

Environmental Geotechnics
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Lecture – 16
Waste and types

(Refer Slide Time: 00:16)



IIT Bombay Slide 1

Lecture Name:
Forms of Waste

Sub-topics

- Waste generation
- Forms
- Hazardous wastes
- Non-hazardous wastes
- Examples and Differences
- **Need for Characterization (important for its utilization, reuse, recycling and recovery of precious materials)**

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Lecture name is forms of waste, the sub topics which I will intend to cover are waste generation their forms and when we talk about the forms there are 2 types of the forms that is a hazardous waste and non hazardous waste. Some examples of this waste and what is the difference between these types of the waste this is the differences. And today's lecture I will try to emphasize that while characterization of waste becomes important.

But, I think you will appreciate the point that characterization is important so, that you can utilize the waste properly, you can reuse it properly, if you want you can recycle it properly and if you want to recover some precious materials then you can recover from the waste. So, this is where the characterization of the waste of the geomaterial becomes very important. So, next lecture onwards I will switch over to the characterization of material and when we say material it will be including both geomaterials as well as the waste. So, let us go ahead with today's lecture.

(Refer Slide Time: 01:38)

IIT Bombay Slide 2

Waste Generation

- Depends on the source of generation
- May degrade into harmless products
- May be: non-degradable & hazardous (and may have cumulative detrimental effects)
- Solid
- Liquid
- Sludges
- Gases
- Combination of all these forms

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So, the first question is how waste is generated. So, basically generation of waste depends upon the source of generation is it not, some type of waste they may degrade into harmless products. So, there is no challenge pose by them, but the biggest challenge is if waste do not a degraded over a period of time and that is where you need to handle them carefully and properly.

So, the first category is that some of the waste may degrade into harmless products. However, majority of the waste maybe non-degradable and they could be hazardous and most important is that there could be some cumulative affect related to detrimental effects or deterioration of the environment in the due course of time. So, this is where actually our whole becomes important and we deal with the waste which are non-degradable, but hazardous and which may have long lasting effects on the environment.

So, depending upon the type of process which you adopting at the industry you may end up producing either solid form of the waste, liquid form of the waste or gases or the sludges, now sludges may include solid, liquid and gases all together. So, most of the time the challenge is to deal with this sludges which are coming out of all activities industrial activities is it not, in day-to-day life also a single activity like let say if you take bath in the morning or any household utility which you are going through the you produce lot of sludge. So, it may become very important to deal with the type of sludge which you have generating either at the domestic level or at the industrial level.

So, as geotechnical engineers we have been quite comfortable and we have been quite you know equipped well with handling solid waste and sludges, you are not talked much in details about the liquids and the gases, but a good example of the system where all these combinations may occur would be a landfill. So, land fill becomes a very challenging problem particularly to geotechnical engineers. So, you dump the solid waste and this solid waste may deteriorate further or decompose or degrade and then the formation of liquid or the leachates may take place.

Sometimes these leachates or the liquids may evaporate they may form gases or there could be some process by which you have to take care of the type of waste which you are generating in the landfills and so on. So, this is a basic summary of how waste is generated depending upon the source of generation. So, intensity of the waste or when we talk about the toxicity of the waste maybe after few lectures will be talking about characterization of the waste and that is where we will try to see what are the parameters or attributes which can be assigned to waste to classify them in some category.

So, there are some attributes associated to the waste which will be using later on, but to start with I think this information should be good enough to understand what a wastage.

(Refer Slide Time: 05:27)

IIT Bombay Slide 3

Waste Generation

- Depends on the source
- Some waste may degrade into
 - Harmless products
 - nondegradable
 - hazardous(& have cumulative detrimental effects)

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So, the waste generation is the process which is basically dependent on the source and if these are harmless products there is no problem, but nondegradable waste are going to pose lot of challenge and their cumulative effect would be very difficult to handle.

(Refer Slide Time: 05:51)



IIT Bombay Slide 4

Waste Forms

- Solid
- Sludge (semi-solid)
- Liquid
- Gaseous

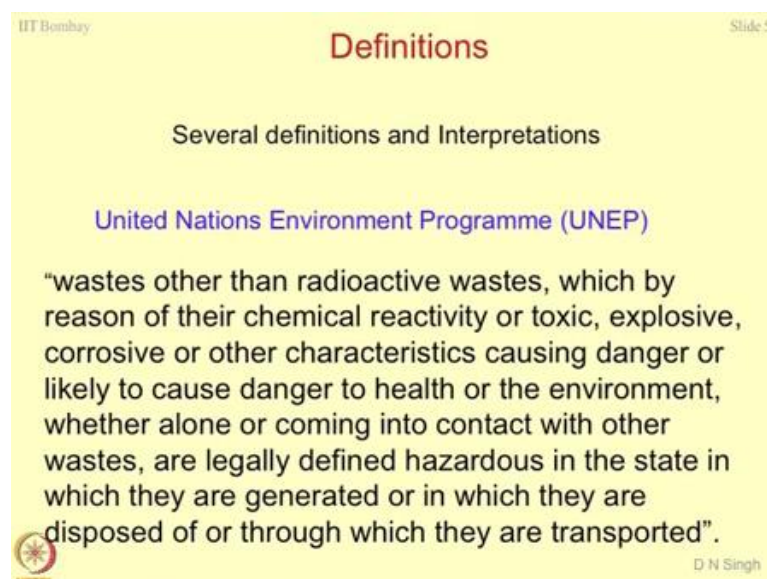
- Or a combination of these

Depends upon the source of contamination & contaminants

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So, what are the waste forms? The waste forms are you have talked about solids, sludge, which are nothing, but the semisolid, liquid or gaseous or a combination of these it will depend upon the source of contamination and contaminants. So, this is where it is again very prudent to define what is meant by a contaminant. So, one of the lectures I would try my best to give you some definitions about the contaminants and contamination process.

(Refer Slide Time: 06:25)




IIT Bombay Slide 5

Definitions

Several definitions and Interpretations

United Nations Environment Programme (UNEP)

“wastes other than radioactive wastes, which by reason of their chemical reactivity or toxic, explosive, corrosive or other characteristics causing danger or likely to cause danger to health or the environment, whether alone or coming into contact with other wastes, are legally defined hazardous in the state in which they are generated or in which they are disposed of or through which they are transported”.

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There are few definitions which are associated with this whole discussion. So, this is the nature of the scientist they do not come up with you know uniform code of conduct. So, there are lot of definitions which are available. So, several definitions and interpretations are available to define a waste. So, if we go by UNEP that is United Nations Environment Program, this is the definition which has been used to define the waste. So, waste other than radioactive waste which by reason of their chemical reactivity or toxic explosive corrosive or other characteristics.

So, some of the attributes of a material which makes it a waste are chemical reactivity, toxicity, explosive nature, corrosive nature and other characteristics which may cause danger or likely to cause danger to health or the environment whether alone or coming in contact with other wastes. So, this is where the interaction process becomes important all right. So, one waste may remain passive in it is original form, but when it comes in contact with some other phase of the material it may become very hazardous.

So, these types of waste are legally define hazardous in the state in which they are generated or in which they are disposed of or through which they are transported. It is a very complicated definition, but of course, it covers most of the attributes of the materials which will classify this as a waste all right. I will talk about out these attributes later on as I said now this just to introduce you few definitions where most of the activity have been define. So, what is the waste, how it becomes? So, important and then how do you classify this as a waste, which is of you know threat to the mankind or animals.


So, this process also very important so, they are legally defined hazardous in the state in which they are generated or in which they are disposed off or through which they are transported.

(Refer Slide Time: 08:55)

IIT Bombay Slide 6

Materials which are:

- inherently dangerous to the human body or to animals, including, but not limited to, materials that are toxic/poisonous
- Irritants
- strong sensitizers
- Flammable
- explosive (i.e., generate power through decomposition, heat or other means)
- infectious (i.e., represent a potential source for transmission of disease to humans, domestic animals or wildlife)
- radioactive (i.e., containing sufficient radioactivity)
- pesticides

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In continuation with the definitions given by other people, organizations so, waste of the materials which are inherently dangerous to the human body or to animals. So, this is simple definition anything which is dangerous to human body or animals is a waste material including, but not limited to materials that are toxic or poisonous. So, this is one of the attributes they are basically irritants. So, you are passing through a fish market what do you feel, what is the first reaction, yes exactly you close your nose or is it not so; that means, the smell which is coming out is not very conducive, it is a irritation this is sort of a.

You go and stand near industry where the petroleum products are being refined or sulphuric acid is being produce or acids are being produce how do you feel like on your skin irritation. So, at attribute is that they are basically irritants, now irritation could be related to skin to observations, feelings, is it not. By seeing something you may feel you know very low moon so, that is also irritant seeing a person for an example. So, you may say that how do you classify the person is of no use. So, waste.

Then strong sensitizers, what is meant by sensitizers? Sensations I don't know you most of felt that you are allergic to few things. So, sensitization is nothing, but you feel you know you get sensitized, this is another attribute they are flammable. So, the waste which we normally we talked about their flammable. So, think of a situation where in a landfill

you are dumping waste which includes hydrocarbons and suppose you are not segregating them at the point of discharge.

So, mixed together if this waste comes to the landfill what will happen during very high temperatures particularly in summers when most of the part of the country attains temperature of the order of 46-51°C. So, this is where actually flammable property of the material becomes very important. So, you have to be very extra cautious when you are dumping this type of waste in the landfill. So, flammable becomes another attribute explosive nature that is they generate power through decomposition heat or by other means so, ok.

So, this is another attribute of the waste which makes them explosive in nature. So, what is the biggest challenge by putting these attributes together can you think of the challenge which our profession is facing. The chemical waste which is coming of the industry would be flammable and could be explosive and most of the landfills are within the limits of the city or slightly away from the limits of the city. So, by any chance if you are dumping the waste which contains everything together you know what is going to happen.

So, you are creating volcanoes within the city. So, this is becoming a very serious issue. So, they generate power basically this power is nothing, but the heat or sound, through decomposition heat or by some other means. This is another threat of the waste material that is it is infectious. So, anything which may be infectious to you is also a waste material you like to throw it away and so, that you can be safe against you know getting contacted by the diseases. So, this represents a potential source for transmission of diseases to human, domestic animals or wildlife.

Radioactive this is another trait which is associated with the material which are classified as waste materials that is any component of radio activity which is associated with the waste will also cause problems or hazard. So, that means, any substance which contains sufficient amount of radio activity will also be considered as a waste material.

Pesticides so, most of the agricultural activities these days are revolving a brown pesticides and fertilizers; so, excessive application of pesticides and manure or the fertilizers also becoming a very big challenge.

(Refer Slide Time: 14:28)

IIT Bombay Slide 7

wastes from commercial or trade companies, which, due to their nature, composition or quantities, are especially hazardous to human health, air or water, or are explosive, flammable or may cause diseases".

Hazardous wastes are those wastes which due to their nature and quantity are potentially hazardous to human health and/or the environment, and require special disposal techniques to eliminate or reduce the hazard.

one that may cause or significantly contribute to serious illness or death or that poses a substantial threat to human health or the environment when improperly managed

waste is any substance for which the owner/generator has no further use and which is discarded.

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Some of the definitions which I like to continue with is that the waste from commercial or trade companies, which due to their nature, composition or quantities, are especially hazardous to human health, air or water, or are explosive, flammable or may cause diseases. So, they all fall in the category of waste.

Hazardous wastes are those wastes which due to their nature and quantity are potentially hazardous to human health and or the environment and require special disposal techniques to eliminate or reduce the hazard. So, most of the people who are working in waste management they have to read these lines very carefully requiring special disposal techniques can you name any special disposal technique which is being adopted presently by our professionals expand by the way you have not supposed to disposal.

So, simple thing which I am asking any special disposal technique landfill itself is a special disposal technique is it not, say it could be engineered landfill or it could be ordinarily landfill or non engineered landfills. So, idea is you dispose of something cover it and forget about it, but now present a society cannot afford to forget about it, that is where actually the geotechnics starts.

So, that is where actually the concerned is how to deal with the waste, how to tackle with it, even if you dispose it in the soil mass or below you burry it how to forget about it. So, that it does not face and you do not face any challenge in days to come. So, if you read this again you will notice that it requires special disposal techniques to eliminate or

reduce the hazard. The best scenario would have been if you can eliminate the hazard, but truly speaking is very difficult. So, what is that you will tend to do; you reduce the intensity of the hazard. So, this is how you negotiate with the problem and try to come with a solution which is the most optimal solution.

So, waste is the one that may cause or significantly contribute to serious illness or death or that poses substantial threat to human health or the environment when improperly managed. So, you will notice that these words are very important actually improper management of the waste which is coming out of the industry and what is that you are trying to do is or someone should try to do is how to eliminate and reduce the hazardousness of the waste by some special techniques. So, this is where the entire waste management scenario or the techniques strategies have been formed and they lot of course, which you have to comply with.

So, waste is any substance for which the owner or generator has no further use and which is discarded, but it should not be discarded in others courtyards. So, the common tendency is that in cities and other places they clean their houses and whatever comes out where it is disposed in front of the house on the road. So, houses are clean, but the cities are dirty all right. So, this is what requires education and enforcement.

(Refer Slide Time: 18:32)



Let us talk about the types of waste. So, there are 2 types, non-hazardous waste and hazardous waste. So, under non-hazardous category we say municipal waste and

industrial non-hazardous waste, hazardous waste industrial mostly. Can you give some example of municipal non-hazardous waste yes, it is not very hazardous that is right industrial non-hazardous waste fly ash how do you characterize fly ash a hazardous waste or non-hazardous waste? So, some are saying hazardous some are saying non hazardous why it is hazardous.

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That is right correct, why you are saying non hazardous.

Sir most of the (Refer Time: 19:31).

It is not stored in anywhere, how much is being used off not more than 5% ok. We will talk about these sub issues slightly later all industrial activities basically generate mostly hazardous waste. So, this question which I am asking you how would you say something is hazardous something is non hazardous. So, there is a full gadget on this and that gadget is basically given by Resource Conservation and the Recovery Act (RCRA). So, those of you who may like to go for your own industries after few years you have to master this first RCRA you have to understand the activity which you are going to get involved with and how to deal with that, unless you understand this act you cannot get clearance from the environmental bodies, statutory bodies environmental boards and so on conservation board and so on.

So, basically what this act talks about any guess, recovery comes must later the first is resource conservation, what is the resource which you would not to conserve characterization comes much later. First thing is resource conservation, what are the resources which you want to conserve.

Water, land.

Water, land, minerals, air.

Air

Everything clear? So, the first issue which tackles is how to conserve the resources which you have and then how to recover something which has fallen in the matrix of

waste. So, this is where actually I have used the word matrix, matrix is very important, what is your understanding about the word matrix of the waste.

Complexity of the waste.

Complexity of the waste, when you say soil matrix have you heard this term, I am not talking about the matrix which you used in mathematics what how do you define matrix of soil. That is right. So, mixture of different constituents clear. So, when we say matrix of waste what is the meaning of this there are different constituents in the waste which may exhibit different characteristics. Now what is of most important to you which may come out of the waste and start contaminating the geoenvironment.

So, the waste matrix is the matrix where all potential candidates which may leach out into the environment are sitting clear. Now how do differentiate between what component of the matrix is going to be hazardous and non-hazardous. So, common sense says the one which is more active is going to be hazardous, one which is passive is going to be non-hazardous.

This is the one way to understand how non hazardous and hazardous wastes have been classified and group together. That means, the potential of the of these species is another word which normally geotechnologists will use when they deal with the waste management system should a species which come out of the waste matrix which are potential threat to the geoenvironment.

So, these are statement normally which is put up. So, species means it could be species of chemicals, species of radioactive material, could be the biomaterial and so on and which has a tendency to leach out from the matrix of the waste and propagate into the system or migrate in to the system.