Municipal Solid Waste Management
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Lecture - 36
Design of Landfill and Bio -Mining of Old Dumpsite

Hello students, so we are in the last lecture of module 11 on the disposal of solid waste. Under in this lecture, we will have some examples, for the design of landfills. This design is not the complete design of landfill, but some of the numerical which will be helpful for the preparation of your gate exam or maybe engineering services. I think these 2 only we will try here.

And also, there is one of the very important topics especially for India after the Swachh Bharat Mission that how waste we can bio mine the old dumpsites because there are a lot of old dumpsites was available. And because of Swachh Bharat Mission, many cities like Indore and many other cities are trying to clean the entire old dumpsites, because getting space also is very difficult for a special place to install the sanitary landfill.

So why not the same land same dumpsite could be useful for to start the new landfill site or new sanitary landfill site. Otherwise, I think some more maybe composting plants could be possible to use in the same location because many hundreds of acres of the area used by the old dumpsites. So first, we will go for numerical followed by biomining.

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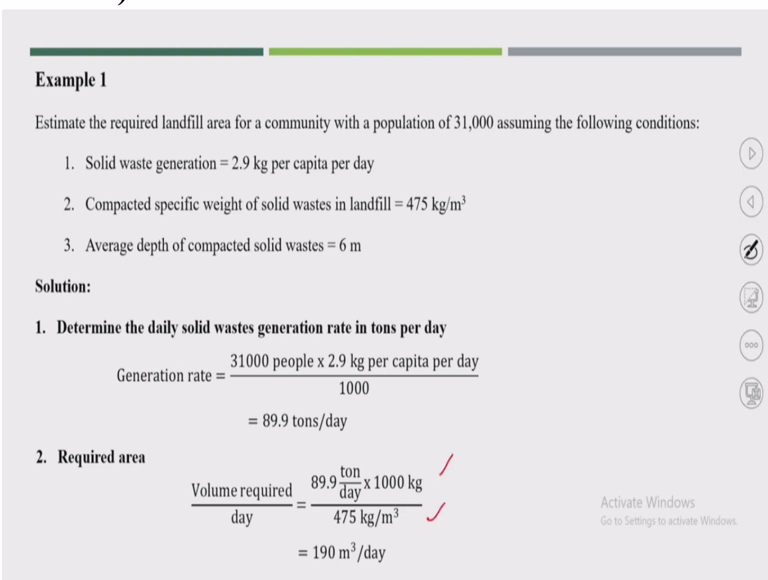

So, the first example we will see here the question is that estimate the required landfill area for the community with a population of 31000 assuming the following data or conditions solid waste generation is given 2.9 kg per capita per day per capita means per person per day and a compacted specific weight of solid waste, say density is given 475 kg per meter cube and average depth of compacted solid waste is given 6 meters.

So, we have to calculate how much area will be required maybe the area we can calculate in a year or maybe it is good to calculate in a year because that data is not given for how many years this landfill site could be useful. So the solution will start, first, we will calculate the daily solid waste generation rate in tons per day.

So, we know we have a population of 31000 and per capita generation per day was knowing 2.9 kg per capita per day. So to convert that kg to ton, we divided by 1000, and finally, the values came to 89.9 tons per day generation rate. Now we will go for a required area for that. So, area we can calculate by the volume available divided by specific weight or compacted specific weight.

And that also the specific weight is given in kg per meter cube and the generation rate we found 89.9 tons per day we convert that in the kg by multiplying 1000 and we calculated the how much volume will be required 190 meter cube per day. So this is the weight. How much is the weight divided by density.

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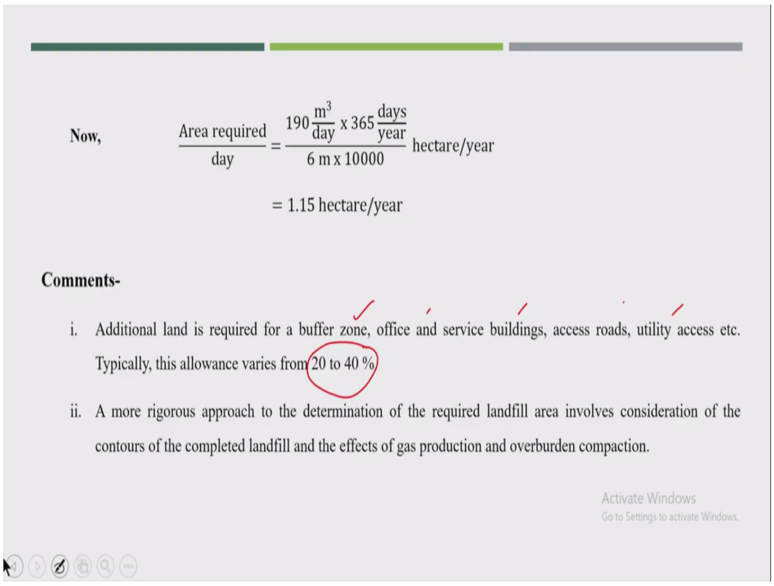

So now we will calculate how much area will be required. So we know the volume and we know the depth. So we will divide by the depth of this depth is given in the question. The average depth is 6 meters and this we are converting in the hectare. So hectare where if you divide by 10000, the volume will come up, the area will come up with hectare per year and per year we multiplied by 365 days in a year.

And now the area is coming 1.15 hectare per year. This is the answer that in a year this much area is 1.15 hectare will be required for disposal of waste from 31000 population. So, and I think few comments because this much area will be required for the disposal and also will be required 20 to 40% area as a buffer zone for office some service building access road some more facility will be required for the landfill area.

So, 20 to 40% area will be required in more. So, this is the answer you need not write, but suppose, the question is asked like how much total area will be required. So, you can put it that 20 to 40% of this area and the sum of which 1.15 hectare will come up with this much total area which will be required along with the waste disposal facility also some there is in the buffer zone for other facilities.

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Example 2

Determination of density of compacted solid wastes without and with waste diversion

- Determine the specific weight in a well-compacted landfill for solid wastes with the characteristics given in table.
- Also, determine the impact of resource recovery program on landfill area requirements in which 50 percent of the paper and 80 percent of the glass and tin cans are recovered.
- Assume that the wastes have characteristics reported in the given table-

Organic fraction | Inorganic fraction

Component	Typical % by weight	Specific Weight(Kg/m³)	Compaction factor
Food waste	9	291	0.33
Paper	34	89	0.15
Cardboard	6	50	0.18
Plastics	7	65	0.10
Textiles	2	65	0.15
Rubber	0.5	131	0.3
Leather	0.5	160	0.3
Yard waste	18.5	101	0.2
Wood	2.0	237	0.3
Glass	8	196	0.4
Tin can	6	89	0.15
Aluminium	0.5	160	0.15
Other metal	3.0	320	0.3
Dirt, ash etc.	3.0	481	0.75

Now, the next example is a determination of the density of compacted solid wastes without and with waste diversion. So, the question is that determining the specific weight in a well-compacted landfill for solid waste with the characteristics given in the table and also the question is asked to calculate the specific weight like in the previous question was to calculate the area.

Now, here is we have to calculate the specific weight and also determine the impact of the resource recovery program and what is the resource recovery program is saying that 50% of the paper and 80% of glass and tin cans are recovered. So, whatever the specific weight will get it for them without any waste diversion program will reduce the specific weight of 50% of paper and 80% of glass and tin.

And these are the data are given so; data are given in the organic fraction, inorganic fraction. So, you see here the up to wood this is the organic one and the remaining are the inorganic one. So, here the weight is given in the percentage is a total is 100% and the specific weight is given for each waste we have to calculate the total specific weight and also the compaction fraction is given.

So, after compaction how much will be the specific weight will remain after compaction because we have to calculate the well-compacted land field for solid waste that specific weight we have to calculate. So, the first will take the weight of the waste.

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Solution:

1. Set up a computation table with separate columns for-
   a) The weight of the individual solid waste components.
   b) The volume of the wastes as discarded.
   c) The compaction factors for well-compacted solid wastes.
   d) The compacted volume in the landfill.

Required table, based on a total weight of 1000 kg, is calculated.

$$\text{Volume as discarded} = \frac{\text{Weight (kg)}}{\text{Specific weight}\left(\frac{kg}{m^3}\right)}$$

$$\text{(For food waste)} = \frac{90\ kg}{291\ kg/m^3} = 0.31\ m^3$$

Component	Weight (kg)	Volume as discarded (m^3)	Compacted volume (m^3)
Food waste	90	0.31	0.102
Paper	340	3.82	0.573
Cardboard	60	1.2	0.216
Plastics	70	1.08	0.108
Textiles	20	0.31	0.047
Rubber	5	0.04	0.012
Leather	5	0.03	0.009
Yard waste	185	1.83	0.366
Wood	20	0.08	0.024
Glass	80	0.41	0.164
Tin can	60	0.67	0.101
Aluminium	5	0.03	0.005
Other metal	30	0.09	0.027
Dirt, ash etc.	30	0.06	0.045
Total	1000		1.8

So, those will first calculate the weight of the individual solid waste component. So, here what I did, I multiplied by 10 of each percentage under total quantity, I assume that 1000 maybe you can go for 10000 also 1 lakh or 10 lakhs you can do or you can put it 1 also. So, this is the total weight, and based on that we calculate the volume and after that compaction factor, we multiplied by that.

So, we will see one by one and finally we calculate the compacted volume. So, the volume we call volume as discarded. So, that we calculate weight divided by specific weight. So, we are knowing the specific weight of each weight we hear we kept by multiplied by 10 and we calculate likewise for food waste the 90 kg was the total weight and specific weight was 291 kg per meter cube. Finally, we got the volume that is 0.31 meter cube.

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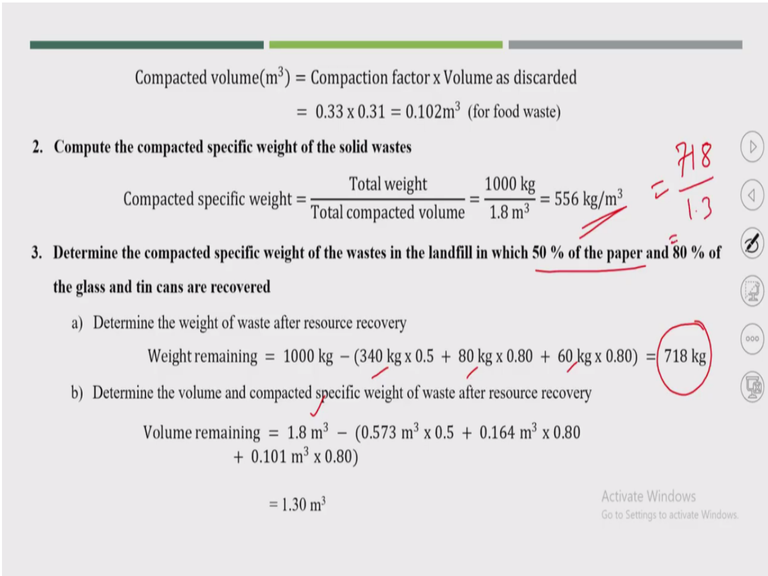

And then the same volume we multiplied by volume is discarded with the compaction factor. So, the compaction factor was 0.33 for food waste you see here so, 0.33 was the compaction factor. So, whatever the volume we got 0.31 multiplied by a compaction factor of 0.33 for food waste. So, we got the compacted volume 0.102 meter cube. Now, this is for the one waste. Now you see here likewise we calculate for all different kinds of waste.

And finally, we got the compacted volume of 1.8 meter cube summing up of all weights. So, the total weight is 1000 and the compacted volume is 0.1 meter cube. Now, we will calculate the specific weight. So, compacted specific weight obviously, that is weight divided by whatever was compacted volume. So, weight was 1000, volume was 1.8 meter cube. So, the compacted specific weight you got 550 kg per meter cube.

This is your answer to the first question. So, how much is the specific weight of well-compacted waste so, that that answer is 550 kg per meter cube. Now, another waste diversion program was given and told here the 50% paper and 80% of glass and tin can be recovered. So, that first will calculate the weight remaining. So, the total weight was 1000 and now, the total weight of the paper was 340 and glass was 80.

And for tin 60 and likewise weight multiplied by each value and finally, we got the volume. So, similar way remaining weight is 718. Now, the earlier the weight was 1000 and after 50% of paper recovered 80% of glass and tin recover will have remained with 718 kg. And now we calculate the weight remaining the similar way we add the total weight was 1.8 meter cube, we reduce volume from the paper glass and tin.

And finally, we got 1.3 meter cube of volume. Now, we can calculate the specific weight again of remaining waste so again the specific weight will be calculated as 718 divided by 1.3 so, this whatever the answer will come up here, this will be here a specific weight now, finally after recovery of paper, glass and tin, this is the final answer. So, I think these are very simple examples to calculate the area.

And to also calculate the specific weight of the waste. So, these are the very simple solutions by that way we can calculate the how much area will be required, how much the specific weight will come up into their compacted waste if you have the proper data, we can calculate that later on then we can design the leachate collection system for that actual problem is that in India there is no proper manual for the designing of these.

But I think if you want to learn that one for designing that, please read or download the solid waste manual 2016 this is available online on the website easily can be downloadable. And you can see that there are some equations are given by that way we can you can design that.

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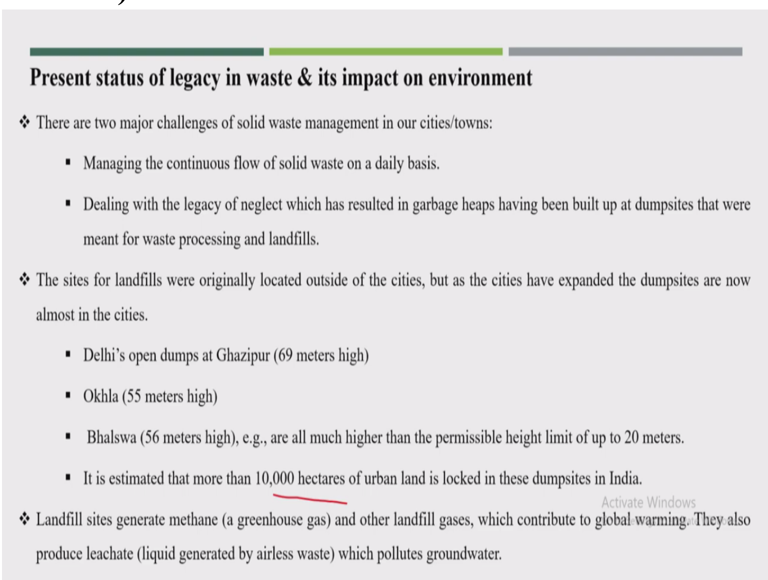

Now we will go for biomining or legacy waste. So, first, we have to see that the present status of legacy in waste and its impact on the environment. So, there are 2 major challenges of solid waste management in our cities or town the first is managing the continuous flow of solid waste on a daily basis. So, this is the very important point that so suppose, if you want to change the location also. So, before changing the location, you need to well aware of another location.

Because the everyday waste needs to be collected and disposed off properly and dealing with the legacy of neglect which has resulted in the garbage heaps having been built up in the dumpsite they were that means waste processing or landfilling. So this legacy waste has become a huge issue and normally this site of the landfill was originally located outside the city but the city has expanded and the dumpsite is now almost in the city.

So I think wherever your city is there in India try to visit the disposal site the earlier because when any particular city they tried to finalize the location. So, the idea was the very simple idea was a location just outside of the city some low lying area so that we can get more volume and easy to transport are the collection costs should be as low as possible, that was the thought, but what has happened because the population has been increased in the city.

You know that lot of rulers people are they are trying to come to the city area and even nearby these kinds of dumpsites a lot of people are working, I think, for collection of recyclable matter to one by one, I think in the small example, if I will give in Guwahati itself, there are 500 different families are residing nearby dumpsites. So, once they will be live it for 10 years or 15 years after that lot of population also will be nearby.

So, likewise and the cities are extending now, so now many cities like if you visit Trichy in Tamilnadu that dumpsite is almost it is the center of the city. Now, because the cities have been extended so far. But now, I think the problem is that the dumpsite is almost in the middle of the city, now that waste becomes a huge issue because the and you know that see already in the previous lectures I told that the monitoring after the closing of the landfill for 20 to 25 year again the monitoring is required for 15 years.

I should not be allowed any kind of construction, any kind of habitation in that area from starting is almost 40 years you cannot live nearby those areas are not habitable those areas now it is a very big issue for the local authority or local corporation. So, how based they can recover that particular location or those legacy ways they can dispose in some other area like I have some data of Delhi open dumpsite, Ghazipur whose maximum height I think is 69 meter.

Okhla 55 meter and Bhalswa 56 meter all are much higher than the permissible height limit of 20 meters and you know that they already have the area of 10000 hectares of urban land, see in Delhi kind of city where these waste took almost 10000 hectares waste area is a very big issue for that particular city and also a lot of problems still coming in those particular areas.

If you go to the Okhla, every time the nearby habitations they will always have the issues about water issue or even the leachate issue always they are seeing in the nearby area and because the landfill site generates greenhouse gases methane and which contribute to global warming also and a lot of health issues are coming because of that by producing leachate which polluting the groundwater also.

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So, this is what one open dumping site, you can see here. So, many municipal authorities across the country are opting for capping as a solution for the legacy of mixed waste capping. So, I think some of the city what they understood by capping I think they close the entire area and put up the soil onto the field with the soil onto the top if you can visit Surat the dumpsites, what they did they the entire area they capped completely and filled with the soil on top of the waste material.

So if you visit that you will see that is a pure soil, soil, soil everywhere but in the bottom, waste sealed soil available and obviously the entire degradation would not be possible so early, so the leachate will always go into the groundwater the nearby habitations will always have the problem not for air pollution but for groundwater issue will be always there. So, what has been done here like in ours Solid Waste Management rule 2016, the schedule 1 clause J has been properly explained how waste we can bio mine this particular area or how waste we can capped such kind of dumpsites.

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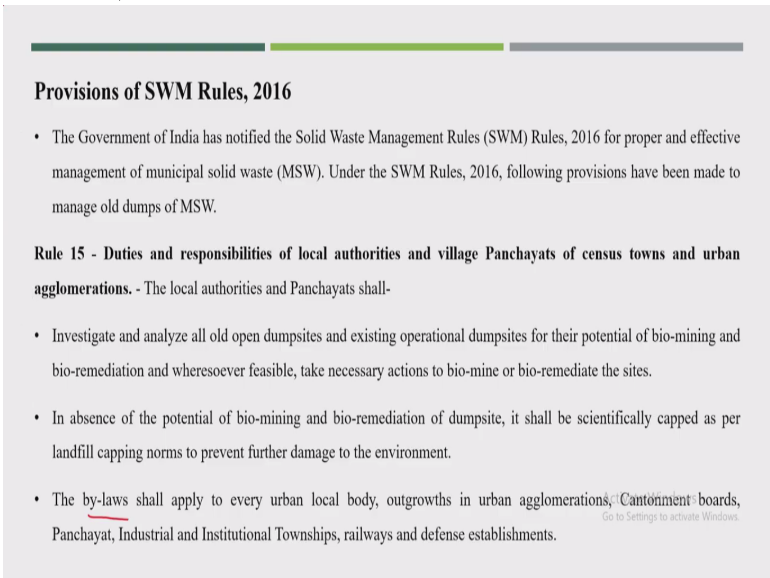

So, what provision has been given in the SWM rule. So, the provision is that the Government of India has notified the Solid Waste Management rule 2016 for proper and effective management of solid waste management and following provisions has been given that is in rule 15 where the duties and responsibility of local authorities or village Panchayats of census towns and urban agglomerations the authorities and Panchayats shall.

Investigate and analyze all open dumpsites and existing operational dumpsites for their potential of biomining and bioremediation and wheresoever feasible take necessary action to bio mine and bioremediate the sites. That was the one special duty are given to the local authority these local authority could be corporations you will be or even the village Panchayats which coming on to the essence census towns.

So, in the absence of the potential of biomining, bioremediation dumpsite, shall be scientifically capped as per the landfill capping norms to prevent further damage to the environment. So, it has been explained that if suppose, the waste does not have the potential of biomining bioremediation, so need to have proper scientific capping not like just filled with the soil on top of the waste material.

But I believe that in India, the mixed waste will how a lot of the easy biomining of bioremediation could be possible. And also had been asked that by-laws shall apply to every urban local body, outgrowths in the urban agglomeration, Cantonment board, Panchayat these and also this kind of biomining could become up through the by-laws. So easy to work on to the biomining projects.

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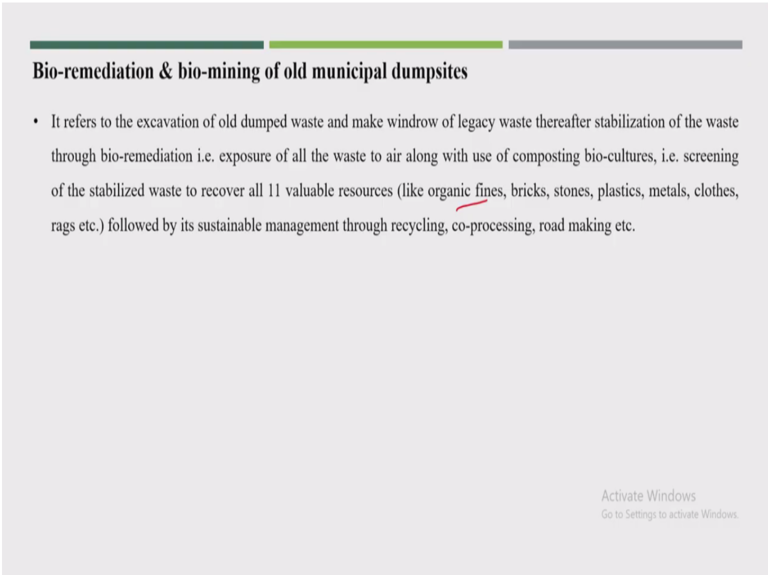

So what do we understand by bioremediation or biomining of old dumpsites, it refers to the excavation of old dumped waste. The first it refers when you say the bioremediation or biomining specially, this biomining word refers that excavation of old dumpsite waste, make windrow of legacy waste, windrow you please remember that when I talked about windrow composting.

So make the windrow a similar kind of windrow thereafter stabilization of the waste through bioremediation. So, they propose that through bioremediation means some kind of culture bacterial culture you add it into the waste so that whatever is the degradable matter will get degrade as early as possible and are they say exposure of all waste to air either air along with the use of vermicomposting bio culture and then followed by a screening of stabilized waste to recover 11 valuable resources.

That also has been explained like organic fines, bricks this organic fines I think this is what we called it is a city compost, but I think saying compost is not a proper word, but I think earlier we used to talk about that was a compost, but it is a proper word is organic fines bricks, stones, plastics, metals, clothes, rags and other under followed by sustainable management through recycling and co-processing.

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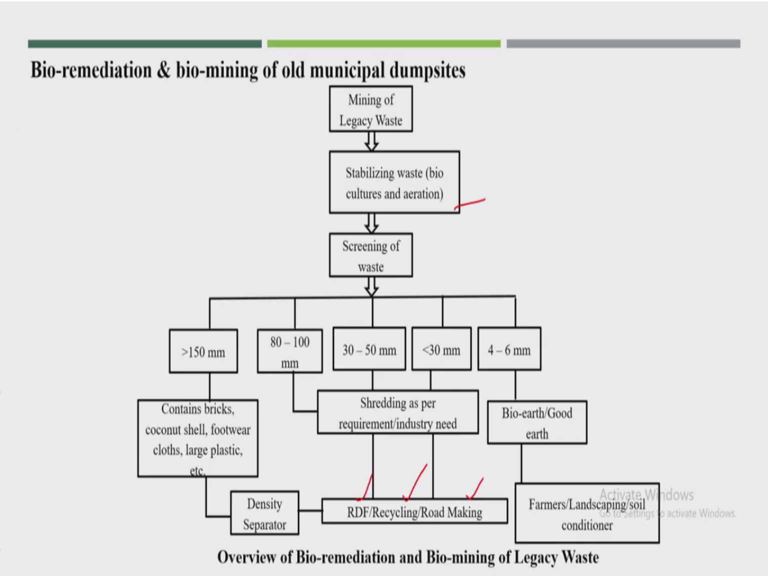

So, this is the complete flowchart you can see that biomining, so, please understand properly here. So, when you say the biomining first is the stabilizing waste means that is a windrow go for windrow and to provide proper aeration and try to add some bio culture for the degradation process. Once the degradation will get over the material will get dry completely under the windrow.

We will go for a screening of waste. So screening of waste in the different sizes the size of more than 150 mm goes to the this could will content like bricks, coconut shell, footwear cloths likewise the different size will have the different kind of compositions like 4 to mm size this could be a mostly a bio earth or we are talking about organic fines. So could be useful for the farmers or can be useful for the soil conditioner.

Remaining that most of the materials could be possible to use it for RDF process or could be useful for the recycling process, maybe some of the materials could be useful for the road construction purpose also could be possible some particular size.

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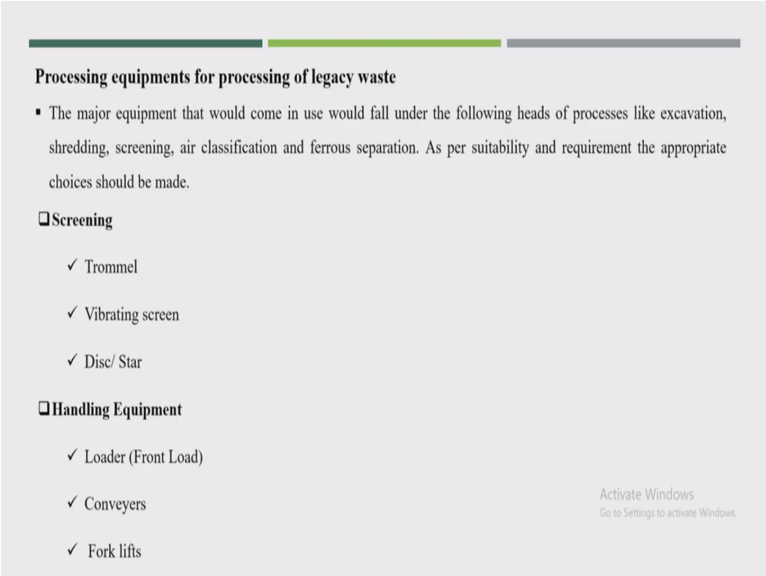

So, the processing equipments for the processing of legacy waste, the major equipment that will come in the use would fall under the following heads are processing like excavation, this is the few important processes like excavation, shredding, screening, air classification or ferrous separation. So, for screening, you will be required trommel remember that these trammel segregation I talked in the composting process.

So, a centralized composting facility or the trommel facility for waste screening or otherwise vibrating screen also can be possible or discrete. These screening also we discuss into the recycling lectures and some handling equipments like front loader, conveyor facility forklift these kinds of organic equipments will be required.

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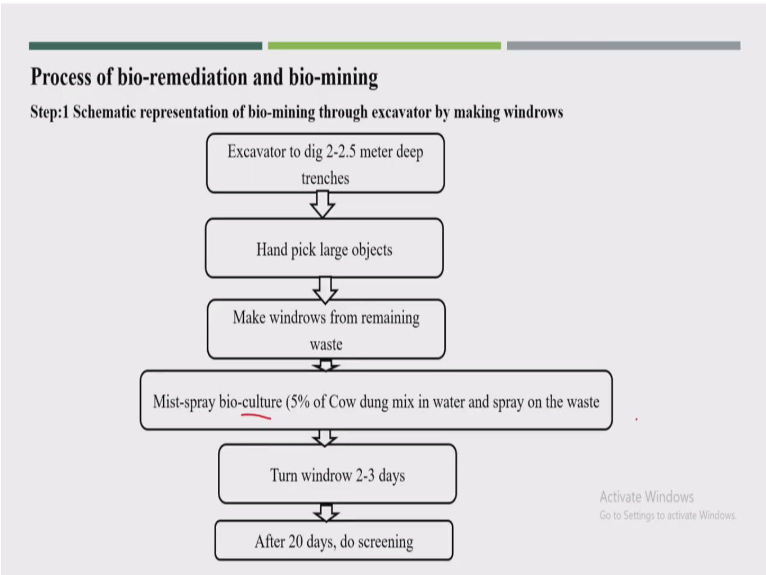

Now, the process of bioremediation and biomining the first step will be the schematic representation of biomining through excavator by making windrows. So, how to make the windrow this is also has been explained properly under over solid waste manual, the first go for excavation to dig 2 to 2.5 meter deep trenches and go for excavation and a handpick the large object while the big particle size or maybe some recyclable matters could be handpicked and then make the windrow from the remaining waste.

So, try to get whatever the handpick could be possible that recyclable matter or large material which could be utilized for some other purposes. Otherwise, you go for windrow remaining waste, and when you go for windrow add the 5% of cow dung mix in water and spray onto the waste that could be your bio culture. So, other than purchasing commercially available bio cultures you can simply 5% cow dung you mix into the water and that you can put it or the spray you can put it onto that particular windrow.

Turn the windrow by 2 to 3 days and after 20 days do screening, maybe 20 days 30 days are well enough for the degradation of whatever organic fractions are available there.

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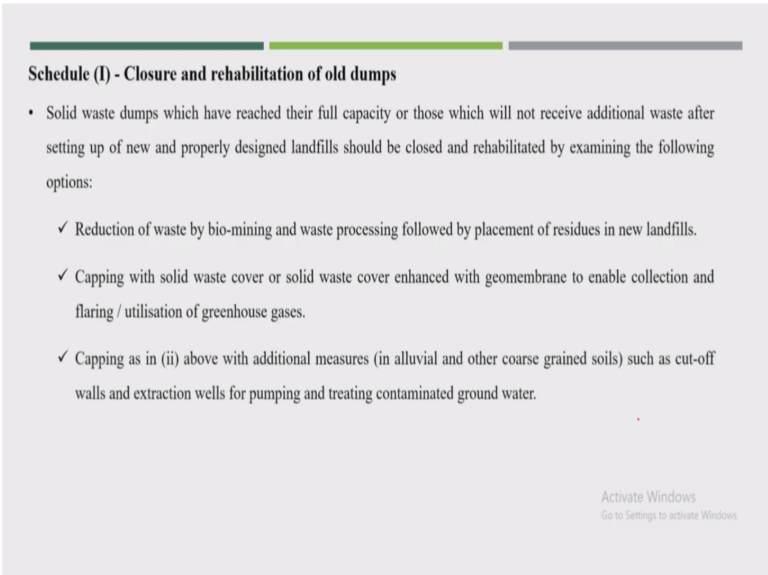

So, the closure and rehabilitation of old dumps solid wisdom which have reached their full capacity are those which will not receive additional waste after setting up of new properly designed landfills should be closed and rehabilitated by examining the following options. So, could be by reduction of waste by biomining, waste processing followed by placement of residues in new landfills. Capping with the solid waste cover or solid waste cover enhanced with a geomembrane to enable collection and flaring utilization of green gases. Or another capping with the additional measures could be possible.

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So I think important is that excavations of dumpsites. So this is the way we can excavate 2 to 2.5 meter depth to excavate or to dig 2 to 2.5 meter deep trenches.

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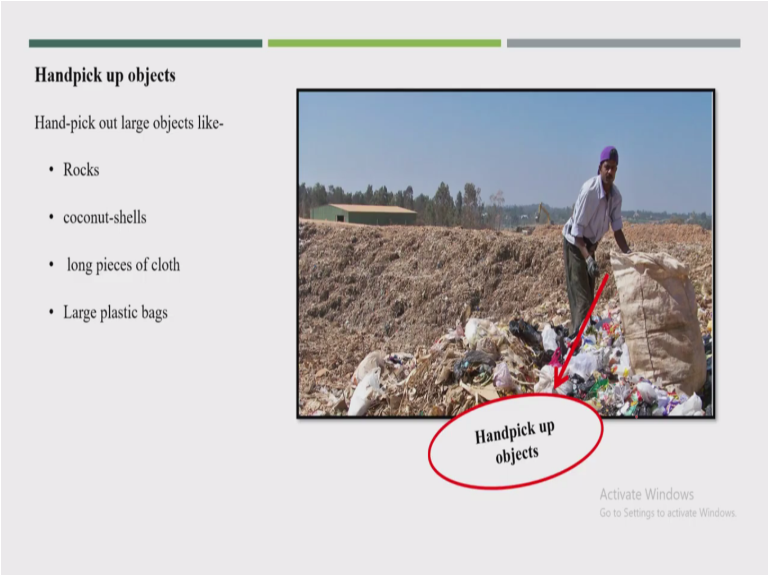

Then handpick the objects like you can see here the hand picking. So try to call the human you can call in this case a lot of block pickers are there available in most of the landfills, ask them to handpick the material, but I think use the proper gloves even the on mouth also try to use your cloth also should be somewhat good should not have any problem while hand picking. So handpicking could be that rock, coconut shells, large pieces of cloths, large plastic bags.

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Then we will go for windrow, so this is what I think windrow this similar kind of composting windrow, but try to go for as small as possible so, that you can turn very easily. So, windrow consists of placing the mixture of raw materials in long narrow piles called windrows almost all of them involve forming the waste into long low heaps of about 1 meter height called windrows to get a maximum surface area to volume. Usually 3 to 4 turnings of legacy waste necessary to stabilize it. And use an excavator to dig deep trenches downward from the top of legacy waste.

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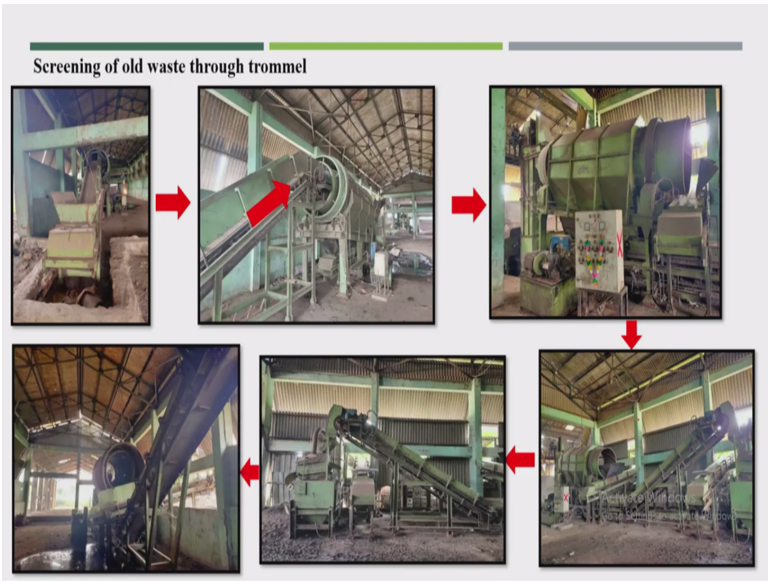

And now after 20 to 30 days go for screening. So, the first you feed it into the first trommel so, this fascinating you remember that the similar kind of pictures I showed it into the centralized composting facility. So, and I especially believe that now, we are in the old dumpsites already those composting facilities are available, why not utilize the same facility their centralized trommel based composting facility for screening off the legacy waste. And this is another trommel and finally, the last trommel that 4 to 6 mm.

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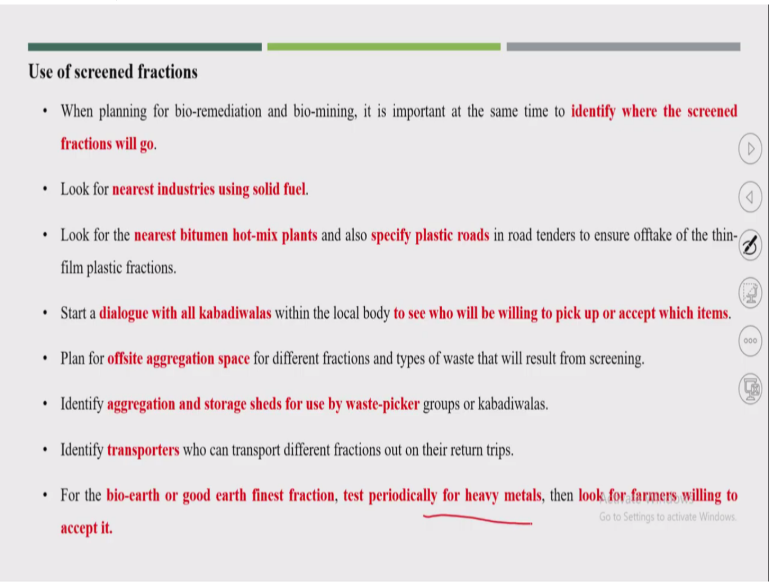

So, what could be the use of screen fractions when planning for bioremediation or biomining it is important at the same time to identify where the screened fractions will go. So, look for nearest industries using solid fuel see, again you remember that when you are planning for biomining, so is not only the excavation handpicking or windrow also, this point is important that what you will do with the screen material.

Because that is also needs to be known otherwise what will happen you screened it and again it will remain in the same location. So, first could be possible that try to find out the nearby industries which can be used that this particular material for does in engine fuel, maybe these dry material, the paper, plastic and that is highly compostable matter can be used as a fuel. Look at the nearest bitumen hot mix plants also specific plastic roads in the road tenders to ensure off-take of the thin-film plastic fractions.

So, it is also possible this kind of material can be used for bitumen hot mix plants or specific plastic road also can come up and the started dialogue with all kabadiwalas within the local bodies to see who will be willing to pick up or accept which item. So, this is also a very important point I tried to put here because there are a lot of kabadiwalas are there these are informal, purely informal sector.

So, this is also possible that you call all the kabadiwalas and ask them this is all segregated material we have available with us if they are able to get it that. So, that is also good, that is beneficial for us also as in local authority, also beneficial to the kabadiwalas they can put it that that particular faction for again for either recycling or they can sell it to the other industries.

Plan for offsite aggregation space for different fractions and types of ways that will result from the screening. So, along with that, I think you have already been in contact with the local people or which can be utilized these kinds of material but also plan for the offsite aggregation space, where we can put these all these factions in different locations. Identify aggregation storage sheds for use by waste picker groups to kabadiwalas.

Because see, when any kabadiwalas will also accept that for them also, they can again segregate the material, they can again screen and thereby putting a lot of manpower because they have long rag pickers are working with them. So for them, I think is good I think you can put one particular shed or some storage facility. So in any kabadiwalas can come in can collect the waste material.

Identify transporter who can transport the different fractions on their return trip. This is also one important point because in kabadiwalas if you can provide them one particular transport that is also beneficial. For the bio earth or good earth finest fraction, test periodically for heavy metals, so, this is the important one. So, whatever I was talking about the organic fraction that 4 to 6 mm that tests periodically for heavy metals why.

Because suppose if you do not find much heavy metal into that, try to find some farmers which are willing to accept it. But I personally believe that farmers would not show that that kind of willingness, but at least for horticulture purposes you can use such kind of material, but check for heavy metals, but it will how the lot of metal percentage into that.

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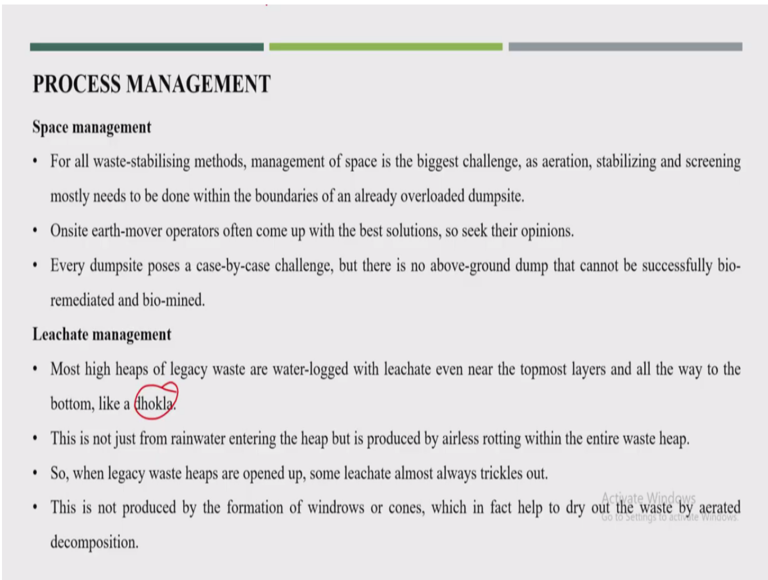

For Process Management like space management has to be there because all these facilities like windrow facility and segregation facility you will require the proper space and along with that the other operations like earthmovers operations you will be required space and every dumpsite poses case by case challenge but there is no above-ground dumb ground them that cannot be successfully bio remediated by bio mined.

And along with space also one important factor is leachate management. Now you will say that surf from where these leachate has come up say this is the old dumpsites and in rainy season a lot of water will be available into the dumpsite and there is the water will be not only in the bottom but in the top area also the water will be like. So you can see that most high heaps of legacy waste are waterlogged with leachate even near the topmost layer and to the bottom this is I put it like dhokla.

A simple way where from the top to bottom say waterlogged. This is not just from rainwater entering the heap but it is produced by airless rotting within the entire waste heap. Because the degradation will be always there. So because of that, the water will also produce, so when legacy waste heaps are opened up, some leachate almost will come out and this is not produced by the formation of windrows or cones, which infact, helped to dry out the waste by aerated decomposition.

So also be ready some drains you provide for such kind of leachate and when you are going for the windrow facility and there is a chance of that leachate will come out. So wherever I think window you are planning a plan for proper drainage or collection of this leachate.

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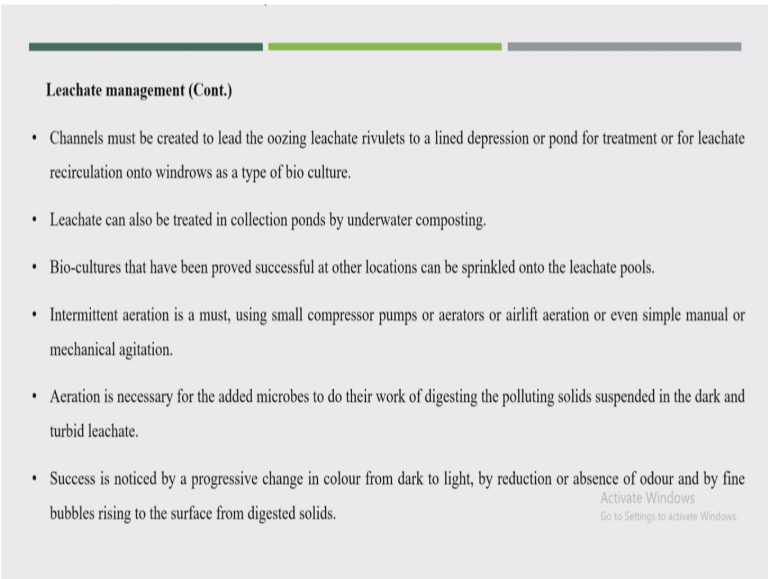

And this leachate management this channel must be created to lead this particular leachate from windrow facility under what we will do with that leachate again you recirculate into the windrow on top of the waste material so that the that can be also used as in bio culture or you can mix with the bio culture and again you can put it into the windrow facility. Are leachate can also be treated in collection ponds by underwater composting?

Also can be treated, but I think this will be a somewhat costly process and bio culture that has been proved successful at other location can be sprinkled on to the leachate pool also the intermitted aeration also will be beneficial and aeration is necessary for the added microbes to their work for digesting the organic matter. And how we can find that how is a beneficial by addition of bio culture or addition of aeration. By changing the colour from dark to light, if you can find you will come to know that the leachate is getting treated.

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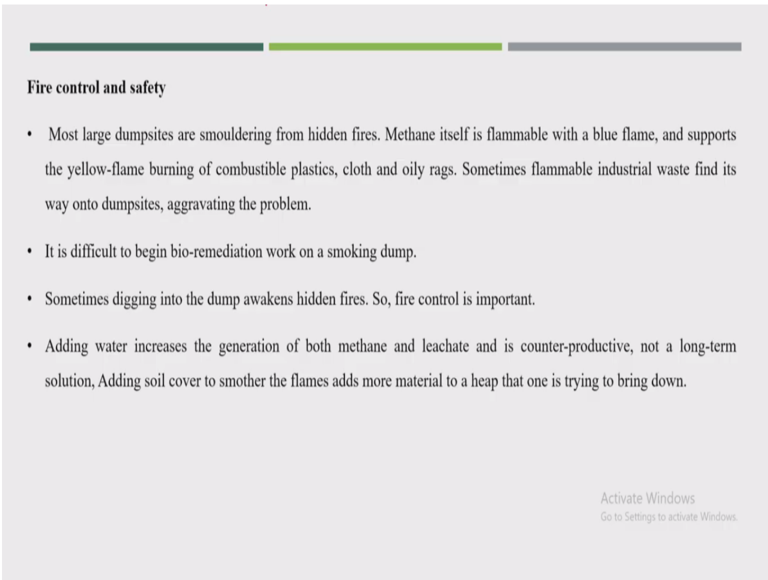

Now fire control and safety this is also one important understanding large dumpsites are could have hidden fires because it contains methane. And many times when you excavate the dumpsite you will find some flames are coming out from the bottom. So it is difficult to begin bioremediation work on smoking dumps. So sometimes digging into a dumb awakens hidden fires. So that fire control is important.

By adding water increases the generation of both methane and leachate. So, could be possible you add water to that but again it will increase the methane production leachate problem will come up but I think is good rather than water add to the soil. So, the soil cover to smoother the flame adds more material to the heap than when it is trying to bring down. So, the addition of soil is much beneficial.

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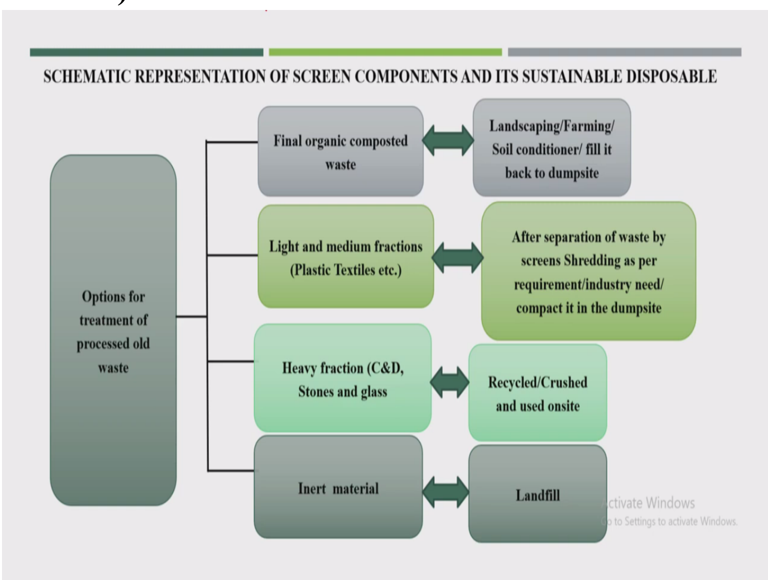

Now schematic representation of screen components and their sustainable disposal. So, this is the again simple explanation like the segregated material or screen material component and what could be the sustainable disposable for that, like for final organic compostable waste can go for landscaping farming can be used as a soil conditioner or fill it back to the dumpsite. That daily cover you can make out of that light and medium fraction can be after separation of ways by screen shedding as per the required industry need compacting to the dumpsite.

So these light water like plastic, textiles many industries can be utilized very easily, like high fraction like C and D waste construction demolition waste stone, glass, wood can be recyclable, or also can in some industries can be utilized and remain that inert material again can go for new landfill sites.

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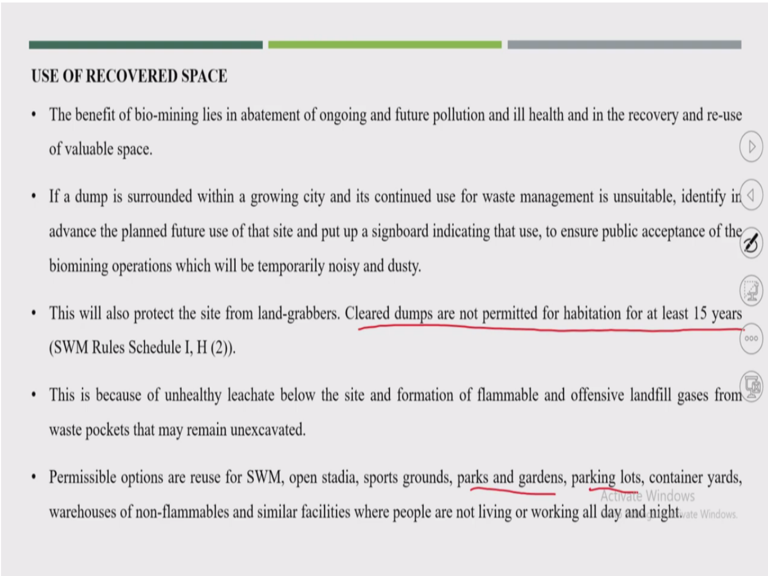

So, what could be the use of recovered space I think once you clean the entire area also have to see that because that will be a valuable space. Now many locations are in the middle of the city. So what we will do with that, is a dump is surrounded within a growing city and is continuously used for waste management is unsuitable, so that we can plan for recovering that particular space.

But the clear dumps these clear dumps are not permitted for habitation for at least 15 years. This is based on the SWM rule schedule 1, H_2 is specially is writing like the clear dumps are not permitted for habitation for at least 15 years. There should not whether it is a very close to the city whether is the center of the city but should not be used for any habitations. This is because of unhealthy leachate below the formation of the site of flammable offensive landfill gases from waste pockets.

See, because we dug up to 2 to 2.5 meter because we thought of because there is a maximum depth in the earlier days goes to like this but still because a lot of leachates has been added into the earth is already leachate is there and because of that a lot of waste pockets some polluted gas will come up and these kinds of issues will be always there. So, what could be the permissible options, what could do in that particular site for at least for 15 years can have some park or gardens or even parking lots.

You can make it that particular area and it is good to grow something in that particular area, maybe the park is the best idea for our garden you can make it but I think and for the initial period also do not allow the local people in that garden for at least wait for 5 years or in time to time collect the gas in that particular area gas samples, try to collect it and also check the groundwater time to time.

So that you will see that by biomining that particular location, how waste you recovered the groundwater quality or recovered the local atmospheric conditions. So, if you see the 2 cases, I think I come up with 2 cases successfully where biomining has been done.

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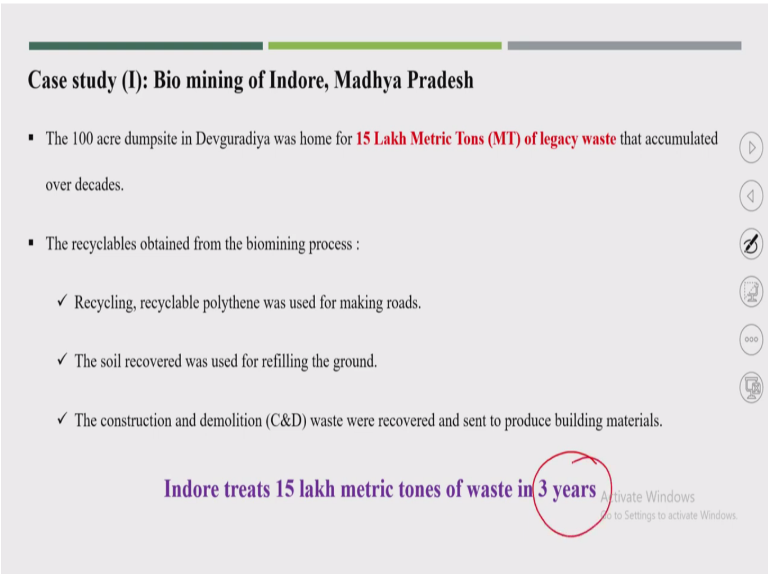

So, the first is Indore I think it is one of the cleanest cities in India is the best clean city. So, they had 100 acre dumpsites in Devguradiya was home to 15 lakhs metric tons of legacy waste and that accumulated over decades. So, when they started biomining their idea was to get the recycling it is recyclable polythene was used in road construction. Soil recovered was used for refilling the grounds.

And construction demolition was recovered and sent to the production building materials. So, that material had been utilized further. And Indore treats 15 lakh metric tones of waste in total 3 years period it is similar kind of facility biomining facility.

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Now, you see here, this was the old-time, see here this was the old dumpsites. Now, you see here the same location this has become like this. Now, nobody can say that these were the old dumpsites. Now, these particular locations are you can see here in this photograph, you can see a lot of habitations very close to the dumpsites. And now, if you ask anyone, anybody will want to have a habitation in this area. And need to see that there should not be any habitation in this particular area.

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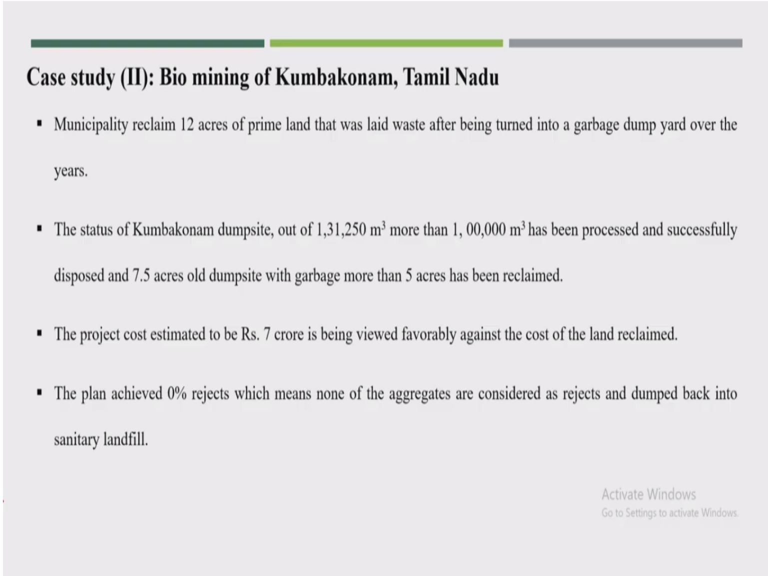

So, another case of Kumbakonam in Tamilnadu is also very, I think one of the best or successful stories of biomining of legacy waste the municipality reclaims around 12 acres of prime land that was laid waste after being turned into a garbage dump yard over the years. The status of Kumbakonam dumpsite out of 1,31,250 meter cube more than 1000 meter cube has been processed and successfully disposed and 7.5 acres dumpsites with garbage more than 5 acres has been reclaimed.

The project cost was around 7 crores that were required and the plan achieved 0% rejects which means none of the aggregates are considered to be rejected and dump back into the sanitary landfill. This is also a very important point no rejects have remained. So everything has been utilized for some other valuable purposes.

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So if you see the photograph, so this was the old one old site. Now, if you see here the how clear area this bigger there is also a lot of habitations nearby area. So, this is also very important now, the legacy waste management and the facility I see the cost also one of the projects I told about 7 crores this also would not be required much because many cities have the trommel facility for SM composting facility.

So, why not the same facility can be utilized for biomining purposes. So, but still, there are a number of cities are remained with the legacy waste. And I think everyone has to look, but see any city can start the biomining, but they should have an alternate site that is available and alternate site not like similar kind of dumpsite then what is the benefit of biomining of the old landfill. So, first, you plan or construct the central landfill start the disposal in the new landfill area.

Close this particular site, close means the fresh waste should not be added into this old landfill then wait for few times few months and then you start the biomining of this particular area. So, likewise, we can do and also remember that once you take it out entire material but try to fill it with the soil again you do the capping of that particular site which you saw in the 2 photographs Indore and Kumbakonam what they did once they collected entire material from that after that they filled with the soil.

Soil means is the one kind of capping they did in the entire location so that polluted gases should not come out but they cannot work for the leachate now and slowly that leachate the concentration of leachate into the ground that will also be reduced with time. So and based on the rule suggestion 15 years you cannot operate. Later on, you can have any kind of habitation into that, but still, I believe that habitation should not be there.

So, other facilities could be for the purpose that can be utilizable or otherwise if you can reclaim the same site and the site is still far away from the city or in the outskirts of the city, you can again work for the sanitary landfill in the same location. This is also possible because many cities do not have alternate locations for them. So go for biomining or otherwise If you out do not have any alternate location parallelly you work for biomining also and parallelly sanitary landfill also you operate in a similar facility.

But the space requirement will be large in that case. So I think here we are finishing our disposal module and here we finish all the 6 functional elements of the syllabus. But again, I was thinking to add a few more modules. Here, especially we did not much talk about spatial waste like construction demolition waste. And also although e-waste or biomedical waste is separate lectures are a separate course to study because their management treatment entirely different, different ways are possible.

But still that e-waste and biomedical waste construction demolition waste are available in the city area. So I thought about how one particular model onto that and finally, we will go for the rules and regulation and integrated waste management facility that we will discuss in the followed lectures and modules. So thank you.