

**Geoenvironmental Engineering (Environmental Geotechnology): Landfills, Slurry
Ponds & Contaminated Sites**
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Lecture - 06
Integrated Solid Waste Management (ISWM): Case Studies

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Good day. And today we start at another lecture. And we are going to continue with the last lecture that is waste minimization by integrated solid waste management. Last time we looked at the principles of integrated solid waste management. The large thought was reduce the waste to the extent possible that is minimize the waste by whatever methods that you can. And then dispose the waste on land in a safe and environmentally sustainable manner. So, let us quickly look at one or 2 slides we did last time and then let us continue from there.

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Integrated Management of Solid Waste

Objectives :

- To minimize waste
- To effectively manage the waste still produced

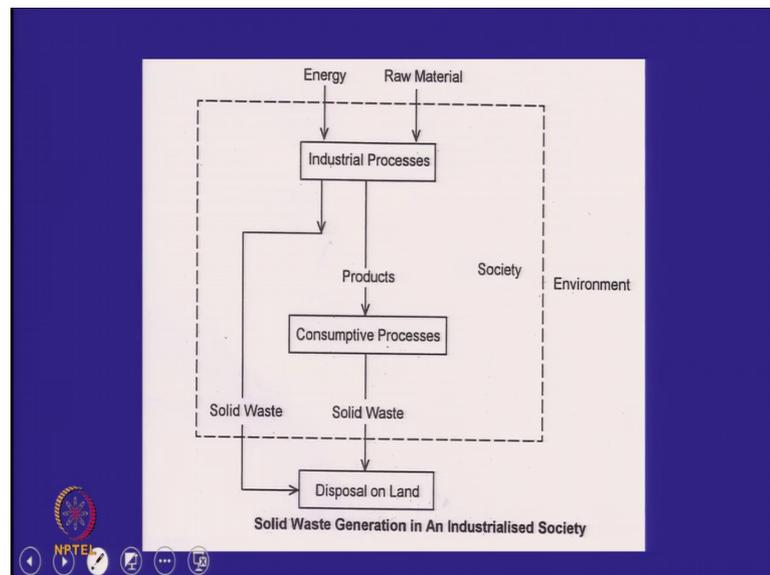
Integrated Solid Waste Management Hierarchy :

- Waste reduction at source
- Resource recovery through separation and recycling
- Resource recovery through waste processing
- Waste transformation
- Waste disposal on land



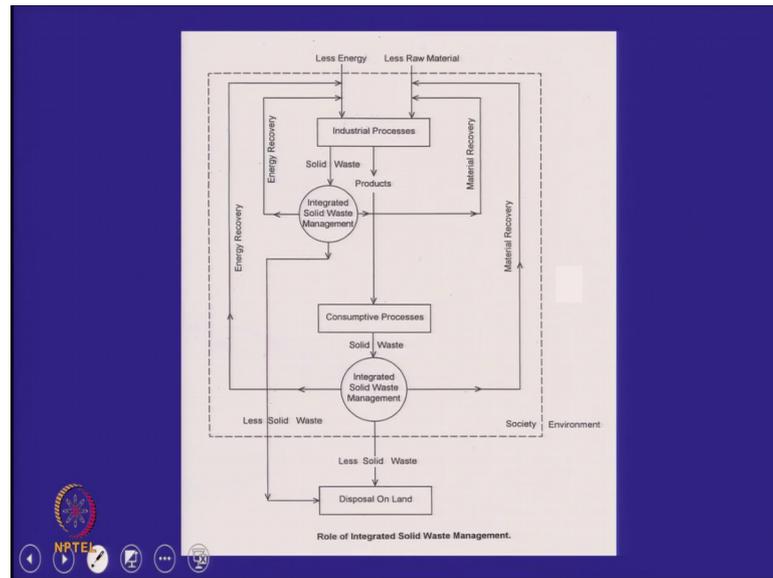
So, what we said last time, minimize the waste effectively manage the waste still produced. So, the hierarchy of waste management options were - waste reduction at source, the source recovery through recycling, the source recovery through waste processing, waste transformation and waste disposal on land.

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And we said that an industrialized society is taking energy and raw materials from the environment and giving out solid, waste the solid waste is produced by the industry and the solid waste is produced by the consumptive processes in a city.

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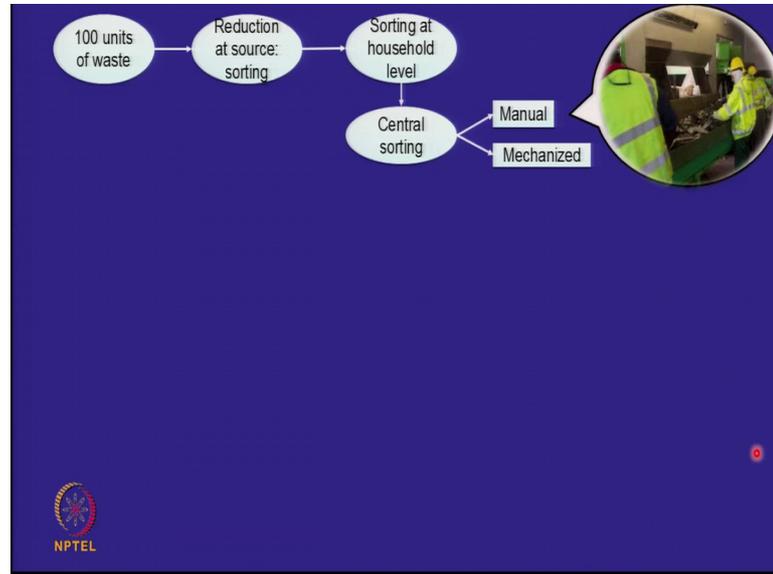
And if we apply the principles of integrated solid waste management, we can apply them here to reduce the quantity of waste coming out and sending back the material and the energy to reduce the energy and raw material required by the industry. And similarly after the consumptive processes we can send back the material which we can use for recycling or we can send back the energy, which we can by burning combustibles we can therefore, reduce this.

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Components	Composition in percentage			
	U.S.	U.K.	Europe	India
Paper & Cardboard	26.5	23.6	31	8
Plastic	12.9	10.2	12	9
Metals	9.0	7.6	8.4	1
Glass	4.4	7.2	4.9	1
Rubber, leather & textiles	9.5	6.0	5.0	3
Wood	6.2	5.7	6.6	1
Biodegradable	28.4	35.1	25.9	48
Inerts	-	-	-	25
others	3.2	3.8	3.4	4

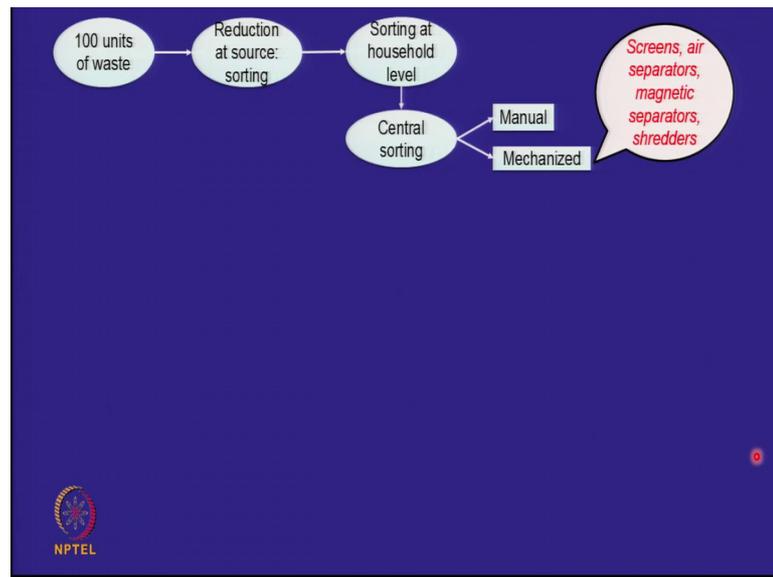
So, let us recall that we said last time India, in India the waste composition looks like.
This

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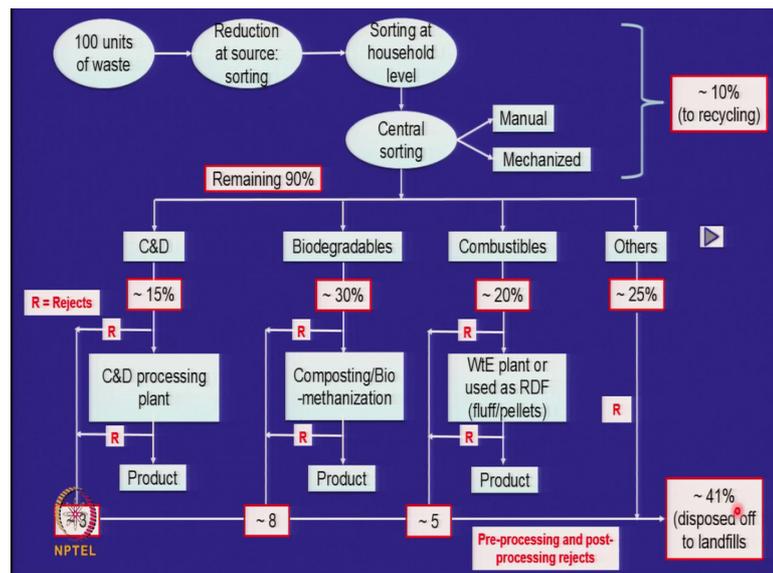
And let us see if you conceptually apply this integrated solid waste management what can we do let us assume that we have a 100 units of waste, then we can reduce the quantity of waste by sorting at the source. This can take the form of sorting at the household level; that means, within the houses, and after sorting at the household level further reduction can also be done at a central sorting unit; that means, at a facility where this waste reaches from the various households. And the central sorting facility you can do manual sorting or mechanized sorting. Manual sorting typically means that the waste is moving on a conveyor belt, and you pick up the various items manually by hands you are of course, wearing gloves.

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And you are having some kind of a mask to prevent any pollution while you are doing manual sorting. The other way of doing sorting in the central plant is by using mechanized equipment such as screens, and trommels air separators which will separate out the lightweight material magnetic separators, which will take out the metallic materials, and even shredders which will cut open the plastic bags to release the recyclables inside the plastic bags.

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So, about 10 percent of the waste can be reduced by sorting at the household level and the central sorting unit. The remaining ninety percent of the waste would be C and D waste, biodegradables combustibles and others. Typically, the C and D waste may be 15 percent of the total waste. The biodegradable comprising of the food waste and other waste such as wood and other garden trimmings would be about 30 percent. The combustibles which could typically be paper plastic cloth and textiles could be 20 percent and others could comprise of intricately mixed material which cannot be separated out into the individual components for recycling.

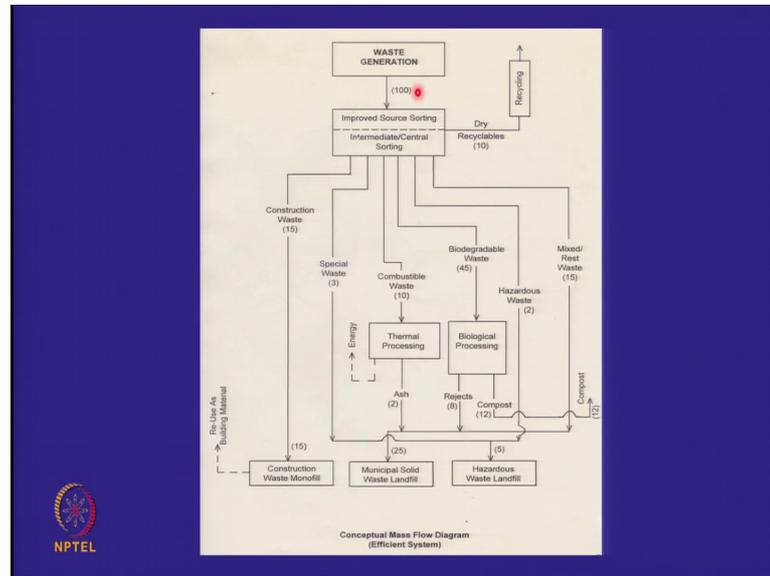
So, the C and D waste can be sent to a C and D processing plant, where it can be processed for reuse in construction. The biodegradables can be sent to a composting plant or a biomethanization plant where the output would be composed which can be used by the farmers or the output could be methane gas which can then be used for producing power. The combustibles can be sent to a waste to energy plant for generating energy or the combustibles can be compacted and converted into refused derived fuel either in the form of pellets or it can remain in the uncompacted form as fluff. Now at each of these plants there will be some preprocessing rejects because all the material which reaches the plant is not 100 percent processable by the equipment in the plant. And after the processing is over there will also be post processing rejects. For example, when you are doing composting then after the composting you might see is the material through 4 millimeter sieve and the finer material may be decomposed and the coarser material may be rejects.

So, the product will be the bulk output and the rejects will be the minor output. Typically, all these rejects will go to the landfill, and the rejects which were coming from the others as well because it is too intricately mixed for reuse will also come here. So, all these rejects as well as this rejects will go to the landfill. Now let us see that we started with 100 units of waste how much of it is going to go into the landfill. We have 15 percent C and D and you will have about 15 to 20 percent rejects.

So, 3 units are rejected. Similarly, at out of the 30 percent biodegradables 8 units are rejects. In the combustibles you are having 5 units as rejects. So, if I total all these 3 plus 8, 11 plus 5, 16 and 25 which are intricately mixed and cannot be separated about 41 percent of the material has to go to the landfills. So, what good integrated solid waste management does is to reduce 100 units of waste to about 40 percent or less, and

therefore, the size of landfill required is lower. I think I have another diagram here which we can go through. I do not know how clear it is, but it essentially captures, what I said we started with a 100.

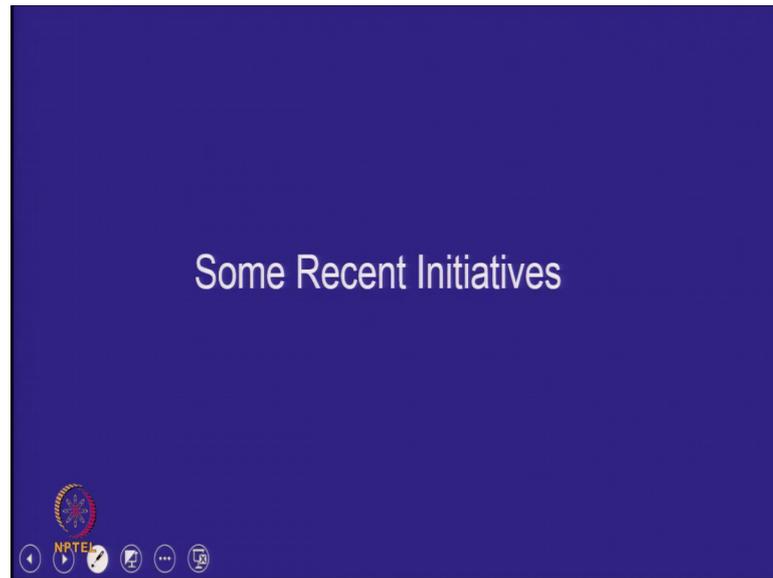
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And we did source sorting intermediate central sorting then went back for recycling construction and demolition 15, special waste sometimes you cannot do anything about it combustible waste, biodegradable waste the figures are different here, for what we have written on the board that is not important what is important is to recognize that there may be some hazardous waste and there will be some mixed waste. And not shown in this diagram and that is erroneous is that from each processing unit no it is shown here from the biodegradable waste, you will get rejects not shown in the combustible waste you will have preprocessing rejects as well as the ash post processing reject of a waste energy plant will be ash and preprocessing will be all that material which the thing will not burn they will return it or say could we please take it away.

So, in this diagram I think it is about 45 and this diagram also says or presumes that your city will have 3 types of landfills the hazardous waste landfill the nonhazardous waste landfill and the inert of the construction and demolition waste landfill.

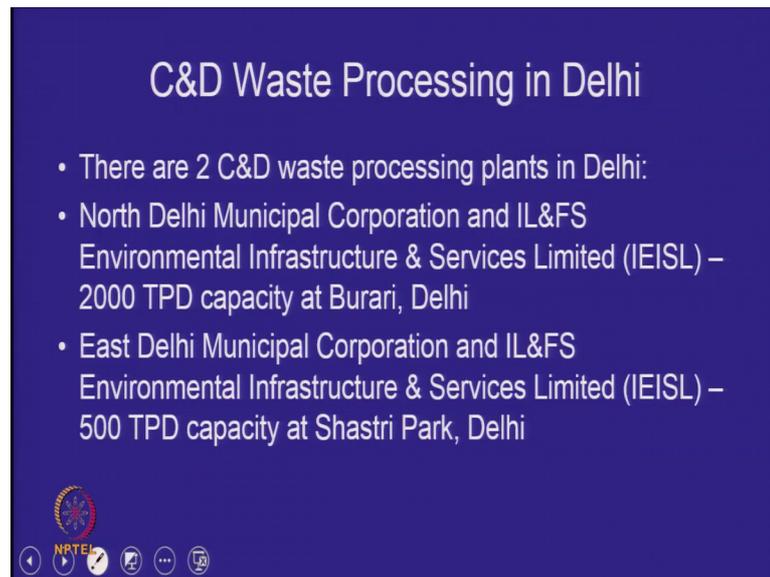
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And this material will reach these locations. So, I would like to look at some recent initiatives in Delhi we been trying to process waste for quite some time in India. I mean, I have the last 20 years we have made lots of investments into waste energy plants composting plants many of them have been unsuccessful, many of them have been unsuccessful. In fact, it is the real processing plant which is successful and the main reason has been the quality of waste reaching the plant you cannot send mixed waste to a waste energy plant.

So, you will find Bombay city signs of contract for waste energy Lucknow signed a contract for waste energy 10 years ago. It did work I already gave you the example that Delhi did about of a couple of decades ago it did not work. So, if you send them only the combustibles or the better types of this that is what will work and then the plant has to be designed for those combustibles if you send them mixed waste which is predominantly wet it is not going to work.

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C&D Waste Processing in Delhi

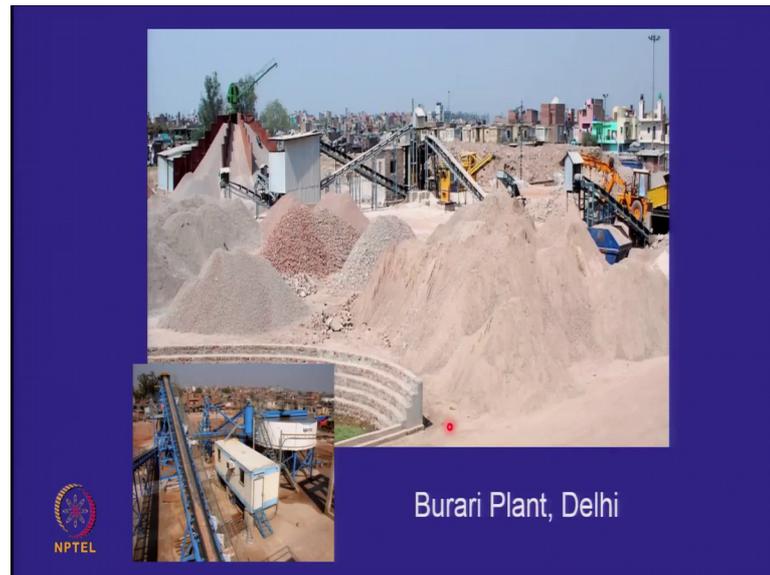
- There are 2 C&D waste processing plants in Delhi:
- North Delhi Municipal Corporation and IL&FS Environmental Infrastructure & Services Limited (IEISL) – 2000 TPD capacity at Burari, Delhi
- East Delhi Municipal Corporation and IL&FS Environmental Infrastructure & Services Limited (IEISL) – 500 TPD capacity at Shastri Park, Delhi

NPTEL

And a large number of composting plants are not also worked because it is not just about composting the whole waste once you compost, the whole waste it is going to have wires it is going to have plastics and a farmer is not going to pick up that compost he wants a very high quality compost for his fields.

So, composing plants have also not worked we come to that later, but the more recent initiative is that we have 2 construction and demolition waste processing plants in Delhi. Please note the moment we get into the C and D field, we are able to almost remove 25 percent to 30 percent of the waste from the main waste. So, that is a huge reduction and what do you do is C and D waste, we can reuse it. Suppose I am got building construction waste, I can use it not as high quality aggregate, but I can use it as aggregate, when I am doing flooring I can use it for embankment construction. I can use this aggregate for whatever purposes it meets the requirement. Suppose I am relaying a road and I am excavating the asphaltic and the bituminous layer I can reuse it in the next row.

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So, at Burari we have first 2000 tons per day capacity plant at Burari and another one of 500 tons per day, which is going to come up or a might have come up very recently at Shastra park, just a few photographs from the Burari plant. So, what is what is the construction and demolition waste plant do? It gets the waste, it crushes it, it removes the metals and the other materials which are like pieces of wood, and then it sells of this crushed waste by first screening it maybe you can get stand out of it, maybe you can get gravel out of it coarse aggregate fine aggregate. So, you can see a variety of heaps here. So, it is like a crushing and screening plant.

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So, the waste will come it will go to some crushing units, then it will screen and then it will be collected and sold off to various people. And sometimes you can also make a end product. So, this is the waste which comes in typically. This is being there again not if you do not want to do a very high end job, you do not want to make high strength concrete from this aggregate, but you can make paper blocks. Paper blocks are not requiring a very high level of the quality of the input of the coarse and the fine aggregate into it. So, they are making paper blocks here the final portion, the final portion of the construction and demolition waste because many a times construction and demolition waste will also be having some soil mixed unit when you demolish a building the foundations will come out you will be excavating it when your excavator is taking out the waste.

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So, they have used with that finer material in a road construction. So, we looked at construction and demolition waste this plant is now doing well. I think the whole issues about how you price it if you are going to price recycled material should it be lower than the original material or higher. Suppose I can get sand at x 100 rupees per cubic meter. Now I have recycle sand should it be less or more.

Student: less

Yeah. So, if I am getting sand at 500 rupees per cubic meter natural sand. And if I start selling my recycle standard 700 and say I am green technology sustainable

environmental friendly, you are making a house you say you may be as much friendly as you want I am getting the 500 rupees, why should I buy the standard 700 rupees. So, the criticality is can be price at lower. And if you cannot price it lower their a 700 rupees is the cost of production, then what is the alternative we have to be subsidized. And who will give the subsidy the government that is where I talked about hierarchy of waste management options. The maximum subsidy should be given to making recycled materials sustainable, subsidy should not be given to make landfills cheap because if you make landfill cheap all the waste will come to your landfill.

So, we have to reprocess that. So, as I said Burari successful as long as the pricing becomes successful and the subsidies become successful, which is a huge gray area. I am going to look at the Hyderabad landfill site. This is an old landfill site, which has been given to a private operator and 1500 tons of fresh waste comes in here every day. 1500 tons is a lot how many trucks do you think that is just to get an idea.

Student: (Refer Time: 17:13).

One truck is how many tones.

Student: (Refer Time: 17:17).

Um.

Student: (Refer Time: 17:20).

Well density of s is very low, do not think that I am filling the truck with sand and Ambrose filling the truck with the concrete. I am filling the truck with all this food waste and yard trimmings

Student: (Refer Time: 17:32).

We will probably get 3 to 4 tons in a normal truck will get. So, 1500 divided by 3 is 500 trucks and divide 500 by 24 it is the, I am if every hour how many trucks it is the landfill just to get an idea.

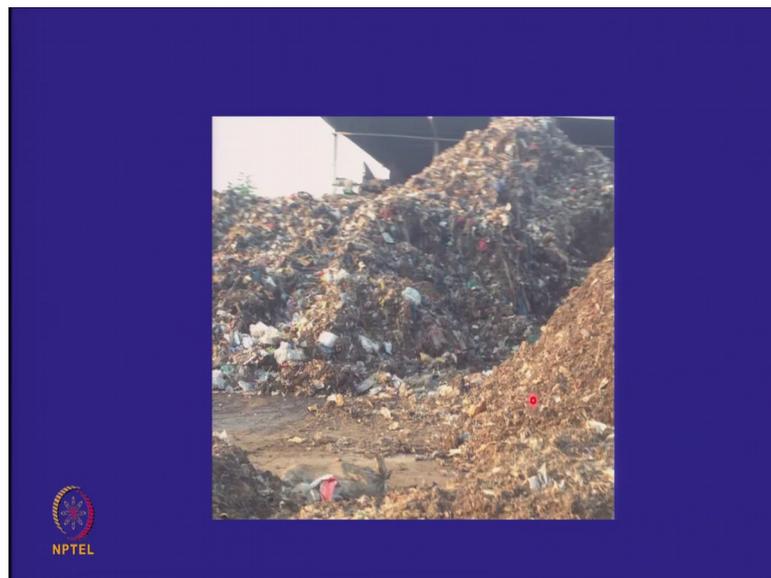
Student: 20 (Refer Time: 17:50).

20 trucks. And if you are only working 8 hours, then the divide 500 by 8, how many trucks which every hour.

Student: (Refer Time: 18:01).

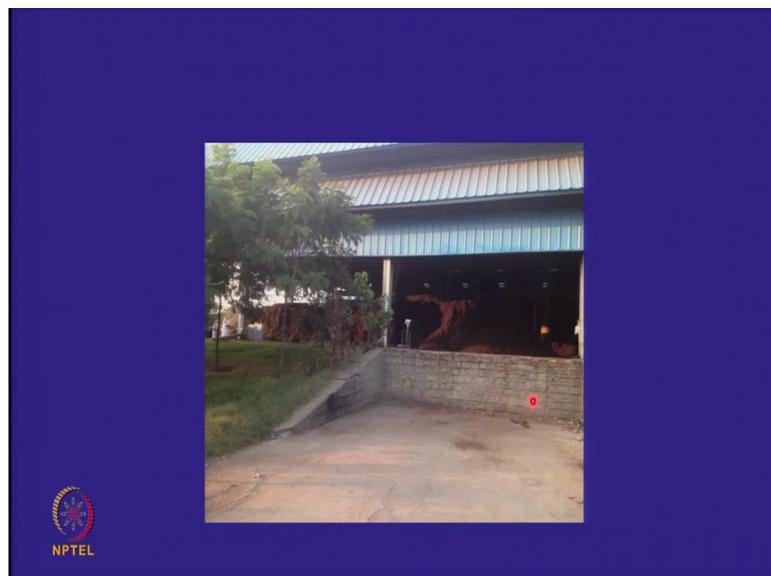
One truck per minute before you can unload the truck the next truck is it. So, that is the fact that is the way that is the quantity of waste that is being handles at this sign.

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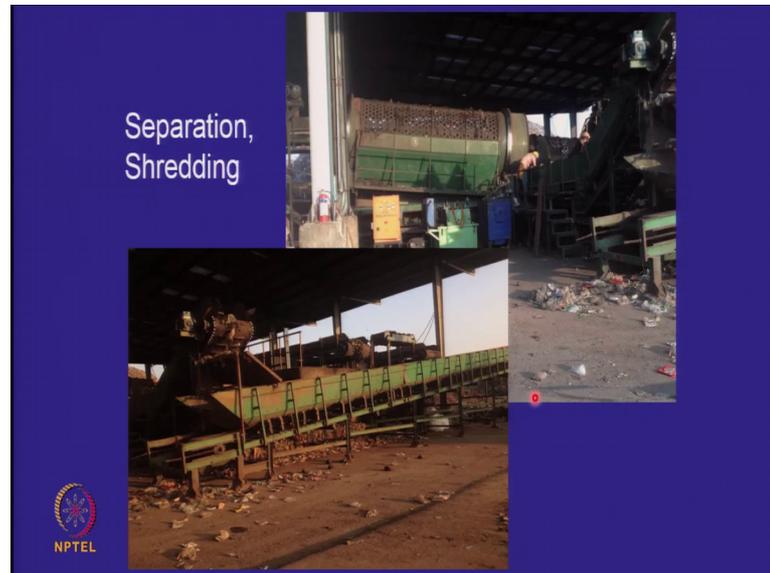
So, that is the municipal solid waste which comes in at the Hyderabad.

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Landfill site next of all kinds that is the covered area in which the composting and the RDF are separated. The most critical operation is trauma link or screening, and the fresh waste comes it is passed through a series of screens.

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And I presume this is the core screen which will talk about. So, the waste comes it is first shredded. And then it is screen means it will be rotated in this. This is this is not the kind of sieve we have in the soil mechanics slab. This is the rotating screen you pass it is its inclined. So, you put the waste at one end it travels down the rotating screen, below this mesh it will fall down, above the mesh it will be coming out as a reject or as the oversize material. So, you can get an undersized material and an oversize material.

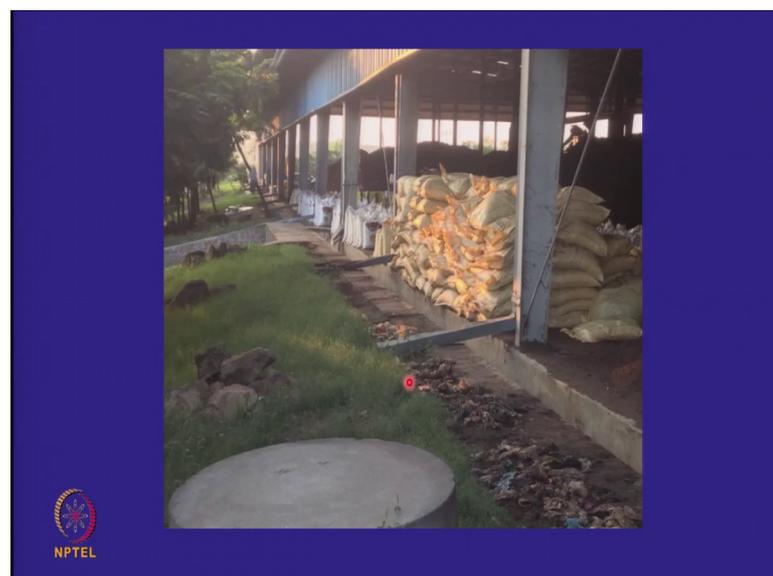
So, if a material comes in I want to put it into 3 fractions, I pass it through 100 mm sieve trommel then the 30 mm sieve trommel and then a 5 mm or the 8 mm sieve. So, I can get those fractions.

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So, here what happens? This is the finer fraction. This I think this is 20 mm down of the waste which has come in through tromelin. And composting is a simple process aerobic composting. You have to aerated allow a lot of oxygen to come into the waste and you have to give it moisture. So, aerobic composting means you make long lines of waste long line. And every day you turn it around why. So, that the oxygen can go into it and you apply some moisture to it. And after a few weeks this will have become soil light or it can be something which can be applied to soil as a manure.

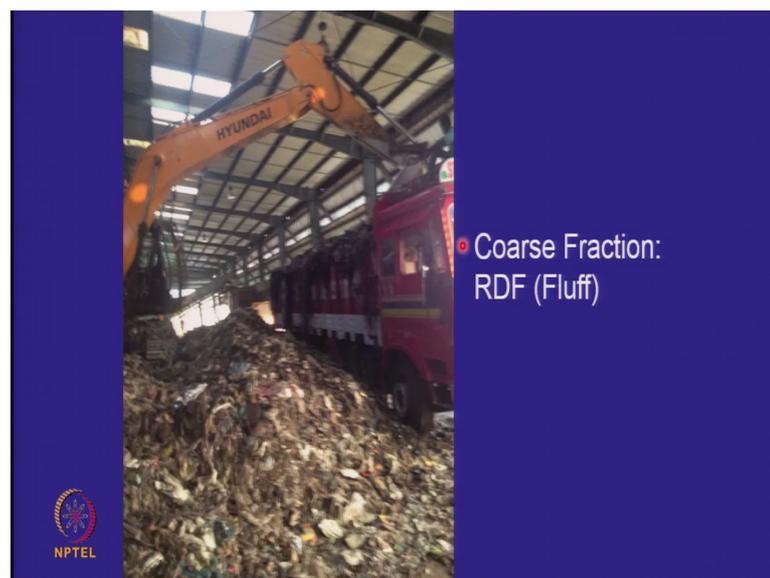
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So, this is the I will composting windrow as you call it. Eventually the compost is filled up in bags it is available to you like a fertilizer bag. You can see inside the fine compost. So, there are preprocessing rejects which come out from the screen. There are post processing rejects after the composting is over they again pass it through the screens because people buy find composed. They do not want any coarse sand like material to come, which is not going to hold water for the plants. So, this probably is 5 mm down, and this is packed in bags. Now luckily for us it composes voluminous. So, if a farmer wants it he needs to carry it in a small tractor or a trolley. He cannot just take one bag behind a bicycle, if a farmer wants to buy a fertilizer an NPK fertilizer, he can put a bag behind his bicycle and you know he can spread it with his hand in the field, but you want to put composed is the soil conditioner it is not a fertilizer it is like manure humans.

So, you in large quantities. So, luckily for us the supreme court has ordered all fertilizer companies, that for every few bags of fertilizer sold they should sell one bag of compost it is incumbent on them to place it in their showrooms. So, this is going to a fertilizer company which is then dispose it from it is various showrooms. When you go to get petrol fill up in Delhi in various petrol pumps you will find that some bags are available that that may be composed from or it may be you know cow dung, but even now municipal solid waste compost is beginning to come into picture.

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What about what happens to the stuff which was bigger than that 100 mm size. So, that is the coarse fraction and the photograph is not very sharp, but it is a lot of cloth rags and plastics in it. So, at this location the fluff this was being sold as fluff, not as pelletized RDF. Please distinguished RDF can be pelletized and RDF can be fluff pelletize means it goes like pellets small briquettes. Fluff means it goes like this into the feed.

So, if you are sending this to a cement manufacturing plant for burning because they need a lot of fuel to burn. They have to modify their inflow feed, because this is not like coal goes in the form of crushed powder into a boiler where it has to burn into a furnace. So, here the coarse fraction is being sold to one of the cement plants. So, they are handling 1500 tons, but they are some kind of a 25 wood 25, 25, 25, 25. I said what is this 25, the 25 is rejects 25 is above 100 mm, which is fluff and 25 goes into compost and some 25 is what you see there are products of reaction.

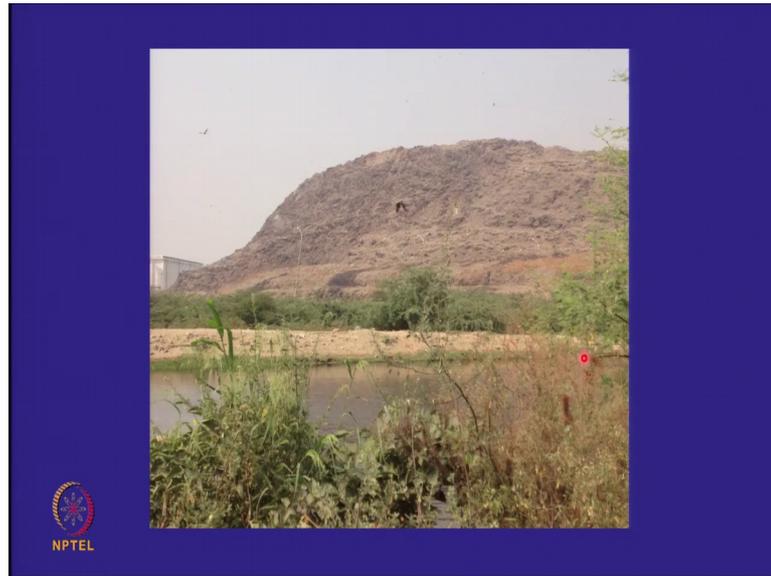
So, do not think everything is 100 to become totaling 200, they are products of reaction. Already the waste says how much moisture content when it comes in pretty high.

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So, 25 will be water that is a thumb rule, this is not given in any book please this is the thumb rule from the private operator.

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Let us look at the ghazipur landfill we talked about it I showed you that slides where it is right in the middle of Delhi and that is the landfill. How high is it? I do not know.

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But now this is will landfill a few years ago, now if you go next to the landfill you have a huge industrial unit what do you think is this.

Student: (Refer Time: 24:04)

Yeah it is a waste to energy plant, it is a waste to energy plant. So, all the fresh waste is now going to go there and be burnt. I am understanding, I understand they are having some teething troubles because if you get in fresh we ask you, but I have a composting plant also if you try to burn the whole waste mass burn is that is what is called, and that is what is being done at the o clock. There are all kinds of problems, you want to run a waste to energy plant efficiently please use the combustible fraction, remove the weight fraction use it for composting, but that requires you to put up a preprocessing unit, it is huge in nature. Anyways it is having teething troubles it is been up since 2015 sometimes it works sometimes, they are just into it finally, we will be able to just put and incidentally this chimney is 40 meters high, and this dump is higher than this chimney.

So, just to get you the idea of the duct kutub minar always we should remember a 74 meters high. So, we are all completing with kutub minar in in terms of waste amps. So, that is the future of Delhi that is the future of Delhi.

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EXISTING PROCESSING & DISPOSAL SITES		
Technology	Capacity MT/day	Present status
Waste to Energy		
Okhla	2000	Operational since Dec. 2011
Ghazipur	1300	operational since Oct. 2015
Narela Bawana	1200	Under construction
Compost		
Okhla	500	Operational since 2007
Narela Bawana	1500	Operational since 2009
C&D Waste:		
Burari	2000	Operation since 2009
Shastri Park	500	operational since Oct. 2015
Ghumanhera	500	for setting up of plant for processing/ disposal/ recycling of Construction and Demolition (C&D) Waste /Malba.
Landfill Disposal		
Ghazipur (Area 70 acres & height 40 mtr)	2500	Over saturated
Bhalswa (Area 40 acres & height 40 mtr)	2500	Over saturated
Okhla (Area 32 acres & height 50 mtr)	2000	Over saturated
Narela Bawana (Area 100 acres)	500	Operational since 2010

So, if you look at, this is a slide from presentation made by the chief engineer of the municipal corporation, one of our alumni. And we you know we have these grandiose plans about how well we handle this waste. So, if you look at the capacities, now we have waste to energy plant at okhla, which is getting 2000 tons per day. Which I said is the mass burn which is always in the newspaper because the residents are always up in arm and complaining about odour to NGT the ghazipur one is getting 1300, it says it is

operational since 2015, but I think it is operational in fits and starts. And the narela bawana one is under construction, but this is the one which is by with the private operator and he will only use the fluff. So, he will separate out everything we have a compost plant in okhla, it has become operational and operated many times and shut down and operated and shut down too much odour for the residents not selling compose the biggest problem with compost plants is what can you sell all your compost, you can manufacture is a lot of compost, but can you sell it and in the bargain offset your costs of product producing the compost.

So, that is one and there is one in the narela bawana, but I think all of them are surviving with this fertilizer companies having to take composed from them, does the compost meet food standards a big question mark because as I said there is a different standard in different countries. And in some of the industrialized countries mixed waste, if you composed it is not allowed to go into the food chain, cannot be use for crops can be used for gardens and flowers and other non edible crops. C and D waste burari started Shastra park it says just started in 2015 and another facility is. Now with all this you feel maybe the whole of delhis waste is taken care of 2000 and 2500 is 4500, 5000, 6500, 7500, 8500. You should actually have no waste Delhi produces about 8 to 10000 tones, but we have waste in ghazipur I have shown you we have a bhalswa landfill, I have shown you okhla landfill. The first shot which I show you all of this black reach it at the bottom of the mountain is the okhla landfill. And all of them are getting wasted. All of them are still getting waste. And this is the private operator narela bawana which you are showing here he is putting up a waste to energy plant is put up a compost plant and here the landfill for the rejects.

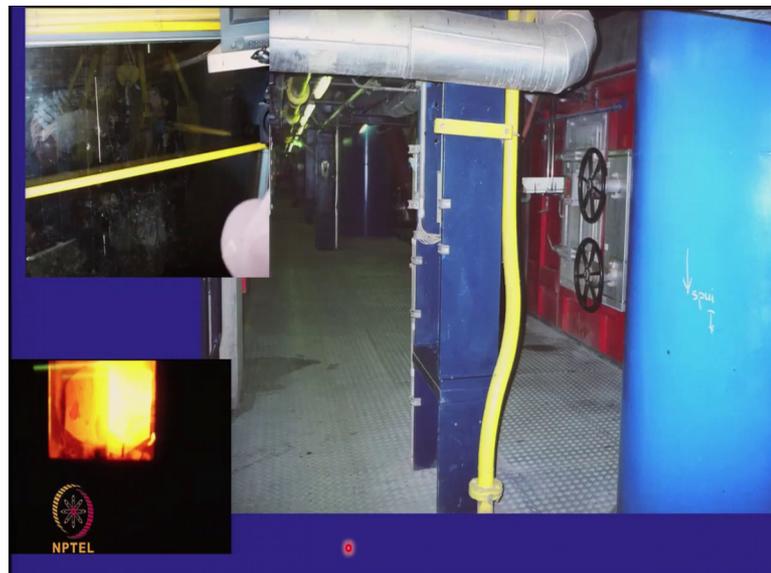
Let me show you some very few slides briefly from my experience, I had gone on a trip to the Netherlands the part of a European union project which we were doing with tu delft and there was a Chinese university. And everybody was taken to see the wastes processing sites we showed our Indian sites we were the best in showing our dumps. And the Netherlands was the best ensuring the processing facilities because they did not want big dumps, they can afford it is I mean nothing to be ashamed of I mean Chinese did not show us anything.

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So, little issue about transparency was in the past because a lot of presentations in the in the workshop in the university there, but. So, that is a huge waste to energy plant in Amsterdam. And I at that time when we went and I think I went in 2006 or 7, this was the world's biggest waste to energy plant.

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And that is what it looks like, it looks like a power plant from the inside you are not allowed much photography. We got some special permission, but that is the furnace where the things are burning I do not know whether you can see this is a grab.

So, all they were doing is the waste is dumped in a huge room and a grab picks it up. And the grab picks it up and what happens then it takes it for burning. So, do remember that when a grab picks up a sample from the top the heavy fines are at the bottom. If the soil like materials the top is the fluff. So, I am not saying they were doing this they probably did not have the fines, but I am told the same thing is done around Okhla block you allow the ways to come in and just pick up. You do not want to set up a presorting units to expenses. So, what do you say you tell a grab operator we pick it up from the top if you pick it out from the top, then it is the lighter material the lighter material is the plastics in the world and the cloth and the other thing anyway it goes to a furnace the only a message I would like to take tell you is that.

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There is a lot of ash which comes (Refer Time: 30:07) do not think a little bit of ash, it is a mountain of ash if you do not know where it is ends, I do not know, I do not know where it ends. And this is hazardous by the way, a nonhazardous waste. Why this hazardous? Because it has leachable heavy metals on it.

So, it has to be disposed off in a particular way ash may also be nonhazardous it is not necessary. So, it depends on what is mixed in your waste right. So, maybe Indian ash will be nonhazardous, maybe we are not as industrialized we do not throw. So, many chemicals into our municipal solid waste, but this has to be then put into a hazardous waste landfill. Or you have to fractionate it and see which part does not have the

leachable heavy metals see, when you burn something the heavy metals also vaporize and then you cool it is settled on to the outside. So, maybe the fly ash has more heavy metals the bottom ash may have less.

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So, that has to be seen in they had a separate unit for tires are difficult to dispose their non-biodegradable and you can recycle and retread and recycle and retread, but after that what you do.

So, here we make in Netherlands you wake up the tires and make them into very small pellets like gravel. So, the tire pellets can be used to substitute gravel in drainage beds you have a garden you know drainage bed, beneath it you have a golf course, you have a football field. So, you can put these to act as substitute for gravel.

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This is a construction and demolition plant at the Netherlands. Beautiful you would come out separately the rebars would come out separately, but important thing to see is the way the waste does been you know what it comprises off this is large, and this are the rejects which are coming out and eventually see this mount.

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So, it is a processed construction and demolition waste which you can use. And it is an expensive operation and finally, some shots I just showed you are composting of at

Hyderabad this is the municipal solid waste plus I think they were adding a little bit of crop residue or wood shavings I do not remember that is the municipal solid waste.

So, that is the windrow for the composting, that is the moisture being added every day and that is turning. So, you cannot have the windrow very high because you know to turn a lot of very high windrow is difficult you need a lot of mechanization here, they have it in I some of our places we do it manually. So, this is giving you this is the compost. So, learnings are many old composting plants and waste energy plants have not been commercially successful in India, they all working well in Europe and the Americas. America has a lot of land filling tradition it has a lot of land. Europe has very little land there is so many countries which are land Japan has no land. So, they do not even bother about composting they do not even who bothered about in recovering energy if they can find, if they cannot then it is incineration putting money to burn it.

So, that this much waste becomes. So, incineration is used as a waste transformation technique; that means, they are going to reduce the volume of waste by burning it. So, japan is an island they do not have land. So, they burn everything Europe is also into composting and burning and waste energy is big. America landfilling is more than waste energy because the lot of public backlash against toxins and other pollutants because everything you process has a side effect to it.

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Learnings / Impediments in India

- Many old composting plants and waste to energy plants have not been commercially successful
- Quality of input & Quality of products
- Odour
- Inadequate finances; tendency to treat waste as a resource and expect to generate profit
- In actual fact, waste processing facilities require significant financial support for sustenance.

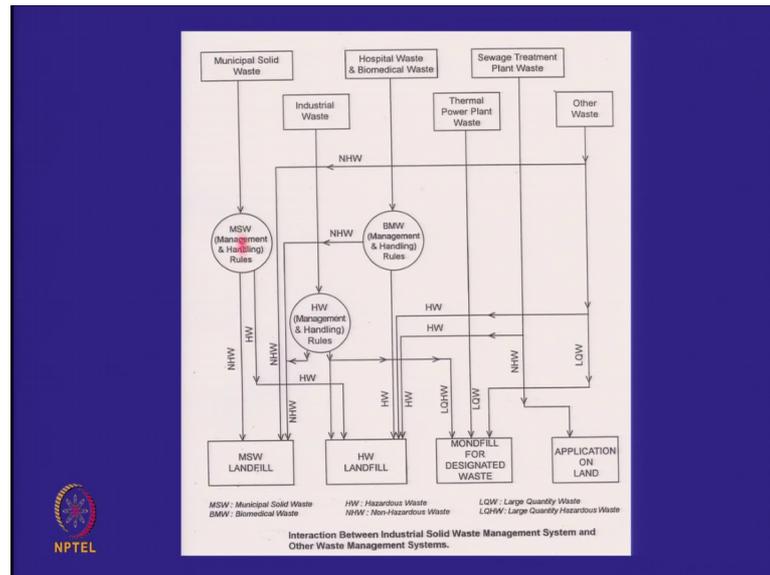
 NPTEL

So, in India these plants have not worked because of quality of input. You cannot use mixed waste produce anything good. You have to have separate fractions. If you do not have it your problem, therefore, the quality of product will not be do well. So, allopath was talking to me yesterday, he just come back from Shimla after seeing of waste to energy plant. He said I cannot believe it that that pellet is called RDF pellet they are made up they are making a pellet, but he says it is wet it is smelly; that means, it has got biodegradable component and he says it is no waste going to burned. Who it is in the industry is going to take a wet palette, but what are they doing they are getting the more coarse material and pulling it in a cylinder and pelletizing it is got moisture in it. So, they are not spending enough energy to dry it inside that.

Odour is a big problem wherever you set up a waste processing plant there is an odour issue in there and this is critical. So, you know these plants have to be away from 3 kilometers away from a habitat or they have to have very stringent odour control measures, which are very expensive in India the biggest cause of failure is inadequate finances. I just gave you an example if I can produce sand which is 700 rupees and the natural sand sells at 500 rupees, I have to subsidize the sand whose going to pay. So, the tendency of a municipality is to think that no I am giving him a resource (Refer Time: 35:23), I have given him raw material for free. So, you should be able to sell it and make the plant run. In all the overseas countries they are giving a tipping fee; that means, here is my waste and here is x 100 rupees extra per ton.

So, that that is your subsidy. So, now, you can sell it in India we are not paying a high tipping fee for waste processing facility. I am a great proponent of that, but people are saying no they should be able to make money from the waste as a waste is gold, which it isnt this is neither coal therefore, it cannot give you profit and waste is also not cow dung or other things which will give you a beautiful compost. So, that has been a big problem. So, waste processing facilities require significant financial support for sustenance.

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And that that will determine whether we are able to have successful facilities are not and good input. And finally, I just want to end this slide. We only talked about the municipal solid waste management stream, but we have a industrial waste management stream, we have a hospital waste management stream. In Delhi they are 2 thermal power plants there is a thermal power plant where management stream then their sewage treatment plants is the sewage sludge hazardous non hazardous where does it go and other waste.

So, a city will have a lot of streams and all of them have to be interlinked. And here sometimes everybody is doing things in compartmentalized manners the industrial development corporation will not talk to the municipal. So, how do the waste go from one stream to another there are a lot of internal engages, but never the less integrated solid waste management means please integrate all your streams.

So, with this I like to end here today. Just given you an overview that what a big city like Delhi, how it is striving to manage it is waste and from a perspective of environmental geotechniques. For the 100 units that we are producing today, if in the next 3 years we can reduce it to 50; oh that is a great task that we have done eventually we may be able to reduce it to 30. I am not so sure we can make waste disappear within the next decade.

Thank you and we will carry on in the next class.