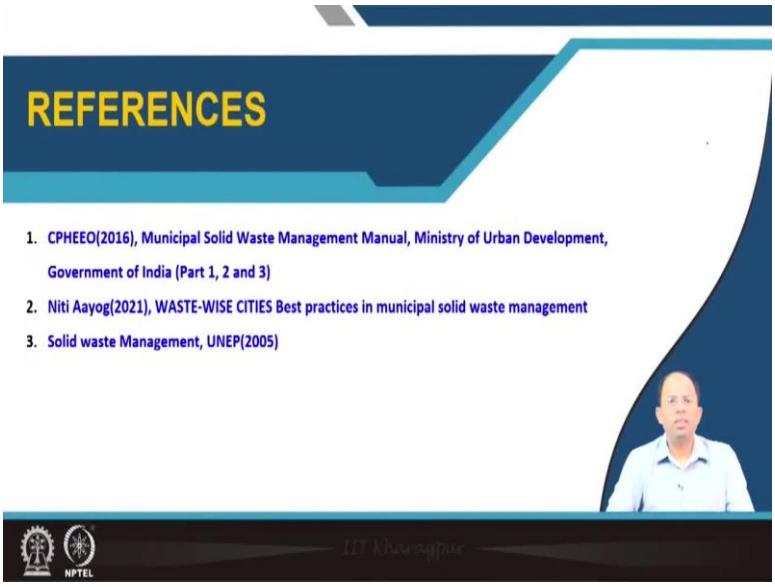


So, these are some of the references you can use.

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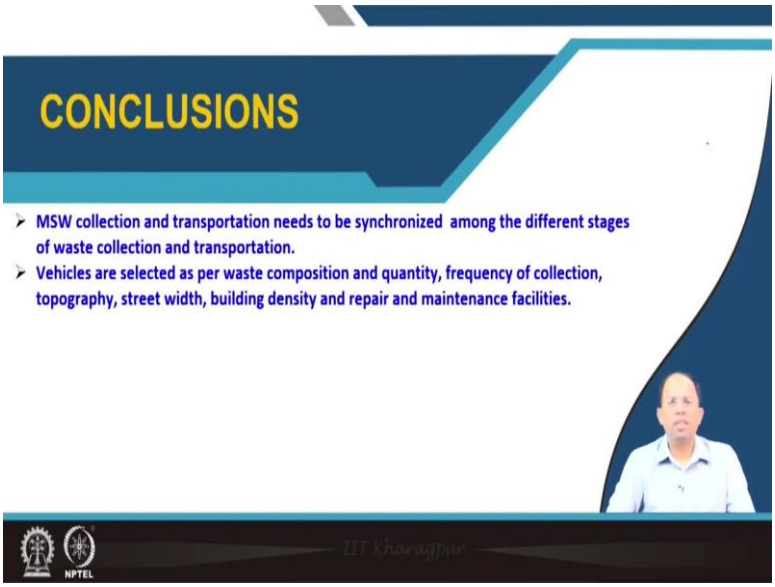


To conclude, MSW collection and transportation needs to be synchronized among the different stages of waste collection and transportation and vehicle size vehicles are selected as per waste composition and quantity, frequency of collection, topography, street width, building density and repair and maintenance facilities. Thank you.