

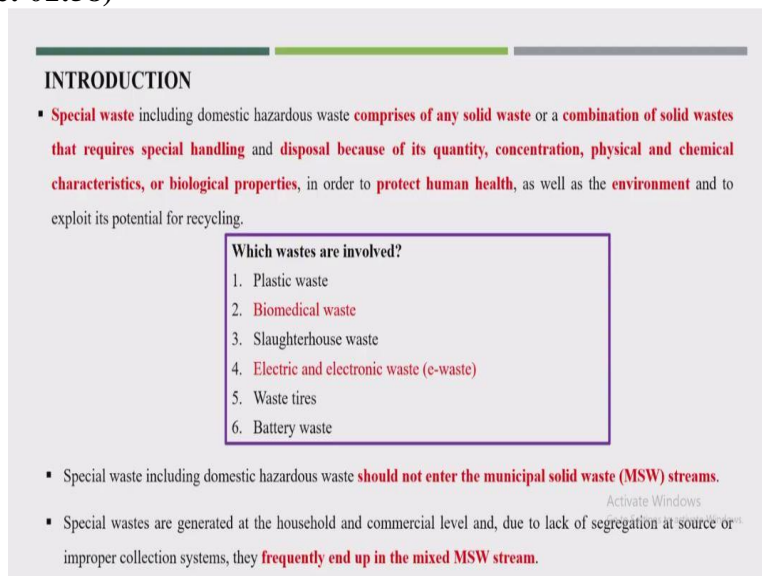
Municipal Solid Waste Management
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Lecture - 38
Management of Bio-Medical, E-Waste and Inert Waste

Hello students, so we are in the 2nd lecture of module 12, particular waste. And in this lecture, I will talk about the management of biomedical e-waste and inert waste. This is just an introduction about these kinds of waste because you need to well aware of these kinds of waste. After all, even biomedical waste e-waste are getting generated in the residential area, even the biomedical waste generated from the household area, even e-waste is also getting generated from the residential area.

So, it needs to be also discussed and but their management collection is different treatment is also different rules also are different for that. Still, I think it needs to aware how these wastes are getting separated from the MSW waste because these waste should not be reached to the sanitary landfill of MSW or whatever treatment facility we talked about in the previous lectures like biological treatment or chemical treatment process, these kinds of wastes should not be reach into those facilities.

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INTRODUCTION

- **Special waste** including domestic hazardous waste **comprises of any solid waste** or a **combination of solid wastes that requires special handling** and disposal because of its quantity, concentration, physical and chemical characteristics, or biological properties, in order to **protect human health**, as well as the **environment** and to exploit its potential for recycling.

Which wastes are involved?

1. Plastic waste
2. Biomedical waste
3. Slaughterhouse waste
4. Electric and electronic waste (e-waste)
5. Waste tires
6. Battery waste

- Special waste including domestic hazardous waste **should not enter the municipal solid waste (MSW) streams.**
- Special wastes are generated at the household and commercial level and, due to lack of segregation at source or improper collection systems, they **frequently end up in the mixed MSW stream.**

So, first, we will talk about the particular waste, which in the last lecture, I spoke about construction demolition waste. Usually, when you talk about specific waste, though sees the C and D waste not consider is not specific waste. So, the definition of particular waste is given, including

domestic hazardous waste comprises of solid waste or a combination of solid waste requiring special handling particular disposal because of its quantity, concentration, and different characteristics, different biological property.

To protect human health and the environment, this is the proper definitions of particular waste. So, these C and D waste do not come under a specific waste, but I thought of doing one specific module. So, in the same module, a particular base module, I thought of including the C and D waste, which I had discussed in the previous lecture. So, when you talk about specific waste, it is typically characterized as plastic waste, biomedical waste, slaughterhouse waste, e-waste that is electrical, electronic waste, waste tires, and battery waste.

The significant classifications are the special waste today because I will talk only about biomedical waste and e-waste because of their large quantity, plastic waste, we already spoke onto the MSW. Also, we spoke, but the slaughter out waste base style is separate, although they are also produced in the municipal area. But I think the more enormous challenges are biomedical and e-waste.

So, special waste, including domestic hazardous waste, should not be entered into municipal solid waste streams. So, whatever that dust bin was provided whatever the treatment facility or sanitary landfill who designed for MSW, these waste should not be entering such facilities and special waste are generated at the household, and commercial level due to the lack of segregation at source improper collection system and they frequently end up into the mix MSW waste.

You will see a lot of household biomedical waste like a tablet or even a lot of liquids are getting mixed into the MSW, and other hazardous waste also is getting integrated into the MSW because of lack of facilities. Also, e-waste like battery usually disposed into the MSW only, but that battery has to be collected. The special rule is available for battery waste disposal, but I think we do not have that kind of facility right now in our country or most developing nations.

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Special waste management including domestic hazardous waste – Guidance from the integrated solid waste management (ISWM) hierarchy

- Reuse
- Recycling
- Waste that cannot be reduced or minimized should be reused (resource recovery) and recycled.
- Electronic waste (e-waste) can be reused or recycled.
- Biomedical waste should not be recycled and should be appropriately treated and disposed of to prevent hazardous impacts of undesirable dumping of these wastes.
- Recycling of special wastes including domestic hazardous waste provides economic as well as environmental benefits and reduces reliance on virgin materials.

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So, this special waste management, including domestic hazardous waste, the guidelines from integrated solid waste management hierarchy wise, if you see that should be reuse, recycle and waste that cannot be reduced or minimize should be reused or resource recovery. The e-waste can be reuse or recycle biomedical waste should not be recycled and should be appropriately treated and disposed of to prevent the hazardous impact of dumping of such waste.

So, mostly the biomedical waste goes to the incineration facilities, and very few concentrations are only getting recycled, but that is only the plastic is coming from the biomedical facilities. Also, recycling special waste, including domestic hazardous waste, provides economic and environmental benefits and reduces the reliance on virgin material. And this is not only for the special waste but for the even for MSW.

If you can reuse paper or plastic, rubber leather, metal tin glass, C and D waste, even e-waste, even some biomedical waste could be possible to reuse. So it is always beneficial because we will be required less virgin materials and is suitable for the environment. First, we will start with biomedical waste.

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Biomedical waste

- ❑ Biomedical waste is **generated during the diagnosis, treatment or immunization of human beings or animals or research activities** pertaining thereto or in the production or testing of biological or in health camps.
- ❑ The biomedical waste shall be **disposed off** in accordance with the **Biomedical Waste Management Rules, 2016**.
- ❑ The Schedule III of the Biomedical Wastes Management Rules, 2016 mandates **local authorities such as gram panchayats, municipalities or corporations to provide or allocate suitable land for setting up of Common Biomedical Waste Treatment Facility** in their respective jurisdictions as per the guidelines of CPCB.

Site selection authority for common biomedical waste treatment and disposal facility

1. The department in the business allocation of land assignment shall be responsible for providing suitable site for setting up of common biomedical waste treatment and disposal facility in the State Government or Union territory Administration.
2. The selection of site for setting up of such facility shall be made in consultation with the prescribed authority, other stakeholders and in accordance with guidelines published by the Ministry of Environment, Forest and Climate Change or Central Pollution Control Board.

So, this biomedical waste generated during the diagnosis, treatment or other activities in the hospitals. So these biomedical waste shall be disposed of under the biomedical waste management rule 2016, and schedule 3 of these biomedical waste rule 2016 mandate the local authority, such as Gram Panchayat municipality or corporation or any you will be provided to allocate suitable land for setting up a typical biomedical waste treatment facility in their respective jurisdiction as far as guidelines of CPCB.

So, this schedule 3 must be implemented in every corporation or every urban centre to have provided one centralized or common biomedical waste management facility. So they are the not only the storage, segregation, some recycling and final disposal, maybe incineration or landfilling also has to be provided in that particular facility. Under schedule 3, site selection is essential.

The department in the business allocation of land assignment shall be responsible for providing the suitable site for the setting up common biomedical waste treatment facility in those in the state government or urban or union territory administration; the selection of location for a set of such facility shall be made in consultation with the prescribed authority or other stakeholders and accordance with guidelines published by the Ministry of Environment forests, climate change and Central Pollution Control Board. So, this site selection is also essential here; this is also a similar site selection for sanitary landfill.

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Household Biomedical Waste (HBMW)

FACTS AND FIGURES

- Based on a small study of 500 households in Hyderabad, biomedical and hazardous waste amounts to nearly **15% of the total waste.***
- As per Press Information Bureau Report of 2016, biomedical waste accounts nearly 10% of total waste.**
- India's BMW is growing at an annual rate of 7% as per Associated Chambers of Commerce and Industry but there is a paucity of data when it comes to HBMW.

***Source:** Ramasamy, Arthy & Dash, Sambit. (2019). Neglect of Household Biomedical Waste.

****Source:** Swaminathan, Mathangi (2018). "How Can India's Waste Problem See a Systemic Change?." <https://www.epw.in/engage/article/institutional-framework-implementing-solid-waste-management-india-macro-analysis>; viewed in December 2018

So now we will talk about household biomedical waste; like based on this small study of 500 households in Hyderabad, the biomedical hazardous amounted to nearly 15% of total waste, so is a good percentage of household biomedical waste. So, suppose you can read this particular source, as per the Press Information Bureau Report. In that case, biomedical waste accounts for nearly 10% of total waste, and India's biomedical waste is growing at an annual rate of 7%. As per the associate Chamber of Commerce and Industry, this good percentage is increasing. This is regarding household biomedical waste.

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The screenshot shows a digital document titled "Economic & Political WEEKLY". The article title is "Neglect of Household Biomedical Waste" by Arthy Ramasamy, Sambit Dash. The text in the article states: "While India has had a biomedical waste management rule since 1996, which was modified for ease in 2016, household biomedical waste has been neglected. Increased lifespan, rise of non-communicable diseases, the growing buying power, and better access to healthcare have resulted in the increased generation of household biomedical waste. This poses serious challenges to a frail public health system. This growing problem needs to be tackled by acknowledging it, introducing guidelines, and decentralising solutions, including facilitating recycling." A red circle highlights the title of the article.

And also, you can read about the neglect of house biomedical waste, so, if you can read this line, there the increased lifespan rise or for non-communicable disease the growing buying power and better access to health care facilities. Because of that, biomedical waste generation is also getting

improved because of the better access to health care facilities, which has resulted in an increased generation of household waste.

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Household Biomedical Waste (HBMW)

FACTS AND FIGURES

- Based on a small study of 500 households in Hyderabad, biomedical and hazardous waste amounts to nearly **15% of the total waste.***
- As per Press Information Bureau Report of 2016, biomedical waste accounts nearly 10% of total waste.**
- India's BMW is growing at an annual rate of 7% as per Associated Chambers of Commerce and Industry but there is a paucity of data when it comes to HBMW.*

BIGGEST PROBLEM

HBMW usually **gets mixed with other household waste** in India posing numerous public health hazards

*Source: Ramasamy, Arthy & Dash, Sambit. (2019). Neglect of Household Biomedical Waste.

**Source: Swaminathan, Mathangi (2018). "How Can India's Waste Problem See a Systemic Change?," <https://www.epri.in/engage/article/institutional-framework-implementing-solid-waste-management-india-macro-analysis>, viewed in December 2018.

And the biggest problem is that these household biomedical waste usually get mixed into the other household waste in India, posing numerous public health hazards.

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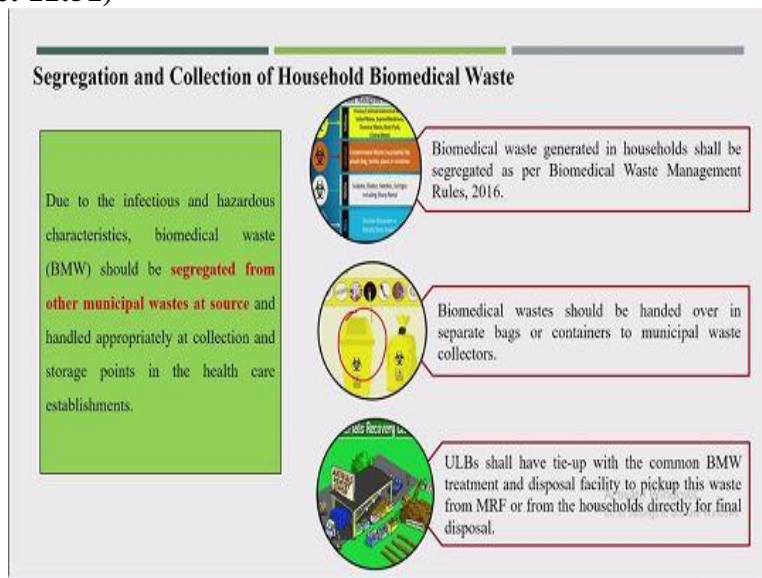
Types of Household Biomedical Waste

- Soiled sanitary napkins
- Adult/baby diapers
- Blood stained cotton buds, used band-aids
- Split mercury (Thermometers)
- Injected needles
- Blood sugar strips

So, what type of household biomedical waste here soiled sanitary napkin and the problem with the sanitary napkins could contain blood these are highly toxic and problematic. Once it mixes into the MSW, it is now challenging to segregate. That's why the MSW rule notified that the entire household waste should be segregated into three wet waste, dry waste, and household hazardous waste. So, this comes under household hazardous waste.

Next is the adult or baby diapers; blood pieces of cotton could be split mercury from the thermometers, injected needles, and these blood sugar strips also contain blood. So, usually, when you take the blood sample, we never thought this could be one of the very hazardous kinds of material. And usually, when you take this one, the blood is getting dried out. So we will dispose simply into that plastic bag our household will mix into the household waste without thinking that this blood could create further issues also discarded insulins.

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Due to the infectious and hazardous characteristics, biomedical waste should be segregated from other municipal waste at source and handled appropriately at collection and storage point the healthcare establishments So; for that, the biomedical waste generating the household shall be segregated as per the biomedical waste management rule 2016, and biomedical waste should be handed over in those separate bags or containers to the municipal waste collector.

Typically, these yellow bins are proposed to each house to store the household hazardous waste and ULBs that local authority shall have to tie up with the common biomedical waste treatment facility to pick up these kinds of waste from the MRF centres from the households directly for the final disposal.

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Biomedical Waste from Healthcare Establishments

- **Healthcare establishments** such as hospitals, nursing homes, pathological laboratories etc., **generate** biomedical waste.
- These wastes should be **segregated at the point of generation** and **stored in the color coded containers** separately following the provisions of Biomedical Waste (M&H) Rules, 1998 and as amended in 2011 and 2016.
- This category of waste is hardly **25%–30% of the total waste generated by health care facilities**.
- The bio-medical waste should be **sent for further treatment and disposal as per Biomedical Waste (M&H) Rules, 2016**.
- This is essential to ensure that **MSW generated from healthcare establishments is not contaminated**, and does not pose any health and environmental risks to the waste handlers, processing plants, and users of end products of MSW at processing facilities.
- Biomedical waste has been **classified into four categories as per the rule (2016)**, and **different treatment or disposal systems have been indicated** for them.

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And now the biomedical waste from the healthcare phase establishment like hospitals, nursing homes or pathologic laboratory these waste should be segregated the point of generation and stored in colour coded containers, which I will show in the next slide separately and based on whatever the biomedical waste rule, that first rule came in 1998 amended in 2011 and 16. So, do the segregation.

Typically, there is a four coloured segregation waste under these category waste hardly 25 to 30% of total waste generated by the healthcare facilities could be hazardous that 25 to 30%. So, primarily people think that entire biomedical waste is hazardous, but that is not true. Only 25 to 30% is hazardous; sometimes, it is well below these kinds of one sees again depend upon what type of health care facilities like the hospitals do not have nursing facilities and only small hospitals.

I think the hazardous waste production will be minimal, and there is no surgery facility in the hospital. So in those cases, I think a lot of your hazardous waste does not come out from such facilities and this biomedical waste against sent to further treatment disposal. So when I say here 20 to 25 to 30% is a hazardous means remaining could be recycled. So this is essential to ensure the MSW generated from healthcare establishment is not contaminated.

And does not pose any health environment risks to the waste handlers, processing plants and users of the end product of the MSW processing facility. So, usually, these biomedical waste classified into four categories as per the rule 2016.

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Category	Type of waste	Color and type of bag to be used	Treatment and disposal options
Yellow	Human anatomical waste	Yellow colored nonchlorinated plastic bags	Incineration or plasma pyrolysis or deep burial
	Animal anatomical waste	Yellow colored nonchlorinated plastic bags	Incineration or plasma pyrolysis or deep burial. In the absence of above facilities, autoclaving or microwave hydroclaving followed by shredding/mulching/comminution of particles and shredding. Treated waste to be sent for energy recovery
	Expiry or discarded medicines	Yellow colored nonchlorinated plastic bags	Expired cytotoxic drugs and items contaminated with cytotoxic drugs to be returned back to the manufacturer or supplier for incineration at temperature >1200° C or to CBMHTF or hazardous waste treatment, storage, and disposal facility for incineration at >1200° C or encapsulation or plasma pyrolysis at 1200° C
	Chemical waste	Yellow colored nonchlorinated plastic bags	Dispose of by incineration or plasma pyrolysis or encapsulation in hazardous waste treatment, storage, and disposal facility
Red	Chemical liquid waste	Separate collection system leading to effluent treatment system	After resource recovery, the chemical liquid waste shall be pre-treated before mixing with other waste lines
	Discarded firm, mattress, bedding, contaminated with blood or body fluids	Nonchlorinated yellow plastic bags or suitable packing material	Nonchlorinated chemical disinfection followed by incineration or plasma pyrolysis or for energy recovery
	Microbiology, biotechnology, and other clinical laboratory waste	Autoclave safe plastic bags or containers	Planned to sterilize with nonchlorinated disinfectants or use as NACD or PHND guidelines, thereafter for incineration
White	Contaminated waste (recyclable)	Red colored nonchlorinated plastic bags or containers	Autoclaving or microwaving/hydroclaving followed by shredding or mulching or combination of shredding and shredding. Treated waste to be sent to required recyclers or for energy recovery or plastics to shreds or fuel oil or for road making
White (transparent)	Waste sharps including metals	Puncture proof, leak proof, tamper proof containers	Autoclaving or dry heat sterilization followed by shredding or mulching or encapsulation in metal container or cement concrete, combination of shredding cum autoclaving and sent for final disposal to iron foundries
Blue	Glucocorticoid, plastic body implants	Cardboard boxes with leak resistant marking	Disinfection or through autoclaving or microwaving or hydroclaving and then sent for recycling

So, these are the four categories; these are colour coded categories yellow, red, white and blue. So, this is the yellow part, and I think if you visit any hospital, you will find these four kinds of containers the yellow, red, white and blue, these four containers different floors also you can you will find it in this kind of facility properly covered, does means. So, like in the yellow bins, which will be what sort of waste is suggested to dispose of like human anatomical waste or chemical waste.

You can also go through that even the biomedical waste rule 2016 also suggested the type of waste and what kind of treatment and disposal is proposed the mostly this yellow waste is typically proposed to go for incineration facility.

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Category	Type of waste	Color and type of bag to be used	Treatment and disposal options
Yellow	Human anatomical waste	Yellow-colored nonchlorinated plastic bags	Incineration or plasma pyrolysis or deep burial. Incineration or plasma pyrolysis or deep burial. In the absence of above facilities, autoclaving or microwave hydroclaving followed by shredding/mulching/comminution of dioxination and shredding. Treated waste to be sent for energy recovery. Expired cytotoxic drugs and items contaminated with cytotoxic drugs to be returned back to the manufacturer or supplier for incineration at temperature >1200° C or to CEMVTF or hazardous waste treatment, storage, and disposal facility for incineration at >1200° C or encapsulation or plasma pyrolysis at 1200° C. Disposed of by incineration or plasma pyrolysis or encapsulation in hazardous waste treatment, storage, and disposal facility. After resource recovery, the chemical liquid waste shall be pretreated before mixing with other waste forms. Nonchlorinated chemical disinfection followed by incineration or plasma pyrolysis or for energy recovery. Pretreat to sterilize with nonchlorinated chemicals on site as NACO or WHO guidelines, thereafter for incineration. Autoclaving or microwaving/hydroclaving followed by shredding or mulching or combination of sterilization and shredding. Treated waste to be sent to regulated incinerator or for energy recovery or plastics to diesel or fuel oil or for road making. Autoclaving or dry heat sterilization followed by shredding or mulching or encapsulation in metal container or cement concrete, combination of shredding with autoclaving and sent for final disposal to iron foundries. Disinfection or through autoclaving or microwaving or hydroclaving and then sent for recycling.
	Animal anatomical waste	Yellow-colored nonchlorinated plastic bags	
	Soiled waste	Yellow-colored nonchlorinated plastic bags	
	Expired or discarded medicines	Yellow-colored nonchlorinated plastic bags	
	Chemical waste	Yellow-colored nonchlorinated plastic bags	
Red	Chemical liquid waste	Separate collection system leading to effluent treatment system	
	Discarded linen, mattresses bedding contaminated with blood or body fluids	Nonchlorinated yellow plastic bags or suitable packing material	
	Microbiology, biotechnology, and other clinical laboratory waste	Autoclave safe plastic bags or containers	
Red	Contaminated waste (recyclable)	Red colored nonchlorinated plastic bags or containers	Autoclaving or dry heat sterilization followed by shredding or mulching or encapsulation in metal container or cement concrete, combination of shredding with autoclaving and sent for final disposal to iron foundries. Disinfection or through autoclaving or microwaving or hydroclaving and then sent for recycling.
White (translucent)	Waste sharps including metals	Puncture proof, leak proof, tamper proof containers	
Blue	Glassware Metallic body implants	Cardboard boxes with blue-colored marking	



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Next is the red one that is a contaminated waste these are the recyclable one should be separated one.

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Category	Type of waste	Color and type of bag to be used	Treatment and disposal options
Yellow	Human anatomical waste	Yellow-colored nonchlorinated plastic bags	Incineration or plasma pyrolysis or deep burial. Incineration or plasma pyrolysis or deep burial. In the absence of above facilities, autoclaving or microwave hydroclaving followed by shredding/mulching/comminution of dioxination and shredding. Treated waste to be sent for energy recovery. Expired cytotoxic drugs and items contaminated with cytotoxic drugs to be returned back to the manufacturer or supplier for incineration at temperature >1200° C or to CEMVTF or hazardous waste treatment, storage, and disposal facility for incineration at >1200° C or encapsulation or plasma pyrolysis at 1200° C. Disposed of by incineration or plasma pyrolysis or encapsulation in hazardous waste treatment, storage, and disposal facility. After resource recovery, the chemical liquid waste shall be pretreated before mixing with other waste forms. Nonchlorinated chemical disinfection followed by incineration or plasma pyrolysis or for energy recovery. Pretreat to sterilize with nonchlorinated chemicals on site as NACO or WHO guidelines, thereafter for incineration. Autoclaving or microwaving/hydroclaving followed by shredding or mulching or combination of sterilization and shredding. Treated waste to be sent to regulated incinerator or for energy recovery or plastics to diesel or fuel oil or for road making. Autoclaving or dry heat sterilization followed by shredding or mulching or encapsulation in metal container or cement concrete, combination of shredding with autoclaving and sent for final disposal to iron foundries. Disinfection or through autoclaving or microwaving or hydroclaving and then sent for recycling.
	Animal anatomical waste	Yellow-colored nonchlorinated plastic bags	
	Soiled waste	Yellow-colored nonchlorinated plastic bags	
	Expired or discarded medicines	Yellow-colored nonchlorinated plastic bags	
	Chemical waste	Yellow-colored nonchlorinated plastic bags	
Red	Chemical liquid waste	Separate collection system leading to effluent treatment system	
	Discarded linen, mattresses bedding contaminated with blood or body fluids	Nonchlorinated yellow plastic bags or suitable packing material	
	Microbiology, biotechnology, and other clinical laboratory waste	Autoclave safe plastic bags or containers	
Red	Contaminated waste (recyclable)	Red colored nonchlorinated plastic bags or containers	Autoclaving or dry heat sterilization followed by shredding or mulching or encapsulation in metal container or cement concrete, combination of shredding with autoclaving and sent for final disposal to iron foundries. Disinfection or through autoclaving or microwaving or hydroclaving and then sent for recycling.
White (translucent)	Waste sharps including metals	Puncture proof, leak proof, tamper proof containers	
Blue	Glassware Metallic body implants	Cardboard boxes with blue-colored marking	



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Next, is a white one white colour one that wastes sharps, including metals? So, these are sensitive material like needles will come into this category.

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Category	Type of waste	Color and type of bag to be used	Treatment and disposal options
Yellow	Human anatomical waste	Yellow colored nonchlorinated plastic bags	Incineration or plasma pyrolysis or deep burial
	Animal anatomical waste	Yellow colored nonchlorinated plastic bags	Incineration or plasma pyrolysis or deep burial. In the absence of above facilities, autoclaving or microwave/hydrochloric acid followed by shredding/plasma/pyrolysis/autoclavation and shredding. Treated waste to be sent for energy recovery.
	Exhaled or discarded residues	Yellow colored nonchlorinated plastic bags	Expired syringes, drugs and other containers with cytotoxic drugs to be returned back to the manufacturer or supplier for incineration at temperature >1500°C or to CEMVTP or hazardous waste treatment, storage, and disposal facility for incineration at >1500°C or encapsulation or plasma pyrolysis at 1500°C.
	Chemical waste	Yellow colored nonchlorinated plastic bags	Disposed of by incineration or plasma pyrolysis or encapsulation in hazardous waste treatment, storage and disposal facility.
Red	Chemical liquid waste	Separate collection system leading to effluent treatment system	If no recovery necessary, the chemical liquid waste shall be pretreated before mixing with other waste forms.
	Discarded linen, mattresses bedding contaminated with blood or body fluids	Nonchlorinated yellow plastic bags or suitable packing material	Nonchlorinated chemical disinfection followed by incineration or plasma pyrolysis or for energy recovery.
	Microbiology, serology, and other clinical laboratory waste	Autoclave safe plastic bags or containers	Pretreat to sterilize with nonchlorinated chemicals on site as NaClO or WHO guidelines. thereafter for incineration.
Red	Contaminated waste (recyclable)	Red colored nonchlorinated plastic bags or containers	Autoclaving or microwave/hydrochloric acid followed by shredding or oxidation or combination of oxidation and shredding. Treated waste to be sent to engineered incinerator or for energy recovery or plastic to be sent or sent for heat treating.
White (translucent)	Waste sharps including metals	Puncture proof, leak proof, tamper proof containers	Autoclaving or dry heat sterilization followed by shredding or oxidation or encapsulation in metal container or cement concrete.
Blue	Glassware Metallic body implants	Cardboard boxes with blue-colored marking	Combination of shredding/saw/successive and sent for final disposal to iron/steel/brass. Disinfection or through autoclaving or microwaving or hydrochloric acid then sent for recycling.

And lastly is the blue, blue because glassware or metallic body implants or cardboard boxes that will come into the blue bin are also recyclable. So, the primary concentration will go to the insulation facility that is yellow dust bin a waste.

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Existing Rules for Treatment of Biomedical Waste		
Laws and Regulations	Major Contents	Type of waste
1. Bio-Medical Waste (Management and Handling) Rules, 1998	<ul style="list-style-type: none"> According to these rules, the 'occupier' (a person who has control over the concerned institution or premises) of an institution generating biomedical waste is responsible for ensuring that such waste is handled without any adverse effect to human health and the environment. The rules govern the categorization, on-site, and off-site storage, transport, treatment, and disposal of bio-medical wastes. 	Bio-medical wastes
2. Draft Bio-Medical Waste (Management and Handling) Rules, 2011	<ul style="list-style-type: none"> The Bio-Medical Waste Management Rules, 2016 mandates every occupier to obtain authorization irrespective of the number of patients being treated Biomedical waste has been classified into 4 categories instead 10 to improve the segregation of waste at source; and specifies color coding for various categories of bio-medical waste to avoid overlapping; establish a Bar-Code System for bags or containers containing bio-medical waste for disposal. 	
3. The Bio-Medical Waste Management Rules, 2016	<ul style="list-style-type: none"> The new rules prescribe more stringent standards for incinerator and existing incinerators to achieve the standards for retention time in secondary chamber and Dioxin and Furans within two years. 	

So, what is the existing rule for the treatment of biomedical waste? So, as I was talking about that biomedical waste rule, it came in 1998 with the idea that the proper handling and disposal of waste is now modified 2016 and 2016 classified in 4 categories. So, earlier in 2011, there were ten categories. They minimize because all these ten categories are the most of the other category few categories used to go for incineration facility.

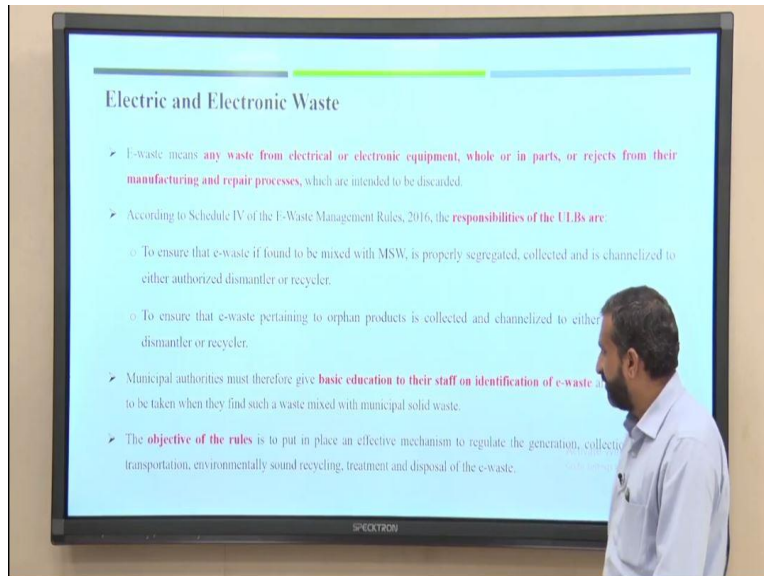
Now the major here is the understanding here in biomedical waste. If you visit any biomedical treatment facilities, few facilities like the important facility will be the incineration facility. So, whatever that yellow dust bin waste is coming that will go for the conversion process insulation facility and what kind of insulation the similar kind of insulation we talk for MSW.

But in MSW, also we talked about waste to energy plants. Still, I think there is not much discussion on waste to energy or energy production in biomedical waste because operation or handling of hazardous waste is difficult. So, the only conversion is enough and how best we can dispose of the residues and clean the polluted air that guidelines are given in the rule under the remaining will go to the recycling facility, mostly the plastic items, even some metal items also is recyclable one that facility you will be able to find also.

Because during segregation because many healthcare wastes or biomedical waste content liquid, that liquid has to be emptied, may be manually or mechanically mostly the manually a lot of manpower was involved in clearing out that material even the many times these kinds of material is under the pockets. So, this could be paper made pockets or plastic pockets that particular material has to be taken out manually only as possible.

So, there is a lot of manpower's you will see that while segregation of the material and that, liquid lot of wastewater is also getting generated. And you will find one wastewater treatment facility also onto the biomedical waste management facilities. So as I told you there are 4 or 5 facilities like start from the incineration facility. Next is the recycling facility, a plastic and metal segregation facility and wastewater treatment facility.

Likewise, you can find and is a fascinating sight to see, but only take care puts a proper mask and do not touch in such kind of locations because mostly these materials are hazardous. Now we will go for E-waste. When you say that e-waste, anybody can understand electrical or electronics waste.
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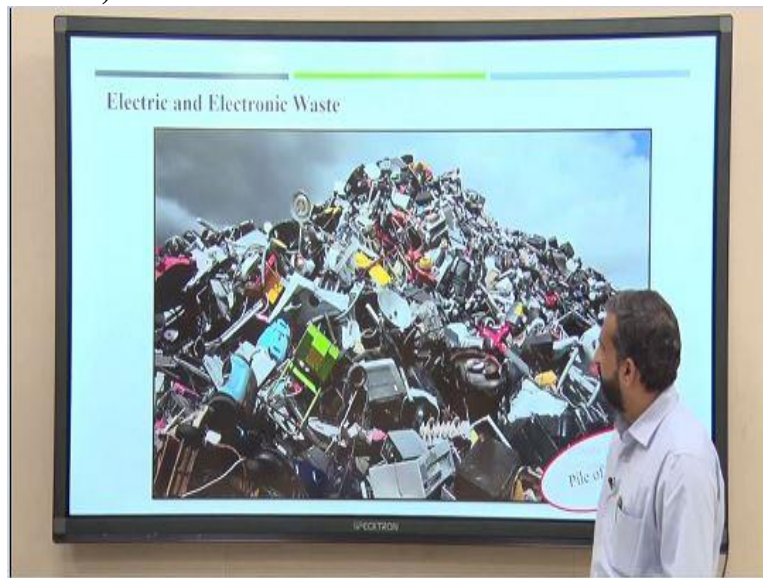
So, e-waste means any waste from the electrical electronic equipment's or whole or part could be rejected from their manufacturing or repair process. And according to schedule 4 of the E-waste management rule, 2016 the responsibility of ULBs are to ensure that e-waste is found to be mixed with MSW is properly segregated, collected and is channelized to either authority or recyclable and to ensure that e-waste about an orphan product is collected and channelized to either and authorize recycling facilities.

So, usually, these e-wastes also you can find in the MSW. So, the local authority must have one particular mechanism to take it out through that e-waste from the MSW, and municipal authority must give a primary education to their staff on identifying E-waste. So, in one of the lectures, I talked about the primary collection by how staff collection facilities so, if that particular person is well level or well understandable to what kind of e-waste.

And if you do the proper awareness in the local areas from the local authorities like corporations and the people will store these kinds of e-waste even biomedical waste also they will be stored in separately. I think the local authority can plan such a kind of collection on one particular day. Maybe you need not arrange to collect such kind of waste every day because everyday generation would not be possible. So, maybe once a week or perhaps for such a kind of waste collection; the excellent idea is to drop off facilities in the particular locality.

So, you can well aware the local authority local people to drop their waste either is an e-waste biomedical waste even the bulky waste like table chair these kinds of in e-waste could be a frozen refrigerator, or more astounding is a big size material even though the tri recycle person also can collect and also you can make it that drop off-centre to the buyback centre. So, maybe somebody can collect such kind of material, when there are a lot of recycler people can be utilized such kind of material also can plant some kind of incentives to the local people, so, that they can prove they will be interested in disposing their waste into such kind of facilities.

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So, this is the pile of e-waste; you can see here is mixed e-waste.

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E-waste Categories		
Waste category	Waste stream	Type of E-waste
Category I	Information technology and Telecommunication equipment	<ul style="list-style-type: none"> ✓ Centralised data processing: Mainframes, Minicomputers. ✓ Personal Computing: Personal Computers (Central Processing Unit with input and output devices), Laptop Computers (Central Processing Unit with input and output devices), Notebook Computers, Notepad Computers. ✓ Printers including cartridges, Electrical and electronic typewriters, Copying equipment, User terminals and systems. ✓ Telephones: Telex, Pay telephones, Cordless telephones, Cellular telephones and Answering systems
Category II	Consumer electrical and Electronics	Television sets (including sets based on (Liquid Crystal Display and Light Emitting Diode technology); Refrigerator; Washing Machine; Air-conditioners' excluding centralized air conditioning plants; Fluorescent and other mercury containing lamps.

It has been suggested that e-waste has to be categorized into two categories, category 1 and 2. So, category 1 suggested the waste from information technology or telecommunication equipments like printers, telephones, and notebook computers. This will become in a special category and other categories consumer electronics like television set refrigerator washing machine the air-conditioned this should be in the separate category.

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E-waste constituents

- ❑ E-waste **consists of more than 1000 different components** which can be categorized as “hazardous” and “non-hazardous”.
- ❑ Typically, **e-waste consists of:**
 - ✓ Ferrous metals (approx. 50%)
 - ✓ Plastics (approx. 21%)
 - ✓ Non-ferrous metals like copper, aluminum, silver, gold, platinum, palladium etc. (Approx. 13%)
 - ✓ Other components like glass etc. (Approx. 16%)
- ❑ Most plastic components in e-waste include phthalate plasticizer and brominated flame retardants, which are hazardous.
- ❑ Therefore, even though the plastic recovery potential from e-waste can be quantified, **presence of above mentioned chemicals limits the actual recycling potential.**

Now, e-waste constituents e-waste consist of more than 1000 different components, which can be segregated a hazardous and non-hazardous. So, typically e-waste consists of ferrous metal, plastic non-ferrous metal like copper aluminium, silver gold could be possible other components like glass and most plastic components in e-waste include that usually is hazardous.

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Important Notes

i The following three E-Waste streams are not covered under the Schedule I of the E-Waste Management Rules, 2016:

- Batteries used in electrical and electronic equipment, such as Ni-Cd, Li-ion, Mercury etc.
- Dry cell batteries

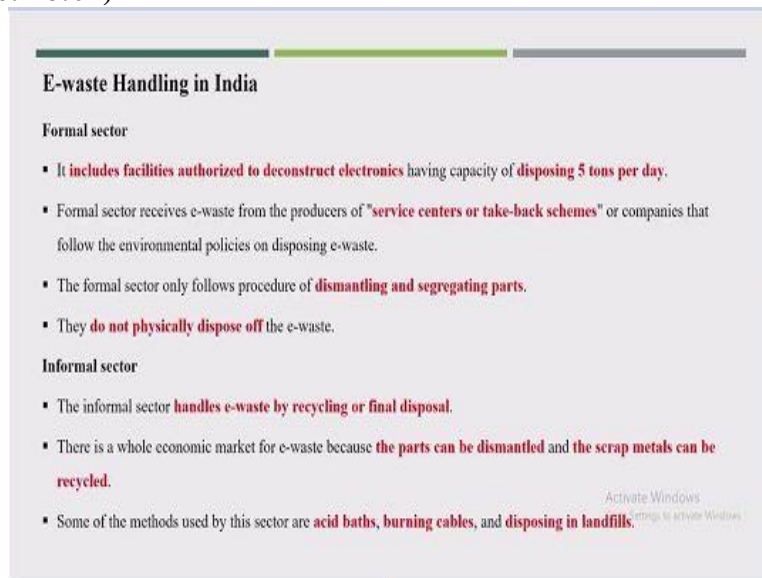
It is very likely that these components are found in municipal solid waste (MSW) despite their inherent recycling potential (since no vendor pays for them). Local authorities (like Ahmedabad Municipal Corporation) has started an initiative of collecting these wastes separately or as part of the special waste stream or mixed with dry waste (where special waste is not collected separately). This special waste is disposed appropriately in a separate designated portion of the sanitary landfill.

i **Compact Fluorescent Lamps Recycling**

There are two methods of recycling compact fluorescent lamps (CFLs): shredder method and end cut method. The shredder method involves crushing of CFLs and chemical treatment of the crushed material in dust-tight containers to avoid spillage of any harmful substances. The hazardous mercury and phosphor are removed by specialised processes, and the remaining material is sorted into glass, metals, and plastics. The end cut method involves removing of ends from the lamps. Ends of lamps consist of metal and plastic which further get segregated, the tube is chemically treated to recover mercury and phosphor. Phosphor powder and mercury can be used in new lamps or other industrial purposes, while glass can be processed further in the furnace for reuse. The aluminium end caps are sent for smelting and other metals are recycled. However, it should be noted that such recycling facilities are not yet commonly established in the country and establishment of such facilities should be encouraged by all state governments.

So, the important notes here that the e-waste like a battery used in electrical, electronic equipment, which is not considered an e-waste management tool, even the dry cell batteries, even the CFLs not under the e-waste category. So, only two categories remember that there are two categories 1 is an Information Technology Telecommunication equipment and 2nd categories Consumer electrical and electronics.

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E-waste Handling in India

Formal sector

- It includes facilities authorized to deconstruct electronics having capacity of disposing 5 tons per day.
- Formal sector receives e-waste from the producers of "service centers or take-back schemes" or companies that follow the environmental policies on disposing e-waste.
- The formal sector only follows procedure of dismantling and segregating parts.
- They do not physically dispose off the e-waste.

Informal sector

- The informal sector handles e-waste by recycling or final disposal.
- There is a whole economic market for e-waste because the parts can be dismantled and the scrap metals can be recycled.
- Some of the methods used by this sector are acid baths, burning cables, and disposing in landfills.

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E-waste handling in India: So, formal sector like it includes the facility authorized to deconstruct the electronics and dispose of 5 tons per day. So, these formal sectors receive e-waste from the producers of service centre or take back scheme. So, I was talking about drop off centres and take back scheme; also, they can propose formal sector only follow the procedure of dismantling and segregating parts and do not physically dispose of e-waste and the informal sector.

The informal sector handles e-waste by recycling or final disposal; there is a whole economic market for e-waste because the part can be dismantled, and scrap metal can be recycled. So, if you ask me also, we do not have accurate information; we do not have data on the informal sector. Even their disposal they perform the acid bath burning cables or disposing of landfill this informal sector.

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Methods of E-waste Treatment and Disposal

Incineration

- It involves combustion of e-waste at high temperature in specially designed incinerators.
- This e-waste disposal method is quite advantageous as the waste volume is reduced and the energy obtained is also utilized separately.
- However, it is also not free from disadvantages with the emission of the harmful gases such as Hg and Cd in the environment.



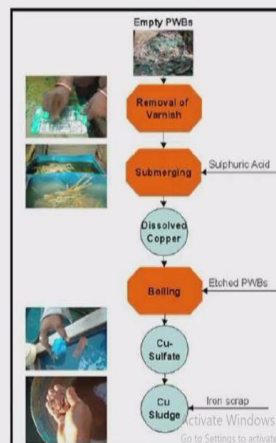
Method of e-waste statement disposal the major is an incineration same similar to biomedical waste. So, incineration the only again problem is that it is very harmful gas is producing.

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Methods of E-waste Treatment and Disposal (Cont.)

Acid Baths

- It involves soaking of the electronic circuits in the powerful sulphuric, hydrochloric or nitric acid solutions that free the metals from the electronic pathways.
- The **recovered metal is used in the manufacturing of other products** while the acids are recovered through various acid recovery processes.



And another is the acid bath. This is also possible for a collection of the metals that could be possible from the acid bath. So, you can see by a bare hand informal sectors are trying to segregate or recover the valued product because gold, silver is easy to find. However, the concentration is low, but a still huge informal market is available for that.

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Methods of E-waste Treatment and Disposal (Cont.)

Acid Baths

- It involves soaking of the electronic circuits in the powerful sulphuric, hydrochloric or nitric acid solutions that free the metals from the electronic pathways.
- The **recovered metal is used in the manufacturing of other products** while the acids are recovered through various acid recovery processes.

It is purely one particular plant of the acid bath.

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Methods of E-waste Treatment and Disposal (Cont.)

Landfilling

- Most common methodology of e-waste disposal.
- Soil is excavated and trenches are made for burying the e-waste in it.
- An impervious liner is made of clay or plastic with a leachate basin for collection and transferring the e-waste to the treatment plant.
- However, **landfill is not an environmentally sound process** for disposing off the e-waste **as toxic substances like Cd, Pb and Hg are released inside the soil and ground water.**

And finally, landfilling is the most common methodology. But, even I would not believe that I would not accept the landfilling of such kind of material because the landfill is not an environmentally sound process. So, it is not recommended particularly from my side also and whomever know that these kind of material can create problem in the landfill area, because it will leach out with a lot of metals into the soil and the groundwater. And a lot of gas also or many toxic substances will get released out from these kinds of materials.

So, it is not acceptable. But now in India, several cities have their own EBS collections policies, mostly the formal-informal sectors are notified by the local authorities who can collect these kinds of waste and can go for proper treatment and disposal of such kind of waste.

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Existing rules for treatment of E-waste		
Laws and Regulations	Major Contents	Type of waste
E-Waste Management Rules, 2016	<ul style="list-style-type: none"> • These rules are based on the principles of Extended Producer Responsibility (EPR), wherein the producer engaged in the manufacture, sale, and purchase of electrical and electronic equipment is responsible for the end of life management of the electrical and electronic products listed in Schedule 1 of the rules. • Procedures are provided for handling E-Waste as applicable to all stakeholders, such as collection centres, dismantlers, and recyclers of E-Waste. • Stipulations for reducing the hazardous substances in electrical and electronic equipment are also prescribed. • Procedures and formats for registration of facilities for recycling E-Waste are specified. 	E-Wastes (electrical and electronic wastes)

So, what existing rule the same like these rules are based on principle of extended procedure responsibility EPR wherein the producer engaged in the manufacturing sales and purchase of electrical, electronic equipment is responsible for the end of life, management of electrical, electronic produce listed in schedule 1 of the rule, I think here I will give one example. As you know, the mobile company like Samsung and LG all comes from South Korea.

So, there what rules suggested because they are these EPR extended producer responsibilities very famous. So, if you purchase any mobile in South Korea, like Samsung or LG, you will get some kind of discount the discount, if you give the old mobile to the same shop. So, if you take your old mobile and purchase a new mobile phone from the same company, you will get maybe 5% 10% discount on the why this discount is provided.

Because that same old mobile is getting recycled by the parent company, whether LG or Samsung, so, that is why the product also is coming into that country is a more recyclable one. Still, the same product of the same company is coming to the other part of the country. Though in their the recycle fractions are significantly less. If you purchase any mobile in South Korea, that will not work in the other part of the world.


And because these are the same company, they are fabricating or manufacturing the product based on their country rule. So, our modified 2016 rule is majorly focused on the principle of extended producer responsibility. So, that I think any like refrigerator company if the same refrigerator company can recycle their old refrigerator. So, I think this is the best way of reuse or disposal of such kind of material. So, I think India is also working on that, and we have to see how we can extend such kind of facilities in India in the next 15, 20 years.

Now, the next waste is inert; this is also very important in the MSW and when this MSW waste collection by the collection crew, they will collect the waste from the household area commercial areas, but also will be collected these inert waste from the street sweeping by the street sweeping activities.

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Inert waste (street sweeping)

- Street cleaning is a fundamental service ensuring clean and hygienic urban conditions.
- Street wastes include paper, plastics, dirt, leaves, and other vegetative matters.



The slide contains three photographs of street waste. The first photo shows a pile of discarded paper and plastic waste on a sidewalk. The second photo shows a large pile of brown dirt and dry leaves. The third photo shows a pile of vegetable matter, including what appears to be a banana peel and other organic debris.

Paper, plastic Dirt, leaves Vegetable matter

- Manual sweeping is commonly practiced in India, as many streets are congested and narrow.
- Inefficient waste collection systems coupled with public littering significantly contribute to waste piles on the streets.

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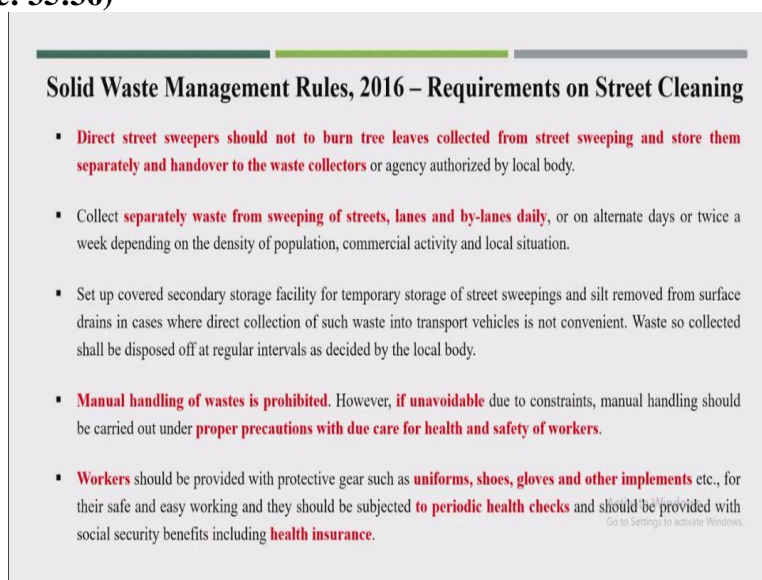
So, street cleaning is an essential service to ensure clean and urban hygiene condition. So, I think when I thought of adding these discussions into these courses because when you say those, such a is in a clean area, we usually will see the roads or the surrounding of that particular area, and that involved the only activity that is the street sweeping activity or is involved into that and nobody will see that how, whether you segregated waste generated in the household area, whether how you disposed of, but the cleaning of the streets is giving the more importance.

That is why this discussion is very important when you talked about waste management in any particular city. The street waste including paper, plastic, dirt, leaves and other vegetative matter. So, you can see here paper-plastic dirt leaves, say for when most of the cities they come up with later bins, the UK you will see some dust bins are hanging somewhere in some particular commercial areas so that all the users can dispose into that particular dust bin.

But I think you know that in India or mainly developing nations, people are not well aware of the waste management, so that is why the paper plastic also you see here, the packaging materials, you are getting into this as in sweeping street material. Dirt leaves, I think we cannot have collected it but has to be clean it time to time, and even vegetative matter also is why you will see several cattle's onto the street especially cow onto the street.

Because they are getting a lot of edible materials into the MSW and manual sweeping is very common in India, as many streets and narrow streets an insufficient waste collection system coupled with public littering significantly contribute to waste piles on the street.

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Solid Waste Management Rules, 2016 – Requirements on Street Cleaning

- **Direct street sweepers should not to burn tree leaves collected from street sweeping and store them separately and handover to the waste collectors** or agency authorized by local body.
- Collect **separately waste from sweeping of streets, lanes and by-lanes daily**, or on alternate days or twice a week depending on the density of population, commercial activity and local situation.
- Set up covered secondary storage facility for temporary storage of street sweepings and silt removed from surface drains in cases where direct collection of such waste into transport vehicles is not convenient. Waste so collected shall be disposed off at regular intervals as decided by the local body.
- **Manual handling of wastes is prohibited.** However, **if unavoidable** due to constraints, manual handling should be carried out under **proper precautions with due care for health and safety of workers.**
- **Workers** should be provided with protective gear such as **uniforms, shoes, gloves and other implements** etc., for their safe and easy working and they should be subjected to **periodic health checks** and should be provided with social security benefits including **health insurance.**

So, what is the requirement for street cleaning under the solid waste management rule 2016? the direct street sweeper should not burn tree leaves collected from the street sweeping and store them separately to the waste collector or agency authorized by the local body. So, these are important directories because, in most of the cases, what the street sweepers will do, they will pile up one

location. Still, I think it is not close to the habitations somewhere in the park or some outskirts area, and they will go for firing of that particular material.

So, the firing is not allowed actually the collect separately waste from the sweeping of street lanes and violence daily or in alternate days, twice a week depending on the density of population. So, similarly, the manual handling of waste is prohibited they have to use the proper hand gloves and proper mask. So that there is they should not have any health issue for a collection of streets sweeping waste. So, this worker should be provided with protective gear such as uniform shoes clothes and proper health insurance also should be provided to the street sweepers.

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Planning for Street Cleaning			
	Small town	Medium City	Mega city
Equipment	<ul style="list-style-type: none"> • Long handled broom • Metal tray and metal plate • Containerized handcart or tricycle • Tractor with covered trolley • Container lifting device 	<ul style="list-style-type: none"> • Long handled broom • Metal tray and metal plate • Containerized handcart or tricycle • Secondary storage bin • Dumper placer or compactor • Mechanical street sweeper • Container lifting device 	<ul style="list-style-type: none"> • Long handled broom • Metal tray and metal plate • Containerized handcart or tricycle • Secondary storage bins • Dumper placer or compactor • Container lifting device • Mechanical street sweeper
Staff requirement based on road density	<ul style="list-style-type: none"> • High density roads: 1 person per 300-350 running meters of road length • Medium density roads: 1 person per 500 running meters of road length • Low density roads: 1 person per 750-1,000 meters of road length 	<ul style="list-style-type: none"> • High density roads: 1 person per 300-350 running meters of road length • Medium density roads: 1 person per 500 running meters of road length • Low density roads: 1 person per 750-1,000 meters of road length 	<ul style="list-style-type: none"> • High density roads: 1 person per 300-350 running meters of road length • Medium density roads: 1 person per 500 running meters of road length • Low density roads: 1 person per 750-1,000 meters of road length

Planning for street sweeping like will be required equipment's and staff requirement will be required. So like when you talk about equipment's will be required a broom for sweeping will require the handcarts or tri cycle or tractor or even the small auto depots will be required. So, it has been suggested for the small town medium sized medium city and mega cities. So, what kind of facilities even the staff requirement like high density road 1 person for 300 to 350 running meters and medium density road like 1 person per 500 running meters of road length. So, these are suggested for the small city medium city and mega cities.

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Street Classification and Street Cleaning frequency

CLASS	CHARACTER OF STREET	FREQUENCY OF SWEEPING
A	City centre - shopping areas	Daily or twice, depending on need
B	Market areas	Daily
C	Minor streets	Daily
D	Sub-urban shopping streets	Daily
E	Residential streets	Daily
F	Roads and streets having no households or establishments on either sides	Once a week
G	Highways	Rarely necessary to sweep highways as motor traffic creates turbulence
H	Suburban main streets	Twice a week
I	Open spaces	Occasionally, when required (minimum once in 2 weeks)

Streets classification street cleaning frequency like these are very important guidelines is given in solid waste manual like they characterize the different states in A B C D E F G H I categories and like take example of A class A that is city center or shopping mall area that particular streets daily or twice depending on need. So, mostly the major streets need to be sweep daily under some roads, even or need not to be clean like highways only in the important occasions need to be clean or some roads need to be clean once in a week. So likewise, this is also good explanation is given on to the frequency of cleaning of roads.

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Street Classification and Street Cleaning Frequency (Cont.)

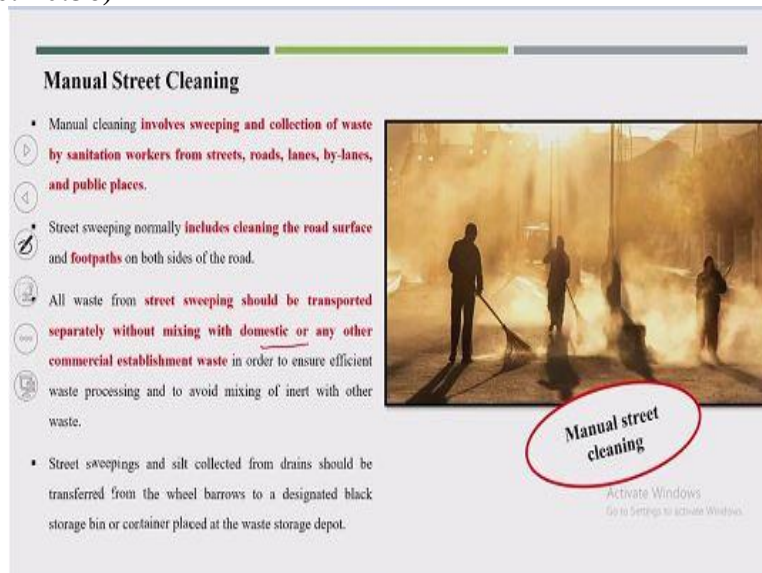
- Street sweeping in residential areas may be carried out in two spells— **5 hours in the morning** and **3-4 hours in the afternoon**.
- Staff involved in street sweeping should also be **responsible for cleaning drains** (up to 18 inches depth), along the same “beat.”
- Multiple handling of wastes should be avoided.
- The **local sanitary inspector should be responsible for inspecting and maintaining records** on the extent of service provision.
- ULBs can adopt different strategies for **tourist places**, where many people are present almost at all hours. In such places, **regular cleaning throughout the day (2-3 times) and during weekends and national holidays** may be necessary.

So the street sweeping in residential area may be carried out in 2 spells 5 hours in the morning in 3 to 4 hours in the afternoon. Staff involved in the street sweeping should also be responsible for cleaning drains up to 18 inch depth and along the same beat this is also another activity for the

street sweeping staffs is not only the street sweeping but also they will be responsible for cleaning the drains and multiple handling of waste should be avoided. Local sanitary inspectors should be responsible for inspecting and maintaining records of that particular activity.

And you will be can adopt different strategies for tourist places. They can adopt different way because the tourist spots. So, maybe the sweeping could be in the different way mechanical sweeping also could be possible motorize sweeping can they can plan are you on trend clinical clean material should not be stored there. So, likewise different policy they can come up and regular cleaning they can propose for the different location like regular cleaning throughout the day 2 to 3 times and during the weekends and national holiday maybe necessary, they can make it.

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Manual Street Cleaning

- Manual cleaning involves sweeping and collection of waste by sanitation workers from streets, roads, lanes, by-lanes, and public places.
- Street sweeping normally includes cleaning the road surface and footpaths on both sides of the road.
- All waste from street sweeping should be transported separately without mixing with domestic or any other commercial establishment waste in order to ensure efficient waste processing and to avoid mixing of inert with other waste.
- Street sweepings and silt collected from drains should be transferred from the wheel barrows to a designated black storage bin or container placed at the waste storage depot.

Manual street cleaning


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So, you will see here manual streets sweeping in the early morning. So, manual cleaning involves sweeping and collection of waste by sanitation worker from the street roads and lanes. This includes a cleaning of road surface footpaths on both sides of the road. And these streets sweeping should be transferred separately without mixing with the domestic or any other commercial establishment in order to ensure efficient. So, these whatever the waste is getting collected should not be involved into the domestic waste means whatever that dust bin is provided that these waste should not be mixed into the that particular dust bin.

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Manual Street Cleaning

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So, there this is another the black dust bin you will see in the number of cities such kind of dust bin is designated black storage bin or container placed in the waste storage depot. So, that these kind of waste we can dispose the staff can be disposed into such locations.


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Type of Street Cleaning Equipments

- Long handled brooms cause less strain and support correct posture.
- An adequate type uses bunches of filaments inserted into a wooden stick.
- The length of the broom should be such that the male and female workforce can use it comfortably, without bending.
- The handle should not be heavy.
- The filaments should be tightly spaced to facilitate easy collection of fine silt and dust, leading to efficient cleaning of streets.



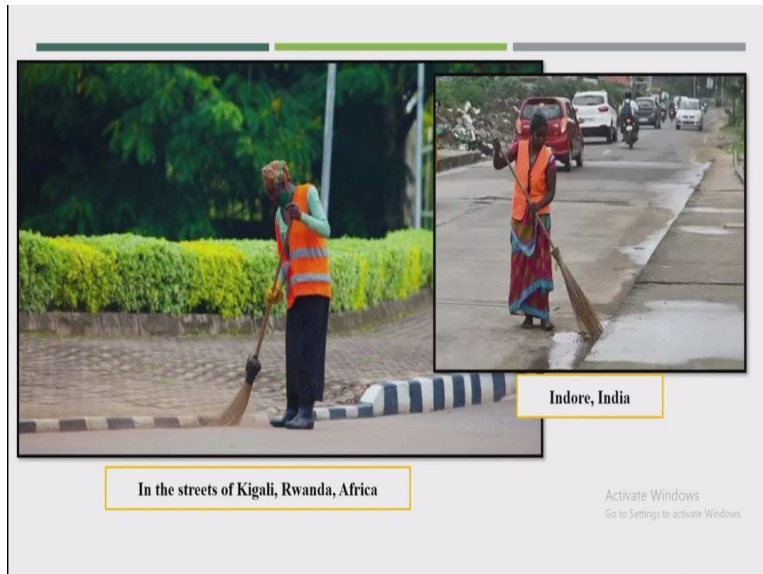
Fan-shaped filament broom:
The filaments of the broom fan out, removing litter from the streets but leaving behind sand and silt.



Bunched filament broom:
The filaments are bunched together to facilitate removal of litter, sand and silt from the streets.

Type of street cleaning equipment: So, type of street cleaning equipment's like long handle broom is required because less strain and support correct posture and handle should not be heavy. So, likewise this is a one kind of broom that is fan shaped filament broom. This is somewhat good and they can broom it in both sides front side and backside both and this is another one the bunched filament broom these normally will do it in the only one side.

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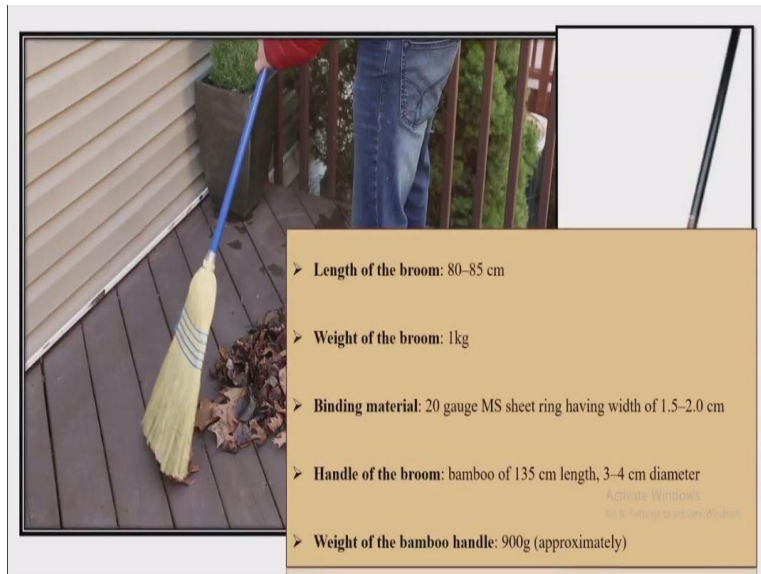
So, you can see here in somewhere in Africa in the indoor.

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This is in Hyderabad but I think still the staffs not using the proper cloth proper shoes also they have to wear.

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So, this is the one kind of broom to sweep the tree leaves. So, normally the length of the broom will be required and specified under the rule is 80 to 85 centimeter weight of the broom is 1 kg binding material 20 20 kg MS sheet ring having width of 1.5 to 2 centimeter. So, likewise the specification also is provided.

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Type of Street Cleaning Equipments

- Shovels**
 - ✓ Heaps of street wastes gathered by brooms have to be picked up and placed in a container.
 - ✓ The conventional tool for this purpose is a large straight-blade shovel or metal plate and metal tray.
 - ✓ However, when the waste comprise large quantities of light materials such as leaves, a shovel is ineffective because dried leaves fall off or are blown away during transfer.
 - ✓ A solution is a pair of flat boards, usually plywood, between which the waste is retained by hand-pressure.




Type of street cleaning equipment's like shovel you will be required for to pick up the material once it is getting piled up, then you have to transport into the vehicle, whether is a handcart or tri cycle rickshaw. So, it will be required shovel for that purpose.

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Type of Street Cleaning Equipments

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A worker with shovel and broom in Ghana, Africa

So, you can see it here are these ladies you using the shovel and along with the broom it is a properly designed broom and handcarts.

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Type of Street Cleaning Equipments

- Handcarts**
 - ✓ Handcarts facilitate transportation of street waste.
 - ✓ Handcarts should have four to six detachable plastic containers with a capacity of 25-40 L each to allow easy transferring of waste into community waste storage bins.
 - ✓ It must have sealed ball bearings and handles having a crossbar up to navel height, and its wheels should have rubber strips or tyres for ease of handling and minimizing fatigue.




I think this is also very popular in the street scale is street cleaning, waste collection under the size is around 25 to 40 liter. So, that any staff can carry or can transport the waste material.

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Mechanised Street Cleaning

- ULBs should make well-informed decisions while choosing mechanical sweepers and should consider local conditions, investment cost, and operation and maintenance costs.

Mechanical Broom Sweeper

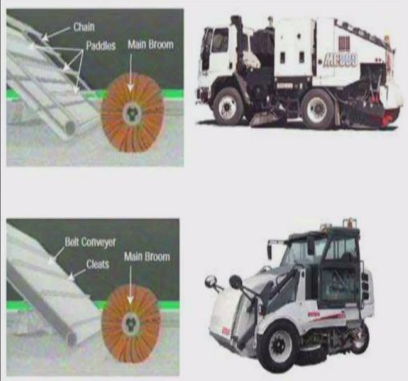
- Designed to remove standard road waste, using various kinds of circulating brushes that sweep material onto a conveyer belt and then into bins.
- Mechanical broom sweepers use a gutter broom which displaces debris from the curb into the path of the main broom, which is attached to a conveyer belt.



So, you see here now mechanized streets cleaning like you will be should make a well informed decision while choosing mechanical sweeper should consider the local condition like this is a mechanical broom is provided. But I think the this is these the you will be can should properly define which particular locations they are employing such kind of mechanical sweeper maybe in the tourist spot they can do such kind of things maybe some area is a well designed area where these machines can be work very well.

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- ✓ Mechanical broom sweepers have an **ability to pick up large debris** such as plastic bottles, cans, wet vegetation, gravel, and coarse sand.
- ✓ They are also **effective in removing packed dirt** from roadways but **ineffective in picking up fine material**.
- ✓ They have **lower energy demand** than regenerative sweepers and vacuum sweepers.




Mechanical broom sweeper

This is another kind of mechanical broom sweeper. So, can also ability to pick up large debris also possible and also they should have lower energy demand.

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- ✓ They are also **effective in removing packed dirt** from roadways but **ineffective in picking up fine material**.
- ✓ They have **lower energy demand** than regenerative sweepers and vacuum sweepers.
- ✓ The **lower powered** mechanical broom sweepers are **more suitable for large, flat, paved surfaces** like shop floors, industrial floors, etc.



Vacuum and regenerative air sweeper

And this vacuum kind of sweeper which means the entire material or entire inner is getting vacuumed into the tank.

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Regenerative Air Sweeper

- It uses forced air and high power vacuum for the collection of fine material using a broom.
- Working principle- Blows high pressure air onto the road to loosen very fine sediment and a vacuum suction lifts all particles and captures them in a hopper.
- Remove fine sand and dust, provided the surface is dry.
- Higher energy consumption compared with the mechanical broom sweeper and quite expensive.
- Pick up large debris, since the blast of air is able to dislodge material and get them into the airflow stream that is created by the suction.
- More productive on flat roads but not satisfactory for most of the Indian roads.



Activate Windows
Go to Settings to activate Windows.

So, this is also regenerating as deeper this also we can use in some of the particular locations.

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Regenerative Air Sweeper

- It uses forced air and high power vacuum for the collection of fine material using a broom.
- Working principle- Blows high pressure air onto the road to loosen very fine sediment and a vacuum suction lifts all particles and captures them in a hopper.
- Remove fine sand and dust, provided the surface is dry.
- Higher energy consumption compared with the mechanical broom sweeper and quite expensive.
- Pick up large debris, since the blast of air is able to dislodge material and get them into the airflow stream that is created by the suction.
- More productive on flat roads but not satisfactory for most of the Indian roads.




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Vacuum Sweeper

- ✓ Uses a broom to move debris towards the vacuum nozzle.
- ✓ Typically, there is a suction inlet on one side of the sweeping head, and the "used" air is constantly exhausted during the sweeping process.
- ✓ There are various types of vacuum sweepers based on the location of the vacuum nozzle. Vacuum sweepers utilize a fan that exhausts air directly to the atmosphere and uses water for dust suppression.
- ✓ Can collect fine particles from within cracks, but cannot pick up large debris like tree trimmings and disposed packaging.
- ✓ Even though vacuum sweepers use water-based dust suppression systems, they exhaust a high level of particulates into the atmosphere on a continuous basis.

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So, like vacuums or sweepers that is also available, which can take up entire inert material and can not only it will clean the area, but also the waste will be collected itself in the vehicle and get it disposed into the particular area.

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Vacuum Sweeper



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Cleaning of surface drains

- MSWM authorities should ensure through campaigning, statutory regulations, and monetary fines that citizens and sweepers do not dispose waste into drains.
- A further approach to prevent this is to make the same staff responsible for cleaning streets as well as adjacent drains up to a depth of 45-60 cm.
- The solid waste dumped in storm drains should be collected by drain cleaners and disposed off, along with drain cleaning and street sweeping material, in a municipal sanitary landfill because of a high possibility of contamination.
- The staff requirement for drain cleaning depends on the length of drain. Rule- one person can clean up to 500 m of a shallow surface drain (not more than 45-60 cm) per day.
- The removal of silt from surface drains or storm water drains deeper than 60 cm and manholes should be done by the engineering division of the local authority. It is advisable to explore new technologies like suction pumps loaded onto trucks for removal of silt from manholes to avoid manual scavenging.

So, this is the vacuum sweeper. Cleaning of surface drains, this is also important activity like should ensure through compelling statutory regulations and monetary fines that citizens and super do not dispose waste into drain I think first thing this has to be follow if anyone you will see that waste is getting deposited into the drain, I think there should be some penalties in such cases that monitoring has to be do further approach to prevent these to make the same staff responsible for cleaning street as well as exhausts.

And drain up to a depth of 45 to say 60 centimeter if somebody is cleaning that particular road. So, in the same the close to that road whatever drains are available, that is also has to be clean it out. And the staff requirement for day trading depend on the length of the drain rule is that one person can clean up up to 500 meter of the of a shallow surface drain not more than 45 to 60 centimeter per day. So, like so.

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Silt Management

- The silt collected from surface drains should not be allowed to stay on open roads or footpaths beyond 4 hours.
- Wet silt should be removed from the main roads in less than 4 hours and, in other areas, within 24 hours and should be directly transported to the landfill or be disposed at the waste storage depots in the black container to prevent nuisance and health hazards.
- This waste is not amenable for composting given the possibility of high contaminants and inert content in the silt.

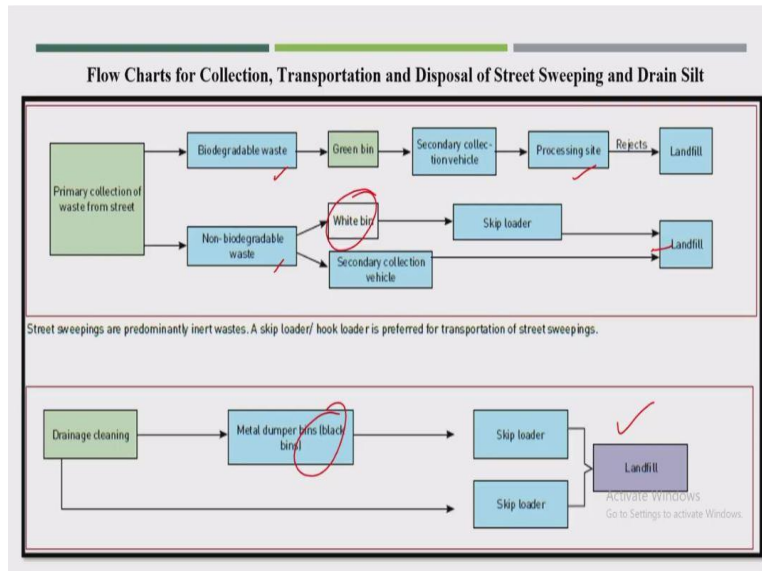


Silt collected from surface drains in Thiruvananthapuram, Kerala, India.

Now, this what this is the one activity you can see silt collected from surface then silt collected from surface then in Kerala you can see the silt collected from the surface and should not be allowed to stay in open roads or footpaths beyond 4 hour. This is important guideline. I think once it is towed onto the road, it should not be stored more than 4 hour and wet silt it should be removed from the main road in less than 4 hours and other areas within 24 hours should be directly transferred to the landfill, proper disposal facility.

And these waste should not be used for or mix into the composting process. This is one very important guideline because many times these kind of material is looking like black and is a fine particles and we can easily mix into the compost and can utilize but is not supposed to be mixed into the compost.

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Now this is a simple flowchart for the collection, transportation and disposal of streets up like the ones who are collecting the primary collection. So could be possible to get some biodegradable matter which will go to the processing site or maybe can add up into the composting facility and non-biodegradable could be properly landfill properly are for filling of low line areas can be utilize under these drainage cleaning now also has to be properly disposed of properly.

So, this will be stored into the black bin and whatever the inert waste will be stored into the white bin, so that you can easily identify what kind of waste are there into the bin. So, in this module, I talked about just a brief introduction about C and D waste, biomedical waste, e-waste, and inert waste also. So although this kind of discussion you can find it in the different courses, like there are special courses for the biomedical waste, e-waste, there are special courses where complete discussion about these kinds of waste.

But it is good to have the basic information about these kinds of waste in the when you talking, talking about MSW municipal waste management. So, thank you.